| Name(s) | Project Number |
|---|---|
| **Mina L. Abbassi** | **J1201** |

**Project Title**

## Paw Dominance in Dogs: The Brain, the Paw, and the Dog

**Abstract**

**Objectives/Goals**
The objective of this project is discover whether dogs have a dominant paw that they prefer over the other, and whether this correlates to the dominant side of their brain.

**Methods/Materials**
Three different tests were conducted on ten dogs with each test being repeated twenty times. Test One was to roll a ball towards the dogs and observe whether they used their paws to capture it. Test Two was to have a clear plastic cup, one for each dog, covering some treats and to observe whether the dogs used their paws to free and eat the treats. Test Three was to position the dogs outside of a door and have someone on the other side of the door call to them. It was then observed whether the dogs used a paw to push open the door.

**Results**
To determine dominant handedness, I figured out which paw was used more by each dog, and in one case, by how much. I calculated that 60% of the ten dogs tested (six out of ten) were dominantly right handed, while 30% of the ten dogs tested (three out of ten) were dominantly left handed, half as many as were right handed. However, 10% of the ten dogs tested (one out of ten), used both paws almost the exact same amount of times, and was therefore determined to be ambidextrous.

**Conclusions/Discussion**
I conclude through experimentation and background research that dogs do have a dominant paw and that it is, indeed, correlated to the dominant side of the dog's brain. By knowing which paw the dog prefers and then using this information to learn which side of its brain is more dominant, one can determine its likely temperament and learning style. This is helpful when training dogs for multiple tasks in life, such as guiding the disabled, training to be a police or search-and-rescue dog, or simply helping a pet dog learn obedience training. Knowing one's dog in this manner can also help one predict how it will react in social situations in the home and community.

**Summary Statement**

By observing their natural behavior in response to three different experiments, I found that dogs do possess a dominant paw that correlates to the dominant side of the dog's brain.

**Help Received**

I designed and conducted all of the experiments myself, with the actual work supervised by Christine Ducey. I received research approval before conducting any experiments from Lea Schroeder, DVM.

| Name(s) | Project Number |
|---|---|
| **Mahmoud J. Alamad** | **J1202** |

**Project Title**

## Autism Listens!  An Attempt to Digitally Simulate a Hearing Aid that Helps Autistic Children with Hyperacusis

**Abstract**

**Objectives/Goals**
The objective of this project was to attempt to create a prototype of a special kind of hearing aid that keeps main conversation sounds (foreground noise) at the same level, while minimizing background noise. The aim is to help children with autism, who suffer from hyper sensitivity to sound, function better. After extensive research, it was realized that such a hearing aid cannot exist at the time since the technology to make a hearing aid that reduces noise does not yet exist. So it was decided to digitally simulate what the hearing aid is expected to do, using the software Audacity.

**Methods/Materials**
Six male subjects between the ages of 13-15 years old, three autistic and three non- autistic, were tested for response time to simple questions and instructions. Four audio files were created using the software audacity with the questions and instructions and background noise present. The background noise included a television, a remote controlled car, and a dishwasher. A stop watch was used to calculate the response time. Headphones were used to listen to the questions. The four different audio files created had the foreground noise at the same level, and each had a manipulated reduction of the decibels of the background noise.

**Results**
After testing autistic and non-autistic children, the results showed that completely eliminating background noise increased the response time for children with autism when responding to simple questions and instructions. Decreasing background noise by 30dB made the response time better than with background noise at normal recorded level and at 15dB reduction, but not better than when the background noise was completely eliminated.

**Conclusions/Discussion**
Children with autism find it hard to focus with background noise present, as their hypersensitivity to sound makes them hear everything at the same intensity. The digitally created audio files with decreased background noise allowed the children with autism to have a faster response time to questions and simple instructions, thus giving them the opportunity to function better. It will also help alleviate the pain and discomfort of hypersensitivity to sound.

**Summary Statement**

An attempt to digitally simulate a hearing aid that helps autistic children with hyperacusis overcome their auditory perception challenges by reducing or eliminating background noise.

**Help Received**

My mother and adult supervisor, Rula Alshanableh, supervised as I tested my subjects and double checked my data and calculation. While I created the necessary audio files myself, my brother, Abdulkarim Alamad, familiarized me with the software audacity that I used.

| Name(s) | Project Number |
|---|---|
| **Zoe R. Alvarado** | **J1203** |

**Project Title**

## How Does the Trajectory of a Horse Change as the Height of a Jump Increases?

**Abstract**

**Objectives/Goals**
As a horse jumps over an obstacle, the biomechanics of the equine have to adjust to the increase in height. This experiment explores the changing nature of the jumping horse.

**Methods/Materials**
This experiment was conducted in an arena; using two different horses. Both horses were jumped three times at each height, were jumped without a rider, using a lunge rope and meter stick. A tape measure was used to measure the points of take off and landing and a rake was used to clear ground after each jump. It was documented with a Canon 7D digital camera, set to sequence mode and a tape measure was used. The photographs were then printed and analyzed with the raw data.

**Results**
1.) At lower level jumps, both horses leave the ground closer to the jump itself.
2.) For higher level jumps, the joint axises are spread out significantly more.
3.) With jumps measured at 6" and 12", the fetlocks and hocks were a little less than 1-foot from the jump itself. At 18" and above, the fetlocks and hocks at least 3 times farther away.
4.) Both horses stayed relatively horizontal at the 6", 12" and even 18" jumps. Both broke the horizonatal line and rose higher for jump set at 24".
5.) The higher the jump, the lower the spine and head came as both horses cleared jump.
6.) Both horses landed father away as the height of the jump rose.
7.) The hip and stifle lower for the higher jumps; slightly lower at medium heights and remain level for low jumps. Both horses brought their center of gravity under them for higher jumps.
8.) At the last full stride before the jump, both horses are typically the same distance from the jump despite the increases in height. At the end of the jumps though, both horses are farther away as the height of the jump increases.

**Conclusions/Discussion**
Both horses cleared jumps of 6", 12" and 18" without breaking their stride or the shape of their trajectory. With a jump set to 24", the horses had to change from a stride to jump mode and alter the shapes of their trajectories in order to clear the increased height.

**Summary Statement**

I jumped two horses to see how their trajectory and biomechanics changed as the jumps were increased.

**Help Received**

Mother took photographs of experiment. Carlie Scarbery, a local horse trainer, oversaw and helped me jump both horses . Dr. Witt did vet check on both horses.

**Name(s)**

Olivia Burkhalter; Ty Koebler

**Project Number**

# J1204

**Project Title**

## Super Pawers: The Study of Brain Lateralization through Paw Preference in Dogs

**Abstract**

**Objectives/Goals**
We wanted to learn if dogs showed paw preference similar to human handedness.

**Methods/Materials**
We performed two tests for paw preference, ten trials each, on twenty different dogs. The first test was a walking test, in which we observed which paw the dog led with in coming toward us from a seated position. We repeated that test seven times. The second test was the Kong test. It used a Kong toy filled with treats and we observed over three minutes whether a dog used one or both of its paws to stabilize the toy in trying to extract the treats. Our main materials were several dehydrated liver treats used in calling the dogs and the Kong toy stuffed with liver treats.

**Results**
35% of dogs showed a preference for the left paw, 35% showed no paw preference, 20% showed a right paw preference, and 10% showed ambidexterity.

**Conclusions/Discussion**
Our results indicated that some dogs do show a preference for one paw over the other. As we learned in our research, this could help people working with animals decide which dogs might make better service dogs, because paw preference has been linked to certain behaviors. In addition, this knowledge might help people address behavioral problems in their dogs because they will understand them better by knowing their preference.

**Summary Statement**

Our experiment explored brain lateralization in dogs by looking at whether dogs display paw preference.

**Help Received**

Our teacher helped us develop our methods and reviewed our results.

| Name(s) | Project Number |
|---|---|
| **Dani R. Chmait** | **J1205** |

| Project Title |
|---|
| **The Triplet Fingerprint Study: Comparison of Fingerprint Patterns of Identical and Non-Identical Co-Triplets** |

**Abstract**

**Objectives/Goals**
Fingerprints develop while a person is within the womb. It is not known whether fingerprint patterns are due solely to environmental factors in the womb, or if there is a genetic component as well. Dizygotic triplets (two identical, one non-identical) can be used to determine the role of environmental versus genetic factors. The objective of this study is to determine if the fingerprint patterns from identical co-triplets are more similar than the non-identical co-triplets.

**Methods/Materials**
Mothers of dizygotic triplets obtained the fingerprints of each triplet, and mailed back the fingerprint cards and consent forms. The fingerprints were de-identified and examined by a fingerprint specialist, Mr. Kurt Kuhn. Each finger was analyzed, and assigned a National Crime Information Center (NCIC) Fingerprint Code. The data from each digit were compared between the identical co-triplets (A+B) and the non-identical co-triplets (A+C and B+C). The datasheet was submitted for statistical analysis to a statistician, Dr. Lisa Korst.

**Results**
Seven mothers of dizygotic triplets agreed to participate. All 21 children provided adequate quality fingerprints of all ten fingers. The number (average ± standard deviation) of fingers with the same pattern between the identical co-triplets (A and B) and the non-identical co-triplets (A and C; B and C) were as follows: A and B was $8.29 \pm 1.25$, A and C was $5.71 \pm 2.29$, and B and C was $6.14 \pm 2.04$. The identical co-triplets had significantly more fingerprint patterns in common compared to the non-identical pairs ($p < 0.05$).

**Conclusions/Discussion**
The identical co-triplets had more fingerprint patterns in common than the non-identical co-triplets. Because all the triplets shared the same womb, but the identical co-triplet pairs had more common fingerprint patterns, this suggests that there is a genetic component to fingerprint patterns.

| Summary Statement |
|---|
| I showed that identical co-triplets had more fingerprint patterns in common than the non-identical co-triplets, thereby showing that there is a genetic component to fingerprint patterns. |

| Help Received |
|---|
| I developed the scientific question. Mr. Kurt Kuhn (Retired, Beverly Hills Police Dept.) help me develop the fingerprint instruction sheet and analyze the fingerprints. Dr. Lisa Korst (Statistician, USC) helped with the statistical analysis. The mothers of the triplets were identified from the USC Perinatal Database. |

| Name(s) | Project Number |
|---|---|
| Jydrianna L. Colon-Kinlecheenie | **J1206** |

**Project Title**

# The Nose Knows Smell, but Does It Know Taste?

**Abstract**

**Objectives/Goals**
The objective of this project is to observe how smell is involved in the ability to taste and which flavors are easier to identify with an impaired sense of smell. I believe that if I take away someone#s ability to smell by making them plug their nose then their ability to taste will be reduced.

**Methods/Materials**
To better compare the ability to taste with or without a sense of smell, I use a control group and an experimental group. I gather 18 subjects, 9 for the control group and 9 for the experimental group. I blind fold all 18 subjects but only have the experimental group plug their noses. Then, I hand each person 1 tablespoon of each food item from the 6 different taste buds. After they try each food item, I ask if they can identify the taste of the food item they are given.

**Results**
I observed that both groups were fully capable of identifying the bitter (vinegar) and salty (potato chips) food items. But only the control group could identify the taste of all food items correctly.

**Conclusions/Discussion**
In conclusion, my results support my hypothesis and show that we actually do need our sense of smell to taste the food we eat. Many people think of taste and smell as two very different senses, but without smell we wouldn't be able to taste.

**Summary Statement**

After completing my experiment, I found that humans use the sense of smell to complete an everyday task, taste food.

**Help Received**

I gathered my test subjects and performed the experiment myself.

| Name(s) | Project Number |
|---|---|
| Michael B. Dechene | **J1207** |

**Project Title**

## The Biomechanics of Pitching

**Abstract**

**Objectives/Goals**
The objective of this study is to determine if fully incorporating the lower body mechanics, while pitching, will affect the speed and accuracy of a pitch.

**Methods/Materials**
Baseball, stopwatch, pitching mound set 50 ft. from target, catcher with glove for target, and pitchers of different age, weight and height. Measured the speed and accuracy of each pitch thrown.

**Results**
The speed of pitches thrown utilizing full lower body mechanics in a leg kick and full stride pitch were faster, sometimes twice as fast, than pitches thrown from a slide step pitch. The accuracy of full lower body mechanic pitches was better than the slide step pitches. The heavier pitchers threw faster than the lighter weight pitchers from both pitching positions. The speed was affected much more than the accuracy with the utilization of lower body mechanics.

**Conclusions/Discussion**
Pitching utilizing the full lower body mechanics will increase the speed and accuracy of a pitch. As a pitcher, my coaches tell me to, "use your lower half," and in doing this project, I found that they are correct and it really makes a difference. This will help me make sure to utilize my lower body mechanics with every pitch.

**Summary Statement**

I showed that the speed and accuracy of a pitch is increased by incorporating lower body mechanics.

**Help Received**

I received help from the pitchers in the Kings Baseball program, my baseball academy, and collected the data myself.

| Name(s) | Project Number |
|---|---|
| Eva M. Eleftheriadis | **J1208** |

**Project Title**

## Can You Breathe as Deeply as Me?  Comparing the Inspiratory Vital Lung Capacity of Athletes

**Abstract**

**Objectives/Goals**
The objective of this study is to determine which one of the three groups of athletes participating in the study (synchronized swimmers, soccer players, or tennis players), with an athletic routine of five or more hours per week for at least one year, has the largest inspiratory vital lung capacity.

**Methods/Materials**
An incentive spirometer, which measures the volume of inspired air in milliliters (ml), was used for each girl to measure her inspiratory vital lung capacity. A total of thirty girls, ages twelve to fifteen, and without any respiratory problems were tested. They were divided into three groups of ten athletes from each sport (synchronized swimming, soccer, and tennis). Each girl inhaled to her maximum ability on her own incentive spirometer three times. The data was then calculated to determine the average measurement of the athletes for each of the three sports.

**Results**
The synchronized swimmers average inspiratory vital lung capacity was 2875 ml. The soccer players average inspiratory vital lung capacity was 3006.6 ml. The tennis players average inspiratory vital lung capacity was 2163 ml. The soccer players had the greatest average inspiratory vital lung capacity and the tennis players had the least average inspiratory vital lung capacity.

**Conclusions/Discussion**
This study concluded that the soccer players had the greatest average inspiratory vital lung capacity of the three groups of athletes.  Although the scientist anticipated that the synchronized swimmers would have the greatest inspiratory vital lung capacity, the results could have been affected by the fact that the soccer players average height and age/physical maturity were both greater than that of the other two groups. The scientist would like to conduct a follow up study with athletes with narrower height and age ranges.

**Summary Statement**

My study determined that the soccer players had the greatest inspiratory vital lung capacity compared to synchronized swimmers and tennis players.

**Help Received**

My science teacher, Mr. Semple, provided feedback throughout the project and proofread my science paper. My father, Ioannis Eleftheriadis, MD and my mother Anne Kounis Eleftheriadis, RN helped me comprehend the scientific vocabulary in my advanced scientific research materials.

| Name(s) | Project Number |
|---|---|
| **Riley L. Espinosa** | **J1209** |

**Project Title**

**Searching for Commonalities among Patients with a Bicuspid Aortic Valve**

**Abstract**

**Objectives/Goals**

To search for patterns, trends, and commonalities among patients with a bicuspid aortic valve in order to help diagnose or predict the condition in others.

**Methods/Materials**

I created a 12 question survey on Surveymonkey.com with questions about BAV, such as the age of diagnoses, how BAV was diagnosed, demographics, gender, family history, other heart conditions, medications, and lifestyle. I then posted a link to the survey on various Facebook groups (such as BAV Group, Children with Congenital Heart Defects, Aortic Health group) and asked people to consider filling out the survey if they had BAV or had a child with BAV. After approximately 2 months I printed out the surveys (273) and began to analyze the data.

**Results**

After looking at the survey results many of the questions were split nearly 50/50, so there was no pattern or commonality (Sports, Surgery, Medication, Gender, Symptoms). Geographically, BAV is spread pretty evenly all over the world. The few questions where there was a distinct trend were: Family History#I can conclude that BAV is not often found in family history; Age of Diagnosis#it is most often diagnosed under 5 years of age, Lifestyle Restrictions#most BAV patients have no restrictions, and Related Heart Problems-75% of BAV patients also have other heart conditions most commonly an aortic aneurysm and stenosis. From this I can conclude that BAV patients are typically diagnosed at a young age and often develop more heart issues as a result but do not have a family history and little lifestyle restriction.

**Conclusions/Discussion**

After analyzing all of the survey data I can conclude that, unfortunately, there are no commonalities among patients with BAV that would be useful in predicting who else might be at risk of the disease or pass it on. I can conclude that if one is diagnosed with BAV it is very likely that they will develop other heart/aortic problems. In the future I would like to continue my research on this issue#several of the questions and responses led me to think of new questions#for example: those with a family history-who in the family has BAV, is it siblings? Parents? Or more distant relatives? I#d also like to survey cardiologists#there seems to be a pretty wide list of medications and lifestyle restrictions and I#d like to learn more about why there isn#t more consistency in treatment.

**Summary Statement**

I created a survey for patients with a bicuspid aortic valve in order to find patterns or trends in hopes of being able to use these trends to predict future patients of BAV.

**Help Received**

My mom helped type the report, my whole family helped put the board together. My mom used her Facebook account to help me post links to the online survey. I also spoke with my cardiologist and the John Ritter Foundation for advice on how to begin my project.

**Name(s)**

Sandra M. Foxx

**Project Number**

# J1210

**Project Title**

## The Effect of Texting on Finger Dexterity

**Abstract**

**Objectives/Goals**

The purpose of my project is to determine whether frequent texters have greater finger dexterity as compared to those that rarely text. This project is influential to present day technology because many people currently use smartphones to communicate via texting.

**Methods/Materials**

Recruit the 40 test subjects and have them verify the number of text messages sent in the month of February. Have all the subjects type 100 characters on the phone with one finger and record the time. Have the subjects take the finger dexterity test (O'Connor Dexterity test based) with one hand only and record the time. Have each subject do the steps until all of the subjects have finished testing.

**Results**

Based on my experiment, the more frequent texters had faster times in both tests. There was a 20.19 second difference in the typing test and a 30.89 second difference in the finger dexterity test.

**Conclusions/Discussion**

My hypothesis stated that the subjects who text more often would have faster times in both dexterity tests. According to my data, my hypothesis was proven correct. Every frequent texter had a dexterity test time under four minutes while the non-frequent texters had times above four minutes. In the typing test, the frequent texters had times under 40 seconds and the non-frequent obtained higher times of above 40 seconds. The testing went fairly well; however, as stated in my future experiments section, I would want to test in a room with only the subject and, also, randomize the order of the test administered.

**Summary Statement**

I tested frequent and non-frequent texters' finger dexterity and found the frequent texters to have a better finger dexterity on average.

**Help Received**

Deen Foxx

| Name(s) | Project Number |
|---|---|
| **Dov Fradkin** | **J1211** |

**Project Title**

## How Do Different Breads Affect Blood Sugar Levels of Diabetics and Non-Diabetics?

**Abstract**

**Objectives/Goals**
The purpose of this project is to determine which bread, sprouted or wholewheat causes the greatest spike in the blood sugar levels of type II diabetics or non-diabetics.

**Methods/Materials**
Testing equipment included lancets, needles, meters, test strips, as well as bio hazard container. A RN conducted the testing of 50 test subjects with 6 tests each. Testing included 1) baseline blood level after fasting 2) An hour after eating sprouted bread 3) final test 2 hours after consumption. Same 3 steps repeated with wholewheat bread the following day

**Results**
Data shows that whole wheat caused a higher spike/crash in both diabetics and non-diabetics. Also the highest overall increase during the spike. Diabetic data indicated a higher crash than spike with the wholewheat. Non-diabetics spike was greater for sprouted wheat & crash was greater for whole wheat. The data from this project suggests that sprouted and whole wheat breads both create a higher glycemic response in diabetics.

**Conclusions/Discussion**
Conventional wisdom dictates that "Low Glycemic" bread does not cause significant spike/crash in blood sugar level. The data indicates otherwise for diabetics and non diabetics. I have not found this data published. The Price Pottinger Foundation recognized this project as important in the field of nutritional research.

**Summary Statement**

The purpose of this project is to determine which bread, sprouted wheat or whole wheat causes the greatest spike in the blood sugar levels of type two diabetics or people without diabetes.

**Help Received**

I benefited from the guidance of my school lab director and diabetics in my community and designed the project on my own.

| Name(s) | Project Number |
|---|---|
| **Margaret M. Franke** | **J1212** |

**Project Title**

## Does the Shoulder Angle of a Horse Affect Its Stride?

**Abstract**

**Objectives/Goals**
To test if the shoulder angle of a horse affects its stride. It was expected that the larger the shoulder angle, the longer the stride.  Similar to humans with longer legs typically having a longer stride, it was anticipated that a larger shoulder angle would result in a longer stride in a horse.

**Methods/Materials**
Using an electronic protractor the shoulder angle was measured for 5 different horses.  Each horse was a different breed.  Each horse was walked through a clean patch of dirt at a normal walking gait.  The distance between each step front to front hoof was measured using a measuring tape.

**Results**
A larger shoulder angle did result in a larger stride with one exception.  One of the horses tested was a miniature horse section B, and this horse is significantly smaller than the other four breeds.  This horse had one of the largest shoulder angles but a much smaller stride than the other horses.

**Conclusions/Discussion**
A larger shoulder angle on a horse did not always correlate to a longer stride.  Certain unique physical characteristics of some breeds impact the stride more than the shoulder angle.  However, in horses with similar characteristics the shoulder angle did correlate to the stride.  Additional testing grouping horses by breed and then testing if the shoulder angle affects the stride could provide more conclusive data.

**Summary Statement**

My testing showed that the shoulder angle of a horse does affect its stride but I discovered that the unique physical characteristics of certain breeds prevent comparing the data across breeds.

**Help Received**

| Name(s) | Project Number |
|---|---|
| **Skylyn T. Goldberg** | **J1213** |

**Project Title**

## Which Will Increase Your Heart Rate More: Biking a 5K or Running a 5K?

**Abstract**

**Objectives/Goals**
The objective is to see which activity, biking a 5K or running a 5K will increase your heart rate more.

**Methods/Materials**
Measured the heart rate of two people while biking and running at 5K distances. Each person completed five 5K bikes rides and five 5K runs. Results were graphed to determine which activity increases the heart rate more.

**Results**
The average of the ten 5K bike rides for the maximum heart rate is 139.5 beats per minute. The average of the ten 5K runs for the maximum heart rate is 166 beats per minute. For my experiment, the heart rate for the ten 5K runs were consistently higher than the ten 5K bike rides.

**Conclusions/Discussion**
Running a 5K will increase your heart rate more than biking a 5K. Experiments like this can be beneficial in real-life settings to help improve one's health. The more running, biking, and exercising in general, that you do, will help you stay healthy and have a strong heart.

**Summary Statement**

I showed that running a 5K will increase your heart rate more than biking a 5K.

**Help Received**

| Name(s) | Project Number |
|---|---|
| **Meiwan M. Gottschalk** | **J1214** |

**Project Title**

# Perceiving with Your Periphery

**Abstract**

**Objectives/Goals**
The objective was to determine which color (out of red, yellow, green, and blue) an adult could see most easily using their peripheral vision. Research done on this says that blue and yellow are seen more easily with your peripheral vision, and yellow can be mistaken for white, so it was expected that blue would be seen more readily.

**Methods/Materials**
Thirty subjects were seated, one at a time, under a large protractor made to measure the degree at which a color card was first recognized. A color card was moved from behind the subject around to the front at the rate of 5 degrees per 2 seconds until the subject said they could distinguish the color on the card. This was repeated three times on each side for each color tested.

**Results**
After experimenting on thirty adults, the results showed that both yellow and blue were seen most easily with the right eye at 71.5 degrees. Yellow only, was seen easiest with the left eye at 74.5 degrees.

**Conclusions/Discussion**
The results partially supported the hypothesis. Blue was seen most easily, along with yellow, with the right eye. These results can be used to help improve pedestrian safety by having people wear yellow or blue while walking, running, or biking.

**Summary Statement**

The project shows which color an adult can see most easily using their peripheral vision.

**Help Received**

Interviewed optometrist Dr. Marcus Appy about the project subject and had my teacher proof-read my work.

| Name(s) | Project Number |
|---|---|
| **Prathik Kakarlamudi; Aditya Udgaonkar** | **J1215** |

**Project Title**

## Does Measured Blood Glucose Correlate with Tear Glucose?

**Abstract**

**Objectives/Goals**
About 347 million people worldwide have diabetes. More than 80% of diabetes deaths in the world occur in low income countries because of lack of awareness. Current testing methods of measuring glucose are complex, expensive and invasive. The objective of this project is to extend our last year project of measuring the concentration of glucose in eye tears by correlating Refractometer Brix scale with actual blood sugar level measured in milligrams per deciliter (mg/dL).

**Methods/Materials**
The two instruments we used to measure the glucose are Brix Refractometer and Blood Glucometer. We already know Brix Refractometer based on our analysis can measure sugar in the tears and Blood glucose monitor can check sugar in the blood drop. The Methods consists of two steps, measuring the Tear Glucose concentration using the Refractometer and measure blood Glucose using a Glucometer for various participants.

**Results**
In this project as planned we collected blood glucose and tear glucose readings from several participants across various ages who are non-diabetic as well as diabetic. We used Pearson Correlation coefficient for comparing Brix scale vs Blood Glucose to correlate the results. We choose this method since it is every popular method used by statisticians. In order to determine how strong the relationship is between two datasets, a formula is used to produce what is referred to as the coefficient value. From the base line data we gathered on various participants, we conclude the results approve our hypothesis. As the Pearson correlation coefficient shows a positive value of 0.796. We could confidently conclude there is a strong relationship and positive correlation between Brix scale vs Blood glucose in mg/dL. However with the limited sample, We CANNOT conclusively confirm this with a degree of certainty. A bigger sample size of hundred may give us a better idea and results.

**Conclusions/Discussion**
Looking at the data we support our original question #Does measured blood glucose correlate with the tear glucose# that there appears to be a positive correlation between Brix scale as compared to Blood glucose.

**Summary Statement**
We demonstrated that there is a positive correlation between the measured blood glucose and tear glucose in humans.

**Help Received**
Thanks to our teacher for mentoring us and our parents for driving us around to gather data.

| Name(s) | Project Number |
|---|---|
| **Ellie M. Knight** | **J1216** |

**Project Title**

## How Do Tones of Voice Affect a Horse's Heart Rate and Reaction?

**Abstract**

**Objectives/Goals**
The objective of this study is to find out if a humans tone of voice can affect a horse's heart rate.

**Methods/Materials**
Took each horse's resting heart rate. Talked to each horse in calming tone. Took heart rate and recorded data. Repeated 6 trials. Repeated 6 trials with 3 different audio tones. 5 horses, stethoscope, 4-5 people including me, measured horse's heart rates to different audio tones.

**Results**
Yes, tones of voice do affect a horse's heart rate and reaction, but there is another variable that comes in to play. That variable is trust. If a horse is familiar or trusts a person then the difference in the heart rate and reaction is small compared to when they do not trust a person.

**Conclusions/Discussion**
Repeated trials with multiple horses revealed that if the horse trusts you there will not be as much of a difference in heart rate or reaction as a horse that does not trust you.

**Summary Statement**

If a horse does not trust a person, when the horse is talked to by that person the horse's heart rate and reaction will be higher than a horse that does not trust a person.

**Help Received**

My grandfather showed me how to take a horse's heart rate.

| Name(s) | Project Number |
|---|---|
| Kylie M. Konyn | **J1217** |

**Project Title**

# How Now Black and White Cow

**Abstract**

**Objectives/Goals**

The objective of this study was to see if age affects the conception rate in bovine.

**Methods/Materials**

Dairy Herd Improvement Association records (computerized recording system), Pens, Pencils, Paper, Artificial Insemination Gun, Holstein Semen, Gloves, and 727 head of bovine including heifers and cows. I bred the animals and recorded the breeding in DHIA records system. I had our dairy vet confirm pregnancies and recorded them in DHIA. I compared records and recorded and analyzed my results.

**Results**

My findings were that heifers had a 97.16% conception rate, 1st lactation cows had a 59.9% conception rate, 2nd lactation cows had a 52.05% conception rate, and 3rd and older lactation cows had a 53.76% conception rate.

**Conclusions/Discussion**

I hypothesized that heifers would have a higher conception rate than first lactation and older cows. I am proud to say that according to my experiment my hypothesis was correct. I found that heifers had almost double the conception rate when compared to cows. I was not surprised that the heifers had a higher conception rate than the lactating cows because being younger means they have more viable eggs. I had not anticipated however that the lactating cows would have such a low conception rate. I expected that the cows would have a conception rate lower but closer to the conception rate of the heifers. One reason for this could be that the cows were lactating during breeding meaning their normal hormone cycle may be altered in some way. I feel that the number of bovine used in my experiment allowed my results to be more valid along with the random selection of subjects.

**Summary Statement**

The purpose of this learning experience was to increase my knowledge of bovine anatomy and reproduction.

**Help Received**

I would like to thank my parents for their love and support and assistance with breeding all of the cows. Dr Joe Ferguson, for his assistance with confirming all of the pregnancies. Diego Vallejo for giving me a presentation on artificial insemination (AI).

| Name(s) | Project Number |
|---|---|
| **Ryan J. Lipsky** | **J1218** |

**Project Title**

## Don't Go Staining My Teeth

**Abstract**

**Objectives/Goals**

My objective was to discover what would stain teeth the darkest: cola, black tea, or coffee.

**Methods/Materials**

I placed 3 molars in small plastic cups. I filled one with cola, one with black tea, and one with coffee. I recorded the color change of each, every day, for 10 days.

**Results**

I proved my hypothesis, coffee will stain teeth the most, wrong. Clearly, this project proved cola to stain the tooth enamel darkest.

**Conclusions/Discussion**

In conclusion, I discovered extrinsic staining of actual human molars to be much more rapid than anticipated. Cola, black tea, and coffee are darkening and thus weakening people's teeth, little by little, every day. I believe the best way to solve this problem will be to encourage everyone to drink water!

**Summary Statement**

I discovered cola stains human teeth darker than black tea or coffee.

**Help Received**

I performed this procedure on my older sister's discarded baby molars. My mother and science teacher both reviewed and gave guidance during this project.

| Name(s) | Project Number |
|---|---|
| **Rishabh Mandayam** | **J1219** |

**Project Title**

## Mutations and Drug Response

**Abstract**

**Objectives/Goals**

The objective of this big data project was to determine if gene mutations impact response to Atorvastatin. Hypothesis was that if the genes involved in the biological signaling pathways that Atorvastatin normally functions through, mutate, then these gene mutations will have an impact on the response.

**Methods/Materials**

A list of candidate genes, involved in the Pharmacodynamics (what drug does to body) and Pharmacokinetics (what body does to drug) pathways of Statins was compiled. For each of the candidate genes, its response to Atorvastatin, the rsID of the allele, whether it is an intron or exon, its DNA codon sequence change, its mRNA codon sequence change, its amino acid sequence change, and its effect were recorded using PharmGKB, NCBI websites and Codon charts into Microsoft Excel worksheets.

**Results**

On analyzing the data charts, of the 43 candidate genes, 16 had an impact on Atorvastatin response. This implies 37.2% of the candidate genes had impact on the response to Atorvastatin. It was also determined that single nucleotide polymorphism (SNP) in the exons of candidate genes has 46.67% impact on the efficacy of Atorvastatin.

**Conclusions/Discussion**

One of the reasons for why these mutations had an impact on the drug response is because in these cases there was a change in the codon sequence in the DNA, mRNA and the amino acid which effectively changed it from polar to non-polar or charged to uncharged amino acid. These seemingly small changes have large impact on response to the drug. These results may fuel targeted therapy for heart diseases. In conclusion, the mutations in the candidate genes have an impact on drug response and the hypothesis must be accepted.

**Summary Statement**

Examining and analyzing the effect of mutations in the candidate genes on Atorvastatin response, I found that gene mutations do impact drug response.

**Help Received**

My science teacher helped me with basic understanding of amino acids. For in-depth understanding, I researched NCBI and PharmGKB Web sites. Tiffany Anne Murray, PharmGKB and Stanford University gave me permission to use Atorvastatin/Lovastatin/Simvastatin Pathways diagram in my science fair

**Name(s)**

Rebecca M. McKinny

**Project Number**

# J1220

**Project Title**

## How a Prosthetic Moves

**Abstract**

**Objectives/Goals**

The objective is to find a difference in motions between biological legs, and double amputees with a transtibial amputation (below the knee) who use a specific running blade. I planned to look at graphs of the motions and to compare them. The most consistent group would have more control of their legs.

**Methods/Materials**

Video Physics Motion Tracker App; Videos of Double Amputees who use Flex Foot Cheetah Legs (Running Blades); Videos of Biological legs while running

**Results**

I compared the graphs of the videos. I assumed that the more consistent the motions, the easier it was to move. I found that Amputees have slightly less consistency in their steps, and the most variation in the bottom of the leg. Biological Legs were more consistent.

**Conclusions/Discussion**

In conclusion, the prosthesis were less consistent and harder to move. The bottom of the prosthetic is the least in touch with the runner, and varies the most in its motions. A Biomedical/Biomechanical Engineer who knows this can try to develop better prosthesis.

**Summary Statement**

I tested the motions of runners with biological legs and compared those to the motions of double transtibial (below the knee) amputees.

**Help Received**

Kim Miller, Ossur Academy, Justin Pratt

**Name(s)**

Nicole M. Poirier

**Project Number**

# J1221

**Project Title**

## Active Dog, Healthy Dog: Using Treats to Keep Vet Bills Down

**Abstract**

**Objectives/Goals**

Dogs typically don't get enough exercise during the day, which leads to diabetes, heart problems, ligament failures, and other health and behavior issues that cost Americans $15.73B per year in vet bills. The objective of this experiment was to understand how much exercise a dog gets and to add devices into a dog's environment to increase the amount of exercise, thereby lowering obesity and improving the dog's health and behavior.

**Methods/Materials**

Twelve dogs were observed in their own homes. For a one-week period the dogs were outfitted with a Fitbit and their activity tracked set a baseline for their normal activities. For a second week the home was outfitted with a custom treat shooter designed to go off each hour, calling the dog with the owner's voice and then dropping a treat. Low, medium, and high activity levels, and amount of steps taken were collected on an minute by minute basis and compared for each dog both before and after the devices were added, and across all the dogs as a group.

**Results**

The experiment showed that you could increase the amount of exercise by adding devices to the home. Addition of a puzzle toy had 83% of the dogs partially or fully engaged all week. Adding the custom treat shooter engaged 100% of the dogs. For 67% of the dogs, their amount of exercise was increased by the combination of the custom treat shooter and puzzle toy. Of the owners questioned, 100% felt that their dog was getting more exercise than they actually were, and only 17% of the owners were even close to guessing the amount of exercise recommended for their dog by the American Kennel Club

**Conclusions/Discussion**

The Active Dog-Healthy Dog Experiment was created to look at ways to increase the well-being of our beloved four-legged friends and to decrease the chance of sickness and disease in their lives. The experiment examined ways to keep dogs active throughout the day, which would increase their level of exercise, improve their health, and preventing them from bad behaviors. By adding devices like the custom treat shooter and the puzzle toy to the dog's home, over a long period of time the added activity should result in reduced chances of injury or illness, increase the dog's life span, and create and a happier pet.

**Summary Statement**

This experiment tested the effectiveness of adding a custom treat shooter and puzzle toy into a dog's daily life to increase the amount of exercise and improve their health.

**Help Received**

My dad helped with building the custom Treat Shooter, My teacher Mrs. Gillum helped with reviewing and editing experiment, Dr Kurowski, Veterinarian helped with providing guidance on experiment, and Donald Robinson, Phd. with reviewing the data.

**Name(s)**

Gina S. Shapiro

**Project Number**

# J1222

**Project Title**

## Blink!  A Study of Blink Rates while Using Computer Devices with Different Screen Sizes

**Abstract**

**Objectives/Goals**
The objective of this study is to compare human blink rates with the use of different computer device types to help people with dry eyes. Previous studies have shown a reduction in blink rate with computer use, but to my knowledge have not compared use of different types of devices. I hypothesized that if a human subject uses four common types of computers (desktop, laptop, tablet, smartphone), then blink rate would be most reduced with the smallest device.

**Methods/Materials**
Using a repeated measure design, 20 test volunteers were placed in 5 test conditions in the same environment while blinks were recorded over 4 minutes for each condition after 1 minute of adjustment time: engaging in relaxed conversation (control) and then playing a standardized computer game on a 1) desktop, 2) laptop, 3) tablet, and 4) smartphone.  Results were analyzed using ANOVA statistical analysis software.

**Results**
Mean blink rate was reduced for all of the devices compared to the control. The greatest reduction was seen with the smallest device, the smartphone, followed in increasing size by the tablet, the laptop, and the desktop.

**Conclusions/Discussion**
Sustained computer use has been associated with dry eye, with studies showing up to 72% of computer users suffering from dry eyes. Blinking is vital to moistening the eye. Previous studies have shown a reduction in blink rate with desktop computer use, but to my knowledge have not compared blink rate reduction with different types of devices. This study compared blink rate reduction with the use of 4 common computer devices (desktop, laptop, tablet, smartphone) and suggests that the smaller the device, the greater the reduction in blink rate. These results can help guide dry eye sufferers in their choice of a computer device type.

**Summary Statement**

I found that there was an inverse association between the size of a computer device type and the reduction in blink rate while using it.

**Help Received**

Dr. Reese helped me refine the design protocol for the study that I previously had formulated.  Dr. Ben-Shahar helped me with statistical analysis.

| Name(s) | Project Number |
|---|---|
| **Aneal Singh** | **J1223** |

**Project Title**

## The Impact on the Patellar Tendon When Squatting

**Abstract**

**Objectives/Goals**
This experiment was done to find the ratio of straining between the quadriceps muscle and the patellar tendon while decreasing the angle of the knee from 150 degrees to 30 degrees when squatting. The question that I addressed, was how much strain is put onto the patellar tendon and the quadriceps muscle when bending the knee at various angles.

**Methods/Materials**
The knee model, consists of three separate pieces of wood (representing the femur, tibia/fibula, and foot) that is hinged and attached to the frame via another block of wood (the hip). The hip was connected with casters giving it ease to move up and down along with a vertical support. A single spring represented the quadriceps muscle, while as the patellar tendon was represented by a nylon G guitar string. The guitar string is attached to the spring at one end and to a guitar tuning mechanism at the other. To measure the strain, I positioned the knee at various angles, resulting in pulling the quadriceps muscle and patellar tendon.

**Results**
From 150 degrees to 120 degrees, the patellar tendon to quadriceps muscle ratio was 2:1. At 90 degrees the straining on the patellar tendon started to plateau because it reached its maximum point in being strained and was starting to reach hyperextension. At 60 degrees both the patellar tendon and quadriceps muscle were proportional to each other and the ratio as 1:1. Out of the seven attempts to reach 30 degrees four of the G guitar strings (patellar tendon) broke.

**Conclusions/Discussion**
When the knee was bent from 150 degrees to 30 degrees while squatting, the patellar tendon was being strained to its maximum ability. At 60 degrees, both the quadriceps muscle and the patellar tendon were strained the same due to the plateauing in the patellar tendon. As the angle decreased to 30 degrees, the patellar tendon tended to rupture easily on the knee model, while as the quadriceps muscle was not at its maximum peak of straining.

**Summary Statement**

I created a knee model that showed the strain of the patellar tendon when set at angles from 150 degrees to 30 degrees in a squatted position.

**Help Received**

I designed, built, and performed the experiments by myself, and my father helped me drill the holes in the model.

| Name(s) | Project Number |
|---|---|
| Natalie A. Walzer | **J1224** |

**Project Title**

## How Can Knee Injuries Be Prevented in Female Athletes?

**Abstract**

**Objectives/Goals**
The objective of this experiment is to determine if the same inclinations for the knee to go into the valgus position that has been proven to occur in older athletes is present in populations younger than 13 years old.

**Methods/Materials**
Used 4 cones to direct test subjects during the 45 degree hop test, recorded and measured the three other movements that occur in sports with an iPhone with the Hudl technique application.

**Results**
Female athletes had larger knee abduction angles than male athletes. However, it was not as significant of a difference as studies that tested high school and collegiate athletes.

**Conclusions/Discussion**
One can conclude from the experiment that the differences thought to occur at the age of thirteen are happening at a younger age and need to be acted upon at this age with injury prevention training. It is believed that this will help decrease the amount of ACL injuries if given before these differences become more prevalent.

**Summary Statement**

I showed that degrees of knee valgus thought to occur at puberty are beginning to appear in younger athletes.

**Help Received**

My dad helped me get access to scientific texts, and my science teacher helped provide me with a way to organize and present my project. I performed and measured the trials of my experiment.

| Name(s) | Project Number |
|---|---|
| **Aaron J. Wolf** | **J1225** |

**Project Title**

## The Boy Who Cried WHAT?

**Abstract**

**Objectives/Goals**
The objective of this study was to determine what gender (at an adolescent age) developed better hearing during the past few millions of years of evolution.

**Methods/Materials**
Computer, multiple audio tracks, some quiet voices, some loud crowded rooms, headphones, adolescent humans, equal number in each gender.

**Results**
one by one, each adolescent was placed in a pitch black room in which five recordings were played to them, one was to test what the maximum frequency they could hear at was. Then the following two recordings were of one female and one male narrating the same book in different locations played quietly every time the subject hears a word that they recognize, they draw a line on the paper. After those two recordings are over, the next two play, the test how well they react to the "Cocktail Party Effect", which tests ones ability to single out words in a crowded room. After they finished these two recordings, they are let out, the results are tallied, and are placed on a graph along with many other subject's results.

**Conclusions/Discussion**
After giving the experiment to a number of adolescents, organized by vocabulary level, I review the results to find that none other than the female adolescents heard better than the male adolescents.

**Summary Statement**

As measured by the amount of words recognized at an adolescent age, I was able to come to the conclusion that female adolescents can hear better than male ones.

**Help Received**

I designed the experiment myself, acquired the audio tracks after an internet search on "Hearing tests", and having my project advisor review them to authenticate them as useable material.