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The Effects of Illicit Substances on Growth Rate Development of Blowflies in Rabbits

Stephanie Arens
Alexis Nelson

The purpose of this research was to investigate if insects colonized on corpses have a modified growth rate due to the presence of illicit substances taken by the deceased. Then, an analysis of that same growth rate was performed to determine if this provided a more precise cause and time of death. Determining the presence of an illicit substance such as morphine or tramadol is considered highly important as the nation is currently in a drug abuse crisis and these illicit substances could directly affect the postmortem interval (PMI), skewing traditional time of death. This project focused on the growth stage of the Lucilia sericata in relation to the PMI and concentration of illicit substance found in the deceased. With the understanding of entomotoxicology methods, field data of a previous experiment was analyzed. In that experiment, rabbits were administered different amounts of illicit substances, all dosages known to have been fatal for humans, except for R0, which contained no illicit substance. Temperature, a known variable in entomology, was kept carefully controlled as was the weight of the rabbits. The insect studied was then deposited in the eyes, ears, and mouth of the rabbits. Each day, larvae were sampled and measured for growth using both length and width; and the mean value was used for the growth curve. Statistical analysis tests such as the ANOVA and Student T-test were used to determine significant differences between the treatment groups. From the experiments analysis, the determination supported the hypothesis that the presence of drugs does in fact affect growth rate development of insects; therefore, providing forensic scientists a more efficient method of determining if the deceased was under the influence of an illicit substance at or near the time of death.


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Determining Whether Drosophila (fruit flies) Have an Innate or Acquired Feeding Behavior

Carter Atkins
Andrew Fazekas

We don't know whether or not if the feeding behavior of insects is an innate or an acquired trait. We do know that insects have the ability to balance their diet, but we want to find out whether or not their feeding behavior can be influenced to understand if it is an acquired trait or an innate trait. Our hypothesis is; if we make Drosophila (fruit fly) cultures deficient in various medium groups then offer them multiple medium groups to eat including the medium group they are deficient in then, the Drosophila will eat more of the medium that they are deficient in suggesting that they have an acquired trait. We created three Drosophila cultures of each medium, formula 4-24 medium, high protein medium, and high sugar medium. Then we gave each culture the choice of all three mediums to determine whether they have an innate or acquired feeding behavior. We observed that many of the base cultures have clustered around the protein and base medium. The sugar cultures have also clustered around the protein medium. The protein cultures have not been tested yet as many of them developed mold and caused the Drosophila to die. The sugar Drosophila trials primarily ate the high protein medium suggesting that they have an innate trait to correct their diet. However, the base Drosophila also primarily ate the protein medium which suggests that they may be just attracted to the protein medium.


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The Effect of Octopamine on Aggression of Acheta Domesticus on the Cricket Community

Jorge Bravo
James Speroni

The main purpose of the experiment is to test the effect of Octopamine on the aggression of crickets in their own community. The experiments being performed will consist of one-on-one interactions, isolation of crickets to test cannibalism, and the effect of octopamine when starving crickets are released into a community of crickets with food.

250 crickets of the Acheta domesticus were experimented on. For the three experiments performed, the independent variable was the octopamine injected, while the dependent variable was aggression observed. Control was crickets without octopamine injections. Crickets were anesthetized, then injected, then isolated until experiment was performed.

The crickets did not demonstrate any aggressive behavior, so there were results. There was also almost no difference between the behavior as the experimental and control groups behavior.

The hypothesis that if octopamine was injected into Acheta domesticus then the crickets would become more aggressive in several settings. This hypothesis was not proven, and there was no proven link between octopamine and aggression. The lack of results show major error in the experiment. For example, the Acheta domesticus is a very non-aggressive cricket, and the Gryllus bimaculatus would have been much better to observe aggression.

Further research could be done on the Gryllus bimaculatus, in which is much better to observe aggression. More research could also be done in giving larger doses to either species of crickets. Also, more research could be done in mixing in chemicals such as chlordimeform, which are known to complement octopamine.


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Enzymatic Digestion of Cryptocaryon irritans’ Exoskeleton: A Cure for Ich

Ashley Carney

Cryptocaryon irritans is a prevalent marine parasite that infects fish. It causes fish to lose color, have trouble breathing, and refuse to eat. These symptoms can quickly lead to the death of the fish. One parasite can reproduce and infect every fish in an aquarium.

The purpose of this research was to determine if protease and/or trypsin enzymes can be used to kill Cryptocaryon irritans by breaking down the exoskeleton of the parasite. Cryptocaryon irritans was taken in the free swimming theront and trophont stages from an aquarium with infected fish. The parasites were placed in jars with saltwater in a temperature controlled environment. In each trial, a control jar had nothing added, protease enzymes were added to the second water sample, trypsin enzymes were added to a third sample and protease and trypsin enzymes were added to the fourth sample. The jars were left 24 hours and the number of living Cryptocaryon irritans parasites in each sample was counted. It was determined that trypsin was the most effective at killing the parasites. Protease was also effective while the application of protease and trypsin together were also effective.

Additional research regarding dosages needs to be conducted before the enzymes are used as a treatment for infected fish. It is supposed that enzymes could be the future of curing marine fish of Cryptocaryon irritans.


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The Relative Determination of Decomposition Rates of Cadavers in Various Salinities

Nikith Chavali
Julia Nutwell

Decomposition rates of human cadavers serve as a missing piece in the forensic community. These types of experiments have minimal data and difficulty with controls when dealing with varying salinity and potential harsh weather conditions. Due to the effects of external conditions, such as snow or excessive rain, the data a research facility can acquire will fluctuate from experiment to experiment. The purpose of this study is to determine if the fluctuations and climate changes correlate in a manner that allows a determination of the relative decomposition rate in a temperate location such as Loudoun County, Virginia. This experiment involves using secondary data from pig cadavers that has been acquired from various experiments. This data has been selected because the tissue very closely resembles that of the human, both anatomically and molecularly. The analysis involves examination of weather conditions and the controls used to protect the cadavers while still allowing some form of natural decomposition to occur. Future experimentation should include analysis of decomposition rates in natural disasters to allow for more accurate postmortem interval determination.


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The Effect of Fire Resistant Clothing on Growth and Regeneration of Planaria

Alexandra Chnyrenkova

Placing fire resistant baby clothing in water with a cut planaria to see the effects of fire resistant chemicals on planaria growth and regeneration. This may provide insight into the effect of fire resistant clothing on child growth and development. The chemicals or polyester fibers may decompose to create harmful residue that will slow the regeneration. This experiment is set to observe the regeneration and the difference of with and without fireproof clothing, and to transfer these results to child development. Spring water from planaria was distributed into five glass cups, pieces of clothing sleeve into the water of four of the cups. Let stand for 12 hours. The planaria were cut directly below the head, 4 planaria per cup. The planaria was observed twice a day (morning and evening) starting the second day. Record activity level, eye presence, alive or not, color variations. Pictures were taken until all have eyes. The analysis the data was done by recording in how many days/ hours the planaria regrew eyes and averaging the four in the plate, as well as their behavior. The hypothesis was rejected since the planaria with the fire resistant clothing had an accelerated regeneration time. This experiment is being repeated.


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Some pesticides do more than just kill bugs. Some destroy the surrounding environment and can cause problems with the human immune system if inhaled. Activated carbon is known to be a sponge for different chemicals such as the active ingredients found in a majority of pesticides. To test if activated carbon can absorb the active ingredient bifenthrin in pesticide, testing chambers made of water bottles were used. On either side of the chamber were two cotton balls, one soaked in water and one soaked in pesticide. This setup was used for the control. For the experimental part of the project, one cotton ball was soaked with pesticide and the other was soaked with activated carbon and pesticide mixture. The subjects of the experiment were drosophila or fruit flies. The results for the control were as predicted. All the flies in each trial for the control died as they were attracted to the side with the pesticide. Each trial was timed for 15 minutes, and the number of flies that were alive were recorded every 5 minutes. The results for the experimental trial were that a majority of the flies did not die. The activated carbon did in fact absorb bifenthrin. The hypothesis of the project can be accepted. The activated did absorb the bifenthrin enough that when the drosophila came in contact with the cotton ball that had the activated carbon, they were not harmed. Further research could explore if there is a ratio of activated carbon to pesticide that can still exterminate pests but not harm the surrounding environment.


Bansal, R. C., & Goyal, M. (2005). Activated carbon adsorption. CRC press. This journal is about the chemical structure of carbon, and how is changes


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The Preference of Pogonomyrmex barbatus: Home or Utopian Colonies

Gerson Galicia Ortiz
Miya Washington

The purpose of this experiment was to find how ants would react in a situation where they are separated from their home colony and placed in an improved utopian environment, then reunited with their home colony. The independent variable was the ratio of food given to the population. The dependent variable was the number of ants traveling to the utopia over a certain time. The control group was ants in a colony with the same amount of food as the utopian colony. This experiment used Pogonomyrmex barbatus (red harvester) worker ants. The ants were put into containers for a month and were fed every few days. After a month, five ants were separated into a different colony and were fed every other day for three days. On the fourth day, the two colonies were reunited. The hypothesis, if ants were placed in an improved environment, then the ants would choose the improved environment over their home colony, was not supported because the ants were 88% more likely to return to their home colony. The null hypothesis was accepted because the independent variable did not have an effect on the dependent variable because the p-value from the chi square test was over .95. The error in this project was mold growing in the colonies, ants escaping, and unpredictable schedule changes. Further research could be pursued to study and explore a whole ecosystem with a variety of species rather than just one species.


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The Effect of Ultraviolet Light on Various Life Forms and Their Offspring With the Consumption of Different Types of Antioxidants

Rebecca Hang
Akhila Kondaka

This project demonstrates the various effects UV rays have on life forms after the consumption of antioxidants. Research has shown that UV rays can cause detrimental and powerful skin cancer. Many antioxidants such as grapes, vitamin E and vitamin C have been known to prevent skin cancer and prevent the spread of it as well. In this experiment, we hypothesize that if fruit flies, cockroaches, and yeast are exposed to grapes, vitamin E, and Vitamin C and then exposed to UV radiation, then the vitamin C will improve the survival rate within the flies. For the cockroaches, vitamin E was beneficial. For the UV stranded yeast, the grapes will prevent the growth of the yeast. The experiment required the use of three different species, fruit flies, cockroaches, and yeast, and three different antioxidants, grapes, vitamin E, and vitamin C. Each yeast specie was equally divided into two sets of four groups to allow for two trials, one with UV stranded yeast and then regular yeast. Each of the four groups were fed the three different antioxidants and the fourth served as the control group. The samples were placed under the UV light one at a time for the same amount of time. Fruit flies, the grapes seems to have increased the survival rate which in turn also produced more offspring than any other antioxidant. The vitamin E showed a slightly lower survival rate than the grapes but higher than normal/the control. The vitamin C demonstrated a reduced survival rate.

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The Effect of Temperature on the Rate of Filtration of Chesapeake Bay Oysters

Jocelyn Hawk

Oysters are an important part of the Chesapeake Bay, as they help filter the water of algae, dirt, and nitrogen. The effect of temperature on the rates of filtration of these oysters can help predict how pollution in the Chesapeake Bay will change over the seasons. This experiment was conducted to determine the effect water temperature has on the rate of filtration of Chesapeake Bay Oysters. Five tanks were filled with five gallons of water gathered from the Potomac River each. One tank was kept at 20C, one at 24C, two tanks at 28C, and one tank at 32C. Two oysters were placed in all of the tanks except for one of the tanks kept at 28C. Nitrate levels, general hardness, carbonate hardness, and pH were tested every 30 minutes for six hours. The only dependent variable with a noticeable trend was the nitrate level. The warmer the water was, the more quickly the nitrate level seemed to drop. The pH level fluctuated in each tank, and the general and carbonate hardness dropped at approximately the same rate in each tank. The nitrate level in the control tank did not drop.

http://chesapeakebay.noaa.gov/oysters/oyster-reefs
http://www.cbf.org/about-the-bay/more-than-just-the-bay/creatures-of-the-chesapeake/eastern-oyster
http://www.cbf.org/about-the-bay/issues/dead-zones/nitrogen-phosphorus

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The Effect Of The Volume Level Of Anthropogenic Sound On The Heart Rate Of Daphnia

Hope Kircher

While research proves that high decibel levels of anthropogenic sound, such as naval sonar, have deadly effects on whales, dolphins, fish, and mollusks, it is unknown what effect the sounds have on microscopic organisms. This project studies the effects of varying decibel levels of sound generated by assorted power tools on daphnia, microscopic freshwater organisms, in order to mimic naval sonar and provide information on how oceanic microorganisms are affected. Daphnias’ heart rates, the dependent variable, are recorded after being exposed to one minute of 65-110 db of sound, the independent variable, and then compared to a constant group that was not exposed to anthropogenic sound. The heart rates increased by 27.53 beats per minute on average with each increase of approximately 10 db. My hypothesis “If the intensity of anthropogenic sound, measured in decibels, is increased, the number of heartbeats in daphnia in a minute will also increase, because the ultra sound will put stress on the senses and body systems of the daphnia,” was supported by these results. The overall increase in beats per minute shows that naval sonar, which reaches levels of 240 db, would give daphnia heart rates of approximately 753.59 beats per minute. This extremely fast heart rate prediction indicates that microscopic organisms are currently being maimed and killed by naval sonar. Further research could explore whether saltwater microorganisms are similarly affected and whether naval sonar has the same effect as the power tools that were used to generate the sound for this experiment.


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Genetically Modifying Zooxanthellae Algae to Prevent Coral Bleaching

Valerie Knowles

Zooxanthellae algae, found inside corals, leave when the water gets 1-2 °C warmer than the normal temperature, killing the coral. Once the corals are dead, the fish leave in search for a better habitat; fishermen will not have fish to catch, tourists will not visit the coastal towns; and it could cause a global depression. There is a way to genetically modify the algae to be heat resistant. In this experiment, the DNA from Zooxanthellae was extracted by lysing the cells with a buffer made from EDTA, HCL, NaCl, SDS, and Proteinase K. The extracted DNA was barely visible until it was suspended in TE buffer. It was concluded that SDS is a crucial material in extracting the DNA; soap will not work as a replacement. The next research part will include growing Zooxanthellae in intervals of warmer water and then using the method to extract the DNA as stated previously. Then the original sample of algae and the ending sample will be sequenced and then compared to determine the genes that changed due to warmer temperature. The samples will then be sent to GENEWIZ (http://www.genewiz.com/) for DNA sequencing. The sequencing information will be entered into the BLAST database (http://blast.ncbi.nlm.nih.gov/Blast.cgi) for analysis. Once the gene is located that controls heat tolerance, it will then be isolated and vectored into the DNA of the control Zooxanthellae by Agrobacterium tumefaciens mediated transformation. The Zooxanthellae will be genetically modified to be heat resistant; preventing coral bleaching.


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Enhancing Survival via Self-medication in Drosophila melanogaster

Louis Montano Arias

Possessing a high tolerance to alcohol gives Drosophila melanogaster the unique ability to survive. Research has shown that when Drosophila are exposed to parasitic wasps, females lay their eggs in areas of high alcohol content in order to increase offspring survival. While wasps attempting to eat larvae will die due to alcohol consumption, larvae survive.

The purpose of this research was to determine if such Drosophila behavior is also present when exposed to other external threats. Drosophila were exposed to E.coli, for 24 hours while insects then were transferred to a container which contained two petri dishes. One petri dish contained Drosophila medium and the other contained medium mixed with a 30% alcohol solution. The number of larvae in each dish was recorded after a week and results were compared to the control. It was determined that the threat and exposure to E.coli did not influence the Drosophila to lay their offspring in the alcohol concentration. Further research would include determining what other aspect in Drosophila behavior influences maternal behavior.


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The Effect of Hydrogen Peroxide Rich Foods on Fungus Infected Ant Colonies

Bryce Pearson
Donal Whelan

Many studies have been performed in order to measure the intelligence of hive insects. They have an ability to act in such a way as to benefit the hive while ignoring individual lives. Members of these species have been observed performing actions that are detrimental to themselves but help the group as a whole. This study set out to demonstrate ant's ability to do just that: medicate against an infectious disease using a harmful diet choice in order to protect the group. In order to do so, ants were separated into 30 groups of 5 and 15 of those groups were infected with a parasitic fungus. All ants were given a choice between their regular food and food mixed with Hydrogen Peroxide, which is a chemical that is toxic to ants, but kills the fungus. Results were inconclusive, as the ants were dying too quickly from the fungus and from poor laboratory conditions to be meaningfully tested and observed. There were a plethora of sources of error present, from ants that may have already been contaminated with a fungus to other nearby experiments causing side effects in the ants. Further research needs to be done with this experiment in a more professional laboratory with more time, larger samples, and a better supply of ants. Once the original experiment is completed, it would be interesting to see the same type of experiment expanded to other species.


The Effect of Sublethal Exposure of the Pyrethroid Insecticide Cyfluthrin on Interspecies Aggression and Predation of the Model Organism Lycosidae (Wolf Spider)

Aayush Raman
Kunaal Sarnaik

The purpose of the study was to determine if sublethal exposure to the pyrethroid insecticide, cyfluthrin would induce a change in wolf spider behavior. Using a double blind study, each spider’s behavior was recorded before and after sublethal exposure to 25 uL of 7.5 ug/mL cyfluthrin. Intraspecies aggression was recorded using the mirror test, in which a mirror was placed in front of each spider and responses recorded. Predation was recorded using the prey capture test.

There was a significant increase in active tracking with the mirror test and increased visual tracking in the prey capture test (Wilcoxon matched-pairs test, P less than 0.05). However, there was no significant difference in visual tracking, and distance away from the mirror in the mirror test, or active tracking and time to capture in the prey capture test (Wilcoxon matched-pairs test, P greater than 0.05). It appears that single-dose cyfluthrin exposure at this concentration has some effect on wolf spider behavior and could possibly increase aggressive tendencies. Data is pending on repeated exposures.

Limitations to the study include the need for a larger group of spiders and repeated exposure. Cyfluthrin has been shown to affect epinephrine, norepinephrine, and serotonin levels in mice and the prolonged sublethal exposure could promote aggression. The literature suggests that continuous exposure could also increase aggression in humans. In order to further the findings of this experiment, other common household insecticides and model organisms must be tested to see if there is correlation between chronic insecticide exposure and changes in behavior.


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The Effects of Aluminum on Brine Shrimp

Emma Smith

The purpose for this experiment was to measure the effects of aluminum on sea creatures. Acid rain contains high concentrations of aluminum and as it gets into the ocean it can lower the PH level causing the water to become more acidic. To test the effects of aluminum on sea animals, three stations of brine shrimp were set up. Group A had .02 g of Aluminum sulfate, Group B had .01 g of Aluminum Sulfate, and group C had 0.0 g of Aluminum Sulfate. The groups each were given the same amount of food and were at a constant temperature. The brine shrimp with aluminum sulfate had a PH of 6 whereas the control group had a PH of 8. Within the first 48 hours of the experiment almost all the eggs were hatched in group C (control), only 3-5 were hatched in group B (.01 g), and none were hatched in group A (.02 g). 5 days into the experiment the shrimp in group C were thriving and growing; 5-7 more hatched in group B, but about 5-6 were dead; only about 3 were hatched in group A, the rest were in dormant cysts. These trials have shown that over time aluminum does effect the life span of Brine shrimp.


University of Utah, The brine shrimp life cycle. (n.d.). Link- http://learn.genetics.utah.edu/content/gsl/artemia/ This website talked about Brine shrimp life cycles

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A More Ecological Approach to Preventing the Airborne Spread of Bordetella bronchiseptica

Lauren Smith

This experiment was conducted to find a safe, effective method to prevent the airborne spread of Tracheobronchitis, Kennel Cough, (canines) and Bordetellosis (felines) in a kennel environment. The diseases branch from the bacteria, Bordetella bronchiseptica (Merck, 1995).

To test the method, a model organism, E. Coli K12 was cultured in twelve 9 mL nutrient broth tubes and then mixed in a spray bottle. The liquid bacteria was sprayed through an air flow system onto a petri dish to mimic the dog’s cough. The independent variables included bleach and UVC light. The bleach trials involved spraying a 1:32 bleach to water ratio (shelter protocol) in a air vent after misting bacteria(UC Davis, 2016). The UVC trials incorporated a UVC light in the air vent while bacteria was misted. The control group sent bacteria through the vent without added variables.

The results were calculated by recording the colony count of the petri dishes. For trials in the UVC group, none of the petri dishes had bacteria growth. The bleach group included an average colony count of 378.684, and the control had a mean of 1281.12. Data was analyzed using a t-test with control compared to bleach, bleach to UVC, and UVC to control(NCS, 2016).

For all three comparisons, p value was less than .05, rejecting the null hypothesis. Thus, all data was significant with little error. As well, results show that UVC is a less toxic and more effective airborne bacteria elimination method than bleach.

This experiment can be further examined by testing the same process on Bordetella bronchiseptica rather than a model organism. In addition, it could be further tested in animal kennels by inserting a UVC bulb in the air filtration system to potentially offer a kennel alternative to bleach.


UC Davis Koret Shelter Medicine Program. (2016).


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Evaluating the Existence of False Positives in the Classical Conditioning of the Parasitic Wasp Nasonia vitripennis as a Cancer Detection Method

Heather Waters

The parasitoid wasp Nasonia vitripennis has a heightened sense of smell far beyond that of a human, enabling them to detect and differentiate between various volatile organic compounds (VOCs) that can be found on anything from the human breath to food sources. Certain cancer cells also emit very specific VOCs to their environment. Previous studies' have determined that honeybees can detect cancer VOCs, but Nasonia are just as capable of detecting and differentiating among scents as honeybees, creating a safer alternate option in cancer detection. However, this method can possibly be prone to false positives. In order to evaluate the existence of false positives, the wasps were divided into three groups of twenty individuals. Each group was exposed to one of three different scents: cyclohexanol (a VOC associated with breast cancer cells), pinacolone (an isomer of cyclohexanol), and a blank control. The Nasonia were conditioned five times by being rewarded with a sucrose solution. In acquisition trials, Nasonia were released into a T-shaped olfactometer with one scent on each end, and their behaviors were monitored in order to determine which scent they preferred. Following data collection, the separate groups of Nasonia were analyzed using a Mann-Whitney to determine whether there was statistical significance between the responses to cyclohexanol and pinacolone, to determine their tendency toward false positives in this means of cancer detection.


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