the e&s
STUDENT PERSPECTIVES ON ENGINEERING AND SCIENCE
2020 VOLUME 64 NUMBER 1

EXPLORING ADVANCEMENT

LOUISIANA TECH UNIVERSITY

EDITOR'S NOTE

Exploring Advancement

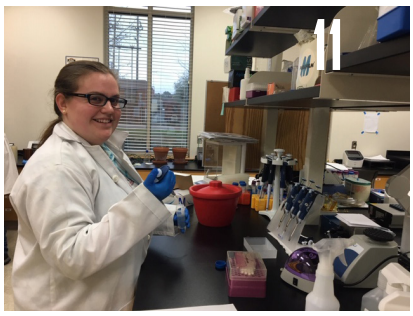
By Katie McKenzie, Editor E&S Magazine

Winter Quarter 2020 is the first quarter in which the Integrated Engineering and Science Building (IESB) was officially open for classes. This opening brought much thought of the advancements being made both on Louisiana Tech's campus and around the world. As a biomedical engineering student, I am surrounded by people who are making it their lives' purpose to improve the world's health, one innovation at a time. Simultaneously, there are geniuses in other fields changing the world in other ways. One of the more interesting changes is a flying car created in Japan. This vehicle, which shows remarkable resemblance to a drone, could revolutionize the way that people experience travel.

Not all world changing innovations come in the form of a new product on the market. To realize this, one must simply look to this edition's featured article. Tech has become a hub of research and discoveries. These discoveries are proof that endless hard work and determination can and will improve the world. Yet, to achieve these groundbreaking changes, we need the continuous creativity and tenacity of our scientists, engineers, and entrepreneurs. With widespread collaboration between groups like this, no obstacle is insurmountable.

the e&s
STUDENT PERSPECTIVES ON ENGINEERING AND SCIENCE

CONTENTS



IN THIS ISSUE

THE E&S MAGAZINE
P.O. BOX 10348
RUSTON, LA 71272

QUESTIONS OR COMMENTS
theengineer@latech.edu

EDITOR
Katie McKenzie

ASSISTANT EDITORS
Behram Dossabhoy
Joshua Iselin
Luke Hansen
Thomas Holland
Julia McCown
Jordan Savoie
Megan Ward

COMICS ARTISTS
Eva Dickenson
Daniel Dickenson

STAFF WRITERS
Elizabeth Amedee
Jacob Christ
Lauren Fogg
Austin Harvey
Elizabeth Kibodeaux
Matthew Marton
Craig Rice

CONTRIBUTING EDITOR
Brandy McKnight

GRAPHIC DESIGNER
Estevan Garcia

FACULTY ADVISOR
Dr. Hisham Hegab
Dean, College of Engineering and Science

DEPARTMENTS

left to right: Mechanical Engineering senior Luke Hanson, Dr Katie Evans, Biomedical Engineering senior Savannah Esteve.

Global Grand Challenges Summit: Engineering in an Unpredictable World

By Luke Hansen, Mechanical Engineering Senior

The Global Grand Challenge Summit (GGCS) is a biennial gathering of students and individuals in engineering or related fields from the United States, the United Kingdom (UK), and the People's Republic of China. The goal of the summit is to collaborate and discuss selected topics related to the United States' 14 Grand Challenges of Engineering and the United Nation's (UN) 17 Sustainable Development Goals (SDG). The 2019 summit was hosted by the Royal Academy of Engineering in London, UK, from September 12-18. More than 900 entrepreneurs, innovators, engineers, and inspired students attended the summit.

Three organizations participated in and sent representatives to the summit: The Royal Academy of Engineering of the United Kingdom, the National Academy of Engineering (NAE) of the United States, and the Chinese Academy of Engineering. As a founding members of the (NAE GCSP), Louisiana Tech sent three representatives to the summit: Mechanical Engineering senior, Luke Hansen, Biomedical Engineering senior, Savanah Esteve and College of Engineering and Science Associate Dean for Strategic Initiatives and NAE GCSP Proposal Review Committee Chair, Dr. Katie Evans.

The first four days of the 2019 GGCS was a student collaboration lab that encouraged cross-cultural collaboration and innovation in solving global challenges. More than 300 students from the three collaborating countries participated in the event. The collaboration lab included several interactive activities between students, the first of which was a country team competition. Fifteen teams, five from each country, competed on the first day by presenting an innovative engineering solution to a global challenge. Three teams were selected as winners and were presented awards to continue their work after the competition. The next portion of the collaboration lab was designed to give students the tools they would need to respond to global challenges. This portion included breakout sessions on topics such as startups, entrepreneurship, and leadership. The final component of the collaboration lab was the formation of teams consisting of representatives from each country. Fifty teams of six students, two from each country, were assigned at random to promote cross-cultural collaboration. Each team was tasked to present a solution to a global grand challenge as defined by either the NAE or the UN. The pace was similar to a hackathon. Each team was given 18 hours to propose a solution and present their idea via PowerPoint and poster presentation to a panel of judges. The judges selected three teams to present their proposals at the summit the following day.

The final two days of the 2019 GGCS were dedicated to speakers and panels in the Queen Elizabeth II Hall. The themes of the summit were how to sustain a world of 10 billion people and how artificial intelligence (AI) will change humanity. The event began with speeches from the presidents of each academy of engineering, and Princess Royal Anne made a surprise appearance to welcome the participants. Subsequently, a thirteen-year-old student inventor named Gitanjali Rao presented her innovative concepts for detecting lead in drinking water. Dr. Keoki Jackson, the chief technology officer of Lockheed Martin, and Professor Luciano Floridi of Oxford University moderated several of the panels concerning the ethics and advancement of AI. Regarding the theme of sustaining a world of 10 billion people, a panel of entrepreneurs and engineers from Africa shared how they were using technology to improve the lives and welfare of their people. The final speaker of the event was the president of DEKA Research and founder of For the Inspiration and Recognition of Science and Technology (FIRST) Robotics, Dean Kamen. He challenged all of those present to remember the next generation by improving youth education in engineering.

The 2019 GGCS highlighted the importance of multinational and multigenerational collaboration. In the years to come, it will be fascinating to see how summits like the GGCS inspire and encourage engineers to innovatively solve global challenges in engineering.

Sources:
https://www.raeng.org.uk/policy/partnerships/international-policy-and-development/ggcs/2019/welcome/agenda
https://www.nae.edu/

Leann Tengowski

By Megan Ward, Chemistry Junior

After graduating high school in 2016, Leann Tengowski chose to pursue an education in biomedical engineering to stand out on medical school applications. She travelled over a thousand miles from Suffolk, Virginia, to participate in Louisiana Tech's program and fell in love with the community she found. Faculty members truly cared about students both in and out of the classroom, and students received the opportunity to participate in hands-on projects beginning their freshman year. After the Freshman Design Expo, Leann was hooked on engineering.

Leann invests most of her free time in the organizations on campus. As a freshman, Leann joined the Biomedical Engineering Society and has served as the organization secretary and president. She currently serves as its professional development chair. Additionally, Leann is a member of the Society of Women Engineers and Alpha Eta Mu Beta, the biomedical engineering honor society. She is also an officer of Tau Beta Pi, the engineering honor society. For the past two years, Leann has driven the Louisiana Tech car for the Eco-marathon team. Her favorite Tech memory is spinning out on the Sonoma Raceway and crashing the car into the barriers going thirty miles-per-hour.

For the past two summers, Leann participated in an REU (research experiences for undergraduates) at the University of Arkansas for Medical Sciences and worked as a process development intern for Boston Scientific in Minneapolis, Minnesota. She worked there on the design of the manufacturing line for medical devices. In the future, Leann aims to work on medical devices in process development, research and development, or manufacturing engineering. Her passion for medicine remains, but it has transitioned from a focus on becoming a medical doctor to a focus on the medical devices field.

When Leann is not doing her engineering homework or working with one of her many organizations, she enjoys hiking, painting, and watching *Friends*. Her favorite hiking experience was hiking a mountain in Guatemala.

Mubarak Muhammed

By Elizabeth Kibodeaux, Biomedical Engineering Junior

Time is an engineering student's greatest enemy. Often, it seems that there are not enough hours in the day; if there are, it is probably because sleep, food, or friends are neglected. Still, there are some engineering students that go above and beyond what most find to be a normal amount of challenging work. Twenty-two-year-old Mubarak Muhammed is not only an industrial engineering senior, but also a full-time athlete for Louisiana Tech's basketball team. Originally from Niger, Nigeria, Mubarak came to the United States to pursue his talent for basketball. He finished his remaining high school years in Florida, and then Tennessee—eventually finding his way to Louisiana Tech after being recognized as the Junior College Basketball Player of the Year.

Mubarak was drawn to industrial engineering because of its business-oriented curriculum. It fits in well with his passion for problem solving and challenging himself. When asked how in the world he juggles both engineering and basketball, Mubarak had a very positive attitude. His response was that the stress he experiences just means that he is pushing himself like he needs to be. Having fun and trustworthy teammates as well as professors who are invested and encouraging helps, too. Following this vein, he encourages the readers to appreciate the people that you meet. He believes that those people, your friends, and the memories you make are what are really going to matter in the long run.

Although his free time is extremely limited, Mubarak did mention that he loves playing piano when he can find the time. He picked up the instrument over the summer.

Louisiana Tech is lucky to have so many multi-talented and hardworking students, with students like Mubarak Muhammed leading the pack.

Dr. David Irakiza

By Josh Iselin, Cyber Engineering Freshman

Dr. David Irakiza was born and raised in Uganda, primarily living and studying in Kampala, the nation's capital. After graduating from secondary school, Irakiza decided to attend Makerere University in Kampala, choosing to pursue an education in computer science. While he had many reasons to pursue a degree in computer science, his main motivation was the opportunities it provided. The field was emerging with exciting new ventures that were intriguing to him. However, he wasn't sure what he would do after graduating.

After graduating from Makerere University with a bachelor's degree in computer science, Dr. Irakiza moved to Ruston to work as a Ph.D. student on a Louisiana Tech research grant at the recommendation of his academic advisor. In the following five years as a graduate research assistant, Dr. Irakiza received master's degrees in computer science and mathematics while working on a Ph.D. in Computational Analysis and Modeling. While working on his Ph.D., Dr. Irakiza contributed to two research papers for the Louisiana Tech Center for Secure Cyberspace, both dealing with user authentication protocols.

After graduating with his Ph.D., Dr. Irakiza decided to stay with Louisiana Tech full-time, becoming a lecturer within the College of Engineering and Science. He specializes in computer science and network security, lecturing in courses for both the Mathematics and Computer Science programs. In his computer science classes, Dr. Irakiza teaches students a variety of programming languages, such as Python and Java, his two favorite programming languages.

Dr. Irakiza has not left his home country behind. At Louisiana Tech, Dr. Irakiza acts as an advisor for the African Students Association and readily enjoys helping support the Ugandan students both on campus and abroad to help pursue an education in the field of engineering, whether domestically or in the United States. Dr. Irakiza also formerly acted as an electoral commissioner for the Ugandan North America Association, an association dedicated to providing support to Ugandans in North America and in their home country. While Dr. Irakiza has slowed his activity with the association, he maintains close contacts with the organization to provide support when he can. In the rest of his free time, when he is not working or helping others, he enjoys leisurely activities, like reading books and watching TV at home.

For Dr. Irakiza, taking the leap to pursue a Ph.D. at Louisiana Tech was a bold move, but one that paid off. While he was at Makerere University, he had no idea that he would be flying to Louisiana to pursue a doctoral degree so shortly after or that he would eventually become a full-time lecturer at Louisiana Tech, but the risk was worth it in the end. Dr. Irakiza enjoys his time as a lecturer at Louisiana Tech, thanks to its welcoming "small-school effect" and concentrated class sizes, which he hopes the University will maintain as it grows in the coming years. However, considering the radical shifts in his life over the past six years, Dr. Irakiza wonders what the future holds for him.

Dr. Irakiza gave advice for undergraduate cyber engineering and computer science majors through one of his favorite quotes: "Make hay while the sun shines." In the modern age, the foundation of interaction and productivity rely on technology, which is rapidly evolving. The world of today will be different from the world of tomorrow, and understanding the foundations and inner workings of the technology that surround us will prepare us for the innovations of tomorrow. Even for the undergraduate students outside of cyber engineering and computer science, Dr. Irakiza suggests that students appreciate their time at Louisiana Tech. While grades are important, ultimately what matters is growing as a person during college; undergraduate years only happen once.

Dr. Joan Lynam

By Julia McCown, Chemical Engineering Junior

Assistant Professor Dr. Joan Lynam has been teaching chemical engineering classes at Louisiana Tech for a little over three years. When not teaching classes, Dr. Lynam is busy running the Biomass Lab, in which she and her undergraduate student members research turning waste from various processes into useable products. She grew up in Pittsburg, Pennsylvania; therefore, in her words, "[she] must be a Steelers fan." Both her father and her brothers are chemical engineers as well.

For her undergraduate degree, Dr. Lynam attended Case-Western Reserve University with a full ride. Although her father feared it would be too difficult for her, she decided to pursue a career in chemical engineering, having previously enjoyed physics and chemistry in school.

After she received her undergraduate degree, Dr. Lynam researched rubber for Goodyear. At Goodyear, she researched how to improve rubber strength and understand the underlying reasons why additives, such as resin, make rubber more resilient. Her interest in conservation research began there when she realized that one fungal infection or disease could kill a whole continent's worth of the trees that rubber is made from, since all rubber trees are clones.

After working for Goodyear for a while, she decided to take a break so she could raise her kids. Soon after, she decided to go to graduate school in Reno, Nevada, to refresh her knowledge and return to chemistry. While at the University of Nevada at Reno, she enjoyed researching for her master's degree, and she applied for a doctorate soon after. After earning her Ph.D., she received offers from several schools, but ultimately chose to teach at Louisiana Tech because she liked the people here.

All of the Biomass Lab's projects are led by Dr. Lynam. The lab focuses on turning waste into products to address the culture of waste that Dr. Lynam believes the United States has developed. The nation is dependent on single-use, convenient products, and she believes the U.S. should try to approach waste the same way that Europe does. In Europe, they recycle as much as they can, with bones being one of the few pieces of biomass tossed in the trash. She wants "Americans to consider the planet more than their own convenience."

She especially enjoys working on a project in collaboration with the Environmental Protection Agency (EPA) to help coordinate the exchange of wastewater from paint companies to cement production companies that include the waste in their product. The result is a win-win situation, as the paint companies do not have to pay to cleanse and release the water and the cement production company does not have to pay for city-provided water.

In another project, Dr. Lynam is working with lion manure, which cannot be composted since lions are carnivores. For such manure, a process called hydrothermal carbonization is used to increase the fuel potential of a raw biomass through high heat and pressure. Once the manure reaches a high enough temperature, it is sterilized and formed into pellets, which are extremely resilient and easy to transport. These pellets can then be burned for energy. A large portion of her work also involves the use of deep eutectic solvents (DESs), since they are biocompatible solvents. DESs are used to break down biomass into lignin, cellulose, and hemicellulose. The lignin can be made into pellets to be used for fuel as a binder or as a plasticizer in cement. The cellulose and hemicellulose can be used to make biofuels.

Dr. Lynam is a fascinating professor who cares about the students she works with and wishes for her students to succeed. One of her favorite parts of being at Tech is working in the Biomass Lab, since all the projects are brand new. She provides the students an opportunity to research something that has never been researched before, and she is so proud to give that chance to her students.

Werner Heisenberg in 1926.

Werner Heisenberg

By Jacob Christ, Chemical Engineering Sophomore

Werner Heisenberg was a German physicist and philosopher, and his work was vital to the modern understanding of quantum mechanics and the nature of the universe. He was born in Wurzburg, Germany, in 1901, and most of his work was done before and during World War II. His work has influenced modern computing, atomic bombs, and chemistry.

His "Uncertainty Principle" was his most famous theory and won him the Nobel Prize in 1932 for the creation of quantum mechanics. The theory states that it is impossible to know for certain the exact location and momentum of a subatomic particle. Both variables are opposite and equal at the same time. Light works by bouncing photons off objects and coming into our eyes. In order for light to bounce off something, like a piece of paper, it must hit the paper atom equally as hard, meaning that when you look at a paper molecule, you are looking at where the paper molecule was and not where it is. The more you shine light off an object the more you bounce it around and the less you end up knowing. This principle is the fundamental truth of the subatomic world.

The reason an atom does not collapse in on itself is because electrons don't get close to the nucleus. Electrons are elusive and would respond to being too close to the nucleus by moving so incredibly fast that they would be hurled uncontrollably into space.

One of the less appealing parts of Heisenberg's career was his work on the German atomic program during World War II. Although he was criticized for not being loyal enough to the Nazi regime, he found himself working for them, in direct opposition to the Manhattan project, on a bomb. He was unsuccessful, mainly due to factors outside of his control. Some attribute this failure to sheer incompetence on his part and others to outright sabotage against the fascist powers. Either way, the Germans lacked the degree of success achieved by the Manhattan project.

Heisenberg's Theory had major implications on both physics and the way that life can be viewed in general. Obviously, this presented some troubling challenges to thinkers at the time. When Heisenberg dared to challenge the worldview of others, he made some enemies along the way. Among the opponents of his theories was Albert Einstein. Einstein was quoted as saying, "God does not play dice with the universe." He was so troubled by this idea that he dedicated the last few years of his life to disproving the superposition theory. All this work was in vain though because his thought experiments only proved to strengthen the theory he sought to disprove.

The universe is not as civilized as society would suggest. It is not objective and measurable but is chaotic and unpredictable. It cannot be said with certainty where an electron is: The electron's location can only be predicted. Maybe there are secrets not meant to be witnessed by mortal eyes. Maybe humans' primitive minds lack the ability to perceive higher dimensions. As humanity explores the extremes of the universe and the extremes of life, each discovery raises more questions. Every day, preconceived notions of life are challenged. Scientists may never be able to see where a particle lies, but that does not stop it from existing and making impacts on day-to-day life.

Sources:
https://www.theguardian.com/science/2013/nov/10/what-is-heisenbergs-uncertainty-principle
https://www.nobelprize.org/prizes/physics/1932/heisenberg/biographical/ www.britannica.com/biography/Werner-Heisenberg/Heisenberg-and-the-Nazi-Party

Dr. Serena Auñón-Chancellor, NASA astronaut.

Modern Biography: Serena Auñón-Chancellor

By Lauren Fogg, Mechanical Engineering Junior

Serena Auñón-Chancellor is a NASA astronaut who has helped make contributions in biology, biotechnology, physical science, and earth science. She recently served as Flight Engineer on the International Space Station (ISS) where her crews performed investigations into new cancer treatment methods and algae growth in space. Her first stay aboard the ISS was 197 days long, and now she covers medical issues and on-orbit support in the Astronaut Office.

Serena was born on April 9, 1976, in Indianapolis, Indiana. Her parents are Margaret Auñón, who writes murder mysteries, and Dr. Jorge Auñón, who was the dean of engineering at the University of Alabama in Huntsville until he retired in 2005. Many children dream of becoming an astronaut. Such was the case of Serena, who knew she wanted to be an astronaut at the age of eight. After graduating from Poudre High School in Fort Collins, Colorado, in 1993, she went to study at George Washington University in Washington, D.C., where she received a bachelor's degree in electrical engineering in 1997. In 2001, she earned her Doctorate of Medicine from The University of Texas - Health Science Center at Houston. Serena completed her medical residency in internal medicine at The University of Texas Medical Branch (UTMB) in Galveston, Texas, in 2004. She then completed an additional year as Chief Resident in the Internal Medicine department at the same place. Serena is board certified in both internal and aerospace medicine.

In August 2006, Dr. Auñón-Chancellor was employed at Johnson Space Center as a flight surgeon under the UTMB/Wyle Bioastronautics contract. During this time, she spent more than nine months in Russia supporting medical operations for ISS crew members in Star City and doing water survival training in Ukraine. She also served as the Deputy Crew Surgeon for STS-127 and held the role of Deputy Lead for Orion - Medical Operations.

In July 2009, Dr. Auñón-Chancellor was selected as one of fourteen members of NASA Astronaut Group 20, the 20th NASA astronaut class, graduating in November from Astronaut Candidate Program. This training included scientific and technical briefings, intensive instruction in space station systems, spacewalks, robotics, physiological training, T-38 flight training, and water and wilderness survival training. She also spent two months from 2010 to 2011 as part of the Antarctic Search for Meteorites (ANSMET) expedition, spending most of her time living on the ice two hundred nautical miles from the South Pole. After her time in Antarctica, Dr. Auñón-Chancellor operated the DeepWorker submersible on NASA Extreme Environment Mission Operations (NEEMO) 16 in June 2012. While operating the submersible, she also served as an aquanaut aboard the Aquarius underwater laboratory during the NEEMO 20 undersea exploration mission. She finally got her chance to go into space on June 6, 2018. During her 197 days in space, she carried out numerous experiments that helped the scientific understanding of the world grow. Now, Dr. Auñón-Chancellor spends most of her time handling medical issues for both the ISS Operations branch and Commercial Crew Branch.

Dr. Serena Auñón-Chancellor has received many awards. In 2004, she was awarded the Thomas N. and Gleaves James Award for Excellent Performance by a Third-Year Resident in Internal Medicine (2004). In 2005, she was inducted into the Alpha Omega Alpha Honor Society. She has also received the William K. Douglas Award, Outstanding UTMB Resident Award, and the United States Air Force Flight Surgeons Julian Ward Award.

Dr. Serena Auñón-Chancellor stands out as a remarkable woman who contributes to the scientific community as both a surgeon and an astronaut.

Sources:
https://www.nasa.gov/astronauts/biographies/serena-m-aunon-chancellor/biography
https://www.tmc.edu/news/2018/09/astronaut-serena-aunon-chancellor-m-d-chats-with-uthealth-students-from-the-international-space-station/

Itaipú Dam and hydroelectric plant with the reservoir in the background.

Engineering Marvels: The Itaipú Dam

By Katie McKenzie, Biomedical Engineering Junior

October of 2018 brought with it a striking publication by the Intergovernmental Panel on Climate Change (IPCC) that, combined with information from the scientists at the United Nations (UN) and the World Meteorological Organization (WMO), informed the world that the time to save the environment is drawing short. Many nations then experienced a renewed sense of urgency to maximize environmental preservation efforts. Yet, while some nations are still striving to meet the minimum amount of emissions recommended, others have been setting the standard of renewable energy usage for years. Such is the status of Paraguay, and this is all thanks to the Itaipú Dam, a hydroelectric dam on the Paraná River between Brazil and Paraguay.

Hydroelectricity has been around for more than 2000 years. The ancient Greeks once utilized water wheels to convert falling water into the ability to grind up grain. The Middle Ages brought with them the spread of hydropower across the rest of Europe. However, the invention that proved most critical to the future of hydroelectricity was the first electric generator by Michael Faraday, who is well known for the concept of Faraday cages. This invention, in 1831, was the starting point for the generation of electricity using hydropower in 1878. By 1882, the first hydroelectric power plant in Appleton, Wisconsin, had a power output of nearly 12.5 kW. From there, hydropower only gained momentum. The Hoover Dam, with an original capacity of 1345 MW was opened in 1936. In just over fifty years, the engineers working on this energy generation technique were able to increase output by roughly six orders of magnitude. One of the next dams to follow this precedence is the Three Gorges Dam, previously highlighted in the Winter 2017 Edition of the *E&S magazine*. The Three Gorges Dam had the largest energy production of 22,500 megawatts. The Itaipú Dam, in comparison, broke the world hydroelectric power record in 2016 by producing 103,098,366 megawatt hours.

The dam was built between 1975 and 1982 and is almost 200 meters tall. The construction of the plant was a team effort between the nations of Brazil and Paraguay. Plans for such a massive undertaking began in the 1960s. Paraguay and Brazil signed the Treaty of Itaipú on April 26, 1973, that became the legal means by which the two countries could collaborate to use the hydroelectric potential of the Paraná River. Part of a larger hydroelectric project, the dam is named after an island near the site of construction. The entity created to build it is called the Itaipú Binacional. The construction cost roughly $19.6 billion.

The construction was led by groups from the United States and Italy who ensured that the project would be viable. Then,

four rock crushing centers and six concrete mixing plants were set up to generate the materials needed to create the dam itself. The river's route also had to be slightly altered to allow for the dam to be built on the original riverbed. The dam is a combination of a main dam composed of concrete and auxiliary dams comprised of rockfill, earthfill rocks, and earth from the other excavations. The concrete portion used 12.3 million m^3 of concrete. The building of these dams created the nearly 30-billion-ton capacity reservoir that would be used to feed into the dam. Altogether, nearly 40,000 people contributed to the construction, and 380 Eiffel Towers could have been built with the iron and steel put into the project.

The plant is comprised of twenty separate generating units. The first two were installed in 1984. The rest were added in over time with the last generator being put into action in 2007. The instantaneous generation capability of the plants is almost 10.6 MW. For reference, in 2014, an average home in the Pacific Northwest required 11 megawatt-hours per year. Beyond that, the Itaipú has a spectacular record availability index of 96.3 percent. The availability index refers to the amount of time that the power from the plant can be accessed.

When it comes to the usage of the massive amount of power generated, Paraguay and Brazil split ownership of the turbines. Yet, the energy requirements of Paraguay and Brazil are vastly different. In 2013, the power plants provided Paraguay with 75 percent of its electricity. This was done by Paraguay only using 10 percent of the energy produced by the plant. Brazil, in contrast, uses 90 percent of the generated energy which supplies Brazil with 17 percent of its required electricity. Paraguay sells its extra power to Brazil as planned in the original treaty. In that initial document, Paraguay was set to sell the unused electricity to the Brazilian electricity monopoly for $124 million per year. In 2009, this was renegotiated, and Brazil tripled its payments to Paraguay while simultaneously allowing Brazilian companies to buy their electricity directly from the other government.

This spectacular feat of engineering has not been without its downsides. From the conception of this dam, there have been opponents to its creation. Although all negotiations occurred between Paraguay and Brazil, Argentina is downstream on the Paraná River and had a multitude of concerns regarding this project. Argentinian leadership was concerned that the dam could be used against them in the event of a conflict between Brazil and Argentina. For example, there was deep concern that the floodgates could be opened in order to flood all the way to Buenos Aires. Despite these concerns, the side canals were blocked off in October 1982, and the reservoir began to form. This flooding forced 10,000 families to move from the area.

Yet, despite these undesirable side effects, the Itaipú Dam is still considered one of the modern wonders of the engineering world. Realizing such a massive plan spanned over two decades and involved rerouting an entire river.

It is no wonder why the dam is considered one of the most expensive things ever built. The entire objective of the company running the dam is "to generate quality electricity with social and environmental responsibility, driving economic, touristic and technological sustainable development in Brazil and Paraguay." Although this is an extremely ambitious mission statement, it acknowledges the true importance of such a massive hydroelectric dam.

Hydroelectric plant with the generating units in white.

In an age when protecting the world is of increasing importance, some countries are already multiple steps ahead of the curve. Unfortunately, not every nation has access to a renewable energy gold mine as the Paraná River and its hydroelectric potential. However, in the instances where a region does have resources like this, Paraguay proves that a country can thrive while almost solely dependent on renewable energy. It's a bonus that this widespread sustainability can be achieved by spectacular engineering.

Sources:
https://energyinformative.org/the-history-of-hydroelectric-power/
https://www.power-technology.com/projects/itaipu-hydroelectric/
https://www.nwcouncil.org/news/megawatt-powerful-question
https://www.hydropower.org/companies/itaipu-binacional http://large.stanford.edu/courses/2011/ph240/mina2/
https://www.atlasobscura.com/places/itaipu-dam

The chimney is the last standing remnant of a house that used to rest on the shore of Lake Peigneur.

Engineering Oops: The Maelstrom of Lake Peigneur

By Thomas Holland, Biomedical Engineering Senior

Lake Peigneur is a small saltwater lake near the Vermilion Bay in south Louisiana. The lake has a maximum depth of 200 feet and is the deepest lake in Louisiana. This size is amazing considering 40 years ago it was a 10-foot-deep freshwater lake. A minor drilling accident caused the entire contents of the lake, 13 barges, a fishing boat, some trees, a house, and half of an island to be consumed in a massive whirlpool. This event dramatically altered the geography and ecosystem of the lake and is an example of how a minor miscalculation can lead to a cataclysmic event.

When the mine collapsed, a large whirpool was created that sucked up barges, trees, a house, and half of an island.

The lake was a popular destination for fishing and other outdoor recreational activities and was home to the locally famous Live Oaks Gardens. Additionally, the area was famous for its massive salt deposits. The Diamond Crystal Salt Company started mining in the area in 1919. Part of the large salt mine was directly under Lake Peigneur. The salt deposit was formed from pressure created by the upper layer of stone. This displacement of salt also created large pockets of space, which can often trap oil. As a result, an oil rig contracted by Texaco was simultaneously doing exploratory drilling in the lake.

On the morning of November 20, 1980, the crew of the infamous oil rig ran into a small problem: Their large 14-inch drill bit became stuck. They soon realized that the bit was trapped in crystal salt. The crew was expecting to hit salt, but not for another hundred feet. When they attempted to free the bit, they heard popping noises and the rig started to tilt. At this point, the crew abandoned the rig and headed for the shore. Shortly after abandoning the rig, the crew watched as the 150-foot oil rig disappeared into the 10-foot-deep lake. Soon, in place of the oil rig, was a maelstrom that was rapidly growing. Several barges were near the hole, these barges were quickly being sucked in by the torrent. Their motors were insufficient to overcome the current, so they had to be abandoned. A tug boat even tried to pull one barge free, unsuccessfully. A small motorized fishing boat was also trapped in the current, but the fisher was able to guide his boat to the edge of the shore closest to the whirlpool and jump out. Down below in the mine shaft, the miners noticed something was wrong when the mine started to fill with water. Luckily, they had a well-practiced evacuation procedure and were all escaped the mine without incident.

As the maelstrom grew, it began to cause the land nearby, including part of a nearby island, to slide into the lake. The water entered the mine with so much force it caused a geyser of compressed air, water, and salt to be launched 400 feet into the air out of the opening of the mine. This geyser continued to spew for several hours until the lake was completely drained. After the lake was emptied, the Delcambre Canal, a man-made river that leads from Lake Peigneur into the Vermillion Bay and, eventually, into the Gulf of Mexico, started to flow backward. This backflow temporarily created a 164-foot waterfall, the largest waterfall in Louisiana history. It is important to note that this is the only time in recorded history that the Gulf of Mexico flowed into the continental United States.

This backflow continued for three days, until the entire mine and lake were filled with water, except this time, the lake was filled with saltwater. The change from freshwater to saltwater was not caused by the salt mine but by the water from the Delcambre Canal, which came from the Gulf of Mexico. After it stopped, the maelstrom had consumed a drilling platform, a fishing boat, a tug boat, a house, 65 acres of land, and possibly hundreds of trees. A few days later, 11 of the 13 barges resurfaced mostly intact. The house was almost completely consumed. Only the chimney, which is still visible through the top of the lake to this day, was left. The locally famous botanical garden, Live Oaks Gardens, which was located on the nearby island, was completely decimated. Miraculously, through this whole event, no one was killed or severely injured. Texaco ended up paying $45 million to the owners of the mine and other local businesses. The area around the lake became the Rip Van Winkle Garden, which is still open for business. Some of the upper shafts that were not under the lake weren't flooded, and the mine wasn't officially closed until 1984. After closure, the mine was bought by the State of Louisiana and is now used to store some of the state's natural gas reserves.

The question is how did an oil rig end up drilling into a salt mine? The answer is amazingly simple. Through testing, the drilling company knew that there was a possible oil pocket near one of the outer mine shafts. The oil rig's crew had planned to drill about 50 feet away from the mine shaft. This plan was approved by the Diamond Crystal Salt Company, and they were given detailed maps on where the shafts were located. Drilling only 50 feet away from a mine shaft that is hundreds of feet under the ground sounds like an impossible task, but it is a fairly easy job. With careful measurements, it should have been easily accomplished, and careful measurements were taken but with the wrong coordinate system! The map used a Universal Transverse Mercator, or UTM, coordinate system. This system estimates the world as an ellipsoid, and splits the world into 60 planes. The planes have a specific scaling and measurements from latitude and longitude. However, the engineer mistakenly thought the map used a Mercator Projection coordinate system. This system is similar to UTM, except instead of splitting the entire world into 60 planes, the Mercator Projection coordinate system relies on a local zone projected onto the larger zone. This system uses a slightly different set of measurements and scaling, which is what caused the error. The ironic part of this ordeal is that the Mercator Projection coordinate system is more accurate within a small area than the UTM. The map maker was not wrong for using the UTM system; it is a valid method for almost every application. The fault lies entirely with the oil company's engineer, who should have confirmed his coordinate systems.

This event shows that even if the math is sound and the measurements are correct, a small mistake can lead to a cataclysmic event. Even though Texaco paid for all damages and no one was killed, the land and the ecosystem are forever changed. What was a shallow freshwater lake is now deep and brackish. This forever changed the ecosystem of the area, changing the aquatic life naturally found in the lake and even the dynamic of the local wildlife. This lake will forever be scarred by the mistake of a simple case of confusing the coordinate systems.

Sources:
https://www.youtube.com/watch?v=p_iZr2-Coqc
https://en.wikipedia.org/wiki/Lake_Peigneur
https://www.atlasobscura.com/places/lake-peigneur
https://www.cntraveler.com/stories/2016-07-11/how-louisianas-lake-peigneur-became-200-feet-deep-in-an-instant
https://en.wikipedia.org/wiki/Transverse_Mercator_projection
https://gisgeography.com/utm-universal-transverse-mercator-projection/

Dr. Lynam's lab team

E&S Research Outreach: Getting Passionate People into Research!

by Elizabeth Amedee, Junior Chemical Engineer; Thomas Holland, Senior Biomedical Engineer; and Julia McCown, Junior Chemical Engineer

To prepare for successful careers in engineering and science, many Louisiana Tech students participate in research. The process of performing research teaches the students patience, perseverance, and teamwork. Often, while the end result of research is shown through presentations and publications, the arduous path to those findings is not discussed. Research prepares students to persevere in their chosen field despite failures they encounter and provides them with experience working in a team. The efforts of an individual rarely result in discoveries; rather, a team's combined knowledge, ideas, and observations provide avenues for innovation. Below, Engineering and Science students Elizabeth Amedee, Julia McCown, and Thomas Holland describe their experiences in research at Louisiana Tech.

Elizabeth Amedee

My name is Elizabeth Amedee, and I like to hammock, box, and cook. After changing my major to chemical engineering during my sophomore year of college, I wanted to get involved in extracurriculars relating to my new curriculum. My first day as a sophomore, I reached out to upperclassmen in my new major and was guided to join a research group. Following my decision to join Dr. Joan Lynam's Biomass Lab, my college-career path shifted. Working in the Biomass Lab, I received a letter of recommendation and advice from my mentor, Dr. Lynam. My position in the lab aided me in the application process for National Science Foundation Research Experience for Undergraduates (NSF-REU) programs across the country.

In the Biomass Lab, I am researching a new recipe for concrete that utilizes waste products from industry, specifically waste created in paper mills. Additionally, I used guayule, a popular shrub found on the U.S.-Mexico border, to construct rubber latex. Another biomass that I have worked with is a pine tree from the Southeastern U.S. called loblolly. Lignin, an organic polymer found in plant cell walls that increases rigidity, can be extracted from these pine needles and refined to create red dyes, biofuels, and other products. Apart from my research in the Biomass Lab, I participated in an NSF-REU at Louisiana State University (LSU). There, I created nanofilms in the Badische Anilin und Soda Fabrik (BASF) lab. BASF, a German chemical company, remains the world's leading chemical producer worldwide. Specifically, in

LSU's BASF lab, the nanofilms were developed to increase the availability of clean water across the globe.

For students looking to begin research at Louisiana Tech, I recommend starting as soon as possible. This journey begins by reaching out to professors who teach subjects that interest you to see whether they have any openings in their lab and whether they know of openings in other labs. While research teams consist of mostly people in a specific concentration, students of related concentrations can also participate. For example, Damien Luke Gautreaux, my good friend from lab, is an industrial engineering major, but he has gained skills and knowledge by working in the chemical engineering lab that he never would have learned in class.

Research provides many benefits. While lab work may seem tedious or pointless at times, the pursuit of knowledge remains worthwhile. Research can begin with one question and end with twenty new questions. In most cases, a correct approach is found after a lot of incorrect approaches have been explored. Once the proper procedure is optimized, a scientific paper is written and submitted to journals for review and publication. Typically, research papers are written by a group of people, thus encouraging collaboration. Additionally, writing scientific papers improves communication skills. Students can even present their research at conferences in the form of talks and poster presentations to further expand their connections throughout the scientific community.

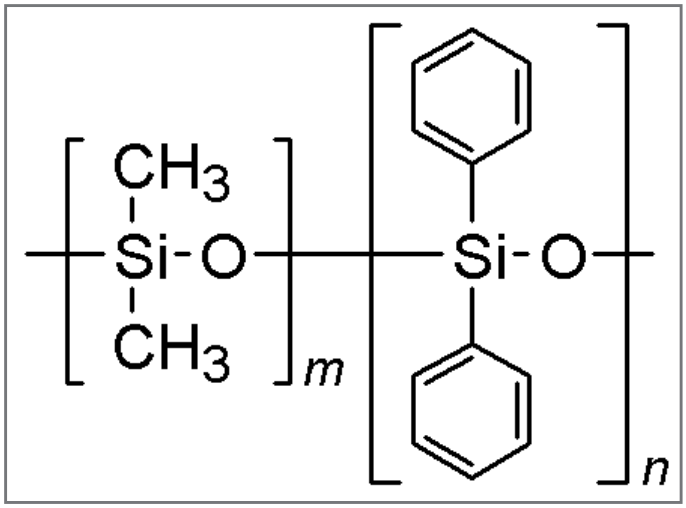
Thomas Holland

Hi, my name is Thomas Holland, like the current actor portraying Spiderman. In my free time, I enjoy woodworking and blacksmithing. As a senior biomedical engineering major, I am involved in multiple organizations on campus, including the Biomedical Engineering Society, Alpha Eta Mu Beta, and Tau Beta Pi. I have also been a member of the Louisiana Tech roller hockey team for the past three years.

Some of my favorite projects have been those in Biomaterials, Calculus II, and Statics I. For three years, I have been working in a lab that focuses on microfluidics devices.

Specifically, my lab manufactures microfluidic devices and performs DNA testing. For my first three years, I worked for Dr. Niel Crews, but this year, I'm working for Dr. Gorgana Nostorova. During my time, I have participated in several projects. My first project involved constructing a microfluidic device that implemented a poly-di-methyl-siloxane (PDMS) and glass bonding technique. This technique is used to mold microfluidic devices. These devices were then used for DNA reverse transcription. Additionally, I worked on a project involving a large volume syringe with a self-contained motor, which served as a pump for microfluidic devices in aerospace research. The biggest project that I worked on implemented a needle required for rapid DNA testing that will soon be used on the International Space Station.

Through my involvement in research, I gained many skills. In class, professors give assignments with a goal and an expected outcome in mind. Typically, students are provided with a general direction and a rubric that determines the student's level of success. In my experience with research projects, I was rarely given an outline or rubric to follow. Sometimes, my principal investigator proposed likely outcomes or potential methods. However, these outcomes and methods were loosely followed since research is new to all of those involved. The end result can be a surprise to both the student and the principal investigator. Research taught me to be independent and resilient. When the proposed procedures failed, I had to be willing to try new methods and sift through scientific journals to find methods that worked in similar situations. Additionally, I was expected to meet deadlines in a professional setting. This results-driven atmosphere created a sense of urgency, and I had to balance other projects and assignments appropriately.

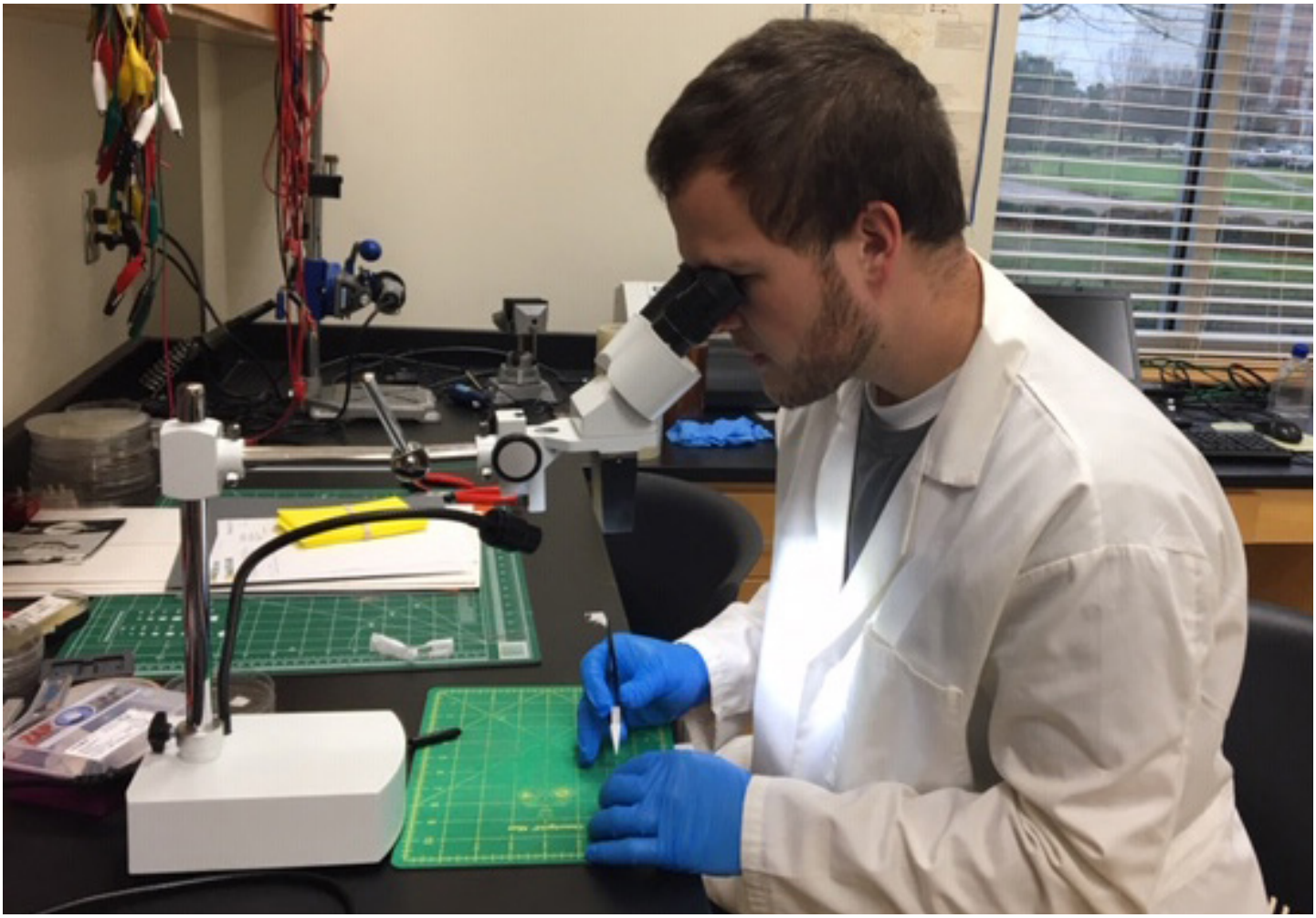


Chemical formula of poly-di-methyl-siloxane (PDMS) which was used for molding microfluidic devices.

Julia McCown

I am Julia McCown, and I am a chemical engineering junior at Louisiana Tech and a member of the American Institute for Chemical Engineers. During the fall quarter of my sophomore year, I took the chemical engineering seminar course, CMEN 301, and learned about all of the lab opportunities available. Dr. Joan Lynam's Biomass Lab piqued my interest, and I scheduled an appointment to meet with her. The Biomass Lab transforms waste byproducts into useful products. For a little over a year, I have participated in Dr. Lynam's research and worked on various projects.

Currently, I am involved with three major projects. The goal of one of these projects is to turn algae into a biofuel using deep eutectic solvents. These ionic solvents are compounds formed by homogeneous mixtures of Brønsted-Lowry or Lewis acids and bases. This mixture has a lower melting point than that of its individual components. For my second project under the LaSpace Undergraduate Research Assistantship grant, I separate synthetic urine into water



Thomas Holland (BS Biomedical Engineering) working in Dr. Nestorova's lab.

and a concentrated urea solution. Since urine contains a large amount of nitrogen, the concentrated urea solution can then be used as a fertilizer. For an Environmental Protection Agency grant, I use hydrothermal carbonization to convert lion manure into a product that can be burned as fuel. Under high pressure and temperatures, hydrothermal carbonization allows organic compounds, like the lion manure, to be made into structured carbons. The formation of brown coal occurs over a span of millions of years, and hydrothermal carbonization essentially emulates this in a few hours. Along with my three projects, I also assist graduate students with their research.

I highly recommend that all students interested in pursuing research join a lab on campus or an REU. Working in a lab provides valuable leadership experience and problem-solving skills. Unlike labs required in the curriculum, research labs do not have set procedures that end in a known result. Not all experiments result in the desired project, but even the failures can result in new findings. Projects in research labs encourage students to become familiar with failure and require passion for that project. Participating in projects gives students a sense of responsibility and the communication skills necessary for group work. If the student decides to forego a future in research after working in a lab, these skills remain invaluable in all fields.

Research opportunities exist for students in every College of Engineering and Science major at Louisiana Tech. Determine which professor performs research that interests you, and ask about openings in his or her lab. Before joining any research lab, consider your goal and what you want from your education. Being in a research lab takes time, but most professors will work with you to accommodate your academic schedule. Ask as soon as possible, and do yourself a favor: Try Louisiana Tech campus research! You only have four years in college, so make them count.

Sources:
https://www.nsf.gov NSF Graduate Research Fellowship Program
https://www.nsfgrfp.org/Louisiana Tech's Biomass Lab
http://www2.latech.edu/~lynam/lab.html

Modifying bandages for the sake of more expedient healing is the newest frontier in making medicine more efficient.

The Endeavor to Develop a Bandage Bound Wound Hearing Sensor

By Austin Harvey, Computer Science Junior

Cuts, scrapes, scabbing, and bleeding: all issues humans inevitably face in their lives. Everyone has experience with the occasional injury, and when it happens, it is time to bring out the all-important bandages and tape to seal the leaking of precious fluids and hemoglobin-filled cells. For many people, the wound heals after a relatively short period of time, and it's like it never happened. Unfortunately, some more serious wounds take much longer to heal and need more time beneath the sealed protection. Various factors may cause a wound to take a long time to heal or even become trapped in a phase of healing. Wounds that take three months or longer to heal are labeled as chronic. With current limitations, these wounds typically must be uncovered to be inspected for progress in healing; though, a team of researchers hopes to create a solution to replace the process of uncovering wounds to check healing.

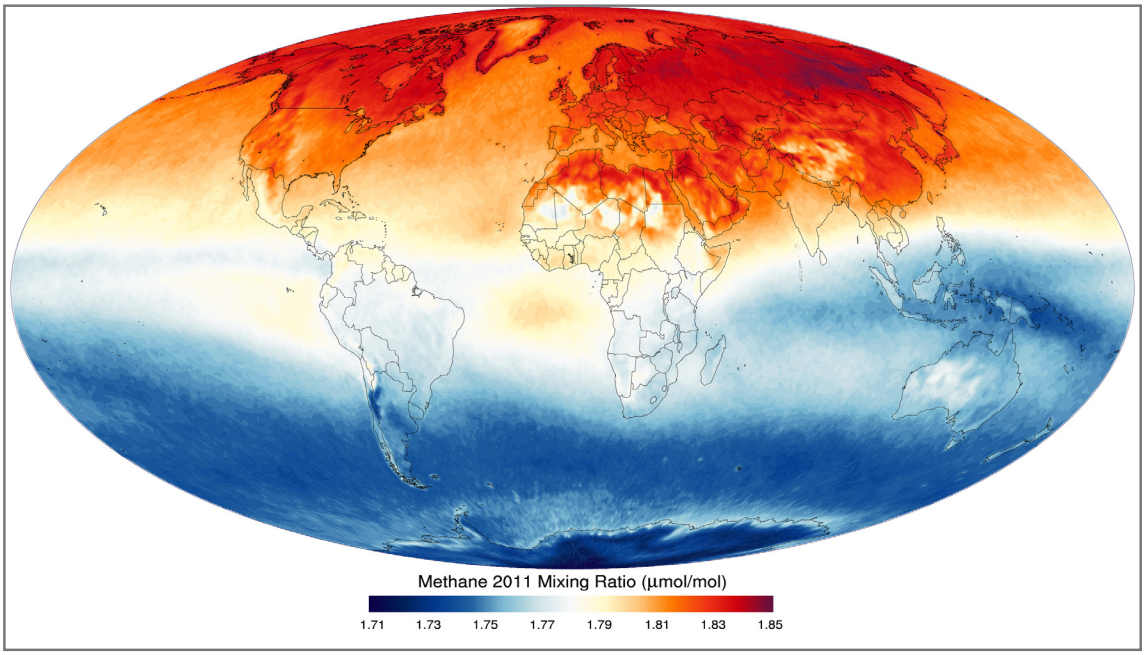
Researchers at Heriot-Watt University in Edinburgh have begun looking into a new approach of detecting information about wounds hidden under wraps. With current bandage technology, the only methods of judgement are based on reports of pain and uncovering the wound when the doctor believes a check should occur. Dr. Michael Crichton, a biomedical engineer at the university, leads their Soft Tissues and Biomedical Devices Lab in the hope of accomplishing two goals: understanding the mechanics of wound healing and creating sensors capable of mapping out the skin beneath the bandage.

Dr. Crichton states that while plenty of research has been done on the properties of wounds, there is a lack of knowledge on the healing of wounds on the microscale. In order to gain this desired understanding, doctoral student Sara Medina-Lombardero utilizes pig skin, an acceptable analogue for human skin, by making tiny incisions in the skin and running them under the lab's Optical Coherence Tomography system. With the 3D visualization, she can analyze each layer of the skin to see how it was affected by the cut. Medina-Lombardero describes her part in the project as aiming "to know how each layer of skin contributes to its mechanical properties". Once the mechanics of a wound can be understood, a sensor making use of the knowledge can be derived.

With the knowledge to be gained from the analysis, the researchers hope to produce a grain-sized sensor, which can be embedded in bandages to alert staff when healing is not occurring properly, allowing them to adjust when necessary. The sensor will be designed to make small vibrations that will test the strength of the skin beneath and receive the reverberations back. It is believed that the speed in which this transmission and reception occurs can be used to determine the strength of the skin beneath. Tracking the changes in the sensor's output and comparing it with the data gathered on how healing skin resonates will enable doctors and clinicians to see the progress of the healing process.

Through their efforts, members of the Heriot-Watt's Soft Tissue Lab hope to revolutionize how medical professionals monitor long term wound healing by cheapening and optimizing the process of checking wounds. The researchers also hope that the technology may be applicable in other fields outside of wound treatment, such as providing noninvasive methods of analyzing organs with similar structures to skin. As the two-year project continues, researchers are getting closer to the results they hope to see.

Sources:
https://tissuedevices.hw.ac.uk/research/
https://www.hw.ac.uk/news/articles/2019/smart-wound-sensor-in-development-at-heriot.htm
https://www.bbc.com/news/uk-scotland-49311598



This graph from the World Resources Institute shows various forms of energy generation and their relation to both energy security and climate effects.

Changing Energy Security in the Face of Climate Change

By Matthew Marton, Mechanical Engineering Junior

Climate change poses a set of challenges unlike any other problem in human history. The problem encompasses every facet of society from economics and politics, to food and energy security. With climate change becoming a more pressing issue, new sources of energy have to be utilized in order to replace the current fossil fuels being used. This factor adds a new layer to the debate on how to handle the challenges, due to the fact that many countries import their energy from other countries.

One problem with addressing both energy security and climate change is that the energy sources that society depends on are cheaper to import than the cost of implementing renewable sources. Germany decreased its dependence on fossil fuels through the early 21st century. However, it also began transitioning away from nuclear energy. In doing so, the country needed to import natural gas from Russia, which is a political rival of the European Union (EU). This energy importation introduced a security problem to the region. While these imports may not last forever, once a country becomes dependent on one source of energy, it can be politically hard to move away from that industry. The United States (U.S.) maintains a heavy dependence on oil and natural gas, and the number of jobs in the sectors and the power of the fossil fuel lobby makes support for renewable energy politically dangerous. While the costs of new energy sources might eventually become cheaper than the current sources, they pose problems with regards to energy security. Several sources of energy that could be useful in combating climate change depend on changes in international supply chains in most countries. Nuclear energy could be the most important non-carbon-based source for fighting climate change, but most countries do not have natural uranium supplies. This lack of supplies means that while a nation could shift away from power sources that release large amounts of carbon, it would depend on other nations for the needed fuel. Even solar power has problems related to the supply of raw materials needed to build batteries for the solar farms. Lithium is a key material in the current generation of batteries, however most of the world's lithium comes from countries like China or Chile. While China is a trading partner to western nations, human rights abuses and global superpower goals often place it at odds with these nations. Places like Chile are not politically stable, which means that output from lithium mining operations could change from year to year. In the modern world it is not possible to eliminate dependence on international trade, but as nations begin to transition to green economies, they will have to secure new trade partners.

The only way for countries to get real energy security in the modern age is by heavily diversifying how they generate power. While climate change is a massive problem, it also provides new opportunities. Poland currently derives most of its power from coal. Eventually, coal will not be economically viable as companies move away from its use and extraction. This economic reality gives Poland the ability to diversify and strengthen its generation base. Even if a country has a problem securing one source of energy, it should not lose everything due to political instability in another country.

Climate change has to be tackled head-on by all nations. Humanity simply cannot afford to ignore the problem any longer, but governments will have to answer many questions surrounding energy security in this new green future. The transition will be difficult, however; the opportunities provided in the new economy can offset these costs. Society has overcome great challenges before, and it can do so again.

Sources:
The Relationship Between Climate Change and Energy Security: Key Issues and Conclusions; David Toke and Sevasti-Eleni Vezirgiannidou
Energy Security and Climate Change Protection: Complementarity or Tradeoff; Stephen P. A. Brown and Hillard G. Huntington; 2-6
https://investingnews.com/daily/resource-investing/battery-metals-investing/lithium-investing/lithium-reserves-country/

Japan's flying car prototype paves the way for a new and exciting future for the transportation of humans and goods across considerable distances. Drawing by Eva Dickenson.

Japan's Flying Car

by Behram Dossabhoy, Computer Science Junior

Flying cars are no longer a figment of inventors' imaginations like they were in the 1950s. Japanese electronics company NEC, formerly Nippon Electric Company, has been able to design, manufacture, and assemble one of the world's first flying cars in the span of a year. In August 2019, in Abiko, Japan, NEC tested their first "flying car" prototype, which resembled a drone with four propellers. Powered by a battery, the approximately 330-pound, 13-foot-long car hovered about 10 feet above the ground for one minute.

What defines a flying car? A flying car is a driverless, electric, or hybrid-electric aircraft, that can touch down and take off vertically. This is often called eVTOL for "electric vertical takeoff and landing."

What was the goal of this project? The Japanese government wanted to showcase the country as a leader in flying cars, especially after missing the opportunity to take advantage of ride-hailing services, such as Uber and Lyft, and of the now-booming electric car industry. In addition, the close collaboration between the Japanese government and the private sector is said to push Japan to the top of the flying car industry. Japan also houses a small, yet passionate, flying car community which is adamant that Japan has the resources and expertise it needs to nurture the flying car industry on a global scale. A specialized fund, called the Drone Fund, devoted to the investment of autonomous, flying aircraft, has already been created by venture capitalists in the country.

Japan plans to start shipping goods by flying cars around 2023, and by the 2030s, to start letting people ride in them for short distances in densely populated cities to help alleviate the problem of traffic jams. Kouji Okada, one of the project's leaders at NEC, said, "We are positioning ourselves as an enabler for air mobility, providing location data and building communications infrastructure for flying cars."

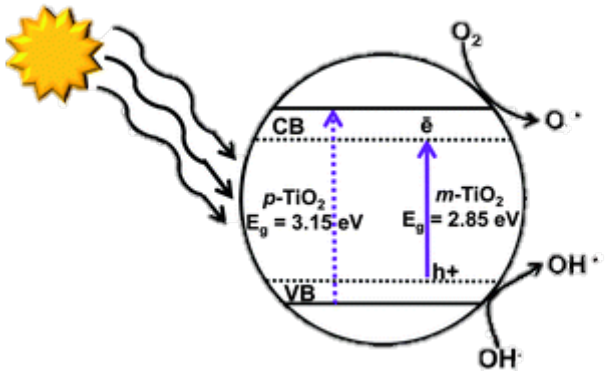
Another company, Cartivator, has agreed to partner with NEC to start mass producing the flying car in 2026. Along with NEC, more than 80 other companies such as Toyota and Panasonic also sponsor Cartivator. However, other countries like the United Arab Emirates and Singapore, and even companies such as Uber and Boeing, are in a competition to produce a better flying car. Cartivator already has an advantage, though – the Japanese government has granted them a permit for outdoor flights.

What is the point of these flying cars? Compared to helicopters, flying cars are cleaner, quieter, easier to maintain, and do not require a trained pilot. Furthermore, there is less need for on-the-ground infrastructure for these vehicles. In addition, companies are touting that flying cars will be useful in disaster relief efforts.

But with advantages, there are some hurdles. A flying car needs to be able to safely hold a number of passengers along with its own weight for some length of time. Battery life will also be an issue. Also, government regulations will pose an obstacle to overcome with these contraptions. For a vehicle that's about 330 pounds, 13 feet long, 12 feet wide, and 4 feet tall, it will be quite difficult to meet what will be strict standards.

The future that many dreamed of in the 1900s will soon be upon us. With technology constantly improving day-to-day, a safe, efficient, quiet flying car is not far from us — the 2030s are just a decade away.

Sources:
https://www.technologyreview.com/f/614072/a-japanese-flying-car-has-successfully-flown-its-first-test-flight/
https://www.popularmechanics.com/flight/drones/a28625730/japan-flying-car-prototype-tested/
https://www.engadget.com/2019/08/05/japan-passenger-drone-nec/
https://apnews.com/2d4ce8955bc04032928afdf97ed42818
https://www.staugustine.com/news/20190809/japans-nec-shows-flying-car-hovering-steadily-for-minute
https://www.bloomberg.com/news/articles/2019-08-05/new-japanese-flying-car-gets-off-the-ground-for-about-a-minute



The semiconductor TiO_2 works because of its energy bandgap and reaction of molecules.

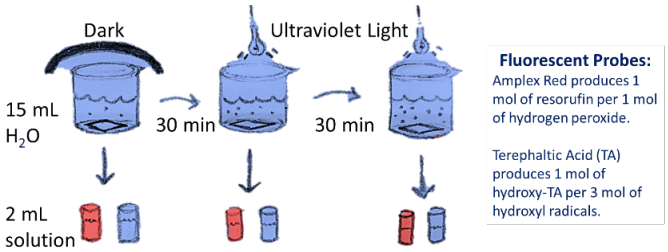
SODIS: Etching Titanium Dioxide before Adding Gold-Nanoparticles

Elizabeth Amedee, Chemical Engineering Junior

Nearly one billion people worldwide lack access to clean water, but titanium dioxide (TiO_2) helps water disinfection efforts due to its photocatalytic properties. Optimizing TiO_2 can aid water treatment and improve the lives in developing countries. Instead of using a flat titanium dioxide surface, a rough surface may allow for improved interaction with the gold nanoparticles for more efficient solar disinfection.

To confirm that etching and gold nanoparticle evaporation has occurred when assembling films, the spectrophotometer records absorption in the 200 to 600 nm wavelength range by passing through a lens and into a white integrating sphere.

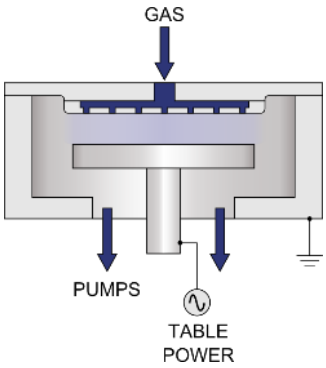
To understand how well the films work to disinfect water, a synthesis runs by placing 1 square-inch films in beakers, and the fluorometer detects collected samples, as shown below. The six tubes are filled with fluorescent probes: Amplex red produces 1 mol of resorufin per 1 mol of hydrogen peroxide, whereas terephaltic acid (TA) produces 1 mol of hydroxy-TA per 3 mol of hydroxyl radicals. A fluorometer measures wavelength/intensity of fluorescence. Measuring the amount of hydrogen peroxide or other reactive oxygen species (ROS) will determine how much disinfection is likely to happen.



Process of testing 1-inch-by-1-inch nanofilms to determine efficiency of disinfection

More sunlight absorbed means more electrons are excited, which means more superoxide is formed to create reactive oxygen species (ROS). Fortunately, hydrogen peroxide has a longer lifespan than hydroxyl radicals and is an antiseptic that damages bacteria cells' or virus' walls.

Clean water is not readily available to many people around the world. Yet, many do not know the full extent of this issue. Some existing ways for obtaining drinkable water are boiling water, solar water disinfection in small quantities for large periods of time (i.e. on a roof in water bottles), and rainwater. By understanding the solar disinfection rate of different surfaces of titanium dioxide, a more effective disinfection process can be derived. Etched nanofilm with gold nanoparticles attached on top can increase the solar disinfection rate. The cost of gold nanoparticles is relatively low, costing as little as a few pennies. Spin-coating, dip-coating, or spraying the titanium dioxide sol-gel onto a surface will have a beneficial impact on the cost of solar-disinfection material. Finally, a reactor can assist in the process of solar disinfection by using the sun's energy to heat the water in order to rid it of bacteria.



TiO2 is etched with an Oxford reactive ion etching inductive couple plasma chamber.

In addition to these processes, to understand why etched TiO_2 films with gold-nanoparticles are important, atomic force microscopy or scanning electron microscopy on films can measure topology and calculate roughness from the pictures acquired. Researchers can implement a flat-film reactor and add bacteria to understand a more direct approach to topical use. For industry, calculations of cost to produce films for public use and scaling the production to create larger films will be considered. These TiO_2 films are inexpensive and can be used continuously anywhere sunlight is present.

If nothing else, acting beyond understanding the breadth of wasteful water use and third-world problems is necessary. Organizations like UNICEF, the Thirst Project, and Living Water International invest in solving these problems. Other charities may also want to help build titanium dioxide nanofilms for outreach to third world countries with less available clean water, and ordinary people can help them reach out to achieve clean drinking water for everyone.

Sources:
https://plasma.oxinst.com/campaigns/technology/reactive-ion-etching
https://pubs.rsc.org/en/content/articlelanding/2014/tac3ta14052k#!divAbstract

Mars-like Soils in the Atacama Desert, Chile, and the Dry Limit of Microbial Life. Navarro-González, et. al.

Natural Science: The Atacama Desert

By Jordan Savoie, Civil Engineering Freshman

When most people think of environments in South America, the picture involves a combination of impenetrable rainforests, swollen rivers, and/or mountain ruins. However, the Atacama Desert on the coastal side of the Andes Mountains lacks any of these landscapes. Running several hundred kilometers along the Chilean coast, the Atacama Desert isn't merely a dry place with little vegetation, but a hyper-arid wasteland that has a surface which is, in some areas, completely sterile of any life.

Lying between the Andes and the Chilean Coastal mountain ranges, the desert is caught in a double rain shadow. A rain shadow is the dry area that results from air being forced up by mountains that lie in the way of rain-bearing winds. High altitudes push temperatures down, causing water vapor to precipitate, falling as rain or snow. Caught in a double rain shadow, the Atacama receives an average of 1.5 cm of water per year, and the amount of rain can dip as low as .3 cm annually. For comparison, the common delimiter for desert rainfall is 50 cm per year; U.S. deserts receive 28 cm per year, and the inland Sahara also receives 1.5 cm per year.

Despite being an uninhabitable wasteland, the desert is home to world-class observatories operated by the European Southern Observatory, the Carnegie Institute of Science, the U.S. National Science Foundation, and various partner institutions. Seven of the world's optical telescopes larger than five meters operate there, and two of the next generation of extremely large telescopes, the 39.3 m European Extremely Large Telescope and the 24.5 m Giant Magellan Observatory, are planned to begin operating in the Atacama Desert by the mid-2020s.

What brings astronomers to this desert? Well, the very fact that it is an uninhabitable wasteland. The arid conditions of the Atacama mean exceptionally clear skies, with many observatories seeing more than three hundred cloudless nights a year. Even without cloud cover, some types of observation simply aren't possible in humid areas because of water's opacity to certain wavelengths of light. Also, the sparse population of the desert means there is little light pollution, allowing observation of objects more faint than possible in most places on Earth. Further adding to the quality of possible sites, the mountainous terrain of Western South America allows for observatories to be built at thousands of meters above sea level, eliminating a great deal of atmospheric interference.

Serving not only as a place to gaze into space, the Atacama also serves as an analog for scientists studying the surface of Mars. Specifically, the desert is a favorite place for astrobiologists to examine, letting them test their ideas of how potential Martian life might live and interact with its environment. Scientists replicated the Viking experiments, performing the same tests on samples taken from across the desert, and found the same results as the Viking had on Mars. Because of these results, ideas for future experiments are tested there. Since 2016, the NASA Ames Research Center has sent a team to work in the Atacama Desert to develop technology for testing soil samples on a rover. The Ames rover is about the size of the Spirit and Opportunity rovers that trekked across the Martian surface gathering geological samples, and the Ames rover carries a suite of instruments to test for over five hundred compounds of interest. Researchers hope that the field testing will lead to the miniaturization and automation many tests that are normally done in a laboratory, making it possible to include them in future space missions.

Sources:
https://ucmp.berkeley.edu/exhibits/biomes/deserts.php
https://www.astronomictourism.com/astronomical-observatories-chile.html
https://www.nasa.gov/ames/arads
https://www.space.com/digging-mars-life-strategy-atacama-desert.html

ARKANSAS NUCLEAR ONE

By STEVEN CAIN

Now that the energy crisis has come to a head with the coal, natural gas, and fuel oil rapidly dwindling, nuclear power seems to be one of the better ways to supply energy. Arkansas Nuclear One will be the Southwest's first nuclear powered electric generating station.

Built, owned, and operated by Arkansas Power and Light, Nuclear One is scheduled for operation and the selling of electrical power in early 1974.

Located approximately five miles to the west of Russellville, Arkansas, Nuclear One will use the Dardanelle Reservoir as its water intake system.

A nuclear power plant is similar to any other steam electric generating plant, for each must use fuel to make steam. The heat brings the water to a boil and the boiling water turns into steam. The steam then drives the turbines which turn the generator to produce electricity. The source of heat is the only major difference.

In the nuclear plant, uranium rods are placed in the reactor and bombarded by neutrons. This bombardment causes a splitting of the uranium atoms and thus by this process called fission, heat is produced. Pressurized water around the rods is heated, then passed into the steam generator where the water is converted to steam. The steam powers the turbines which in turn causes the generator to produce electricity. The steam is then cooled and condences back into water and then is pumped back into the steam generator to be used again.

There are two units at the nuclear plant. Unit One is to be an open system as compared to Unit Two which is to be a closed system. The open system will take water from the reservoir, use it, and return it back to the lake. The closed system will take in the water but will reuse it over and over again.

By the time the water flows to the center of the lake in the open system, it must have no more than a 2° F difference in the temperature between the intake and the output. The temperature of the output is 15° higher than the input immediately leaving the plant, but by the time the water flows the 2 miles of access stream to the lake, the water is approximately the temperature of the input.

The input water system has numerous screens of decreasing size to keep logs and other floating debris out of the reactor. Should any material pass through the screens, the material will be ground to a fine powder and fed back into the output.

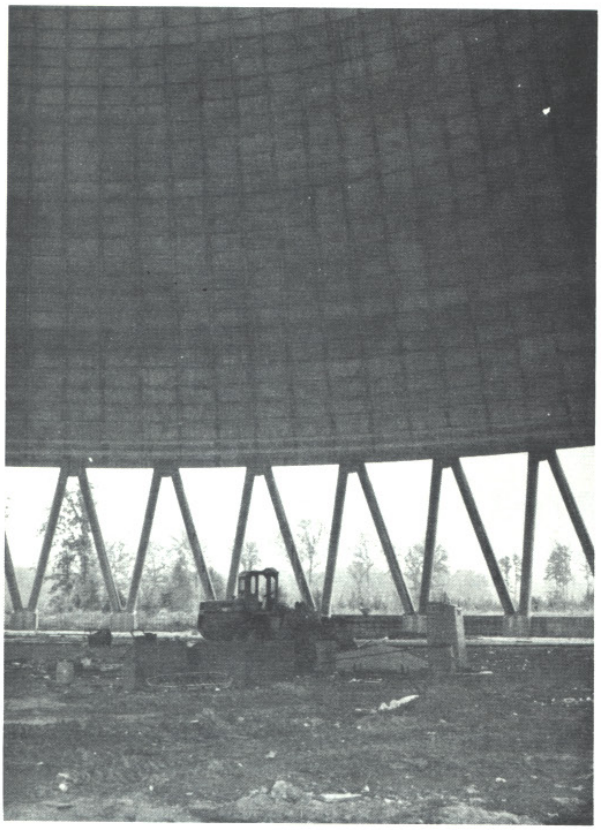
Most of the fish in the lake will be kept out by the screens. The small fish that make it through the screens will be turned back by a wall of bubbles.

The intake of the water for Unit One will be approximately 750,000 gallons per minute. If the water was not returned back to the lake, the plant would drain the Arkansas River dry in 3 hours.

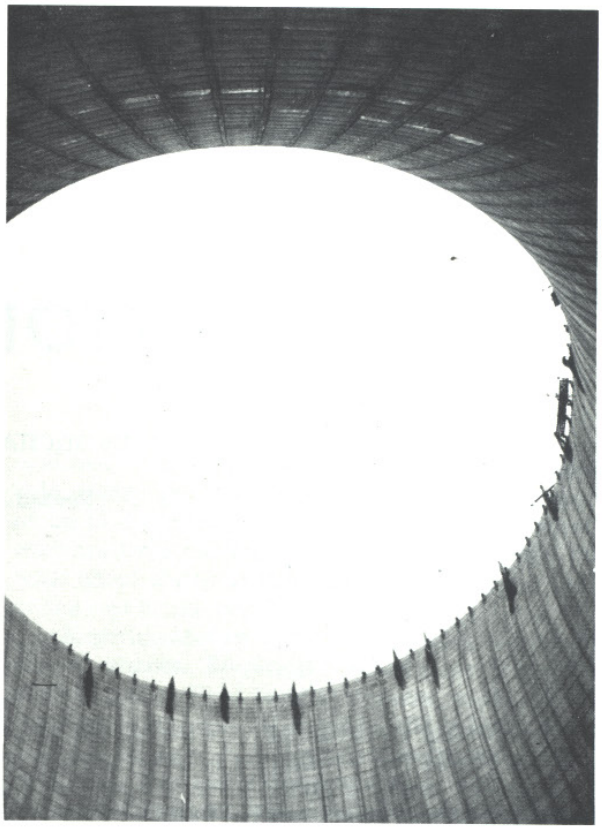
The Unit Two will be a closed system. The water will be taken from the lake but will not be put back after use. Although the temperature of water at the output would have been within the set temperature limits, it would have been running close to the limits. Therefore a natural draft cooling tower was constructed.

This tower is made of concrete and its cost for construction was over 8 million dollars. The hyperbolic shaped tower is 450 feet high with a 258 feet diameter at the top and a diameter of 330 feet at the bottom. The bottom of the tower is approximately 60 feet above the surface of the ground. The water from the reactor will be placed in a pool 9 feet deep which is directly below the tower. The tower will have hot water circulating in pipes in the upper portion of the tower where the diameter is the smallest. This will cause a vacuum affect and the heat of the water will rise to the top of the tower and be discharged into the atmosphere. The water will be returned to the reactor as soon as the temperature is low enough to be useful.

Anyone working near the reactor must wear



The Cooling Tower Support System.



The Cooling Tower from the inside looking up.

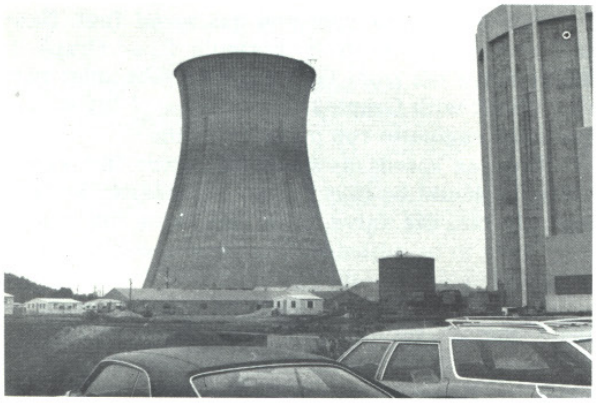
special clothing similar to hospital gowns. The clothes will be washed and the water will be stored underground in tanks permanently. The workers themselves must shower and wash any tools that may have been in the area. This water will join the clothes water in the permanent storage tanks.

The operators of the reactor must have control of an area with a radius of 6.5 miles from the center of the reactor. They will monitor 52 doors and gates from the main control center by the use of computors.

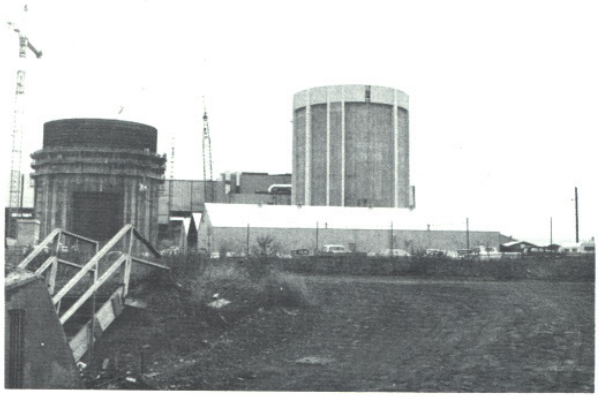
Mr. Ralph Nader visited the plant and after a complete tour said that there was no problem with the plant or with its controls for safety. There are many back up systems needed to insure the safety of the plant. Should one system fail, another system will go into operation. Each system backs up the previous system. These consist of electric engines, diesel engines, and batteries, to name only a few.

There have been no lawsuits against the plant and Nuclear One has paid over 4½ million dollars in taxes to the town of Russellville.

Nuclear power is the most efficient means of supplying energy in dollars and cents. As the energy crisis increases, the nuclear power plants will be the leaders in supplying the power to the ever growing need of mankind.



The Power Plant Reactor.



The Cooling Tower for the Unit Two System.


Oh, look at that.
whew!
Freshman projects... must be that time of year again.
I sure have come far.
And I've got to admit.
It feels pretty good to be out of the woods.
Senior Design
tap tap tap tap tap tap

IT WOULDN'T BE A QUARTER AT TECH WITHOUT A GROUP PROJECT!

LET'S MEET YOUR GROUPMATES FOR THIS QUARTER!

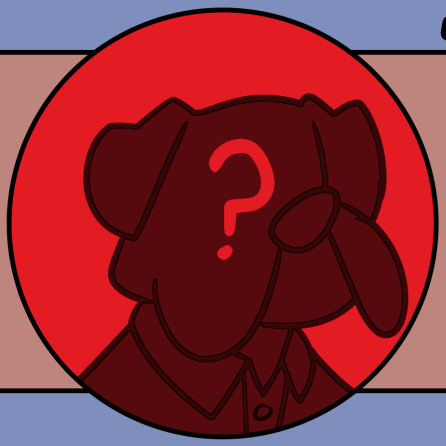
The Geeky One

THE MOST EXCITABLE MEMBER OF YOUR GROUP- AN AVID POP CULTURE FAN. SURE, HE COULD TALK ABOUT STUFF RELATING TO THE PROJECT, BUT HE FEELS AN INCREDIBLE NEED TO DISCUSS SOMETHING WITH YOU. HE *WILL* BRING UP STAR WARS, SO TREAD LIGHTLY: DON'T SAY ANYTHING ONE WAY OR THE OTHER ABOUT THE PREQUELS, AND ESPECIALLY DON'T SAY ANYTHING ABOUT THE NEW TRILOGY. YOUR LIFE- AND YOUR SANITY- DEPENDS ON IT.

The Popular One

THE OUTLIER OF THE GROUP, THIS STUDENT WILL INEVITABLY CARE EVEN LESS ABOUT NON-WORK-RELATED TOPICS THAN YOU. IN FACT, SHE DOESN'T HAVE MUCH INTERESTS IN BEING WITH THE GROUP AT ALL: DURING ANY FREE MOMENTS, SHE'LL INEVITABLY BE ON HER PHONE CHATTING WITH HER FRIENDS. YOU'RE NOT MAD AT HER FOR DOING IT: YOU'RE MAD BECAUSE YOU CAN'T DO THE SAME.

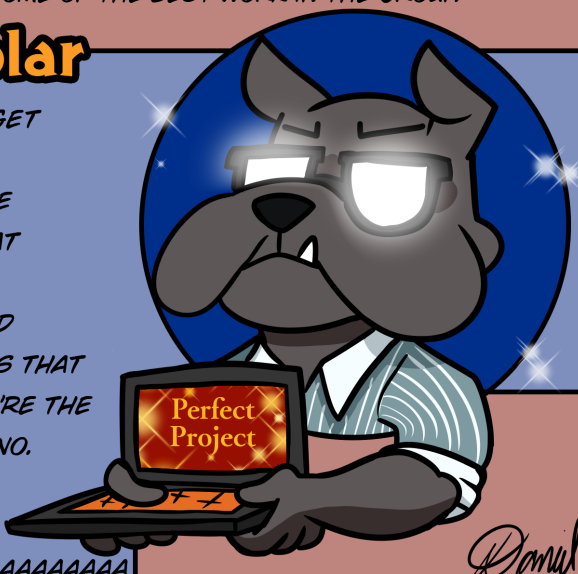
The Shadow



A MYSTERIOUS ENTITY, ONLY SEEN WITHIN THE CLASSROOM'S WALLS. GOOD LUCK FINDING THEM AT ANY MEETINGS: THEY'VE DISAPPEARED INTO THE NIGHT AND ARE NOWHERE TO BE FOUND. TEXTS ARE UNREAD, EMAILS HAVE NO REPLY, AND CALLS PROVIDE NO RESULTS. ANY CONFRONTATIONS IN THE CLASSROOMS ARE DISMISSED WITH A WAVE OF THE HAND. DESPITE ALL THIS, THEY HAVE A DECENT CHANCE TO DO SOME OF THE BEST WORK IN THE GROUP.

The Scholar

AN INCREDIBLY SMART STUDENT YOU WERE LUCKY ENOUGH TO GET PAIRED WITH! THEY DO THE BEST WORK IN THE GROUP, THEY'RE ALWAYS PREPARED... SOMETIMES YOU FEEL LIKE YOU DON'T HAVE TO DO ANY WORK! ..ACTUALLY, WAIT, YOU REALLY DON'T HAVE THAT BIG OF A ROLE IN THE GROUP. DID YOU EVEN NEED TO SHOW UP TO THAT LAST MEETING? IT WAS AN HOUR AND A HALF LONG AND IT DIDN'T EVEN MENTION YOUR SECTION. WAIT A SEC, WHAT DOES THAT MAKE YOU IN THE GROUP? HOW DO THEY SEE YOU? WHAT IF YOU'RE THE LAZY GROUP MEMBER THAT DOESN'T GET ANYTHING DONE? OH NO. YOU'VE BEEN THINKING SO HARD ON THE OTHER GROUP MEMBERS THAT YOU NEGLECTED TO CHARACTERIZE YOURSELF. TIME TO FEEL GUILTY FOR THE REST OF THE PROJECT OH NO AAAAAAAAA



AND JUST LIKE THAT, ANOTHER GROUP PROJECT OVER! WASN'T THAT FUN?

The American Society of Civil Engineers (ASCE) and The American Institute of Steel Construction (AISC) has had a great start to the year! We have attended several on-campus organization browses that were geared towards bringing in freshman to ASCE/AISC. We have had several freshmen join our student chapter that are excited to get involved with ASCE and AISC. This year, we also held our first ever Civil Engineering Week on Louisiana Tech's campus. During Civil Engineering Week, we hosted several industry meetings and wanted to give students a chance to see some of the possibilities and career options that are available with a civil engineering degree.

We are also excited to see the progress we have made so far with our concrete canoe and steel bridge teams. We've had several canoe meetings to discuss this year's canoe theme, design, and mix. We have also begun our concrete canoe racing team practices. For steel bridge, we have had several design meetings.

In December, members of ASCE attended the Asphalt Road-eo competition in Texas where they designed and manufactured an asphalt slab for rutting, skid resistance, cracking, and sustainability testing. During Winter Quarter, we had our canoe pour day, more industry speakers, service events, and general body meetings. With such a great start to the year we are looking forward to the events that we have coming up.

The Biomedical Engineering Society (BMES) has been working on some large events this year. Originally, a biomedical engineering career fair was slated for the fall quarter. This event had to be cancelled due to outside circumstances, but we are now working to bring these companies to the spring career fair. In addition, we are setting up a professional development event for both industry and graduate school. Our mentorship program has also been gearing up. This past quarter has been spent pairing up mentors and mentees, but this upcoming quarter has a few larger events kicking off with a lock-in at Lambright.

However, we have fun activities beyond the more professionally focused events mentioned above. Our Christmas party, a potluck-style event open to the entire university, occurred just before the Christmas break. This event was one of our biggest last year and achieved the same result this year. Who doesn't like live music and free food? As the cold weather set in, we also offered hot chocolate at our upcoming study sessions so students could stay warm while working out homework problems with the assistance of our student tutors. Finally, we offered a community service project opportunity to our members so they could help better the community we find ourselves in for four years. You'll have to wait to see what the event is so keep your eyes peeled for an upcoming email...

ECO-CAR

BULLDOG DEVELOPMENT TEAM

LOUISIANA TECH UNIVERSITY - COLLEGE OF ENGINEERING AND SCIENCE

The Louisiana Tech Eco-Car team is on a roll this year. Literally. We've recruited new members, installed new student leadership, and members worked it out for a chance to drive at competition. Some drivers were running practice laps in Apawlo, the gasoline car that made its debut in Sonoma, Calif., at the Shell Eco-marathon Americas 2019, by the end of the fall quarter.

To top it off, the Louisiana Tech Bulldogs football team welcomed Apawlo, driven by Andrew West, to the field on October 19 to deliver game balls to the referees. The short drive in front of thousands of attendees celebrated the STEM Day game at Joe Aillet Stadium.

We've also built a battery electric (BE) car, that is already breaking team records. The chassis for the BE car is the lightest our program has ever seen, weighing under 20lbs. The chassis is strong enough to support the full body of the design, including the mechanics and driver. The BE car will also sport the classic pass through design that the program used on XX, Diesel Dawg, and Champ, for those who remember.

We've spent time upgrading components inside of Apawlo too, like the steering wheel features and casing. During the summer, an engine swap was done on the car by senior mechanical engineer, Luke Moreau and his big brother, Beau. The pair's dedication to the car during the off season will make an obvious and incredible difference in April 2020.

In October, both Louisiana Tech cars passed phase 1 of registration for the 2020 Shell Eco-marathon. The team is looking forward to showing off at competition both on and off the track in early April at Sonoma Raceway. Follow the team on Facebook, Twitter, and Instagram to keep up this season: @latechecocar.

The E&S Magazine
Louisiana Tech University
P.O. Box 10348
Ruston, LA 71272-0046

I hope you've enjoyed our humble magazine

With all its magnificent stories to be seen

Woah - are those some flying cars?

A person who has touched the stars?

Oops, Lake Peigneur seemed to have an issue

But you don't need a tissue

Because now your spirits will be inflated

With all the stories that have been stated

All the news that's fit to engineer

Get all of it right here

By Craig Rice, Psychology Sophomore