

STEM EXPO

RRCC Student Research Symposium

Poster session presentations:

Wednesday, May 1st

10am-12pm, 12pm—2pm

Thursday, May 2nd

10am-12pm, 12pm—2pm

Posters, artwork and project demos will be on display on
the Bridge at the Lakewood Campus

Student talks will be ongoing both days in Grays and
Torreys Peak Rooms

Spring 2019 Program



HONORS PROGRAM
Red Rocks Community College



Thanks to all the students and faculty that participated in the STEM Expo this year!

Faculty Advisors:

Tracy Gray, Biology

Steve Kaye, Biology

Emmanuel Santa-Martinez, Biology

Mursheda Ali, Biology

Stephen Fahey, Physics

Carlos Medina, Physics

Shane Spivey, Physics

Toni Nicholas, History

Barbra Sobhani, Honors and Space Grant

STEM EXPO Organizers: Barbra Sobhani, Shane Spivey and Tracy Gray



RRCC STEM EXPO

Spring 2019 Program

Talk Schedule

Student Research Presentations

Wednesday, May 1

Water Quality Management STEM EXPO

4:00 Innovative Biological Nutrient Removal

4:30 Wastewater Microorganisms

5:00 The Water Footprint of Pre-treatment

Thursday, May 2

3:00 RockSat-X Team Presentation

Mission Statement: As participants in a global effort to prevent harmful repercussions associated with increasing space debris, our project mission is to design, implement and fly a sounding rocket payload that will collect the foundational data needed to develop passive, cost-effective methodology for de-orbiting small, fragmented space debris, using a platform of electrostatic repulsion and incorporating material properties of 3D printed components.

Poster Sessions

Wednesday, May 1, 10am – 12pm

1. Civil Conflict, Hyperinflation and Clean Water Scarcity in the Sudan's

Dawn Florance, HIS 247, Advisor: Toni Nicholas

Water connects every aspect of life. According to OXFAM International, in South Sudan, only 55% of the people have access to safe drinking water. Juba is the capital of South Sudan, due to increased costs of production, water providers are producing less and charging more. This constricts people's access to safe water even further. Most families in the Sudan's, spend a third of their total earnings on water, or 33%, the international average is 5%. If they cannot afford clean water, they use it as is. This puts them at great risk for waterborne disease. Women spend hours on end fetching and returning water to their homes. There are not many water points available, those that are available for use are nearing depletion as a result of overuse. Since war erupted in South Sudan nearly 7 years ago, an estimated 4 million people have been displaced and half of the population are at risk of famine. The people living in rural areas are hit the hardest. Some can no longer afford safe water, and those who can are paying more than double what they use to. The cost of living has increased by nearly 30%. Access to water may not be limited, but the access to clean and safe water is very scarce and expensive.

2. Radio Telescope 2.0

Nathan Clapp, Lydia Rice, Marieke Spiegleman, NASA Space Grant Advisor: Barbra Sobhani

Last year's Space Grant group constructed a working radio telescope capable of detecting signals in the hydrogen spectrum. Our plan is to upgrade some of the telescope's components and expand upon its current functionality. . The main issue to be addressed is that the telescope cannot turn, limiting it to drift scans. We will improve upon the current infrastructure by installing a fully-articulating, motorized mount. We will design a user manual containing information about the history of the project, a full schematic of the telescope's assembly, maintenance records and requirements, and data processing software instructions. Additionally, we will program the data processing software to interface with our motorized mount. We are also considering interfacing a camera with the motorized mount to automatically track star clusters. Our goal upon completion of these improvements is to leave future users with a telescope design that allows for easier, more accurate data collection, and all the information necessary to utilize the system.

3. Crystal Radio

James Cook, Jerod Lawrence, Lydia Smith, Connor Williams, PHY 212 Advisor: Shane Spivey

A crystal radio exists as one of the earliest radio designs. The antenna of a crystal radio receives ambient radio waves and then channels them into an electrical current, which powers the radio. A solenoid narrows down the desired radio waves, which are then transmitted at a maximum level through a crystal earphone. The experiment conducted with our radio explored the effects varying the number of turns of the coil, the radius of the solenoid, and the capacitance of the tuning capacitor had on the resulting frequencies and strengths of the signal received. The crystal radio circuit demonstrates how specific radio wave frequencies can be received from a distance.

4. Levitron

Logan Bedford, Jason Johns, Elias Melendez, PHY 212 Advisor: Shane Spivey

In this project we were analyzing Ampere's law. To analyse this physical law we are using an electromagnetic levitation device or levitron that we designed. We found the magnetic field produced by 4 separate solenoids with 4 separate wire densities. Once we found each of these values for the magnetic

field produced for the coils, we used a force equation for the force of a magnet due to an electronic dipole to determine the force on the magnet from the electromagnet. The next step was to use Newton's second Law to calculate the mass that each solenoid should ideally be able to levitate. Once we calculated the mass that each magnet could levitate, we compared the mathematical value to the actual mass that we could levitate. We ultimately Found that the model that we used provided too large of a margin for error so we determined that this was not an accurate way to prove Ampere's Law. We found that the electromagnets could levitate more then the calculations would suggest. Had we been able to continue the experimentation we would have searched for a more accurate model for the magnetic force for a solenoid, this is likely were our high percent error came from.

5. Ring Launcher by Electromagnetic Induction

Tristan Medina, Jaylynn Medina, Evan Greager, PHY 212 Advisor: Shane Spivey

In our project we are trying to demonstrate Lenz's and Faraday's laws through a ring launcher. We're trying to show that an alternating current makes an alternating magnetic field that induces a current that makes a counter magnetic field that opposes the original magnetic field (Lenz's law). Also that a changing magnetic field induces a voltage in a conductor (Faraday's law). In this project we have established our own model of a ring launcher that uses wall power (120V, 60Hz AC) in a hand wound solenoid to induce a current and thus opposing magnetic field in various conductors on top of the solenoid. We decided to utilize 500 ft 12-gauge solid core wire wrapped around 1-1/2in PVC to make a solenoid (with variables cores), wired to a momentary switch and a outlet plug. We made 8 copper tubes that all have a constant diameter that have a length that range from 1 cm to 6 cm so that we can test for the optimum ring for our launcher, as well as explain the differences between all the tubes. All that's needed to test is to slide the tube over the core of the solenoid and press the button and the ring goes flying. Initially as we were testing we noticed that the longer tubes as well as the smaller rings didn't travel as far as other rings that have a length in between them. Through testing we realized that there is an optimum point for our launcher where the cross sectional area from the tubes allows more current and thus a stronger magnetic field from the tubes, resulting in up to 1.2 meters of height from our rings.

6. Single Stage Coil Gun

Ryker Fish, Meredith Haanstad, Mackenzie Malkowski, Atticus Pond, PHY 212 Advisor: Shane Spivey

In this project, we investigated the correspondence between electricity and magnetism by constructing an electromagnetic projectile launcher. The purpose of our project was to construct a simple device which would allow us to demonstrate and analyze the interplay between those forces. We constructed a coil gun which consisted of a solenoid and a capacitor in a simple circuit, enabling us to launch ferromagnetic projectiles using electricity. We fired projectiles using voltages from 10 volts to 30 volts and documented how far a projectile traveled under those conditions. We found a direct correlation between voltage used and distance traveled, revealing a relationship between the current through a solenoid and the magnetic field created within. This demonstrates the connection between electricity and magnetism, showing why they are known as not two separate forces, but one united electromagnetic force.

7. Chladni Figures

Nathaniel McKernan, Brett Peabody, PHY 212 Advisor: Shane Spivey

To gain an understanding of resonance frequencies and standing waves, we built a sine wave generator that would, through a speaker, vibrate a metal plate at its resonance frequencies to create standing wave patterns known as Chlandi Figures. We would then compare the locations of the peaks and dips in the waves to where the mathematical models predicted they would be. It was found that, through errors in the construction of our Chlandi plate, the predicted patterns did not represent the true shape of our figures. However, when accounted for, the figure could be mathematically modeled.

8. Prospect Park Waterways and Invasive Species

Lindsay Russell, SCI 105 Advisor: Lynnette Hoerner

Prospect Park in Wheatridge faces many environmental issues including invasive species. This poster describes some of the issues and how to get involved.

9. Hurricane Katrina

Kuiana Askew, ENV 110 Advisor: John Curchin

My poster board will be regrading Hurricane Katrina

10. Effects of Radiation on Seed Growth

Angela Abeyta, Erica Gutierrez and Meghan Lutz, BIO 111 Advisor: Mursheda Ali

This experiment examined the effect of seed growth when the seed was microwaved. The test was to determine what was the best time for the fastest growth. Eight seeds were tested. Four garbanzo seeds and Four soybeans. Each seed was microwaved for different amounts of time. Two seeds were not microwaved to serve as the control group. The times were 20 seconds, 40 seconds, and 60 seconds. What we found with this experiment is that the garbanzo bean at 40 seconds sprouted first and grew faster in the beginning. The control garbanzo bean sprouted next, the third bean that sprouted was the bean at 20 seconds. The 60 second bean never sprouted.

11. How Does Spicy Food Effect the Body

Traci Thompson, Sarah Moon, Olivia Powell, BIO 111 Advisor: Mursheda Ali

In this experiment, four students tested four various hot sauces collected from Wing Wagon in Conifer to determine the physical symptoms they had on the body, but more specifically if the body's internal temperature fluctuated after the hot sauces were ingested. All four sauces tested used Frank's Red-Hot sauce as their base ingredient. These four sauces included Crazy Jerry's Brain Damage Mind Blowin' Hot Sauce, Mad Dog 357 Hot Sauce, Blair's Ultra Death Sauce, and Mad Dog Midnight Special Pepper Extract with Premium Pure Oleoresin Capsicum. Each sauce ranged from 500,000 to 2,000,000 Scoville Units, which measures how many sugar-water molecules are needed to cool the palate completely. We hypothesized that as we ate sauces higher in Scoville units, it would cause a higher spike in our temperature as well. For each sauce, Sarah's temperature was recorded before ingesting and again 30 seconds after the sauce was swallowed. She then tested various methods to cool her mouth down. Milk chocolate worked the best for this experiment. Olivia tested the same sauces as a control and also recorded the physical symptoms she experienced after eating each sauce. The results supported our hypothesis and concluded eating spicy food does increase your internal temperature. This is caused due to "spicy" not being a flavor, but actually a signal of pain. As the spicy food touches the taste buds, they send pain signals to the brain which causes the brain to enact the autonomic nervous system (Sweating, runny nose, increased heart rate, watery eyes, etc.). The spicy food also causes your gut to contract which can cause stomach irritability.

12. Bacteria Growth in Yogurt

Sarah Tronoe, Caelan Beach, Jimmy Truong, Andrew Bernklau, BIO 111 Advisor: Mursheda Ali

Our experiment exhibited the bacterial and microbial growth in three different kinds of yogurt samples, which were placed in an incubated anaerobic chamber for 48 hours. Our purpose for this study was to observe the results of the bacterial growth after a short incubation period and collect the data. This experiment was very simple and straightforward, yet still yielded formidable results. We wondered if, by using different yogurts, which would grow more bacteria and produce the best yield of microbes. We used Yoplait, a common branded yogurt somewhat high in sugar, Activia, a yogurt somewhat high in sugar but also high in probiotics, active bacteria cultures, and finally Fage, being a Greek yogurt high in microbes

and very low in sugar due to the lean content and the probiotics active. The group designed the study by swabbing each yogurt on two separate agar plates for each kind, sealing and labeling them, and finally incubating them for a 48 hour period. The findings yielded as Activia having the highest microbial growth followed by Fage, and finishing out with Yoplait. The group expected the least amount of growth from yoplait due to almost no probiotics coupled with high sugar. We conclude that higher probiotic yogurts yield maximum microbial cultures post incubation, whereas lower probiotic yogurts yield a minimal amount of microbial cultures.

13. Proteolytic Capabilities of Bromelain Exposed to Extreme Environments

Taylor Bosick, Rhett Cito, Blair McVicker, Tascia Quintana, BIO 111 Advisor: Mursheda Ali

The experiment tested the capabilities of the proteolytic enzyme bromelain found in liquified fresh pineapple on the collagen derived protein structure gelatin after the bromelain enzymes in pineapple juice were exposed to extreme environments. Pineapple juice was exposed to extreme conditions including: freezing, boiling, strong acidic, and strong basic environments. The treated samples of bromelain were incorporated into the preparation of powdered-gelatin to observe if bromelain proteolytic capabilities were preserved after exposure each extreme environment. The implications of the bromelain enzymes' extreme environment exposures remained unobserved until each variable sample of bromelain within the pineapple juice were mixed into a heated, aqueous gelatin solution and cooled. Experimentally, bromelain retained its proteolytic activity after being exposed to neutral, acidic, and freezing conditions and the gelatin-pineapple juice preparation remained as a liquid. In basic and boiling conditions the bromelain enzymes' capacity for proteolysis was nonexistent, indicating denaturation, resulting in the pineapple-gelatin solution transforming into a semi-solid upon cooling. The results imply that Bromelain is stable and functional in an acidic and neutral pHs as well as temperatures below freezing, while bromelain cannot withstand boiling temperatures or basic environments. It was hypothesized, "If the bromelain enzymes found in pineapple juice are exposed to an extreme environment and remain stable, then their incorporation into a heated gelatin solution will result in the pineapple juice-gelatin preparation to remain a liquid. Conversely if the bromelain enzymes found in pineapple juice are exposed to an extreme environment and denature, then their incorporation into a heated gelatin solution before its refrigerated to cool will result in the pineapple-juice gelatin preparation to cool into a semi-solid gel."

14. Ecotones Among Us

Moe Alasadi, Julia Breadon, Eliot Foy, Ashley Lechman, Gina Mauro, Angelica Morrill, Aria Saunders, Emily Walters, BIO 112 Advisor: Steve Kaye

Ecologists call a place where one biome transitions into a different biome an ecotone. This ecological study tested the hypothesis that the presence of an ecotone can be signaled through changes in topography. Researchers in this study evaluated an ecological research site located on Red Rocks Community College Campus near a gully, where they observed, tested, and verified the changes in biotic and abiotic components between the highest quadrant and the lowest quadrant.

Wednesday, May 1, 12 – 2pm

15. Testing the Quality of Water in Rapids, Moving Water, and Still Water by Analyzing Bacteria Colony Growth: A Qualitative Research Analysis

Kendall Mills, Kaitlyn Weaver, Kolton Oliver, Mike Lucas, Cassie Baca, BIO 111 Advisor: Steve Kaye

Water quality varies significantly around the world. The quality of water depends on myriad of factors such as location and the speed at which water is moving. In this experiment, we aimed to test the hypothesis that water from rapids is cleaner than still water and slowly moving water. To do so, we collected 3 samples from two different rivers: Boulder Creek and Clear Creek. After collecting the samples, we placed a few drops of water collected from the creeks in their own agar dish and incubated them. By doing so, we were able to promote observable colonial bacteria growth, which is what we used to determine how clean each water sample was. To ensure these results were valid, distill water was

used as a control. The consensus reached from the data asserted that the speed of water movement directly affects the quality of water, with water from rapids producing the least amount of colonial bacteria growth. Further analysis on the samples collected from Boulder Creek and Clear Creek are explained throughout the paper.

16. Effects of Acids and Bases on Cheek Cells

Geetali, Lupita, Elizabeth, BIO 111 Advisor: Emmanuel Santa-Martinez

Our research project allowed us to observe the impact of daily fluids on our cheek cells based on each fluid's pH level. We aspired to observe the damage or indifference different pH and corresponding liquid have on cheek cells, which led us to our question, how do day to day acidic and basic substances affect the cells in our cheek on contact? Our hypothesis for this experiment was that the substance apple cider vinegar would do the most damage to the cell structure because of its acidity. In total, we tested three liquids that we consume and encounter everyday, our acidic base being apple cider vinegar, our neutral base being water and our alkaline base being Listerine mouthwash. We used each and tested the cheek cells and their condition before and after for three subjects. We were able to acquire a visible picture of cells under the microscope by extracting with a wooden toothpick the inside of our cheeks, placing them in a microscopic slide with methylene blue. Which we then used to conduct our results.

17. Impacts of Abiotic Components on Plant Growth

Ari Sharp, Cassidy Kirk, Matt Jensen, Myles Tallmadge, Shikie Lindsay, Yuliya Aparsheva, BIO 112 Advisor: Steve Kaye

In this ecology study we are looking at how the abiotic components of an ecosystem affect the growth of plants. To this end, we are examining temperature, soil composition, location, and humidity, then looking at the type and frequency of plants in two locations with distinctly different plant growth. Our margin of error is dependent on the amount of human interference, and measures will be taken to discover such tampering. Our hypothesis is that shadier, wetter areas will harbor a greater number and diversity of plant life.

18. How Trees Contribute to an Ecosystem

Rachel Okrey, Catheline Colon, Secia Porreco, Nadina Scarlett, Ashley Perry and Aubrey Jackson, BIO 112 Advisor: Steve Kaye

The hypothesis for the study at hand is that a larger population of trees within an environment will increase the amount of biodiversity in comparison to a non-wooded area or grasslands. Trees create habitats for thousands of organisms as well as providing structural support to the soil. In addition, trees can offer a canopy of shade which allows water to stay in the soil longer than if exposed to direct sunlight. For these reasons and more, the thought is that there will be much more biodiversity in an environment containing trees than if there are none. Prior to setting up the ecological study site, Group 1 had decided to study a forested area. Group 1 gathered and selected a site that included various species of trees and shrubbery. From a selected central point, Group 1 measured approximately seven meters in 5 directions to account for the 5 areas to be studied and observed as part of the ecological study as opposed to moving segments within the study site. This allows for the simultaneous study of multiple sites by various subgroups within the overall study site. To ensure various types of data are taken into account, the ecological study site incorporates grassy areas, areas covered in shrubbery, and canopied areas as provided by large trees. The data collected will be compared to data from a similar study conducted in a grassland environment only 50 meters from this site.

19. Trebuchet

Kevin Resnick, Chriss Moder, Zack Zimora, PHY 211 Advisor: Carlos Medina

Our team is going to build a trebuchet similar to the one built by Tom Stanton, demonstrated in his YouTube video "Optimising a Trebuchet". We will also be using information from Science Buddies "Effect of Trebuchet Arm Length or Counterweight Mass on Projectile Distance" as a starting point. The physics involved include gravitational potential energy transferred through angular motion to the payload in the form of kinetic energy.

20. Not Losing Our Marbles

Gabbi Chrysler, Will Brackney, Dallas McKeough, Ryan Roberts, PHY 211 Advisor: Carlos Medina

Using concepts of Physics I learned in class, as well as vector mathematics, we will be applying the rules of projectile motion, frictional forces (specifically the friction coefficient formula), gravity principles, the concept of x and y components, and taking the magnitude of vectors in our experiment.

21. Noo Noo Launcher

Moriah, Tristian, Colton, Will, PHY 211 Advisor: Carlos Medina

One of the most simple yet fascinating aspects of physics is projectile motion. The concept seems plain yet science has found a multitude of unique ways to create projectile motion that may come as a surprise. In this lab we will be creating a version of projectile motion that uses nothing but the air around us to launch objects. This experiment by today's standards is simple but the first physicists would only have been able to theorize. That is because in order to achieve a significant level of force to move an object you would either require a vortex of incredible wind speeds or a vacuum devoid of air. The latter is easier to achieve and more precise hence why with today's technology we can create such an environment. With a few tools to aid us we will be able to build a closed environment devoid of any air in which our object will sit. One small and sudden opening in that environment should result in a air pressure change great enough to launch our small object. With proper constant and flexible variables we will be able to accurately record projectile motion cause and effects as well as how it interacts with other components of physics such as friction, gravity and Newton's laws.

22. Air Compressed Cannon

Nathan Raczynski, PHY 211 Advisor: Carlos Medina

23. Breaking the Physics Illusion

Mohammed Yaseen, Anastasia Stang, John Edelen, Brock Williams, PHY 211 Advisor: Carlos Medina

For this project we plan on creating an experiment that shows a double sided cone (DCC) object rolling up an incline, and then explaining the physics pertaining to how and why it moves up and down the incline.

24. Pendulum Wave Machine

Xue Sun, Skyler Schultz, PHY 211 Advisor: Carlos Medina

Pendulum waves are a series of pendulums of different lengths that have different periods, and if the lengths and angles are just right, when you start all of the pendulums from the same angle position they cascade through the periods at slightly different rates from their neighbors resulting in some pretty visually stunning patterns and wave forms. Topics from the text include potential energy, kinetic energy, air resistance, aliasing, as well as having a strong base in pendulum physics.

25. Gyroscopes

Joshua Eaton, PHY 211 Advisor: Carlos Medina

Gyroscopes are essential to an array of different technologies. Current uses include, but are not limited to, cellular phones, aircraft, and satellites. Cell phones utilize gyroscopes for motion tracking and

calibration for certain applications such as the iPhone's compass. A good visual example is when a phone is turned sideways during a video, the gyroscope detects this and sends a command to rotate the screen.

26. The Star Destroyer

Anthony Javier, Ben Wartofksy, Dave Bonner and Michael, PHY 211 Advisor: Carlos Medina

The name of this project is called "The Star Destroyer" (Star Wars reference). We'll be working on building a hovercraft, we want to find all of the forces in the X and Y directions that the hovercraft exerts when moving, we'll also be using some differential equations. We're going to build the hovercraft out of Styrofoam and 3D built housing fans with a controller. The hovercraft will have an Arduino board so it can communicate with the controller

27. Spoiler Alert

Forrest Getz, Erick Diaz, Trevor Nicholas, PHY 211 Advisor: Carlos Medina

Since the birth of aviation, there has been a substantial amount of technology that has been developed through decades of refinement. One in particular is an airfoil. Airfoils are the main source of lift in airplanes but they are also used for an opposite effect in motorsports: increasing downward force. This is known as downforce. The project Spoiler Alert models how an airfoil wing creates downforce, and how that can be measured in regards to an object's weight.

28. Physics that goes beyond Assumption

Zachery Fahrny, Max Moreland , PHY 211 Advisor: Carlos Medina

The purpose of this project is to show that physics goes beyond human intuition and helps explain phenomena that without physics humanity wouldn't be able to understand.

29. Project Projectile

Kramer Kilroy, David Long, Jasmine Prieto, Benjamin Trunko, PHY 211 Advisor: Carlos Medina

This project will use the kinematic equations of projectile and angular motion to accurately predict the velocity, height, and distance of a projectile launched from a scale model trebuchet when the launch angle is changed.

30. The Brachistochrone Curve

Kobi S O'Neil, Andrew Lesuer, Alejandro Gonzalez, Antoan , PHY 211 Advisor: Carlos Medina

Our team aims to prove the legitimacy of the Brachistochrone Curve by conducting a race. We will have several different tracks each with varying slopes beginning and ending with the same (x,y) coordinates. The time taken from start to finish on each track will be our variable.

31. Seis em Up

Jordan Al-Hamdani, Austin Reynolds, Abdul Al-Aqil, and Justin Deberry, PHY 212 Advisor: Shane Spivey

Our project consisted of building a seismometer in order to accurately detect vibrations in the area, and experimenting with how changing the characteristics of the seismometer would change our results. Before construction we researched both the function and the design of seismometers in order to find a design that wouldn't be impossible to build and would also guarantee accurate results. After settling on a design, we gathered all our materials and constructed our seismometer, documenting the process we took. We decided to vary the seismometer's spring constant and the weight of the magnet arm, as these characteristics were easy to modify and would give replicable results. We tested these with different

springs and additional weights respectively, using the same impulse to create the wave each time. From measuring the current generated by our seismometer over time, we were able to see how changing our variables caused a change in the wave detected. We concluded that these created different but noticeable effects on the wave detected by our seismometer, and that it could be quite accurate under certain conditions.

32. E-cart

Steven Hu, Tyler LeClear, Levi Reveles, & Solomon Sidhu, PHY 212 Advisor: Shane Spivey

The process of converting potential electrical energy into mechanical energy is an elaborate task that requires at least an intermediate amount of understanding with circuitry and energy; which is precisely the task behind this project. The goal of our experiment is to test how changing electrical properties, such as voltage, resistance, and circuitry configuration, alter power consumption and production. The entirety of the kart is composed of multiple intricate electrical and mechanical components. Though the original materials required for the kart consisted of six 12V batteries, an alternator, and the basic kart assembly kit; more electrical components had later been included to the list such as a voltage regulator, a switch, and breakers. By powering the stator windings within the car alternator and removing the rectifier diodes, we were able to convert the alternator to act as an electric motor. As our source for mechanical energy, we've decided to use a decommissioned car alternator, and had rewired it as a functioning motor. The ideal measured variables that the project will be focused on, is to relate the amount of thrust exerted when the alternator is provided with a certain amount of voltage.

33. Solenoids

Tyler Cole Rummelhart, and Santiago Chavez, PHY 212 Advisor: Shane Spivey

For this experiment we are determining what alters the magnetic field in a solenoid by changing the wire gage, number of turns, and coil density of the solenoids.

34. Force on an Electromagnet

Bryon Peabody, Ines Benavides, Szymon Ligas, Louis Clark, PHY 212 Advisor: Shane Spivey

Current flowing through a wire produces an magnetic field. Using this concept, it is common to use coiled wire to make an "electromagnet". The coils in the wire allow the magnetic fields to overlap, making a stronger overall magnetic field with the principal of superposition. By varying the number of coils in the electromagnet and the current through the wire, you can vary the strength of the resulting field. Using 3 different electromagnets and 3 different voltage values, we will see what it takes to lift a screw off of a platform. By knowing the force of gravity, we will calculate the strength of the force produced by the different magnetic fields.

35. Infinite Sustain Driver

Rhiannon Larsen, Jorge I Torres M, Everett Oklar, Manisha Jaiswal, PHY 212 Advisor: Shane Spivey

This project is about making a mechanism that interacts with the magnetic pickup on an electric guitar, and analyzing how sound is converted to voltage. This instrument will drive a sustaining pitch on a guitar string, which sounds similar to bowing a stringed instrument. The custom "Ebow," which we will call the "external sustain driver," will use 2 coils and an amplifier to create a feedback loop with a maximum amplitude. The string on the guitar will continue to vibrate at the original frequency, and the magnetic pickup on the guitar will read the change in flux and amplify the sustained frequency. The sound will be similar to bowing the string of an instrument.

36. 1931 China Floods

Dakota Smith, ENV 110 Advisor: John Curchin

When the Yangtze River of China flooded in 1931, it killed more than 3.7 million people both directly and indirectly over the course of the months that followed the initial flooding. Indirect causes of death included starvation and disease due to swamped rice fields and polluted water.

37. 1883 Eruption of Krakatoa

Maxwell Eyre, ENV 110 Advisor: John Curchin

The 1883 eruption of Krakatoa was an event that shook the world and laid waste to thousands of lives. The event was one that built up for several months before all coming to a head on August 25th when the first true eruptions began to build to the ultimate finale on the 27th of August. The events that transpired would prove to cause unforeseen devastation and lead to the following year to become known as the year without a summer, shaping the world not geographically but also leading to a shift in the very culture of the world.

38. The 2002 Hayman Fire

Craig Blea, ENV 110 Advisor: John Curchin

For the topic I plan on talking about is the Hayman fire that burned 138,114 acres and had a total cost of around \$40 million. I also want to talk about how the fire was started by the man with the name of Terry Barton. The total casualties was only 6 but it caused the evacuation of 5,340 people from their homes.

39. Tri-State Tornado

Julia Whitman, ENV 110 Advisor: John Curchin

The Tri-State Tornado is the worst tornado in U.S. History, hence the name it passed through 3 states and injured 13,000 people. I will be explaining not only the event itself and the cause of the tornado but also 5 fundamental concepts that relate to all natural hazards.

40. Mt. Pelee Eruption of 1902

Matt Tafoya, ENV 110 Advisor: John Curchin

The 1902 eruption of Mt. Pelee on the island of Martinique was the most deadly eruption of the 20th century. The island is located in the Caribbean and the town of St. Pierre was virtually wiped out in a matter of minutes.

41. Mt. St. Helens

Rachael West, ENV 110 Advisor: John Curchin

I chose to explore the prominent bulge in Mount St. Helens before the explosion happened. I wanted to learn that it happened.

42. Tambora Eruption of 1815

Curtis Hanock, ENV 110 Advisor: John Curchin

Presentation will highlight the global impact of the 1815 eruption of mount Tambora. It will also describe the sustained impact the eruption made on the transmission of disease and the creation of a worldwide depression due to the impact of drastic climate change.

43. 2011 Tohoku Earthquake

Logan Davis, ENV 110 Advisor: John Curchin

The sheer devastation of the 2011 Tohoku earthquake of Japan is both terrifying and fascinating. With a magnitude of near 9.1 and total casualty count of over 16,000, it is by far Japan's worst earthquake ever recorded, and truly one of the most destructive natural catastrophes the world has ever seen.

44. 1970 Peru Avalanche

Diustin Smith, ENV 110 Advisor: John Curchin

For my STEM project I will be doing a Power Point/3 sided poster board. I chose to present on a natural disaster (avalanche) that occurred in Peru 1970. I will delve into any history of disasters in that specific area, the cause of the event, the damage (loss of life/property) the media stories about the disaster, how the people in that area recovered, and what could have been done to prevent the damage, and if they've prepped for any future potential disasters.

45. Hurricane Mitch

Kirsten Abbott, ENV 110 Advisor: John Curchin

Hurricane Mitch occurred in October 1998. It struck Central America and came to Florida as a tropical storm. This hurricane killed more than 11,000 people and left 5 billion dollars in damage. Learn about the process of how hurricanes are formed and the specifics of how Mitch formed, what it struck, and the aftermath of the hurricane.

46. 2018 Indonesian Tsunami

Matthew Macey Vaught, ENV 110 Advisor: John Curchin

For my STEM Project/Presentation I have selected the Tsunami that happened in Indonesia in 2018. I am leaning towards a PowerPoint presentation and video for the class presentation. For the STEM Expo, I will create a 3-sided poster to display the information presented in my PowerPoint as my laptop will be utilized to show a video, documenting the events of the tsunami, that will run on a loop. For my location, I would like a spot on the bridge.

47. Joplin, Missouri Tornado

Colin Scott, ENV 110 Advisor: John Curchin

The research at hand explores the catastrophic tornado that struck Joplin, Missouri in May of 2011. An extensive evaluation was done on the specific event itself to find out the root causes of an above average death toll, near complete destruction of numerous buildings, and how to properly mitigate and prevent a future disaster alike. Damage assessment with this specific twister proved that zero buildings could be associated with EF-5 winds justifying that Joplin was not built properly for a violent tornado. The poor construction of many permanent residences/box buildings such as Home Depot and Walmart as well as the lack of shelters lead to the higher fatality counts in these specific locations. This was especially true following the collapse of walls after the roofs had failed. Infrastructure changes were more than necessary following the disaster and this includes the addition of hurricane clips to all buildings to strengthen the buildings against horizontal as well as vertical winds and prevent the separation of the roof. All rebuilt and undamaged schools, hospitals, businesses and other critical structures were required to have community safe rooms or shelters to create a safe zone for people to hide in during future tornado warnings. A change to models studied by meteorologists is also necessary to keep increasing the tornado warning lead time so people can have increased time to find shelter and safety. To conclude all of the research and information given, it is vital to realize that tornadoes will always occur as long as atmospheric conditions create the recipe for one. It is important to keep tornadoes a hazard that they always are and mitigate the chances of them becoming disasters or catastrophes. With proper self-awareness, numerous safe locations, and plenty of warning ahead of time, this can all be accomplished.

Thursday, May 2, 10am – 12pm

48. Creating a Data Discussion Between Human and Robot Teams

Stacie Barbarick, HNR 102 Advisor: Barbra Sobhani

Robotic technology in space has countless applications and will be the next paradigm shift in aerospace technologies, however, little attention has been paid to creating joint human-robot teams. Often communication systems between humans and robots limits the capabilities of the team since current AI systems do not provide the ability to discuss a situation or a decision and often decisions are made based on thousands of perceptual cues provided by the environment. Currently, HRI (Human Robot Interfaces) rely on explicit dialogue or task commands. Essentially, the human “speaks” and the robot “listens”. However, we need to build systems that enable robots to interact with humans directly so the human can assist with sharing cognition and demonstrating perception. My mission is to design and develop a robotic interface that is controlled by a “sensory” glove for use in a virtual environment. Here, haptic information is sent from the robot and the human can respond based on the visual sensory data given in real time and remain in a safe, remote location. To this end, I created a soft silicone glove that when worn by the human user, provides visual cues for a tactile activity. By combining the flex sensor with a static resistor, a variable voltage is generated and interpreted by a microcontroller's analog-to-digital converter and provides signals to strips of LEDs. For my prototype application, I employed the changing of LED colors to represent increased tactile pressure. Experimental data show that changing LED colors can be directly linked with changing flex data from an embedded sensor. When the human user performs tasks while wearing the gloves, they are receiving and interpreting visual cues from their touch perceptions. This allows the human user to learn and interpret these visual data and provide incorporated decision-making abilities when controlling a robot user remotely. Technologies such as these create endless opportunities for research and advancement in uninhabitable environments such as space.

49. Dehydrated in the East

Donny Herrera, HIS 247 Advisor: Toni Nicholas

50. Nuclearization of the Bikini Atoll

Micah Wiederwohl, HIS 247 Advisor: Toni Nicholas

A study of the effects of nuclear testing in the bikini atolls in 1946, in particular Operation Crossroads. A look into the problems with nuclear testing on humanity and on the environment.

51. The Disaster of Chernobyl

Joleigh Burgett, HIS 247 Advisor: Toni Nicholas

My research discusses the effects that the explosion of Chernobyl had on plant life, animal life and the human life near and around the site. I have discovered how far hazardous materials traveled just through water. There was a common theme: rain and nearby water sources affected plant life which then led to animal life eating the affected plant life which then resulted in the affects on humans. I personally have taken an interest in this topic because the effect that the radiation had on people hits close to home. My father is a firefighter and he is exposed to many different levels of radiation all the time. More than half of the firefighter line of duty deaths are a result of exposure to hazardous material like chemicals and radiation. The firefighters who responded to the fire and the Chernobyl site are true hero's.

52. Water Crisis in Rural America

Emily Smith, HIS 247 Advisor: Toni Nicholas

In this project, I researched how America's rural areas are affected by water pollution. The fact of the matter is that many smaller towns are affected by water pollution and some governments even keep this fact hidden away from their citizens for years. The reasoning behind the water pollution differs in different towns: from pesticide runoffs from farms, insufficient government funds to fix a problem, a lack of agency over regulating water quality, or fracking. While water pollution in cities is also a huge issue that needs to be fixed, the awareness is there. People know when big cities get water pollution, they get more media coverage than they do actual help. Yet, places outside big cities, such as Native American reservations and farming towns can struggle in silence while no one even cares. This project is not only meant to bring awareness to a large water pollutant issue, but note the disparity of action taken to fix these problems.

53. Technologies that Have Been Providing Clean Water

Jorge I Torres Marchand, HIS 247 Advisor: Toni Nicholas

This is a research in where the tools and systems we used in our society in order to get clean water are analyzed. Specifically, the research focused on Colorado and in some areas from Costa Rica: mainly, this research was focused on Colorado because it is the state in where we all live, it was also focused in Costa Rica since some students from the RRCC honors program visited Costa Rica making several researches including researches about water, meaning that this would bring us first-hand information.

54. Effects of Pollution in the Ganges (Ganga) River

Manisha Jaiswal, HIS 247 Advisor: Toni Nicholas

The river Ganges (Ganga) in India is rich in Indian culture and history. The effects of pollution in the Ganges are wide ranging. Culture, people's belief, growing population and toxic industrial revolution all contribute to the pollution of the river. The pollution of the Ganges is alarming to not only humans, but also the aquatic creatures of the river. This is ultimately contributing to climate change. The Ganges is in dire need of some action. The government of India has implemented some cleanup efforts in the Ganges, and it is still ongoing.

55. Tamarisk in the Colorado River Basin

Maxwell Kempe, HIS 247 Advisor: Toni Nicholas

The Tamarisk is an invasive plant that was introduced to North American in the late 1900's to control flooding. The plant got free and spread to cover the banks of most of the Colorado River Basin. They are now causing Native species to go extinct, decreased river flow, and increasing the probability and size of forest fires.

56. The Gaza Strip Water Crisis

Zane Prose HIS 247 Advisor: Toni Nicholas

For this project I sought to answer a couple questions, being who's at fault for Gaza's water pollution, what are the effects of the contamination of water, and what are the future fears as a result? The underlying theme derived from my chosen sources proved to be that there is a heavily contentious relationship between ethnic groups residing within the region which has given rise to neglect for the environment and lack thereof a political structure in which to mandate environmental action. That being said, some efforts have been made internationally to mitigate the pollution and help raise awareness of the growing crises, however, there is still a long way to go. The argument could be made, however, that international aid has been solely for own benefit as the health of the Mediterranean Sea impacts a large number of neighboring countries. As a result, Gaza is quickly spiraling out of control in regards to water sanitation and is at the risk of catastrophic consequences if efforts aren't made to revert past environmental neglect.

57. The Aral Sea

Maeve Wilder HIS 247 Advisor: Toni Nicholas

Just 60 years ago the Aral Sea was still a hub of life in the arid steppes of the Middle East. Since then the shrinking of the Aral Sea has had huge economic, social, and ecological impacts that are still very big issues in the region today. This poster will demonstrate the history of the Sea and the role the Soviet Union played in its downfall. The impact on the surrounding people and ecology will be examined and explained through primary sources from the scene of the disaster.

58. Analysis of the Three Gorges Dam

Nathaniel McKernan HIS 247 Advisor: Toni Nicholas

The purpose of this project was to analyse the Three Gorges Dam and determine if it will have a net positive affect or a negative effect on China. This was done by looking at several secondary and primary sources relating to the Three Gorges Dam and by analysing the pros and cons of the construction of the dam using that information. It was found that there were a plethora of environmental, social, and humanitarian issues involved with constructing the dam. Some of the issues associated with the contraction of the dam include the reduction and possible extinction of animal and plant species, the loss of ancient culture, and the botched relocation attempts to force the many thousands of people who lived in the river valley. Some of the pros associated with the dam, however, include the production of cheap, non carbon emitting electricity, the ability to control flooding, and a boost to the international prestige of the People's Republic of China. However, it is also possible that the dam will fail, which will cause a humongous issue for people living downstream. Therefore, it would seem that the cons outweigh the pros. Thus, it would seem as though the current idea of the construction of the massive Three Gorges Dam was not the best of ideas.

59. Water Crisis in Flint, Michigan

Roman Valdez, HIS 247 Advisor: Toni Nicholas

For this project I will be exploring the ongoing issue of the water crisis currently happening in Flint, Michigan. My overall goal for this project/poster is to further educate myself on the matter in order to be able to educate others as well. I will give a brief yet effective timeline of everything that has happened relating to the water crisis in Flint prior to the issue, up to the current situation. I will explore the reasoning as to why Flint choose to switch water systems, and why government regulation played a huge factor as to why this crisis got so out of hand. My research is constructed of scientific facts regarding the stability of the water, as well as legit citizens of Flint, Michigan who give their side of the story. Many Flint residents were candid about what was happening in their city, and how a majority of poor communities got the burnt end of the stick. Much of the scientific evidence provided relates to the water quality and more specifically the lead percentage that was being distributed from these water pipes into the homes of Flint residents. My poster will provide factual evidence along with reliable sources, as well as pictures to help further relay the information provided on the poster. The poster will be appealing to the eye in order to catch attention, but will not distract from the main purpose of Flint, Michigan.

60. Water Crisis: Yemen

Juan Espinoza HIS 247 Advisor: Toni Nicholas

The topic chosen is that of the water crisis occurring in Yemen in the early 21st Century. The topic will focus on how a severe mismanagement by the state's government, have led to a dire scarcity of potable water, and the consequences it has had on the people of Yemen. While the area has always been subject to low amounts of precipitation and has had to relied on reserves of groundwater for most uses, the situation has been exacerbated by changes in consumption of water, particularly in the agricultural sector. The shift towards resource demanding cash crops, antiquated irrigation systems, and depletion of groundwater resources have led to a national instability and crisis. This has led not only to a scarcity of

clean water, but also cholera outbreaks due to contaminated waters, and less food, due to not enough growing of nutritious food crops.

61. Yemen's Struggle for Water

Kristina Greenwalt, HIS 247 Advisor: Toni Nicholas

Yemen is currently in turmoil after the 2011 revolt against then president Ali Abdullah Saleh began a long fight against the Houthis. Alongside the political instability that riddles the country of Yemen, the water scarcity throughout the region has plagued the people of Yemen with food-insecurity, poor sanitation systems, if any, leading to large outbreaks of disease. Despite being a coastal country Yemen's main water source, their groundwater, has been dissipating from the lack of government regulation among other things. Even before the political instability experts were concerned for Yemen, claiming that it'll be the first country to run out of water.

62. Dispute over Water in the Nile River

Kadeja Salem, HIS 247 Advisor: Toni Nicholas

For thousands of years the Nile has been at the heart of human civilization but now the world's longest river is dividing three counties that share its life bringing waters. The Anglo-Egyptian Treaty of 1929, signed between Egypt and Great Britain, and the 1959 Bilateral Agreement between Egypt and Sudan gave Egypt claim on the Nile's waters. No water was allocated to Ethiopia or the other eight countries of the Nile Basin. The agreements granted Egypt veto power over construction projects on the Nile River and its tributaries anywhere upstream. The growing population is leading to water scarcity and pollution in the Nile River. Ethiopia started to build the Grand Ethiopian Renaissance Dam in 2011 to help bring its people out of poverty and grow their economy. Ethiopia says that they are not bound to the agreements because they were never parties to them. Sudan is bounded to Egypt by the agreements, however the dam would benefit Sudan by providing cheaper power. Additionally, the dam will regulate the rivers flow and reduce flooding which is good for Sudan's farmers. So, Sudan is now siding with Ethiopia over the dam. However, Egypt is against the dam because it might reduce the river's flow in Egypt. The Nile river plays an important role in Egypt's culture and sense of identity. A threat to the river is considered a threat to its sovereignty. Egypt does not trust Ethiopia because they started building the dam without asking or checking what the impact would be downstream. Egypt can no longer bank on the water allocation it has received until now. There is nothing Egypt can do about it, except take military action which would be extreme. Diplomacy and collaboration are the only means of resolving this issue.

63. The Colorado River Crisis

Jacquelyn Thomas, HIS 247 Advisor: Toni Nicholas

For thousands of years the Nile has been at the heart of human civilization but now the world's longest river is dividing three counties that share its life bringing waters. The Anglo-Egyptian Treaty of 1929, signed between Egypt and Great Britain, and the 1959 Bilateral Agreement between Egypt and Sudan gave Egypt claim on the Nile's waters. No water was allocated to Ethiopia or the other eight countries of the Nile Basin. The agreements granted Egypt veto power over construction projects on the Nile River and its tributaries anywhere upstream. The growing population is leading to water scarcity and pollution in the Nile River. Ethiopia started to build the Grand Ethiopian Renaissance Dam in 2011 to help bring its people out of poverty and grow their economy. Ethiopia says that they are not bound to the agreements because they were never parties to them. Sudan is bounded to Egypt by the agreements, however the dam would benefit Sudan by providing cheaper power. Additionally, the dam will regulate the rivers flow and reduce flooding which is good for Sudan's farmers. So, Sudan is now siding with Ethiopia over the dam. However, Egypt is against the dam because it might reduce the river's flow in Egypt. The Nile River plays an important role in Egypt's culture and sense of identity. A threat to the river is considered a threat to its sovereignty. Egypt does not trust Ethiopia because they started building the dam without asking or checking what the impact would be downstream. Egypt can no longer bank on the water allocation it has

received until now. There is nothing Egypt can do about it, except take military action which would be extreme. Diplomacy and collaboration are the only means of resolving this issue.

64. The Nuclear Meltdown of Fukushima

Ryan Jolly HIS 247 Advisor: Toni Nicholas

My project is going to cover the nuclear meltdown of Fukushima and how and if the area is still affected. I am going to give in depth background information about the event. I am also going to cover whether or not the area is still being afflicted by radiation. As well as see what changed as far as regulation for nuclear power plants.

65. Glacial Recession

Brandon Edge Kaplan HIS 247 Advisor: Toni Nicholas

My poster is about Glacial Recession and the links to climate change, it talks about what glaciers provide for the environment, and what consequences will follow if they are to disappear. My poster also gives steps that individuals can follow to better the environment.

66. Ecology Project

Ashton Toler, Zac Johannes, Abigail Somers, Will Schieffelin, Cheng-Yi Ho, Gage Leach BIO 112
Advisor: Steve Kaye

Studying abiotic factors and how they affect organisms in an ecosystem.

67. Music and Heart Rates

Sara, Michelle, Kuiana, Michell, BIO 111 Advisor: Emmanuel Santa-Martinez

This project is based off of testing people of different races using four different songs to measure their heart rate.

68. Genetically Inherited Aversion in *Drosophila Melanogaster*

Kendall Brown, Destynee Martinez, BIO 111 Advisor: Mursheda Ali

Aversion responses have been shown to be consistently present in humans too young to have learned the behavior from their parents or environment. This experiment addresses genetic inheritance as a potential source of this behavior. In it, *Drosophila melanogaster* were given a choice between a non-lethal food source and a lethal one possessing a distinctive feature. The offspring of the surviving generation were then raised in isolation from their parent generation with the same two food sources. The results showed a decrease in the percentage of *D. melanogaster* that consumed the lethal food source between the first and last generation, supporting the notion that genetic inheritance plays a role in an organism's inherent aversion response.

Thursday, May 2, 12 – 2pm

69. Ecology Study – Forest Ecosystem at RRCC

Lauren Adams, Kathryn Bumpus, Miranda Hamm, Jamie Edwards, Ally Buckner, James Bergman, BIO 112 Advisor: Steve Kaye

Ecology is the study of the relationship between organisms and their biological and physical environments. In this study, we looked at a plot in a forest, took samples of the biotic and abiotic components, and studied their relationships. The plot in the forest has three sections with trees and three without, so our group began wondering if the sections would have different amounts of communities of organisms depending on if there is a tree in the plot or not. Therefore, our question was which sections of the plot might have more communities of organisms. Our hypothesis was that in the sections of the plot with trees, there would be more communities of organisms than in sections without trees. This hypothesis was based on the idea that the presence of trees would encourage the growth of communities. Each group member took one aspect of the study, such as trees, macroinvertebrates, etc., and investigated it. They each sampled and studied in the lab or identified organisms within the plot and documented it. Our hypothesis was confirmed and there were more communities of organisms found within the sections with trees. However, there were actually more macroinvertebrates found in sections without trees than in the sections with trees, but this was only true for the macroinvertebrates. Overall, we found that communities of organisms are found more prevalent close to trees than in an area with fewer trees. This shows the importance of trees in the diversity and amount of organisms in the forest ecosystem.

70. Virtual Reality: Revolutionizing the Way We Learn

Matthew Kline, Instructional Technology Advisor: Jon Johnson

Virtual reality has amazing potential in education. The goal of this poster is to help teachers and students understand how they can use this technology in the classroom. Through my job as a research assistant, I've been investigating educational applications for VR. This involved online inquiries about VR apps in different subject areas, talking to VR hardware and software vendors, and development of new apps based off teachers' needs. To date, I've found and created apps that can be applied in many different areas, including medicine, computer aided design, and mathematics. They range from smartphone software to experiences made for entire rooms with specialized equipment. Activities like field trips and experiments are expensive and the conventional classroom has a hard time facilitating active learning. VR has the potential to change this by giving students a virtual "hands on" experience instantly. This year, more teachers are becoming aware of this and it's my hope that the educational use of VR will become more mainstream.

71. Harsh Conditions Can Grow Potatoes, Who Knew?

Salvador Garay, Caeden Obrecht, Marin Salgato, Patrick , Cameron, BIO 111 Advisor: Emmanuel Santa-Martinez

The main focus of the experiment is to test whether or not if potatoes would grow within harsh conditions. The experiment that was performed consisted the use of six seed potatoes that were planted in the same soil. The potatoes were then separated into three different groups (wet, damp(normal), and dry) to simulate different weather hazards such as floods, normal climate, and drought). The soil, lighting, and potatoes were held as controlled variables in the experiment. The height of the plant (cm) is the dependent variable of the experiment. The amount of water (oz) varied between the three groups of plants. This experiment was chosen to see how durable the potato plant is to different weather climates with a semi constant temperature. This experiment more applies to areas with an arid climate that experience floods and droughts. The experiment ended in success but with a different hypothesis the

plant in the wet soil, experiencing a flood, grew the tallest out of all six plants. At the end of the experiment the potato plants in the wet soil grew to about 31cm.

72. Rainbow Flowers

John Immordino, Anusetsen Baatartsogt, BIO 111 Sec 7

Plants and their components are very similar to humans and their veins and arteries. Transporting nutrients and proteins to various parts of the body. Just as a plant, transports fluids through their xylem and phloem. These structures and tubes of plants act very similar to the veins in humans. As when the plants are in water they use their components to suck up the nutrients. If the water is colored then the xylem will suck up the colored water and change the leaves.

73. Microbial Growth in Winogradsky Columns Using Pond and Tap Water

Jasmin Menez, Matthew Eckelberg, BIO 204 Advisor: Lynne Albert

Winogradsky columns can be used to visually assess synergistic microbial growth in complex ecological systems. During January of the spring 2019 semester, each of two microbiology sections set up Winogradsky columns using either pond water or tap water. In both the pond and tap water Winogradsky columns, we included a column with a source of sulfur and carbon nutrients to help culture the microbes and a column without the additional nutrients. Water and the soil sample from the local pond contributed both a matrix for microbial growth and microbial inoculation. All Winogradsky columns were subjected to the same light conditions. Throughout the semester, microbial stratification was observed by watching the development of green and purple bacterial growth layers in the Winogradsky columns containing pond water and tap water. Photos of the columns were taken once each week to monitor the growth of the microbes in each column. The columns containing pond water were the first to see microbial growth.

74. Electric Induction Generator

Maxell Kempe, Mitch Morgan, Jacob Lawrence, Jordan Tehranchi, PHY 212 Advisor: Shane Spivey

We propose to construct an electrical generator utilizing magnetism. We will measure the power output of different combinations of magnets in order to determine their magnetic flux. We will then determine the amount of the total flux being used to generate power, by comparing the calculated value to the expected value online. We will also see how using multiple magnets together can change the total magnetic flux.

75. Impact of Design and Placement on Water Wheel Output

Shay Rossignol, Ian Boyd, Sarah Dukmak, Zeb Jones, PHY 211 Advisor: Shane Spivey

The project was designed to discover the effects of different factors on the net torque of a water wheel. This is important for situations where water wheels are used to perform work, or generate power. For the factors, the impact of the flow of water, water pressure, overshoot vs. undershoot, and the design of the water wheel, were studied. To test these factors we constructed two different types of water wheels, one entirely from scratch using pvc pipe, and one using a hamster wheel and pvc pipe for the paddles.

76. Optimizing the Motion from a Spring-Powered Projectile Launcher

Faith Fyles, Ivan Gonzalez, Oscar Hammond, Jose Ramirez, PHY 211 Advisor: Shane Spivey

Three springs with different sizes and spring constants were tested at various compression displacements and launch angles to determine the optimal conditions that allow for the longest horizontal distance traveled by a golf foam ball projectile. The spring-powered projectile launcher is comprised of a hinge between wood blocks, where the ball is launched from the spring within a tube on top. The hinge was arranged at angles 12.177° , 29.17° and 51.38° for all trials, and launched the projectile with three compression displacements unique to each 1.75", 2" and 3" spring. Kinetic friction and drag were taken

into consideration for loss of momentum of the projectile. It was determined that the longest spring with its greatest compression displacement at the lowest angle resulted in the greatest horizontal distance in the project, which matches the expectations held by kinematics and spring force equations.

77. Pneumatic Cannon

C.J. Nearing and Drew Worthley, PHY 211 Advisor: Shane Spivey

The purpose of this experiment was to find the ideal launch angle of a pneumatic cannon to achieve maximum distance through accurately predicting and measuring where a projectile would land when the pressure and angle were varied. In this project, a 143.23 gram wax filled bottle was used to find the initial velocity at different pressures via slow-motion video. Using an excel spreadsheet, with graphing tools, the predicted distance was found using the kinematics and drag equations under ideal conditions. Next, after running multiple trials with the pneumatic cannon, experimental values were found, showing an ideal real-world angle is between 30 and 45 degrees. However, these values varied an average of 23.07% away from the ideal conditions. This experimental error was due to having inconsistent air resistance from wind, the ball socket preventing the valve from opening instantaneously, the projectile not fitting the tube perfectly, and assuming the drag coefficient to be that of a sphere. Therefore, after completing this lab, it was possible to calculate roughly where a projectile of a fixed mass would land, under perfect conditions, using projectile motion equations and an excel spreadsheet. This is vitally important because this lab, if expanded on a larger scale, is applicable to real-world situations, such as that in the military or NASA.

78. Bridge Stress Analysis

Katria Clark, Lee Hill, Christian Lemishko, Skylar Johns, PHY 211 Advisor: Shane Spivey

Many would come to the conclusion that bridges are static in nature; however, they undergo myriad types of stressors in terms of differentiating forces and respond accordingly. In this project we will be observing the effect of mass loads when placed on various points along a beam style bridge. This system is one of the most common and essential styles of bridges, so it is useful to test for its propensity when it encounters conflicting forces in varying locations. The mass loads used on this bridge began at 25 grams and were increased in 25 gram intervals until we observed a tipping point. Once we observed said threshold, a resulting rotational torque about a fixed axis occurred. This allowed us to calculate the net torque and compare mass placement and amount to how the bridge collapse occurred. We hypothesized that there would be little, if any, rotational movement when the load was placed in the center of mass of our bridge, as well as a higher likelihood of tipping if we placed masses towards the edges. Our experimental results support this hypothesis through demonstrating stability towards the center with a net torque of zero and rotational movement about a fixed axis towards the end points.

79. Bungee Cord Projectiles

Brigid Courtad, Dan Debruyne, Clayton Spielman, Kalev Wade, PHY 211 Advisor Shane Spivey

Through an understanding of projectile motion and the calculation of tension, this experiment is able to demonstrate how tension in a system and drag affect the distance a specified projectile is launched. Through the use of a medieval-style catapult and bungee cords, we posed the question of what tensions would result in the furthest and most predictable distances. The variables included three distinctive bungee cords and two projectiles, a sphere and a cube. These bungee cords were attached to the catapult in order to launch the different projectiles. Each launch had a recorded distance and time for each projectile. The results from these launches depict the most successful bungee cord and its calculated tension given the displacement, average velocity and acceleration of the two projectiles.

80. Express Mega

Nick Vail, Andrew Pankey, Nathaniel Yardeny, Bradley Gunther, PHY 211 Advisor: Shane Spivey

In an effort to understand how drag affects the landing position of projectile objects, our project was to compare experimental data from a pneumatic projectile launcher with theoretical data provided by a program. Both components of the project were designed, tested and operated by the members of the team. Our goal was to provide meaningful data to allow us to understand the variable force of drag, while learning how to minimize experimental error, engineer the proper testing apparatuses and implement the software needed to carry out such an experiment.

81. ATP Production and Krebs Cycle

Anna Li Qiao Gilstrap, PHY 105 Advisor: Stephen Fahey

Cellular respiration is one of the most efficient recycling systems of our bodies. It creates and uses its own chemicals and reactions. The cellular respiration (ATP) process converts glucose into usable ATPs (acetyl triphosphate) over three constantly active, yet effective stages: glycolysis, Krebs cycle, and electron transport chain. This project presentation will include and explain the Gibbs equation, hydrolysis and synthesis of ATP, history of the Krebs cycle, nerve impulses, and the muscle contraction cycle- all of which pertain to cellular respiration and ATP.

82. Orbital Debris Redirection and Thermal Re-entry Experiment

Ian McComas, Stacie Barbarick, Rhiannon Larsen, Dallas McKeough, James Cook, Cass Bliss, Nick Vail, Bruce Bell, Ruby Gomez, Ryan Wade, Henry Reyes, Ethan Ford, Joseph Harrell, Audrey Whitesell, Jack Dryden, Space Grant Advisors: Barbra Sobhani, Victor Andersen, Jennifer Jones

Mission Statement: As participants in a global effort to prevent harmful repercussions associated with increasing space debris, our project mission is to design, implement and fly a sounding rocket payload that will collect the foundational data needed to develop passive, cost-effective methodology for de-orbiting small, fragmented space debris, using a platform of electrostatic repulsion and incorporating material properties of 3D printed components.

83. Thermal Re-entry data for Sounding Rockets

Ian McComas, Stacie Barbarick, Rhiannon Larsen, Dallas McKeough, James Cook, Cass Bliss, Nick Vail, Bruce Bell, Ruby Gomez, Ryan Wade, Henry Reyes, Ethan Ford, Joseph Harrell, Audrey Whitesell, Jack Dryden, Space Grant Advisors: Barbra Sobhani, Victor Andersen, Jennifer Jones

Arapahoe Community College, Community College of Aurora and Red Rock Community College present D.O.T.T.S (Debris Orbital Tumbler and Thermal Sensors). Our mission is to develop a concept for clearing fragmental debris in Low Earth Orbit, and to build on research for more cost-effective materials to be used in space travel and space technologies. The mission requirements for our secondary experiment's mission requirements include recording and sending temperatures via thermocouples of a variety of 3D printed materials from the time that systems turn on, through the payload reentry. We predict that our secondary experiment will provide us with data to determine which type of 3D printed materials are best suited to withstand extreme conditions (such as reentry) and thus determine a cost-effective material to help make space travel more obtainable and less expensive overall. We have integrated telemetry systems for both our experiments to send live data for immediate analysis. This includes successful launches, positioning of debris samples, and temperatures of the 3D printed material exposed while in flight. Our deck layout has been carefully designed to accommodate the experiments and protect vital systems, such as a hollow pedestal under our experiments for wiring, as well as an electronics chamber to protect our computer and electronic components from the harmful environment of launch to reentry and water during our splashdown. We have completed a wide variety of stress tests on different 3D printed materials, to determine which materials should be tested upon reentry.

84. Mold Growth on Organic versus Non-Organic Tomatoes

Brittany Brunger, BIO 111 Advisor: Mursheda Ali

Mold is a type of fungi that we've likely all encountered as it likes to grow on common foods such as breads, fruits, and vegetables. There are a number of factors influencing the species of mold that grows on such products, in addition to how quickly it grows. An influential factor that was observed in this experiment includes the procedures for growing such products. Therefore this research topic examines the influence a growing process may have on the incidence of mold and the type of mold produced. The two growing processes of interest specifically for this experiment include "conventional (non-organic)" and "organic" growing processes. In Case 1: (tomato)- there seemed to be a faster rate of growth and a more thorough "infection" in the control than in the test subject. The control grew what we determined to be *Rhizopus Stolonifera*, while the test subject grew a separate mold, *Penicillium inferably*.