



# RRCC STEM Expo

## Spring 2018 Program

### Talk Schedule Student Research Presentations

		Gray's Peak		Torrey's Peak	
Wednesday, April 25	8:00 am	<i>Electricity and Magnetism</i> (PHY 212 – Spivey)			
	11:30 am	<i>Electricity and Magnetism</i> (PHY 212 – Spivey)	12:00 pm	<i>Natural Disasters</i> (ENV 110 – Campbell)	
	1:30 pm	<i>Cosmology</i> (AST 160 – Curchin)	1:00 pm	<i>Electricity and Magnetism</i> (PHY 212 – Medina-Hernandez)	
	6:00 pm	<i>Mechanical Systems</i> (PHY 211 – Long)			
		Gray's Peak		Torrey's Peak	
Thursday, April 26	9:00 am	<i>Experimental Design</i> (EGG 151 – Spivey)			
	11:00 pm	<i>Mechanical Systems</i> (PHY 211 – Spivey)	11:00 am	<i>Biology</i> (BIO 112 – Kaye)	
	3:00 pm	<i>Speaker Series: Brandon English</i>	12:00 pm	<i>Biology - independent</i>	
	5:45 pm	<i>Electricity and Magnetism</i> (PHY 212 – Medina-Hernandez)			

## Talks: Wednesday April 25 8:00am PHY 212 – Spivey

### **Railgun!!?**

Jose Sandoval, Chad Rogers, David Palcsak, Brett Webb

Our project is to build a basic railgun to propel a non-ferrous metal projectile at maximum velocity. A typical railgun uses a power source (battery) to charge capacitors to generate an electric field. A projectile is then moved into a magnetic field and the field causes it to accelerate and exit the muzzle. This project should be an excellent demonstration of capacitance, magnetic field, and an objects interaction with an magnetic field. Our project has a stock (which we 3D printed in the IDEA lab), a housing for the action, barrel, plexiglass, copper bars (for generating the field), 8 AA batteries, a voltage converter, a voltmeter, 32 63V 22000 $\mu$ F capacitors, a 3D printed trigger, and various screws, wire and connectors. The capacitors are connected to two bars 3mm apart to generate a magnetic field to propel the projectile. The trigger will be used to move the projectile into the magnetic field to give it an initial velocity when entering the field. We plan to vary quantity of capacitors and voltage that we are charging the capacitors to. We planned to use equations for magnetic field force to calculate the force acting on the projectile when it left the railgun. We'd then use equations for electric field potential to estimate the energy of the projectile when it leaves the railgun. We'd then use conservation of energy equations to determine the projectile's theoretical velocity (if it had worked). For testing procedures, we would have used a high speed cameras with a grid behind the projectile to determine velocity at or near the muzzle. With this information we can determine projectile acceleration in the magnetic field, the strength of the field, total capacitance. Then we will hypothesize reasons for error and do some rebuilding and retesting.

### **Operation Crystal Radio**

Tate Holmes, Garrett Cooper, Kathryn Linz

The purpose of this project was to build a functional crystal radio and analyze all of the different components and how they work together to produce an audible sound. A crystal radio operates on the idea that there are AM radio waves everywhere. The radio picks up these waves and uses the induced current to convert it to an audible sound. The energy picked up from the AM waves is the only power source utilized by the radio. In our radio, there was not a fixed capacitor; instead a variable capacitor was used to adjust the volume, and a diode was used to convert the induced AC current into DC current for the earpiece. Through experimentation and calculation, the configuration of the tuning bar and capacitor, which picks up an audible sound, is found. To search experimentally for a functioning configuration, we first isolated a single frequency with the inductor, then adjusted the variable capacitor. We were not able to clearly distinguish any radio station, and the most the radio was able to produce was a small amount of static. However, we still examined the general design of our radio to determine how it should have operated in a perfect environment. This confirmed that the radio's inability to function stemmed purely from experimental error.

### **The Effect of current on the frequency of oscillators**

Jesse Gibbons/ Michele Brou

The production of electric waves in a circuit is essential for modern technology. An understanding of the different methods of production is critical not only in engineering new technology, but also in maintaining and repairing old products. They form the basis of alternating currents. In direct currents they are mixed to produce patterns of sound or light. They enable a computer to perform logical and arithmetic operations. In all of these purposes, a change in the attributes of the wave, such as its wavelength and height, must be carefully engineered to produce the desired result.

In our experiment, we will compare and contrast the effectiveness of three different oscillators: oscillator using a quartz crystal, oscillator using an inductor and an oscillator using two transistors. We compare the relationship between an oscillator's frequency and the current when using a quartz crystal oscillator, an inductor oscillator, or a two-transistor oscillator. After building the three different circuits, we measure the voltage through the circuit, the voltage through the crystal, the current through the crystal and the

frequency of the crystal. The three examined types of oscillators behaved very similarly. For the oscillator using two transistors and the inductor oscillator, the voltage difference through the respective oscillator was proportional to the voltage through the circuit, whereas the voltage through the quartz crystal was relatively constant. Additionally, the inductor circuit did not produce the power required to turn the LED on, so we initially shorted it to take the measurements and found that there was no wave. Due to the non-relationship between the voltage through a crystal's frequency and the voltage provided in a circuit, the crystal's difference in voltage is more predictable than that of the other oscillators. However, it requires a high voltage to work at a higher frequency. Furthermore, it is difficult to take advantage of an electric wave produced by an inductor. Therefore, the two-transistor oscillator is the preferred type.

### **Solar Powered Battery Charger**

Johnny Boos, Bradford Pettengill

For our project we decided to build a solar powered battery that would use Arduino to allow for us to charge various types of batteries. We thought this would be an interesting topic because it allows us to use a renewable energy source to charge another type of renewable energy that can be used in many different ways. We planned to measure the output of voltage and current being produced to see if its effective enough and then test on different batteries to see if its successful or not. We have not yet received any data yet, as we are trying to work out the kinks in the system and obtain a working system, hopefully to get a output of some voltage and current. This project has had some very difficult bumps in the road, but overall has been a good way of figuring out ways to use renewable energy and could be something very useful in the future if we can allow the system to respond to different batteries or sources that need power. Which would allow us to make changes in the system to adapt to the output of power required and only need one system for many different sources.

### **Theremin Therapy**

Criston Sloan, Michael Feron, Justin Nichols, Bradley Helliwell

The purpose of our project was to create a theremin, which is a musical device that changes pitch as you bring your hand closer and further away from its antenna. This was accomplished by utilizing the hand, as a capacitor, to vary the overall capacitance of the system.

We created the theremin on a breadboard by creating two RC circuits comprised of differently valued resistors and capacitors. These RC circuits acted as oscillators that created a beat between the varying frequencies. This difference ultimately produced the sounds we heard once played through a low impedance speaker.

From our experiments with the theremin we built, we found that getting results was difficult. Theremins are extremely sensitive to their surroundings and have a lot of room for error, especially those of less complex construction like ours. However, our theremin does work as intended; as you bring your hand closer to the theremin, the frequency increases. As we moved our hand toward the RC circuit, we found that the frequency does in fact alter in the expected range, therefore verifying our hypothesis. This means that our hand is successfully modifying the capacitance in the circuit. From there, we utilized a potentiometer to compare a varying resistance through the potentiometer that would manipulate the time constant, which would change the frequency. We then created a program to determine the theoretical frequencies we should expect from this change in the time constant. We were able to compare these to our experimental results, with an error of approximately 19%.

In conclusion, after realizing the difficulty that comes with perfecting the intermakings of a theremin, we were extremely satisfied with our results. Moving forward, we would try to incorporate a more complex circuit that would include an RLC type functionality to provide us with better manipulation of our time constant. This would allow us to produce more musically appealing sounds.

### **Period of a Blackburn Pendulum**

Tailyn Heckle, Hannah Garland, Aaron Dickman, Deonte Robinson

A pendulum is a weight hung from a one fixed pivot, allowing it to swing in any direction with ease. A Blackburn pendulum is suspended from two points creating a “Y” shape while the bob acts as a funnel that allows for a constant and steady release of a medium to trace the motion. While this may not be applicable for practical use, a pendulum with one or more pivots can be very useful in various forms of mechanics. We constructed a Blackburn pendulum from a 3-foot wooden frame, strings, and a weighted plastic bottle with a hole in the lid. Our experiments tested the effects several different variables have on the period of motion, such as mass of the bob, length of the strings and ratio between the two working ends and the central string, angle and height of release, number of pivots, and angle between the pivots. From a control trial, we altered one of these factors at a time, and determined its effect. Our tests concluded increased length of the string, and a longer primary string in proportion to the two pivots will increase the period. Additionally, a fewer number of pivots and symmetry in their placement offers the widest range of motion which will also increase the period of motion. Mass and amplitude, which is the angle and height of release, have no effect on period in our demonstration. In conclusion, variables that expand the range of motion will extend the length of the period.

### **Drag Project**

Trevor Le Borne, David Koehnke, Eric Hay, Flamur Sopaj

This project offers a detailed analysis of the effect that forces such as drag and friction have on objects in motion. There are many real-world applications to our experiment, such as improving the efficiency of motion of cars, airplanes, and even spaceships leaving the atmosphere. This project was designed to answer the question of how an object’s shape can be modified to reduce drag, and what effect mass has on the forces of drag and friction. Our experiment followed the model of a scientific control, wherein we attempted to minimize the effect of friction on an object in order to better analyze the effects of drag and vice versa. The objects we used varied in shape and distribution of mass along the x, y, and z axes. For example, we took an object with mass evenly distributed between the x and y axes, and compared it to one whose mass was concentrated primarily along the z axis. Among all of our comparisons the same trends were followed, with mass having a negligible effect on the object’s velocity and cross-sectional area having a more noticeable impact overall. Concerning mass specifically, the object’s total mass did not matter as much as how that mass was distributed along the three axes. Though our experiment reaffirmed the current beliefs of the scientific community regarding friction and drag we hope it will dispel some common misconceptions about the basic workings of aerodynamics. Ultimately, our findings have led us to conclude that objects that are pointed in the direction of motion with an even distribution of mass along the z axis are less hindered by drag and friction.

### **Radio Telescope Project**

Kamron Correia, Christian Amundson, Liam James, Justin Nichols, Alex Langfield, David Palcsak, Ian McComas

Using Radio Astronomy to observe the Milky Way. In our project, a group of students used an abandoned 12-ft diameter dish to create Red Rocks’ very own radio telescope. This Radio Telescope detects and observes the Hydrogen line spectrum, allowing us to pinpoint high concentrations of hydrogen in space, and allowing us to answer the question: Does Hydrogen Radio Frequency show us more than our eyes can?. The dish was used to construct a massive telescope that uses a Software Defined Radio (SDR) system in order to gather and interpret data that has been passed through a low noise amplifier (LNA) and a down converter. We calibrated and tested the accuracy of the device by measuring the hydrogen output of the Sun and comparing our observed data with published data, confirming the functionality of our design. After testing, our calibrated device allows us to detect radio waves from various celestial bodies around the galaxy, and by using physics and math concepts like the fourier transformation, these results can be analyzed to calculate stars’ position and activity. At the moment, the telescope is programmed to read the hydrogen line spectrum at 1.42 GHz, but the device can be calibrated to enable the detection of other frequencies whenever a user would like. Through this project, we have granted access to the stars to the members of RRCC.

## **Macroscopic Capacitor and Dielectrics**

Chad Matthews and Dmitri Seniw

Our project built a macroscopic parallel-plate capacitor and to test dielectrics in said capacitor. Capacitors are used to store charge in electrical circuits, and dielectrics simply increase the amount of charge a capacitor can store (capacitance). Our project studied how plate separation and different dielectric materials changes the electric potential and charge storage of the capacitor. The first data set was open air (without dielectric) at varying plate separation. We then took data on paper, wood, and cardboard dielectrics (at same plate separation intervals as the open-air data set). We ran theoretical calculations, then compared them to the actual data collected. We then compared the theoretical and actual data to see if they were congruent. Our analysis was performed upon an oversized capacitor, which allowed us to collect data upon charge storage and dielectric performance. Our data showed that the capacitor did indeed hold charge, but it was a much smaller value than expected. The rate at which the system discharged made it difficult to gather data, especially accurate data. Although the data had some major errors, the general trend was in the correct direction for the dielectrics. It showed that the denser materials had a higher dielectric constant, and thus increased the capacitance (paper lowest, cardboard middle, and wood highest). We were unable to gather any empirical data on force, since the capacitor was not as strong as originally intended. In the end, we learned about the ins and outs of capacitors. Dielectrics do indeed help increase capacitance, and what material matters a lot.

### **Wednesday April 25 11:30am PHY 212 – Spivey**

## **Resonance Frequency**

Kyle Beller, Jordan Marsh, Derek Stillwell

Our Physics II project team was motivated to discover the natural frequencies of different isotropic materials. Every object has its own discrete frequencies based on the material and its geometry. When a material experiences an external vibration with the same frequency, it induces that same frequency in the material which grows in amplitude due to the constructive wave interference (standing waves); as a result a standing wave is created within. To test for natural occurring frequencies we used the driving force of an subwoofer which was attached to a Chladni plate (square steel plate). We played frequencies through a tone generating phone application, which vibrated the plate at the top. A natural occurring resonant frequency created distinct patterns on the plate. If a frequency was played and did not match the plate, the pattern medium would become disorganized and the plate would vibrate in a disorganized manner. After thoroughly testing numerous plates, pattern mediums, frequencies and amplitudes we were able to find that various frequencies create different patterns. We also found that different materials have a different amount and range of resonant frequencies. This project consisted of considerable trial and error. Eventually, we discovered the 3/16th lument wood produced the most distinct patterns in addition to more natural occurring frequencies.

## **Magnets and Induced Fields**

Tristan Strayer, Westin Pocsik, Zach Bain

Premise: How much velocity is required for a magnet being swung at a metal plate to overcome the induced field and hit the plate? What can we change to make this happen more or less often? These questions are answered with our tests.

Methods: The way we tested this was by tying a cubic magnet to an arm and swinging it at the metal plate, which was standing up. We also measured the angle using a protractor and the magnetic field over time using the GLX. Lastly, we also changed the plate between copper and aluminum to compare which metal induced a stronger field

Results: We found that the higher the angle, and thus the higher the initial velocity, the more likely the magnet was to hit the plate. We also found that if the plate was composed of copper instead of aluminum, the induced field was stronger, so the magnet was more strongly repelled and less likely to hit the plate.

Conclusion: The magnet is more likely to hit the plate if it has a higher starting angle, and thus a higher initial velocity, and if the plate is made of aluminum rather than copper.

### **Gauss Rifle**

Huilin Ren

Nowadays, more and more technology involves magnetism, such as: MRI and magnetically levitated train. To know how to test the magnetism is a very important technique. Bao Duong, Huilin Ren and Dion Mayes are going to build a Gauss rifle to test how magnetic force affect acceleration. Taped two wood sticks together, set magnet stages 3.8 cm away from the beginning, put two steel balls on the right side of the magnet stage, at the beginning use one steel ball to run the experiment, and then changing to other factors that they concerned about. Test the magnetic field, magnetic flux, magnetic dipole, and the acceleration between steel ball and magnet stage. The experiment is very simple, but the calculation involved is very difficult. Analyze which factor affect the Gauss rifle the most. They also had different prediction of the experiment. In this project, they will show how they prove each prediction is wrong or right. They want to find out what factors can make the last steel ball shoot even faster. There are two results they will get from the experiment. First one is, adding more magnet stages, the acceleration will decrease. Second one is adding more ball bearing, the acceleration will increase. In short, the magnet stage is not the only factor that could affect the acceleration of the last ball.

### **How to Build a Better Paint Missile: Projectile Optimization Study**

Stacie Barbarick, Marcus Bowen, Tyler LeClear, Christian Prather

Applications of projectile and aerodynamic optimization are crucial in aerospace, military, commercial airline and paintball industries. Aerodynamic shell design requires determining the relations between design features and their effects on performance objectives. The purpose of this study was to determine the maximum distance we could obtain varying a critical aerodynamic feature: fin design. To do so, we constructed a variable gauge, compressed air-powered PVC mortar fitted with a fast-release butterfly valve to accurately deliver 30 psi to the projectile launch tube. Additionally, we designed three distinct fin styles in SolidWorks, which we printed and used to construct projectiles. We conducted a series of three launches per style and measured range, time of launch and time of flight of each. Using this information, we compared our experimental data to theoretical results (specifically Time of Flight and distance data) to identify potential sources of inefficiencies. We found tailfin design #1 (0-degree angular twist) had the lowest percent error in both TOF and distance data.

A robust combination of kinematic and force factor analysis and data collection is essential when attempting to optimize the ballistics of any projectile. Key factors include minimizing external environmental factors and robust repeatability. Our launcher would be ideal to conduct future trials in which the thrust force (psi), launch tube length and launch angle could be varied and visualized.

### **Triboelectric Generator**

Drake Langer / Michael Volz

The prefix "Tribo" in triboelectrification is a Greek word that means "rub". In our project we explored the various ways of making a simple triboelectric generator and the overall efficiency of these simple machines. We varied the size and material of the generators (simple note card sized generators that were coated in graphite and Teflon tape) in hope of finding the most effective form of generating electrical power. For each variation that we made and tested we would measure the maximum voltage and current created from the generator, while trying to minimize all other external factors. With this in mind we found that you could generate a significantly high voltage. Our most affective generator was a standard sized note card covered in graphite and this produced up to 20 volts. We did find it much harder to produce a significant amperage. This could be contributed to how many external factors we found in both the building process and the actual testing of our generators. We did find a direct correlation to the size of the generator and the effectiveness. If we had continued this experiment further we would have reduced

some of the limiting factors that we found when executing our tests, like amount of graphite, rate and the force applied to the cards, and wire connection.

### **Basic Railgun**

Carly Arndt, Jessica Graham, and Annabelle Cunningham

In this project, we will explore the relationships between electromagnetism, the magnetic field, and electric current via the Lorentz Force through the construction of and data collection from five different railguns. During the testing of each railgun, the rails and projectile materials were varied as well as the size and shape of the rails in order to collect the maximum amount of data. The materials used for the rails are copper, aluminum, and graphite. For the projectile, graphite and copper were tested with each of the rail types. We introduced neodymium magnets into our design in order to increase the magnitude of the Lorentz force. The results of our experiments indicate that the most successful railgun was the graphite projectile combined with the graphite rails, as this combination moved the projectile the farthest for a given voltage and measured current.

### **Transformer of The Future**

Yousef Noor, James Moffatt, Nick Barcalow, Yejin Hong

For our project we wanted to analyze how a transformer is able to step up and step down voltages and what factors were used to determine these values. We did this by wrapping an iron core (in our case rebar) with a ratio of 1:2 and 2:1 number of wraps to see if there was any resulting change to the output voltage. After much analysis and experimentation, what we found was directly what we hypothesized, the number of wraps can either double (1:2) or halve (2:1) the output voltages. Although in a real world transformer the  $V_{in}$  should almost directly correspond to the  $V_{out}$  by the factor of how many wraps. In our project there was a drastic change between the  $V_{in}$  and  $V_{out}$  but both of the  $V_{out}$  values for the 1:2 and 2:1 wraps were proportional factors of one another. Meaning, we were able to conclude that this dramatic difference could be attributed to not having a pure iron core or another systematic error within the build.

### **The Physics of a Railgun**

Nathan Clapp, Braden Moore

The purpose of this project is to indirectly measure the magnetic field perturbation present around neodymium bar magnets in a railgun, using the responsiveness of certain projectile masses, volumes, and compositions when subjected to the Lorentz force. To quantify this responsiveness, the range of each projectile was tested by firing the railgun. After the acquisition of data, a MATLAB script was used to process each projectile's range, radius, starting height, circuit voltage, and resistance values, outputting a predicted value for magnetic field. Magnetic field strength along the railgun's track was verified using a smartphone's magnetometer. Testing demonstrated that projectiles' ranges vary inversely with mass, in accordance with Newton's Second Law. It was also found that range is directly proportional to voltage and railgun height, but decreases with increasing resistance. Projectile composition plays an essential role in both the direction of travel and the net resistance of the railgun circuit. For a given current direction, the eddy currents within steel projectiles cause a forward motion, while brass projectiles experience a much smaller, back-pointing acceleration [1]. The testing conducted shows the special importance of eddy current behavior in electromagnetic devices. All these combined variables and processes demonstrate the information and analytical techniques which can be used to assess an unbuilt railgun's efficacy.

### **Putting the Pen in Pendulum**

Gracie Cole, Patrick Bales-Parks, Kenny Gerke, and Trenton Spittler

A harmonograph is a system of physical pendulums which uses a writing utensil to create precise geometric patterns known as Lissajous curves. While often strikingly beautiful, these patterns demonstrate core physical and mathematical principles; it is a confluence of art and physics. We built a harmonograph and measured its movements to calculate the damping coefficient that results from drag and friction, which eventually causes the pendulums to stop oscillating. While there are many different types of harmonographs and pendulum arrangements, we chose a two-pendulum system: one pendulum controls the pen as the other pendulum simultaneously controls the writing surface. Under a variety of initial conditions, we measured the angle of the pendulum arms at their oscillatory amplitudes and the time elapsed for oscillations to cease in order to calculate the damping coefficient in the parametric equations that define the resulting Lissajous curves seen on the writing surface. The damping coefficient is what determines the rate of exponential decay. We calculated the average damping coefficient to be 0.018961 for the Pen Arm and 0.013002 for the Writing Surface, and used this average to predict the damping coefficient for a subsequent trial with predetermined initial conditions. The percent error of the damping coefficient of our final trial vs. the average was 27.99% for the Pen Arm and 80.73% for the Writing Surface.

### **Wednesday April 25 12:00pm ENV 110– Campbell**

The students have created posters about anthropogenic sources to natural disasters. They are investigating how natural disasters are heightened by human contributions and also how they can be prevented through advanced preparation. Come join us for lively discussion and presentation of issues.

### **Wednesday April 25 1:00pm PHY 211 – Medina**

### **Wednesday April 25 1:30pm AST 160 – Curchin**

#### **The Fermi Paradox**

Candy Gonzalez-Collazo AST 160 Advisor: J Curchin

I will be presenting my topic in a 3 sided poster board composition. Explaining what the Fermi Paradox is, and presenting several proposed solutions to it, under three main categories: They Exist But Have Not Communicated, They Are Already Here, and They Do Not Exist. I will also have a small section of statistics to inform the viewers on the current discoveries in astrobiology (exoplanet #'s, giant Earth's/candidates, and the scale of the universe). To further engage my viewers in the topic of life outside the solar system, I'll provide them with a chance to use the Drake equation, and will list the different data as the time passes. This will help show how the Drake equation is based on opinion, and how surprising the results may be when considering a pessimistic view on the opportunity for extraterrestrial life.

#### **Hubble newly reveals 2 trillion detectable galaxies**

Raye and Taryn AST 160 Advisor: J Curchin

The Hubble telescope allowed this discovery to be made and the findings were published October 13th, 2016 on the NASA government website. To collect facts and data about this discovery along with the NASA website we will additionally pull information from studies as other legitimate sources.

#### **Olber's Paradox**

Ryan Gibson AST 160 Advisor: J Curchin

My STEM project consists of the topic of Olber's Paradox, and the resolution of said paradox through modern advancements that help to disprove the theory. The basis of the paradox states that an infinitely

old universe with an infinite number of stars put in an infinite space would make the sky brighter than dark. I would then bring in Kepler's argument about how this constitutes for a finite universe, as well as other mainstream explanations from various sources such as Edgar Allan Poe suggesting a finite universe, or the Big Bang and its expansion of space causing energy of light to be reduced via redshift. Some alternative explanations to bring in would be steady state, finite age of stars, brightness, or fractal star distribution.

### **Black Hole Stem EXPO**

Eric Rodriguez AST 160 Advisor: J Curchin

I will be showing the formation among other details and facts that come with the life time of black holes. I will also discuss concepts and terms that come into talk about black holes like equivalence principles and space time curve. This will be about a 15 min presentation.

### **Genetics and Space Travel**

Eric Locascio AST 160 Advisor: J Curchin

### **What's the Deal with Dark Energy/Matter?**

Hannah Eggers AST160 Advisor: J Curchin

### **The life of black holes**

Deane Long AST 160 Advisor: J Curchin

The life cycle of a black hole, what a black hole really is. How they form, how long they stick around/what are they doing during that time. What happens when they "die".

### **Evolution of the Model of the Universe**

Morgan Oertli AST 160 Advisor: J Curchin

### **How do stars turn on?**

Jason Cawthorne AST 160 Advisor: J Curchin

### **What is Plasma, and What Can it Do?**

Jackson Hahn AST 160 Advsor: J Curchin

Project based around explaining what plasma is, it's nature, what it's used for and can be used for.

### **Nuclear Winner**

Austin Matthew Ortiz AST 102 Advisor: L Hoerner

For too long people have been under the misconception that Nuclear power is too dangerous to use. Instead we rely on coal which pollutes our planet, releasing large amounts of greenhouse gasses into the atmosphere. My proposal is to replace the use of coal power with Nuclear power. By explaining the benefits of this change and all the rules and regulations in place, I hope to convince the populous to change their mindset and save the earth.

**Wednesday April 25 6:00pm PHY 211 – Long**

### **Centrifuge and Circular Motion**

Kim Skocz, Kyle Phillips, Andrew Mills, Valerie Svaldi

In order to investigate rotational kinematics, a centrifuge had to be built. The project consists of two main concepts. Rotational kinematics and a way to measure and calculate an unknown motor rpm using centripetal and tangential acceleration. The program solidworks and a three dimensional printer was used for the build of the testing apparatus. Once the components were assembled testing began. This was accomplished by using an Arduino, Reed Switch sensor and magnet that measured revolutions per millisecond. Once the data was collected it was noted that this was a working device that this was a working device that measured rotations per millisecond. The centrifuge that was built required a learning curve. Materials needed to be studied and used effectively along with calculating the correct angular velocity using a computer program. The process of angular momentum is the fact that objects in space in general want to move in a straight line, however, a force or a tension causes them to constantly change the direction they move resulting in a circular motion. As a result of this circular motion the measured object is constantly accelerating. Knowing an object's centripetal acceleration and angular velocity and tangential velocity allows one to find the objects angular acceleration to calculate the moment of inertia. Effectively this is a device that has the potential to measure torque of a motor.

### **Determining Terminal Velocity**

Khay Alwaissi, Cole Delery, Robert Schmidt

The purpose of our experiment is to calculate terminal velocity while skydiving at approximately 14000 ft above sea level, the time it takes to achieve our terminal velocity, and the effects weight has on that velocity. To calculate these results, we will be using the Free Fall kinematics equations along with the terminal velocity equation. We predict that our terminal velocities will be around 180 mph, that weight has a linear relationship with terminal velocity, and that it would take us around 8 seconds to hit terminal velocity.

### **Modeled Ski Jump**

Jesus Flores, Thomas Johnson, Curtis Plachy, Nathan Haefele, Jess Sheridan

The data we gathered appeared to show that as the mass of the circular object increases, the distance which the object travelled in projectile motion increased. This was a case of "correlation does not imply causation;" however, we ultimately found that the distance difference is attributed to the varying diameter of the rolling object, as they were slightly different on the varying objects. This ultimately proved our hypothesis to be correct because any change in the differing diameters and of test objects reflected the change in air resistance and rotational velocity. Despite the effects caused by dissimilar objects, we were able to demonstrate mathematically that each of these objects would indeed land on the same spot even though each object's weight was different.

On the surface, the rolling object does not appear to model a skier very well due to the physical dynamics of a solid, rolling object, as they are more complicated than a linearly translated, sliding mass, such as a person on skis. However, with further examination of our results it almost seems to be an ideal way to model it. This is supported by three factors: 1) a rolling object travels down the jump with very little resistance, 2) it has a potential energy at the top of the jump equal to the gravitational potential energy according to its mass, and 3) all objects act the same in projectile motion (provided no other environmental/situational influences). Obviously all three of these points hold true for either a skier or the balls used in our system. Therefore, the application of our results is that an ideal ski jump can be engineered to satisfy the average skier's weight and air resistance, such that weight is negligible. That is why terrain parks at ski resorts do not have listed weight limitations on each jump; instead, you sign a waiver to ski at your own risk.

### **Wind Turbine**

Abdulla Ermila, Tyler Kipp, Matt Clark, Adam

Harvesting wind energy is not exactly a new idea and has been around for hundreds of years. Early examples of people harnessing the energy of the wind include sailing ships, wind-pumps, windmills and

even horizontal axis water pumping wind mills found in rural parts of North America. The first wind turbine to be utilized to generate electricity was recorded in 1888 by Charles Bush, who developed a 60-foot tower and 56-foot rotor that could generate a whopping 12kW of electricity. Wind is an important alternative energy source that is still widely used and a contributing factor in lowering our carbon footprint. Wind turbines are inherently a very simple machine. The rotating blades on the turbine capture the kinetic energy from the wind, which is turned into rotational kinetic energy. This rotation then turns a shaft that is also connected to a gearbox and generator that turns this energy into electricity. Wind power is proportional to wind speed cubed. The wind energy is the kinetic energy of the moving air and the wind power increases with the cube of the wind speed. That is, doubling the wind speed will give eight times the wind power and output.

In our experiment, our main goal was to be able to find and compare the kinetic energy of the wind to the rotational energy of the blades. By doing so, we will demonstrate the transfer of the winds kinetic energy into the blades. By finding the efficiency of the blades under the subjected conditions, we can quantify the effects of those conditions. The wind is the force on the blade that drives torque and thus the rotation by overcoming friction to produce energy. The law of conservation of energy is evident in this experiment, because energy can neither be created nor destroyed and can only be transformed from one form to another. We wanted to determine how much energy from the wind is transferred into the blades of the turbine, which then turns the two gears and powers the Nema 11 stepper motor inside our turbine.

### **Thursday April 26 9:00am EGG 151 – Spivey**

#### **Ballistic Parachute For Drones**

Joe Kelly, Derrick Hayward, Holden Pierce, and Matt Alcon EGG 151 Advisor: S Spivey

RC drones is a new common hobby amongst many people that takes hours of practice and the consequences of inevitable crashing is very costly. As we are still at a beginner level in the hobby and don't have much disposable income, we wanted to create a parachute for medium sized drones that will deploy on command from the same transmitter used to fly the drone. Our approach was to research, do calculations, design and then build a spring loaded parachute. The drone that was used was weighed (633.8g/1.4lbs) and we determined the size of parachutes needed to support at the decent rate of 15-20 feet per second. We cut out two 24" inch parachutes out of nylon material. Strings were then glued to each point of the octagonal shaped chutes (8 strings for each chute). A 3D box was designed and printed to hold the packed chutes and strings along with room for springs that will eject the packed chutes. A lid and latch was also printed, which was the mechanism the servo arm moved to deploy the chutes from the spring loaded box. We bound the servo to the transmitter and attached it to the box and latch. The box design was then attached to the bottom of the drone. During the build process, the servo released the parachutes everytime without jam or snagging. The final design was thick, sturdy, had constant deploy results and could be used over and over again. Overall the design was successful in that it met our general requirements; spring loaded, deployed on command and supported weight of falling drone. However, the design did not meet our specific desired results because the build was extremely heavy, bulky and descended much faster than wanted. The whole build was much bigger and heavier than other drone parachutes on the market. It was easy to tell the drone was carrying a load and the maneuverability was decreased. With the foundation of our working design, many improvements can be made to reach better, more desired results.

#### **The Retractable Staircase: Stairs of the Future**

Andrew Bazel, Joe Anselmi, Derek Anderson, Jesus Ortiz EGG 151 Advisor: S Spivey

Stairs play a significant role in our daily lives, providing a means to get between the levels of the buildings that we both live and work in. Yet due to the fact that they are unmoving and consume more space than is absolutely necessary, we decided to attempt to address this problem by building an affordable, and aesthetically pleasing design that would fold away into the walls when not in use and free up the floor space it previously occupied. We discussed many different designs, some which slid into each other, some which folded in extravagant ways. We decided on a simple design that would be integrated into a

standard wall of a building with a unique vertical tracking system for guidance a stability. The track is two vertical lengths of 2x4 built into the wall to support the stairs. The stairs have a tread width of 33in and a length of 10in. They are spaced 7in high and pivot on a front axis formed by a 3/4in steel rod. These stairs we designed to hold a max weight of 450lbs and are built on two stringers made of wooden 2x10. While we only have a rough prototype outlining our idea, but with future development our creation will be the building block for a safer, more space-effective generation of stair.

#### **Thursday April 26 11:00am PHY 211 – Spivey**

##### **The Slippery Ski Slope and Sled**

Chloe McCaffrey, Enrique Cervantes, Anand Zorig, Drew Rackow

Our project consists of a car with 3D printed wheels traveling down a large ski slope in which we test the coefficient of friction between 3D print filament material (polylactic acid) and the surface of contact, Veranda, which is a material made from a wood polymer. We then compared our results with steel wheels, in which the coefficient of friction is known, to calculate the difference between the known material and what we calculated to account for an error range. The different trials included differences in weight of the vehicle, shape of the vehicle, and material of the wheels in order to compare what is known to what is unknown. We tested the experiment by attaching a Pocket Lab to each of the cars, which tracks the change in height and the change in acceleration over time. This information was then used to determine the coefficient of friction between dry Veranda and the varying wheel material.

We used the 3D print wheels and steel wheels to test the friction forces; our hypothesis was that the steel wheels will moved down the track faster, because metal typically has a lower coefficient of friction than polymer material due to the different intermolecular forces. We determined this hypothesis to be incorrect; the coefficient of friction we obtained for the steel on the Veranda was approximately 0.284, while the coefficient of friction obtained for the filament was approximately 0.265.

##### **Exploring Kinematics With A Pneumatic Cannon**

Criston Sloan, Tyler Derington, Christian Nieves, Jaylynn Medina

Physics is not always intuitive—but even when a concept is understood, a physical demonstration and analysis can cement the concepts in a tangible and exciting way. The purpose for having constructed our pneumatic cannon—composed of PVC pipe, cement, and a modified sprinkler valve—was to provide a means of closing that intuitive gap in an engaging way that produces consistent results. Furthermore, we sought to discover whether or not an accurate prediction of a projectile's trajectory could be made by applying the concepts of kinematics and dynamics learned in our Calculus-Based Physics course. Basing what we've learned about kinematics and incorporating our previous knowledge of pressure, we are able to calculate an approximation of the projectile's trajectory, initial velocity, resistant drag forces, net force, and whether or not the object will reach terminal velocity. By using a visual reference (such as a meter-stick) and a video camera, our projectile's experimental initial velocity can be quantitatively verified from the camera's frame rate and our distance reference. Our predicted trajectory and drag-force calculations are equally verifiable through the use of a measuring wheel. Discounting the distortion introduced by the camera lens and/or the recording not taking place perfectly perpendicular to the launch, our theoretical trajectory parabola fits the path taken by the projectile in our recordings (given the axes are proportionally scaled).

#### **Thursday April 26 11:00am BIO 112 – Kaye**

##### **An ecological survey of the plant life of RRCC.**

Nick Paunovich/James Bravo/Calvin Bowles/Kevin Houghton BIO 112 Advisor: S Kaye

For our project we performed an ecological survey of the plant life of the RRCC campus. For the survey we broke the campus into two sections. One section is the landscaped and heavily watered part of the school in front of the main entrance and the other is the natural grasslands found behind the school. We performed our survey by blindly throwing a 12" x 12" square 10 times in each section and then identifying the plant species that we found in those randomly selected areas. We also gathered data on water usage on the landscaped side from the school. The reason we performed it in this way was to demonstrate the diversity of plant life associated with the natural, non-watered side and to show the high cost of water usage. Our results show that the plant life chosen on the landscaped side is wasting water on a massive scale and that there are native plants that would be better suited to the environment than what is currently in place.

### **Parsley and Cilantro Growth within an Aquaponics System**

Saige Claussen and Morgan Maddox BIO 112 Advisor: S Kaye

The purpose of this experiment is to determine if aquaponics is a superior growth system and also, to determine whether cilantro or parsley grow at a faster rate. All seeds will be germinated in an at home environment that uses Miracle Grow soil to keep the germination environment constant, then one set of herbs is transferred to the aquaponics system after two weeks of growth. The other set of cilantro and parsley is kept in the original soil and used as the control variable. Over the five month semester, growth will be measured based on primary and secondary growth twice a week. Primary growth is defined as height of the herb above ground and secondary growth is defined as the root length of the herb. The collected growth values are converted to rate of growth per day to determine which herb exhibited more growth and in which system. Originally the experiment tested bamboo growth, but after pests ate the initial bamboo specimens the experiment was reformulated.

### **Water Utilization with Ecological Study**

Manisha Jaiswal, Brianna Roybal, Donny Herrera, Rebecca Erek BIO 112 Advisor: S Kaye

In regards to ecological study we examined the water usage for landscaping on both East(non-native) and West(native) sides of campus to compare the species of plants that grow on both sides. We took ten random pictures of landscape in a 0.5-meter square from a fixed point to get a good comparison between the sites. We then calculated how much water is used to maintain both sides of the campus in these areas. Now we developed a plan of action to minimize the water usage on the Lakewood campus of Red Rocks Community College.

### **Can Fungi save the Forests? Researching the viability of Fungal Endophytes to prevent Beetle Kill**

Kenya N Gates, Independent Project/IDEA Lab

Endophytic fungi are organisms that live symbiotically within a host plant, and have been found to have applications in insect infestation prevention in forestry and in agriculture. Insecticides, produced during the fungi's metabolic process, are distributed throughout the xylem and phloem of the plant and deter insect activity. This relationship may play an important role in a tree's ability to resist beetle kill, an epidemic that has resulted in the deaths of over 830 million trees in Colorado in the last three decades. *Picea engelmannii*, a high-altitude Spruce tree that plays an important role in the regulation of watershed at high altitudes, may be at risk for future beetle kill outbreaks, which is why our team selected that species for our studies. Our goals in our research are to A) identify the species of endophytes present in Colorado's Spruce-dominant forests, and B) screen for species that may be able to prevent beetle kill in the future.

We chose multiple sample sites in and around Summit County, Colorado, ranging in elevations between 9,000 and 11,000 ft. From these sites, we selected trees that appeared completely healthy, i.e. displayed no signs of disease or insect activity to serve as our control group, as well as trees with obvious signs of beetle boring to serve as the experimental group. After the collection of our pine needle samples, they

were sterilized and plated in order to culture the internal endophytes. We then extracted the DNA from our samples using CTAB methods, and will run ITS sequencing in order to determine species and phylogeny.

We expect that after comparing the DNA from our samples to those in GenBank, we will be able to identify the best candidates for beetle kill prevention.

#### **Thursday April 26 5:45pm PHY 212 – Medina**

##### **Potato Powered Circuit: Boiled vs. Unboiled**

Dana Foulk/Joshua Jacobs/Cassandra VanDeventer PHY 212 Advisor: C Medina

The potato battery is a classic in science experiments that demonstrates a conversion of chemical energy to electric energy to create what is known as an electrochemical cell. One potato is enough to power a small, simple clock or even an LED light--meaning many potatoes within the same circuit could produce even more power. This experiment will be exploring the idea that a boiled potato can produce up to ten times the amount of power compared to an unboiled potato. Voltmeter readings will be taken for both unboiled and boiled potato batteries, as well as both potato types being compared within a circuit to light up light bulbs of various voltages.

# Poster Sessions

**Wednesday, April 25, 10am – 12pm**

## **Aquaponics Project**

Emily Filatov, Megan Raad, Seth Baca, Sam Yakimow, BIO 112 Advisor: S Kaye

Aquaponics is a process of sustainable farming that combines the sciences of hydroponics and aquaculture to allow the growth of plants in an indoor environment that conserves water and can speed up the growth. In this experiment, Red Cherry tomatoes, Beefsteak tomatoes, and Brandy Wine tomatoes were added into both a lava rock bed and a floating water bed and their heights were compared over a few weeks. Our results concluded that the tomatoes were very successful in both the lava rock and the floating beds due to the constant access to nutrients and water.

## **Can you even lift? A pre-workout supplement can help you out!**

Michelle Salazar, Josue Salazar, Joe Russell-Seymour, and Tristan Robinson BIO 111 Advisor: T Gray

To determine if a pre-workout is beneficial to a workout and increases performance by 10% during a specific activity. This will allow for a more efficient workout for all those that attempt this experiment. Our chosen activity is the bench press completing 10 sets of 10 reps. First, find a weight that a person can complete 1 set of 10 reps but not all 10 sets. Determine a workout schedule over 3-week period scheduling 2 workouts per week and allowing a minimum of 2 days between each session. Each session attempt 10 sets of 10. During week 1 consume no pre-workout. During week 2 10 minutes prior to workout consume  $\frac{1}{2}$  serving of Energize. The third week 10 minutes prior to workout consume 1 full serving of Energize. Record all results. Using these three weeks of data collection we are then able to compare the total reps completed during each week and see if a pre-workout increases performance. Our group average increased their completed attempted reps by 15.64% during week 2 and 32.75% during week 3. There is a positive correlation between the pre-workout supplement "Energize" and amount of completed reps in a workout session. We determined that due to the average increase of rep completion being higher than 10% at each increment our hypothesis concluded true. We found the following factors impacted our data: diet, sleep, stress, attitude, and other factors varied between weeks. Our group size consisted of 3 participants and were all male. We believe further testing would be beneficial addressing the above factors and increasing our number of participants.

## **Wireless Electricity Transmitter**

Jackie, Kyli, Alaina PHY 212 Advisor: S Spivey

Electromagnetic induction is commonly seen in the use of wireless charging. Wireless charging allows the user to move semi-freely within the range of the magnetic field created. The purpose of our experiment was to determine the efficiency of wireless charging and examine the physics behind it. In order to do so, we built a conductor made from magnetic copper wire, a transistor, and a phone charger. The wire was wrapped into two coils, one attached to a power source and transistor, and the other attached to a lightbulb. We opted to use an LED rather than a phone to show energy transfer because of the AC current created by the transistor. AC current is required for electromagnetic energy transfer because magnetic field is induced by a changing electric field. Observed results show a major inefficiency regarding electromagnetic induction through air. Thicker wire, more turns, shorter distance between coils, and some alternate mediums appear to increase the efficiency of conduction. Wireless charging remains highly inefficient, as distance must remain within centimeters of the coil in order to receive any measurable amount of energy transfer.

## **Mold Growth Under Various Conditions**

Dylan Dewitt, Elizabeth Maureaux, Abigail Wilson, Jacob Alexander BIO 111 Advisor: A Barun

This project was executed to support or disprove our hypothesis that bread that does not have preservatives, is not kept cold, and is exposed to water will be the most conducive to mold & bacteria growth. The experimental procedure we undertook was to take breads with different ingredients and put them all in the same varying conditions to see how they fared comparatively. For our control we left a slice of each kind of bread in a sealed bag on the counter. The first experimental group was exposed to water and left on the counter. The second experimental group was exposed to cold in the fridge. Each group member monitored and measured a complete set of each kind of bread to produce four replications in varied environments to get an average of the data. We did one trial of the experiment with four replications to collate enough data to draw a reasonable conclusion. In conclusion, our hypothesis was supported; the breads with the least preservatives began to mold the quickest. However, the variable of cold prolonged mold growth in every kind of bread. That being said, bread either needs preservatives or to be kept under a certain temperature to regulate the growth of mold. They use other plants and animals for energy. In summary, our experiment did support our hypothesis. Bread that was kept cold or had more preservatives did go the longest before showing signs of mold growth, which was in line with our hypothesis. A way we could have taken this experiment even further would have been to get the mold growth tested to see what kind of mold grew in the most proliferation. We could have improved the experiment by having chosen different breads; possibly including another bread with more preservatives. We also could have done more frequent measurements of mold growth. Our results indicate that exposure to water increases rate of mold growth, and placing bread in the refrigerator will prevent mold, but also cause the bread to go stale very fast. The best way to store bread is on a counter or table, and freeze it after several days for later use.

## **Black-Tailed Prairie Dogs**

Savannah Gordon, Lenny Gilbertson, Adam Bellinghiere, Chris Hanson, Alamir Alasadi BIO 112 Advisor: S Kaye

For our ecological study we went out and surveyed the North and South sides of the Lakewood campus. Our hypothesis that we came up with was to compare the Black-Tailed Prairie Dog population with the presence of the Red-Tailed Hawk population on the Northern and Southern sides of the campus. We wanted to see whether or not the Black-Tailed Prairie Dog population would have correlations with the Red-Tailed Hawk population based on the Northern side of the campus which is considered to be the more native side as opposed to the Southern side which is more urbanized. We did field research on each side of the campus to compare the differences between the two by going out each day to count the numbers of each population to configure our data. Our data rejected our hypothesis due to our inability to observe more than one Red-Tailed Hawk on the Northern side of the campus. We would have liked to have more time to go out multiple times a day to do observations based on the fact that most predatory birds hunt in the early mornings and in the evenings. While our data rejected our hypothesis, we did find data correlated to a higher population count of the Black-Tailed Prairie Dog on the Northern side of the campus. We concluded this may be due to the more recent urbanization of the Southern side of the campus.

## **Wind Turbine**

Tim Teska PHY 112 Advisor: S Chakraborty

The experiment I have chosen to do is to construct a wind turbine in order to provide power to a rechargeable battery and also explain the physics that occur during this process.. The materials needed

in order to assemble the experiment require pvc pipe, electrical wire, a switch, a cpu fan blade motor and a rechargeable battery. My plan is to design a small scale model of a wind turbine using the pvc pipes and cpu fan blade and feed electrical wire through the bottom and out to a switch which will regulate the flow of current to the rechargeable battery. The physics behind our machinery is to transform rotational kinetic energy into electrical energy, and this is possible by the force of the wind being exerted onto the propellers which then rotate a rotor causing copper coils that are wrapped around oppositely charged magnets to generate electromagnetic induction and thereby creating electricity. My resources will come from our College Physics 112 textbook by Randall Dewey Knight, Brian Jones, and Stuart Field which are Chapter 20-26 (p. 632-840) and these sources and 2 other online sources that I will put on a poster.

### **Natural Antibiotic Agent's Potency on Human Mouth Microbiome**

Lynzee Allen, Jacob Trelease Advisor: S Chakraborty

An antibiotic is a chemical that kills or inhibits the growth of bacteria and is used to treat bacterial infections. The implication for antibiotics has vastly changed the nature of medicine and the death rate due to bacterial diseases. It is hypothesized that honey, due to its viscosity, will provide the largest zone of inhibition when compared to Tree Tea oil and Eucalyptus oil. LB-agar plates were used to grow and test the bactericidal potency of different natural antibiotics. A sterile cotton swab was saturated with nutrient broth and then swabbed in the left cheek of a mouth for 20 seconds. The cotton swab was then streaked across the LB-agar plate. The plate was heavily inoculated. A 7mm disk of filter paper that was saturated for 25 minutes in Tea Tree oil was then added to the plate. This process was repeated for Eucalyptus oil and honey with 2 minute intervals in between each mouth swab. Replicates were done of each disk by treating each half of one plate with a disk. An additional plate was treated on one side with over the counter antibacterial ointment on filter paper, and a water treated filter paper disk on the other. These four plates were then incubated for 48 hours at 37°C. After the incubation period the zone of inhibition was measured and averaged for the varying agents. It was observed that there were at least two strains of bacterial growth on all of the plates. The relevance for this research was to observe which natural antibiotic was most potent in inhibiting the natural biome of the human mouth. This study supports that Eucalyptus oil is an antibiotic, but in comparison to Tree tea oil and honey no correlation can be made without further investigation.

### **The Impact of Turning in Virtual Reality on Real World Movement**

Barrett Sullivan BIO 111 Advisor: T Gray

With the introduction of Virtual Reality (VR) to a person's home, accidents like hitting a wall or other objects are a common occurrence, often resulting in injuries to self or property damage. The purpose of this experiment was to see what impact turning in VR had on how far a user deviated from their initial standing position. Knowing what causes these deviations might help in finding a solution for preventing accidents when using VR. Since rotation in a virtual environment has been connected to postural instability and cybersickness, turning in VR may cause the body to make more adjustments, meaning more movement. To test this subjects were made to complete 3 mazes in VR of varying severity of turns, and after each maze the furthest distance traveled from their starting point was measured. Subjects were also asked to rate their level of cybersickness after each maze. Distance overall increased with the increase of turning in mazes, with only some variability in one of the mazes. Cybersickness increased with the mazes as well but did not exactly correlate with distance. Turning can be assumed to be a main component of why VR users walk around their real world space so much while playing.

### **Animal Diversity of Red Rocks Community college Lakewood campus**

Alivia, Tyler BIO 112 Advisor: E Santa-Martinez

We did a project on the animal diversity of the Lakewood campus looking at the west and east side of campus and compared the two of them collecting data for three days at the same time and comparing them on graphs. With pictures of the animals, where they come from where why they might be in this location and if anything is effecting them.

### **Effect of Temperature on Beer Yeast**

Cheng-Yi Ho, Jessica Wailes, Nathan Jones, Heidi Fredere BIO 111 Advisor: A. Barun

Fermentation is the process by which yeast converts glucose in the wort to ethyl alcohol and carbon dioxide. This gives beer its alcohol content, carbonation and flavor. Temperature, among other factors, greatly affects the behavior of the yeast. In this experiment we were investigating the effects of temperature on fermentation of yeast by measuring the alcohol by volume (ABV). Our hypothesis is that at a lower temperature (10°C) the yeast production will be slowed yielding a low ABV, at an optimal temperature (20°C) the yeast will yield the greatest ABV, and at a high temperature (30°C) the yeast will denature and produce little to no ABV. To conduct this experiment, we brewed an 18-liter batch of beer. We began by bringing our liquid malt extract to a boil and then added hops to create the wort. We then cooled the wort to 21°C. After the cooling process, we placed 250mL of wort and 0.121 grams dehydrated yeast into nine small fermentation vessels. Three vessels were kept at 10°C, three at 20°C, and three at 30°C for one week. After one week, a few drops from each group of three vessels were placed on a refractometer to show the ABV produced. The results were that at 10°C the yeast yielded 0.83% ABV, at 20°C the yeast yielded 2.93% ABV, and at 30°C the yeast yielded 5.20% ABV. This proved our hypothesis incorrect as the highest temperature yielded the highest results. After looking at the results of our experiment, we concluded that the reasons for our incorrect hypothesis might lie in a variation of yeast measurements, fluctuating temperatures, and changes in the volume of the wort.

### **Strawberry Fungi Growth**

Dylan Keller, Paige Pappas BIO 111 Advisor: A Barun

For our presentation, we wanted to identify what factors create fungi growth faster on a strawberry. The fungi we are trying to identify is Botrytis Cinerea. Our hypothesis is strawberries in sugar would be preserved more, and there will be faster fungi growth in the stawberry with lemon juice. identified the rate of fungi growth on 3 different strawberries placed in different substances. We cut open the strawberries and one strawberry was placed in lemon juice, the second strawberry was placed in sugar and the final strawberry had no substances added. The results determined our hypothesis to be true. The strawberry in lemon juice grew fungi faster than the other strawberries. The strawberry with no substance added grew fungi slower than the strawberry in lemon juice. The strawberry in sugar seemed to grow the fungi slower than all the strawberries and one result shows no fungi growth. Our conclusion is that our hypothesis is supported by our data. The lemon juice strawberry grew fungi faster and the sugar strawberry grew fungi slower and was preserved more. I would redo the experiment with organic v. non organic strawberries to see which strawberry the fungi would grow faster on.

### **Five Second Rule**

Stephanie Silvas, Diana Barron, Dorrette DeLeon BIO 111 Advisor: A Barun

Are there more bacteria on wet food or dry food after its been on the floor for five seconds? This lab project looks at which food attracts more bacteria when it is on the floor. The products we tested on was a sponge, a spoon, artificial rose petals, and small color pom-poms to represent food. We tested them each three times once to test them right out of the packaging, the second time we sanitized them then drop it

on the floor and third time we sanitized them as well but we put them in the water and then dropped them on the floor for five seconds. Our hypothesis was the wet food will have more bacteria than the dry food. The Petri dishes that represented wet and dry food grew the same amount of bacteria. Five out of the twelve Petri dishes didn't have any bacteria growth. Our results did not support our hypothesis.

### **The Effects of Technology Advancement on Scientific Literacy**

Michelle, Gabriela, Katie, Robert BIO 111 Advisor: A Barun

In this study we attempt to see if technology had an impact on science literacy. To answer this question we tested two groups of participants and compared the data with the original results collected by Nathan Zohner in his experiment "The Dangers of Dihydrogen Monoxide". In his experiment, participants were given a fact sheet detailing the supposed horrors of the molecule and were asked if they would ban dihydrogen monoxide. The original Zohner experiment concluded with 43 participants voting yes to ban, 1 voting no, and 6 undecided (fig 1). Since Zohner conducted the experiment in 1997, we can use this as a basepoint of data collected while the internet was not as readily available for most people. The U.S. government census bureau once estimated that in 1997, 36.6% of households had a computer at home and only 18.0% of households had internet access (fig .2). (Newburger) This is a stark contrast to 2018 data from the Pew Research Center which shows an average of 98% of adults ages 18-29 and 97% of adults ages 30-49 currently use the internet (fig 3). (Pew Research Center).

For this study we have included two groups. Group A consists of participants surveyed in-person and in full view of the surveyors. Group B consists of participants surveyed online with no monitoring whatsoever. Both groups were given a survey and a fact-sheet that was designed to create a negative opinion of hydroxillic acid. Both groups had to decide if they wanted to ban tap water. From these results we were able to test if the participants were able to apply science to the real world. If they could see past the name, it could be used as a way to indicate the level of scientific literacy within these groups. During administration of the in-person survey, the surveyors were also keeping record of how many participants used their personal devices to access the internet and search for answers. This allows us to quantify the difference between the original Zohner experiment as little to no internet access, group A as limited to near unlimited access to internet, and group B as unlimited access to internet. Furthermore, in order to ascertain if there were any other trends not previously accounted for, we also included questions asking for basic demographic information.

### **Bacteria in Mascara**

Danielle Parsons, Azaria Van Vorst, Katie Olsen, Valerie Svaldi BIO 111 Advisor: A Barun

Eyelash mites, scientifically known as Demodex., naturally live on the surface of the eyelid, coexisting in a symbiotic relationship with the human body; living off of the dead skin and oils from our eyelids. Demodicosis is caused by excess oil on the surface of the skin, or by going to sleep with mascara on. An additional complication that can occur is Blepharitis: An inflammation of the eyelid caused by bacteria. This can cause redness, swelling, itchy-ness, flaking of the skin, and can even cause eyelash hairs to fall out. Bacterial infections such as pinkeye or a sty can be caused by the use of old or expired mascara. With time, bacteria can build up on a mascara wand and inside the bottle. Leaving mascara on the eyelashes for long periods of time is another contributor to these types of bacterial infections. In this pilot study we tested the amount of bacteria in mascara after repeated use. Four people wore newly purchased Maybelline New York mascara and applied three swipes to their lashes, every day for four weeks. Growth of bacteria was tested once a week by culturing it in a sterile petri dish for two days. The bacterial colonies of each individual sample were counted and the averages were recorded. Evidence of bacterial growth was recorded on three of the four group member's control sample and each of the

group member's sample number one prior to use, indicating bacteria was present in the unopened mascara tube. Results of bacterial growth was recorded on each group member's test number two. However, further test samples yielded no bacterial growth. The results support our initial hypothesis that repeated use of mascara does in fact increase bacteria on a mascara wand.

### **Baby Food Resilience**

Heidi Seale BIO 111 Advisor: A Barun

The purpose of this experiment is to discover what factors directly influence the rate of food spoilage, in order to determine the most efficient way to preserve food for the longest shelf-life. Research showed that correct storage is crucial to food preservation. Bacteria thrives in moist environments, therefore storing food in an air tight container is crucial to avoid spoilage. The company Beech-Nut uses a unique technique for their baby food to preserve the color and maintain the highest quality possible: at the same time the puree is finished, the air is removed. Using baby foods of similar ingredients, samples were exposed to different conditions for organic/ nonorganic including refrigeration/ non refrigerated, covered/ uncovered, and saliva contact/ no saliva contact. We hypothesized that the baby food stored in the cupboard, exposed to air contact, exposed to saliva, and baby food that was nonorganic would increase mold growth and spoilage rate. The experiment resulted in no mold growth after refrigeration for both organic and nonorganic, while the uncovered nonorganic baby food had the most mold growth. The hypothesis was supported because covered, refrigerated, and organic baby food all showed the highest resilience to spoilage.

### **Using a Parallel Plate Capacitor to Affect the Path of Charged Particles in Space; Steps Towards a Solution to the Kessler Syndrome**

Rhiannon Larsen and Maggie Franchois Space Grant Advisor: B Sobhani and J Jones (ACC)

A small scale test will be conducted in a microgravity environment. The capacitor assembly will be attached to a plate installed in a sounding rocket. It will be exposed to space for a short period of time which will allow a microgravity environment exposure.

### **To Grow or Not to Grow: Plant It Mars**

Annie Strange, April Beal, Nick Pine, Kayla Andis Space Grant Advisor: B Sobhani

Research shows that plants that undergo more stress have different priorities in growth and produce different fruits than plants that do not undergo stress. These differences have been determined by observing plants growing in different environments. The harsher the environment the more the plant tends to focus on the production of its fruit than the reproduction of the plant overall. Yet this difference of harsh versus ideal environments has yet to be tested on the seed itself undergoing different exposure conditions. High altitude balloon launches can help researchers expose seeds to near space conditions, similar to conditions on Mars, including extremely low temperatures, high levels of UV irradiation and low pressure. The effects of exposure on each seed can be studied by observing the growth and germination process of seed types that don't need pollination.

### **Yeast at the Edge of Space: Exploring Viability in Eukaryotic Organisms**

Donny Herrera, Courtney McCreery, Christian Amundson Space Grant Advisors: B English, L Albert, B Sobhani

Both humans and yeast are eukaryotic organisms, and since eukaryotic cells do not survive extremely low temperatures or radiation, high altitude research provides opportunity to explore viability using fast growing yeast colonies to produce general hypothesis about eukaryotic organisms. A past

experiment provided anecdotal evidence indicating that yeast cells subjected to the harsh conditions of the stratosphere fermented sugar into alcohol at a faster rate than grounded control yeast cells. The intention of this experiment is to scientifically verify that two different species of yeast, *Saccharomyces cerevisiae* and *Saccharomyces pastorianus*, ferment at a more rapid rate when exposed to conditions in the stratosphere. This work could be followed by experiments designed to elucidate the specific environmental cause for an increase in fermentation rate.

### **Wednesday, April 25, 1 – 3pm**

#### **Soiled Asquacalli**

Jacob Romo, Caleb Schenck, Lacey Straup, Dan Boyle, Dosano Aletheuo BIO 112

Our ecology study focused on comparing the soil between the landscaped lawn on campus to the natural westward soil behind the sculpting building. We predicted the natural soil would have greater invertebrate population and diversity, while the landscaped lawn would have greater concentration of nutrients. We tested this by examining two samples from each plot for invertebrates, nitrogen, phosphorous, and potassium. We also looked at differences between the soil stratigraphy between the four samples. Our results indicated that our hypothesis was rejected based on the chemical analysis, and that the landscaped soil held greater diversity and population of micro-invertebrates.

#### **Total Internal Reflection**

David Reveles PHY 112 Advisor: S Chakraborty

The purpose for displaying total internal reflection is to demonstrate how a light ray could continue to travel a path by using the reflective surface of the water. The materials needed in order to do so are a laser pointer, and a clear glass bowl containing water. The reason for the bowl needing to contain water is so the audience can visibly see the path of the laser traveling. To predict the possible final location for the light ray; why and how a laser can reflect against the surface of the water must first be determined. Even though light travels in a straight path the density of water is greater than the density of air and so must also be its index of refraction. The reflected image is the critical angle of the light hitting the surface of the water and then bouncing off at or nearly at 100% light intensity. To find the critical angle use the inverse sine for the index of refraction of water divided by the index of refraction of air to achieved total internal reflection.

#### **Lasers In Neurosurgery**

Nastassja Michel, Nicole Davis PHY 112 Advisor: S Chakraborty

Lasers have played an extremely important role in the advancement of neurosurgery. Scientists experienced a major breakthrough by inventing the laser in the 1960s. The laser was first engineered by Theodore Maiman in 1960. He had constructed a Pulsed Ruby Laser which is still used in tattoo removal today. In 1964 the Nd:YAG was invented which used crystals. The carbon dioxide laser was invented the same year and is used for cutting in surgery today. Lasers differentiate from typical 'white light' by the select wavelength that it allows. This is why lasers have distinct colors, such as the red laser which allows 680 nm wavelength (the longest visible wavelength). Lasers have a lasing medium which works to excite an electron that will then emit a photon in order to return to a lower energy level. This starts a cascade of excited electrons to release a photon, resulting in many photons with constructive interference being released through a shutter. Since the waves are constructive and are released through a small hole, there is little divergence.

Lasers are used in neurology more and more today because of the improved laser technology in recent years. Neurology is the field of medicine concentrating on nerves and the nervous system. Lasers are primarily used in neurosurgery by treating cerebral lesions. The precision of lasers allows for less human error and faster healing. CO2 lasers in the past have not been very effective in neurology. This is due to

the fact that not enough energy was emitted by a CO2 laser to treat the surgical site. This was because the wavelength being emitted was too long. In more recent years, a CO2 laser has improved accuracy and power. Ultimately, laser surgery is less invasive and avoids any damage surrounding brain regions.

### **The Fermi Paradox**

Candy Gonzalez-Collazo AST 160 Advisor: J Curchin

I will be presenting my topic in a 3 sided poster board composition. Explaining what the Fermi Paradox is, and presenting several proposed solutions to it, under three main categories: They Exist But Have Not Communicated, They Are Already Here, and They Do Not Exist. I will also have a small section of statistics to inform the viewers on the current discoveries in astrobiology (exoplanet #'s, giant Earth's/candidates, and the scale of the universe). To further engage my viewers in the topic of life outside the solar system, I'll provide them with a chance to use the Drake equation, and will list the different data as the time passes. This will help show how the Drake equation is based on opinion, and how surprising the results may be when considering a pessimistic view on the opportunity for extraterrestrial life.

### **What's the Deal with Dark Energy/Matter?**

Hannah Eggers AST160 Advisor: J Curchin

### **The life of black holes**

Deane Long AST 160 Advisor: J Curchin

The life cycle of a black hole, what a black hole really is. How they form, how long they stick around/what are they doing during that time. What happens when they "die".

### **Evolution of the Model of the Universe**

Morgan Oertli AST 160 Advisor: J Curchin

### **How do stars turn on?**

Jason Cawthorne AST 160 Advisor: J Curchin

### **What is Plasma, and What Can it Do?**

Jackson Hahn AST 160 Advsor: J Curchin

Project based around explaining what plasma is, it's nature, what it's used for and can be used for.

### **Retail/Approach project; with and without Store Product**

Joanna, Kayla, Diana BIO 111 Advisor: T Gray

The purpose of our project is to determine if wearing a stores product contributes to the amount of time it takes for an employee to approach a customer. Our variables include Product vs. No Product (independent) and Time (Dependent). Our control variables are the times of day that we conduct the experiment at 12pm-2pm, the female subjects used to collect data with ages ranging from 18-21, and casual clothing for the no product. Our method for collecting our data is to have each of our group members/subjects perform two separate trials; Trial One consists of each subject walking into a Victoria's Secret and PINK while wearing product from these establishments with logos that are clearly noticeable to employees. Our store locations are from the Cherry Creek Mall and 16th Street Mall. Trial Two will be almost identical to Trial One but without wearing any product and simply casual. Each subject is equipped

with a stopwatch and starts the stopwatch the second they enter the store. Subjects are to have a steady pace and appear to be interested in the items in the store. Once an employee has greeted the subject, they are to stop the stopwatch and record the time it took from entry to greeting.

### **E-coli, Salmonella, & Staph: The Hidden Roommates**

Alyssa E Barnhill, Haley Thomas BIO 111 Advisor: T Gray

In the hospital setting, there are standards to changing dressings after each patient, disposing of cleaning supplies, and tools after a certain number of patients. Precautions such as these keep the hospital environments relatively clean. In the home, we use sponges to do most of the cleaning on our household dishes. If a kitchen sponge is encountering food waste and warm water, we could assume the sponge would grow mold and bacteria. When is it safe to say a sponge has reached its lifespan? When the edges are worn and falling apart? When it begins to smell? How many days does it take to grow bacteria on a kitchen sponge with normal or average cleaning habits? After testing sponges at two homes that used relatively normal cleaning practices we found that bacteria begin to grow between three to five days, depending on the cleaning habits of the home. The samples were identified with a gram stain test and observation. The samples were taken on agar petri dishes at three, five, seven, and ten days. After this experiment, we do not believe that common kitchen sponges should be kept longer than a five days. Because we are not experts in the field, most of our findings are speculation and were found by comparing our results to pictures and diagrams of common household bacteria and viruses.

### **Replicating Constantine Slobodchikoff's Work in Decoding Prairie Dog Language**

Goran Shikak, James Tapia, Christopher Mulligan BIO 220 S Kaye

The purpose of the experiment we conducted was to determine if C.N. Slobodchikoff's work on deciphering Gunnison Prairie Dogs (*Cynomys gunnisoni*) could be replicated in other species of prairie dogs. This concept was briefly overviewed in their teams own research, but not as thorough as with the Gunnison prairie dogs. The species of choice for this study would be the Black-Tailed prairie dogs (*Cynomys ludovicianus*) since they are heavily distributed through Colorado and also in extremely close proximity to the Red Rocks Community College Lakewood campus. What we focused on testing was whether or not the prairie dogs in the town would use different alerts where information was being transmitted to different members of the colony. Recordings were taken when we stimulated a response from the colony and when other species that we observed organically elicited a response. Theoretically, if different variables were introduced while others were held constant, different information would be communicated to the surrounding populace. By analyzing recorded sonograms, with each representing the different variables and species, this helped to showcase just how intricate and specific the language of prairie dogs, specifically *Cynomys ludovicianus*, when paired with specific behavioural responses. The sonograms and the statistics showed that there were variations in the different vocalized responses. When deconstructing the responses into statistical data, while being close estimations, what was shown is that there are variations pertaining to each variable we chose to observe.

### **The Encouragemints**

BIO 112 Advisor: S Kaye

Our project began on the thought of bringing medicine to rural places. Plants have been used for centuries to cure common ailments from a stomach ache to sunburns. Today, that is still very much the case and with the advent of biochemistry plants are essential to create many of our pharmaceutical products. However many of these plants require a lot of water and nutrients and in many areas those are difficult to come by. Aquaponics would be a solution to that since it uses less water and with the fish, it has a constant source of Nitrogen, phosphorus, and potassium. Therefore, the plants will grow vigorously,

providing cures for everyday ailments. In our project we took calendula, lemon balm, and mint and placed them in the aquaponics system. We choose these plants because we have used them before to cure our everyday problems and personally experienced benefits from them.

### **Magnetic Induction**

Douglas Kerber, Ramon Sasse, Devin Birocci PHY 112 Advisor: S Chakraborty

We will be building a setup of circuitry using multiple solenoids, a power source, and a variety of lightbulbs. We will then use a bar magnet to induct current in the solenoid that will be carried to the lightbulbs and effect the output light intensity of the lightbulbs. We will have a demonstration set up of the circuitry accompanied with the presentation poster detailing the history of faraday's law and how the motion of the magnetic field causes a change in current. The change in current when using this setup is proved using a combination of ohm's law and faraday's law. This equation is a combination of Faraday's law which is used to determine the induced emf and then ohms law which is used to combine the induced emf and total resistance to determine the induced current from the motion of the magnet. (We would like to be able to set up within 20 feet of a power outlet due to our need for a power source)

### **Water you Thinking?**

Elisabeth Sheffer, Mikayla Agüero and Sharon Johnson BIO 111 Advisor: Johnson

We are testing the potential effects that pH has on the taste of water. Because ions send electrical currents to the brain which are interpreted as taste, and pH is a result of ion transfer, we have concluded that pH effects the taste of water. Our hypothesis states: If the water has lower levels of pH then it will taste sweeter, while the water with higher pH levels will be more bitter. The water samples we collected were from four different areas: Arvada, Aurora, Lakewood and Conifer, with a control group of Aquafina bottled water. We measured the pH of each water and then had 12 subjects sip the water to determine what the water tasted like. The results showed that Aquafina actually was not the sweetest coming in below both Conifer and Lakewood. Lakewood had the highest pH of 7.8 and Aquafina had the lowest with pH of 6.1, but the Lakewood water, rated 6.29 of 10, was sweeter than the Aquafina water, rated 6.08 of 10. We also had the subjects rank the water on what was liked best and both waters were ranked second.

### **Re-animating Microbes from 4-year-old Mars Analog Cryptobiotic Crust Samples Collected in Death Valley**

Laura Spedale BIO 204 Advisor: L Albert

The ability to bring samples from Mars to Earth could be an important step in establishing physiological characteristics of potential microbes from Mars. We could understand what grows on Mars a little better with this knowledge. RRCC collected cryptobiotic crust samples from the desert several years ago. These samples were dried and stored in amber vials in a cool dry location mimicking the long transport time samples would endure between Mars and Earth. In February 2018 I took a portion of the cryptobiotic crust and placed it on Nutrient Agar plates. The plates were placed in different conditions, such as sunlight, or lack of sunlight to see if different species of bacteria from the crust will grow. Surprisingly several different bacterial and fungal strains immediately began forming colonies. Some of the strains that I hope to identify are cyanobacteria, spore formers, actinomyces, and other various bacteria and possibly fungi. I will gram stain and use biochemical tests in attempts to identify the microbes growing from the samples. In the future, I would like to identify additional bacterial species using 16S genetic sequencing techniques. As the samples were successfully re-animated I think it is realistic to conclude that if life exists on Mars, samples may be transported to Earth for further biochemical and genetic testing. This could open the door to finding other life forms on other planets, possibly similar life, or at least different kinds of life to compare other organisms to.

## **Observing Effects on Pseudomonas stutzeri After Exposure to Stratosphere**

Kenya Gates, Nathan Haefele, Sarah Kidder Space Grant Advisors: L Albert and B Sobhani

As countries worldwide set their sights on Mars colonization, it has become increasingly important to determine the viability of Martian soil for agricultural purposes. At Red Rocks Community College, space grant students are developing an analogue soil in hope to supply a cheap and reliable simulant for future studies. A component of that study is to investigate the procedures and methods of inoculating Martian soil with microbes to aid in agricultural optimization. Research has shown how important these tiny life forms are to the enrichment and sustainability of Terrestrial soil, but little is known about the effects that Mars' toxic elemental composition might have on these microscopic organisms.

*Pseudomonas stutzeri* is a denitrifying bacterium with properties that allow it to degrade pollutants and metals into nutrients, meaning it might be a highly effective solution to the issue of soil toxicity. However, it is possible that this microbe cannot grow in the extreme atmospheric conditions on Mars. To address this issue, samples of a specific strain of *P. stutzeri* were spun down and sent up to the stratosphere on a Demosat payload. Then we measured the optical density of the samples with a spectrometer to quantify a growth rate of *Sijderius* in specific, which is a low-cost, non-infectious strain of *P. stutzeri*. It was found that optical density increased in all the samples. This tells us that cells were dividing and the colonies survived the flight. One of the more complex issues regarding RRCC's Martian analogue soil will be detoxification and enrichment, so determining the effectiveness of soil microorganisms is essential. As our research on the viability of certain bacteria progresses, we hope to apply our findings from this project to future research involving the colonization of Mars.

## **DIY: Martian Soil for Life Sustaining Experiments on the Red Planet**

James Cook, Khalid Al-Kalifia, Christian Amundson, Nathan Clapp, Bri Treffner, Sarah Kidder, Kenya Gates, Ian McComas Space Grant Advisors: B Sobhani, B English

The Red Rocks Community College (RRCC) Martian Soil Team is a group of students dedicated to replicating, to the best of our abilities, martian soil in order to continue conducting our own experiments for finding complications and sustainability for life on Mars. Previously, we had obtained soil from Orbitech, a company that has since gone out of business. We started utilizing soil from other companies but it became expensive. So, we decided to try and make our own cheaper and efficient recreation of our own soil for furthering our projects. We have gathered our own samples of basalt rocks from various locations on the Western Hemisphere. These samples are composed of many of the same minerals that make up the Martian landscape. We are getting pieces of our sample rocks tested to determine exactly what minerals these rocks are made of so we can create the best sample for our soil. The tests we will be able to do with this soil will be numerous. From Martian gardens to water filtration and microbial habitats, the possibilities are endless! With our mineral samples, we hope to compose an accurate analog of Martian soil to conduct these tests and compile data for potential martian colonization.

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## **Thursday, April 26, 10am – 12pm**

### **Invasive Species Removal and Ecosystem Health: Moving Towards Campus Transformation**

Barbra Sobhani, Cole Delery, Nicole Dickinson, Donny Herrera, Manisha Jaiswal, Rhiannon Larsen, Chad Matthews, Christian Prather HNR 102

Our Stewardship action project will be an assessment and mapping of invasive species on the campus grounds as a first step. The students participated in an introductory project with our partners, the Sierra Club and Jefferson Conservation District, to learn about invasive species and proper removal techniques.

We visited two sites that have projects in different stages of development. The students are now planning the campus survey and assessment. They will decide which species to focus on for potential removal. They will also learn about native plants and water-wise landscaping through the Denver Botanic Gardens and the Sierra Club Water Quality Committee and Organic gardening group. One class will be focusing on choosing a site for a teaching garden and planning the landscaping and native plants. The other class will be conducting the campus assessment and determining a plan for invasive species removal. The second stage of the project will include implementing the invasive species removal and the planting of the teaching garden. The third stage will be to expand the areas of invasive removal and restoration of the native pollinator species.

### **Testing Ancient Medicine**

Lindsay Hoard BIO 111 Advisor: A Barun

My experiment was intended to test whether or not ancient medicine is effective in prohibiting bacterial growth. I hypothesized that, yes, ancient medicine could prohibit or kill bacteria. To conduct the experiment, I found an ancient Egyptian medical recipe from the Ebers papyrus, which was said to help with “diseases of the mouth.” The recipe needed goose grease, honey, incense, caraway seeds, dirt with lead, and water. I swabbed the inside of my mouth and rubbed the swab onto nine petri dishes. Three dishes had the medicinal mixture, three had Lysol disinfectant (to compare the effectiveness of ancient medicine), and three had nothing except the swab rubbing (the control). I measured the growth of bacteria for ten days, and found that my hypothesis was incorrect—ancient medicine actually increased bacterial growth, more so than the Lysol disinfectant and the control group.

### **Ballistic Parachute For Drones**

Joe Kelly, Derrick Hayward, Holden Pierce, and Matt Alcon EGG 151 Advisor: S Spivey

RC drones is a new common hobby amongst many people that takes hours of practice and the consequences of inevitable crashing is very costly. As we are still at a beginner level in the hobby and don't have much disposable income, we wanted to create a parachute for medium sized drones that will deploy on command from the same transmitter used to fly the drone. Our approach was to research, do calculations, design and then build a spring loaded parachute. The drone that was used was weighed (633.8g/1.4lbs) and we determined the size of parachutes needed to support at the decent rate of 15-20 feet per second. We cut out two 24" inch parachutes out of nylon material. Strings were then glued to each point of the octagonal shaped chutes (8 strings for each chute). A 3D box was designed and printed to hold the packed chutes and strings along with room for springs that will eject the packed chutes. A lid and latch was also printed, which was the mechanism the servo arm moved to deploy the chutes from the spring loaded box. We bound the servo to the transmitter and attached it to the box and latch. The box design was then attached to the bottom of the drone. During the build process, the servo released the parachutes everytime without jam or snagging. The final design was thick, sturdy, had constant deploy results and could be used over and over again. Overall the design was successful in that it met our general requirements; spring loaded, deployed on command and supported weight of falling drone. However, the design did not meet our specific desired results because the build was extremely heavy, bulky and descended much faster than wanted. The whole build was much bigger and heavier than other drone parachutes on the market. It was easy to tell the drone was carrying a load and the maneuverability was decreased. With the foundation of our working design, many improvements can be made to reach better, more desired results.

### **The Retractable Staircase: Stairs of the Future**

Andrew Bazel, Joe Anselmi, Derek Anderson, Jesus Ortiz EGG 151 Advisor: S Spivey

Stairs play a significant role in our daily lives, providing a means to get between the levels of the buildings that we both live and work in. Yet due to the fact that they are unmoving and consume more space than is absolutely necessary, we decided to attempt to address this problem by building an affordable, and aesthetically pleasing design that would fold away into the walls when not in use and free up the floor

space it previously occupied. We discussed many different designs, some which slid into each other, some which folded in extravagant ways. We decided on a simple design that would be integrated into a standard wall of a building with a unique vertical tracking system for guidance and stability. The track is two vertical lengths of 2x4 built into the wall to support the stairs. The stairs have a tread width of 33in and a length of 10in. They are spaced 7in high and pivot on a front axis formed by a 3/4in steel rod. These stairs we designed to hold a max weight of 450lbs and are built on two stringers made of wooden 2x10. While we only have a rough prototype outlining our idea, but with future development our creation will be the building block for a safer, more space-effective generation of stair.

### **Aquaponics**

Leila, Alec, Dayne, Brad BIO 112 Advisor: S Kaye

Aquaponics is a food production system which aims to create a closed loop and limit both nutrient and water loss. It has been put forth as a possible solution for growing nutritional demands worldwide. There are a number of different aquaponics systems which employ diverse strategies and it has yet to be determined which system may prove to be the most effective. This study focused on comparing the growth of four different nightshade species (tomatoes, tomatillos, eggplant and peppers) between two growth platforms; floating rafts and lava rock beds. Complications in both germination and water availability lead to plant mortality, specifically within the lava rock beds, which made it difficult to compare the two platforms. However, the limited data gathered suggests that floating rafts are more suitable for aquaponics systems than lava rock beds. The floating beds address the problem of fluctuating water levels in a very basic, but effective manner. When water levels raise and lower, the floating beds move in accordance with them, which results in the plants always having access to water and nutrients. Lava rock beds prove more difficult, because as water levels raise and lower, the rocks and the plants within them, remain stationary which can leave the plants flooded or high and dry.

### **Water you Thinking?**

Elisabeth Sheffer, Mikayla Agüero and Sharon Johnson BIO 111 Advisor Johnson

We are testing the potential effects that pH has on the taste of water. Because ions send electrical currents to the brain which are interpreted as taste, and pH is a result of ion transfer, we have concluded that pH affects the taste of water. Our hypothesis states: If the water has lower levels of pH then it will taste sweeter, while the water with higher pH levels will be more bitter. The water samples we collected were from four different areas: Arvada, Aurora, Lakewood and Conifer, with a control group of Aquafina bottled water. We measured the pH of each water and then had 12 subjects sip the water to determine what the water tasted like. The results showed that Aquafina actually was not the sweetest coming in below both Conifer and Lakewood. Lakewood had the highest pH of 7.8 and Aquafina had the lowest with pH of 6.1, but the Lakewood water, rated 6.29 of 10, was sweeter than the Aquafina water, rated 6.08 of 10. We also had the subjects rank the water on what was liked best and both waters were ranked second.

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## **Thursday, April 26, 1 – 3pm**

### **Students Embrace an Alternative Approach to Non-Profit Work in Everest Region of Nepal**

Connor Weddle, Madison Anderson, Alexandria Smith CSM Advisor: R Osgood

Non-profit organizations typically implement a top-down approach, in which those with the means to supply help begin an organization and then find someone in need of aid. Hike for Help, a non-profit organization founded by a Nepalese Sherpa that focuses community development projects in the Khumbu Valley (Everest Region) of Nepal, functions differently. Local people propose self-sustaining

projects, like public restrooms, to Hike for Help. In turn, Hike for Help in Golden, CO raises funds and helps in conceptualizing the project. Ultimately, the funds and plans are turned over to the local people, who are then responsible for the implementation and maintenance of projects.

The initial success of Hike for Help's non-traditional approach has strengthened its partnership with locals leaders and led to new partnerships with government officials in the Solukhumbu District of Nepal. Students from the Colorado School of Mines have become an integral part of Hike for Help's vision and operation. McBride Honors students have been closely involved in preparing for, designing, and helping to implement projects' aimed at "self-enabling help" for the people in Nepal. However, progress has not come without challenges.

Because Hike for Help operates in close concert with the local people, the students must adapt to the locals' culture, skills, and resources in order to help project implementation. In our poster presentation, we will share and reflect on this process, as well as discuss the role that Mines' McBride Honors students play on campus and in the local communities of Golden, CO and the Khumbu Valley to support and implement Hike for Help's projects.

### **pH of Common Drinking Water**

Ryan Velasquez, Josh Nelson BIO 111 Advisor: T Gray

Safe drinking water is the most important part of our day to day lives, so we wanted to test the pH of common sources of drinking water to test if they were in a safe range. The World Health Organization claims a permissible pH level is between 7.0-8.5 while excessive is less than 6.5 and greater than 9.2. We wanted to find the water source that was closest to 7.5. We used a Orion Star A111 pH meter to test the pH of the different water sources and we used Universal Indicator Solution (pH 4-11) to visually show the difference in water pH between the test samples. We found that there was a pH range of 5.52-8.17 between all test samples. This shows that there is no sample that is excessively basic, but there are several samples that are excessively acidic. Some water bottles advertise a specific pH level, we recommend reading labels and doing research on water pH to ensure the water is in the permissible pH range.

### **Examining the Ecological Impact of New Construction at Red Rocks Community College**

Kim Pineda, Kenya Gates, Andrew Allmong, Lilian Sosa BIO 112 Advisor: E Santa-Martinez

As the human population in Colorado increases, it becomes more and more important to assess the impact of new construction in our ecosystems. After the completion of the student recreation center at Red Rocks Community College in 2017, our team was interested in investigating the differences in soil properties, flora species richness, and relative abundance between the disrupted and uninterrupted areas on campus. To determine the impact of new construction, we compared the west side of the campus, where construction has not taken place, with the east side of campus, where the new student recreation center resides. We collected samples at random locations within these parameters using 1' by 1' quadrats, documented the amount of flora present in each quadrat, and documented the amount of species of flora per quadrat. Additionally, we collected a 12"X1" soil core sample for each location to determine the soil quality. The data collected shows that the west side of campus had lower compaction in the soil, large overall plants, and signs of late ecological succession. The east side of campus showed higher compaction in the soil, smaller overall plants, and signs of early ecological succession. The collected data supports the hypothesis that construction of the new RRCC student center has disturbed the environment, and degraded the soil quality and the abundance of plant species. Information that may help further this research would be to obtain larger samples sizes, and run mineral testing on soil samples.

## **Prairie Dog Populations Across the RRCC Campus**

Mikayla Katus BIO 112 Advisor: E Santa-Martinez

Our research is the study on the population size of the prairie dogs on both the east and the west side of the Red Rock Community Campus. We believed that the construction that has been done on the east side recently may have reduced the prairie dog population on that side. But we were wrong, the colony of prairie dogs that were on the east side of campus but they were nowhere near the construction so they have not been affected by the changes on campus. In Fact the population was bigger on the east side then on the west side. To determine this, we observed the prairie dogs on each side for three separate days for fifteen minutes each and counted the number of individuals we saw. We observed more on the east side than on the west side. We believed that the construction would cause the east side to be smaller, but because of the distance from the construction, the colony was unaffected and we determined that the east side has a larger colony due to the fact that it is located in an area less trafficked by humans.

## **The Effect of pH Levels of Lotions on Skin Condition**

Taylor, Sinchal, Erika, Samantha BIO 111 Advisor: A Barun

We tested the effect of pH value of lotions on the health and integrity of skin. Due to prior research and results of previous related experiments, we hypothesized that the more acidic a lotion was, the more effective it would be in maintaining the health and integrity of the skin. In this experiment, we tested four different lotions at four different pH values between 5.0 and 7.0. Before beginning the experiment, each lotion was diluted with distilled water and the pH of the solution was tested. Once the pH values were determined, three people out of the group used each lotion for a week while the fourth person used no lotion to act as a control group. After all the lotions had been tested for a week each, we rated each lotion on a scale from one to ten. The results we gathered based on the ratings led us to the conclusion that our hypothesis was correct, the more acidic lotions seemed to work the best.

## **Design, Construction, and Installation of a Radio Telescope for Student Use**

Alexander Langfield, Christian Amundson, Ian McComas, Justin Nichols, Liam James, David Palcsac, Kamron Correia

About 15 years ago, a large radio dish was installed on the campus grounds of Red Rocks Community College(RRCC), however, it has simply remained unused. Our team has decided to utilize the dish to construct a functioning radio telescope for the purpose of providing an opportunity for inexperienced students to have open access to radio astronomy. The telescope that we are designing will be an Software Defined Radio(SDR) system, reducing cost and increasing ease of access to the manipulation of data collected by the telescope. The telescope will be set to observe the hydrogen radio spectrum (at 1.42GHz). Once the telescope is sufficiently operable, we hope to calibrate and test its accuracy by measuring the Sun and comparing our observed data with published data, confirming that our design is functional. We hope that having access to a local radio observatory will encourage future students to utilize the telescope for their own further research.

# STEM ART EXPO: Using Art to Communicate Science

The STEM EXPO is a showcase of student research and projects, the Art category displays photography or art pieces that address the theme of climate change, ecosystem health or sustainability. The focus is on utilizing art to communicate science. Each piece is accompanied by an artist's statement.

## **Artist: Kenya Gates**

We live in an age of mass extinction. By the most conservative estimates, the rate at which species are dying off is 114 times more rapid than historical averages, and regardless of whether or not one believes in climate change, humans are playing a huge role. In addition to increasing global temperatures, our contribution to the pollution of bodies of water and our encroachment upon natural habitats have resulted in the extensive and critical endangerment of Earth's species.

Coloradans have the impacts of climate change firsthand. During the peak of the beetle kill outbreak that occurred in the last three decades, entire mountainsides were reddened with dead and dying trees. In total, the bark beetle outbreak caused the death of over 830 million trees, an event that was mainly caused by increasing winter temperatures that allowed beetle populations to skyrocket.

"Survivors" explores a different side of the story of a forest: how they come to be, how they stay healthy, and what happens when they disappear. The focal point, however, is not the trees, but the lichens: These unassuming organisms play a critical role in the forest ecosystem at all stages, from the creation of the very soil in which trees grow to the decomposition and recycling of exanimate organic material. The word 'survivor' is used in the context of inheritance, in which the resources of one organism are passed down to the next after it dies. This project was undertaken to draw attention to the extraordinary process of ecological succession, and to draw attention to the life forms that make it possible.

I'd like to demonstrate that there is more to a forest than its trees, and the cyclical nature of life promises that even after destruction and decay, it will persist.

## **Artist: Rhiannon Larsen**

I would like to submit a tribute piece to the pristine beauty of San Isabel National Forest Land of Colorado, where much of my coming of age processes took place. The majesty encapsulated here invokes both awe, smitten inspiration and transcendental terror, which in turn build character and develop integrity. This drawing depicts the striking view of Mt Princeton across the Arkansas valley from a solitary campsite perched high on Ruby Mountain. From epic visions of the collegiate peaks to Mt Elbert and Mt Massive looming above Leadville, pink in the morning and dark at dusk, the Colorado Mountains have been the backdrop to many life lessons. I have learned so much about myself in the company of these giants. This contemplation led me to view nature with the wondering eyes of a scientist. The inspirational quality of natural wonders is not to be discounted. It is in these places of wild beauty that we receive revelations and insights essential to human progress and innovation. We as humans climb these giants to conquer our fears, achieve clarity, and experience the glorious hand of Nature in all of its logical order. Through observation of nature, humans find keys to understanding everything from tech to society to politics to psychology to environmental connectivity, to spirit to .....ultimately.....solutions to the world's problems. Conservation is more than just a nature lovers battle.

From the resounding words of Henry David Thoreau:

“I went to the woods because I wished to live deliberately, to front only the essential facts of life, and see if I could not learn what it had to teach, and not, when I came to die, discover that I had not lived.”

**Artist: Danae Fidler**

Her countless love for animals has always been Danae's biggest inspiration and drive. Observing and drawing animals from life builds upon her understanding of how to bring life into the subjects of her artwork. She strives to celebrate the daily lives of animals in their natural environment by creating her own rendition of the wildlife that inspires her. In doing so, she hopes to bring awareness and educate the public of these animals through visually telling their stories. She hopes to use her work to bring more awareness of the conservation of wildlife and their environments to people's minds.

Unfortunately in today's world, there is much wildlife that struggles to survive. Since Danae hopes to educate the public about wildlife conservation and help conserve species for years to come through her artwork, she usually picks subjects that are rarely known or are threatened to disappear in the future. Bringing life to her subjects is done through studying and observing their behaviors and anatomy from life, either in the wild or at a zoo. The cassowary, greater one horned rhino, and the okapi are a few of many endangered subjects she studies. Pen and ink chosen to hopefully bring more permanence to them and show their life.

Sister's Play is an acrylic painting brought about telling the story of the African Wild Dog. Like typical canines, they highly sociable and family oriented. Play fighting with one another helps in family bonding, honing in survival skills, and determining pack hierarchy. African Wild Dog packs are extremely large, ranging from 10 member to up to 40. Unfortunately though, they are also one of the rarest sights in Africa, which is why only two are shown in this painting. They are considered one of the most endangered carnivores in all of Africa with a population of only 6,600 due to habitat loss, poaching, human conflict, and disease. This painting's purpose is to celebrate the African Wild Dog's playfulness and daily sociable behavior, but also bring awareness that these large packs are declining in numbers as well.

**Sister's Play**

*African Wild Dogs*

Acrylic on Canvas

**Zoo Life Studies**

*Okapi and Greater One Horned Rhino*

Pen and Ink

**Zoo Life Studies**

*Cassowary*

Pen and Ink

**Artist: Barbra Sobhani**

Something that weighs heavily on my mind is stewardship of the planet. Humans are having an incredible impact on the health and well-being of all ecosystems. Humans are rapidly pushing the climate to extremes. Climate change is happening now and we can see the impacts all around us. As a scientist, I have a drive to understand the interconnections and intricacies of ecosystems. How does one action affect other parts of the system? How does each individual contribute to the larger system?

I chose these works to highlight the interplay of the beauty of species in their natural and not natural habitats. Changes to ecosystems drive adaptation. Where is all of this change leading?

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

**Faculty Advisors:**

John Curchin, Astronomy

Lynne Albert, Biology and Space Grant

Tracy Gray, Biology

Steve Kaye, Biology

Arijana Barun, Biology

Emmanuel Santa-Martinez, Biology

Brandon English, Chemistry and Space Grant

Chelsea Campbell, Environmental Science

Saonti Chakraborty, Physics

Dave Long, Physics

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