

STEM EXPO

RRCC Student Research Symposium

Poster session presentations:

Wednesday, November 28th

10am-12pm, 12pm—2pm

Thursday, November 29th

10am-12pm, 12pm—2pm

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

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

Fall 2018 Program



HONORS PROGRAM
Red Rocks Community College



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

Faculty Advisors:

Tracy Gray, Biology

Steve Kaye, Biology

Emmanuel Santa-Martinez, Biology

Dave Long, Physics

Carlos Medina, Physics

Shane Spivey, Physics

Barbra Sobhani, Honors and Space Grant

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



RRCC STEM EXPO

Fall 2018 Program

Talk Schedule Student Research Presentations

Wednesday, November 28	Gray's Peak		Torrey's Peak	
	8:00 am	<i>Mechanical Systems</i> (PHY 211 – Spivey)		
11:15 am	<i>Mechanical Systems</i> (PHY 211 – Spivey)			
		12:45 pm	<i>Electricity and Magnetism</i> (PHY 212 – Medina-Hernandez)	
5:45 pm	<i>Electricity and Magnetism</i> (PHY 212 – Medina-Hernandez)			
Thursday, November 29	Gray's Peak		Torrey's Peak	
	8:00 am	<i>Electricity and Magnetism</i> (PHY 212 – Spivey)		
	11:15 pm	<i>Mechanical Systems</i> (PHY 211 – Medina-Hernandes)	12:00 pm	<i>Speaker Series – Saving the Pika</i>
			3:00 pm	<i>Speaker Series – Rocksat-X</i>
5:45 pm	<i>Mechanical Systems</i> (PHY 211 – Long)			

Talks: Wednesday November 28 8:00am PHY 211 – Spivey

The A+ Launcher

Logan Bedford, James Cook, Ryker Fish, Atticus Pond

In this project, we analyzed the law of conservation of energy using a pressure-based projectile launcher. The purpose of our testing was to compare a model for projectile motion with our test data in order to see that energy is conserved and to understand the shortcomings of our model. We did this by using a slow-motion camera to determine the muzzle velocity of the launcher, and we used that number to predict how far a projectile should travel. Subsequently, we launched projectiles at various angles to determine the distance they traveled in the real world. Then, we compared the distance the projectile traveled to our calculated predictions. We found that our predictions were within a reasonable margin of error which we attribute to factors such as wind and variable projectile mass. Because our results fell within that reasonable margin of error, we concluded that energy was conserved within the system nearly in accordance with our predictive model. Had we continued experimentation, we would standardize the projectiles in order to achieve results that would be more useful in the desired context.

Exploring Kinematics Through Pressure and Projectile Motion

Katie Ammon, Kayla Andis, Josh Brody, Lydia Smith

For our project, we built a projectile launcher to study how various pressures affected the initial velocities and the distances traveled by a small ball. We mounted a syringe onto a wooden base and secured it with 3D printed supports. Pressure was inputted into the lower end of the syringe by a bicycle pump. The projectile was held in place against an airtight seal with the use of a pin system until the syringe reached our desired pressure. The pin would then be released. We built a ballistic pendulum to calculate the initial velocity of the projectile as it left the syringe with the use of elastic momentum. Once we found the equation for the initial velocity using the concepts of conservation of energy and elastic collisions, we were then able to determine the distances that the projectile would travel when acted upon by differing amounts of pressure through the use of kinematics.

Projectile Motion Analysis

David Granquist, Tristan Medina, Anas Al Qaysi, Sam Yakimow

Projectile motion is a form of motion that experienced by an object that is thrown or launched near the earth's surface that moves in a parabolic motion with only gravity acting on it. With that said, certain variables can be calculated with equations designed for projectile motion. So for this experiment, we decided to test the theoretical values obtained from these equations and compare it to experimental values. To test this, we designed a device that launches projectiles with the use of different bungee cords. The way this launcher works is the bungee cords are attached to a wooden plank and stretched with the projectile resting on the wood inside. The bungee cords are then released; launching the projectile forward. After the projectile is launched, we measure the distance and the time it takes for the projectile to land. We will then use these measurements to calculate other variables and then compare them to theoretical calculations.

Spring Powered Car

Manisha Jaiswal, Abdulrahman Al Aqil, Tyler Rummelhart

This project involves a mechanically charged car powered by springs. The potential energy stored in the springs will allow the car to move by the transformation of energy. Friction was neglected in all calculations.

Wednesday November 28 11:15am PHY 211 – Spivey

Spring Loaded

Elias Melendez, Jordan Al-Hamdani, Jason Johns. Steven Hu

The project consisted of testing different components (length, diameter, wire gauge, and spring constant) of a spring to determine which would launch a marble the farthest. This was done by building a spring-loaded device made up of PVC piping, a metal rod to hold the spring in place, and metal washers. The marble was launched by each spring three times at three different angles (nine times total for each spring). We analyzed all six of our springs before testing them to find their length, diameter, wire gauge, and spring constant. We thought the greater the wire gauge, the greater the spring constant. This observation we made about the springs did not have a great impact on how far the marble traveled. We observed from our testing that the length of the spring had the greatest effect on the distance the marble traveled. With the data we collected, we were able to determine what component of a spring allowed a marble to travel the farthest.

Spring Cannon

Colton Martin, Nathaniel McKernan, Jher Qin Yeap

For our project, we studied the physics that affect how far a projectile travels. We did this by altering the variables of a spring cannon so that we could get a projectile to fly the maximum distance it possibly could given the materials he had on hand. What we did is we recorded the distances the wooden ball traveled after using different springs, varying the spring displacements, and after changing our angles. We found that if a large, tightly wound spring with a displacement of seven centimeters is used to fire the projectile with the cannon at an angle of 30 degrees, the projectile would travel the greatest distance. The other springs we tried, a small, tightly wound spring and a big, loosely wound spring, did not propel the ball as far as the other spring. Also, we found that angling the cannon at an angle of 30 degrees to the horizontal produced the best results when compared to the other angles we tried. We also we found that for every spring, pulling the spring back to its greatest possible displacement propelled the ball the furthest. Therefore, it is best, when designing spring cannons, to pull a spring that is both big and tightly wound as far back as possible before firing the projectile at an angle somewhere around 30 degrees. These recommendations come from our understanding of motion in two dimensions that we obtained through this experiment.

Washtub Bass

Rhiannon R Larsen, Isabella Montoya, Levi Reveles

The possibilities of creating harmonic waves from everyday objects are boundless, and for this project we decided to test the physics of sound manipulation using a metal washtub bass. The materials required to assemble and test a functioning bass are a washtub basin, broomstick, slightly elastic cable, spring, eye screw, and properly placed nuts and bolts for support. The only changing variable in testing was the difference of cable material being used. The different materials used were airline cable and weedwacker line. Once the construction process of the bass was complete the design was improved on further by attaching a carefully crafted piezo pickup to the custom bridge on the bottom of the bass which allowed for connection to a bass amplifier. Multiple data components for each cable were tested such as pitch/frequency, wavelength, change of spring position, angle of change, tension, and the pull force required. Physics equations were used to compare theoretical pitch values with experimental pitch values on each cable. The airline cable did not stretch with tension, but the weedwacker line did. In the results, this is shown as a relatively small accuracy gap between theoretical and experimental pitches in the airline cable, and a larger accuracy gap between theoretical and experimental pitches in the weedwacker line. However, both cables produced theoretical frequency predictions that correlated strongly with experimental frequency readings.

Hovercrafters

Justin Deberry, Keegan Dillon, Austin Reynolds

The purpose of this project was to analyze the effectiveness of a small hovercraft made to carry a person. First, we researched hovercraft design principles and what makes them work. We chose a starting design, then refined it and finalized it to fit our constraints. Then, we tested it in the field both to see that it did work and to collect data on the ability of the craft to reduce its coefficient of friction with the ground. After that, we used physics formulas to derive values for the coefficient of friction and analyzed our hovercraft's ability from that. We concluded that our hovercraft was quite effective in lowering the coefficient of friction, allowing us to drag almost 200 lbs with little effort.

LEGO Mechanical Cars

Jared Steffen/Daniel McGuire/Connor Williams/Karl Eggers

The purpose of this lab/lab report was to design, construct, and test various designs of LEGO cars that are powered mechanically. The cars used were powered by a rubber band, a spring, gravity, and a mousetrap. The rubber band, mousetrap, and spring car are all powered by spring potential energy and the gravity car is powered by gravitational potential energy. The testing revealed that the cars were able to hold much more potential energy than originally thought.

Wednesday November 28 12:45pm PHY 212 – Medina

Produce Power

Luke Meyer, Dan German, Tiffanie Page

The team will perform this by creating a power circuit using copper wire, which will act as the cathode, galvanized, zinc coated nails, to act as the anode, LEDs as resistors and three different fruits, a lemon, papaya and potato, as a power supply. These fruits are dependant on availability.

Gauss Rifle

Colin Munch, Don Chu, Dominic Vance

A Gauss rifle, also known as a magnetic linear accelerator, will demonstrate the effects of magnetic fields. Also, the rifle will show how magnets can be used to show conservation of momentum and to derive acceleration from velocity. To build this project, several materials are needed. These materials include a track, made from two dowels or a yardstick, four neodymium magnets, and ten nickel-plated steel balls, and a tape measure. A bucket of sand or a sheet of newspaper can be used for better accuracy in determining distance.

Conservation of energy with a Gauss Gun

Alexis Torres, Matt Klein, Michael McGrath

Thursday November 29 8:00am PHY 212 – Spivey

Coil Gun

Josh Nelson, Ryan Velasquez, Abdulla Ermila, Jaden Adams

An electric current creates a magnetic field around the wire that the current runs through. If this wire is wrapped in a loop, the magnetic field created is perpendicular to the loop of wire. The magnetic field will attract magnets and other ferromagnetic objects. With this project we aimed to design and build a

functioning coil gun to show this induced magnetic field and to calculate the force on the magnet used in our coil gun. We designed a LR circuit as the coil gun to be able to calculate the time required for charging and discharging. The time that the magnet was in the barrel was also recorded and then used to calculate the velocity as the magnet left the barrel.

The Relationship Between the Harmonic and Rotational Motion of a Clock

Jerod Lawrence, Mitchell Morgan, Marieke Spiegelman

The relationship between harmonic and rotational motion of the model helps explain how a grandfather clock works as a result of the interactions between the pendulum and counterweight of the system. Experimental research was conducted in five ways: measurement of the period of the various pendulums, timing of the descent of varying counterweights, timing of a revolution of varying gears, the time it takes for the counterweight to fall in just half a period, and the time it takes for the varying gears to rotate one revolution with the pendulum attached to the system. The analysis consisted of comparing the slopes of the experimental graphs to the slopes of the theoretical graphs. In order for the model to function properly, a balance was required between the pendulum and the counterweight. The pendulum needed to have a greater magnitude of torque than the counterweight in order to work. The pendulum with a larger radius took longer to oscillate than the pendulum with a smaller radius, even though the mass was also increased. The moment of Inertia of the pendulums had a more significant impact than the mass of the pendulums. The longer the radius of the pendulum the longer the descent of the counterweight. In conclusion, the harmonic and rotational motion of a clock are proportional.

Double Slit Interference Pattern Anatomy Versus Laser Distance

Joseph D'Ambrosia, Keith Hedlund, Brant Moore-Farrell

The famous "Double Slit Experiment" has often been used as proof that photons and other subatomic particles exist as both waves and particles. In this experiment, the validity and accuracy of this experiment, as well as similar experiments like the single-slit experiment, were verified. Furthermore, several variables including slit-wall distance, laser-slit distance, slit width, and laser frequency were systematically varied to determine the relationship of these variables on interference pattern separation and height. To do this, Styrofoam supports were used to support the slit apparatus and laser, allowing easy and consistent measuring of the characteristics of the interference pattern. The interference pattern itself was projected onto a blank sheet of notebook paper so as to enhance the visibility of the bright and dark bands. The experiment concluded that the angle of each band, given by N , to the center of the slit-apparatus is given by $\theta = N/a$, where a is the distance between the wall and the slit apparatus. This is consistent with previous experiments, confirming the validity of the commonly taught double-slit equations. There were several sources of error in the experiment, including interference from the atmosphere which could be reduced in future experiments by performing the experiment in a vacuum. Furthermore, the measuring implements used to record each distance were only accurate down to the millimeter, which is not nearly precise enough for experiments that can vary with tenths or even hundredths of a millimeter. Using more precise implements, such as digital measuring forceps or even light detectors, could be key to determining the specificity and exactitude of these equations in the future.

Maglev Train

Khay Alwaissi, Sarah Rodpai, Flamur Sopaj

The purpose of this project is to build a 3D printed miniature model of an electromagnetic levitation train that travels on a track using electromagnetic propulsion on DC current. For this project we studied how electromagnetic levitation trains work, learned the differences between the various types of trains, and what parameters made this train more efficient. We have successfully built a working 3D Maglev train.

Electromagnets and Magnetic Levitation

Aaron Dickman, Eric Hay, Jake Romo, David Koehnke

Magnetic levitation trains are a hot topic in the world of future transportation. The goal of the project was to build a magnetic levitation train to test models of behavior for electromagnets -- particularly the relation of magnetic field generated by a solenoid to number of loops in an electromagnet as well as current running through the solenoid. However, as the project progressed, a more streamlined "magnetic-levitation projectile launcher" was settled on to test these principles. In the experiment, a low friction environment was constructed via the use of magnetic forces -- a wooden "train" was outfitted with ordinary ceramic permanent magnets on the bottom, and the bottom of the constructed track was outfitted with neodymium magnets such that the magnets from the two surfaces repelled. A solenoid with varying coils, as well as varying voltages running through it, was then used to repel the train. The strength of the magnetic field was measured by how far the interaction propelled the train.

Overall, we were able to confirm previously known relations for magnetic fields and solenoids. Specifically, we confirmed that an increase in the number of coils in a solenoid results in an increase in the strength of the resulting magnetic field. In addition, an increase in the current running through the solenoid also increases the strength of the resulting field. However, these results in some ways ran counter to expected results -- diminishing returns were found in the strength increase provided by the number of turns, whereas models we used predicted a linear increase. Further avenues for experimentation include using different cores for solenoids to investigate values of magnetic permeability as well as different track constructions to completely eliminate friction.

Did you hear that? A study in Acoustic residue diffuser design

Stacie R Barbarick, Marcus Bower, Christian Prather, Valerie Svaldi

Noise in educational environments has well-documented, adverse effects on key aspects of learning including, technical writing, reading comprehension and mathematical problem solving. Studies have shown background sound impairs auditory and communication-related skills such as listening cognizance, lasting retention and recollection in professional situations, even when the listening conditions are within the acceptable acoustic range. Sound waves travel the same way light radiates and is reflected off nearby surfaces. Depending on their intensity and time of arrival to the listener, reflections can be beneficial by creating high sound articulation or deleterious by generating distortion and obscuration of spatial perception. Since the goal for students and employees alike is cognitive cultivation, classrooms and auditorium designs need to incorporate acoustic elements like signal-to-noise ratio and reverberation reduction. Countless analyses have shown that a combination of sound damping, and diffusion produces an ideal auditory experience. We constructed and tested three styles of acoustic quadratic residue diffuser designs to experimentally determine the optimal configuration for sound diffusion at a specific frequency based on the change in decibels detected from direct sound waves and waves forms reflected from the diffusing surface.

Chladni Plate Resonance

Tyler Derington, Tailyn Heckle

Resonance is the result of a vibrating object or system that forces another object or system into vibrational motion at a greater frequency. All objects have a natural frequency and at least one frequency at which they resonate. The purpose of this project was to test varying metal plates and analyze the natural resonating characteristics and difference in resonance between the plates. A chladni plate is a piece of metal sprinkled with sand that vibrates and displays the resonance or motion of the vibration in the sand. The source of vibration we used was a speaker, and a frequency generating phone app. The

vibration comes from the center of the plate, and the waves move outward. This creates cymatic shapes with nodes and antinodes because the waves reflect off the edge of the plate and move back toward the center. The superposition, or addition/subtract of the waves as they meet is what creates the nodes. In our testing, we used several plates of the same shape with varying thickness, and some of the same gauge but different shape. Our testing showed the higher the frequency, the more complex the cymatic design will be. Through our trials, we discovered a 14 gauge circular saw blade produced the most distinct and rapidly changing resonant frequencies.

Thursday November 29 11:15am PHY 211 – Medina

simple hARTmonic motion

Gabriela Tolosa-Ramirez, Nick Probst, Mackenzie Malkowski

Simple harmonic motion will be studied and applied through the creation of a “homemade” Pendulum Wave. We will also utilize knowledge about pendulums and simple harmonic motion to create paint art from a pendulum suspended over a canvas. The pendulum wave will have various pendulums lined up in a line - each created from strings with a different length and nuts/washers. The pendulum paint will implement similar ideas and have a pendulum consisting of a paint bottle and a string that will be released from different lengths to create different artwork.

Strand Beast

Jacob Lawrence, Jordan Tehranchi, Max Kempe, Justin

We are building a 'Strand Beast' inspired from larger models. Our goal is to compare the efficiency between our models based on their friction, torque, and mass.

Projectile with Motion

Santiago Chavez; Jonn Yang

First part is A small cart is rolling at constant velocity on a flat track. It fires a ball straight up into the air as it moves. After it is fired, what happens to the ball is that it falls right back in to the cart. The second part is that Now that cart is being pulled along a horizontal track by an external force and accelerating. It fires a ball straight out of the cannon as it moves. After it is fired, what happens to the ball is that it falls right behind the cart.

Rocket Physics: The simple kinematics of model rockets

Szymon Ligas, Joe Wittek, and Blake Brown

The purpose of this project was to build simple model rockets and interpret their underlying simple kinematic mechanics. Kinematics forms the basis for motion in three dimensions and in the context of the notoriously complex field of rocket science, allows rockets to be predictable, controllable, and useful in a variety of functions, from space travel, low-orbit applications, and missile defense systems. Through experimentation and calculation, the flight path and landing zone of a model rocket is found. To find a functioning configuration, we used free body diagrams to model a rocket launch vertically, involving the forces of gravity, thrust, and drag. Using the data from the first series of launches, we predicted the landing zone of a rocket when launched at an angle using projectile motion. The analysis of field data gave us insight into the effect of angle, wind speed, and atmospheric pressure on the rocket's flight path. Due to the influence of unpredictable variables beyond our control, our results were met with a substantial margin of error. Despite these results, we found that theory of simple kinematic motion is readily measurable and experimentally verifiable even in the context of complex rocket motion, and that the angle of fire can be fine-tuned for something like a simple military application as a inexpensive projectile weapon.

The Perfect Game

Linus Woodard, Ryan Teskola, Kobi O'Neil

Skee ball! Fun for all ages. But When you intuitively aim for your target hoop and let the ball roll up the runway you may not consider all the factors at play. In our project we designed a launcher which, after taking all forces at play into effect, will consistently hit the target. Our launcher uses a spring to propel a ball at varying speeds, thus through testing of its properties, it is possible to determine energy of the ball as it is being launched. All that was left to do was construct a model skee ball table to test this on. After taking measurements of our table it was possible to calculate the necessary energy of the ball as it left the launcher in order to hit its desired target. Calculations were made and our hypothesized energies were put to the test. Overall, results were nearly identical to those hypothesized, thus proving that through simple testing the energy of our ball launcher could be used to consistently hit our target in Skee Ball.

The Siege of Helms Deep

Natalie Plata, Paul Smith, Evan Greager, Juan Espinoza

The purpose of this project was to create a trebuchet on a smaller scale and calculate the projectile range, velocity, kinetic and potential energy of our launched object. Since a trebuchet utilizes a falling object on one side of the lever to accelerate the projectile held in the sling, additional measurements such as: launch angle, torque, and structural dimensions were also taken into consideration. In addition, due to its complexity, many components such as air resistance and mass of structure were assumed to be negligible. Overall, this project showcases both theoretical and actual values obtained from Kinematics principles and Newton's Law of Motion, in order to compare and contrast both theoretical and actual values, and how/why certain sources of error change certain values.

Effects of Accelerated Corrosion on Release Torque of Bolted Joints

Stephen Gillan, Jordan Ledbetter, Vincent Benoit, Solomon Sidhu

A common occurrence when working on an old vehicle is running into a stuck bolt. Usually a stuck bolt is due to corrosion or rust increasing the torque necessary to loosen the fastener. There are several ways to deal with a stuck fastener due to corrosion. Usually the method of first resort is to use more leverage by increasing the length of the socket or breaker bar handle. Another method is to apply lubricant or penetrating oil to decrease the friction of the bolted joint. Another common method to loosen a stuck bolt is to use heat on the bolt itself, generally done with an oxyacetylene torch.

This project will explore these methods to see which is the most effective in reducing the torque necessary to release a corroded bolted joint. We will cut 3 steel angle bars, drill and tap threads to accommodate our bolts and then put the bars into an accelerated corrosion chamber to form the corrosion between the threads of the bolts and the joint (including nut) and the head of the bolt and the surface of the bar. We will test each bolt with a torque measuring device to the point of breaking the bolt free. We will include a control group, a penetrating oil group to explore how lubricity reduces the frictional forces and lastly, we will use a homemade induction heater. We will measure the torque required to break the bolt free and then calculate the force required to reach that torque. Our hypothesis is thus, we expect the heat condition to be the most effective in lowering the breaking torque of our bolts. Next, we expect the lubricity test condition to be somewhat less effective than heat, and finally our control group will give us a baseline to compare each test condition.

Poster Sessions

Wednesday, November 28, 10am – 12pm

The Sensitivity of Empirical Regression Models of Solar Irradiance to Underlying Methodology

Ian McComas Internship, Advisor: Dr. Odele Coddington

Magnetic variability in the Sun can be observed through two surface manifestations, sunspot darkening and the faculae brightening. These magnetic features drive irradiance variability on the Sun. Therefore, one approach to solar irradiance modeling is to derive coefficients using multiple linear regression that scale incremental change in proxies of magnetic activity into equivalent irradiance change. The modeled irradiance change is sensitive to the derived scaling factors. In this work we address the question, How sensitive is a TSI regression model to underlying regression methodology?

We present comparisons from two regression methodologies: ordinary least squares (OLS) and orthogonal distance regression (ODR). We quantitatively evaluate the TSI models against SOLARcycle TIM TSI observations on solar rotation and solar cycle time scales.

Non-organic Fertilizer VS Organic Fertilizer in the Plant Life

Shelbey Thomas, Abigail Somers, Raniah Shahwaz BIO 111 Advisor: E. Santa-Martinez

The purpose of this research was to detect which fertilizer, organic or non-organic, had more of a positive impact on the population of algae. In this experiment, three containers were used to house Euglena algae, fertilizer and tap water. Each container was marked; (A) non-organic, (B) organic, (C) control. The algae were measured on three different occasions utilizing a microscope with one drop of the mixture and five repetitions for each container, counting the live Euglena algae. Through each observation, it was observed that the control did not have any algae accounted for with zero improvements. As for both fertilizers it was seen that the populations declined but both differed. In the beginning of the experiment the number of algae in the organic container was higher than that of non-organic. Near the end of the procedure, the organic algae population declined faster than that of the non-organic, leaving the number of live algae less on the last observation. The project was held in a green room which may or may not have caused possible interactions that could have affected the experiment. The temperature was not controlled and as it fluctuated and got colder the number of Organic algae then seemed to drop at a quicker rate.

Strawberry DNA Testing

Angela, Jan, Emeli, Brandy, Meagan, Michael BIO 111 Advisor: S. Kaye

This experiment was conducted to find out how effective soaps are in extracting strawberry DNA. We tested foaming hand soap, 7th generation dish soap, and Downy laundry detergent, along with a control that had no soap. The lab setup included four beakers, one for each type of soap and the control. Organic strawberries, obtained from King Soopers, were a constant variable in the experimental design to ensure each test in the lab is the even. Our dependent variable was the amount of DNA extracted and our independent was the test subject itself, soap. Our controlled variables were constant measurements using precise beakers, measuring spoons, and scientific test tubes. The lab duration was an hour long and we have accomplished the full DNA extraction with minor flaws; including the ingredients of the soaps instead of looking at them by brand name. Also involving the age of the strawberry for the future project. The ripeness of the fruit can impact on the DNA extraction. For the lab conclusion, we proved our hypothesis by agreeing Downy laundry detergent extracted the most DNA out of a strawberry.

Wednesday, November 28, 12 – 2pm

Cloud Chamber

Nicholas Redwing, Cole Delery, Robert Schmidt, Sam Indian PHY 212 Advisor: C. Medina

ABSTRACT

In 1911, one of the first observations of subatomic particles were made with the perfected invention of the Cloud Chamber or the Wilson Cloud Chamber. A cloud chamber is a simple device that uses condensation of alcohol to form a cloud inside itself. When high energy subatomic and atomic particles pass through this cloud, they leave a path that can be seen with the naked-eye. During the early 20th Century, this technique became one of the pivotal ways to observe subatomic particles, in turn, pushing forward the field of Particle Physics. Nonetheless, atomic particles were being observed and scientists came to a realization that the particles they observed were undergoing ionization radiation. Ionization radiation is a radioactive process where an atomic nucleus loses an electron, proton, or neutron from decomposition because of atomic instability or because of the presence of an outside high-energy source. Everyday our lives are bombard with the particles from sources inside and outside our planet. When they break down into subatomic particles they form Alpha and Beta particles, Positrons, neutrinos, and plenty more; however, for this paper, Alpha and Beta particles will be the main focus. The common cause for these particles to undergo ionization energy is the collision with the atoms in Earth's atmosphere. In order to observe these ionized particles, the chamber uses a common alcohol, a heat source, and a cooling source in an isolated system to produce the cloud. The heat source evaporates the alcohol from the top of the chamber, and the evaporated alcohol falls into the cooler part of the chamber which causes the gas to quickly condensate into a form of rain. Through this rain one can clearly see the high energy particles' paths as they move through the chamber.

Tesla Coil

Anand Zorig, PHY 212 Advisor: C Medina.

For our Physics II Project, our group has decided to create a Tesla Coil, as it includes many of the subjects that we have learned or soon will learn in the class. Namely, our project will include the practical applications of Electrical Fields, Electrical Potential(Volts), Resistance, Amperes, and waves. Combining all these topics, we hope to demonstrate wireless electrical output with the Tesla Coil we intend on building.

How Inversions Affect Blood Pressure

Angel Wiggins, Isaiah Ornelas, Parry Mattette BIO 111 Advisor: T Gray

High blood pressure is a health problem prevalent in society and people are searching for various ways to prevent it. Inversions have been shown in previous studies to temporarily reduce blood pressure. We designed the experiment so participants practiced daily inversions to measure the effects of overall blood pressure. We defined inversions in this study as a posture where the heart is elevated above the head.

The goal is to empower people to prevent high blood pressure with a natural method.

Five participants had their blood pressure measured prior to practicing inversions for five consecutive days. Blood pressure was recorded on the sixth day and inversions were practiced again for another five consecutive days before another record. The inversion postures were practiced for one minute each day. Participants supplied information that could have affected their blood pressure such as sleep, caffeine intake and changes in stress.

The study showed the overall change in blood pressure was lowered by 4.5%. All but one of the participants had a decrease in overall blood pressure throughout the experiment. The study suggests that the movement of blood during inversions is a healthy practice to promote heart health.

Effects of household cleaners on killing kitchen sink bacteria

Miranda Wilson, Heather Honeyman, Megan Winberg, Chloe Stibb BIO 111 Advisor: T Gray

It is common knowledge that bacteria is present all around us in our everyday lives. If not controlled, the growth of bacteria can get crazy. Within our experiment, we tested the survival rate of bacteria used from

our kitchen sinks when sprayed with a homemade cleaner and a store bought cleaner. Our hypothesis is that a vinegar solution would kill off bacteria lingering in our kitchen sinks more effectively than 409 cleaner. To test this, each person in the group swabbed their kitchen sinks three times, then we put each petri dish into the incubator and then refrigerator to stop the growth. Then they were split into three different sections, one section being the control, one section being sprayed with a homemade cleaner, and the last section being sprayed with a 409 store bought solution. Even though the results are a little hard to fully see due to our inexperience of microbiology, our hypothesis was clearly not supported by our results, as more bacteria was shown to be killed off after using the 409 cleaner rather than the homemade cleaner. It is safe to say that this experiment was a little more chaotic than we had originally thought, so our results may not be completely accurate and should be tested again at some point in the future due to the possibility of some cross contamination.

This experiment was conducted to uncover the transfer of bacteria from 4 environments based on the 5 second rule. This concept is defined as food that is exposed to contamination, however is consumed within a 5 second window in hopes that the food remains safe to eat. This experiment simulates these occurrences such as dropping a french fry, chip, or crumb.

The 5 Second Rule

Davin, Huillin, Julz, Maria BIO 111 Advisor: E. Santa-Martinez

The method for five second rule is to grab the original bacteria from different environments and put in the beaker, control the same temperature for all beakers. Set 48 hours as the time. After 48 hours, compare the control beaker with different environment. To see how five second rule changes the bacteria amount in different environment. The seat of a car resulted in the most bacteria on the agar inside of the petri dish. The agar was fully covered in bacteria. The results of the dirty table and the floor were very similar. The petri dishes were covered in irregular shapes of bacteria. The clean table resulted in petri dishes that were the most clear. There were several large translucent rhizoid shapes and irregular shapes on the agar inside of the petri dishes.

In conclusion, this study verified that even before the 5 second rule, food will always pick up a certain amount of bacteria but the type of surface the food falls on makes the most difference. The piece of cantaloupe we used to test our experiment picked up the most bacteria when dropped in a car environment, than it did when dropped on the floor and a dirty table. Based on these results we can say that occasionally eating food that was briefly dropped will not make you sick but it depends on what you dropped and the type of surface environment you dropped the food in.

Mushrooms Vs. Radiation

Sophie Raffin BIO 111 Advisor: T Gray

Our project was researching the effects 2000mW of emf radiation would have on oyster mushroom mycelium. We cultivated two agar plates of mycelium, one as the control, and the other was placed on an antenna plate connected to a software that would emit a constant frequency of emf radiation. We hypothesized that the presence of radiation would slow growth by at least 20% as compared to the control. The results showed that the radiation did weaken the mycelium and reduce growth compared to the control. The purpose is to research ways to control mold and unwanted growth in homes, restaurants, etc. We concluded that small amounts of radiation would help eliminate these contaminants.

The Effectiveness of Hand Soap and Hand Sanitizer in Inhibition of Bacterial Growth

Luisa Nunes Machado, Jared Wilhoite, Jaylynn Jones BIO 111 Advisor: E. Santa Martinez

The most common ways to have our hands clean are by utilizing hand soap or hand sanitizer. This project was conducted to test the effect of hand soap and hand sanitizer to inhibit bacterial growth. It was predicted by the team if we wash our hands with hand soap then the hands will show less bacterial growth. The hypothesis proposed was that the Dial Gold Antimicrobial liquid hand soap samples will have the least amount of bacterial growth in comparison to the other treatments. The experiment provided observational pieces of evidence supporting the hypothesis proposed. The agar of the Petri dishes with hand soap samples turned out clearer than the hand sanitizer samples, meaning fewer bacterial growth. Some unexpected results occurred likely due to the difficulties during the experimentation process, external agents, and also the lack of proper types of equipment, tools, and materials. The samples from one of the subjects of the study had to be discarded due to the discrepancy of the amount of bacterial growth. The experiment supported the hypothesis that hand soap is more efficient than hand sanitizer, or just water. This experiment should be repeated in the future for more accurate results by improving the methodology used, in terms of equipment, population samples, procedures, materials, and tools.

Anaerobic Digestion

Cole Sharpe, Zach Powers BIO 105 Advisor: T Gray

In this lab, anaerobic sludge was studied as a function of time under incubation, in addition to the time that the sludge spent in a heated digester at 99 degrees Fahrenheit. The incubation conditions were as follows: nineteen degrees Celsius in sealed petri dishes containing agar. The gases that are produced from anaerobic sludge after a certain mandated time are Carbon Dioxide, Methane and Nitrogen, each of which yields greenhouse gases.

In addition to the experiment above, the potential of hydrogen that was found in the bio-matter was analyzed under four different criteria's. The activity of microbes, the pH of the sludge, and the amount of toxic gases derived using anaerobic digestion. The microbes were not active, pH remained basic, although fluctuant, and it did not seem as though anaerobic cake was produced.

How Does Color Affect Mood?

Angelica Morrill, Jessi, Madison, Celia

How does color affect mood? We explored how colors can change your mood, from rating your mood on the scale 0-10. We determined how the color red or blue clothing will affect you throughout the day. We predicted that red will increase mood, whereas blue will leave mood on the lower end of the scale. We tested to see if our predictions were right, through asking a firsthand audience who were wearing a red or blue shirt that day. We are students who are interested in psychology, and agree mental health is especially important for students. We can control our immediate environment without even noticing, so hopefully these little bits of research may help fellow students. We tried to make our experiment as simple as possible, without factoring in too many variables. We chose red and blue because; they are both on the opposite ends of the color spectrum. We decided to rate mood on a basic scale of 0-10, where 0 is complete worst, and 10 being the best. We were testing to see if simple things even such as colors can affect our moods.

Thursday, November 29, 10am – 12pm

Ballista Projectile Launching Analysis

Aaron Broadus, Meredith Haanstad, Issac Marchand, Jaylynn Medina PHY 211 Advisor: S. Spivey

Our project sought to analyze projectile motion; more specifically, projectile motion. In order to analyze projectile motion, our group decided to make a medieval style wooden ballista. We decided to see how

launch angle and mass would effect the distance a projectile travels and also how it impacts final speed. After analyzing the results of our test data, we confirmed that mass and angle of launch impact final speed and distance traveled. We experimentally proved that mass has a negative correlation with distance and acceleration, and also that two objects with the same shape but different masses have the same final velocity. Our results also showed that objects of the same shape with different masses traveled different distances, with the lighter projectile going the furthest.

Electro-POWA

Laila Amery, Gunnar Merrick, Mark Dyck, Chase Kozoh PHY 212 Advisor: C. Medina

Electromagnetic forces have made a huge breakthrough in the last couple of years through the use of charging something near and dear to everyone's hearts; their cellular phones. By using an electromagnetic force, these newer devices can now charge wirelessly, anywhere, on the go. Team Electro-POWA wants to create an electromagnetic charging device that is capable of charging electronic devices wirelessly.

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.

The Mum Murderer Report

Wesley Hayter, Karen York, Chris Case BIO 111 Advisor: S. Kaye

In an article by Snopes.com a grandmother claims that her granddaughter performed a science experiment of watering plants with microwaved water and regular water. Within five days the plants watered with microwaved water displayed yellowing and wilting of their leaves. Despite some inconsistencies in the scientific process of this young person's experiment, the grandmother concluded that microwave radiation is harmful to plants and thus all living organisms, including humans (2006). As researchers we wanted like to further explore the question regarding microwave radiation and its impact on plants, as well as consider the impact of the temperature of the water introduced to the plant. The plants experienced browning and wilting early into the experiment. However, it was observed that the plants that had been given water that was heated and then cooled to room temperature, experienced wilting whether microwaved or boiled. So a simple experiment was conducted to test for contaminants. Water quality tests indicated higher levels of fluoride in the heated water. The Jetboil heated water was higher than the microwave irradiated water. The microwaved water was higher than the control.

Effects of Exercise on Academic Cognitive Function

Myles Tallmadge BIO 111 Advisor: S. Kaye

Exercise is healthy, most people are aware of this. However, most only think of how it affects their body, not their mind. Aside from the more subjective effects of feeling better when healthy, does exercise have more immediate effects on one's cognitive functions? Cognitive functions is a very broad category, so it

was narrowed down to simply academic cognition, or how well one will do in scholarly environment. Academic ability was measured by how long one took to complete a set of math facts before and after exercising, both directly afterwards and after a significant period had elapsed. It was found that on the whole, scores increased directly after a short span of exercise. This suggests that an effective strategy for academic success, especially in a testing environment, is to exercise shortly beforehand, leaving both the body and mind energized and ready to succeed.

Thursday, November 29, 12 – 2pm

Hidden Piercing for an Invisible Illness

Stephanie Maya BIO 111 Advisor: T. Gray

For my entry I would like to present a project on a very special ear piercing that has been showing positive results in the lives of those that get it done for their migraine pain. You see, I am a body piercer and decided to do a study in my field. I gathered as many people as I could who suffer from chronic migraines and were willing to get this done in hopes to help their issues subside. My presentation also touches on the comparison of other treatments for this ailment, such as botox and acupuncture. Although the the study is small the results are actually pretty huge! Plus, this piercing's claim to fame is actually becoming more and more known. Being in the industry I am in I would love to be apart of putting it on the map and seeing the positive results from this different approach.

Does Visualization Improve Performance?

Cassidy Kirk & Anthony Salas BIO 111 Advisor: T Gray

In this project, we studied the effects of visualization on success. We chose to use basketball free throws to model visualization of success or failure and their respective effects on performance. We recorded 2 videos to show to participants depending on which group they chose at random, there was a control group who did not watch a video. One of the videos featured clips of a basketball player making every free throw, while the other contained a video of a basketball player missing every shot. We then compiled the results and compared the different groups' data.

Nature Vs Nurture Mushroom Lab

Aubrey Jackson, Kateri Droege BIO 111 Advisor: S. Kaye

In this lab we investigated nature versus nurture principles by growing two separate sets of mushrooms in environments created to mimic nature versus nurture scenarios. The results supported our hypothesis qualitatively and not quantitatively, however a few flaws in our experimental design could have caused the variations in the data collected. Mushrooms being heterotrophs allows them to be more dependable test subject for the nature versus nurture principle because it rules out the possibility of a carbon dioxide and oxygen exchange being a second independent variable. Mushrooms use oxygen during their energy creating process or cellular respiration --unlike plants--which we considered using for the experiment. However, the exchange of carbon dioxide from speaking to the plant would have thrown off the results. Overall, between our experimental design, the data collected and the final results, our hypothesis was supported, yet our prediction was indirectly supported.

Compost and Fertilizer

Sandy Raquel BIO 111 Advisor:

For those out there without a green thumb, you might want to consider adding a boosting agent to you soil. It might give your garden the help it needs to take it from basic to "WOW!" For this experiment, we

compared the results of an ordinary garden bean growing within different soil mixtures to find out which would be the better helper. Our group predicted the compost mixture pots would yield the better growth than that of the other two pots. We tested our hypothesis by planting a single seed within each pot, nine in total. There were three pots of a compost soil mixture of one-to-two, three pots of a fertilizer soil mixture, also one-to-two, and and three pots of plain gardening soil supplied by our local home improvement store. All nine pots were kept together and indoors under a light for 12 hours a day. They were watered daily with 15 ml of water. After approximately 39 days from time of planting, the compost soil mixed pots produced the longest plant growth and heaviest root growth supporting our hypothesis. It's also worth adding the number of leafs produced by the compost soil mixed pots also had a higher count to that of the rest of the other pots.

Terrestrial Ecology of the RRCC Lakewood Campus

Eustacia Bean, Michael Fromandi, Azaria Van Vorst BIO 112 Advisor: S. Kaye

This ecological investigation questions and focuses on the comparison of two sample sites within the same geological location at Red Rocks Community College in Lakewood CO. Two small groups of students investigated the sites A and B on the north side of the Red Rocks building. Our group sampled site A which is described as the tree plot and east of site B which was described as the shrub plot. The experiment examined the differences, diversity, population densities and frequencies of all species types such as trees, shrubs, macroinvertebrates, microscopic invertebrates, microorganisms and large animals. As exhibited throughout our experiment, the sampled plot A had a small population of plants and a mediocre population of invertebrate species. The primary reason for this is likely due to our relatively small circular plot area of 50m². Unfortunately, the comparison group provided unusable data to make a final comparison of the sites and we are therefore unable to derive a concluding statement of whether our hypothesis was supported or not.

Underwater Photosynthesis

Hyeonah Shim BIO 111 Advisor: E. Santa-Martinez

Plants need photosynthesis for their growth and survival. Plants on land can acquire sunlight, water and carbon dioxide from their atmospheric environment for their photosynthesis. Plants submerged underwater can utilize water and carbon dioxide from its aquatic environment. However they seem to have limited access to sunlight unlike plants on land. When plants are totally submerged underwater, are they able to do photosynthesis with the sunlight outside the water? For the experiment, Java Moss plant was used to see whether it could utilize the light for its photosynthesis. It is hypothesized that underwater plants such as Java Moss do photosynthesis with the light and the amount of exposure to the light affects the growth of the plant through photosynthesis. The amount of light exposure was controlled for six hours, twelve hours and eighteen hours a day. The initial weight, height and width were measured to measure the growth against. The weight, height and width of the plant were measured after three weeks and five weeks after the initiation of the experiment. After five weeks from the initiation of the experiment, it is observed that Java Moss exposed to light for eighteen hours grew most in terms of its weight, height and width, and the plant exposed to light for six hours grew least in terms of its weight, height and width. Therefore it is concluded that underwater plants utilize the light for their photosynthesis although they are submerged underwater.

High Doses of Caffeine Raise Your Heart Rate By 1%

Juan Contreras/Caleb Holmes/Murar Al Khafaji/ Arselan Shikak BIO 105 Advisor: T Gray

For our scientific experiment we decided to research the effects of coffee, specifically Death Wish Coffee. This brand advertises as being the strongest coffee on earth. Many students, including most of us, depend on the energy we get from coffee to help us through the day. Caffeine is also used by athletes due to its benefits of alertness, and sustained energy. So, we asked a question, what makes Death Wish Coffee the strongest coffee on earth? We proceeded to do research on what makes coffee strong? what are the effects on the human body? And, are habitual coffee drinkers less affected by coffee than others? We found that it was the large amounts of caffeine that Death Wish Coffee contained that was most likely the reason why this coffee was so strong. We took all these factors and came up with a hypothesis; drinking high levels of caffeine raises your blood level of epinephrine, thus increasing your heart rate by 1 percent.

Dog vs. Human Petri-Dish Lab

Allysa Buckner BIO 111 Advisor: S. Kaye

In this experiment, I wanted to test the theory that dogs are more dirty than humans. In order to test my theory, I decided to order some premade petri-dishes that were all prepared with an equal amount of agar nutrient coating on the bottom off of amazon. In order to make the experiment work, I had to either incubate the petri-dishes or find a way to keep them warm in order to simulate a body-like environment. I did not have an incubator, thus I made one out of an old aquarium we had lying around the house. The petri-dishes were then kept at a stable temperature range between 90°F and 98°F. The results of the experiment were absolutely fascinating! What I ended up finding out was that dogs spawn more fungal colonies, while humans spawn more bacterial growth. I believe that this result proved an indirect part of my theory, supporting the antibacterial part of the dog saliva helps keep them clean from bacteria, but also proved that their mouths and cleaning rituals does not necessarily do anything for fungus. Meaning, dogs are dirtier in the sense of fungus, but are cleaner in the sense of bacteria.

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: 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.

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?