RRCC STEM Expo

Fall 2017 Program

Wednesday, November 29, 10am – 12pm

What Should You Know About Your Water?
Kayla Andis, April Beal, Cole Delery, Nicole Dickinson, Donny Herrera, Manisha Jaiswal, Chad Matthews, Christian Prather, HNR 100 Advisor: B Sobhani

The people of Denver should know more about their water. A recent survey of RRCC students showed that there are concerns about access to clean water in the future. A large percent of the water we use is actually recycled water so we need to be cautious of the things we put into our water. Our city does add things like anti-corrosives and chlorine to keep us safe. Thick biofilms also line most pipes to protect us from corrosion of hazardous lead pipes. Replacing these pipelines has large costs associated with it. The city is only responsible for water up to the meter, the homeowner is responsible for everything from the meter to the faucets. If the city replaces part of the meter, then it is in the best interest of the homeowner to replace the other part otherwise the difference in the biofilms of the pipes can cause negative outcomes. Luckily, the city has incentive programs in place that won't offset the entire cost. Our city takes care of us the best they can, however we do need to be more mindful of what we put into our water and how important maintenance is.

Recycling Program
Sydney White, Steven, Homar, Landry, Christina, Chris, SCI 105 Advisor: L Hoerner

We will have a poster set up to inform students around the campus about recycling. From where the can recycle on campus to what they can recycle to how it benefits the environment.

Mechanics of Cranes in Non-Ideal Circumstances

David Bonney, Chad Matthews, William Thomas PHY 211 Advisor: S Spivey

Cranes are widely used tools to aid in lifting items great heights for the sake of transportation and construction. We are testing how a mass on a crane will act in non-ideal circumstances, such as swinging on a pendulum or dropping, as well as testing the former two at varying angles. We constructed a crane-like apparatus using wood, rope, and pulleys to test the aforementioned circumstances on a smaller scale. We found that a pendulum undergoing simple harmonic motion imparted a negligible effect on the force perceived on the crane's base, but dropping a mass exerted a large force in a linear fashion based on distance dropped. Dropping 120g from 20cm, 30cm, and 40cm averaged 4.7N, 5.43N, and 6.15N, respectively; and a larger angle upwards did mitigate the observed force to 3.85N and 3.7N dropping the 120m 20cm at 26.6 degrees and 40.8 degrees, respectively. In conclusion, masses suspended by crane should be suspended at tall angles, and to take measures to avoid dropping any suspended mass.

Ballista Ballerz (Build and Test Medieval Ballista)
Johnny Boos, Kyle Beller, Jordan Marsh, Alex Langfield, PHY 211 Advisor: S Spivey

Team Ballista Ballerz was motivated to construct a medieval-style ballista to challenge ourselves to go where no RRCC Physics Team has gone before. The concept and design is essentially a massive cross-bow which launches arrows and projectiles with tension. Our group will calculate the projectiles velocity, max height, drag, and other kinematics of motion variables. Analysis of our projectile data is still in progress. We will continue to make adjustments to achieve our desired distance of approximately 100ft. Fabricating a Ballista light enough to be cost-effective and mobile while simultaneously withstanding the tensions forces required is critical. The projectile data we collect and analyze with give us a greater comprehension of adjustments to make in materials selection and design moving forward.

Electromagnetic Railgun

Jason Gregg, Amy Austin, Sophia Wyss PHY 212 Advisor: C Medina

An advanced weapon used by the United States Navy is the electromagnetic rail propulsion system that utilizes electromagnetic force to launch missiles. We built a prototype to demonstrate electromagnetic field occurrence, and verified that voltage directly impacts acceleration of a projectile. Our build comprised of a capacitor bank, an AC/DC converter power source, and a parallel copper rail system. Providing an initial velocity, we measured acceleration of ½ gram aluminum cylindrical projectiles at three different voltages (20V, 30V, and 40V). Our results indicated a linear increase in acceleration due to increased voltage. Errors resulted from inaccurate spacing of rails and surface contact of aluminum projectiles. Steel spherical projectiles failed the system. Electromagnetic systems could significantly impact future weapons design.

The Effect Of Color Film On Lemon Basil Growth
Sana Xiong, Lynzee Allen, Jacob Trelease, Jamie Rush, BIO 112 Advisor: S Kaye

The following experiment was done to test out the effect color filter has on lemon basil growth height over a period of six weeks in an aquaponic environment. This experiment included lemon basil as the main crop, and color filter blue, yellow and green. In the experiment 12 basil plants were tested, three for each color filter and three for control. It was hypothesized that the green filter would negatively impact the growth height of lemon basil, the most, out of all three colors including the control group. In conclusion, the hypothesis was not supported. The green color filter group was actually the most successful group in height growth.

Bridge Stress Analysis
Huilin Ren. PHY 211 Advisor: S Spivey

Knowing how much stress a bridge can bear is very important for real life, because there's an increasing number of bridges being built. Knowing the max stress a bridge can hold as well as the max torque will help people build safe bridges. Huilin Ren, Gabriel Hegarty, and Dion Mayes built a truss bridge, arch bridge and beam bridge. They want to know which structure could hold the most weight by testing them with torque and stress.

Physics Cannon

Jose Sandoval, Brett Webb, David Palcsak PHY 211 Advisor: S Spivey

We will be calculating the projectile motion of the object with a lot of description, including air resistance, and anything that affects the object being shot. We do not know how to calculate the combustion of the reaction so we will not be including it in our calculations. We are measuring strictly projectile motion, including air resistance (drag).

Spring-Powered Car

Tristan Strayer, Chad Rogers, Bradford Pettingill, Woody Graklanoff PHY 211 Advisor: S Spivey

Premise: How much spring force is required to launch a small, wooden car forwards? What variables will change the velocity and range of said car? With these tests, we intend to find out.

Methods: The way we tested this was by changing different variables, such as the mass of the car, and where we attach the rubber bands to the car. Then, we would measure the time the car took to move through two sensors, from which we derived the velocity, and the range of the car given those conditions.

Results: We found that, as expected, increasing the mass of the car lowered the average velocity and range. Also, attaching the rubber bands to hooks that are further away, and thus stretching the rubber bands further, we found that more spring force was generated and the car went further, faster.

Conclusion: The car goes faster with less mass, and with a higher amount of spring force acting on it.

The Design and Production of a Low Cost Reliable Thermal Cycler to conduct polymerase chain reactions

Christian Prather, NASA Space Grant, Advisor: L Albert

Here at Red Rocks Community College, student research is being done on exposing living bacterium to unfamiliar conditions. A device which allows for the amplification of DNA on returning organisms, via PCR, is needed for detailed study of induced genetic changes. Thermal cyclers are ideal, but are costly. This is why we are aiming to provide high precision, low cost thermal cyclers to students. If we are able to produce a reliable and accurate device that can be created at any makerspace for around $100.00 we will eliminate a huge barrier to entry for those wishing to do more in the scientific field.

To solve this problem we have been researching the mechanics of current thermal cyclers and looked at other possible approaches. We have designed our own custom circuit board, using only off the shelf low cost components. All control is executed through custom code that is purposely kept as user friendly as possible in an attempt to allow for any student or individual with even basic understanding of code to follow the logic and make changes if desired. The casing was modeled in SolidWorks and ran through simulation to determine how it will open and operate. This is the final step and is designed to be made with common materials such as plywood or MDF.

Through this process we are hoping to get a reliable, easy to use device that can be made by any student for less than $100.00. This will hopefully allow for students to gain access to industry used equipment and perform higher level scientific research. In conclusion we are shooting for a testable device by the end of the month and after initial testing we will revise design aspects to make it as accessible and open source as possible.

Physics of a Crane

Michael Feron PHY 211 Advisor: S Spivey

The purpose of this project is to build a functional crane and analyze the force interactions acting upon it, as well as develop a formula capable of relating a maximum arm angle and maximum weight of tipping. Cranes operate on the idea that the linear force and torque acting upon every point along them sum to zero, preventing them from tipping. Through experimentation and calculation, the model crane's maximum lifting capacities at given boom angles are found.

Roller Coaster

Lara Cucarola, Kyli Doke, Kyra Squier PHY 211-001 Advisor: Shane Spivey

Have you ever taken a ride on a roller coaster? We set out to discover just how high a roller coaster would need to be to make one full loop-the-loop maneuver. This project aims to provide a model for perfecting the loop-the-loop motion. This project has real world applications such as a model for military planes, manufacturing and machinery, data for the building of high-speed highways, and for several entertainment purposes, like stunt performances and amusement rides. To perform this project, we built a scale model of a roller coaster and performed several different calculations to discover the optimum height required for a roller coaster to achieve a loop-the-loop action. After several time trials we were able to calculate the average velocity throughout the roller coaster's ride and find the angle of the drop needed to perform the loop. We discovered that the minimum height needed to complete a full loop-the-loop was 1.42875 meters for a radius of .1651 meters.

Self Rotating Wind Turbine

David Reveles & Tim Teska PHY 111 Advisor: M Hoerner

The purpose for the self rotating wind turbine is to supply cost efficient power to LED lights. The energy conversions that are present in this model include changing rotational kinetic energy into electrical energy. The materials needed in order to assemble the turbine will consist of four main components: pvc pipe, propellers, electrical wire, and an A 22t Dromida motor. To begin, construct the base and figure for the model out of pvc pipe while also drilling in specific holes. Positive and negative electrical wires are then fed through the holes into the pvc pipe, so it may connect to the motor and LEDs while also having a protective outer shell. Now begins the process of physically supplying power to the motor and LEDs. This process is possible by the force from the wind; which then rotates the propellers causing the motor to supply electricity to the LED lights. Once all items are assembled properly the amount of voltage is measured with a VOM, Volt-Ohm-Milliameter. Once the amount of volts are measured out, every other component including work, velocity, and force can be found by converting volts into joules. Once all work force are evaluated we can then determine how efficient the wind turbine truly is.

Changing the World Through Hybrid-Electric

Alexis Quintana, Charlotte Kloska, Trinity Wagner PHY 111 Advisor: M Hoerner

A qualitative and quantitative approach was used to compare and contrast the three main types of electric vehicles: hybrid-electric, plug-in hybrid-electric, and general electric. By comparing these types of vehicles to each other and to conventional vehicles, it was easy to see how power and energy are conserved and used differently between them. The factors that were assessed for each vehicle were: how and when each type of engine converts its main source of energy to other sources of energy, storage sources that

each vehicle relies on, what kind of batteries each vehicle runs on, how efficient each type of vehicle is in relation to its cost, and what problems there are with these types of vehicles. The results were found by conducting extensive research on the above-mentioned factors as well as by analyzing previous studies conducted on these vehicles. To fully illustrate the differences between these types, a general model was made of each type of vehicle's engine. These models included the battery involved and how energy was transferred and transformed within the system. Ultimately, this technology is worth the cost because they conserve energy and don't rely entirely on fossil fuels. There should not be a "price tag" on saving the environment. Although using hybrid-electric vehicles is one of the best options to environmental conservation, these vehicles are not easily accessible to the public. Making these cars more affordable for the public would increase the purchases of these cars in turn helping the environment. These hybrid cars can be reduced in cost by not adding all of the unnecessary features like leather interiors and touch screen navigation systems that inflate the price. As the environment continues to become a bigger concern in politics, the government should promote such vehicles.

Wednesday, November 29, 2 – 4pm

Arc Welder (Talk)
Justin Flint PHY 212 Advisor: Mark Scruggs
Build and arc welder and test weld depth with varied currents.

Curie Point (Talk)
Ahilya Lom, Vincent Casados PHY 212 Adviser: Mark Scruggs

In the experiment researchers set up an apparatus to investigate the concept of the Curie point. The Curie point is the point at which a piece of iron is no longer attracted to a magnet due to its high temperature. To do so a 6 volt power supply was connected to a steel wire with alligator clips, a small plastic cup and wooden paddle were used to hold up the wire. Magnets were then suspended by a stand made of PVC over the apparatus. Researchers could then change the amount of magnets in the experiment to either increase or decrease the overall attraction. Researchers analyzed how temperature was affected by increasing the number of magnets in the experiment. Researchers also analyzed the effects the experiment had on the current of the wire. The results of this experiment were a you increase the number of magnets, the magnetic force increases hence the curie point does as well. Additionally researchers analyzed if increasing the strength of the power supply affected the results previously stated. A high voltage battery source will pass more current through the wires hence affecting the magnets.

Magnetic Powered Projectile Rifle
Matthew Tallant/Justin Gomness PHY 211 Advisor: Shane Spivey

Friend or Foe - Aquaponics
Erin BIO 112 Advisor: S Kaye

Aquaponics is a self-sustaining system in aquaculture in which waste from fish is used to supply plants with nutrients and in return the plants that grow in the hydroponic environment filters or purifies the water for the fish. For our group project, our team decided to compare growth of plants when surrounded by "friendly" plants and "unfriendly" plants. Cabbage was our control, with broccoli being "unfriendly" and

cucumber being "friendly" to cabbage growth. Our hypothesis was that cabbages grown next to cucumbers would have a greater percentage increase in biomass over eleven weeks. We planted 6 plants paired respectively - cabbage and cabbage as our control, cabbage and cucumber and lastly cabbage and broccoli together to be our dependent groups. We measured biomass as well as primary and secondary growth for all our plants. At the end of the ten weeks we compared all measurements to determine if there was more growth between the control, friend, or foe. Our results did not support hypothesis, and instead cabbage growth next to cucumber did worse than cabbage growth with control and next to broccoli (unfriendly).

Determining the Success of Flowers in an Aquaponics System

Shaydie Boyd, Mike Moore, Nima Sabri, Julianne Taylor, BIO 112 Advisor: S Kaye

Traditional agriculture is a leading contributor to pollution, and is proving to be a non-sustainable method of producing food. Aquaponics, however, is an alternative method which uses less water and utilizes fish and plants in a symbiotic relationship. In this closed loop system, fish excrete nutrients needed for the plants while the plants filter the water. Previous aquaponic studies at Red Rocks Community College have focused on food based plants, yet many flowers are also grown for both food and commercial use. For this reason, our study aimed to determine the outcome of flowers from three different families in an aquaponic system. Using the prescribed aquaponics methods, we measured the primary growth of four different species in two different plant beds. Despite the relatively short study, we found all three families to be successful in the aquaponics system. However, further studies are still needed to investigate the potential of many other plants and flowers, particularly to accommodate longer germination and fruiting times.

Aquaponics

Colton, Javier, Sankit, Tim, BIO 112 Advisor: S Kaye

Abstract: Due to pests getting into our experiment our goal has changed a couple times to fit the available data. Our goal is now to determine which herbs grow best utilizing only the waterbed portion of our aquaponics project. First, we germinated three types of basil and two indian mustard plants for about 2 weeks each. Next, we planted our sprouts in the water bed after they have grown about an inch and a half. Third, we continually monitored our plants periodically measuring growth, in inches. Next, once our plants reached maturity, we trimmed the leaves from our plants once they reached about 6-9 inches for the basil, and about 2-5 inches for the mustard. We then weighed the leaves directly after they were trimmed. Since many herbs, including mustard and basil, are dried and used as a seasoning, we dehydrated the leaves and then weighed them again to get a dry weight. Last, we compared the growth and yield of each plant and compared them to each other to find which plants did the best in the waterbed portion of the aquaponics system.

An Investigation Of the Possible Existence Of A Constant Modifier To The RPM Of A Brushed DC Motor Under Constant Voltage

Benjamin Stanton, Tuyasaikhan Boldbaatar, Mohamed Babou, PHY 212 Advisor: C Medina

An ideal DC motor would have no loss of RPM due to friction, drag or torque, resulting in an easily predicted linear relationship between voltage and RPM. The authors predict, however, that there will be some loss of RPM due to the torque of the shaft and friction. The goal of this paper is to investigate the

existence of such a loss experimentally, using accurate measurements of the RPM and voltage. Additionally, the authors wish to investigate whether such a loss of RPM, if it exists, could be described by some constant modifier.

Portable Water Turbine

Andy Cross PHY 211 Advisor: C Medina

The goal of this project was to build a functioning water turbine that can be used to charge small electronic devices. The design for this turbine is based around a propeller turbine and uses a 3D printed propeller/ nose cone assembly to drive a small dc brush motor housed in a pvc tube. The motor is fixed inside the pvc tube and is attached to a nose cone, which is attached to the propeller blades that rotate freely around the pvc tube. The design for the propeller was inspired from various youtube tutorials on how to make a propeller in solid works, but modified to fit around the pvc tube. The nose cone was designed to nest inside the propeller cylinder for a better fit.

To calculate the ideal energy from the generator the following equations were used, $W = \rho V g h$ where W= energy (J), V = water volume (m3), ρ = density (this study takes the density of water to be 1000 kg/m3), g= acceleration due to gravity (9.8m/s2) and h= falling height (m). To calculate the efficiency of the generator two equations were used, Pth (theoretical power)= $\rho q g h$ and Pav(available power)= $\mu \rho q g h$, taking ρ, g, and h to be the same as in the previous example, and μ and q to represent efficiency and water flow (m3/s) respectively. The testing was done by using a tank to hold a fixed amount of water and a pvc tub with a ball valve to release the water at a designated time, the voltage generated was measured using a multi-meter.

Electromagnetic Ring Launcher

Peter Kvokotov, Nick Holewinski, Annie Strange, PHY 212 Advisor: M Scruggs

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The Science of Fidget Spinners

Liam James, Jessica Graham, Ian McCComas, PHY 211 Advisor: S Spivey

The goal of this project is to determine how much of the energy used up during the activation of a fan is lost to thermodynamic energy. A thermo gun will be used to take temperature measurements of a motor powering a fan. This will give an approximate efficiency from the various energy sources. Variations to the system include material and size of the fan blades, different energy sources, and different methods of measuring. It is predicted that, by using the laws of thermodynamics, Etotal-Ekinetic=EThermal

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Crane Forces

Chad Matthews, David Bonnet, Will Thomas PHY 211 Advisor: S Spivey

Abstract:

Viability of Aquaponics vs. Soil in Capsicum annum "Early Jalapeno" and "Red Stuff Hybrid"
Morgan Utley, Amy Scapin, Axel Hernandez, BIO 112 Advisor: S Kaye

Aquaponics is the combination of aquaculture and hydroponic technology to grow both fish and plants together in a closed-loop system. While aquaponics can play a role in increasing food security, it may also be a potential educational tool because of its interdisciplinary nature and required technological skill set. With aquaponics, we as students are able to study and conduct hands on experiments involving all aspects of the sciences such as physics, chemistry and biology. Aside from the sciences, aquaponics can play a very important role in the future for the survival of our species. This is possible thanks to its complex nature that can include environmental science, agriculture, the food system, health, economics, business and marketing.
To begin, we planted two varieties of Capsicum annuum., commonly known as jalapenos and sweet peppers. We started with a total of 16 rockwool beds of peppers. Eight of the beds are seeded with jalapenos, and the other eight with sweet peppers. After germination, we split the beds, planting 8 in soil and placing the other 8 in the aquaponics floating beds where they will spend the duration of their growth. Both growth experiments will take place in the same greenhouse under the same, if not identical environment. Qualitative data were collected through pictures and rulers for growth measurement. Ultimately, our exploratory findings will help educate us on the growth of peppers in soil vs our expectations for growth with aquaponics while establishing objectives for our particular educational purpose.

Thursday, November 30, 1pm – 3pm

Women and Bicycle Commuting Preferences

Erin Johnson, Amy McWhirt, Evan Tetamore BIO 111 Advisor:T Gray

Premise of Study: Women can be considered an "indicator species" throughout biking communities. The risk averse nature of women in different facets of life has them choosing to cycle more often in areas with protected bike lanes and off road multi-use paths.

Hypothesis: Women are 10% more likely to cycle in separated bike lanes or separate cycle paths, then on shared bike lanes with traffic where there is no physical barrier.

Method: We split up to do a traffic count of men and women cyclists over three different bike routes from the Denver Bike Map. We chose our points by taking into consideration whether there was a nearby safer option where the bicyclist didn't have any other choice but to use whatever type of lane available.

Our control was a location on Market Street and 15th Street where there was a traditional bike lane. Our independent variable was the type of bike route, either a shared street lane, a protected street lane, or a bike path. The dependent variable was the percentage of female riders on each type of bike route.

Findings: Both the protected lane and multi-use path were greater than our hypothesis of 10% with 28.7% and 35.3% female use, respectively in relation to male usage.

Conclusion: This supports the idea that women are the indicator species of a safer cycling infrastructure. Where women show a preference for bicycle riding, higher total numbers will follow. Denver would do well to encourage more safe bike lane options to inspire more bicyclists and ease the pollution and traffic congestion rampant in Colorado.
Recommendations: More data will always improve the results of an experiment. Also, there may have been errors in determining gender of cyclists being counted as gender can on occasion be vague.

The Dudes' Aquaponics 2017

Donald Bargas, Ben Matous, Ryan Mosgeller BIO 112 Advisor: Steve Kaye

Food is a driving force that influences all aspects of animal nature; from behavior, to the very anatomy, food is the paramount pressure for adaptation. Agriculture is the epitome of human adaptation and marked the rise of our species from feeble creatures hunting and gathering for this precious commodity, into the global elites that we are today. Just as we humans have advanced, so too have our methods of agriculture. Aquaponics is an up and coming new form of self or quasi self sustainable husbandry relying on the symbiosis between fish, plants, and bacteria in an easily controllable and regulated system. Our project focused on harnessing this technology to grow a variety of berries and legumes in order to test the correlation between seed size and the rate at which it reaches its projected adult height. This presentation will outline a more in-depth look at aquaponics, our own method and results, as well as discuss applications of this form of agriculture and its potential for growth, and its potential impact on the future.

The Physiological Effects of Music

Josephine Cooper, Morgan Maddox, Meliha Delic BIO 111 Advisor: T Gray

The purpose for the experiment was to further prove that music does more than just entertain. We chose this experiment for our project because all of us are involved in healthcare, all of us love music, and in many cases, people have said that music is a staple in their own life. Is this because it not only is a source of entertainment but also can have physiological effects on the human body? Do different types of music lead to various physiological responses? This is what we will be investigating.
Hypothesis:
If we introduce people to five different types of music and measured their blood pressure and pulse after listening to the song(s) for one minute, then we will see the blood pressures rise by 10% or drop by 10% with each song and pulses rise or fall by 15% because of people’s personal experiences.

Stirling Engine Efficiency

Annabelle Cunningham, Michele Brou, Antonio Contreras, Ryan Hart PHY 211 Advisor: C Medina

It was originally thought that all Stirling engines would have the same efficiency due to similarities in their designs. In this experiment, four Stirling engines of slightly different designs were built. Using simple techniques to vary individual aspects of the engine, it can be seen first hand how a change in variables directly effects engine performance. In order to compare the four engines built for this project, many tests were conducted such as lifting masses, calculating the efficiency and power output, using different shapes for the rotating mechanism, and varying heat input. By process of comparison and collective reasoning, this study will determine which engine best suits which purpose in terms of cost, efficiency, mechanical work and structure.

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 rocks 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 rocks 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.

Light in a vacuum

William Williams, John-Michael Centers, Colton Ketterling, Jarrid Carol-Frey PHY 212 Advisor S Spivey

Light in a vacuum travels at 3x10^8 m/s, it's so fast that nothing in the Universe is allowed to travel faster than it, but even light slows down when it travels through mediums other than empty space. The purpose of this experiment is to experimentally observe the speed of light in a vacuum and in atmosphere. Measure the difference in speed between the two mediums and confirm the cosmic speed limit that is light.In order to achieve this we have constructed a dark chamber with two parallel mirrors in order to bounce a laser, that is projecting a square wave that then must travel different distances by varying the amount of times it reflects of the two mirrors lengths and measure the difference in time it takes for the laser to travel the different distances using an oscilloscope. The results we are expecting should confirm the speed of light in and outside of a vacuum, thus reaffirming the cosmic speed limit.

The seismometer; a bridge between kinematics and energy physics

Sheena Skinner, Sean Ross, Cyrus Young, Dylan Waters PHY 212 Advisor: S Spivey

Seismology is the study of the propagation of seismic waves through the earth. A seismometer is an instrument that can measure and record these waves. By designing and building a seismometer with a variable spring height (variable K constant), and by using data from the literature on the ideal period of the spring's motion, we can determine the rate of change of magnetic flux over time as a magnet suspended from the spring and vibrated by the seismic waves moves in the solenoid. With this theoretical data and EMF data from the reading, we can calculate the ideal number of turns required in the solenoid in order to most accurately and precisely capture the seismic data.

Optimal Angle for Maximum Distance of a Projectile Launched from an Air-Powered Cannon

Madison Whitehead, Jacob Romo, Adam Blanco, Cade Mayhak PHY 211 Advisor: C Medina

The problem we are trying to prove is to maximize distance, the optimal angle is 45 degrees. It is important to understand this because there are real-life applications for projectile objects. It is interesting to see how far we can shoot a rubber ball at different angles because this concept is relevant for all ball sports. We built an air-pressurized cannon out of pvc pipe so that we can launch a rubber ball at various angles. We observed the range given at each angle to determine an optimal angle. We do not have results yet but we predict that distance traveled by the projectile will be largest at an angle of 45 degrees. This implies that athletes should launch a ball at 45 degrees in order to maximize range.

Skydiving with a purpose

Jonah Rich, Sam Rahantoknam, Kevin Hawekotte, Yousef Noor PHY 211 Advisor: C Medina

The project that we chose to carry out was an experiment on the forces of gravity and drag. The members of our group went skydiving in tandem to determine terminal velocity. Our group used a highly reputable smartphone application that collects altitude data. In addition to the application that gathered altitude data, the instructors our group went skydiving with were equipped with sensors that collected our speeds as well as the altitude as a failsafe, in case the application didn't run. As a group we were able to use the data we collected from our experiments to determine the force of drag as well as our terminal velocities.

Tesla Coil

Corey Kennedy, Brian Dalke, Darrian Schade, Chris Corona PHY 212 Advisor: S Spivey
The purpose of this project was to build and perform experiments on a Slayer-Exciter variant Tesla Coil. The motivation for this project was interest in the device which Nikola Tesla first created in 1899. Our experiments consist of varying the voltage input and type of top-load while recording the effects on the size and shape of the measurable electric field. We found that there is a direct correlation between voltage and electromagnetic field strength.

The Light Benders

Julianna Valenzuela, Jake Shelhamer, Mia Manning, Bryan Saenz PHY 212 Advisor: C Medina

Light can be used as a tool to better understand the world. In order to study how light works, we created a method with which we directed light waves to refract and diffract by shining the light through slits in cardboard. We observed how light reacts with obstacles and by comparing our results with theoretical data, obtained an understanding of how a light wave behaves. While we aren't discovering subatomic particles with this method, it is a good foundation to work with and can provide better understanding for more complex research in the future.

Capturing Electromagnetic Induction: Electromagnetic Motor

Sarah Elrod, Mitchell Keeler, and Loren Griffeth PHY 212 Advisor S Spivey

For our project we chose to design a motor that runs on electromagnetism, which is arguably one of the most important discoveries of the nineteenth century. We retraced the scientific footsteps of Michael

Faraday, James C. Maxwell, and Joseph Henry through neodymium magnets and 3D printing. In our project we chose to vary the number of coils and the flow of current in order to calculate the power and efficiency of our motor. Through a mixture of trial, error, mild electrocution, and GLX issues, our results showed that power, the number of coils, and voltage are intrinsically linked. These results show us how important electromagnetism is to nearly every facet of modern life.

Potential Energy Car

Bradley Helliwell, Don Chu, Ayaka Schmitz, Daniel Faltz PHY 211 C Medina
It is important to understand that potential energy has the potential to change the state of other objects around it, including speed and the configuration of motion. In this case we are experimenting to understand how potential energy is converted to kinetic energy through a spring in the form of a rubber band. We solved this problem by measuring the amount of potential energy though rotating the rods which then correlates with the maximum speed of the car. By testing different surfaces, we were able to consider how friction affects how much kinetic energy is lost to heat. By utilizing the conservation of energy equations we were able to determine the Δx of the spring empirically. We then compared this with the expected Δx. Our results did not follow the expected linear line. Elasticity of a rubber band decreases each time it is stretched so our K value which we considered constant is actually changing in small increments. In conclusion, there are multiple factors that could not be tested in this experiment which lead to the errors we had.

Evaluating Pressure on Frames

Kyle Crump PHY 211 Advisor: C Medina

Using a Fan Powered Car to Calculate Velocity and Friction

Marc Sabin, Wyatt Morris, Jesse Gibbons, Tucker Mattson PHY 211 Advisor: C Medina

In order to analyze the effects of friction and gravity upon a moving vehicle, our study evaluated the motion of a fan powered car. We tested the vehicle, which was constructed out of wood and plastic, on different surfaces and angles on a ramp. We originally tested the wood-bottomed car without any wheels. In order to calculate the specific effects of friction and the force enacted by the fan, we performed the tests with wheels in an attempt to minimize opposing friction. To determine the effects of gravity on the car, we ran tests uphill, downhill, and horizontally.

Underwater Wave Pendulum

Isaac Conrad, Joshua Jacobs, Molly Gallivan PHY 211 Advisor: C Medina

A wave pendulum moves in a way that dazzles the human eye. Pendulums in sequence move so quickly, it creates the visual illusion of double helices and waves. This experiment takes the wave pendulum and offers results to how the system works and changes while submerged underwater. In the experiment, the wave pendulum will be tested both in and out of water. The results of both will then be compared to show differences between the swing time of each pendulum and the difference in period length repetition.

The Electromagnetic Eddy Coaster

Duncan Edgington, Emma Naylor, Tyler Pirner, Bryanna Priddy, PHY 212 Advisor: S Spivey

Eddy currents are induced when a magnetic object in motion passes a stationary, nonmagnetic, conductive material and the induced current inside the stationary object creates a magnetic field opposite that of the moving object. The force due to the opposing magnetic fields acts to slow the moving object until an equilibrium point is reached as the object moves at a constant velocity. This concept can be used in a magnetic braking system to smoothly and efficiently slow an object. Example applications include a pulley system used to slow a falling rock climber and the system used for stopping a roller coaster after its descent. This project explores analytically and experimentally the effect of the force acting upon a magnetic object passing by a nonmagnetic conductive surface as the distance from the conductive plate increases using a model roller coaster track. The theoretical model of this braking force as a result of a magnet over a conductor is developed from electromagnetism, as proven with Faraday's and Lenz's laws, and verified experimentally with graphical analysis and theoretical versus experimental results. The following experiment can be used to determine the terminal velocity of the car under the influence of the magnetic drag from the induced eddy current.

Gyro effect

Colton, David, Cody, Alex PHY 211 Advisor: C Medina

We are trying to better understand the Gyro effect, and how mass is related to it. We care because the Gyro effect is an interesting phenomenon that could have strong implications on some technologies. We are using a homemade gyroscope and weights to test how the weight of the actual rotating disc changes how effective the gyroscope is. We will use physics relating to energy, momentum, inertia, and rotational kinematics to solve for the most efficient weight ratio for a gyroscope. We plan to video the Gyro and study it in slow motion for an in depth understanding of what is happening.

Fusion Reactors

Cody Johnson, Peter Hinaman, Jared Kirts, Dante Pei PHY 111 Advisor: M Hoerner

The earth is running out of an effective way of creating energy, this is why the future of fusion reactors are so important. Fusion Reactors will be efficient and the only byproduct of it is the release of hydrogen. The fusion reactors work by heating up isotopes (usually hydrogen) to about 50 million degrees Celsius. Once they are heated up to this temperature they must keep the Isotopes at that temperature. They keep it at that temperature until the nuclei fuses. After the nuclei fuses, physicist and scientist alike use the energy from that reaction to create power. This is difficult to achieve. Scientist say that by 2050 we will have the appropriate technology to be able to sink in and properly use the Fusion to make power. You need physics to tell how fast one needs to launch these particles. Without physics we would not be able to take advantage of Fusion Reactors and many other power saving methods like that.
In our home made lab we used a model in which we set mouse traps in a box and dropped ping pong balls inside. The ping pong balls bounce around very fast to demonstrate how fast the isotopes will move when they are heated to such high temperatures. The ping pong balls clash together making sound to demonstrate the energy that would be given off if they were actually to collide and create one nucleus from the two. Hopefully in the future we can take full advantage of this to save our dying planet.

Bring on the Heat: The Study of the Relationship between Geothermal Energy and Thermodynamics

Amina Hodzic, Lexi Vroom, Chandler Glander PHY 111 Advisor: M Hoerner

The purpose of this project is to analyze how thermodynamics within a heat engine can be related to geothermal energies. Geothermal energies are important due to their ability to be a renewable energy source. Our hypothesis is that the heat engine will contain the same idea of thermodynamics as it does in a geothermal system.
The second law of thermodynamics states that heat will flow from a hotter area to a colder one. In order for it to be efficient two separate temperatures must be involved. The heat source will make the gas within the system begin to move, moving the piston up and then down once cooled. This continued cycle of heating and cooling will keep the piston moving up and down. Similar to how a geothermal system uses heat to create energy.
With further development, geothermal energy can be the key for a cleaner and more sustainable energy source. Whereas solar and wind power can have limitations to supply, geothermal breaks that barrier with a more flexible supply.

Tracking vs Non Tracking Solar Panels

Jessica Deighton, Lynzee Allen, Nathan Haramaki, Jacob Trelease PHY 111 Advisor: M Hoerner

Tracking solar panels could greatly increase the efficiency of this renewable energy technology by decreasing the process limitations of non-tracking solar panels. The purpose of this experiment is to determine and compare the efficiency of tracking vs. non-tracking solar panels. The hypothesis states that tracking solar panels are significantly more efficient than non- tracking solar panels.
Materials that were utilized included: a meter stick, a high wattage heat lamp, a 3”x2” solar panel, a voltmeter, and a diagram with premeasured line angles. First, lines were drawn in 15° increments across 180 on a whiteboard. The solar panel was placed in the center. The high wattage lamp was attached to the end of a meter stick and was rotated to each increment around the arc with one end of the meter stick stationary and pivoting from a central point. The solar panel was attached to the voltmeter. Two variations were tested. One being where the solar panel was placed flat with the center of the panel facing the 90° line to represent non tracking solar panels, while the meter stick and light rotated around the arc. For the second variation the solar panel was rotated with the meter stick around the arc facing the center of the solar panel at the light to represent tracking solar panels. Three trials were done of each of these variations and averaged out. The physics behind solar panel technology is all about energy transfers. In solar panels, light energy is transformed to electrical energy and then that energy moves to the battery where it is transformed into chemical energy, and when energy is needed, it is transferred to electrical energy. This experiment looks to maximize light energy transformation. The results from the experiment confirm our hypothesis.
Efficiency is reduced due to process limitations and fundamental limitations. By using tracking solar panels, process limitations are decreased, thus improving efficiency by 93.1% and confirming the original hypothesis. Although tracking solar panels are a greater initial cost, the return on investment is much higher due to the greater efficiency of the product.

Student Research Presentations

Wednesday, Nov. 29	**Gray's Peak**		**Torrey's Peak**	
	8:30 am	***Mechanical Systems*** (PHY 211 – Spivey)	**12:45 pm**	***Electricity and Magnetism*** (PHY 212 – Scruggs)
	11:30 am	***Mechanical Systems*** (PHY 211 – Spivey)	**3:00 pm**	***Physical Geology*** (GEY 111 – Camann)
	5:45 pm	***Electricity and Magnetism*** (PHY 212 – Medina-Hernandez)		
Thursday, Nov. 30	**Gray's Peak**		**Torrey's Peak**	
	9:00 am	***Physical Geology*** (GEY 111 – Camann)	**8:15 am**	***Electricity and Magnetism*** (PHY 212 – Spivey)
	12:00 pm	***Physical Geology*** (GEY 111 – Camann)	**11:15 am**	***Mechanical Systems*** (PHY 211 – Medina-Hernandez)
	5:45 pm	***Mechanical Systems*** (PHY 211 – Medina-Hernandez)	**2:45 pm**	***Mechanical Systems*** (PHY 111 – Hoerner)

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

Faculty Advisors:

Lynnette Hoerner, Astronomy

Lynne Albert, Biology

Tracy Gray, Biology

Steve Kaye, Biology

Marie Hoerner, Physics

Carlos Medina, Physics

Shane Spivey, Physics

Barbra Sobhani, Physics & Honors