LWTech Applied Research Symposium 2021

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LAKE WASHINGTON INSTITUTE OF TECHNOLOGY

KIRKLAND

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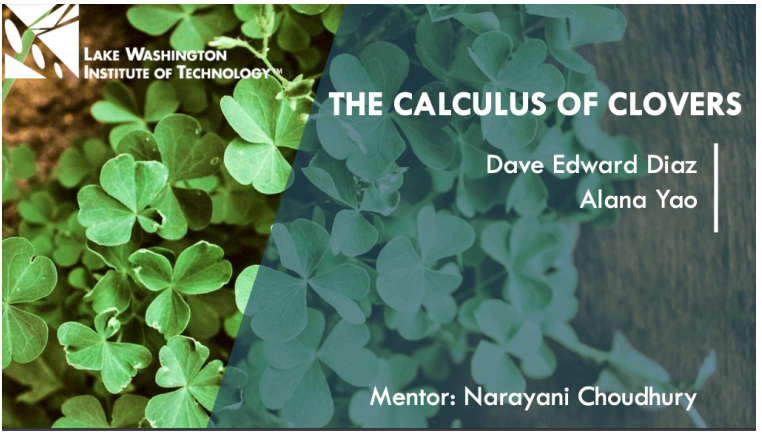
This book represents student research from the Applied Research Symposium at Lake Washington Institute of Technology on May 13, 2021. The Applied Research Committee welcomes and supports student work including research and project work in all disciplines across the college. In this issue, students contributed research from fields of art, behavioral health, biology, education, engineering, social science, and mathematics. This was the second annual symposium on campus. The symposium was organized by the Applied Research Committee, including:

Michael Rodriguez, Chair
Benjamin Meyer, Vice-Chair
Doug Emory
Sarah Chandler
Christine Turpin
Laura Toussaint
Sharon Raz
Kimberly McClure
Barcin Acar
Neha Kardam
Lauren Cline
Hany Roufael



The Calculus of Clovers by Dave Edward Diaz and Alana Yao

Note: Click on image to see PowerPoint presentation

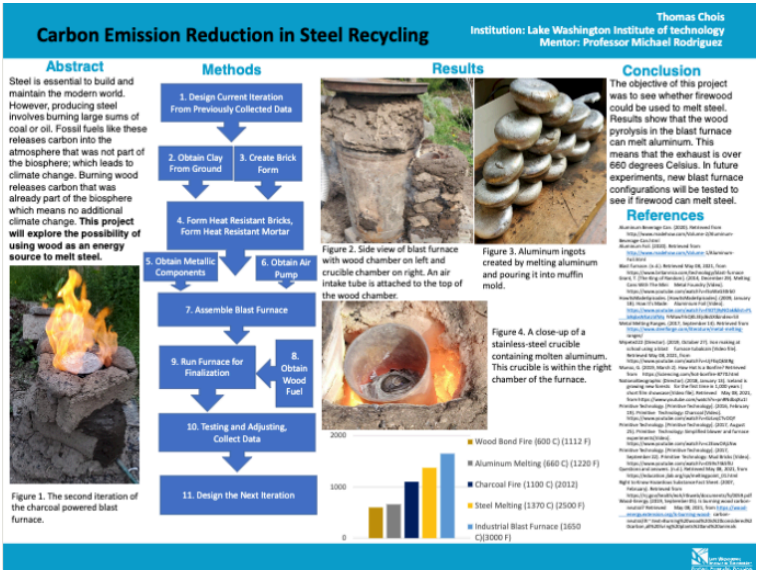
Summary

Here, we will discuss the calculus of the clover-leaf shape. Using double integration with polar coordinates, we find the areas of these shapes. We use multivariable calculus-based methods to estimate the average height of water in a clover-shaped swimming pool. The methods we use are very generic that elucidate the calculus of clovers. Such studies have many real-world applications as the clover-leaf is a fundamental shape that manifests often in nature. Its shape is seen in leaves, flowers, tRNA, etc. T-RNA (transfer ribonucleic acid) is a type of RNA molecule that helps decode a messenger RNA (mRNA) sequence into a protein. Cloverleaf shapes are used in engineering design elements. The electronic d-orbitals

have a three-dimensional cloverleaf shape. The Chandra observatory discovered exciting findings of clover-leaf quasars that provide evidence of large-scale star formation in the early universe. We have a cloverleaf interchange at the 85th street at Kirkland. The calculus of clovers thus has many applications in fundamental sciences, engineering, and transportation.

Carbon Emission Reduction in Steel Recycling

THOMAS WON CHOIS



Carbon Emission Reduction in Steel Recycling by Thomas Won Chois

Note: Click on image to access poster

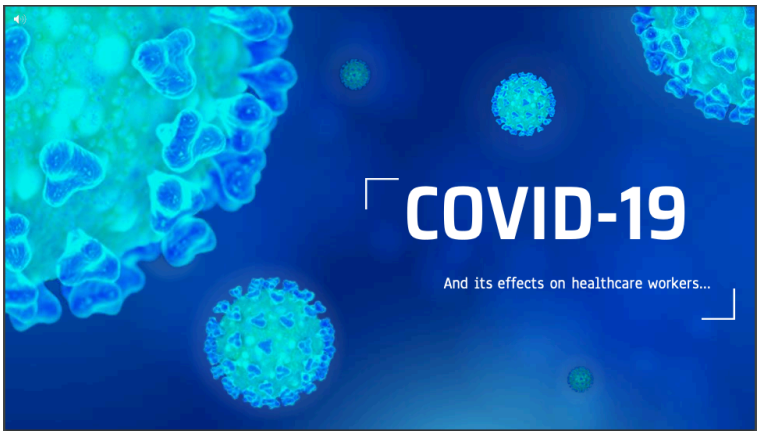
Summary

Steel is essential to build and maintain the modern world. However, producing steel involves burning large sums of coal or oil. Fossil fuels like these releases carbon into the atmosphere that was not

part of the biosphere; which leads to climate change. Burning wood releases carbon that was already part of the biosphere which means no additional climate change. This project will explore the possibility of using wood as an energy source to melt steel.

COVID-19 And its effects on healthcare workers...

COY KINDE AND BINNAY PIROT



COVID-19 And its effects on healthcare workers... by Sabrina Do and Binnay Pirot

Note: Click on image to see PowerPoint presentation

Summary

The pandemic has rapidly increased the demand for frontline healthcare workers. In December 2020, we surveyed healthcare workers to identify, assess and summarize research on the mental health impact of the COVID-19 pandemic on healthcare workers. Psychological problems were assessed using a generalized anxiety

disorder scale, the Healthcare Worker Survey, and Anxiety Depression Test. Our results revealed a significant psychological impact of COVID-19 on healthcare workers.

The Power of Art: A Mental Health Therapy

MONICA SHOEMAKER

The Power of Art: A Mental Health Therapy by Monica Shoemaker

Note: Click on image to access poster

Flu Vaccine Analysis

BINNAY PIROT AND SABRINA DO

Flu Vaccine Analysis by Sabrina Do and Binnay Pirot

Note: Click on image to see PowerPoint presentation

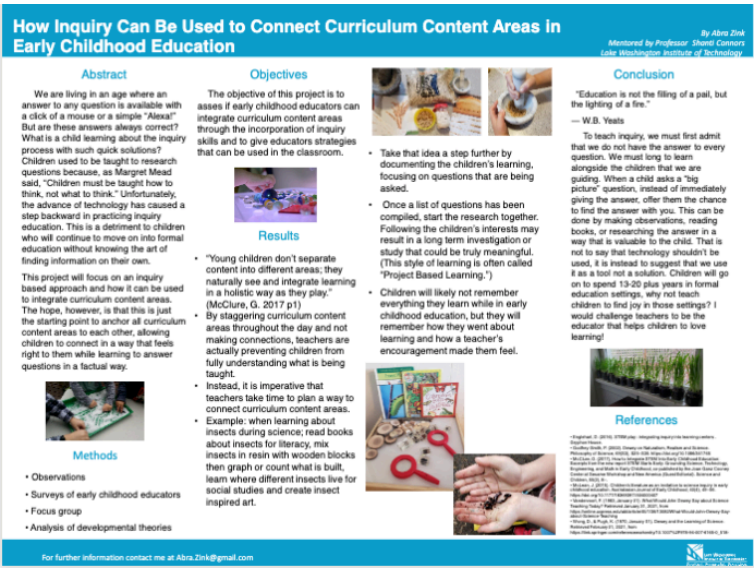
Summary

The aim of this descriptive cross-sectional study was to see whether the COVID-19 pandemic influenced the decision by healthcare workers and non-healthcare workers to get a flu vaccine. From November 9th through the 21st of 2020, participants were invited to complete an online survey on how likely they were to get the flu vaccine in the year 2020, the start of the pandemic, versus pre-COVID 19, year of 2019. A total of 305 participants 18 years and older in Washington State participated in this study. Healthcare professionals were found to be more likely to get a flu vaccine compared to non-healthcare workers in 2020. Among participants 55 and older, flu vaccination did not vary from 2019 to 2020. Little

mention of the COVID-19 pandemic was brought up in the completed questionnaires where participants were asked to state their reason for getting or not getting the flu vaccine. Out of the 305 participants, only 3 mentioned COVID-19 (less than 1% of all responses) as one of their reasons. It is recommended to get a flu vaccine during the COVID-19 pandemic as these two viruses share similar symptoms. In times of uncertainty, any prevention method can help decrease the risk of flu and COVID-19 infections. Through public health surveillance, results of this study can be updated as the pandemic continues. With the rise of COVID-19 vaccinations and flu season set to come around yet another year, administered flu vaccines may very well rise from the initial study.

How Inquiry Can Be Used to Connect Curriculum Content Areas in Early Childhood Education

ABRA ZINK



How Inquiry Can Be Used to Connect Curriculum Content Areas in Early Childhood Education by Abra Zink

Note: Click on image to access poster

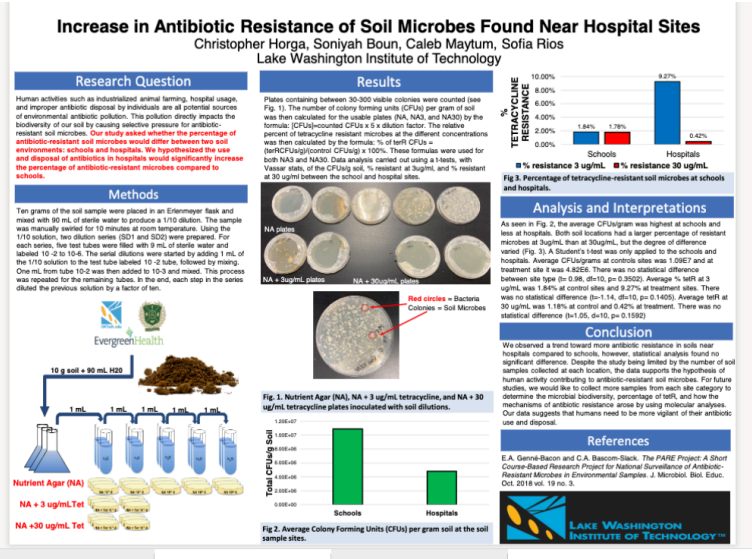
Summary

We are living in an age where an answer to any question is available with a click of a mouse or a simple "Alexa!"

But are these answers always correct? What is a child learning about the inquiry process with such quick solutions? Children used to be taught to research questions because, as Margret Mead said, "Children must be taught how to think, not what to think." Unfortunately, the advance of technology has caused a step backward in practicing inquiry education. This is a detriment to children who will continue to move on into formal education without knowing the art of finding information on their own. This project will focus on an inquiry based approach and how it can be used to integrate curriculum content areas. The hope, however, is that this is just the starting point to anchor all curriculum content areas to each other, allowing children to connect in a way that feels right to them while learning to answer questions in a factual way.

Increase in Antibiotic Resistance of Soil Microbes Found Near Hospital Sites

CHRIS HORGA



Increase in Antibiotic Resistance of Soil Microbes Found Near Hospital Sites by Christopher Horga

Note: Click on image to access poster

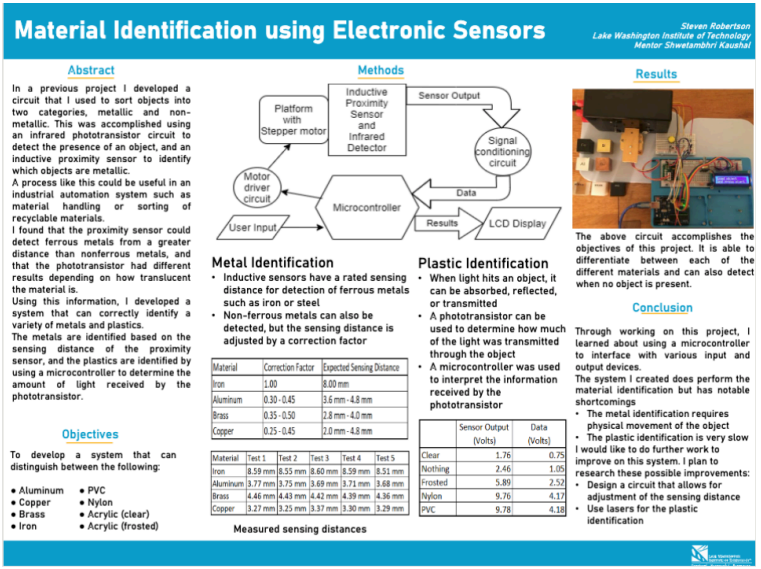
Summary

Human activities such as industrialized animal farming, hospital

usage, and improper antibiotic disposal by individuals are all potential sources of environmental antibiotic pollution. This pollution directly impacts the biodiversity of our soil by causing selective pressure for antibiotic resistant soil microbes. Our study asked whether the percentage of antibiotic resistant soil microbes would differ between two soil environments: schools and hospitals. We hypothesized the use and disposal of antibiotics in hospitals would significantly increase the percentage of antibiotic resistant microbes compared to schools.

Material Identification using Electronic Sensors

STEVEN ROBERTSON



Material Identification Using Electronic Sensors by Steven Robertson

Note: Click on image to access poster

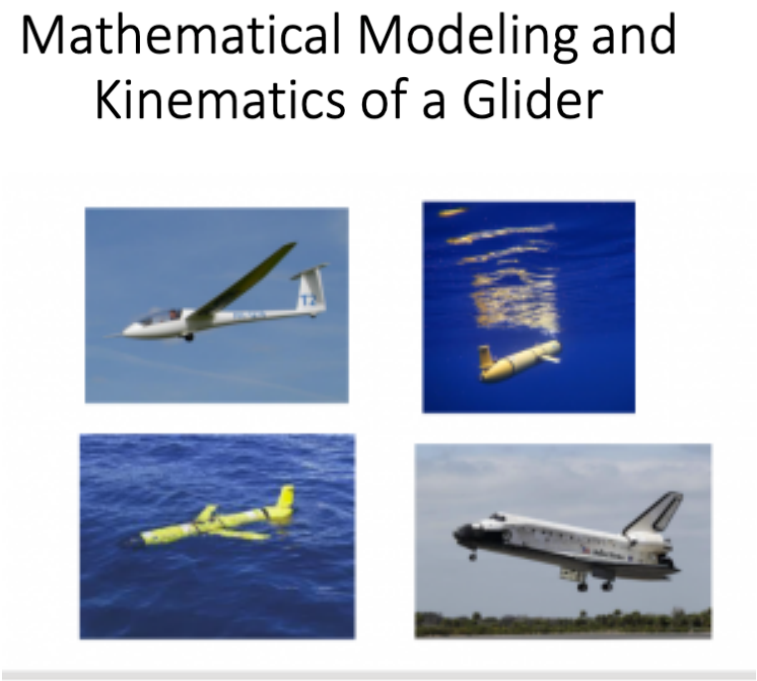
Summary

In a previous project I developed a circuit that I used to sort objects into two categories, metallic and nonmetallic. This was accomplished using an infrared phototransistor circuit to detect the

presence of an object, and an inductive proximity sensor to identify which objects are metallic. A process like this could be useful in an industrial automation system such as material handling or sorting of recyclable materials. I found that the proximity sensor could detect ferrous metals from a greater distance than nonferrous metals, and that the phototransistor had different results depending on how translucent the material is. Using this information, I developed a system that can correctly identify a variety of metals and plastics. The metals are identified based on the sensing distance of the proximity
sensor, and the plastics are identified by using a microcontroller to determine the amount of light received by the phototransistor.

Mathematical Modeling and Kinematics of a Glider

ALEX GALE, KWAN JIE LEE, ANGELA LEE, AND LUCAS MINET



Mathematical Modeling and Kinematics of a Glider by Alex Gale

Note: Click on image to see PowerPoint presentation

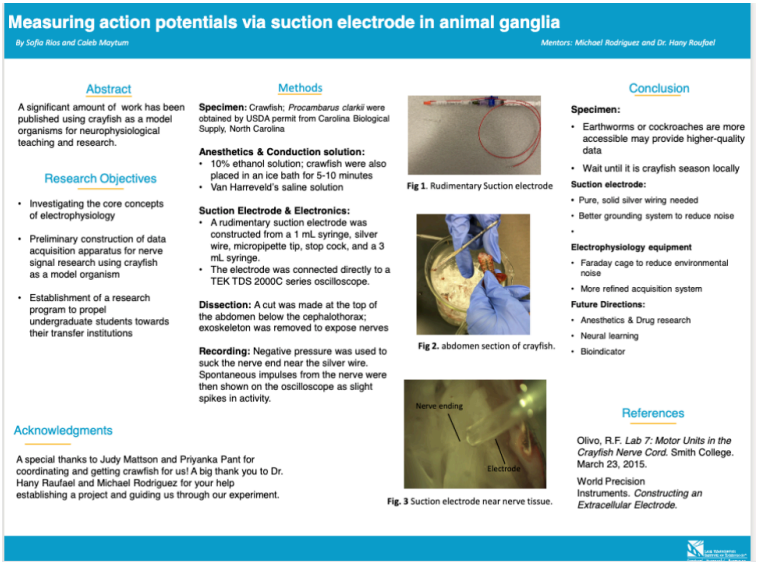
A video element has been excluded from this version of the text. You can watch it online here:
https://openwa.pressbooks.pub/lwtechappliedresearchsymposium2021/?p=80

Summary

Under water gliders are free-swimming robotic vehicles that gather conductivity-temperature-depth (CTD) data from the ocean for months at a time and transmits the data in real time via satellite telemetry. Studies using gliders have important applications in oceanography, engineering, and remote sensing. Here we employ mathematical models for studying the flightpath of a glider using vector valued functions. We use these models to calculate the osculating plane of the glider. The model parameters are optimized to minimize turbulence. We studied the kinematics of a glider using reported real time GPS data. We analyzed the reported glider velocity data and used vector-calculus based methods to derive the instantaneous and average velocities and acceleration vectors. We apply matrix-algebra based methods to translate and rotate the glider to position it at appropriate coordinates underwater for gathering data. This research involves mathematical modeling of real-world data, applied optimization, and data visualization. These studies provide novel avenues for hands on exploration and application of key mathematical concepts.

Measuring Action Potentials via Suction Electrode in Animal Ganglia

SOFIA RIOS



Measuring Action Potentials via Suction Electrode in Animal Ganglia by Sofia Rios

Note: Click on image to access poster

Summary

Considerable research has been done examining the method of

nerve signal initiation and propagation in model organisms. However, few to no experiments have encompassed a hybrid technique using both electrical signal collection and laser signal analysis. The focus of this research is to determine the efficacy of a hybrid experimental technique and applications for this type of research. Several animal models have large nerve fiber axons that can be studied using a microscope and an electrode probe including crayfish, earthworms, squid, crickets, and cockroaches. In this study, we stimulate sensory receptors and collect nerve transmission data using a student-fabricated electrode probe and a photonics setup to correlate data tissue dynamics. This research should lead to interesting undergraduate research applications in the future.

Post Partum Depression disorder: A Hidden Epidemic?

OLGA OKHAPKINA

Postpartum Depression Disorder: A Hidden Epidemic by Olga Okhapkina

Note: Click on image to see PowerPoint presentation

Summary

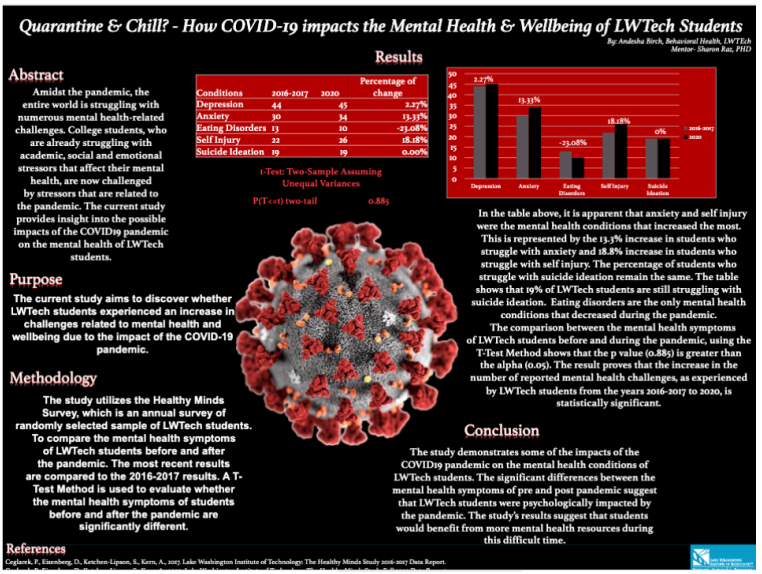
In recent times more often the joy of motherhood is increasingly darkened by postpartum depression disorder (PPD). PPD is similar to depression. It occurs when women who gave birth feel emotionally and physically exhausted with or without any definite reason, and in this state, they can be driven to an emotional

breakdown. The condition usually develops several weeks after pregnancy and can last up to 1.5-2 years. Many women conceal the fact that they have PPD, due to social phenomena like misconception, ignorance, and prejudice. Since childbirth is generally perceived by society as a happy occasion, many find it hard to understand that it may cause traumatic experiences as well. The main purpose of the study to increase awareness of postpartum depression disorder.

The hypothesis of the study is based on a recent meta-analysis which claims that 20% of mothers experience clinical depression after childbirth. This study has a cross-sectional design, and in order to test the hypothesis, an electronic questionnaire was created. The participants were recruited through a convenience sample from Facebook social media in October 2020. The results showed that the number of women who struggled with PPD was higher than the hypothesis states (41.8%). Moreover, the concealing of PPD symptoms can be seen by some of the given answers as well. Only 10.7% of women were officially diagnosed with PDD, yet 41.8% of women stated that they concealed the fact that they had depression after childbirth. Society has many various stereotypes and social stigma which may force new mothers to hide their depression. My research shows that the social stigma due to PDD is having a real impact on mothers in our community. Community efforts to combat this stigma are needed.

Quarantine and Chill - How COVID-19 impacts the Mental Health and Wellbeing of LWTech Students

ANDESHA BIRCH



Quarantine & Chill – How COVID-19 impacts the Mental Health & Wellbeing of LWTech Students by Andesha Birch

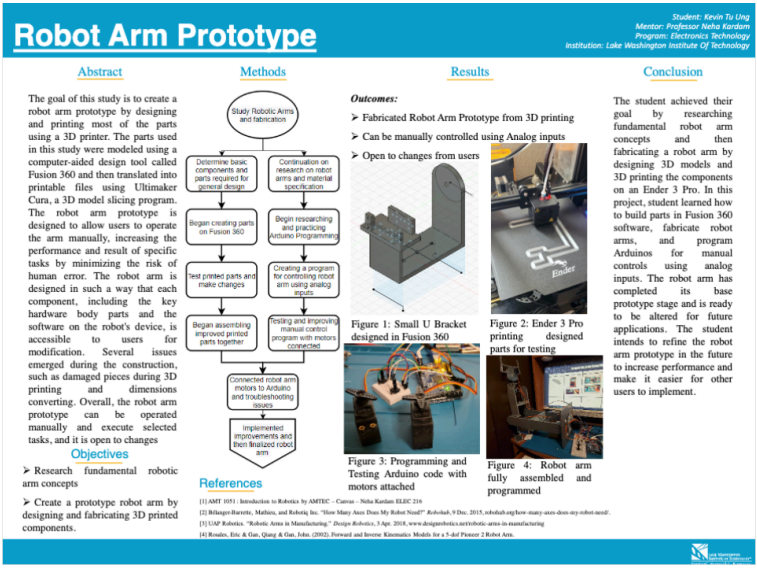
Note: Click on image to access poster

Summary

Amidst the pandemic, numerous health-related perplexities emerged. One of the lesser discussed perplexities includes trends among different age groups. For college students, these perplexities mostly consist of their inability to meet expectations in academic pursuits, and the ensuing social and emotional challenges. At LWTech, it has yet to be determined the enormity of COVID-19 on the overall wellbeing and mental health of students. The current study seeks to discover whether LWTech students experienced an increase in mental health challenges due to the impacts of COVID-19. The study will employ the "Healthy Minds Study" which is an annual study conducted via online survey of randomly selected samples of LWTech students. The current study will compare the results from the 2016-17 survey to the recent 2020 survey results. The comparison of the mental health conditions of LWTech students before and after the pandemic will provide insight on the impacts of the pandemic on the mental health conditions of the students. The data from the Health Mind Study will be compared to a similar study conducted by the University of Vermont (Copeland et al., 2021) to highlight the possible impacts of COVID-19 on college students and to suggest areas in which measures can be implemented to reduce COVID's negative impact.

Robot Arm Prototype

KEVIN UNG



Robot Arm Prototype by Kevin Ung

Note: Click on image to access poster

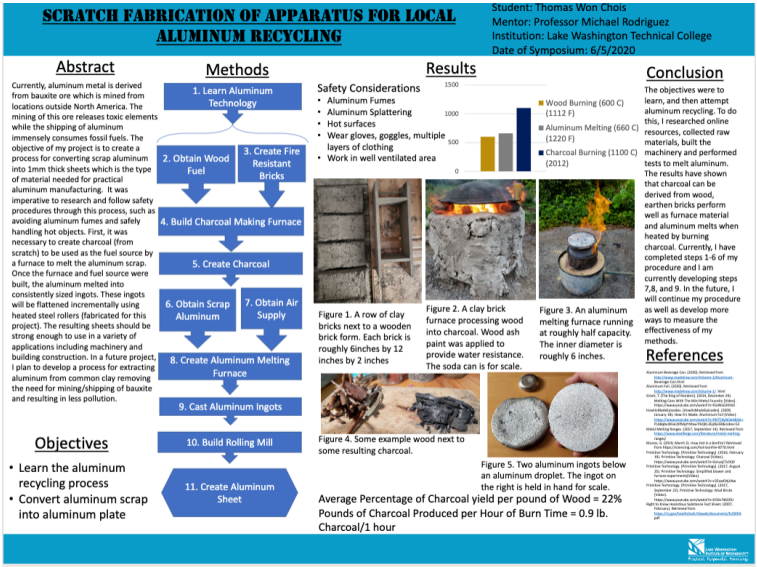
Summary

The goal of this study is to create a robot arm prototype by designing and printing most of the parts using a 3D printer. The parts used in this study were modeled using a computer-aided design tool called Fusion 360 and then translated into printable files using Ultimaker Cura, a 3D model slicing program. The robot arm

prototype is designed to allow users to operate the arm manually, increasing the performance and result of specific tasks by minimizing the risk of human error. The robot arm is designed in such a way that each component, including the key hardware body parts and the software on the robot's device, is accessible to users for modification. Several issues emerged during the construction, such as damaged pieces during 3D printing and dimensions converting. Overall, the robot arm prototype can be operated manually and execute selected tasks, and it is open to changes.

Scratch Fabrication of Apparatus for Local Aluminum Recycling

THOMAS WON CHOIS



Scratch Fabrication of Apparatus for Local Aluminum Recycling by Thomas Won Chois

Note: Click on image to access poster

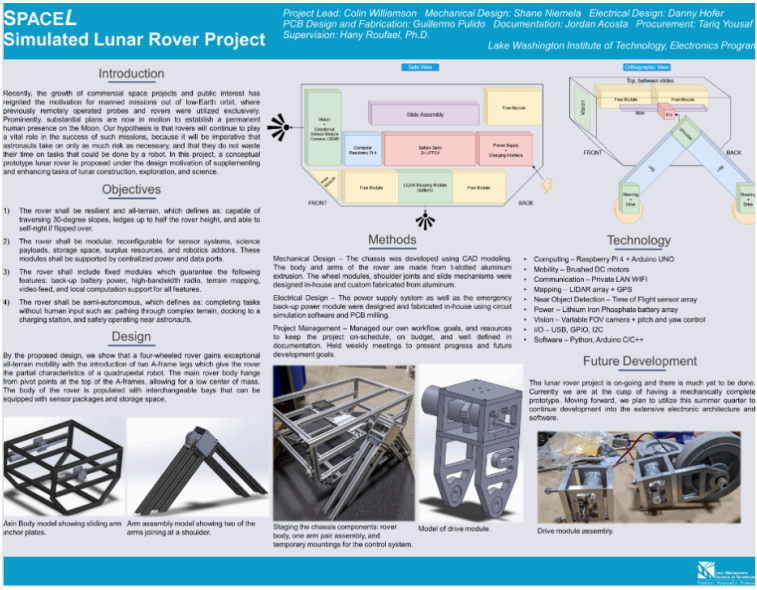
Summary

Currently, aluminum metal is derived from bauxite ore which is

mined from locations outside North America. The mining of this ore releases toxic elements while the shipping of aluminum immensely consumes fossil fuels. The objective of my project is to create a process for converting scrap aluminum into 1mm thick sheets which is the type of material needed for practical aluminum manufacturing. It was imperative to research and follow safety procedures through this process, such as avoiding aluminum fumes and safely handling hot objects. First, it was necessary to create charcoal (from scratch) to be used as the fuel source by a furnace to melt the aluminum scrap. Once the furnace and fuel source were built, the aluminum melted into consistently sized ingots. These ingots will be flattened incrementally using heated steel rollers (fabricated for this project). The resulting sheets should be strong enough to use in a variety of applications including machinery and building construction. In a future project, I plan to develop a process for extracting aluminum from common clay removing the need for mining/shipping of bauxite and resulting in less pollution.

Simulated Lunar Rover Project

COLIN WILLIAMSON



Simulated Lunar Rover Project Poster by Colin Williamson

Note: Click on image to access poster

Summary

Recently, the growth of commercial space projects and public interest has reignited the motivation for manned missions out of low-Earth orbit, where previously remotely operated probes and

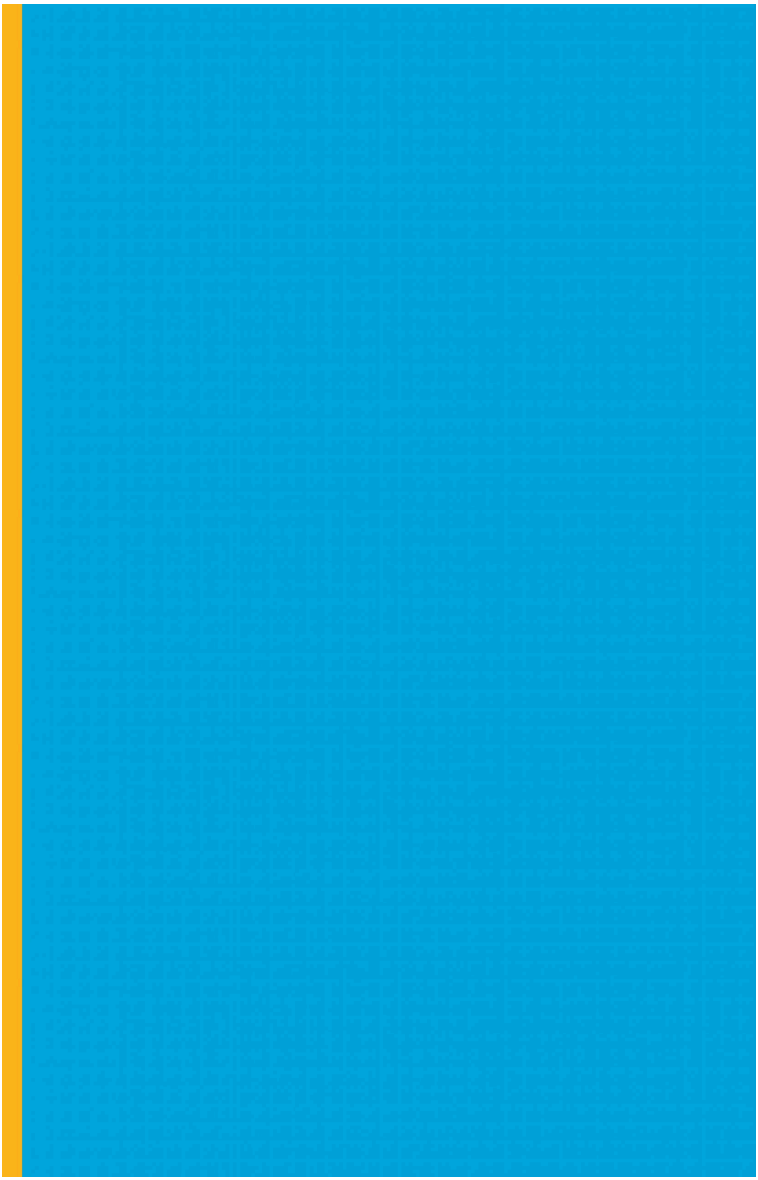
rovers were utilized exclusively. Prominently, substantial plans are now in motion to establish a permanent human presence on the Moon. Our hypothesis is that rovers will continue to play a vital role in the success of such missions, because it will be imperative that astronauts take on only as much risk as necessary, and that they do not waste their time on tasks that could be done by a robot. In this project, a conceptual prototype lunar rover is proposed under the design motivation of supplementing and enhancing tasks of lunar construction, exploration, and science.

Velocity and Acceleration Profiles of a Shuttle

KWAN JIE LEE, ALEX GALE, LUCAS MINET, AND ANGELA LEE

Velocity and Acceleration Profiles of Space Shuttles by Kwan-Jie Lee, Alex Gale, Lucas Minet, Angela Lee

Note: Click on image to see PowerPoint presentation

Summary

STS-121 is a NASA space shuttle mission to the International Space Station (ISS). The ISS is a habitable satellite (Space station) in a low Earth orbit. We employ calculus-based methods to analyze and study the flightpaths, altitude, velocity, and acceleration profiles of the STS121 data reported by NASA as it travelled through outer space. Our studies unravel information about the critical points, local maxima and minima, concavity, and inflection points in the altitude data. The velocity profiles were fitted to polynomial functions using least square data fitting using linear algebra-based methods. The acceleration data involve piecewise functions which is related to the time scales involving burning of the propellent and separation of the external propellant tank as the space shuttle gets ready to move into orbit. We estimated the work done in transferring a load from Earth to the International Space station. We used optimization methods to design an optimal solar panel geometry for a satellite by minimizing the surface area. This research provides novel applications of the fundamental theorems of calculus to study motion in outer space and involves mathematical modeling, optimization, curve fitting, data analysis and data visualization.