CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY

Name(s)
Melissa A. Barcelona

Project Number
S1401

Project Title
The Effect of Different Enzymes on Protein Digestion

Abstract

Objectives/Goals
The objective is to determine which plant digestive enzyme is most efficient in digesting proteins and from what source.

Methods/Materials
Egg whites, the protein source, were cut and placed into 6 separate glass bottles. A positive control of egg white with 5 mL of pepsin, HCl, and H(2)O and a negative control of egg white with only H(2)O were used. The remaining bottles included the addition of either papain or bromelain from a capsule or fruit juice source. The egg whites were weighed after allowing 24 hours of digestion.

Results
The papain capsule digested an average of 0.6 g protein more than the bromelain capsule. The papaya juice containing papain digested 0.2 g protein more than the pineapple juice containing bromelain. The papain enzyme digested 2.0 g of protein while the bromelain enzyme digested 1.6 g when averaging the capsule and fruit juices.

Conclusions/Discussion
The bottle containing pepsin with no added enzymes digested the most protein. The papain capsule digested the most protein between the bottles containing added enzymes. Between papain and bromelain, there was no clear distinction on which enzyme is more efficient in digesting proteins.

Summary Statement
This project compares the efficiency of adding different plant digestive enzymes to aid protein digestion in the human body.

Help Received
Teacher supplied most materials and taught basic laboratory techniques

CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY

Name(s)

Robert Costigan; Kristin Shaffer

Project Number

S1402

Project Title

Can You Hear the Mo-skee-to?

Abstract

Objectives/Goals

In this project, you will discover how the ear works. People will hear a variety of different frequencies played through a computer using audio software and depending on the condition of the inner and outer hairs in one's ear, they may or may not be able to detect the pitch.

Methods/Materials

Computer, speakers, audio software, human test subjects, paper, pencils, and a printer.
Step one: Find a good audio program online where you can download a wide variety of frequencies (ranging from 8 khz to 22.4 khz).
Step two: Recruit test subjects in 4 different age groups (13-18, 19-30, 31-40, and 41-55).
Step three: Give a basic hearing test involving voice comprehension.
Step four: Use audio program to test the subject's ability to hear different frequencies.
Step five: Record results on paper and later put into a Microsoft Excel program.
Step six: Use data to make charts and graphs on Microsoft Excel.
Step Seven: Print results and data.

Results

The hearing of the different mosquito ring tones decreased from ages 31-40.

Conclusions/Discussion

We were able to test the different age groups and it is determined that most people over 40 cannot hear the mosquito ringtone at 14.9 khz. Based on this information, our hypothesis was correct. There are some experimental errors however. We were unable to get equipment such as headphones to work with the software, so we had to rely on the computer#s speakers to carry the sound to the subject#s ears. Another source of error was that we forgot to ask people if they had a case of hearing loss or listened to music or to the radio with high volume. This could have meant that their inner and outer hair cells were partially or completely damaged and were unable to pick up the high frequencies we played on our audio software. Through these possible experimental errors, we learned that next time we need to perform more thorough tests of the subjects before the final test. We also need to find a way to hook up headphones to our computer so the ringtone is isolated to the subject#s ears. Through this experiment, we learned that there are frequencies that may or may not be heard based on the age of the subject. This information proves to be useful to most teenagers trying to get away with using their cell phones in class. The only information they need is their teacher#s age, which is usually classified information.

Summary Statement

We are trying to determine the aproximate age at which people are unable to hear the mosquito ringtone.

Help Received

Neighbors, family and friends helped with our sample size

CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY

Name(s)

Logan L. Davis-Wallace

Project Number

S1403

Project Title

What Is the Optimal Ratio of Glucose to Fructose that Prevents Fructose Malabsorption?

Abstract

Objectives/Goals

Chronic abdominal pain occurs in 30% of children (ref. 1). A symptom of fructose malabsorption is abdominal pain (AP). Fructose is commonly used as a sweetener. Initial studies for this project showed that 70% of human subjects malabsorbed 50g of fructose dissolved in 8oz of water and that none of the same subjects malabsorbed 50g of fructose and 40g of glucose in 8oz of water. This proved that the presence of glucose facilitates fructose absorption in humans. The objective of this project was to find the optimal ratio of fructose to glucose that prevents fructose malabsorption and AP.

Methods/Materials

10 subjects, 9 years or older were used. All subjects were fructose intolerant. 3 different ratios of fructose to glucose in 8oz water were tested. 50g fructose/0g glucose, 50g fructose/12.5g glucose, 50g fructose/25g glucose, 50g fructose/40g glucose and 0g fructose/0g glucose (as control). Fructose malabsorption was assessed by breath hydrogen analysis and gas chromatography following established procedures (ref. 2).

Results

100% of subjects malabsorbed 50g fructose/0g glucose. 90% of malabsorbers had AP.
50% of subjects malabsorbed 50g fructose/12.5g glucose. 80% of malabsorbers had AP.
20% of subjects malabsorbed 50g fructose/25g glucose. 50% of malabsorbers had AP.
0% of subjects malabsorbed 50g fructose/40g glucose. 0% had AP.
Subjects served as their own controls. 0% of subjects demonstrated malabsorption or AP with water.

Conclusions/Discussion

Results showed that a 55% fructose to 45% glucose mixture eliminated malabsorption of fructose and AP in all subjects. Adding smaller amounts of glucose improved the absorption of 50 g of fructose, but did not eliminate malabsorption and AP in all subjects. The presence of glucose clearly improves the absorption of fructose by the human intestine in a dose dependent fashion. This would be consistent with fructose, in the presence of glucose, being absorbed by a different mechanism then when fructose is absorbed in the absence of glucose. This study suggests that adding glucose to high fructose foods could have therapeutic benefits in people with chronic AP, as fructose malabsorption may be an important factor in people with AP.

Summary Statement

This project showed that the addition of glucose to fructose improved or eliminated fructose malabsorption and associated gastrointestinal symptom of abdominal pain in humans.

Help Received

Dad showed me how type data into Excel; California Digestive Disease Center provided the gas chromatograph and breath hydrogen analysis supplies under the direction of Dr. Judy Davis; mom helped with the application; Mrs. Coburn, chemistry teacher, reviewed my project.

CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY

Name(s)

Anuhya Ghorakavi; Naman Gupta; Anshum Sood

Project Number

S1404

Project Title

Remote Ischemic Preconditioning

Abstract

Objectives/Goals

To test the effect of remote ischemic preconditioning on the human body.

Methods/Materials

Baseline bleeding time, platelet aggregation, and blood samples were obtained from each subject prior to the remote ischemic preconditioning protocol. Baseline bleeding time and platelet aggregation testing was then carried out 4, 24, 48, 72 hours and 7 day intervals following the preconditioning stimulus.

Results

Bleeding time was recorded before the RIPC stimulus and at 4, 24, 48, 72 hours and 7 day intervals. At 0 hours, overall the average bleeding time was 4.34 minutes, in particular, females recorded an average bleeding time of 5 minutes, which was higher than that recorded in males of 4 minutes.

Following preconditioning, an increase in bleeding time was observed at early time-points followed by a decrease in bleeding time back to baseline by 48 hours, with a second peak observed at 72 hours. Overall, bleeding time was increased at 4 hours interval following RIPC; recording a mean of 5:300.05. However, when separated by gender, a significant difference was apparent in the peak bleeding time of males compared to females. In males, bleeding time peaked at the 4h time point (6:200.048); whereas, in females, bleeding time initially peaked at the 24 hour time point (5:520.14) followed by a larger peak at the 72 hour mark. There appeared to be a gender-related trend with females; they generally recorded higher bleeding times than males throughout the study

Conclusions/Discussion

Taken together, the findings of the present study suggest that RIPC increases bleeding time and decreases platelet aggregation and that such alterations may be gender dependent. These findings may have implications for the prophylactic treatment of heart attack and stroke.

Further studies are warranted to elucidate the exact window of efficacy and mechanism of protection of RIPC. Specifically, studies that investigate changes in gene expression in response to the RIPC stimulus may provide targets for clinical therapy. Such studies would enable us to pinpoint potential effector molecules responsible for the protection afforded by RIPC.

Summary Statement

Testing the effect of remote ischemic preconditioning on human body

Help Received

Used lab at UC Davis M.I.N.D Institute under supervision of Dr. Turner

CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY

Name(s)
Eric V. Jang

Project Number
S1405

Project Title
4D Telomere Modeling: Studying Morphological Differences of Cancerous Telomeres

Abstract

Objectives/Goals
Telomeres and their interactions with other structures within the cell is currently the subject of active research in the study of genomic stability. Cells undergoing tumorigenesis exhibit irregular telomere behavior in the nucleus, and thus it is important to study the spatial organization of telomeres in a cell over time to characterize these genomic changes. However, no method currently exists to visually compare telomere distributions in 3D space and over time. This project presents a novel, unique way to visualize dynamics of telomeres by displaying the convex hull that describes the shape of telomere organization as changing over time.

Methods/Materials
The Laboratory of Dr. Yuval Garini provided confocal microscopy data of U2OS osteosarcoma nuclei and healthy 3t3 fibroblast nuclei. The images were segmented by binarization, mask filtering and flood-filled algorithms that were extended specifically to operate in 3D. These functions were implemented through a Telomere Analyzer Tool written in C++ using the Visual Studio IDE. Segmentation results were passed through the Quickhull convex hull algorithm. Convex hull polytopes and telomeres in each frame were calculated and displayed over time in the Blender software through an importer script written in Python. The resulting animations were observed at different angles. Segmentation error was validated through variable noise applied to phantom data.

Results
Telomere clustering is more prevalent in the U2OS nuclei. U2OS telomere convex hulls and ellipsoid models take on an oblate shape, and have gradually increasing volume and surface area over time. The volume and surface area of the U2OS models are greater than their 3t3 counterparts. Segmentation error for telomere locations does not change when the S/N ratio exceeds 16.5 (min error = 0.078 um).

Conclusions/Discussion
A novel method of studying telomere dynamics and organization is presented in this study. Observations of generated animations suggest that cancerous telomeres are organized in a more clustered, oblate fashion. Understanding telomere organization in cancer cells leads to improvements in therapeutic medicine and treatment strategy. This project has can be used to intuitively study of quantitative and qualitative differences in telomere dynamics between healthy and diseased cells, as well as the role of telomeres in signaling pathways.

Summary Statement
Comparing healthy/cancerous telomere dynamics by using a novel time-lapse 3D visualization algorithm.

Help Received
Lab data provided by Dr. Yuval Garini; father introduced the basics of image processing.

CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY

Name(s)
Taylor L. Kerr

Project Number
S1406

Project Title
Ferrum Pectus Pectoris

Abstract

Objectives/Goals
Does age have an effect on a horses heart rate during recovery after excercise? I hypothesize that the older the horse the longer the recovery time, and the younger the horse the less amount of recovery time is needed. Each horse is in age groups, the groups are 1-5, 6-10, 11-15, and 16-20 years old.

Methods/Materials
Round pen, stopwatch, 9 horses, stethoscope, height/weight tape. Take horses resting heart rate, weight, height, and age. Work horse to the right for 3 minutes and to the left for 3 minutes. Stop the horse and take heart rate. Continue taking the heart rate for every minute for the next five minutes. Repeat this on all 9 horses three times each.

Results
Group 1-5 years average resting heart rate:33 BPM+/-1BPM average for minute 1:66BPM+/-1BPM Average for minute 2:61BPM+/-1BPM Average for minute 3:52BPM+/-1BPM Average for minute 4:46BPM+/-1BPM Average for minute 5:37BPM+/-1Bpm
Group 6-10 years average resting heart rate:36BPM+/-1BPM Average for minute 1:89BPM+/-1BPM Average for minute 2:76BPM+/-1BPM Average for minute 3:70BPM+/-1BPM Average for minute 4:60Bpm+/-1BPM Average for minute 5:56BPM+/-1Bpm
Group 11-15 years average resting heart rate:36BPM+/-1BPM Average for minute 1:67BPM+/-1BPM Average for minute 2:45BPM+/-1BPM Average for minute 3:51+/-1BPM Average for minute 4:46BPM+/-1BPM Average for minute 5:39+/-1BPM
Group 16-20 years average resting heart rate:33BPM+/-1BPM Average for minute 1:64BPM+/-1BPM Average for minute 2:59BPM+/-1BPM Average for minute 3:52BPM+/-1BPM Average for minute 4:44BPM+/-1BPM Average for minute 5:33BPM+/- 1BPM

Conclusions/Discussion
My hypothesis was wrong, the older horses did not have a longer recovery time, and the younger horses did not have the shortes recovery time. The group of horses that were tested had around the same recovery time. Age does not affect a horses heart rate during recovey after excercise.

Summary Statement
Is there a correlation between the horses heart rate recovery and there age.

Help Received
Sister helped get the horses

CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY

Name(s)

Taylor Livingston; Jessica Orosco

Project Number

S1407

Project Title

Equus caballus and the Capacity for Their Short-Term Recollection

Abstract

Objectives/Goals

The objestive for our project was to conclude whether or not horses short-term memory exceeded scientists origional assumption.

Methods/Materials

We placed five large buckets in an arena and spread them out approximately five feet away from each other. We then took each horse individually and led them to a particular numbered bucket containing a carrot. After waiting five minutes, we then released them into the arena to record their response. We then repeated the process with each horse.

Results

Our results showed that the accuracy of the test increased with repetition. Each individual horse and the overall group of horses improved their short term memory with each test.

Conclusions/Discussion

Our conclusion from these experiments was that the average horse has a short- term memory extremely similar to the human memory. Humans can also improve short term memory with repetition. With practice, our short-term memory grows increasingly better as with horses.

Summary Statement

We tested the capacity of the horse's short- term memory, and what increases that capacity.

Help Received

My ranch owner Jan supplied most of our horses.

CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY

Name(s)
Sarah E. Rice

Project Number
S1408

Project Title
The Physical Effects of Constant Exposure to Noise on Mus musculus

Abstract

Objectives/Goals
The objective of my experiment was to investigate the physical effects of exposure to constant auditory stressors on Mus musculus (mice) by observing changes in weight, food consumption and physical behavior over a 21 day period.

Methods/Materials
Create four constant environments to house four groups of mice. Tag and separate 20 mice into four groups. Two groups of 5 female and 5 male mice will be used for the control groups and bare only the ambient noise. The other two environments of 5 female and 5 male mice will be used for the test groups and be exposed to 6 hours of 30 to 75 decibels (dB) of noise for 21 days using the metronome. On the first day, each mouse is weighed to establish a baseline. Every other day, each mouse is weighed and the amount of food consumed by each group is documented. Each group's behaviors are observed and recorded every other day as well.

Results
The female control group had an average 30.5% weight gain (19.0 grams to 24.8 grams) and the male control group had an average weight loss of 1.2% (28.6 grams to 28.3 grams) over the study period. The results for the experimental groups were a 32.5% weight gain (24.0 grams to 31.8 grams) for the females and an 18.4% weight gain (29.4 grams to 34.8 grams) for the males.

Conclusions/Discussion
After comparing the weight changes between the four groups, my hypothesis was inconclusive. The experimental groups did not lose weight as expected, but both did have an increase in weight which is in fact an indicator of stress. Also, the tested male mice did become aggressive as a result of the constant exposure to noise. In conclusion, noise is a potential factor of stress in everyday life.

Summary Statement
My experiment was conducted to determine if constant exposure to noise over an extended period of time would physically stress mice.

Help Received
Dr. Zea Borok, Chief of the Division of Pulmonary and Critical Care Medicine at the University of Southern California, who conducts research involving mouse models of human disease, provided guidance and signoff on the certification form and Ms. Fusco for the use of the decibel reader.

CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY

Name(s)
Lupita M. Rodriguez

Project Number
S1409

Project Title
Do String Players Have Longer Left Fingers?

Abstract

Objectives/Goals
This project takes advantage of a "natural experiment" on stress and bone development. String players exert stress on the fingers of their left hands as they apply tension by compressing the strings to produce different notes. My main goal in this project is to determine whether or not if stress exerted on the left fingers when playing a stringed musical instrument can show that their fingers are longer than their right-handed fingers. Most string players, especially experienced ones, vibrate with their left fingers to make the notes played sound more intricate. Also, when playing difficult pieces, sometimes a player has to stretch their fingers widely in order to hit those certain notes. So does this increased stress, result in longer fingers of the left hand compared to the right hand in string players? How about non-string players?

Methods/Materials
My methods used in this project can be defined in four simple steps: 1.) Select 2 groups: Stringed Musicians & Control Group within the same high school age range of 13-18 years old.
2.) Measure the lengths of each participants index, middle, ring finger and pinky for both hands.
3.) Calculated the difference in length between fingers of left hand and fingers of right hand for each individual.
4.) Analyzed my data.
My materials used were the following:
1.)Volunteers of approximately 50 participants in each group: Stringed and age-matched non-musicians.
2.) Metric ruler for measuring finger lengths.
3.) Calculator and computer with spreadsheet program for analyzing results.

Results
My results concluded that for string players, 78% of those observed had longer left fingers and 22% of them did not. For non-string players, 83% did not have longer left fingers and 17% of them did.

Conclusions/Discussion
My hypothesis proved to be true after analyzing my results and that the stress exerted by playing a stringed musical instrument does increase in a length of the left hand finger bones than the right.

Summary Statement
My main goal in this project is to determine whether or not if stress exerted on the left fingers when playing a stringed musical instrument can result in an increase in the length of the finger bones.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY

Name(s)
Alanna J. Russell

Project Number
S1410

Project Title
Exploration of Stress on the MCL and LCL in Dancers

Abstract

Objectives/Goals
Exploration of amount of stress dancers put on lateral and medial collateral ligaments when performing a plié. Stress on models of ligaments will be measured at 180° (straight leg), 80° (demi plié) and 40° (grande plié). Project will measure stress to ligaments when dancers use improper technique.

Methods/Materials
Lengths of MCL and LCL springs when lower leg rotated versus aligned in three angles (180, 45 & 80) measured, differences in lengths of MCL spring when rotated versus aligned, and differences in lengths of LCL spring when rotated versus aligned compared.
Materials: Flat screws, washers,hook eyes, springs, hinges, wood, guitar strings, guitar tuners,gate locks, ruler, protractor, latches, pins.

Results
Springs at rest were 2.5 cm long. With knee parallel, length of LCL spring went to 3.7 cm, length of MCL spring went to 3.9 cm when knee was bent to 80°. When angle of knee was bent to 40°, length of LCL spring was 2.7cm, and MCL spring 2.9 cm. With lower part of knee rotated 45°, length of springs remained same at 180° (at rest). When knee bent to 80°, length of LCL spring stretched to 3.0 cm, but MCL spring length increased to 4.1cm. At 40°, length of LCL spring returned to 2.5cm, and length of MCL spring went to 3.2 cm.

When aligned, length of MCL spring was 0.2 cm longer than LCL at both 80 and 40 degrees. When rotated 45°, length of MCL was 1.1 cm longer than LCL at 80°, and 0.7 cm longer at 40°.

Length of MCL spring was .2 cm longer when knee was turned out as opposed to when it was aligned at 80°, and it was .3 cm longer at 40°. Length of the LCL spring was .7 cm shorter when knee was turned out as opposed to when it was aligned at 80°, and was .2 cm shorter at 40°.

Conclusions/Discussion
In alignment, stress on MCL and LCL is greatest at 80°, This is most likely because attachment sites for ligaments are farthest apart at 80°. In rotation, stress on LCL is less than in alignment. Similarly, stress is greater at 80° than 40°: as attachment sites are closer. When lower leg is rotated, stress on MCL increases because attachment sites are farther apart than they were when leg was in alignment. Results support hypothesis that when dancer turns out incorrectly, additional stress is put on MCL, therefore increasing chances of irritation, sprain, or rupture.

Summary Statement
This project explores the amount of stress dancers put on the lateral and medial collateral ligaments in their knees when they perform a simple plié (knee bend)

Help Received
Parents helped with shopping and building of knee

CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY

Name(s)
Cassandra E. Thompson

Project Number
S1411

Project Title
The Effect of the Height of a Jump on the Trajectory of a Jumping Horse; A Study of Equine Biomechanics

Abstract

Objectives/Goals
When jumping a horse, the biomechanics that the horse executes vary as the height increases. This experiment explores what adjustments occur as the height of a jump increases.

Methods/Materials
The initial jumping part of the experiment occurred in an arena. It was documented with video and tape measures. The video information was edited into stills that were used to map the jump trajectories. Overlays were compared for each jump.
The characteristics of the trajectory is best understood by analyzing it at key positions along the jump trajectories. Still images for each of the key positions over the 18 jumps was extracted and the 15 major axis of joints and spine connections of the horse's body were mapped through the trajectory. Using computer overlays, the trajectory of the various axis for each jump height were compared.

Results
1) At the lower height jumps, the horse leaves the ground closer to the jump.
2) At higher jumps, the joint axis are spread out substantially more than for lower jumps.
3) At the 6" high and 12" high jumps, the fetlocks and hocks were about 1' from the jump, at the 18" and higher jumps the fetlocks and hocks started 3 to 4 times farther away from the jump.
4) The stifle, hip, sacrum and scapula stay relatively horizontal at the 6", 12" and 18" jumps, but rise higher and higher for the 24", 30" and 36" jumps. The horse can jump in stride at lower height jumps, but must break its stride to jump over 18".
5) The higher the jump, the lower the spine and head came down as the horse clears the jump.
6) The horse lands much farther away as the height is increased.
7) The hip and stifle lower for the high jumps. They lower slightly for the medium jumps. They remain level for the low jumps. The horse brings it center of gravity under it for higher jumps.
8) At the last full stride before the jump, the horse is typically the same distance from the jump regardless of the height; however, at the end of the jump, the horse is farther way as the height of the jump increases.

Conclusions/Discussion
A horse can clear modest jumps of 6", 12", and sometimes 18" without breaking its stride or changing the shape of its trajectory: however, the horse must change from a stride to a jump motion and alter the shape of its trajectory to clear jumps at 24" and above.

Summary Statement
This study of equine biomechanics explores the effect the height of a jump has on the trajectory and physiology of a jumping horse.

Help Received
Father taught me how to use image capturing and drafting software. Erin King, a professional horse trainer, rode the horse in the jump trials.

CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY

Name(s)
Sara Yusufaly

Project Number
S1412

Project Title
The Effects of Body Mass Index on Sensory Nerve Conduction

Abstract

Objectives/Goals
The objective of this study was to explore and determine the effects of the body mass index on median and nerve conduction velocity, latency and amplitude. My hypothesis stated that having a higher body mass index number would decrease nerve conduction velocity, increase latency, and decrease amplitude.

Methods/Materials
The hand-held stimulator of the electromyography machine was used to determine the subject's latency and amplitude when the arm of each subject was in the neutral position. By dividing the latency by .08 centimeters (mathematical procedure), the nerve's velocity was determined. This investigation tested a ratio of 1:1 subjects with a body mass index above and below 25.

Results
Although the data gathered throughout this investigation illustrated a variety of ideas, my hypothesis was, in the majority of instances, supported. The nerve conduction velocity and latency of subjects with a lower body mass index number was higher than that of subjects with a body mass index above 25. However, the data gathered from the amplitude of sensory response expressed a variety of discrepancies and outliers; many factors may have led to these results.

Conclusions/Discussion
The hypothesis throughout this experiment stated that the nerve conduction velocity and amplitude of sensory response would be lower in subjects who had a higher body mass index number; latency, on the other hand, would be higher in these subjects. The data gathered supports latency and velocity related hypotheses, but slightly rejects the hypothesis that the amplitude of sensory response would be higher in some subjects over others. This may be due to many factors including the electrical interference in the room, and/or the volts with which the machine was used.

Summary Statement
This experiment was an investigation of the effects of body mass index on median and ulnar nerve conduction velocity, latency of sensory response, and amplitude of sensory response.

Help Received
Neurologist monitored the use of the electromyography machine; Parents and brother provided guidance, additionally helping construct the board; Subjects agreed to be tested;