CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Garnet A. Abrams

Project Number
J1901

Project Title
Mass Production: Do Frog Eggs Hatch Faster in Warmer Water?

Abstract

Objectives/Goals
The objective of my experiment was to see how water temperature (the variable) affects the development of eggs of Northern Red-legged frogs (Rana aurora aurora). I hypothesized that the eggs in the warmer water would hatch first, the eggs in ambient water temperatures would hatch second and the eggs in the colder water would hatch last.

Methods/Materials
I used three ten gallon aquariums that were each equipped with an aerator, gravel, data loggers, and thermometers. One tank inside also had an aquarium heater that maintained 18ºC(65ºF). Another aquarium inside also had a chiller unit set at 10ºC(50ºF). The third aquarium had nothing extra, and I placed it outside where it would get sun part of the day and the temperature would vary. I put ten eggs from five different egg clutches, to establish validity, in each tank. I observed and recorded when eggs hatched in the three different tanks, the 'warm tank', the 'cold tank', and the 'control tank'.

Results
Overall, the eggs in the warm water tank hatched the soonest. Most of the eggs in the cold water tank hatched second and most of the eggs in the control water tank hatched last.

Conclusions/Discussion
My hypothesis was partially correct. The eggs in the warm tank did hatch first. Most of the eggs in the cold tank hatched second, and most of the eggs in the control tank hatched last, which I did not expect to happen. The results could have been influenced by the warm tank and the cold tank having nearly the same water temperature early in the experiment. I had expected the room temperature to be much warmer than 15ºC(60ºF), which is what the cold tank's chiller unit was originally set at. Two days into the experiment I realized this ineffective variable and installed a water heater into the warm tank. I also turned down the chiller unit in the cold tank to 10ºC(50ºF). The warmer temperature in the cold tank at the beginning may have influenced the faster development of the eggs than those in the control tank (which reached much colder temperatures at night).

Summary Statement
My project was to see if the eggs of Northern Red-legged frogs (Rana aurora aurora) would hatch sooner in their ambient water temperatures, in warmer water, or in colder water.

Help Received
Robert Darby, Sr. Aquatic Biologist, professional guidance and computer expertise; Mike Dunkelberger, Assist. Aquatic Biologist, research assistance and escort to the frog pond; Scotia Pacific, for providing equipment and resources; Parents for transportation and supplies.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
David J. Anderson

Project Number
J1902

Project Title
Eggs 'n Veins

Abstract

Objectives/Goals
My objective was to find out if spider mites lay their eggs in the same areas on the leaves of different plants.

Methods/Materials
I selected three different types of plants and infested them with spider mites. I took four samples of leaves from each plant and viewed them under a microscope. In total I tested 36 leaves. My investigation is still continuing today as I am still studying leaves.

Results
I found that spider mites lay their eggs on the edge of the tomato plant leaves. They laid their eggs near the main veins of the other plants.

Conclusions/Discussion
I noticed that the tomato plant leaves had a heavy density of trichomes and that the other leaves didn't. I believe that this is the reason that they lay their eggs on the edges of the tomato plant leaves. My research is still continuing.

Summary Statement
Trichomes on leaves seem to have an affect on where spider mites lay their eggs on leaves.

Help Received
Bobbie Orr, Syngenta, use of microscope and spider mites

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Heather C. Chou

Project Number
J1903

Project Title
The Effect of Temperature on the Activities of Garden Snails

Abstract

Objectives/Goals
My objective was to find out the effect of temperature on the activities of garden snails. I believe that snails placed in a normal room temperature will consume more food than the ones placed in a refrigerator.

Methods/Materials
The experiment was split into two parts, laboratory observation and outdoor observation.
1) Six snails were obtained and placed into plastic jars with lettuce for food. Three jars were put into a refrigerator at about 4.5°C and three jars were put into a cabinet at room temperature (about 23.5°C). Every other day for one month the lettuce weight, snail weight, and number of feces were recorded.
2) Observations were conducted on my front lawn every 3 days in the evening. The total number of snails present on the lawn was recorded, and the average temperature of the day of observation was also recorded by consulting newspapers.

Results
For the laboratory observations, the three snails that were put into a cabinet at room temperature consumed more food, gained more weight, and produced more feces than the snails in the refrigerator. For the outdoor observation, when the temperature was higher, there usually were more snails present on my lawn.

Conclusions/Discussion
Garden snails placed in an environment at a higher temperature will consume more food, gain more weight, and produce more fecal droppings than snails placed in a colder environment. Also, there is correlation between temperature and the number of snails present outdoors # higher temperatures mean more snails present and colder temperatures mean less snails present.

Summary Statement
My project was about the effect of temperature on the activities of garden snails.

Help Received
I thank my advisor, Mr. Lee, for obtaining the snails necessary for my laboratory observations. He also helped me with the analyses. I also thank my mother and father for driving me to the grocery store to buy lettuce.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Courtney A. Clerico

Project Number
J1904

Project Title
What Color Food Do Hummingbirds Choose the Most?

Abstract

Objectives/Goals
The objective was to see what color food hummingbirds prefer.

Methods/Materials
Four hummingbird feeders were modified using a plastic container,with lids colored red, yellow, and blue. (one left white) One part sugar to four parts water was boiled for three minutes. Food was colored to match feeders with one left clear. Each feeder was weighed on a gram scale, recorded, and hung two feet apart. After seven days, each feeder was weighed and recorded. Feeders were cleaned and the process was repeated for six trials.

Results
Results showed that yellow was the most prefered by the hummingbirds. Clear was the least eaten.

Conclusions/Discussion
This experiment supports my hypothesis that yellow would be the most chosen.Yellow should be used in hummingbird food. This project proves that hummingbirds prefer yellow in their food.

Summary Statement
The purpose of this project is to determine what color of food hummingbirds choose the most.

Help Received
My parents supervised while making the food, and hanging the feeders.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Zoe A.M. Davidson

Project Number
J1905

Project Title
The Butterfly's Secret: How Do Temperature and Light Affect the Time It Takes a Chrysalis to Hatch?

Abstract

Objectives/Goals
My objective was to see how light and temerature made a difference to the amount of time the Painted Lady butterfly was in its chrysalis.

Methods/Materials
As the Painted lady caterpillars formed into chrysalises I numbered them and put them into 1 of 4 clear plastic boxes. Box A: warm/light temp:71.4 deg F with 12 hours of daylight and 12 hours of darkness. Box B:warm/dark temp.71.4 deg. F. where there was 20hrs of darkness and 4 hours of daylight.Box C: cold/light temp.56.6 deg.F where there was 12 hrs of daylight and 12 hrs of darkness.Box D:cold/dark temp.57.1 deg.F where there was 20 hrs of darkness and 4 hrs of daylight. A digital themometer was used.

Results
The first chrysalis hatched in 8 days,it was one in Box B, the warm and dark box where the temp was 71.4 deg F.and there was 12 hours of daylight. The last chrysalis to hatch, hatched in 27 days,it was in Box D where it was cold and dark, where the temperature was 57.1 degrees F. and there was 4hrs of daylight.

Conclusions/Discussion
What I found out was that the warmer the temperature the less the light makes a difference to the amount of time a butterfly is in its chrysalis. When it is cold the amount light to which the chrysalist is exposed makes a big difference to the hatching time of the chrysalis.I think that when its cold the chrysalises need more light because the light gives off heat like the sun does to the earth, this makes up in part for the low tempertaures.

Summary Statement
How do heat and light affect the amount of time it takes a chrysalis to hatch?

Help Received
I discussed my experiment design with my family and my mom helped me in making the graphs.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Camila G. de la Llata

Project Number
J1906

Project Title
Stick, Slime, and Slide: Turban Snail Survival Series

Abstract

Objectives/Goals
I performed a series of eight related experiments and studies to determine if the black turban snail (Tegula funebralis) is well suited to its rocky shore habitat. I focused on the turban snail's shell strength, structure, the effect of waves, and the snail's reaction to predation.

Methods/Materials
I used clay to represent the force of waves, a hose to represent the pressure of waves, and various surfaces (smooth, sandy, and rocky) to represent the habitat of black turban snails. I used a pisaster star (Pisaster giganteus), a natural predator, to observe the black turban snail's response to the threat of predation. For the clay study, I used only turban snail shells; live black turban snails were used for all other experiments and studies.

Results
The turban snail's hydrodynamic shape helps it withstand the constant pressure of waves and its strong foot helps it hold on to its rocky surface. But its shape and foot don't always protect it from predators. A turban snail will do one of three things in response to predation: drop, "run," or clamp down. The turban snail's quickest response to a pisaster star, a common tide pool predator, is to release its grip on the surface and drop. But where it falls determines if it can turn over and whether or not it can escape.

Conclusions/Discussion
A black turban snail's conical shell design and compressive strength enable it to survive in the intertidal zone. The uneven surface of the rocky shore and the constant presence of waves help the black turban snail turn over and distance itself from a predator. Its ability to survive for a period of time outside of the water allows it to deliberately escape from a predator. My study series suggests that the black turban snail's survival skills are perfectly suited to its marine habitat.

Summary Statement
I conducted a sequence of eight related experiments and studies to determine if the black turban snail (Tegula funebralis) is well suited to its rocky shore habitat.

Help Received
My mother helped me type my report.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Cassandra C. Fausel

Project Number
J1907

Project Title
Water Break: Is Tap Water Toxic to Planaria's Regeneration?

Abstract

Objectives/Goals
Are the chemicals and impurities in tap water toxic to living things? From previous research I have found that Vitamins help Planarias regeneration. This year I want to see if the chemicals in tap water will effect the regeneration process.

Methods/Materials
Planaria,Petri dishes,brushes,pipettes,Boiled Egg,Tap water,Fresh spring water,Water test kit,Magnifying glasses,Dissecting Microscope,Razor blades,Ruler,Stove. METHOD: Obtained Planaria.Defined 4 groups and label Petri dishes: Water solutions are X2(200ml)X5(500ml)X10(1000ml)and X50(5,000 ml)Control(spring water and regular tap water) Boiled tap waters down to various concentrations as assigned groups accordingly. Took water samples and measured for pH, alkalinity, hardness, nitrate,nitrite,chlorine,copper and iron. I put the Planaria on an ice cube to help freeze the specimen and used razor blade to bisect the Planaria. Using a brush, I placed both the head and tail in a petri dish with the water solutions described above. Measured and recorded data on Planaria regeneration growth weekly for the next 3 weeks.

Results
Once the water evaporated, all the chemicals increased. The increases for each of the chemicals were different.The most abrupt changes were at X5. The concentrations after X5 increased significantly. Copper and iron had the largest increases in chemicals change. The Planaria had a regenerative growth in control (spring water). In tap water and tap waterX2 all Planaria lived and regenerated like the control (spring water). At tap waterX5 the tails died but the heads lived and regenerated. In concentrations greater than X5, all of the Planaria died.

Conclusions/Discussion
The Planaria that were in groups of less than tap waterX5 lived and regenerated. All the groups after X5 died because the increase in chemicals was too harsh. The increases in concentration made it more difficult for the Planaria to live or regenerate as the water evaporated and left the chemicals behind. Therefore, my hypothesis is partially correct. I thought that the highest concentration of chemicals in the water (tap waterX50) would kill or stunt the Planarias growth. This was correct except for the tap waterX10 also killed the Planaria and tap waterX5 killed the tails of the Planaria. In conclusion, concentrated water is toxic to Planaria.

Summary Statement
I wanted to see if Planaria's regeneration is effected by various tap water concentrations

Help Received
Myoma Dunes Water Company, Bermuda Dunes; Mrs. Colleen Ferguson, my Science teacher, My dad, Dr. Richard Fausel for helping with questions.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Gregory J. Feaver

Project Number
J1908

Project Title
Marching Ants

Abstract

Objectives/Goals
My objective was to learn if differnt colors of chalk would affect the feeding patterns of ants.

My hypothesis was that "Black Chalk" would best deter the ants from visiting the bait source.

Methods/Materials
1. Locate two different ant hills
2. Place pork rinds in an area near the ants hills so that the ants would find them and start to feed.
3. Once the ants were feeding count the number of visit to the bait source in a given time interval. Record the number and repeat.
4. While the ants were still feeding draw a chalk line around the bait source and count and record the number of visits to the bait source for the same time interval. Repeat this step with 4 different colors of chalk.
5. Repeat Items 3 & 4 four times in order to get adequate data.
6. Repeat 3 through 5 on the other ant hill.
7 Compare the data without chalk to the data with chalk.

Results
Red chalk best detered the the ants from visiting the bait source. Black was next best at detering the ants, and then green and last was blue. Blue had the least affect on the ants behavior.

Conclusions/Discussion
My conclusion showed that my hypothesis was not correct. My hypothesis was that black chalk would best deter the ants from visiting the bait source. Tests showed that Red did the best job and black was second. Red and Green also did a good job. The real test seemed to be that the pigment in the chalk interfered with the pheromone trails left by the ants in their feeding trails.

Summary Statement
To test the effects of different color chalk lines on the feeding behavior of ants.

Help Received
Mother helped type the report; Dad helped fill out this form and file it

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Kyla M. Fenning

Project Number
J1909

Project Title
How to Increase the Longevity of Plankton Samples

Abstract

Objectives/Goals

Problem Statement: Can the longevity of plankton samples be increased by providing aeration or changing the temperature and lighting conditions?

Hypothesis: Creating conditions similar to the ocean environment by maintaining the samples at ocean temperature, with natural light fluorescent aquarium lighting, and with strong aeration should increase the longevity of the plankton samples. It is expected that the temperature variable will have the most individual benefit and the lighting variable the least individual benefit.

Methods/Materials

Materials:
1 Sample of plankton from Ocean Institute (approximately 1-1 ½ cup)
4 Airstones and tubing
2 Empty fish tanks (approximately 20 x 10 in)
8 Uniform sized glasses
1 15 watt aquarium fluorescent light bulb
2 Air pumps
2 15 watt aquarium incandescent light bulbs
5 Floating thermometers
Ice and tap water (as needed)
4 Plastic bowls
1 Eyedropper; 3 inch rectangular glass specimen slide with indentation in center; 8 fl. oz. glass measuring cup; clear plastic petrie dish; tablespoon; plastic straw; microscope; black permanent ink Sharpie; poster board; plastic bucket with approximately 5 quarts of reverse osmosis water

Procedure:
A. Receive sample from Ocean Institute
B. Allocate plankton sample
C. Eight test samples: 1-(Control) room temperature, no aeration, incandescent light; 2- variable: ocean temperature; 3- variable: fluorescent light; 4- variable: aeration; 5- variables: ocean temperature, fluorescent light; 6- variables: ocean temperature, aeration; 7- variables: fluorescent light, aeration; 8- variables: ocean temperature, fluorescent light, aeration

Summary Statement

My project investigated the potential of increasing the longevity of plankton samples by controling lighting conditions, aeration, and temperature .

Help Received

Several people at the Dana Point Ocean Institute helped me with my project including arranging for the plankton samples to be drawn for me, giving advice, and answering any questions I had. They also provided me with the microscope.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Billy C. Fernandes

Project Number
J1910

Project Title
It's No Joke, Xanthophylls Make a Difference in the Yolk

Abstract

Objectives/Goals
The objective of my project was to find out which of the chosen feeds would change the color of my hens egg yolks. I was interested in finding this out because we have 50 hens and the hens which are housed free range have naturally occurring yolks that are darker than the caged hens. Feed is made up of various ingredients including plant material. Xanthophylls are the pigments found in all plants and are present in varying amounts depending upon the type of plant material.

Methods/Materials
Twenty-four confined laying hens were used. All of the hens were the same breed, age, and genetically very similar. The hens were then placed six in each group. Three hens per cage to allow for ample room. Each group received free access to water and to their prospective feeds. The amount of light available was also kept constant at 17 hours per day by artificial lighting supplementing natural lighting. Group 1, the control group, received 18% protein Brookhurst brand lay mash. Group 2 received 50% lay mash, 50% grated carrots. Group 3 received 50% lay mash, 50% cracked corn. Group 4 received 50% lay mash, 50% milo. Egg samples were taken from each group on day 1 of the experiment and then every three days thereafter for one month. Colors of yolks were determined by comparison to paint color cards obtained from Sears. Tallies of colors by group were made to determine which independent variable had the most effect on the dependent variable.

Results
The egg yolks from the hens fed the added corn were the darkest yellow of all the groups, earning a color score of 3.33 out of a possible 5.00. The egg yolks from the hens fed the added carrots were a darker yellow than that of the control group earning a color score of 3.17. The egg yolks from the hens fed the added milo were the same color as the control, which was a color score of 2.83.

Conclusions/Discussion
My conclusion is that the xanthopylls present in the feeds I chose did make a difference in the color of the hens egg yolks.

Summary Statement
My project was to determine if the xanthophylls present in three different feeds fed to my hens would make a difference in the color of their egg yolks.

Help Received
My mom helped me with graphs.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
William B. Hance

Project Number
J1911

Project Title
The Attraction of Hummingbirds to Hummingbird Feeders

Abstract

Objectives/Goals
My main objective while conducting my experiment was trying to find out what color hummingbird feeders attracted hummingbirds the most. I also wanted to find out how many different species of humingbirds would be attracted to my feeders.

Methods/Materials
In my experiment I used many materials. While I was concocting the nectar, I used a measuring cup, sugar, water, and my refrigerator to cool the nectar. In preparing the feeders I bought 4 feeders and 3 different colors of tape (green, white and yellow). I then taped over 3 of the feeders an hung them in a blue hisbiscus tree, over some azalea bushes, in my backyard. While observing hummingbirds, I used a stopwatch to time how long they were at the feeders; binoculars to get a closer look at them, and a compass to determine which direction the hummingbirds approached the feeders from. I observed how long a hummingbird stayed at the feeder, which direction it approached the feeder from, what color the hummingbird was, and what time the hummingbird visited the feeder.

Results
While observing hummingbirds on 25 different days from December to February, I observed 152 hummingbirds visit my feeders, and 137 different hummingbirds because 15 hummingbirds drank from the feeders more than once. While the hummingbirds drank from the feeders, they stayed at the feeder an average of 31 seconds, and most of the hmmingbirds that visited the feeders were grey or grey with a green breast. At the conclusion of my experiment the red feeder had the most visits with 77, followed by the yellow feeder with 51 visits, the white feeder with 13 visits and then the green feeder with 11 visits. The red feeder had approximately 11% more visits than the yellow feeder, 61% more visits than the white feeder, and 63% more visits than the green feeder. Also at the end of the experiment the red feeder had 51% of its nectar left in it, the yellow feeder had 73% of its nectar left in it, the white feeder had 93% of its nectar left in it, and the green feeder had 98% of its nectar left in it.

Conclusions/Discussion
I have concluded that the results of my experiemnt fully and clearly support the predictions stated in my hypothesis. I conclude that the color of feeders that hummingbirds are most attracted to is red.

Summary Statement
Finding out what color hummingbird feeder attracts the most hummingbirds.

Help Received
Mother helped paste up the board.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Torren Heine; Colin Potter

Project Number
J1912

Project Title
To Free or Not to Free: Calcium Carbonate Levels in Egg Shells

Abstract

Objectives/Goals
Our objective is to find out how much calcium carbonate is in the egg shells of free-range versus cage-raised chickens.

Methods/Materials
Eggs from several sources of cage-raised and free-range chickens were carefully washed, dried and powdered. 10 two-gram samples from each source were reacted with 1M HCl for 24 and 48 hours and titrated to determine the HCl used by the calcium carbonate. The data was averaged and compared.

Results
The free-range shells were roughly 25% higher in calcium carbonate than the cage-raised shells in all tests.

Conclusions/Discussion
Our hypothesis was wrong. We thought that the cage-raised egg shells would have more calcium than the free-range. The ability of the chicken to absorb calcium from its diet depends on different factor such as the form of calcium, the levels of vitamin D, exposure to sunlight and the presence of other needs for calcium in the chicken. The results suggest that other factors besides the levels of calcium in the diet have a big effect on the calcium carbonate percentage in chicken egg shells. Chicken farmers might have fewer broken eggs if these factors are more carefully considered.

Summary Statement
Our project is to determine if a corelation exists between the diet of cage-raised versus free-range chickens and the percentage of calcium carbonate in their shells.

Help Received
High school science teacher (Colin's dad) provided equipment and chemicals, Colin's mother helped with typing and backboard layout.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
John-Michael L. Jones

Project Number
J1913

Project Title
Matilda's Many Returns: How Many Babies Can Be Produced by One Praying Mantis?

Abstract

Objectives/Goals
This study follows the egg laying of a praying mantis (Iris oratoria). Over the course of 212 days she laid eggs 18 times. Last year (and completed this year) I studied how food intake effected egg laying. The literature and entomologists I talked to suggested that babies would hatch from the first 7 egg cases. Was Matilda just laying eggs for fun? This year I followed the hatchings from 18 layings and my hypothesis was that babies would hatch from egg cases 1 through 7.

Methods/Materials
Materials- 18 layings from one wild caught praying mantis, in separate hatching cups (if possible) - kept in a 10 gallon fish tank.
Methods- record feedings to complete food intake data: record observations, laying dates and daily hatchings: recount hatching apertures, candle for un-hatched embryos.
Use computer to make tables and graph.

Results
Surprisingly babies hatched from egg cases 1 through 16. The average hatching from egg cases 1 through 15 was 92.3%. Egg case #15 which was laid at 180 days (almost one month beyond expected time limits) hatched to 87%. Over 5 monthes an estimated 1216 babies hatched from a food intake equivalent to 1252 flies.

Conclusions/Discussion
The number of hatchings far exceeded expectations. My hypothesis was short by 9 egg cases. This mantis was not just laying eggs for fun and is an example of why this species, Iris oratoria, has been so successful in spreading through California.

Summary Statement
This project follows the hatching of babies from 18 layings by one praying mantis.

Help Received
I wish to thank Dr. Mike Maxwell and Dr. David Yager (scientific review, advice), Mr. Greg Ballmer (advice), Uncle Paul (photos), and Aunt Sharon (proofreading and old fashioned typing).

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Kristen D. Kelley

Project Number
J1914

Project Title
Do Crickets Communicate Information About Their Environment Through Chirping?

Abstract

Objectives/Goals
Crickets are well known for their chirping behavior. According to research, male crickets chirp for three main reasons: 1) to attract a female, 2) as a warning or 3) when they are fighting. The purpose of this project is to determine if cricket chirping might also contain information about whether the crickets are located in a desirable environment. Information about whether the cricket is currently in a desirable environment would be important for the male crickets to attract females.

Methods/Materials
During the experiment, cricket movement was monitored to see if they move towards a preferred environment instead of a plain environment. Their choice of which direction they moved would be based upon chirping information from crickets located within the preferred and plain environments. This was completed by constructing a special testing container with two side compartments for chirping crickets in the two kinds of environments. Control tests were also done with no chirping in order to compare the results.

Results
The result of the experiment was that 78% of the crickets were attracted towards crickets chirping in the preferred environment. In most of the control experiments the crickets seemed to wander aimlessly.

Conclusions/Discussion
The conclusion is that it appears that crickets do exchange information when they are in a preferred environment.

Summary Statement
This project studies whether crickets communicate information about their environment through chirping.

Help Received
My parents assisted with purchasing the materials and helping create the testing container.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Emily A. Koch

Project Number
J1915

Project Title
Controversy in Forensic Entomology and Crime Scene Investigation: The Question that Is Bugging Forensic Entomologists

Abstract

Objectives/Goals
My question was: Is maggot mass temperature significantly above ambient air temperature so as to affect the calculation of accumulated degree hours in estimating the time of exposure of decaying animal tissue? I learned that there is a huge controversy among forensic entomologists as to the effect of maggot mass temperature and I tried to design an experiment to help settle this disagreement.

Methods/Materials
I raised Sarcophaga bullata fleshflies and exposed them to rotting beef liver. After the fleshflies deposited larva on the liver, I monitored the development of the maggots through the first, second, and third instars stages of development. I placed third instar maggots in groups of 25, 50, 75, 100, 125, and 150 in individual jars with rotting beef liver. I put a digital thermometer in the middle of each maggot mass and recorded the temperatures every hour for 22 hours until the maggots escaped to pupate. I also recorded the ambient air temperature and humidity during this time. I used time lapse photography on my digital camera and a digital watch to record the data.

Results
As a result of my experiment, I recorded 176 temperature and humidity readings. Group I - An average of 1.03% higher than ambient air temperature. Group II - 2.21% higher. Group III - 2.86% higher. Group IV - 4.04% higher.
Group V - 2.25% higher. Group VI - 1.22% higher. The highest percent above ambient air temperature was 5.81% in Group IV. The data suggested that the more maggots in a mass, the higher the temperature they generated.

Conclusions/Discussion
My experiment proved that maggot mass temperature is significantly above ambient air temperature. This may affect the calculation of accumulated degree hours in estimating the time of exposure of decaying animal tissue or post- mortem interval. However, since my maggots were confined to rotting beef liver in glass jars, my data may or may not apply to field work. From contacting members of the American Board of Forensic Entomology, I have learned that maggots may self-regulate their temperature by moving in and out of the feeding mass. More research is needed to determine the general effect of maggot mass temperarure.

Summary Statement
My project measured maggot mass temperature and compared it to ambient air temperature.

Help Received
Forensic entomologists Dr. M. Lee Goff, Chaminade University of Honolulu; Mr. David Faulkner, San Diego; Dr. Richard Merritt, Michigan State University; Dr. Neal Haskell, Rensselaer, Indiana; Ms. Rebecca Bullard, UC Davis. My mother helped me design my graphs and my father helped me set up my

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
William C. Piper

Project Number
J1916

Project Title
The Balance of Nature: How Does Varying the Number of Freshwater Snails Affect a Closed Aquatic Ecosystem?

Abstract

Objectives/Goals
My objective was to find out the effect of varying the number of freshwater snails in a closed aquatic ecosystem. I predicted that a closed aquatic ecosystem with two freshwater snails and one freshwater plant would provide the best balance and the healthiest ecosystem.

Methods/Materials
The experiment involved setting up 12 identical ecosystems using jars with gravel, thermometers, freshwater plants, and purified water. Each of three trials had four jars: a 0-snail jar, a 1-snail jar, a 2-snail jar, and a 4-snail jar. The pH of the water was recorded for each jar at the beginning and end of the experiment. The condition of the snails, plants, water, and the water temperature was recorded daily.

Results
The results showed that the water temperature and the pH did not change significantly in the jars. The water conditions changed only in the 4-snail jars. The plants stayed healthy and green only in the 2-snail jars. 33% of the snails died in the 1-snail jars, 16% died in the 2-snail jars, and 50% died in the 4-snail jars.

Conclusions/Discussion
Based on my observations, my hypothesis was correct. The jars with two freshwater snails and one freshwater plant were the healthiest and provided the best balance. The plants in the jars with no snails suffered without carbon dioxide from the snails in order to photosynthesize. In the jars with too many snails, there was not enough oxygen produced by the plants for the snails, and there was too much waste product produced by the snails. This experiment demonstrates the balance of nature. In an ecosystem when there is too much of one thing or not enough of another, the effects spread throughout the unbalanced system.

Summary Statement
My project tested the effect of varying the number of freshwater snails in a closed aquatic ecosystem.

Help Received
My mom and dad helped me set up the jars for the experiment. My mom helped me with my display board.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Allison B. Richina

Project Number
J1917

Project Title
Comparing Different Various Natural Substances In Attracting and Repelling Drosophila

Abstract

Objectives/Goals
My objective was to learn if the Drosophila will be attracted to Citrus fruits more than the peppers and spices.

Methods/Materials
Obtain the Drosophila flies along with the Natural Substances. I divided the Substances into Citrus fruits: Lemon, Grapefruit, Lime, Orange; Peppers: Black, Lemon, Jalapeno, Cayenne, white; and Spices: Mustard, Paprika, Oregano. For each Natural Substance, I placed it along with a 1/2 cup of water in a food processor to make a liquid. 10 Drosophila flies are placed in vial A and vial B. I saturated the sponge lids, and counted the flies at different intervals, 15 min., 30 min., 45 min., and 1 hour.

Results
The results that I have determined has been obtained by the number of Drosophila landing on the sponge surfaces at 15 min., 30 min., 45 min., and 1 hour intervals. Individually, the highest percentages are orange-45%, Paprika-61%, and Jalapeno-44%. Averaging the test substances under Citrus, Peppers, and Spices are Citrus-38%, Spices-56%, and Peppers-28%.

Conclusions/Discussion
In conclusion, I found my objective "The Drosophila will be attracted to the Citrus Fruits more than the Spices and Peppers" was incorrect. Taking an average of the Natural Substances, the Citrus Fruits did attract more than the Peppers, but it attracted less than the Spices. Overall, the control attracted very few Drosophila, but any substance of taste or odor will attract the Drosophila.

Summary Statement
The ability of Natural Substances to attract or repell the Drosophila fly.

Help Received
I used lab equipment from our high school, with the assistance of Mr. W. My mom cut letters out at the teacher center.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Alexander D. Roux

Project Number
J1918

Project Title
An "Eggcellent" Experiment

Abstract

Objectives/Goals
My project was designed to test the effects of adding protein supplements to a chicken's diet on the protein content of their eggs.

Methods/Materials
Seven chickens of identical breed and age were fed varying degrees of protein supplements through their water. They were fed diets of 0, 5 and 10 tablespoons per gallon for one-week periods and all eggs laid during this period were collected. The eggs were then tested for protein content.

Results
I found that the amount of protein found in the chickens diet was directly proportionate to the amount of protein introduced to the chickens. The high protein diets constantly showed higher protein content than the lower protein diets.

Conclusions/Discussion
My conclusion is that the amount of protein introduced to a chicken is directly proportionate to the protein content in that chicken's eggs.

Summary Statement
My project was designed to test the effects of adding protein supplements to a chicken's diet on the protein content of their eggs.

Help Received
Science teacher ordered

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Monica R. Schmidt

Project Number
J1919

Project Title
Planaria: The Amazing Cross-Eyed Worm

Abstract

Objectives/Goals
According to the Greek legend, one of the twelve labors of Hercules was to destroy the Hydra, a gigantic monster with nine heads. He found that as soon as one head was cut off, two new ones grew in its place. For ages, people have been fascinated with the idea that lost parts of animals can be regrown. That is what my science fair project is about -- regeneration. During the experiment, the effect of different cuts on the regeneration of Planaria was examined.

Methods/Materials
Three trials of 16 cuts were performed and the results monitored over a four week period.

Results
Trial #1 had 50% of the Planaria surviving with different degrees of regeneration. Trial #2 had 75% of the Planaria surviving with different degrees of regeneration. Trial #3 had 100% of the Planaria surviving with different degrees of regeneration. After four weeks, most of the surviving Planaria were fully regenerated. The Planaria that still were not fully regenerated were the smaller cuts, #4, 7 and 8 (see research notes).

Conclusions/Discussion
Overall, I believe that the purpose of my experiment was successfully achieved. My goal was to learn about and study the regeneration of Planaria. I found my hypothesis was correct in that the Planaria cut in larger pieces regenerated faster than those cut into small pieces. However, the Planaria with cuts down the head and up the tail did not grow two heads and two tails. Instead the wounds healed and reformed back together within the first week. I believe I would need to re-cut them daily in order to keep them from fusing back together. This would be an interesting trial for a future experiment. Another interesting trial would be to determine how temperature affects the regeneration rate of Planaria.

Summary Statement
During my experiment, the effect of different cuts on the regeneration of Planaria was examined.

Help Received
Thanks to my Mom for helping with pictures and report typing and to my teacher, Ms. Asherson, for inspiring all the 6th graders on their projects.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Leigh M. Sherwood

Project Number
J1920

Project Title
The Edge Effects of Different Development Types on Bird Species Diversity

Abstract

Objectives/Goals
In several studies it has been shown that urban development can affect the number and type of bird species in the adjacent habitat. This is known as edge effects. Edge effects can include pets, exotic plants, lighting, and noise. The goal of the project is to determine if these edge effects from different development types causes bird numbers and species composition to also be different in the adjacent habitat.

Methods/Materials
Materials used to conduct the study included a measuring tape to layout the transects, flagging to set transect points, binoculars, field log, and field guide. Transects were established in coastal sage scrub habitat adjacent to residential, school, and commercial areas. A control transect in undisturbed habitat was also set up. Observations of total birds and species, and activity levels at the development edge were documented during the trials.

Results
The results of the study indicated that the transects adjacent to the school and commercial areas, where there are high activity levels, had the greatest number of birds and species diversity. These transects also had the greatest number of species that would not be expected in coastal sage scrub habitat. At the residential and control sites, where activity levels were lower, there were fewer total birds and species, but a greater continuity in species composition.

Conclusions/Discussion
Overall, the conclusions tend to support the hypothesis, that the different types of development edges can affect bird species composition and diversity in the adjacent habitat. It also appears that residential development has less of an edge effect and results in less habitat fragmentation than commercial or school development.

Summary Statement
The project focused on the edge effects from different development types on bird species diversity and composition in the adjacent habitat.

Help Received
Father helped with transects layout.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Tami Shore

Project Number
J1921

Project Title
What's Eating You? Forensic Entomology

Abstract

Objectives/Goals
The purpose of this project was to determine how long a corpse has been somewhere, depending on the life spans of the insects on the body.

Methods/Materials
Two cans of Kal Kan cat food were used, in place of a corpse, and were put into to two separate Tupperware containers. One was put in the sun and one was in a box for shade. For the next seven days, both of the containers of meat were checked on every day for maggots and flies. Two pictures of each were taken, one in the morning and one in the afternoon, and weather reports were written down. Once the seven days ended, the data relating to the meat in the sun and the meat in the shade was graphed and compared.

Results
The results of the project showed that insects develop more successfully in shade than in sun, but the climate still has to be warm, rather than cool.

Conclusions/Discussion
In the beginning of testing, the climate was very moist and cool, which prevented any bugs from developing on the meat. But, after the third day, the climate warmed up from at least sixty degrees to at least eighty degrees, and insects were automatically attracted. Despite the warm weather, the insects still developed faster and more successfully on the shaded meat. Therefore, the hypothesis was correct because it said that the insects would be affected depending on the climate and the temperature and whether the meat was in sun or shade.

Summary Statement
This project concerns the study of insect development as it relates to determining the length of time a corpse has been in a particular location.

Help Received
Mr. David Faulkner, a nationally recognized forensic entomologist, served as my adviser.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Ariel E.T. Single

Project Number
J1922

Project Title
Effects of Habitat Diversity and Basin Size on Bird Use of Ponding Basins

Abstract

Objectives/Goals
There are many ponding basins in Fresno, but not much other wetland habitat. Many birds use these basins. I looked at how the habitat diversity and size of ponding basins affected the total number of birds, and the species diversity of birds using the basin.

Methods/Materials
I estimated pond size and measured habitat diversity of 8 ponds in a 36 square mile area of northeast Fresno. I visited each pond 10 times during December-January 2002-2003. Using binoculars, I recorded the number and species of birds at each pond, their activity, and what habitat they were using.

Results
Ponds were 11.9ha - 2.9ha, with 3-7 habitats per pond. The habitats were emergent vegetation; short grass; shallow water; open water; mudflat; shoreline, bare ground; and weeds. I saw 37 species of birds, mostly shorebirds and waterfowl. The number of species observed at each pond ranged from 1 to 12. Species diversity was predicted by pond size and the combination of habitat diversity and pond size. Bird numbers were predicted by pond size.

Conclusions/Discussion
I expected habitat diversity to be an important predictor for species diversity, but that did not happen. Instead, pond size, and the interaction of size and habitat diversity were good predictors for species diversity. Larger ponds might have more habitat diversity, and might provide more space for the different species to coexist. Pond size was also the only predictor for number birds. Larger ponds might provide more space and resources to hold more birds.

Summary Statement
How bird numbers and species diversity are affected by pond size and habitat diversity.

Help Received
Mom: glueing board, editing, statstics. Dad: data editing, driving to ponds, learning birds.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Aaron J. Thiele

Project Number
J1923

Project Title
Torpic Fury!

Abstract

Objectives/Goals
To find out if I can manipulate a common frog into hiberntion due to temperature changes in its environment.

Methods/Materials
Adult frog (pet, purchased); large aquarium; mud; water container; thick piece of cloth; lamp with infrared bulb; thermometer; timer; small, clear container with holes; ice cubes. I set up the aquarium with mud and a shallow bowl of water, introduced the frog, heated the interior with an infrared bulb, and observed the frog. I removed the lamp and added ice cubes to the wather bowl and continued to gradually add more ice cubes. I observed the frog at timed intervals. I repeated the process, this time with the frog in a small container.

Results
The frog eventually entered a state of torpor, if not true hibernation. It showed the following signs of torpor: No body movement; reduced gullet movement showed reduced heart rate; eyes closed; mouth partially open; mucous coating over body.

Conclusions/Discussion
It is possible to cause a frog to go into torpor by gradually lowering the temperature in its environment. My project illustrates the sensitivity of frogs to their environment.

Summary Statement
I gradually reduced the temperature of a Red-Legged Walking Frog's environment and caused it to go into a state of torpor.

Help Received
Mother helped type, timed heartbeats, discovered one of the Web sites for research, sister helped design backboard research display, father took pictures. sister helped with backboard display of research, father took pictures research

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Hannah M. Tillmann

Project Number
J1924

Project Title
Owl Pellets, Falcon Pellets, What's the Difference?

Abstract

Objectives/Goals
My project was to deturmine the differnce between the pellets produced by owls and the pellets produced by falcons, by finding the percentage of bone that they contained. My hypothesis stated that I thought the owl would have a larger percentage of bone in its pellet than the falcon, because owls have less acid in their digestive juices which are necessary to digest bones.

Methods/Materials
In my experiment three owl pellets and three falcon pellets were needed. Each of these were weighed to find their masses. Then the owl pellets were dissected, and seperated into two piles, one was fur and the other was bone. Both the fur's and the bones masses were found and by using those averages, I calculated the percentage of bone in the owl pellets. (I followed the same procedure for all three falcon pellets.)

Results
Results: I found out many things while doing my science project. The average mass of the owl pellets was 9 grams, and the average mass of the bone that they contained was 5.05 grams. In conclusion the average percent of bone in an owl's pellet was 56.1 percent. The average mass of the falcon pellets was 1.7 grams, and the average mass of bone that they contained was .38 grams. I found that there was 22.5 percent bone in the falcon's pellets. During my project I observed that the owl's pellets were of much more mass that the falcon's pellets. And that the owl pellets had a much higher percentage of bone in them.

Conclusions/Discussion
Conclusions: In my experiment I found that the owl pellets had 56.1 percent bone in them, and that the falcon#s pellets had only 22.5 percent bone in them. My hypothesis was supported by my data. The hypothesis that I wrote stated that I thought there would be a higher percentage of bone in the owl's pellet than in the falcon's pellet. And in my experiment the owl pellet did have a higher percentage of bone in its pellet than that falcon.

New Questions and Applications: A possible real life application to the knowledge that I gained through this project would be useful to find out if birds of prey digest differently than other birds of prey. If I were to do another science project on the same topic, I would investigate the difference between eagle pellets and owl pellets.

Summary Statement
the difference between the pellets produced by different birds of prey

Help Received
mother and father helped me to put my board together

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Hannah R. Van Winkle

Project Number
J1925

Project Title
A Zoological Rat Maze: Which Food on Which Surface?

Abstract

Objectives/Goals
The objective of my project was to find out which food's scent trail on a certain surface would cause a rat to follow it through a maze quicker than the scent trails of all the other foods I used. I also wanted to find out if spreading bedding over the trail would affect a rat's following it.

Methods/Materials
The materials I used were 4 foods, building materials,and 2 rats. I used the foods to make the scent trails by rubbing them on the maze's base along the selected route to the maze's end. The types of mazes I made were a cardboard maze without bedding on its bottom, a cardboard maze with bedding, a wood maze without bedding, and a wood maze with bedding. I made 16 mazes so that the rats would not memorize them. I used the cardboard to make eight of the mazes' bases and to make the walls of all sixteen mazes. I used the wood to make eight of the mazes' bases. The hot glue and hot glue gun were used to glue the wall to the mazes' bases. I used the bedding to cover the entire bases of eight of the mazes, four made out of cardboard and four out of wood. The mesh wire was used to cover the mazes so that the rats could not get out of them. I used 2 rats named Dixie, a blue rat, and Roxy, an albino rat. My experimental disign was the way I had each of the rats go through the mazes. Over a period of days, I ran each of my rats through all sixteen of the mazes. I did three trials per maze with each rat, with a total of 96 trials all together. I did three trials in each maze to show just how fast my rats would memorize the mazes.

Results
Through doing this project, I learned that the rats followed the scent trail of the cheese on the wood quicker than the other foods and the bedding did not affect the rat's sense of smell. I also found out that rats memorize mazes quickly. I found out exactly what I wanted to find out in my objective.

Conclusions/Discussion
My results enabled me to reach my objective because they taught me all that I wanted to learn through doing my project. They broadened the knowledge of zoology by showing that rats have a good memory span and that rats pick up smells on harder surfaces better than softer or porous surfaces.

Summary Statement
My project is about the fact that rats use their sense of smell to find food, and I wanted to test how well they follow food trails.

Help Received
My parents helped me with my project through my dad buying the supplies needed for my project, and my mom helping me to type my report and with my display board.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Zoe Eve Walp

Project Number
J1926

Project Title
What Do Owls Eat?

Abstract

Objectives/Goals
My goal was to determine if owls in different areas of California prey on different animals.

Methods/Materials
I obtained and collected owl pellets from Novato, San Diego, and Santa Barbara, California. Those were my main materials but I also used gloves, a scale (grams), plastic bags, and facial masks to conduct my experiment. Using dissecting techniques, I analyzed the contents of the owl pellets, and identified skeletal remains of different mammals.

Results
My results were that in Santa Barbara the ratio of gophers to voles was 2.6:1 while in San Diego it was 1:4 and in Novato it was 1:3.

Conclusions/Discussion
My hypothesis, that owls in different areas of California prey on different species, was supported by the data collected. In Santa Barbara they ate more gophers than voles and in Novato and San Diego they ate more voles than gophers. I think that's the case because the owl pellets that were found in Santa Barbara were found in the suburbs and the owl pellets from other places in California were found in riparian coastal scrub communities. The data suggests that there are more voles in the rural environments and more gophers in the city environments.

Summary Statement
My science project was about determining whether owls in different places of California prey on different animals.

Help Received
My friends from Novato and the Audubon Society of San Diego collected owl pellets from those areas for me. My mother and father helped me a little with the dissection of the owl pellets. Also, Paul Collins of the Santa Barbara Museum of Natural History was a great help in identifying owl pellet bones.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Amy L. Wolfberg

Project Number
J1927

Project Title
Green Tree Frogs Changing Color

Abstract

Objectives/Goals
My project was to test whether green tree frogs (Hyla cinerea) would change color to match their surroundings.

Methods/Materials
A 20 gallon aquarium was divided in half with a barrier that isolated frogs on each side. All of the sides, artificial plants and rocks were colored brown on one side and green on the other side. After taking pictures of the frogs, three of them went into the brown side and the other three went into the green side. Pictures were taken of the frogs at three day intervals for eighteen days. The pictures were developed onto a CD. The computer program Adobe Photoshop was used to characterize the values for the cyan, red, yellow and black for each frog over time. The results were graphed for comparison.

Results
The frogs in the brown environment turned brown and the ones in the green environment turned green. The frogs were light green when purchased. A short term and long term process of color change was observed. During the long term process, while in the tank, the frogs changed color to match their surroundings. The short term process was observed when they were taken out for pictures. All of the frogs started to turn brown when they were captured and handled.

Conclusions/Discussion
This experiment was important because it demonstrated that these animals are capable of adapting to their environment. With this information the frogs and their habitats can be better managed to increase their chances of survival in the future.

Summary Statement
This experiment determined that green tree frogs are capable of changing color to blend into their environment.

Help Received
This experiment determined that green tree frogs are capable of changing color to blend into their environment.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Lauren A. Zeidler

Project Number
J1928

Project Title
Can California Quail, Which Are Normally Ground Feeders, Be Trained to Eat from an Elevated Feeder?

Abstract

Objectives/Goals
The purpose of this experiment was to see if California quail, which are normally ground feeders, could be trained to eat from an elevated feeder.

Methods/Materials
The first step was to purchase two troughs that the quail could eat from easily. Then a quail block, cracked corn, and a mixture of white millet, milo, and sunflower seeds were placed in the feeders. The troughs were left on the ground for a week in order for the quail to become accustomed to eating from the troughs. After one week, the troughs were raised three centimeters and observed as much as possible. Whenever the quail were seen eating from the troughs, the date, height of trough (in centimeters), time, number of male and female quail, and any other species of all the birds that were in the troughs were recorded. The troughs were raised daily until they reached their final height of 42 cm. The experiment was repeated, but this time the feeders were raised every 3 days rather than daily.

Results
In the first experiment, the number of quail eating at the feeder receded after the troughs had been raised to only a height of 12 centimeters! The number of quail feeding continued to recede as the troughs continued to be elevated. When the experiment was repeated, the troughs were raised three centimeters every three days instead of each day, allowing the quail to get used to the elevating troughs. Unlike the first experiment, with the slower elevation of the food troughs, the number of quail feeding remained stable.

Conclusions/Discussion
The second experiment strongly supported the hypothesis. The number of quail eating from the troughs did not recede as the troughs got higher. Since the number of quail feeding stayed the same even as the troughs were elevated, the quail appeared to have been "trained" to eat from the elevated feeders.

Summary Statement
The purpose of this experiment was to see if California Quail, which are normally ground feeders, could be trained to eat from an elevated feeder.

Help Received
Mother helped identify bird species and purchased the seeds and troughs; Father made the three centimeter blocks; Roxanne Hunker gave support and encouragement.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
J.P. Zimmerman

Project Number
J1929

Project Title
An Aquarium Built with Multi-Temperature Zones and Sensors to Determine if Goldfish Have Water Temperature Preferences

Abstract

Objectives/Goals
My project was to determine if goldfish will choose a certain temperature range and avoid others.

Methods/Materials
An experimental aquarium (acrylic tube 1.8 m tall X 8 cm diameter), including 11 thermocouples, was built from scratch to measure water temperature changes simultaneously. A fully equipped commercial aquarium was purchased to hold five, small equal sized goldfish between experiments. During control experiment aquarium water was at room temperature. During each of the six 15-minutes trials, ice (bottom zone) and heat (top zone) were added at the same time. As water changed in the experimental zones, room temperature was maintained in the middle zone. After each trial, goldfish were returned to a commercial aquarium.

Results
During the control experiment (room temperature), goldfish first go to the aquarium bottom then migrate throughout the tube. The results of the six trials suggest that goldfish prefer the upper middle zone (room temperature) followed by short excursions into the cold and warm zones.

Conclusions/Discussion
My conclusion is that goldfish when given a choice will choose a specific temperature environment. My data supports my hypothesis, goldfish prefer room temperature over cold or warm. However this experiment opens other questions such as did the shape and size of the aquarium make a difference in goldfish behavior? Do other species of fish show temperature preferences? Can fish raised for commercial purposes be raised at room temperature, therefore being more economical for fish farming which in turn will reduce over-fishing?

Summary Statement
To determine the temperature preference of goldfish using a home built aquarium and temperature sensors.

Help Received
My dad supervised me when I used electric tools and adhesives during construction of aquarium and thermocouples. My mom helped me proofread my report and with the supervision of the goldfish health. My science teacher taught my class scientific methods and corrected rough drafts.

CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Clara J. Lisle

Project Number
J1999

Project Title
Ant Nests: Efficient Home Heating

Abstract

Objectives/Goals
My project was to see how Formica rufa (wood ants) keep their nests warm. My hypothesis is that the ants may use sunlight or the heat that composting materials generate to heat their houses.

Methods/Materials
I constructed three fake ant nests. Two were made out of shredded hay and one was made out of Redwood Compost. The hay nests test the compost hypothesis because hay is a composting material. The redwood compost nest tests the sun's effect because the material won't heat up since it has already composted. The false nests were constructed next to a real ant nest. I measured the temperature of the nests with a digital thermometer twice a day for about a month.

Results
The hay nests got very warm (up to 65° C!) and then slowly cooled off while the redwood compost nest stayed just above ground temperature. The real ant nest maintained a temperature of about 25°C the whole time. The ground and air temperatures varied with the weather. I applied vents (fifteen straws) to one of my hay nests and the temperature rose again.

Conclusions/Discussion
Ants could indeed use the warmth the compost makes to heat their nests, but they would have to find a way to regulate it. I don't think that the sun has a very big impact on heating ant nests.

Summary Statement
False hay nests made out of compostable and non-compostable materials are used to test the hypothesis that ants use sunlight or composting organics to heat their nests.

Help Received
Father mowed the hay for the nests, parents showed me how to use Excel to enter and plot my data,I used my Father's digital thermometer. I discussed my project with Professor Nathan Sanders of Humboldt State University.