Abstract: Science and Engineering Fair of Houston

1070

Using Radiation to Minimize Mold Growth on Bread

Peter Zwart
Clear Creek ISD /Westbrook Intermediate School

Category

Biochemistry and Microbiology

In my experiment, I hypothesized that if I put increasing amounts of Americium-241 on slices of tortillas, then mold growth will be inhibited. To conduct my experiment, I laid out 5 slices of tortillas with wire mesh on top. I then placed no pellets on the control, 1 pellet on the 1st piece of tortilla, 2 on the 2nd, 3 on the 3rd, and 4 on the 4th. I also sprayed each piece of tortilla with one squirt of water. Each half a day, I recorded if each tortilla piece had mold. During this experiment, I had a lid over the Styrofoam box. I repeated this three times, and used a data table to document my findings. I then graphed the data. Overall, my hypothesis was correct. However, my control never had mold growth during all three trials. I cannot be sure why this happened, but, if I had to guess, I would say because the Ziplock bag was not sealed all the way, or the water evaporated from the tortilla. If I were to redo my project in the future, I would put another pellet over my control, however, there would be no Americium-241 in it.

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[ ] vertebrate animals [X] microorganisms [ ] rDNA [ ] tissue

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[ ] yes [X] no

4. This project is a continuation of previous research.

[ ] yes [X] no

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Abstract: Science and Engineering Fair of Houston

1071

Enzymes Activity Lock and Key Model

Saneyi Sanandi
Houston ISD /BCM Academy at James D Ryan - MS

Category

Biochemistry and Microbiology

My research finds that enzymes are biological molecules that accelerate chemical reactions such as digestion. Gelatin is made of a protein called Collagen. I wanted to see if changing the conditions affect the reaction when I add pineapple juice (enzyme Bromelain) to the Jello-O (Substrate Gelatin). First, I made Jell-O according to packet instructions by using boiling water and due to the hot water, its long chain unwinds. Divided equally in 6 bowls. I used two conditions: one is temperature, and one is ph. I added cold water, warm water and room temperature water in bowl 1, 2 and 3. I added one teaspoon of lime juice (acid- pH less than 7) in bowl 4, 1 tablespoon of baking soda solution (alkaline pH 8 or 9) in bowl 5, bowl 6 has no acid or alkaline which is my control. After 24 hrs. in the refrigerator add pineapple juice which has enzyme bromelain in each bowl and observe the time that changes in consistency of all Jell-O bowls. I observed that the room temperature (Bowl 1) dissolved at first, then warm water (bowl –2) but cold-water bowl –3 did not dissolve completely. I also observed bowl 4 (acid dissolved completely but not the alkaline one (bowl 5). I conclude that the enzyme Bromelain breaks down the peptide chain in gelatin.

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Abstract: Science and Engineering Fair of Houston

1072

How Does Salt Affect The Visibility of A Cell Line Using Alexa Fluor Dye

Isabelle Bostic
EMERY WEINER JEWISH SCHOOL

Category

Biochemistry and Microbiology

Many people wonder what would happen if they were stranded at sea without water. This question often elicits the response, 'Well, if you have water all around you, just drink it,' without knowing that it would result in death. Often unanswered, however, is why, exactly, drinking seawater kills you. The explanation lies in a process called crenation, or the movement of water out of a cell when exposed to a hypertonic solution. Exploring this process in detail, I used a compound microscope, ToupView, and some 1, 2, 3, and 4% saline solution to view the plant cell version of what would happen to our cells when ingesting salt water. The Atlantic Ocean, for reference, has a salinity of ~3.7, which greatly outweighs that of humans, 0.9. As the cells were exposed to the 3 and 4% saline solutions, a substantial amount of water exited the cells, causing the cell membrane and all of the organelles within it to shrivel up within as little as 7 minutes. When there was no more space for food generation – photosynthesis – to occur, the elodea leaves wilted and died. Now, what would happen if these were human cells? Although space would no longer exist for organelle movement or chemical reactions, homeostasis would break, electrolyte levels exceeding water levels in your body coupled with increased urination that further dehydrates you would ultimately kill you upon ingesting seawater.

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Abstract: Science and Engineering Fair of Houston

1073

What is the effect of different essential oils used on the amount of S. Epidermis bacteria they can remove?

Harisha Joshi
Clear Creek ISD /Brookside Intermediate School

Category

Biochemistry and Microbiology

This project was completed to figure out which essential oil could best remove s. epidermis, a bacteria meant to resemble an acne-causing c. acnes, and acne in general. This project could benefit the world because it presents an easy, cheap, and natural solution to acne, providing a plant-based replacement to the world's current over-the-counter medication. Essential oils are also affordable and easily accessible to the general public, as well as backed up by olden day medical traditions and current day research when it comes to helping the body and removing acne. It was hypothesized that thyme oil would remove the most s. epidermis. The different oils were tested by comparing how much s. epidermis would grow with that oil against how much s. epidermis would grow by itself. By following this procedure, oregano oil was shown to be the best at removing s. epidermis with an average removal percentage of 35%. Tea tree and rosemary oil scored second, with an 18% removal. Finally, thyme scored the worst, a contrary to the hypothesis, and got 17%. The constant, plain facial soap, did worse than all the oils, even thyme, as it got a removal percentage of -3%. By completing this testing, the best oil to remove acne was determined, meaning people can now use this oil to fight their acne.

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Abstract: Science and Engineering Fair of Houston

1074

What is the quantity of bacteria on different floors?

Maya Yallambalse
Conroe ISD /York Junior High

Category

Biochemistry and Microbiology

The purpose of this experiment was to find out the bacteria levels of several surfaces. The experiment was conducted at school by dropping apple slices on multiple surfaces. The apple slices were picked up after 5 seconds and the side that faced down was swabbed into the agar in the petri dishes. The bacteria grew over a period of 6 days, and observed on 3, final measurements were made on the sixth day. The findings show that while all of the surfaces had a significant amount of bacteria, some had a lot more that than other. The most important conclusion that can be drawn from this experiment is that floors are extremely dirty, and if any food comes in contact with it, the food should be dispossessed rather than consumed.

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Abstract: Science and Engineering Fair of Houston

1075

What is DNA? & Which fruit has more DNA? Strawberry or Banana?

Philip Bae
SST - Champions College Prep - MS

Category

Biochemistry and Microbiology

The purpose of my experimentation is to see which fruit contains more DNA, bananas or strawberries & to explain what DNA is. The procedure is first, we will crush up a strawberry and ⅓ of a banana in separate bags, then mix them with a substance with 2 tsp of dish soap, 1 tsp of table salt, and ½ of water (only 2 tsps). Then, we will squeeze out the fruits in separate coffee filters and squeeze them down into a cup. Lastly, we will pour ½ a cup of cold isopropyl alcohol to the cup (don't let it mix) and extract the stringy stuff which is DNA and see which has more DNA. After the experiment I will explain what DNA is. The most important results I found were that strawberries contain more DNA than bananas because of their octoploids, and that DNA is the code for life. In conclusion, me and my team extracted DNA from a banana and strawberry, and the strawberry has more DNA. We also discovered that DNA is the code for life. The resources we used were Rockefeller University, MedlinePlus, etc.

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Abstract: Science and Engineering Fair of Houston

1076

how do different decomposing bioplastics affect moisture content in soil?

jessica henriquez
Houston ISD /BCM Academy at James D Ryan - MS

Category

Biochemistry and Microbiology

Pollution being a major problem everyone talks about everyday. I wanted to find the most convenient and effective way to decrease the amount of contamination we do. According to current estimates, the world produces around 400 million tons of plastic waste annually, as found through Our World in Data. I conducted an experiment, my testable question being "how do decomposing bioplastics affect moisture content in soil?" where I'd bury two types of biodegradable plastics (bagasse and cellulose-based) alongside with a non-biodegradable plastic (styrofoam) to investigate the most sustainable plastic that would decompose within an acceptable timeline. within my experiment, i found that bagasse-based plastics, being made from sugarcane pulp, also being a biodegradable plastic, lost about 4.08 centimeters of width and 0.71 centimeters of length, also having a maximum moisture level of 3.1. Cellulose, being a biodegradable plastic as well, lost about 1.93 centimeters in width and 14.12 centimeters in length, having a maximum moisture of 1.9. while styrofoam, a non-biodegradable plastic, lost about 0.91 centimeters of width and 1.53 centimeters of length, having a maximum moisture level of 1.9. In conclusion, biodegradable plastics like cellulose and bagasse based plastics can decompose more efficiently than non-biodegradable plastics.

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Abstract: Science and Engineering Fair of Houston

1077

How Well do Disinfectants Work

Sophie Cone
Conroe ISD /Irons Junior High

Category

Biochemistry and Microbiology

The objective of this science project is to see how well disinfectants work. The findings of this project will help improve people's understanding of cleaning products. The hypothesis stated "If I change the type of disinfectant, then the cleanliness of the surface will change". In order to test the hypothesis, I would have to obtain petri dishes for bacteria, as well as swabbing a door knob, a sink handle, and a light switch with 3 different cleaners. Then, I would lightly rub the swab onto the petri dishes. After that, I put the petri dishes into a ziplock bag, leaving it open, and take it to school and incubate for 12-48 hours or more at temperatures between 85-100 degrees. The data showed how the bacteria colonies change before and after cleaning. Some colonies would decrease after cleaning and some would increase after cleaning. This study shows how different cleaners affect the cleanliness of a surface.

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Abstract: Science and Engineering Fair of Houston

1078

A Novel Usage of Lactic Acid Bacteria rich diets to inhibit Chlamydia Pneumoniae drawn Illnesses

Sai Sahasra Maram
Abhirami Ramadas
Sudeeksha Kommula
Fort Bend ISD /Quail Valley Middle School

Category

Biochemistry and Microbiology

Chlamydia Pneumoniae (C. Pneumoniae) is a harmful bacterium which induces several illnesses including Lung Cancer, Asthma, and respiratory infections. The purpose of this project is to determine whether Lactic Acid Bacterium (LAB) Rich Diets inhibit a fatal bacterium; Chlamydia Pneumonia. Currently a bacteria labeled Tetracycline is used to combat Chlamydia Pneumoniae. This project hypothesizes that Lactic Acid Bacteria rich diets will more efficiently combat this harmful bacterium. Firstly, 3.5 grams of uncontaminated Roquefort Cheese, a substance rich in C. Pneumoniae, was directly placed in 8 petri dishes. These petri dishes were labeled category 1 and 2. Four were in category 1 and were contained without agitation. Of these, two petri dishes contained Lactic Acid Bacterium substances and two contained Tetracycline bacteria substances. This repeated in category 2 petri dishes. In category 2, there was agitation, combining the substances with the bacteria, and these were oxidized for one day. These Petri dishes were observed for 5 days. At the end of this project, the Tetracycline was not effective in inhibiting growth of C. Pneumoniae, and colonies of Chlamydia Pneumoniae continued to grow. The LAB succeeded in inhibiting growth and previous development of the colonies of Chlamydia Pneumoniae. The hypothesis was correct, LAB inhibited the growth of Chlamydia pneumoniae more effectively than Tetracycline, which failed to react. Through this research, patients struggling with respiratory issues have a higher chance of survival with these dietary actions by consuming yogurt and pickled items which were the two LAB substances successful in combating C. Pneumoniae.

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Abstract: Science and Engineering Fair of Houston

1079

We want germ-free bathrooms!!!

Maison Shelton
Central Middle School

Category

Biochemistry and Microbiology

This is a continuation project from last year. Last year, I observed three petri dishes, and this year, I observed 6 strategically placed petri dishes. My project is about bacteria spores and whether they reach your daily hygiene products. The reason I chose this project is because ever since I was a little kid, when I brushed my teeth, I tasted the way the bathroom smells. I got petri dishes and caught the bacteria in separate places. After they grew, I checked the label on them and found out that there were a lot of bacteria next to the toothbrushes. In conclusion, the bacteria do reach your daily hygiene products.

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Abstract: Science and Engineering Fair of Houston

1080

Bar soap Vs. Liquid soap

Janet Flores
Houston ISD /BCM Biotech Academy at Rusk - MS

Category

Biochemistry and Microbiology

This study investigated the effect of how much bacteria would be left on my hand with bar soap and liquid soap. Before washing my hands with any soap, I swabbed a sterilize q tip on both of my palms and then swabbed the same q tip onto the petri dish and incubated the bacteria. The data showed me that the liquid soap worked better on removing bacteria than bar soap did, since on the petri dish less bacteria was shown after washing my left hand with liquid soap than after washing my right hand with bar soap. I concluded that antibacterial liquid soap decreases the number of bacteria left on the hand.

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Abstract: Science and Engineering Fair of Houston

1081

Is the 5 Second rule real?

Brady Hant
Conroe ISD /McCullough Junior High

Category

Biochemistry and Microbiology

food for 3-seconds and 5-seconds. I used oranges, bread, gummy bears, cooked chicken, and raw chicken- taking swabs of each subject before they were dropped. My independent variable was the types of foods I dropped, and my dependent variable was colony growth. My experiment was conducted in school with a teacher present to supervise. I used petri dishes to get an accurate visual representation of the amount of bacteria on each piece of food. Around the fourth day of my experiment, the bacteria on the dishes exploded. Through these tests, I established that the five second rule is incorrect, proving my hypothesis true. Something that stood out during my experiment was that the cooked chicken, which was dropped for 3 seconds, developed more bacteria then cooked chicken sample that was dropped for 5 seconds. Through my results I found out that raw chicken dropped for five seconds created the biggest colony, covering 95% of the petri dish. Tied for second, cooked chicken that was not dropped and raw chicken dropped for 3 seconds both produced a colony that covered about 75% of the petri dish. The subject that produced the widest range of colonies was cooked chicken that was dropped for 3 seconds (creating 3 different colonies), and the subject with the least colonies created was the raw chicken that was dropped for 5 seconds because it created one large colony instead. These results are important because learning that the five second rule is untrue can help people better understand their unhygienic, and unhealthy, choices when eating food off of the ground. In conclusion the five-second rule should not be practiced.

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Abstract: Science and Engineering Fair of Houston

1082

How Safe is Your Password?

Zachary Arnold
Conroe ISD /Irons Junior High

Category

Biochemistry and Microbiology

The objective of this science project is to bring light to how easy it is to get into people's passwords, and how to make it better. The findings of this project will help improve people's understanding of how password crackers work and how to make a password against that. The hypothesis stated If I change the password cracker then the time will change for the password cracked depending on it. In order to test the hypothesis, I made several different password crackers and tested an easy password. Then, I tested it by making a harder password, and using the attack. Finally, I had made a second password cracker to test the different passwords with the new cracker, and found a method of creating a quality password. The data showed that with a brute force cracker, it guesses any password, with the downside of it taking a while, but on the other hand, a dictionary attack is super fast, but does not guess everything, only words. This correlation means that people should make passwords that are random symbols and different keyboard characters to make it. This study shows that people need to be mindful of how easy their passwords are to get into.

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Abstract: Science and Engineering Fair of Houston

1083

Yeast Destroyers: The Effectiveness of Natural vs. Synthetic Antifungal Active Ingredients

Lauryn Wallace
Conroe ISD /Peet Junior High

Category

Biochemistry and Microbiology

Introduction: Fungi are organisms found in soil, air, skin and within the body. These organisms can lead to infections of the nails and skin. Historically, natural antifungal treatments, and more recently, synthetic antifungal treatments have been used to treat fungal infections. The purpose of this project was to evaluate the effectiveness of natural versus synthetic antifungal active ingredients. This test used baker's yeast, antifungal synthetic medicines, and natural remedies. When yeast grows, the process produces carbon dioxide (CO2) gas. The less CO2 gas generated, the more effective the antifungal active ingredient is. Problem: How effective are natural antifungal active ingredients compared to synthetic ingredients? The hypothesis was natural antifungal active ingredients would be more effective fungal treatments. Procedures: Three synthetic ingredients (clotrimazole, tolnaftate and undecylenic acid) and three natural ingredients (oregano, tea tree and citronella oil) at 1% concentration were tested. Three trials for each active ingredient and three controls were performed. The amount of CO2 gas generated was measured using a gas collection apparatus and water. Results: The data shows synthetic antifungal active ingredients were more effective than natural ones. Undecylenic acid was the most effective in 66.7% of the trials. It also had the lowest CO2 generation rate of all the active ingredients. Conclusion: The hypothesis was incorrect. Natural antifungal active ingredients were not the most effective antifungal treatment at the comparable concentration of 1%.

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Abstract: Science and Engineering Fair of Houston

1084

Lettuce Beet Food Waste

Anha Neal
Conroe ISD /McCullough Junior High

Category

Biochemistry and Microbiology

Can food waste be reduced by using common cleansing techniques to extend fresh produce life, therefore reducing landfilled methane emissions? Waste ends up in landfills and cannot decompose due to lack of oxygen. Methane is produced, which increases greenhouse gases that are more damaging than carbon dioxide. Therefore, it is vital to find simple and effective food storage methods to extend the shelf life of food. Common cleaning techniques to remove contaminants can help extend the freshness and quality of produce. The proposed hypothesis is: if fruits and vegetables are cleaned in a way to minimize introduction of pathogens, then they may last longer and be less likely to decay rapidly. The initial test was to observe food spoilage in different cleansing techniques in raspberries, strawberries, lettuce and cucumbers. Food was untreated and used as is from the grocery store. This is a positive control. Food was washed with water only. Food was treated with vinegar, baking soda, or a commercial wash found in stores. Food was treated with lemon and garlic essential oils, Nisin or ozonated water. A ten day study was performed to observe changes in smell, texture, color and visible microbes on the produce. Daily observations were recorded. Graphical data of this experiment showcasing the day when the first signs of food decay could be observed. The next test calculated the estimated colony count of the samples in the same 9 treatments. These samples were swabbed on a petri dish to observe microbial growth and colony counts were calculated.. Results for the food decay observations were that baking soda 5%, 10% and vinegar 10% treatment delayed decay of raspberries compared to strawberries. The non-traditional treatments have a delay in food decay. All treatment on vegetables showed no observable difference between treatments for the decay assay. For the colony growth assay, vinegar, baking soda, commercial wash, and essential oil treatments reduced colony counts on fruit.

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Abstract: Science and Engineering Fair of Houston

1085

Behind the Stains

Elizabeth Liera
Alief ISD

Category

Biochemistry and Microbiology

The purpose of this experiment is to see which drinks stain teeth more. This experiment is useful to see which drinks can cause health problems for your teeth. The hypothesis is if the eggshells are placed in coffee, then the coffee will cause more damage and stains to the eggshells. We used different drinks such as tea, coffee, Coca-Cola, cranberry juice and water poured into each cup a long with eggshells. We used eggshells because they have similar compounds, such as calcium, as human teeth. The results were that the drink that caused greater stains was cranberry juice, followed by Coca-Cola, coffee, tea, and lastly water which caused no stains. In conclusion, I began this project thinking that coffee would do more damage because of acids, sugar, and color, but cranberry juice ended up being the one with the most damage. I believe the cranberry juice did more damage because of its higher sugar content and acids. Water did not stain the eggshell because it does not contain harmful chemicals that can cause stains or bacteria, it is neutral.

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☐ vertebrate animals ☐ microorganisms ☐ rDNA ☐ tissue

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☒ yes ☐ no

Abstract: Science and Engineering Fair of Houston

1086

Do different cleaning agents help remove Bacteria from cutting boards that were in contact with raw chicken?

Luke Arabis
Clear Creek ISD /Brookside Intermediate School

Category

Biochemistry and Microbiology

he purpose for this project is to find a way to lessen the amount of people getting infected from food-borne illnesses every year by testing if different cleaning agents help kill bacteria from a cutting board from raw chicken. The hypothesis is if bleach is used to kill bacteria off a cutting board from raw chicken, then bleach will kill off the most bacteria. 4 cutting boards were placed in rows of five with raw chicken on it. Once it was an hour since the chicken was sitting on them, the cutting board was cleaned off by the chosen cleaning agent. After this the rest of the cutting boards were cleaned off but every 4 cutting boards had a different cleaning agent. Once the cutting boards were swabbed after the cleaning process, they were taken to the incubator. The petri dishes with the bacteria within them were measured for 2 days. The results showed that vinegar would kill off more of the bacteria than any of the other ones, the worst cleaning agent was the control, which was water. These findings from this project show how dish soap isn't enough to kill the bacteria. This gives useful information to chefs and home chefs around the world to have a safe, clean, and comfortable cooking space.

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Abstract: Science and Engineering Fair of Houston

1087

Living Lightbulbs

Rowan Unser
Tomball ISD /Creekside Park JH

Category

Biochemistry and Microbiology

This study investigates the impact of different light, stimulus, and pH conditions on the length and luminosity of the bioluminescence of dinoflagellates. Nine different flasks of dinoflagellates were given a certain condition and tested with an aquarium bubbler for their bioluminescence. Results show a correlation between the length of the bioluminescence and the total luminosity. The longer the bioluminescence lasted, the more light was given off total. The results suggest that a low to medium light condition along with a low stimulus condition could create the best possible solution for replacing LED lighting. Further research should be conducted to explore several changes at once on the dinoflagellate flasks, such as a low light condition with a low stimulus condition.

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Abstract: Science and Engineering Fair of Houston

1088

Screening of Antifungal Activity of School Garden Plants

Fortress Adeyemo
Houston ISD /BCM Academy at James D Ryan - MS

Category

Biochemistry and Microbiology

Antifungal resistance in fungal infections is an emerging global concern, and thus research on natural plant-based antifungal agents is of interest. This paper discusses the antifungal activity of sweet potato (Ipomoea batatas), banana (Musa spp.), and grass (Poaceae) leaves, which are very accessible, even within the school garden. Water and ethanol extracts from these plants were tested for their antifungal activity against baker's yeast on agar plates. The results showed that water extracts of all three plants inhibited fungal growth, although sweet potato leaves had the most pronounced antifungal activity, showing no growth in all trials. Banana and grass extracts allowed various degrees of growth, with grass allowing the highest growth overall. Ethanol extracts of sweet potato leaves also showed antifungal activity, though to a lesser degree, while banana leaves showed very limited effects, and grass extracts showed no inhibition.These findings are indicative of sweet potato leaves having the most potent antifungal activity among the plants tested and may therefore be a goldmine in the search for natural remedies for fungal infections. This study expresses the prospect and the potential of utilizing common garden plants found in the school garden as convenient and sustainable sources of antifungal agents to address the problem of antimicrobial drug resistance.

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Abstract: Science and Engineering Fair of Houston

1089

Microplastics in Estuaries

Kate Leo
Karen Tovar-Garron
Weis Middle School

Category

Biochemistry and Microbiology

Microplastics are an arising problem all around the world, especially in oceans. We collected 109 fish from two different estuaries in Port Mansfield Pass and Galveston Bay. In Port Mansfield Pass we collected a total of 72 fish and shrimp and from Galveston bay there are 37 total fish and shrimp. We collected pinfish in three size groups and white shrimp from Port Mansfield Pass. We collected white shrimp, anchovies, and silversides from Galveston Bay. The white shrimp from Galveston bay had 6 microfibers, the silversides had 8 microfibers, and the anchovies had 9 microfibers. The white shrimp from Port Mansfield Pass had 3 microfibers, the 1st pinfish group had 6 microfibers, the 2nd group had 7 microfibers, and the 3rd group had 7 microfibers. We dissected the fish under a microscope and then put them in a hot water bath with KOH or potassium hydroxide. 48 hours later, we washed the liquified gastrointestinal tract through a 68 micron sieve. We then put the remains in a watch glass to be observed for plastics.

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Abstract: Science and Engineering Fair of Houston

1090

Bacteria around the school

Ella Smith
Ken'Lynn Hill
Weis Middle School

Category

Biochemistry and Microbiology

Our hypothesis was correct. The school bleachers grew bacteria. Considering we only use them once a month, this shows the bleachers aren't being cleaned effectively.Get your cotton swabs and petri dishes. Swab surfaces (bleachers). Wipe swabs on the petri dish. Label what is in the petri dishes. Wait 5 days to see the results. Compare which one has the most bacteria or mold.Discovering what was growing in our school helped us determine how to clean it. Now our school has been cleaned and smells better. Kids can now learn in a safer environment.

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Abstract: Science and Engineering Fair of Houston

1091

Fruit DNA

Nuria Esperanza
Fort Bend ISD /Lake Olympia Middle School

Category

Biochemistry and Microbiology

This project investigated which fruit of a strawberry, kiwi, grape, and banana contains the most DNA, hypothesizing that the strawberry would yield the most DNA. The experiment was conducted in three trials. In all three trials the strawberry had the most DNA, and the grape had the least. The results of the experiment indicated that the fruit with the most DNA is a strawberry because of their octoploid structure, which means that each cell contains eight copies of each chromosome.

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Abstract: Science and Engineering Fair of Houston

1092

Save Our Sandwich- In which location does bread mold the slowest?

Sofia Kharko
Conroe ISD /York Junior High

Category

Biochemistry and Microbiology

In this experiment, slices of bread were placed into a plastic bag, sprinkled with warm water, and stored in several locations to determine where the bread would maintain freshness the longest. The purpose of this experiment was to identify the best location to keep bread in typical households. It was discovered that the bread placed outside in warm, humid conditions showed mold before any of the other locations. This experiment also found that bread stored in the fridge molds significantly slower than bread kept in other locations, showing the importance of storage conditions in extending bread's shelf life and saving resources.

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Abstract: Science and Engineering Fair of Houston

1093

How much protein is in different types of eggs?

Gwyneth Galimberti
Natale San Lucas
Spring Branch ISD

Category

Biochemistry and Microbiology

In our project to find which type of chicken eggs had the most protein in them, we found that carton egg whites were ranked highest, then pasture raised, then Cage Free and Free range having the same average, and in last were conventional eggs. To test which eggs had the most protein we used the biuret test. This is a test where we take the egg white, dilute it, add in the biuret reagent, and observe. Whichever one turns the darkest purple we marked as five. We did this five times. We feel that this applies to the world because people need their protein and it is very important for your body. Protein is made up of amino acids which help the body repair muscles and bones, they also help to make hormones and enzymes.

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Abstract: Science and Engineering Fair of Houston

1094

Uses of Auxin in Heavy Metal Bioremediation

Noah Ansari
Conroe ISD /McCullough Junior High

Category

Biochemistry and Microbiology

Heavy metals in drinking water can cause long-term health problems even in extremely low concentrations. Algae, specifically chlorophytes, have been shown to remediate lead from water in various studies. My experiment was trying to study if auxins, a group of naturally-occurring growth hormone, are able to increase the efficiency of the consumption of lead in the chlorophyte strand, C. vulgaris. My study tested the algae with and without Indole-3 Acetic Acid (IAA, a type of auxin). My research found that the algae with the IAA was able to increase the efficiency by about 30%. My research shows how promising auxin can be when applied to existing bioremediation strategies.

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Abstract: Science and Engineering Fair of Houston

1095

The differences between salicylic acids on clearing your acne

Isabella Ortiz
Houston ISD /BCM Biotech Academy at Rusk - MS

Category

Biochemistry and Microbiology

My project is on the effects of different Salicylic Acid brands on acne, this is imperative since it'll offer assistance to a large population in just the US. People are attempting to discover a quick and easy solution to their acne. Dermatologists also want individuals to treat acne early to decrease scarring and emotional distress. The article from AAD (American Academy of Dermatology) has expressed that individuals feel depressed, anxiety, and more. What my project does helps minimize this. I was able to identify which serum out of the three I tested showed the most significant outcome on clearing and preventing your acne. I used E.coli K to reference acne. I then placed a drop of each of the acid brands (The Ordinary, Minimalist, and Artnaturals) on the bacteria. I then observed the bacteria over the course of seven days and recorded my observations on a chart. Despite my hypothesis being If the acid by The Ordinary is used, it will kill the most bacteria and clear up the fastest,it was proven to be inaccurate. Instead, it promoted growth, reaching a dime-sized circle by Day Five. It continued to grow. In comparison, Minimalist exhibited the most growth, having bacteria forming shapes by Day Three, growing into larger cloudy appearance by Day Four, and continuing to grow along the edge of the dish. Artnaturals showed zero bacteria growth, suggesting that it's more effective for clearing up skin quickly. Salicylic acid didn't prevent total bacterial growth as anticipated.

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Abstract: Science and Engineering Fair of Houston

1096

Optimizing Storage to Reduce Food Waste

Kritika Bharadwaj
Conroe ISD /Knox Junior High

Category

Biochemistry and Microbiology

This experiment aims to find the effects of water activity, pH, and temperature on the spoilage rate of non-climacteric fruits and vegetables. The hypotheses state that if non-climacteric produce has a lower water activity, an acidic pH, and is stored at lower temperatures, then it will spoil more slowly because these conditions make a less favorable environment for spoilage bacteria to thrive. In this experiment, the scientist performed three separate tests, altering the water activity, pH, and temperature of green peppers and carrots. Water activity was changed by soaking the non-climacteric produce in a saltwater solution to perform osmotic dehydration. Temperature was varied by storing the produce in 3 different settings. pH was modified by soaking the produce in a citric acid solution to make the green peppers and carrots more acidic. Next, daily intervals were taken by covering part of the produce's skin with parafilm every 24 hours to track bacterial growth. Finally, the skin samples were taken to a lab to determine the number of colony-forming units of spoilage bacteria per cm^2 surface. This experiment observes the growth of bacteria between 24-hour intervals based on its condition. In conclusion, the produce with the lower water activity, pH, and temperature had significantly less amount of bacteria than the other samples taken. The hypothesis has been supported. This information will be useful in developing the scientist's formula to predict spoilage in non-climacteric produce. It will also be beneficial to future applications on lowering food waste and saving money.

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Abstract: Science and Engineering Fair of Houston

1097

Us and Our Genetics

Natalie Harlow
Chandler Brown
Charlotte Catherine Joseph
Stafford STEM Magnet Academy

Category

Biochemistry and Microbiology

We chose this project because we wanted to better understand the make-up of our genetics.Our question is " How do our parents shape our DNA?" Our hypothesis is that your parents and ancestors have a large contribution rate to what we look like, due to a process called meiosis. We did two experiments due to the first one being inconclusive. The second experiment test for 5 different genes that have to do with your taste buds, by testing our own DNA by swishing gatorade into our mouth. Our conclusion was that based on the results, we conclude that your parent's DNA have a lot to do with your own DNA make-up.

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Abstract: Science and Engineering Fair of Houston

1098

Analyzing and Calculating Protein Content in Common Foods

Aditya Chanda
Fort Bend ISD /Quail Valley Middle School

Category

Biochemistry and Microbiology

Most existing methods for analyzing protein content focus on animal-based foods, neglecting plant-based alternatives. With the growing number of people adopting plant-based diets in 2023, understanding alternative protein sources is crucial. This experiment analyzed and compared protein content in commonly consumed liquid foods, hypothesizing that protein source significantly affects protein levels. Plant-based samples included almond, coconut, oat, and soy milk, while animal-based samples included cow milk, goat milk, liquid egg white, and chicken soup. Protein content was measured using test strips, with color changes analyzed visually and via hex/RGB scales. Each sample was tested in triplicate, and results were averaged for accuracy. The results revealed that plant-based liquids had a higher average protein content (3.25 g/L) compared to animal-based options (2.825 g/L). These results underscore the potential of plant-based alternatives as significant protein sources. To complement this research, ProteinIQ, a web application, was developed. ProteinIQ includes a dietary planning calculator to estimate daily protein intake and a feature suggesting protein-rich foods to meet dietary goals. This project highlights the importance of plant-based options for health-conscious individuals, those transitioning to plant-based diets, and athletes seeking alternative protein sources. It provides actionable insights into making informed dietary choices and reinforces the growing relevance of plant-based nutrition in today's society.

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Abstract: Science and Engineering Fair of Houston

1099

How Much DNA Can You Pack into a Cell?

Sandra Samuel
Aanvi Patel
Aanvi Patel
Central Middle School

Category

Biochemistry and Microbiology

We chose this topic because sometimes packing suitcases can be challenging, and learning about the correlation between an animal's genome size and cell nucleus size interests us. Have you ever tried to pack a suitcase? If so, you know there's a limit to what it can hold, so if you have a lot of stuff you need a bigger suitcase. Do you think the same concept applies to DNA in a cell? Does an animal with a bigger genome need a larger cell nucleus to store its DNA. This project is gonna help us answer our question. We collected data on nucleus size and genome size in 15 different amphibians, birds, and fishes. Using Excel, we organized our data into a table and created a scatter plot with a trendline, to help us analyze our data. The results that we got from looking at the trend line from the scatter plot is that the correlation between nucleus size and genome size has a strong positive correlation. Our conclusion statement is, the data indicates a strong positive correlation between nucleus size and genome size, as demonstrated by a best-fit line that extends from the origin to higher y-value.We calculated The Pearson Correlation Coefficient using SPSS (Statistical Package for Social Sciences) software. The Pearson correlation coefficient (r=0.8) showed a strong positive correlation between nucleus size and genome size, which was statistically significant (p-value < 0.05).

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Abstract: Science and Engineering Fair of Houston

1100

Makeup Brush or Beauty Blender - Harbinger of Bacteria?

Ella Smart
The Woodlands Methodist School - MS

Category

Biochemistry and Microbiology

The purpose of this experiment was to compare the amount of bacteria growing in a beauty blender versus a makeup brush after 3 days of use. For the control, a beauty blender and a makeup brush was tested for bacteria when it came out of the package. For the independent variable, another beauty blender and makeup brush was used for 3 days and then tested for bacteria. The dependent variable was the amount of bacteria colonies. The control group for the makeup brushes averaged 20 colonies but the beauty blender control averaged 298 colonies of bacteria.The test group for makeup brushes averaged 111 colonies of bacteria but the test group for the beauty blenders averaged 791 colonies of bacteria. The results of this experiment demonstrate that a beauty blender is likely to have a greater number of bacteria than a makeup brush proving the hypothesis to be correct.

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Abstract: Science and Engineering Fair of Houston

3052

HMM & Structural Docking In Silico Framework for Identifying & Inhibiting CCN3 Protein Pathway Mutations in Osteosarcoma

Abhiram Jyosyula
Oduna Akonzee
Avaneesh Parasnis

Category

Biochemistry and Microbiology

Osteosarcoma, the most prevalent primary bone cancer in adolescents, is characterized by complex genetic alterations that drive tumor progression. Among these, the CCN3 (NOV) protein plays a pivotal role in tumor proliferation and metastasis through its involvement in key signaling pathways. This study develops a novel computational framework integrating Hidden Markov Models (HMM) and structural docking to identify and target CCN3 protein pathway mutations associated with osteosarcoma. HMMs were trained on homologous protein sequences of CCN3 to identify mutational hotspots in critical functional domains, such as IGFBP, VWC, and TSP1. Analysis of osteosarcoma-related mutations revealed a subset of deleterious mutations disrupting ligand binding and signaling regulation. Structural modeling of mutated CCN3 was conducted using AlphaFold2, followed by molecular dynamics (MD) simulations to assess the structural and functional impact of these mutations. Small-molecule inhibitors targeting CCN3 pathway interactions were identified through in-silico docking simulations using AutoDock Vina and screened against a library of 2,500 compounds. Top candidates exhibited binding affinities of -9.2 kcal/mol to -11.3 kcal/mol, suggesting potential to restore pathway balance. Additionally, probabilistic models derived from HMMs guided the design of a therapeutic peptide capable of counteracting mutational effects, with preliminary docking simulations indicating stable interactions and minimal off-target binding. This framework demonstrates the power of combining computational biology and cheminformatics to address complex genetic diseases. The identified inhibitors and therapeutic designs hold promise for experimental validation, paving the way for personalized treatment approaches in osteosarcoma.

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Abstract: Science and Engineering Fair of Houston

3053

Evaluating the Impact of Environmental Pollutants on Antibiotic Resistance in Wild-Type E. coli Compared to Genetically-Modified Strains

Ishya Magesh
Conroe ISD /AST: Academy of Science and Technology

Category

Biochemistry and Microbiology

Antibiotic resistance poses a significant global health challenge, as freshwater ecosystems serve as breeding grounds for resistant E. coli strains. This study explores the connection between environmental pollution levels and the occurrence of antibiotic-resistant E. coli. Water samples were collected from various locations with differing pollution levels, and key factors such as nitrate, phosphate, and turbidity were measured using a spectrophotometer. Wild-type E. coli was introduced into these samples to examine how environmental conditions affect the development of antibiotic resistance. Competent E. coli cells with an ampicillin-resistant plasmid were also tested to establish baseline growth comparisons. The samples were plated on LB agar, and the disk diffusion method was used to evaluate bacterial growth and resistance. Trends in growth rates, resistance patterns, and their correlations with pollution levels were analyzed. This research's focus is to better understand how pollution contributes to the spread of antibiotic resistance, emphasizing the need for stronger environmental policies and better wastewater management. By bridging the gap between lab-based and naturally occurring resistance, the study brings awareness to the public health risks posed by resistant bacteria. Future research will focus on understanding how mobile genetic elements, such as plasmids and transposons, contribute to the spread of resistance genes in E. coli. This will involve isolating plasmids linked to resistance through gel electrophoresis, and studying how transposons transfer genes under high pollution or nutrient shortages.

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Abstract: Science and Engineering Fair of Houston

3054

Direct Cell Reprogramming of Organ Transplants

Trinity Lai
Fort Bend ISD /Hightower High School

Category

Biochemistry and Microbiology

This experiment serves as purpose to explore direct cell reprogramming and identify whether skin cells are ideal to reprogram into other organs for transplantation. Firstly, I used NCBI gene database to get the RPKM values of a skin transcription factor to determine the amount of expression, then I used KEGG pathway database to identify any known functions and signaling pathways. After the experiment, 9/10 transcription factors were able to be highly expressed in other cell types, therefore making it ideal to alter the gene expression into another organ.

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Abstract: Science and Engineering Fair of Houston

3055
GlioPath - Using Precision Oncology to Develop a Novel Personalized Treatment Response for Glioblastoma Multiforme (GBM)

Shaivi Moparthi
The Kinkaid School - HS

Category

Biochemistry and Microbiology

Glioblastoma multiforme (GBM), a deadly brain cancer with a median survival of only 15-18 months, presents a significant hurdle for personalized treatment. Accounting for nearly half of primary central-nervous-system tumors, GBM is conventionally treated through surgical resection, radiation therapy, and temozolomide (TMZ) chemotherapy. The MGMT gene's promoter methylation, observed in 40-60% of glioblastomas, enhances TMZ response and serves as a prognostic-biomarker. That is why the presence of MGMT-promoter can be used to determine which treatment-method to use for certain tumors, based on whether TMZ will be effective or not. However, the current gold-standard of genetic-analysis to determine MGMT methylation-status from surgical-specimens is time-consuming and may necessitate subsequent surgeries based on the results. This research introduces an innovative machine-learning solution to streamline MGMT-status determination. Implemented using a convolutional-neural-network architecture for tumor-identification and predicting MGMT methylation, the model utilizes MRI-brain-scan images of GBM-patients from The Cancer Imaging-Archive (TCIA) and genomic-data from The Cancer Genome-Atlas (TCGA), achieving an impressive 96%accuracy. To further demonstrate clinical-viability, I integrated the model with a web-application, "GlioPath," enabling rapid MRI scan-uploads and delivering MGMT-status in less than 2 seconds. This novel-breakthrough minimizes the need for invasive-biopsies, significantly reducing time and cost. Oncologists can leverage GlioPath to recommend personalized treatment-plans based on MGMT-status. Beyond overcoming biopsy limitations, this AI-driven approach revolutionizes treatment decision-making, offering more effective and personalized-care for GBM patients. With this innovative-solution I hope to revolutionize the field of medicine by combining healthcare with technology to improve patient care and potentially save millions of lives.

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Abstract: Science and Engineering Fair of Houston

3056
The Dirty Truth: Which Makeup Tools are a Breeding Ground for Bacteria?

Charly Lemmon
Ella White
Leire Vail
Conroe ISD /ASHP: Academy for Science and Health Prof

Category

Biochemistry and Microbiology

Acne is a widespread condition that often leads to long-term insecurities, with many individuals unaware of the underlying causes. According to the National Institute of Health (NIH) acne thrives when bacteria enters skin pores leaving the host with skin imperfections. Makeup is one of the leading ways to contract bacteria on one's face, but more specifically the makeup applicator itself as it frequently comes in contact with the applicant's skin. Naturally this will cause the bacteria to build up over time if not properly cleaned. After analyzing the bacterial growth of the two most common makeup applicators in 24 hour intervals for a total of 48 hours, It was determined that the method of application plays a role in skin characteristics. When comparing the observed vs. expected values of bacterial growth between two makeup applicators, a brush, and a beauty blender, a beauty blender was presented as having the greater chi-square value after 24 hours being 22,521.00>21,940.00. However after 48 hours the brushes value almost doubled entirely, essentially harboring more bacteria, being 34,609.33>27,942.67. A rubric was then used to compare the bacteria found on the applicators to one's skin characteristics scaled 1-5, 1 being clear skin, 5 being severe acne. It was discovered that when the bacterial count on both applicators was >300 the skin characteristics fell under 3-5 on the scale. These results suggest that greater bacterial growth on a makeup applicator is associated with more noticeable skin imperfections.

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Abstract: Science and Engineering Fair of Houston

3057

The Science of Citric Acid & its Effect on Beef

Daniel Putzeys
Aldine ISD /Avalos PTech

Category

Biochemistry and Microbiology

This study explores the effects of pH levels, particularly citric acid, on the condition and tenderness of beef. The pH scale, a system developed by Søren Sørensen, measures a substance's acidity or alkalinity, with lower values indicating higher acidity. Utilizing citrus fruits as a source of citric acid, this experiment investigated how acidic liquids impact beef's preservation and structural integrity over time. Beef samples were submerged in lemon, lime, mandarin juices, and water (as a control) and monitored at intervals of 1, 12, 48, and 96 hours. Measurements included pH levels and the force required to pull through the meat, documented in Newtons. Results revealed that highly acidic juices (low pH), such as lemon and lime, preserved the meat's color, smell, and firmness while reducing spoilage. Mandarin juice had moderate effects, while neutral water offered no preservation, resulting in spoilage and tenderness. These findings support the hypothesis that lower pH levels enhance meat preservation. The study highlights the potential of citric acid for food preservation and its culinary applications, offering insights into acids' effects on consumables. Future research should broaden the scope by incorporating additional variables, such as different food types and a wider range of acidic substances, to deepen our understanding of pH's role in preservation and texture

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Abstract: Science and Engineering Fair of Houston

3058

Testing the antimicrobial properties of Smilax bona-nox on Escherichia coli K-12 strain

Saketh Komaragiri
Conroe ISD /AST: Academy of Science and Technology

Category

Biochemistry and Microbiology

Smilax bona-nox is a plant that was used by native americans to treat UTIs which are caused by E. coli. S. bona-nox is a woody vine that has many active phytochemicals such as glycosides, saponins, and flavonoids that have antimicrobial properties. This research was conducted to test the antimicrobial properties of different parts of S. bona-nox on E. coli K-12 strain. Different samples were prepared from different solvents such as ethanolic, isopropyl alcoholic, and aqueous extracts from the stem, leaves, and rhizomes of S. bona-nox. These samples were then tested for antimicrobial activity against E. coli using a zone of inhibition test. After incubating for two days, the bacteria were observed and there were some interesting results. The isopropyl alcoholic and ethanolic extracts had a lower zone of inhibition than the control. The cold aqueous extract showed probacterial properties, and the hot aqueous extracts actually proved the hypothesis and showed significant antibacterial properties. Applications of this project could be synthesizing an antibiotic drug that specifically targets the pathogenic strains of E. coli which cause UTIs. Using the cold aqueous extracts, a probiotic drug could be developed to target the good strains of E. coli that are present in the gut microbiome to solve problems that are correlated to an undiversified gut microbiome.

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Abstract: Science and Engineering Fair of Houston

3059

An Innovative Approach for Studying IgG Glycosylation Significance in Traumatic Brain Injury

Amelie Nguyen
Clear Creek ISD /Clear Lake High School

Category

Biochemistry and Microbiology

When a Traumatic Brain Injury (TBI) occurs, aberrant glycans and dead brain tissue become significant points of concern, possibly leading to greater implications in the future such as an internal infection or debilitating neurological issues. The immune response, which the glycoprotein Immunoglobin G (IgG) plays a large role in, to TBI is important to clear out and repair damaged brain tissue. However, despite IgG Glycosylation being known to play a large role in the immune system, its direct relation to TBI remains unclear. It was hypothesized that through studying IgG Glycosylation abundance in various TBI patients, the identification of an IgG Glycosylation biomarker can be found that would indicate the severity of TBI based on the abundance of IgG glycans. Studying the aberrant glycans produced from TBI could suggest the severity of the injury and if long-term complications, such as seizures or sensory issues, are of concern. Evaluating TBI human serum samples through liquid-chromatography mass spectrometry (LC-MS) machines resulted in trends such as a significant increase in the expression of Sialylated glycans in IgG and other glycoproteins and a significant decrease in Fucosylated glycans in other glycoproteins. Additionally, the IgG N-glycans 4502, 4610, 5502, 5400, and 4501 were identified to be a potential panel of biomarkers for detecting the severity of TBI. Continuation of this work would include isolating TBI cohorts with new human serum samples to validate the candidate IgG glycosylation biomarkers and trends.

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Abstract: Science and Engineering Fair of Houston

3060

Targeting pMHC: A Novel Tripartite In-Silico Approach for Liposome-Aided Ultralong Antibody Therapy in Colorectal Cancer Variants

Aarush Kudariya
Seven Lakes - HS

Category

Biochemistry and Microbiology

Colorectal cancer is the second-leading cause of cancer-related deaths worldwide. Yet targeted antibody therapies are generally ineffectual: the majority of cases - 51% - involve an immunosuppressive tumor microenvironment and buried HLA-antigen complexes, rendering cell-specific treatment impractical. Further, approved treatments are inconsistent due to the binding-site barrier (BSB) effect. This study investigates the application of Liposome-Aided Ultralong Antibodies (ULAbs) in targeting and treating colorectal tumor cells. ULAb structures were first simulated upon convex and concave (buried) cell membrane architectures, revealing increases of 20% and 100%, respectively, in potential approach angles compared to short-chain antibodies, correlating to proportional increases in binding kinetics. Upon verifying physical advantage, the ULAb Heavy Chain (HC) 3 region was designed using site-specific homology sequences corresponding to T-Cell Receptor Complementarity Determining Regions 1 & 2. Deep-learning modeling was used to generate various ULAb HC1 regions complementary to HLA-presented neoantigens available in public Colorectal cancer patient data. Molecular dynamics and substrate docking indicate marked increases in binding affinity (54%), specificity (28%), and neoantigenic discrimination (37%) compared to modern monoclonal antibody treatments. Coupling designed ULAbs to calcium-phosphatidylcholine positively-charged liposomes, electrostatic Monte Carlo simulations show an average 22% increase in the enhanced permeability and retention effect compared to modern liposome-based therapies, indicating tumor-specific aggregation while minimizing the BSB effect. Further, an improved half-life (31%) increases circulation time and probability of tumor recognition. Overall, this study nominates novel Liposome-Aided ULAbs in pharmaceutical development against colorectal cancer and offers future avenues for in vitro production and similar treatments against other cancers.

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Abstract: Science and Engineering Fair of Houston

3061

Low-Cost Microorganism Preservation: Exploring High-Subzero Cryopreservation for Short-Term Storage on Philodina roseola and Saccharomyces cerevisiae Utilizing Cryoprotectants

Thoshika Srinithi Dayalan Gokulakrishnan
Conroe ISD /AST: Academy of Science and Technology

Category

Biochemistry and Microbiology

Cryopreservation is a remarkable practice of preserving biological material such as cells and organs for short- and long-term periods; however, it is extremely limited in developing countries because of insufficient resources, lack of funding, and the high-cost technology that is required. Due to this, developing countries miss out on major benefits that are possible with cryopreservation research, such as alleviating organ shortage issues, reviving defected organs, and improving tissue quality. The goal of this experiment was to analyze whether high sub-zero cryopreservation of the microorganisms Philodina roseola and Saccharomyces cerevisiae was effective using common, low-cost technology and, additionally, whether zinc chloride, glycerol, or dimethyl sulfide cryoprotectants were most successful at preserving the microorganisms. The researcher hypothesized that after adding in cryoprotectants to each group, going through the freeze-thaw process, and then analyzing the viability rate of each group, the cultures containing zinc chloride would prove to be most effectual due to the cryoprotectant's low toxicity compared to the others. First, the microorganisms were exposed to zinc chloride, glycerol, and DMSO. All samples were frozen in a standard freezer at -5°C for 4 weeks and then thawed to examine the viability rates through a hemocytometer and the methylene blue dye procedure. The researcher concluded that the S. cerevisiae culture was effectively preserved with glycerol, and Philodina with zinc chloride. These findings pave the path for limited-resource areas, educational institutions, and beginner lab facilities in developing countries to practice cost-effective cryopreservation research, increasing the potential to develop groundbreaking medical advancements.

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Abstract: Science and Engineering Fair of Houston

3062

Investigating the Prevalence of an Inflammatory Phenotype in Granulocytes and Monocytes in Response to Different Concentrations of Interleukin-8 (IL-8).

Udhayan Shanmugam
Saikarthik Swaminathan
Conroe ISD /AST: Academy of Science and Technology

Category

Biochemistry and Microbiology

This study particularly focuses on granulocytes, a type of white blood cell which is linked to inflammatory protein and cytokine Interleukin 8 (Il-8). As the cytokine activates the round inert granulocytes, they grow podia which enable them to move to sites of inflammation. The experiment tested the response of white blood cells to IL-8, which is essential to further understand as it plays a pivotal role in the body's ability to combat an ailment or injury. Blood samples were separated using magnetic particles allowing the isolation of granulocytes. Through the use of a bioanalyzer, the concentration of the desired white blood cell was determined. Finally, after completing the fixing and culturing processes, the cells were imaged under a fluorescent microscope where images were captured. The cells were scored from 0 to 4, with 0 indicating completely inactivated cells and 4 representing highly amorphous cells showing the maximum level of activation. Our results suggested that an increase in the concentration of IL-8 (1,10,100) led to an increase in the scoring metric - showing that more granulocytes had been activated. The original research goal aimed to explore the extent of inflammation provoked by an antagonist (IL-8) on granulocytes and monocytes. However, due to a higher concentration of red blood cells being prevalent within the sample, the data was eschewed. Additionally, a pharmacological inhibition study could be conducted to evaluate IL-8 inhibitors and their ability to prevent inflammatory responses, subsequently supporting research for rheumatoid arthritis.

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Abstract: Science and Engineering Fair of Houston

3063

An In-vitro Analysis of the Effect of Analgesics on the Development of Antibiotic Resistance in Escherichia coli MG1655

Aditi Venkataraman
Conroe ISD /AST: Academy of Science and Technology

Category

Biochemistry and Microbiology

Antibiotic resistance, a significant issue in public health, contributes to over 1.27 million deaths annually. Antibiotics, the mainstay for treating bacterial infections, have been misused/overused in recent years, allowing bacteria to acquire genes or mutations, which make them prone to resistance. Therefore, it is important to investigate the factors that affect antibiotic resistance development. Studies have shown that ibuprofen, a commonly used analgesic, when used alongside antibiotics can promote antibiotic resistance. Additionally, studies have also shown that bacteria can develop resistance to analgesics that possess the ability to inhibit bacterial growth (acetylated salicylate). This study tested whether bacteria pre-treated with non-antibiotic drugs are more prone to developing antibiotic resistance. Experiments were conducted using the bacterial model Escherichia coli MG1655, the antibiotic kanamycin, and analgesics (acetylated salicylate and ibuprofen). Minimum Inhibitory Concentration (MIC) assays were used as the primary method of experimentation, to determine the extent of bacterial inhibition and resistance development: In assay 1, the MICs of the individual drugs and the antibiotic (control) were determined; in assay 2, the effect of co-treatment of kanamycin and the analgesic drugs was tested; and in assay 3, the ability of cells pre-exposed to the analgesic drugs to grow in the presence of kanamycin was tested. Preliminary results showed that E.coli treated simultaneously with ibuprofen and kanamycin showed increased kanamycin resistance, consistent with prior results. However, pre-treatment with ibuprofen correlated with increased sensitivity of E.coli to kanamycin. Pre-treatment and co-treatment with acetylated salicylate both showed increased sensitivity to kanamycin.

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Abstract: Science and Engineering Fair of Houston

3064

A Novel Approach to Developing Bioluminescent DNA Sensors for Real-Time Detection of Antibiotic Resistance Genes

Isabella Teves
Cypress Woods - HS

Category

Biochemistry and Microbiology

Antimicrobial sensitivity and culture, while a relatively straightforward process in developed areas with established laboratory systems, remains a challenge in underserved areas or globally in developing countries. Further, there is the duration to consider wherein traditional antibiograms typically take between 18 to 24 hours to complete, especially for fastidious organisms. Recently, pathogen identification and resistance patterns can be achieved more rapidly via polymerase chain reaction (PCR), which identifies both the pathogen and genes encoding antimicrobial resistance. However, PCR assays require costly equipment, and minimum inhibitory concentration assays must still be conducted. A faster method is Pharmacokinetic/Pharmacodynamic (PK/PD) analysis, which analyzes microbial growth in relation to drug concentration in the body. This study aimed to develop an efficient and cost effective method for determining antibiotic resistance using Nanoluc (NLuc) luciferase, which binds to viable organisms. The bacterium Escherichia coli (k-12) was exposed to doxycycline, amoxicillin, and cephalexin at concentrations of 10 Âµg/ml, 50 Âµg/ml, and 100 Âµg/ml. Following inoculation and incubation of said strain in antibiotic solutions, Nanoluc luciferase was added, creating a bioluminescent reaction measured using a luminometer. Samples exposed to cephalexin were proven to be antibiotic-sensitive, displaying a lower light intensity as antibiotic concentration increased. Those exposed to doxycycline and amoxicillin were resistant, expressing a higher light intensity. The correlation between bioluminescence intensity and antibiotic resistance provides a reliable method for identifying resistant strains; this approach could improve diagnostic capabilities, particularly in resource-limited settings, by reducing testing time and allowing for more accurate results.

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Abstract: Science and Engineering Fair of Houston

3065

Repurposing FDA-Approved Drugs as a Strategy For Developing Next-Generation Antimicrobials

Sujit Vadlapatla
Shreyas Bishnu
Clear Creek ISD /Clear Lake High School

Category

Biochemistry and Microbiology

Antimicrobial resistance is a growing health issue, causing over 35,000 deaths each year in the U.S. Repurposing FDA-approved non-antibiotic drugs, like Ivacaftor and Auranofin, originally for cystic fibrosis and rheumatoid arthritis, is gaining attention for their antibacterial effects. In this study, we tested their efficacy against Salmonella enterica serovar Typhimurium, a common foodborne pathogen. Drug concentrations ranging from 0 to 512 Âµg/ml were used to determine the minimum inhibitory concentration (MIC). Auranofin reduced bacterial growth by ~70% at 128 Âµg/ml while only ~20% at 0.25 Âµg/ml. Ivacaftor showed 51-61% growth reduction at concentrations ranging from 512 to 4 Âµg/ml, with 2% growth reduction at 0.25 Âµg/ml. To explore if Pentamidine, a drug that permeabilizes the bacterial membrane, could enhance this effect, we did a checkerboard assay. The addition of Pentamidine (64 Âµg/ml) with Auranofin depreciated growth by ~50% when compared to Auranofin alone. The combining Pentamidine with Ivacaftor resulted in a >75% reduction in Salmonella growth at 64-16 Âµg/ml. These findings show Auranofin and Ivacaftor are effective against Salmonella, and combination with Pentamidine may be promising strategy. Studies to find the lowest MIC with >99% efficacy are in progress.

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Abstract: Science and Engineering Fair of Houston

3066

One Blood Drop to New Hope: A Novel Test Method to Improve Fertility Assessment

Melina Kumar
Clear Creek ISD /Clear Lake High School

Category

Biochemistry and Microbiology

At-home blood collection, such as the dried blood spots for fertility workups has been challenging due to low circulating Anti-Mullerian Hormone (AMH) concentrations and dependence on trained personnel for reliable blood sample collection. AMH is a hormone produced by small-growing antral follicles (AFC) in the ovary and has been suggested to provide a snapshot of a woman's reproductive potential. This study aimed to develop and validate an AMH blood test using dried matrix micro samples (DMMS), a novel technique that allows continuous absorption of a single blood drop. This DMMS AMH test is convenient, cost-effective, accessible, and can help assess women's fertility at an early stage. Diagnosing poor responders (≤5AFC,POI) will help avoid repeated IVF cycles and diagnosing hyper responders (>40AFC,PCOS) will help avoid ovarian hyper-stimulation. In addition, this test can help breast cancer subjects in assessing their fertility potential before and after estrogen treatment. AMH measurements from DMMS are reproducible (<8%CV), accurate (no cross-reactivity to FSH, LH, Inhibin B and Estradiol) with non-significant interference to hematocrit (dilutes linearly, y=0.98x). DMMS AMH measurements strongly correlate to plasma AMH levels (rs=0.996) and have a slope of 0.66. DMMS AMH concentrations with 0.66 factor can be reported to plasma equivalents. DMMS AMH measurements were highly correlated to AFC collected using trans-vaginal ultrasound (rs=0.813). The fertility assessment at >5AFC and AMH cutoff of 0.66ng/mL has a sensitivity of 91.8% and accuracy of 90.9%. The addition of Inhibin B measurements to the AMH test improved the sensitivity to 95.9% with an accuracy of 94.6%.

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Abstract: Science and Engineering Fair of Houston

3067

Development of IVT Vector for RNA Vaccines Against RSV Associated pneumonia

Madison Jones
Tara Fawaz
Handan Capraz
Harmony Public Schools - Houston North District /Harmony School of

Category

Biochemistry and Microbiology

Respiratory Syncytial Virus (RSV) is the cause of severe respiratory infections, including bronchiolitis and pneumonia, especially in young children, older adults, and individuals with weakened immune systems. However, no effective vaccine against RSV exists. This study will meet the urgent need for an RNA vaccine directed against the Fusion (F) glycoprotein of RSV, which mediates viral entry into human cells. In order to neutralize RSV, an RNA vaccine encoding the F glycoprotein is proposed to produce antibodies. The codon-optimized RSV F gene synthesized and inserted into a linearized UH-IVT plasmid vector using in-fusion cloning. Prepared and sequenced plasmids by Sanger sequencing and gel electrophoresis in transformed E. coli showed a 100% alignment in sequences of several positive colonies. These findings show that creating an RNA vaccine that targets RSV is feasible and validate that the plasmid was successfully constructed and prepared for RNA synthesis. Further work involves transfecting synthesized RNA into HEK cells to assess F protein expression by ELISA and its capacity to evoke a specific immune response, scale up the production process, and conduct a preclinical trial to establish the vaccine's ability to fight RSV infection.

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Abstract: Science and Engineering Fair of Houston

3068

Saccharin: A Second Look | Investigating Dose Dependent Inhibition of Fermentation in C. butyricum via Saccharin

Kendrick Toennies
Clear Creek ISD /Clear Brook High School

Category

Biochemistry and Microbiology

Saccharin is a widely consumed artificial sweetener. While it is not metabolized by humans, recent studies demonstrate that it interacts with and modulates bacteria in the human gut microbiome. It has also been observed that saccharin consumption is associated with metabolic dysregulation. Butyrate is a short-chain fatty acid (SCFA) produced by the microbiome and provides the primary energy source for colonocytes which regulate metabolic health. I tested the hypothesis that saccharin inhibits fermentation in the butyrate-producing human gut bacteria Clostridium butyricum. Five cultures with mediums containing 0.00 to 1.00 M were tested. Anaerobic conditions were produced using a candle jar design and thioglycolate medium. Each culturing apparatus was connected to a gas syringe; readings were taken seven times across 72 hours. At the end of 72 hours, the cell population of each culture was determined using a hemocytometer. A negative linear relationship between butyrate fermentation rate and saccharin concentration (R^2 = 0.3536), with a decrease of 34.7 nmol/log(h)/cell. The culture with the highest saccharin concentration of 1.00 M had the lowest fermentation rate of 37.931 nmol/log(h)/cell, 76.419 nmol/log(h)/cell less than the control. This project determined that saccharin inhibits fermentation in butyrate-producing human gut bacteria, thus inducing butyrate deficiency and posing an unforeseen risk to human health. Excessive saccharin consumption may be contributing to worsening metabolic health in the United States. Future in vivo studies will quantify induced butyrate deficiency, and future enzyme studies will identify what step of the biochemical pathway of butyrate fermentation is inhibited.

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Abstract: Science and Engineering Fair of Houston

3069

Uncharted Waters: Biochemical Trapping via Green Synthesized Metallic Nanoparticles in Water Purification

Karishma Parghi
Rishabh Yadav
Conroe ISD /AST: Academy of Science and Technology

Category

Biochemistry and Microbiology

Upwards of 2.2 billion people lack access to potable drinking water. Widespread potable water is limited due to the cost and energy demands of conventional water filtration technology. Nanotechnology offers transformative potential through the unique quantum properties and high surface area-to-volume ratio, enabling magnetic filtration in oil spills and solar absorption for desalination. Water purification techniques can be enhanced using nanotechnology by two approaches: magnetic filtration and solar-absorption based desalination. In this experiment, green synthesis methods were used to derive silver and gold nanoparticles from spent coffee grounds, confirmed through UV spectroscopy demonstrating peaks of 570 nanometers for the silver nanoparticles and 445 nanometers for the gold nanoparticles. Subsequently, these green synthesized nanoparticles were tested against traditional mechanical filtration methods on a synthetic oil spill with a novel laser absorption spectrometer developed internally. This nanoparticle based magnetic filtration significantly outperformed mechanical filtration methods, achieving statistically significant water clarity ($p < 0.001$). The nanoparticles' solar absorption properties were additionally tested against deionized water for their applicability in desalination, measured by passing a Fresnel lens-concentrated solar array through silver and gold nanoparticles into the quantification device. The solar absorption of the silver and gold nanoparticles drastically increased relative to deionized water ($p < 0.001$). This experiment proves the efficacy of green synthesized nanoparticles in oil spill remediation and solar absorption with statistical significance. Green synthesized nanoparticles offer a cost-effective, eco-friendly alternative to conventional water purification techniques.

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Abstract: Science and Engineering Fair of Houston

3070

Exploiting Telomerase Complex Assembly as a Key Vulnerability in Cancer Cell Proliferation

Rohan Battula
Shadow Creek - HS

Category

Biochemistry and Microbiology

Telomerase, a ribonucleoprotein complex responsible for maintaining telomere length, is frequently upregulated in over 85% of human cancer types, enabling their indefinite proliferation. This study targets the interaction between TERT (telomerase reverse transcriptase) and the P6.1 stem-loop of TERC (telomerase RNA component), a critical binding region essential for telomerase assembly, hypothesizing that disrupting the P6.1 loop will disrupt telomerase assembly and reduce its activity in cancer cells. Computational approaches were employed to investigate and disrupt the P6.1 loop of TERC. Initially, RNAComposer was used to model the TERC structure based on its human sequence. A library of 1,200 FDA-approved compounds was then screened using Schrodinger's computational suite to identify potential small-molecule inhibitors that can target the P6.1 loop. Top candidates were selected based on their docking scores, MM-GBSA binding affinities, and ADMET properties, evaluating their predicted efficacy and pharmacokinetic profiles. The most promising compound was then subjected to structure-based optimization, enhancing its molecular interactions with residues of the P6.1 loop. The optimized inhibitor achieved a docking score of -8.2 kcal/mol and an MM-GBSA binding affinity of -58 kcal/mol, while maintaining highly favorable ADMET properties, suggesting a robust potential to impede TERC-TERT complex formation. By selectively targeting this RNA-protein interaction, the inhibitor aims to reduce telomerase activity, leading to telomere shortening and induction of cancer cell senescence. These in silico findings pave the way for a novel anti-cancer therapeutic approach, with future steps involving in vitro and in vivo validation to confirm its inhibitory effects on telomerase function and cancer cell proliferation.

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Abstract: Science and Engineering Fair of Houston

3071

Efficiency to Treat Grey Water Using Chlorella, Bacillus Subtilis Culture, and Titanium Dioxide

Sherry Gao
Conroe ISD /AST: Academy of Science and Technology

Category

Biochemistry and Microbiology

Water pollution has been a long since recognized problem and though there have been methods to try to reduce it, many have side effects that continue to damage the environment instead of healing the problem. This is where microalgae, bacteria, and nanoparticles come in. These subjects are known to be able to effectively clean water and have been proven to be efficient and effective, causing little to no negative impact on the environment. This study aims to find if combining each subject would show an improved efficiency or effectiveness, tested over a two week period. Each method would be placed in a control by itself and also placed with another method to attempt to create a symbiotic environment. Each group would be placed in a greywater, contaminated with fertilizer, oil, and dish soap which replicates most runoff waters found in the environment. Though there was no observed significant difference, the overall decrease in negative substances in the water showed that each method would be able to be applied to a larger scale in the real world and effectively heal our waters.

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Abstract: Science and Engineering Fair of Houston

3072

Uncovering Nonlinear DNA Methylation Patterns: A New Perspective on Biological Age

Kevin Chen
Houston ISD /DEBAKEY HIGH SCHOOL FOR HEALTH PROFESSIONS - HS

Category

Biochemistry and Microbiology

DNA methylation is a dynamic process that adds methyl groups to DNA molecules, which plays an important role in gene expression regulation, genome stability, and aging. Epigenetic clocks developed over the past decade have used DNA methylation values at specific CpG sites combined with factors such as environmental influences and lifestyle factors to predict biological age with remarkable accuracy. However, these epigenetic clocks, built using conventional penalized regression models, have several limitations: (1) they assume consistent linear changes in methylation with age; (2) the selected CpGs in these clocks often lack specific biological significance; and (3) there is minimal overlap among the selected CpGs across different clocks. I applied my own CpG selection method, which does not assume a lifelong linear correlation between DNA methylation and age. I divided the lifespan into overlapping age windows—[0, 20], [5, 25], [10, 30],... ,[55, 75], [60, 80]—and identified CpGs that showed strong correlations with age within each specific window. Most CpGs were selected in young and old age windows, while few were selected in the middle-aged windows, indicating fast DNA methylation changes during child development and aging. I then performed clustering, uncovering four main patterns: (1) increase during adolescence, (2) decrease during adolescence, (3) increase in old age, and (4) decrease in old age. These findings suggest that age-related methylation changes are more complex than previously thought, with implications for refining epigenetic clocks and redefining the way we study aging.

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Abstract: Science and Engineering Fair of Houston

3073

Detecting Heart Failure Before It Strikes: In Silico Analysis of Aptamer-Mediated GPNMB Protein Detection in Congestive Heart Failure (CHF)

Sahasra Vedagiri
Jordan - HS

Category

Biochemistry and Microbiology

Heart failure is when the heart can't pump enough blood and oxygen to meet the needs of the rest of the body. Glycoprotein Non-metastatic B, GPNMB, is a protein encoded by the GPNB gene. This protein plays a role in cell and tissue survival and inflammation. Studies have shown that it also plays a role in heart damage as it plays a role in tissue recovery and remodeling. In some cases, it has been linked to promoting fibrosis, disrupting electrical contractions and the behavior of macrophages. Aptamers are single-stranded chains of nucleotides, either DNA or RNA, which are synthetically produced to bind to specific receptors in proteins and molecules. We hypothesize that aptamers binding to the surface of the BPNMB could be used to detect the diagnosis of heart failure. Based on the number of interactions aptamer ss9 was selected as an appropriate candidate. Molecular docking simulations were used to find the most effective and best-fit binding spot between the aptamer and protein. This research aims to develop a solution that would help identify how far along a patient is in regard to heart damage to give a better disclosure for the patient and physician.

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Abstract: Science and Engineering Fair of Houston

3074

Finding the Concentrations of the Antiseptics: Honey and Turmeric On Bacteria Growth Inhibition by Using Petri Dishes

Alexandra Ellent
Conroe ISD /AST: Academy of Science and Technology

Category

Biochemistry and Microbiology

Millions of people face the challenge of finding an effective substitute for common antibiotics every year. Outside of antibiotics are antimicrobials such as honey and turmeric. However, the most effective benefits of these antimicrobials are unclear. This problem motivated me to research the properties of honey and turmeric further, and answer the question: what is the most effective concentration for honey and turmeric to inhibit bacterial growth? To find how various concentrations of honey and turmeric showcase their most preeminent inhibition against E. coli K-12. This project uses Petri dishes to identify the best concentration for inhibiting bacteria. This experiment aims to help people find an alternative way to recover from illnesses faster and more successfully. Honey and turmeric were tested utilizing different concentrations on a Petri dish containing an agar nutrient inoculated with e-coli. The honey was tested with the measurements of .25, .5, and .75 grams over a 96-hour and 48-hour time period with 15 microliters of e-coli. The turmeric was tested with the measurements of 1000mg, 2500mg, and 500mg over a 96-hour and 48-hour time period with 15 microliters of e-coli. This research showed that the honey inhibited better exponentially with the most preeminent inhibition of short-term growth at a concentration of 0.5 grams. The turmeric inhibited more linearly with the optimal inhibition for long-term growth at a concentration of 2500mg. This experiment identified honey and turmeric as affordable, helpful, and accessible antimicrobials that showcase healing properties.

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Abstract: Science and Engineering Fair of Houston

3075

The pH Paradox: How Phytoplankton affects the Ocean's Chemistry

Ushanee Danansooriya
Y Nguyen Pham
Adriel Virse Andot
Conroe ISD /ASHP: Academy for Science and Health Prof

Category

Biochemistry and Microbiology

Ocean acidification is the greatest threat to marine life, especially the coral reefs, which would eventually affect the different organisms that depend on them for food and protection. This is mainly caused by the increased amount of CO2 emitted from the atmosphere. This research will explore three types of phytoplankton: Diatoms, Dinoflagellates, and Cyanobacteria. Over six weeks, we seek to identify if some types of phytoplankton are more efficient in raising the pH than others. From the results, there is no statistical difference in the change in pH across between the three phytoplankton types in the replicated ocean water but, we have recorded that the phytoplankton, Dinoflagellates, has made the highest average change from week 0 to week 6; the average change that we have recorded was a pH reading of 0.3. Further trials will be conducted using various combinations of the phytoplankton to determine whether these combinations and the original test have a greater significant difference.

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Abstract: Science and Engineering Fair of Houston

3076

Dissolvability of Red Blood Cells in Household Acids and Bases

Darren Kyle Asentista
Harmony South District

Category

Biochemistry and Microbiology

The dissolvability of red blood cells in household acids and bases experiments aims to aid forensic research by revealing the presence of blood at a crime scene. To achieve this, red blood cells were each placed in 4 beakers containing different sodium hydroxide (lye), hydrofluoric acid, acetic acid, and drain cleaner (lower concentration sodium hydroxide). They were left to dissolve in the solution and would be tested every 20 minutes for the presence of red blood cells through the protein, hemoglobin. From the data, the Blood cells dissolved in both the controls, but required more experimentation on the test variables. The data provided can be used to aid forensic investigations and can be used to determine the time of death since the red blood cells can be dissolved within a set amount of time, leading to a more accurate determination of the time of death If red blood cells were dissolved using any household acids and bases at the scene.

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Abstract: Science and Engineering Fair of Houston

3077

Screening for Soil-Derived Antibiotics: A Study of Microbial Inhibition in Urban and Rural Ecosystems

Sofia Rivera
Friendswood ISD /Friendswood High School

Category

Biochemistry and Microbiology

This research investigated microbial inhibition and growth in both urban and rural soils, testing the research question of "Can bacteria isolated from diverse soil environments produce antibiotic compounds capable of inhibiting the growth of common bacteria and if so, which soil environment (urban or rural) produces an antibiotic that best inhibits the growth of bacteria?" Soil samples were collected from both an urban and rural location. The hypothesis was that soil from a rural location will produce more effective antibiotics that best inhibit bacterial growth in comparison to soil from an urban location. Soil dilutions were made from each sample and spread on agar to grow. The microbial colonies that grew were transferred to agar plates inoculated with Staph and E. coli. The goal was to observe zones of inhibition around the microbial colonies, which would indicate antibiotic activity. While inhibition zones weren't observed, the contrasting growth patterns revealed differences in how urban and rural soil microbiomes interact with harmful pathogens. The coverage of microbial colonies was analyzed using ImageJ and t-tests were performed to find significance. It was found that the differences in microbial colony coverage between urban and rural soils were statistically significant when interacting with Staph. The lower microbial colony coverage in rural soil suggests that soil microorganisms in rural environments are less competitive in the presence of bacteria like staph and e.coli. This project serves as a baseline for further research regarding urban and rural soil.

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Abstract: Science and Engineering Fair of Houston

3078

Syndecan-1 is a Key Mediator of Entosis and Cellular Competition in Pancreatic Cancer

Kara Li
Glenda Dawson - HS

Category

Biochemistry and Microbiology

Entosis, a form of cell-in-cell (CIC) structure formation where one cell invades and becomes internalized by another, has long been observed in various malignancies and is considered a critical cellular process in cancer progression, with potential impacts on tumor heterogeneity, survival, and metastasis. Syndecan-1 (SDC1), a transmembrane proteoglycan involved in cell adhesion and communication, plays a pivotal role in these processes, yet its specific function in entosis within pancreatic ductal adenocarcinoma (PDAC) remains underexplored. This study aimed to investigate whether SDC1 facilitates entosis in PDAC cells and to assess its impact on tumor aggressiveness and patient outcomes. Using immunohistochemistry, flow cytometry, entosis assays, and statistical analysis, our findings reveal that SDC1 prominently localizes at cell-cell contact points, facilitating stable intercellular adhesion and promoting entotic activity. Knockdown experiments reveal that reduced SDC1 expression significantly diminishes CIC formation, implicating SDC1 as a critical mediator of this process. Analysis of clinical samples revealed that high SDC1 expression correlates with increased entotic activity in PDAC tumors and is associated with decreased patient survival. These results suggest that SDC1-mediated entosis enhances tumor aggressiveness by contributing to cellular competition and heterogeneity. Our study sheds light on the critical role of SDC1 in promoting CIC formation and cancer progression, highlighting its potential as a therapeutic target to disrupt entotic mechanisms in PDAC.

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Abstract: Science and Engineering Fair of Houston

3079

Computational Modeling of Calprotectin-Targeting Aptamers as a Crohn's Disease Biomarker

Aiden Chemmanoor
Klein Cain - HS

Category

Biochemistry and Microbiology

Crohn's disease is an inflammatory bowel disease that causes inflammation and scarring in the intestine. Due to its nonspecific, overlapping symptoms and the need for invasive, complex diagnosis, Crohn's disease is often diagnosed late, resulting in further complications. Calprotectin is a protein released due to the inflammation caused, and accurate measurement of this protein could be a noninvasive and easy diagnosis strategy for this disease. Aptamers are nucleic acids from DNA or RNA that attach to specific targets and have gained popularity in protein binding and disease diagnosis. We hypothesize that the aptamer binds to the calprotectin protein and can be used for early detection of Crohn's disease. In the research, we have performed computational simulations of aptamers targeting calprotectin. The calprotectin 3D structure was initially obtained using the AlphaFold 3 web server. To model the aptamer, we used UNAfold, a nucleic acid folding software, and FARFAR 2, a tool for building the full model of an RNA, and they gave us the single-stranded structure of the aptamer. To locate where the aptamer would bind to Calprotectin, we used HDOCK, a protein-DNA/RNA docking server with a hybrid strategy, which gave us the binding site. The results show that the aptamer M1 binds strongly to the protein and could be used in protein detection. This research could create calprotectin-binding Aptamers in labs for a non-invasive diagnosis of Crohn's disease in patients, allowing them to be diagnosed earlier in age and faster instead of using invasive procedures like colonoscopies.

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Abstract: Science and Engineering Fair of Houston

3080

Carbohydrate Levels in Juices

Destiny Samuels
Alief ISD

Category

Biochemistry and Microbiology

The student's experiment aimed to determine the best method for measuring sugar levels in popular fruit juices in the U.S. to promote healthier choices and reduce the number of diabetes diagnoses. The independent variables included orange juice, apple juice, pineapple juice, lemonade, and mango juice, while the dependent variable was the sugar content in each juice. The sugar levels were measured using Benedict's test, which assessed color changes corresponding to sugar amounts. The student also used a digital refractometer that calculated sugar percentages. The hypothesis posited that identifying carbohydrate percentages in these juices would help individuals make healthier choices, potentially lowering type 2 diabetes diagnoses. The findings revealed that Benedict's test was the most effective measurement method for visual representation, while the digital refractometer had better accuracy. The results indicated that apple juice, mango juice, and lemonade contained the highest sugar levels. This research supports the hypothesis, suggesting that by understanding the sugar content in their beverages, individuals can make informed choices about their drink consumption, contributing to a potential decrease in diabetes cases.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

☐ human participants ☐ potentially hazardous biological agents

☐ vertebrate animals ☐ microorganisms ☐ rDNA ☐ tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

☒ yes ☐ no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

☐ yes ☒ no

4. This project is a continuation of previous research.

☐ yes ☒ no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

☐ yes ☒ no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

☒ yes ☐ no

Abstract: Science and Engineering Fair of Houston

3081

Upregulation of chaperone mediated autophagy in a genetically induced model of acute senescence

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Category

Biochemistry and Microbiology

Cellular senescence is the transient response to cellular damage. Persistent senescence is one of the drivers of aging contributing to functional loss and vulnerability to age-related disorders. Chaperone-mediated autophagy (CMA), a lysosomal degradation pathway involved in protein quality control, decreases with age and may contribute to persistent cellular senescence. Previously, chemical stressors have been used to induce senescence, but their possible direct impact on CMA complicates interpretation. In this study, we took a novel approach to investigate CMA activity during acutely induced senescence by genetic modulation. I employed mouse embryonic fibroblasts with a floxed telomere-capping protein TRF2 and an estrogen-responsive CRE recombinase (TRF2-CREERT2). Treatment with tamoxifen in this system induces TRF2 deletion, leading to telomere uncapping and uniform senescence induction. CMA activity was assessed using the fluorescent reporter KFERQ-Dendra, which highlights lysosomes as fluorescent puncta when delivered there by CMA. Our findings demonstrate a significant upregulation in CMA activity at 1-, 2-, and 5-day intervals following senescence induction. Immunoblot analyses confirmed effective senescence induction with increased p21 and decreased HMGB1 levels. Consistent with increased CMA activity, Dendra levels also decreased. These results collectively indicate that CMA activity increases during acutely induced senescence through genetic modulation. This study introduces a genetically controlled model that underscores the critical interplay between autophagy and cellular senescence and enables further mechanistic investigation of CMA upregulation. These findings have broad implications as modulating CMA (enhancing it/ preventing its decline with age) could be effective in mitigating the pathological consequences of aging and enhancing cellular resilience.

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[X] yes [ ] no