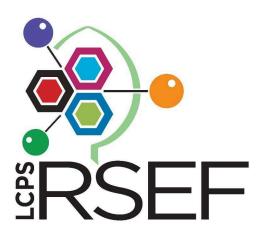# Abstracts for the
42ⁿᵈ Loudoun County
Regional Science & Engineering Fair

March 20, 2024
John Champe High School

LCPS RSEF Categories

Number	Category Name
100	Animal Sciences
200	Behavioral & Social Sciences
300/700	Biochemistry; Chemistry
400	Biomedical & Health Sciences
500/2200	Biomedical Engineering; Translational Medical Science
600/800	Cellular & Molecular Biology; Computational Biology & Bioinformatics
900	Earth & Environmental Sciences
1000/1100	Embedded Systems; Energy: Sustainable Materials & Design
1200	Engineering Technology: Statics & Dynamics
1300	Environmental Engineering
1400	Materials Science
1500/1700	Mathematics; Physics & Astronomy
1600	Microbiology
1800	Plant Sciences
1900	Robotics & Intelligent Machines
2000/2100	Systems Software; Technology Enhances the Arts

For detailed category descriptions visit the ISEF website at:
https://student.societyforscience.org/intel-isef-categories-and-subcategories

Project Numbering

For exhibition, all projects are given a number. The first series of numbers indicates the category & project number. For example, project **1303T10** is the third project in Environmental Engineering. The letters, **T** or **X**, in the project number indicate whether a project is a Team (**T**) project or an Individual (**X**) project.

LCPS Regional Science & Engineering Fair
Projects by Student Name

Last, First Name	Project No.	Project Title
Abdulmajeeth, Azim	1801T12	How Does Microplastics Concentrations Effect Plant Development and Soil Health
Abu-Kassem, Zaina	101T12	The Effect of Oxybenzone on Ramshorn Snails in an Aquatic Environment
Abushaban, Omar	401T12	The Impact of Diet Composition on Performance and Climbing Speed in Drosophila Melanogaster
Adatsi, Doreen	201X12	What concentration of collagen is optimal to result in the fastest regeneration in planaria worms and/or flatworms of the class Turbellaria (phylum Platyhelminthes)?
Aggarwal, Anoushka	402X11	A Comparison of the Protective Capability of Withania somnifera and Acetylsalicylic Acid on Stress using Daphnia magna as a Model Organism
Ahmed, Hassan	2001T12	Using AI to detect AI
Akasam, Dyuthi	901T12	Best Soil Conditions for Food
Alawneh, Leen	701X12	Extraction and Characterization of silica dioxide from Musa acuminata (bananas) via Acid Leaching Method
Alexander, Ethan	1901T12	Designing a Low-Cost Robotic Prosthetic Arm: Enhancing Accessibility and Functionality
Allam, Rishika	101T12	The Effect of Oxybenzone on Ramshorn Snails in an Aquatic Environment
Amin, Shriya	102T12	The impact of Astragalus membranaceus and Ilex paraguariensis on Cellular Regeneration in Dugesia tigrina exposed to Microplastic contamination
Amireh, Hazim	403T12	The Effects of Osteonectin on Muscular Hypertrophy Using Drosophila Melanogaster as a Model Organism
Amperayani, Siri	404T11	The Effect of Artificial and Natural Serotonin on Drosophila Hydei's Ability to Survive in Stressful Environments
Ananthoj, Ritika	105T12	The Effect of Vitamin C on the Mobility of Acheta domesticus
Andberg, Emmy	702X12	The efficiency of filtering Gamma Hydroxybutyric Acid out of alcohol and, as an extension, can a self-filtering straw be created? (aka Project Safe-Sip)
Angara, Vanya	1401X11	Creating Nightlights with Glowing Zoo-plankton and Dinoflagellates
Appelt, Mckenna	405T12	The Effect of Heteractis crispa Venom on the Degradation of Drosophila melanogaster Neurons Modeling Parkinson's Disease.
Arnold, Jack	902X12	The Effect of Relationships in an Aquatic Community
Arria, Jason	403T12	The Effects of Osteonectin on Muscular Hypertrophy Using Drosophila Melanogaster as a Model Organism
Asar, Anushka	601X12	A Chemical Parasol: Using Natural Compounds to Prevent DNA Damage in the Skin of UV-Sensitive Populations
Ashraf, Omar	406X12	The Effects of Loud Music on Cochlear Hair Cells, and its Sensorineural Hearing Loss Implications
Athavale, Rishi	1902X12	Hebbian-Based Meta-Learning for Supervised Tasks
Austin-Handy, Brian	301X12	The Effect of Sand on Peptide Bond Catalysis
Aziz, Sana	1601X12	The Effect of 253.7 nm Radiation on the Growth of Mycobacterium smegmatis
Babu, Pranav	409T12	The Effects of p-Coumaric Acid on α-Synuclein Aggregate Concentrations in Drosophila Melanogaster with Parkinson's Disease
Baires, Lazaro	107T12	Anthropogenic Noises Effect on Drosophila melanogaster Social Behavior
Balachander, Ananya	602T12	The Effect of Increased Trypsin Concentration Upon Degranulation in an RBL-2H3 Cell Model of Peanut Allergen-Induced Anaphylaxis

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Projects by Student Name

Last, First Name	Project No.	Project Title
Balagao, Stefanie Nicole	103X12	The Behavioral Effects of Red 40 Synthetic Dye on an Ant Farm
Balaji, Anirudh	2201T12	The effect of honokiol supplementation on tau-mediated degeneration in Drosophila melanogaster expressing tau toxicity (AD)
Balisetty, Nishitha	407X11	Exploring the Effect of Caffeine on Teen Sleep and Physiology using Fruit Flies
Barahona-Bonilla, Dianne	104T12	Investigating the Impact of Sound Frequencies on Cellar Spider Behavior
Barkman, Connor	2002X12	A Combinatorial Optimization of Elevator Dispatch Algorithms to Cut Down on Energy Consumption
Berlik, Grady	1101T11	Developing a Stochastic Analytical Framework to Assess Storage Needs in Texas
Bhadange, Rohan	2201T12	The effect of honokiol supplementation on tau-mediated degeneration in Drosophila melanogaster expressing tau toxicity (AD)
Bhikha, Nishka	408X11	Cross reactive allergenic effect of Prunus dulcis on Blaptica dubia infected with Schistosoma mansoni
Biswas, Akshita	801X12	Using Learning Classifiers in Machine Learning to Predict the Likelihood of Ischaemic Stroke
Bojji, Alisha	2202X12	Effects Ataxia Has On Health With Or Without The Help Of Medical Attention/Devices
Bose, Karthik	1402T12	The Efficacy of Carbonized Wood as an Alternative Power Transfer for Fire Prevention
Brubaker, Elizabeth	1301T12	The Effectiveness of Coffee Grounds as an Aggregate for Mortar
Cameron, Lilly	903X12	Nitrogen Content of Lichens as a Bioindicator of Data Center Impact on Air Quality
Challa, Rushil	409T12	The Effects of p-Coumaric Acid on α-Synuclein Aggregate Concentrations in Drosophila Melanogaster with Parkinson's Disease
Champagne, Emily	904T12	The Effect of Iron in Pleurotus ostreatus (oyster mushroom) as a Bio Filtration Device
Chand, Jordan	909T12	Are Fiddler Crabs Fit Bioindicators for Microplastic Pollution in the Chesapeake Bay?
Chapman, Lex	202T12	Boosting the Efficacy of Anxiety-reducing Remedies.
Chawla, Brahmjot	1903X12	Comparison and Testing of an N2-inspired k-UpCCGSD to Reduce the Probability of a Barren Plateau
Cheedalla, Varun	1302T12	Determining the Compressive Strength Capability of Crosslinked Graphene-Treated Aerogels
Chellarapu, Sai Ashutosh	302T12	The Effect of Autoinducer Analogs on the Quorum Sensing Systems of S. epidermidis RP62A
Chin, Kayla	1602T12	The Effect of Cistus Incanus Tea and Honey on the Biofilm Production of E.Coli K-12
Choi, Iris	202T12	Boosting the Efficacy of Anxiety-reducing Remedies.
Chowdhury, Ayan	1102T12	Wave Energy Attenuator Net Design Structural Analysis
Clippinger, Nick	905X12	Effects of Plastic Leachate on Oxygen Production in Aquatic Plants
Cocklin, Lilliana	703X12	Filtering estrogen in water using a hydrophobic interaction chromatography column
Cohn, Olivia	906X12	The Effect of Zophobas Morio on Breaking Down Polystyrene in Different Environments in the Pursuit of a New Waste Mediation System
Collins, Victoria	1403X12	The Effect of Duct Tape Grade and Surface Type on Trace Evidence Transferability
Cox, Colin	1304T12	The Effect of Respirator Components on Emissions from Vehicular Exhausts
Crabb, Alex	706T12	What is the best way to efficiently distill seawater

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Cutforth, El	1603X12	Inhibition of E. coli growth using Lactic Acid
Czeszewski, Deven	2101X12	Design and Development of a Virtual Reality Program for Enhanced Home Retail Capabilities
Dabre, Emily Ria	102T12	The impact of Astragalus membranaceus and Ilex paraguariensis on Cellular Regeneration in Dugesia tigrina exposed to Microplastic contamination
Darapuneni, Sarayu	1704T11	Analyzing gravitational lensing to find the distance (ly) of astronomical objects from Earth
Das, Saumik	203X12	The effect of koumine on social interaction and locomotion of a traumatic injury induced Drosophila melanogaster offspring model (mimicking preterm birth effects)
Davis, Layla	907X12	A Correlation Between Chesapeake Bay pH Levels and Oyster Shell Size
Deal, Gillian	904T12	The Effect of Iron in Pleurotus ostreatus (oyster mushroom) as a Bio Filtration Device
DeMartin, Lily	118T11	Does the Type of Music Affect Learning in Drosophila Melanogaster?
DeWitt, Zoe	204X12	The Usage of Hericium erinaceus as a Treatment for Conditioned and Genetic Aggression
Dickersheid, Ruthie	410X12	The Effect of Different Sleep Agents on the Development of Dementia/Symptoms of Dementia
Divins, Sarah	908X12	Earthworms Response to Climate Change
Dolan, Greyson	1701X12	How Well Does Citzen Science Work, A Case Study Using Exoplanets
Dondapati, Suhani	1201X11	Recreating a Cupping Wing Movement on a Robotic Butterfly
Donepudi, Ridhi	104T12	Investigating the Impact of Sound Frequencies on Cellar Spider Behavior
Doraiswamy, Ryan	1501X11	Applications of the Riemann Hypothesis in Cryptography
Dunn, Holly	909T12	Are Fiddler Crabs Fit Bioindicators for Microplastic Pollution in the Chesapeake Bay?
Elango, Nehal	1202X11	Making a Quartz Portable Battery
Elshaer, Sofyan	1203T12	Effect of Mars Rover Wheel Design on Maneuverability in Simulated Martian Terrain
Engen, Kiersten	2102X12	3D Open-World Adventure Game in Godot
Ezumah, Kaobimdi	910X11	The Effect of Herbs/Spices on Drosophilas with Spinocerebellar Ataxia
Farah, Hanan	2203X11	The Effect of Frankincense Serrata Oil on Parkinson's Disease Tested on PINK-1 C. elegans
Ferdinando, Heaven	1604T12	The Effects of Sine versus Sawtooth Ultrasonic Sound Waveform Administration on Necrosis in Escherichia coli K-12 and Lactuca sativa var. capitata
Firdous, Sara	105T12	The Effect of Vitamin C on the Mobility of Acheta domesticus
Floyd, Aidan	109T12	Polystyrene Digestion Effects on Superworms Nutritional Value
Foard, Sarah	1802T11	How do bleach and peroxide (common biohazard cleaners) affect the way plants grow?
Forrester, Mimi	1301T12	The Effectiveness of Coffee Grounds as an Aggregate for Mortar
Foxx, Sydney	1803X12	The Viability of Spherified Seeds For Farming Process
Frank, Miriam	303T12	How pH Impacts the Antimicrobial Properties of Eucalyptus globulus Oil
Friend, Nathan	802X11	The Percentage of Wolbachia in Land Related Arthropods Compared to Aquatic Related Arthropods

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Gadicherla, Arushi	1813T12	Optimizing Hydrogen Concentrations to Enhance N.oculata Amplification for Algae Biofuel Production
Gallagher, Josh	1203T12	Effect of Mars Rover Wheel Design on Maneuverability in Simulated Martian Terrain
Ganey, Alexandra	411T11	The Effect of Home Remedies on Drosophila Melanogaster Infected With Alzheimer's Disease
Garcia-Soliz, Daniel	412X12	Proposing R195 Drosophila melanogaster as a new model for further research in the mutant IDH
Garland, Nate	911X12	Uptake of Heavy Metals via Echinometra mathaei (sea urchins): Aquatic Remediation using Spines
Gatupa, Ankur	1911T12	Comparative Analysis of Machine Learning Frameworks LightGBM and XGB
Ghosh, Diya	2204X12	Analyzing the Effects of Altretamine Chemotherapy Drug on Drosophila melanogaster Ocular Melanoma Models
Gibi, Adrena	1904T11	Diagnosing Burn Wounds through Machine Learning
Gingerich, Ashley	912X12	An Investigation Comparing Rural and Developed Soil Health in Loudoun County Communities
Goel, Abhigya	1905X12	Development of a Photogrammetry-Enabled Drone with Image Recognition and LiDAR Obstacle Avoidance for Optimized Hurricane Disaster Zone Mapping
Goli, Rishika	413T12	The Effect of Additives on Glutamate Production in Helix aspersa
Gop, Cyrus	1204X12	Construction of a Concrete 3D-Printer to Test Martian Magnesium Oxide Concrete
Gottipati, Amulya	803T11	Forecasting the Spread of Dengue Outbreaks with a Synthesis of Machine Learning Models Utilizing Exogeneous Variables
Gross, Sophie	106X12	The effect of artificial light cycles and colors on wolf spider predation of crickets
Guddeti, Jahnavi	303T12	How pH Impacts the Antimicrobial Properties of Eucalyptus globulus Oil
Gunawardhana, Chetana	1205X12	Submersible Aerial Vehicle Design Study
Gupta, Ananya	1302T12	Determining the Compressive Strength Capability of Crosslinked Graphene-Treated Aerogels
Guzman Fuentes, Brian	501X11	Effective Joints in Prosthetics
Haider, Reyhan	304X11	A Comprehensive LC-MS Metabolomics Approach Identifies a Novel Biomarker Panel Using An apoE4 Mouse Model of Alzheimer's Disease
Hannis, Charlotte	704X12	Palatable or Population Control: Determination of Inorganic Phosphate (Pi) in LCPS School Lunch Products Through the Use of Thin-Layer Chromatography (TLC)
Hanumanula, Deeksha	2205T12	The Effect of Citrus bergamia Supplementation on Parkinson's Driven Locomotor Impairment in Drosophila melanogaster
Hari, Vyasa	913X12	A Novel Fruit Fly Repellant
Harigopal, Neel	2003X12	Clean Environment Score
Harper, Kamryn	1804T12	Eco-Friendly Pesticides on Plant Health and Garden Pests
Hayman, Natalie	212T12	Exploring Consciousness in Physarum Polycephalum: Insights from Decision-Making of Oats Enhanced With Varying Sleeping Agents and its Implications on Understanding of Human Brain
Hays, John	931T11	Studying the Relationships Between Physicochemical Factors and Phytoplankton as Methods of Determining Water Quality in the Potomac River

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Last, First Name	Project No.	Project Title
Helveston, Mia	1805X12	The Effect of Mycorrhizal Fungi on Atmospheric CO2 Levels
Hoey, Jack	107T12	Anthropogenic Noises Effect on Drosophila melanogaster Social Behavior
Iliassov, Sofiya	1604T12	The Effects of Sine versus Sawtooth Ultrasonic Sound Waveform Administration on Necrosis in Escherichia coli K-12 and Lactuca sativa var. capitata
Ilodianya, Chinenye	205X12	The Effect of Sesamin on Reducing Increased Aggression after Traumatic Brain Injury and Decrease of GABA Function in Drosophila Melanogaster
Ingle, Dani	1702X12	The Impact of Small Collisions on Solar Panels in Low Earth Orbit
Iragavarapu, Sreeja	803T11	Forecasting the Spread of Dengue Outbreaks with a Synthesis of Machine Learning Models Utilizing Exogeneous Variables
Islam, Nina	1806T12	The Impact of the probiotic Lactobacillus plantarum on Apple Decay
Jani, Parv	414X12	Assessing Efficacy of Gene Therapy Interventions for Sickle Cell Disease: A Secondary Comparative Analysis
Johanson, Graeme	1703X12	Creating an Affordable and Still Effective Clinostat
John Kennedy, Sarah Benedetta	1305T12	Evaluating the Filtration Ability of Douglas Fir Xylem for Lead Removal
Johnson, Bryan	108X12	Testing methods for exterminating planaria from freshwater aquariums
Johnson, Joseph	1605T12	Isolation Of Trace DNA In A Household Environment
Johnson, Joshua	2004X12	Biscuit Allergy Detection
Johnson Quinchia, Sofia	1103X11	Green Hydrogen through Solar Electrolysis of Sea Water
Joseph, Catherine	2103X12	Speech to American Sign Language Translator
Kadri, Arwa	914X11	Removing Perchlorate from Mars Regolith
Kagalwala, Rahul	1402T12	The Efficacy of Carbonized Wood as an Alternative Power Transfer for Fire Prevention
Kakarlapudi, Sahasra	707T12	The Effect of Chemical Precipitation on Lithium-Ion Battery Runoff Polluted Lake Water
Kamalakannan, Rithika	804X12	Brain Tumor Detection
Kamath, Ankita	932T12	The Prevalence of Microplastic Contamination on Microplastic Abundance Variation Across Different Locations
Kandhari, Mishka	1606X11	The Effect of Different Concentrations of Color Additives on the Development of E. Coli K-12
Kannan, Nitish	1807T12	Optimizing the Effectiveness of the Bioinoculant Formulation of Bacillus subtilis and Pseudomonas fluorescens in Aquaculture Crop Yields using Machine Learning
Kanwar, Krish	2104T12	Music Style Transfer AI
Karthik, Niesha	1906X11	Experimentation Into Use Of PIML To Test The Effect Of Rocket Fin Configuration On Its Trajectory
Katoch, Samiya	1101T11	Developing a Stochastic Analytical Framework to Assess Storage Needs in Texas
Kattamuri, Tanush	401T12	The Impact of Diet Composition on Performance and Climbing Speed in Drosophila Melanogaster
Keller, Rachael	2105X12	Utilizing the Imagineering Design Process and Engineering Analysis to Design a Roller Coaster
Keyser, Dylan	2005X12	Using Computer Vision to Analyze and Provide Feedback on Distance Running Form

LCPS Regional Science & Engineering Fair
Projects by Student Name

Last, First Name	Project No.	Project Title
Khan, Aleeza	1609T12	The Effect of Gut Probiotic Intake on the Progression of Intestinal Integrity with Ulcerative Colitis in Drosophila melanogaster
Khan, Maira	415X12	Comparative Analysis of Natural Substances on Earthworm Regeneration: An Experimental Study
Khan, Maysoon	1607X11	The Effect of Combinations of Various Natural Agents on Antimicrobial-Resistant Bacteria
Khan, Zain	109T12	Polystyrene Digestion Effects on Superworms Nutritional Value
Khanna, Riya	918T12	The Effectiveness of Natural Oils against UVA Rays: An Environmentally Friendly Alternative
Kifayat, Sophia	206X11	The Effect of Different Colored Environments on Cognitive Activity Using Drosophila melanogaster as a Model Organism
Kim, Leslie	215T12	The Effect of Aging on C. elegan Neuroplasticity
Kim, Madison	416X11	The Effect of Infrared Light on GAL4-UAS Drosophila melanogaster Expressing Human APP
Kluzinski, Alexa	1608X12	The Production of Human Insulin In A Microalgae Based Bioreactor
Knowlden, Jessica	417T11	The Effect of Senna extract on the body's ability to regulate blood suga
Korff, Zoe	915X12	The Chemical and Physical Effects of Climbing Chalk on Crustose and Foliose Lichen
Kosoor, Soumya	207T12	The Effects of Valeriana Officianalis, Exogenous Melatonin and Matricaria Chamomilla on Reducing the Effects of Insomnia-Induced Aggression in Drosophila Melanogaster
Kulkarni, Akash	110X11	The Effect of a Disrupted Circadian Rhythm on the Cognitive Function of Drosophila Fruit Flies
Kulkarni, Rohit	1907X11	Adversarially-Driven Generation of De Novo Proteins for Therapeutic Drug Design
Kumar, Nakul	2104T12	Music Style Transfer AI
Kunapuli, Srikar	1404X12	Enhancing Tensile Strength of Mycofabricated Leather Derived from Penicillium Chrysogenum
Kunta, Kritika	1809T12	What methodologies of ecological restoration best support soil remediation for native plant growth?
Kurowski, Benjamin	1206X12	Designing a Morphing Airfoil to Maximize Flight Efficiency
Kuturu, Siri	1307T12	Generating Energy From Benthic Mud Across Loudoun County Using a Microbial Fuel Cell
Kyle, Edwin	705X12	Development of a Novel Method for the Retrieval of Precious Metals from Waste Nanoparticle Solutions
Labatch, Aaron	916X12	An Evaluation on Need and Placement of Category IV Buildings Based on Seismic Hazard Zones in Rural Communities
Lackey, Eryn	1808X12	The Effect of Juglone on Virginia's Invasive Miscanthus sinensis
Latta, Sidney	917X11	Analysis of environmental variables on the prevalence of Dreissena polymorpha; an assessment utilizing United States Geological Survey and Geological Information Systems data sources
Lawing, Lily	1704T11	Analyzing gravitational lensing to find the distance (ly) of astronomical objects from Earth
Liu, Andrew	2006X12	Design and Implementation of an On-Demand-Transit Application
Loeu, Nyla	1303T12	The Effect of Auxins on Zinnia Phytoremediation in Oil Contaminated Soil

LCPS Regional Science & Engineering Fair
Projects by Student Name

Last, First Name	Project No.	Project Title
Lomelin, David	1807T12	Optimizing the Effectiveness of the Bioinoculant Formulation of Bacillus subtilis and Pseudomonas fluorescens in Aquaculture Crop Yields using Machine Learning
Ludwig, Jake	706T12	What is the best way to efficiently distill seawater
MacDuffee, Trevor	111X12	Taxological and Quantitative Review of Rafinesquince winchesterensis as Found in the Millersburg Member of the Cynthiana Formation, KY
Maddipatla, Jagadeepram	1001X12	Performing Optical Fast Fourier Transforms through the use of Silicon Photonics
Mahboob, Sonia	918T12	The Effectiveness of Natural Oils against UVA Rays: An Environmentally Friendly Alternative
Maheshwari, Krish	2205T12	The Effect of Citrus bergamia Supplementation on Parkinson's Driven Locomotor Impairment in Drosophila melanogaster
Mai, Charlotte	112T12	Are the receptors on ants' antennas the only determining factor that they use to differentiate between a healthy and denatured cell?
Major, Grant	1207X12	The Search for an Association Between a Tensile Integrity Structure's Bar Count and Impact Force Mitigation
Makassi, Eunice Marie-Josee	1303T12	The Effect of Auxins on Zinnia Phytoremediation in Oil Contaminated Soil
Mallett, Jonathan	1705X11	An Evaluation of the Sustainability of "Green" Energy
Mallipeddi, Jugalsai	1908T12	Development of an IA capable of sefl grading Free Response Questions
Mamilla, Sree	2206T12	Natural Food Combinations to Relieve Hyperacidity
Manikonda, Nitya	1609T12	The Effect of Gut Probiotic Intake on the Progression of Intestinal Integrity with Ulcerative Colitis in Drosophila melanogaster
Mansfield, Sara	2007X12	Implementation of Generative AI into a user-friendly Website Application as an Advancement to the Gamification of Learning
Mathen, Evin	1706X11	Optimizing the feasibility of a quantum levitation system through use of a vacuum environment, for application in transportation.
McClelland, Charlie	1909X12	Development of an Autonomous Beach Clean Up Vehicle Utilizing Object Detection
McGee, Kiley	418X12	Bacillus subtilis as a Potential Probiotic Treatment for alpha-Gal Syndrome
McGrath, Kailey	1809T12	What methodologies of ecological restoration best support soil remediation for native plant growth?
McMahon, Olivia	433T12	The Effect of Menstrual Cycle Phase on the Blood Lactate Threshold of Eumenorrheic Women during High Intensity Aerobic Exercise: A Meta-Analysis
McQueen, Hunter	113X12	The effects of linearly reflected polarized light on the navigation of drosophila melanogaster
Medavarapu, Sanvik	1405T12	Predicting Electrospun Poly(vinyl alcohol) Nanofiber Porosity from Processing Parameters Using Machine Learning
Megahed Elhefnawy, Nada	1707X11	Quantum Entanglement and Local Relativity: The Black Information Hole Paradox, Entropy, General Relativity, and the Universe as a Domino Effect
Mehta, Parth	1908T12	Development of an IA capable of sefl grading Free Response Questions
Mekuriya, Abi	2008X12	RPC Based Compilation: A Dual Binary Approach for Distributed Languages
Mengesha, Nardos	928T12	The Effect of Organic Pesticide Eugenol on the Innexin Genes of Lymnaea Stagnalis
Menon, Nandha	919X11	The Effect of Arbuscular Mycorrhiza on the Survival Rate of Plants Susceptible to Flooding
Midda, Nikhil	1810X11	Impact of Invasive Plant Species on Native Plant Health in Shared Habitat

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Last, First Name	Project No.	Project Title
Miller, Abbie	1811X12	The Effect of Various Wavelengths of Light on the Efficiency of Plant Growth
Miller, Hayden	1304T12	The Effect of Respirator Components on Emissions from Vehicular Exhausts
Minhas, Kabir	2001T12	Using AI to detect AI
Motter, Lyn	920X12	Studying Water Conservation Programs to Enhance Water Security in Drought-Prone Communities
Moyer, Ryan	1910X12	Utilizing Machine Learning to Scout South American Soccer Defenders
Mulla, Zaara	2009X11	How can different Mars Rover prototypes best navigate space in a VR simulation?
Mummadi, Anishreddy	419X10	Investigating the Potential Implications of Periplaneta americana as a Cost-Efficient Peanut Allergy Model
Munagapati, Sanjay	1901T12	Designing a Low-Cost Robotic Prosthetic Arm: Enhancing Accessibility and Functionality
Murray, Matthew	1208X12	The Effect of Thermal Paste Design on CPU Efficiency
Murugan Ayyappan, Aadarsini	707T12	The Effect of Chemical Precipitation on Lithium-Ion Battery Runoff Polluted Lake Water
Mussmon, Vaughn	1812X12	Do Venus Flytraps in colder environments exhibit faster sensory hair reaction times when exposed to a rapid increase in temperature or when given ants?
Mutima, Emmanuelle	1209X12	Hair Braid Cooler: A Device to Prevent Pediatric Burns in the Process of Dipping Braids
Nadella, Shivani	1305T12	Evaluating the Filtration Ability of Douglas Fir Xylem for Lead Removal
Nareddy, Saahiti	1814T11	Effectiveness of acid rain buffers on Glechoma Hederacea
Nasef, Layan	413T12	The Effect of Additives on Glutamate Production in Helix aspersa
Ngo, Duc	1914T12	Effectiveness of an AI Model on Detecting and Classifying Drosophila Behaviors
Nguyen, Andrew	1610X12	Varying strengths in disinfectant resistance to Escherichia Coli K12
Nijkamp, Lexi	405T12	The Effect of Heteractis crispa Venom on the Degradation of Drosophila melanogaster Neurons Modeling Parkinson's Disease.
Noll, Prescott	1104X12	Increasing the Economic Viability of Hydrogen Energy through Plasma Enhanced Catalysis
Nukta, Lana	114X12	Analysis of Bird Wing Morphology in Response to Wildfires
Olorunda, Deborah	921T12	The Effect of Sunscreen Agents: Homosalate, Octocrylene, Avobenzone, and Zinc Oxide on The Cell Growth and Decay of Nannochloropsis Oculata
Orfaly, Sarah	1602T12	The Effect of Cistus Incanus Tea and Honey on the Biofilm Production of E.Coli K-12
Palicherla, Anshu	1813T12	Optimizing Hydrogen Concentrations to Enhance N.oculata Amplification for Algae Biofuel Production
Papaiya, Vrushali	2207X12	The Effectiveness of Uraria picta in Treating Cardiac Arrhythmia Using Daphnia magna as the Model Organism
Paranjpe, Aarya	420X12	The Effect of New Generation Pesticides on Memory and Social Behavior in Drosophila melanogaster as a Model Organism
Paranjpe, Aditya	1911T12	Comparative Analysis of Machine Learning Frameworks LightGBM and XGB
Patel, Haley	1306T12	The Quantification of Water Quality after Hydroponic Greywater Filtration
Pendyala, Pranav	1405T12	Predicting Electrospun Poly(vinyl alcohol) Nanofiber Porosity from Processing Parameters Using Machine Learning
Petros, Simon	1105X11	The Power of Karman Vortex Streets: Innovative Solutions for Building Sustainability

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Last, First Name	Project No.	Project Title
Phillips, Wyatt	922X12	Testing Different Water Sources that Lead into the Potomac River to see if they Contribute to the Nutrient Overflow in the Chesapeake Bay.
Philpot, Madison	603X12	Development of novel allosteric inhibitors to commonly used antibiotics that are resistance susceptible
Phomsopha, Katie	1306T12	The Quantification of Water Quality after Hydroponic Greywater Filtration
Pondugula, Eswar	302T12	The Effect of Autoinducer Analogs on the Quorum Sensing Systems of S. epidermidis RP62A
Potluru, Tanishta	604X12	E. coli and Household Chemicals
Prasanna, Kabilan	208X11	Mastermind: A Novel Ensemble Model Approach to Detecting Mental Illnesses through Natural Language Processing
Prashanth, Harshitha	1605T12	Isolation Of Trace DNA In A Household Environment
Qazi, Shahnoor	112T12	Are the receptors on ants' antennas the only determining factor that they use to differentiate between a healthy and denatured cell?
Raab, Tristan	2106X12	3D Voxel Modeling for Visual Simulation of Clouds
Rabinowitch, Tori	921T12	The Effect of Sunscreen Agents: Homosalate, Octocrylene, Avobenzone, and Zinc Oxide on The Cell Growth and Decay of Nannochloropsis Oculata
Ramaswamy, Ananyaa	2206T12	Natural Food Combinations to Relieve Hyperacidity
Rao, Ankit	1912X11	A Low-Cost and Durable 3D Printed Prosthetic Finger Driven by Deep Learning
Rao, Nikita	923T12	The Effect of Flavonoids on the Growth/Protection of Phaseolus lunatus L. (lima beans) when Introduced with Soil Nematodes.
Rao, Sanjana	923T12	The Effect of Flavonoids on the Growth/Protection of Phaseolus lunatus L. (lima beans) when Introduced with Soil Nematodes.
Ravva, Sai	421X12	Examining how the transcription factors, Nurr-1 and ATF4, affect the expression of the dopamine D2 receptor in the kidney.
Rayapati, Pranay	1406X12	Carbon Nanotube Air Fiter
Repalli, Anirudh	1801T12	How Does Microplastics Concentrations Effect Plant Development and Soil Health
Restrepo, Alejandro	1407X12	The Development of Conductive Ink via Graphite Powder
Riesz, Emily	1210X12	Building and Testing a Mechanical Wave Force Tank with Dynamically Adjustable Parameters.
Rizvi, Tamera	1408X12	Developing a Wearable and Affordable Iontophoresis Device for Hyperhidrosis Management
Robinson, Christine	1913X12	Saurorover (Sauropod Mechanism)
Romdhani, Hajer	209X11	Analyzing Crime using Criminal Profiling and Crime Mapping
Romero, Arturo	924X11	The Effect of Temperature Spikes and Mild Winter Temperatures on the Germination of Native Species from Virginia
Rose, Will	210X12	High Risk Decision Making in Hockey: "Pulling the Goalie" Play Implementation
Rosher, Emma	925X12	The Effect of Green Roofs on the Energy Usage of Data Centers in Loudoun County
Ruthala, Abhiram	2010T11	Assistive VR Technology Utilized In Mental Health Applications
Sadu, Aakash	115X12	Beetle speed when pulling different weights.
Sakpal, Shlesh	1708X11	Forecasting Space Weather Events Through Analysis of Active Region Magnetograms using Artificial Intelligence

LCPS Regional Science & Engineering Fair
Projects by Student Name

Last, First Name	Project No.	Project Title
Salamanca, Melqui	211X11	Measuring the Effect of Stress on Regeneration in Planaria
Salmin, Natalie	1106T12	A New Design for the Pool Umbrella Incorporating Solar Fans
Sanchez, Sergio	2208X12	The Effect of Various Air Pollutants on Drosophila Activity, Ultimately Drawing Comparisons to Humans.
Sangameswaran, Kamal	1914T12	Effectiveness of an AI Model on Detecting and Classifying Drosophila Behaviors
Sarna, Jas	926X11	Assessing the Impact of Microplastic Pollution on Fucus Seaweed and Reef Zooplankton
Sathguru, Yazhini	927X12	Azolla Caroliniana's Phytoremediation Effect on Nitrate
Sayed, Humera	1904T11	Diagnosing Burn Wounds through Machine Learning
Schwedes, Summer	116X12	Investigation of the Non-Caloric Sweeteners Stevia and Aspartame on the Microbiome Relative to Intestinal Permeability
Senthil Nath, Sakthi	930T12	The Effect of Root Type on the Filtration of Ammonia and Nitrate as a Biofilter
Sevugan, Daiwik	2010T11	Assistive VR Technology Utilized In Mental Health Applications
Shah, Naavya	605X12	Intracellular Origami: Refolding Mutated TP53 by PRIMA-1 in Acute Lymphocytic Leukemia
Shah, Selina	422T11	The Effect of Ginseng on Alzheimer's Disease
Shane, Natalia	1802T11	How do bleach and peroxide (common biohazard cleaners) affect the way plants grow?
Sharhan, Hiba	417T11	The Effect of Senna extract on the body's ability to regulate blood suga
Sharma, Saumya	207T12	The Effects of Valeriana Officianalis, Exogenous Melatonin and Matricaria Chamomilla on Reducing the Effects of Insomnia-Induced Aggression in Drosophila Melanogaster
Sharvirala, Sanjana	423X12	The Web of Diet and Nephrolithiasis: A Laboratory Investigation
Sheets, Sadie	117X11	An Investigation of Commercial Fragrances on Fruit Fly Health
Shelton, Gabrielle	424X12	The Effects of Different Concentrations of Lidocaine on Spinal Epidural Hematomas Using Periplaneta americana as a Model Organism
Sidhu, Veer	928T12	The Effect of Organic Pesticide Eugenol on the Innexin Genes of Lymnaea Stagnalis
Silverstein, Leah	1106T12	A New Design for the Pool Umbrella Incorporating Solar Fans
Simancik, Katelyn	305X12	Medication of Yeast to Isolate and Predict Increase of GABA Amounts
Singh, Arsh	425X12	Comparison of Omega 6 and Omega 3 Fatty Acids on Human Embryonic Development using Drosophila melanogaster as a Model Organism
Sinha, Soham	708X12	Creation and Implementation of a Semi-Organic Ferrofluid Colloid as an Advancement to Drug Delivery Procedures
Smith, Isabel	426X12	The Impact of Food Insecurity and Malnutrition on Fertility Rates in Drosophila melanogaster
Smith, Mia	1804T12	Eco-Friendly Pesticides on Plant Health and Garden Pests
Soska, Lilly	2011X12	The Effect of AI Bias on Resume Evaluations
Soyannwo, Seunfunmi	427X11	The Effect of Medicinal Herbs on Wolbachia pipientis in Preventing Mosquito Reproduction Using Drosophila melanogaster as a Model Organism
Srikanth, Prakruti	1002X11	Comparing the Efficacy of Benzoyl Peroxide and Ayurvedic Treatments on Staphylococcus epidermidis

LCPS Regional Science & Engineering Fair
Projects by Student Name

Last, First Name	Project No.	Project Title
Srikonda, Taran	1502X12	Mathematical Modeling of Integrated Approaches for Treating Acute Myeloid Leukemia
Srivatsavai, Prakhyath	1102T12	Wave Energy Attenuator Net Design Structural Analysis
St. James, Siena	929X12	The Effect of Oxybenzone on Green Algae Euglena
Stafford, Camden	212T12	Exploring Consciousness in Physarum Polycephalum: Insights from Decision-Making of Oats Enhanced With Varying Sleeping Agents and its Implications on Understanding of Human Brain
Sugasi, Nandita	901T12	Best Soil Conditions for Food
Sukumar, Shivani	422T11	The Effect of Ginseng on Alzheimer's Disease
Suresh, Karishma	1814T11	Effectiveness of acid rain buffers on Glechoma Hederacea
Suri, Navya	118T11	Does the Type of Music Affect Learning in Drosophila Melanogaster?
Talla, Sreemedha	602T12	The Effect of Increased Trypsin Concentration Upon Degranulation in an RBL-2H3 Cell Model of Peanut Allergen-Induced Anaphylaxis
Tammana, Akhilesh	1409T12	Utilizing Biochar from Pyrolyzed Biosolids and Mycelium for Sustainable Concretes
Tandon, Raina	428X12	The Effect of Magnesium on Tachycardic Daphnia Exposed to Dopamine
Tartaglione, Michael	2209X12	Investigating the Antiparkinson Effects of the Anti-Prion Compound Ebastine on the Deaggregation of Alpha-Synuclein in Drosophila Melanogaster.
Teng, Olivia	429X12	Development of a Bioactive Gel to Inhibit Dental Plaque Formation of Streptococcus Mutans via Quorum Sensing
Thameem, Aamira	1815X12	Analysis of Brassica napus va pabularia's difference in stomate density through biomass to accommodate varying root zone temperatures in hydroponics
Thikkalathuru, Harshini	930T12	The Effect of Root Type on the Filtration of Ammonia and Nitrate as a Biofilter
Tholasi, Namitha	213X12	Investigating How Behavioral Aspects Are Affected by Different Blue Light Intensities in Drosophila Melanogaster
Thomas, Norah	404T11	The Effect of Artificial and Natural Serotonin on Drosophila Hydei's Ability to Survive in Stressful Environments
Thompson, Cathy	1709X11	A Meta-Analysis on the Theories of Dark Matter
Tirrell, Maggie	119X12	The Effect of Environmental Enrichments on Memory Retention in Aβ42 Expressing Drosophila melanogaster.
Tomlinson, Sammi	931T11	Studying the Relationships Between Physicochemical Factors and Phytoplankton as Methods of Determining Water Quality in the Potomac River
Tran, An	430X12	The Effect of Snail Slime on Staphylococcus epidermidis to Determine Antimicrobial Properties against Acne
Tran, Emily	1003X12	Mitigating Racial Bias in Automatic Faucets
Tucker, Ava	214T12	The Effect of Neurological Supplements on Fruit Fly Memory
Tucker, Grace	214T12	The Effect of Neurological Supplements on Fruit Fly Memory
Uppalli, Isha	932T12	The Prevalence of Microplastic Contamination on Microplastic Abundance Variation Across Different Locations
Vadlamudi, Nimisha	431X12	Exploring the Effects of L-theanine on Teen Sleep and Physiology using Fruit Flies
Valentini, Katherine	432X12	The Effect of Amyloid Beta Protein on Cognition in Drosophila melanogaster Following Traumatic Brain Injury

LCPS Regional Science & Engineering Fair
Projects by Student Name

Last, First Name	Project No.	Project Title
Vatsavai, Niharika	1307T12	Generating Energy From Benthic Mud Across Loudoun County Using a Microbial Fuel Cell
Veepujarla, Sarah	606X12	Effects of Music on Cognition and Cell Growth in Fruit Flies
Walter, Aaryav	805X11	The Application of Neural Networking to Analyze the Relationship Between Intensive Care Unit (ICU) Medical Diagnosis and Propofol Infusion Syndrome (PRIS).
Ware, Leila	1409T12	Utilizing Biochar from Pyrolyzed Biosolids and Mycelium for Sustainable Concretes
Warsame, Nura	933X12	Which plant grows best in Mars Regolith?
Wasique, Faris	1806T12	The Impact of the probiotic Lactobacillus plantarum on Apple Decay
Waterfield, Kayla	1410X12	Finding a safer alternative to remove an acrylic nail.
Waters, Mariah	433T12	The Effect of Menstrual Cycle Phase on the Blood Lactate Threshold of Eumenorrheic Women during High Intensity Aerobic Exercise: A Meta-Analysis
Weatherly, Lucas	2210X11	Automated Interpretation of Blood Culture Gram Stains by a Neural Network for Early Sepsis Diagnosis
Wells, Rylan	1211T12	Regenerative Shock Absorber
Welsh, Kayla	1308X11	Synthesis and Evaluation of Biodegradable Plastics
Welsh, Severn	1211T12	Regenerative Shock Absorber
Wildman, Cora	1309X12	Analysis of the Degradation of Polyester Polyurethane by Pestalotiopsis microspora Aided by UV Exposure
Wooldridge, Ianto	1710X12	Finding and Assessing the Habitability of Exoplanets using Machine Learning
Wooley, Blaine	411T11	The Effect of Home Remedies on Drosophila Melanogaster Infected With Alzheimer's Disease
Yurish, Natalie	1816X12	The Use of Jasmonic Acid to Improve Upon Tomato Plant Resistance to Hornworms
Zerfas, Sammie	1310X12	Where Riparian Buffers Should Be Built In The Potomac River Watershed
Zheng, Christina	215T12	The Effect of Aging on C. elegan Neuroplasticity

Animal Sciences (100)

Project No.	Student(s)	Project Title
101T12	Zaina Abu-Kassem, Rishika Allam	The Effect of Oxybenzone on Ramshorn Snails in an Aquatic Environment
102T12	Shriya Amin, Emily Ria Dabre	The impact of Astragalus membranaceus and Ilex paraguariensis on Cellular Regeneration in Dugesia tigrina exposed to Microplastic contamination
103X12	Stefanie Nicole Balagao	The Behavioral Effects of Red 40 Synthetic Dye on an Ant Farm
104T12	Dianne Barahona-Bonilla, Ridhi Donepudi	Investigating the Impact of Sound Frequencies on Cellar Spider Behavior
105T12	Ritika Ananthoj, Sara Firdous	The Effect of Vitamin C on the Mobility of Acheta domesticus
106X12	Sophie Gross	The effect of artificial light cycles and colors on wolf spider predation of crickets
107T12	Lazaro Baires, Jack Hoey	Anthropogenic Noises Effect on Drosophila melanogaster Social Behavior
108X12	Bryan Johnson	Testing methods for exterminating planaria from freshwater aquariums
109T12	Aidan Floyd, Zain Khan	Polystyrene Digestion Effects on Superworms Nutritional Value
110X11	Akash Kulkarni	The Effect of a Disrupted Circadian Rhythm on the Cognitive Function of Drosophila Fruit Flies
111X12	Trevor MacDuffee	Taxological and Quantitative Review of Rafinesquince winchesterensis as Found in the Millersburg Member of the Cynthiana Formation, KY
112T12	Charlotte Mai, Shahnoor Qazi	Are the receptors on ants' antennas the only determining factor that they use to differentiate between a healthy and denatured cell?
113X12	Hunter McQueen	The effects of linearly reflected polarized light on the navigation of drosophila melanogaster
114X12	Lana Nukta	Analysis of Bird Wing Morphology in Response to Wildfires
115X12	Aakash Sadu	Beetle speed when pulling different weights.
116X12	Summer Schwedes	Investigation of the Non-Caloric Sweeteners Stevia and Aspartame on the Microbiome Relative to Intestinal Permeability
117X11	Sadie Sheets	An Investigation of Commercial Fragrances on Fruit Fly Health
118T11	Lily DeMartin, Navya Suri	Does the Type of Music Affect Learning in Drosophila Melanogaster?
119X12	Maggie Tirrell	The Effect of Environmental Enrichments on Memory Retention in Aβ42 Expressing Drosophila melanogaster.

Category Student Count: 27

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Oxybenzone on Ramshorn Snails in an Aquatic Environment

Zaina Abu-Kassem, Rishika Allam

Oyxbenzone, a common chemical in sunscreens, has been known to be toxic to coral reefs; however, there is not much information on how oxybenzone can affect common aquatic organisms, such as Planorbella magnifica, otherwise known as the ramshorn snail. Aim or purpose of research: Explore the effects of oxybenzone on ramshorn snails regarding their Method used: Introducing sails to different amounts of molarity of oxybenzone, while putting 6 snails in different buckets with different concentrations of oxybenzone. Findings/results: Data is still being collected. Snails in the containers with oxybenzone are lethargic do not move much.

Oxybenzone has a negative impact on ramshorn snails when present in an aquatic environment.

Oyxbenzone, a common chemical in sunscreens, has been known to be toxic to coral reefs; however, there is not much information on how oxybenzone can affect common aquatic organisms, such as Planorbella magnifica, otherwise known as the ramshorn snail. The experiment is intended to investigate how the presence of oxybenzone in the environment can affect the ramshorn snails' birth rates, death rates, and behavior. In order to explore the effects of oxybenzone on ramshorn snails, the snails were exposed to oxybenzone through their environment at varying concentrations. Though data is still being collected, results indicate that the presence of oxybenzone reduces the activity and movement of the snails, and the more oxybenzone is present the less activity there is among the ramshorn snails. Overall, oxybenzone has a negative impact on ramshorn snails and their behavior.

LCPS RSEF OFFICIAL ABSTRACT - 2024

The impact of Astragalus membranaceus and Ilex paraguariensis on Cellular Regeneration in Dugesia tigrina exposed to Microplastic contamination

Shriya Amin, Emily Ria Dabre

As plastic production has increased in the 21st century, plastic has emerged as a global pollutant, with microplastics as a significant contributor. The impact of these microplastics upon humans and saltwater ecosystems have been researched, but their effect upon freshwater ecosystems is still relatively unknown. Regenerative medicine has also been a prevalent field of study for several decades. Although there has been significant progress in this field, current pharmaceutical treatments are costly and unsustainable for both the human body and environment. The use of herbal medicine offers a cost-effective and renewable alternative. Ilex paraguariensis, or Yerba Mate, is a plant often consumed through teas, known to have health benefits including anticancer and anti-inflammatory properties. The root of the Astragalus membranaceus flower is known to have similar effects, including respiratory and gastrointestinal benefits. The model organism for this study is the Planarian flatworm species Dugesia tigrina, commonly used in regenerative studies, due to their reliance on adult stem cells. During experimentation, planaria were exposed to microplastics and treated with one of the two herbal remedies to determine the change in regeneration rates due to the contamination and treatment. To conduct this experiment the optimal concentrations of the treatments were determined through a toxicity assay. Then, the worms underwent a tail amputation and were exposed to herbal treatments and microplastic contamination over the 3-week regeneration period. The regeneration rates of the worms were determined and analyzed by a comparison of their lengths post-amputation and after full regeneration is complete.

Amin, S. (2022). Determining the effect of Circumin and Ilex paraguariensis on the cellular regeneration in Dugesia tigrina. Academy of Science. Unpublished manuscript.

Gambino, G., Falleni, A., Nigro, M., Salvetti, A., Cecchettini, A., Ippolito, C., Guidi, P., & Rossi, L. (2020). Dynamics of interaction and effects of microplastics on planarian tissue regeneration and cellular homeostasis. Aquatic Toxicology, 218, 105354. https://doi.org/10.1016/j.aquatox.2019.105354

Gao, T., Sun, B., Xu, Z., Chen, Q., Yang, M., Wan, Q., Song, L., Chen, G., Jing, C., Zeng, E. Y., & Yang, G. (2022). Exposure to polystyrene microplastics reduces regeneration and growth in planarians. Journal of Hazardous Materials, 432, 128673. https://doi.org/10.1016/j.jhazmat.2022.128673

LCPS RSEF OFFICIAL ABSTRACT - 2024

The Behavioral Effects of Red 40 Synthetic Dye on an Ant Farm

Stefanie Nicole Balagao

Red 40 synthetic dye is commonly used in various food products that are regularly sold around the world. In recent years, there have been speculations raised about the effects of the dye on living beings. As many European countries banned the use of Red 40 synthetic dye in food products, people in other countries are concerned about the safety of consuming Red 40 dye. The purpose of the research on Red 40 synthetic dye is to conclude evidence about the effect of Red 40 synthetic dye on living beings.

To simulate an environment, two ant farms were set up. One is given a soaked cotton ball of Red 40 dye infused sugar water, and the second farm is given just a soaked cotton ball of sugar water. The second farm serves as the controlled environment, so there is a comparison to then observe the behavior. All other factors are consistent from additional nutrients to the ants' diet, the time they are fed, and the size of the ant farms. After feeding the ants sugar water twice a week, the behavior of the ants together are being observed.

The experiment is ongoing. The initial observations are that the control ant farm continues the consistent activity, mainly remaining underground and displaying little interest in the food presented. In contrast, the experimental group becomes more hyperactive about seeing the food, becomes more active on top of the ant farm, and increases interaction with each other more compared to the control ant farm.

Chumanevich, Z. (n.d.). The synthetic food dye, Red 40, causes DNA damage, causes colonic inflammation, and impacts the microbiome in mice. Redirecting. https://doi.org/10.1016/j.toxrep.2023.08.006

WebMD. (n.d.). What is Red No. 40?.
WebMD. https://www.webmd.com/diet/what-is-red-40

YouTube. (2020, August 1). How to raise an ant colony 101 | The ultimate guide to keeping pet ants. YouTube. https://www.youtube.com/watch?v=o1421IyFKuU

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Investigating the Impact of Sound Frequencies on Cellar Spider Behavior

Dianne Barahona-Bonilla, Ridhi Donepudi

This experiment aims to investigate the effect of sound frequencies on cellar spider behavior with the goal of identifying frequencies that may repel cellar spiders from human dwellings. Understanding cellar spider sensitivity to sound frequencies could inform non-invasive methods for cellar spider control in indoor environments. Various frequencies will be tested to determine if any elicit aversive responses from cellar spiders, potentially leading to their departure from the test environment.

Flores, Rachael, *Scientists patent new microphone inspired by spider silk*: Science and Technology, Binghamton University, 2024.

LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Vitamin C on the Mobility of Acheta domesticus

Ritika Ananthoj, Sara Firdous

Various supplements are used in athletic diets to enhance performance. This proposed experiment involves using crickets exposed to a heightened concentration of vitamin C (independent variable) as models for human athletes to observe mobility, focusing on jumping frequency (dependent variable). 20 crickets were used at any time in this experiment, about 4-5 weeks old and 2 cm in size. Control group is the crickets that have not been given vitamin C. Constants include the amount of vitamin C given to the crickets and amount of time for observations. The data shows that vitamin C had an effect on the mobility of the crickets; the experimental group (given vitamin C) has shown a decrease in jumps compared to the control group (no vitamin C). The mean of the control group is 0.95 jumps, and the mean of the experimental group is 0.58 jumps. These results are statistically significant, supported by the T-test performed.The alternative hypothesis is that the crickets will exhibit increased mobility when exposed to vitamin C. According to the data, this hypothesis was not supported. The jumps in the experimental group are significantly less than compared to the control group, indicating that the vitamin C led to decrease in mobility. More crickets died and were replaced in the control group, which may have been a variable that significantly increased mobility. Further research could explore the effect of multiple drugs, such as antibiotics, on mobility and how that may affect the social dynamics of cricket communities.

Jonathan, T. (2018, January 24). A multi-ingredient athletic supplement disproportionately enhances hind leg musculature, jumping performance, and spontaneous locomotion in crickets (Acheta domesticus). Wiley Online Library. Retrieved February 2024, from https://onlinelibrary.wiley.com/doi/abs/10.1111/eea.12642

Lewis, L. N. (2020, August 27). Lower Dietary and Circulating Vitamin C in Middle- and Older-Aged Men and Women Are Associated with Lower Estimated Skeletal Muscle Mass. NCBI. Retrieved February 2024, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7549302/

Long, J. (n.d.). Dietary amelioration of locomotor, neurotransmitter and mitochondrial aging. Sage Journals. Retrieved February 2024, from https://journals.sagepub.com/doi/10.1258/ebm.2009.009219

LCPS RSEF OFFICIAL ABSTRACT - 2024

The effect of artificial light cycles and colors on wolf spider predation of crickets

Sophie Gross

Changes in environments across the globe have continuously proved detrimental to sensitive insect species, especially because physiological constraints impact biological adaptations (Canals, et. al, 2015). Spiders can adapt quickly to abrupt environment changes, meaning that their behavior directly correlates to the pressures they are exposed to. Artificial light is an environmental factor that significantly alters visually-dependent species. Spiders are known to be nocturnal creatures, however, the repeat exposure to artificial light and abnormal light cycles shortens active periods by reducing darkness (Reddy, Reddy, & Sharma, 2023). In this experiment, 26 wolf spiders will be fed crickets every other day. Prior to and after experimentation, the wolf spiders will be placed in a 2 week 'fattening period' where they are fed as much as possible with the goal of them gaining weight. 2 spiders will be left in ambient classroom lighting, while the other 24 will be sorted into one of the 6 experimental groups. A light chamber made from a cardboard box and LED light strips will be placed over each enclosure, each with varying durations of light cycles and an inclusion of a blue light color, for a total of 2 weeks. The mass of the spiders will be weighed each week, and the number of crickets eaten each feeding will be recorded. The longer the wolf spiders were exposed to the light cycles, the less they began to eat and the more they began to adopt respective behaviors depending on the cycle they were exposed to.

Harvery, J. A. & Dong, Y. (2023). Climate change, Extreme Temperatures and Sex-Related Responses in Spiders. Biology, 12, 615. DOI: https://doi.org/10.3390/Biology12040615

Noriega, J.A.; Hortal, J.; Azcárate, F.M.; Berg, M.P.; Bonada, N.; Briones, M.J.I.; Del Toro, I.; Goulson, D.; Ibanez, S.; Landis, D.A.; et al. (2018). Research trends in ecosystem services provided by insects. Basic Appl. Ecol., 26, 8-23. [CrossRef]

Canals, M., Veloso, C., & Solis, R. (2015). Adaptation of the spiders to the environment: the case of some Chilean species. Front. Physiol., 6, 220. DOI: https://doi.org/10.3389/fphys.2015.00220

LCPS RSEF OFFICIAL ABSTRACT - 2024

Anthropogenic Noises Effect on Drosophila melanogaster Social Behavior

 Lazaro Baires, Jack Hoey

Anthropogenic noise such as traffic noise from highways has become prevalent in many environments in the past hundred years and can affect all species including invertebrates due to the specific acoustic communication many of them use. Roads near natural environments cause high levels of noise pollution that can affect all the species near them. The research in this experiment was conducted in order to determine the effect of anthropogenic noise on invertebrates social behavior, specifically wild Drosophila melanogaster. D. melanogaster were used for this experiment due to their similarity to many other invertebrates as well as the ease of experimentation. It's believed that the noise pollution will hinder the social interactions of the flies due to their use of acoustics to communicate causing them to become more aggressive. In this experiment, communities of flies were cultured in order to extract 15-25 flies per trial to analyze their social interactions for 2 minutes in a clear container. Video recordings were analyzed for aggressive fly behaviors consisting of headbutting, hind leg lifts, and wing lifts, to see if there's a difference in behavior between trials with and without noise. This experiment hopes to find evidence that anthropogenic noise causes D. melanogaster to become more aggressive, altering their social behavior. This experiment hopes to highlight the danger noise pollution poses to the environment and the biodiversity of invertebrates.

Classen-Rodríguez, L., Tinghitella, R., & Fowler-Finn, K. (2021). Anthropogenic noise affects insect and arachnid behavior, thus changing interactions within and between species. Current Opinion in Insect Science, 47, 142–153. https://doi.org/10.1016/j.cois.2021.06.005

Phillips, B. B., Bullock, J. M., Gaston, K. J., Hudson☐Edwards, K. A., Bamford, M., Cruse, D., Dicks, L. V., Falagan, C., Wallace, C., & Osborne, J. L. (2021). Impacts of multiple pollutants on pollinator activity in road verges. Journal of Applied Ecology, 58(5), 1017–1029. https://doi.org/10.1111/1365-2664.13844

Watts RD, Compton RW, McCammon JH, Rich CL, Wright SM, Owens T, Ouren DS. 2007 Roadless space of the conterminous United States. Science 316, 736– 738. (doi:10.1126/science.1138141)

I/We hereby certify that the above statements are correct and the information provided in the Abstract is the result of one year's research. I/We also attest that the above properly reflects my/our own work (digitally signed).

LCPS RSEF OFFICIAL ABSTRACT - 2024

Testing methods for exterminating planaria from freshwater aquariums

 Bryan Johnson

Planaria are a problem that aquarists have all around the world. They are slimy pests that feed on snails, shrimp, fish fry, and other invertebrates. In many cases, they are able to eradicate populations of invertebrates inside of an aquarium without proper treatment. People have been trying to find the perfect treatment for aquariums that don't harm the intended inhabitants but exterminate the planaria for a long time. Many different chemicals and medications have been used, most of them being at least somewhat harmful towards all invertebrates. There is one drug that stands out. Betel nut extract is an all natural substance used for medication and recreation by over 600 million people around the world. Although it isn't very healthy for humans, it should be for invertebrates, well all except for planaria. This drug is said to have the capabilities of killing parasites/organisms around the family of planaria, and I'm testing this theory. I will be using flubendazole as a control medication, and experimenting with betel nut extract. There will be two separate tanks, one with snails the other with planaria, and I will administer doses of the two drugs mentioned in each for multiple trials. The purpose of this experiment is to find whether betel nut extract is really that effective, and what the dosage is for the most effective treatment.

Bogert, David. (2019).10.13.3. Planaria. Aquarium Science.
https://aquariumscience.org/index.php/10-13-3-planaria/

Faouzi, M. (2018). Areca nut extracts mobilize calcium and release pro-inflammatory cytokines from various immune cells. National Library of Medicine.
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5773534/

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Polystyrene Digestion Effects on Superworms Nutritional Value

Aidan Floyd, Zain Khan

This study investigates the potential of *Zophobas morio* (superworms) to degrade polystyrene, a non-biodegradable material, and its effects on their nutritional value. By comparing the levels of nitrate and ammonium in superworms fed polystyrene with those fed natural foods, the study aims to contribute to waste management and understand their digestive capabilities. Superworms were divided into two groups: a group fed natural foods (sweet potatoes, apples, and pears), and an experimental group fed polystyrene packing peanuts. After two weeks of feeding and observation, the worms were collected and their nitrate and ammonium levels were measured using specialized electrodes after being turned into a puree. The study is still ongoing, however, data points towards a significant difference between polystyrene and fruit fed superworm nutrition levels. The alternative hypothesis that feeding superworms polystyrene would result in lower levels of nitrate and ammonium was supported by the data. This suggests that superworms can potentially digest polystyrene, impacting their nutritional composition. All groups showed cannibalistic behaviors, resulting in worms being tested before the 2 week mark. Future studies could delve into the microbial communities present in the digestive tracts of Superworms during polystyrene digestion and explore potential applications in bioremediation. Additionally, investigating the effects of other types of plastics on superworms' nutritional value could provide insights into broader waste management solutions.

Dragojlović, D., et al. Comparison of Nutritional Profiles of Super Worm (*Zophobas morio)* and Yellow Mealworm (*Tenebrio molitor*) as Alternative Feeds Used in Animal Husbandry: Is Super Worm Superior? *Animals* (Basel), vol. 12, no. 10, 2022, pp. 1277-, https://doi.org/10.3390/ani12101277.

Greenwood, V. (2022, June 21). Don't Try This at Home: Styrofoam as a Snack Food? Superworms Just Pack It In. *New York Times,* D2(L). https://link.gale.com/apps/doc/A707729227/SCIC?u=sta95509&sid=bookmark-SCIC&xid=218e387c

Hampton, O. (2022, June 24). How "superworms" could help solve the trash crisis. NPR. https://www.npr.org/2022/06/23/1106967044/scientists-think-superworms-might-be-a-solution-to-the-trash-crisis

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of a Disrupted Circadian Rhythm on the Cognitive Function of Drosophila Fruit Flies

Akash Kulkarni

This experiment assesses the cognitive capabilities of Melanogaster fruit flies by subjecting them to a maze with varying environmental stimuli to alter their circadian rhythm, allowing for comparison with a control group.The circadian rhythm acts as an internal clock, regulating vital functions like sleep and metabolism to maintain homeostasis. The brain's ability to receive signals through environmental stimuli that activate the body's hormones and alter one's inner biology provides more insight into how circadian rhythms can affect cognitive function entirely. By assessing such phenomena more closely within animal models and experimentation, evolutionary studies suggest that similarities that knit animals and humans together can simply provide more insight into the cognitive function of humans. Circadian rhythm disruption in humans have caused long term implications of physiological development including risk of depression and bipolar illness, so assessing disruption in fruit flies who are similar to humans in many physiological ways, provides better insight into humans evolution against such risks.

To examine the cognitive abilities of flies, 3 fly groups were subjected to a maze after different light durations: Group 1 experienced fully dark conditions, Group 2 experienced 50% light exposure, and Group 3 experienced 100% light exposure. Their paths were recorded and compared to the control group to evaluate the efficiency in locating a melon in subsequent maze trials. By performing such experimentation, it provided clear insight into the difference that circadian development plays on the cognitive function of mammals and how it could even correlate with that of humans.

Jones, H., Steven (2001). Circadian rhythms, multilevel models of emotion and bipolar disorder– an initial step towards integration? ScienceDirect/Clinical Psychology Review. https://www.sciencedirect.com/science/article/abs/pii/S0272735801001118

Turek, W., Fred (2010). Circadian disruption and metabolic disease: Finding from animal models. ScienceDirect/Clinical Psychology Review. https://www.sciencedirect.com/science/article/abs/pii/S1521690X10000771

Valdez, Pablo (2023). Circadians rhythms in cognitive performance: implications for neuropsychological assessment. Taylor & Francis Online. https://www.tandfonline.com/doi/abs/10.2147/CPT.S32586

LCPS RSEF OFFICIAL ABSTRACT - 2024

Taxological and Quantitative Review of Rafinesquince winchesterensis as Found in the Millersburg Member of the Cynthiana Formation, KY

 Trevor MacDuffee

Rafinesquina winchesterensis is an extinct species of articulate brachiopod found only in the Cynthiana formation. The brachiopod dates back to the end of the middle Ordovician period, and spans into the upper Ordovician, however how far is unknown. R. winchesterensis was first referenced in a field journal made by August F. Foerste and later quantified again in a report on Rafinesquina species from 1942. Despite the prevalence of R. winchesterensis In historical documentation, it is not recognized as an existing species or synonym, and is also not referenced as being void in favor of another taxon. Despite this, the Smithsonian has nineteen specimens that are currently labeled Rafinesquina winchesterensis two of which are syntype specimens, meaning they are the basis for the species designation. My project aims to collect quantitative data about R. winchesterensis and compare it with data from similar data from Rafinesquina species of the same lineage. The data I used was the length, width, ratio of length to width, and population spread. Using this data I attempt to determine whether R. winchesterensis is in fact its own species, or is a member or variation of another existing species and why. I do this using the probability values between closely related and established species and subspecies to generate significance thresholds which account for variability. I then use these thresholds to define the position of the taxon R. winchesterensis in relation to the other established taxon. I found that in most terms R. winchesterensis likely possesses enough difference to be categorized as its own species relative to other related species established differences, and should be labeled as such. However, my project also brings to light discrepancies in the relationship between other species and subspecies, and suggests that the genus has probably been oversplit.

Rafinesquina winchesterensis Foerste. (1910).Denison Univ., Sci. Lab., Bull. 16, p. 42-43, pl. 5, figs.13a-c.https://books.google.com/books/about/Preliminary_Notes_on_Cincinnatian_and_Le.html?id=gg3mXwAACAAJ

Salmon, E. S. (1942). Mohawkian Rafinesquinae. Journal of Paleontology, 16(5), 580–581. www.jstor.org/stable/1298780

Darwin, C. & Kebler, L. (1859) On the origin of species by means of natural selection, or, The preservation of favoured races in the struggle for life. London: J. Murray, 37-49. [Pdf] Retrieved from the Library of Congress,www.loc.gov/item/06017473/.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Are the receptors on ants' antennas the only determining factor that they use to differentiate between a healthy and denatured cell?

Charlotte Mai, Shahnoor Qazi

After researching, we found that ants were able to develop a refined sense of smell which gave them the ability to detect cancer due to the receptors on their antennas. This sparked our interest and caused us to wonder if the antennas were the only determining factor. There are two groups with 32 ants each: one with mineral oil on their antennas which was applied using a micro-tip and one without mineral oil (control group). Both groups will go through one ant being placed in the middle of two choice chambers. After repeating this for the control group, ants that have mineral oil on their antennas. There are 3 different trials with each group; a healthy cell vs. nothing, a denatured cell vs. nothing, and a healthy cell vs. a denatured cell. Up to this point we have conducted all of the control groups' trials and the results have yielded that the ants tend to gravitate towards a healthy cell when placed with a healthy cell and nothing. In the trial with a denatured cell and nothing, the data varied but the ants went towards the denatured cell slightly more than the cell with nothing. Lastly, in the trial with a denatured cell and a healthy cell, the results were mixed; however, the ants gravitate more towards the denatured cell. The data was collected on 30 second time intervals where the time in each chamber was measured. However, all of the data has not been collected; therefore, there is no definitive conclusion yet

Ant antennae are a two-way communication system. (2016, March 16). ScienceDaily.
https://www.sciencedaily.com/releases/2016/03/160330103328.htm

Coleman, J. (2023, January 24). *Ants can sniff out cancer*. Scientific American. https://www.scientificamerican.com/article/ants-can-sniff-out-cancer/#:~:text=Ants%20don't%20have%20a,use%20it%20to%20detect%20tumors.

Piqueret, B., Bourachot, B., Leroy, C., Devienne, P., Mechta-Grigoriou, F., D'Ettorre, P., & Sandoz, J. (2022). Ants detect cancer cells through volatile organic compounds. *iScience*, *25*(3), 103959.
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LCPS RSEF OFFICIAL ABSTRACT - 2024

The effects of linearly reflected polarized light on the navigation of drosophila melanogaster

Hunter McQueen

Many insects, such as fruit flies, rely on circularly reflected polarized light in the atmosphere for navigation, raising concerns about the ecological impacts of solar panels, particularly their linearly reflected polarized light. This study investigates how such light influences fruit fly navigation behavior. Using enclosed mazes, fruit flies' navigation patterns are observed under varying polarized light conditions. One maze is set up with a solar panel along the bottom, while the other is not. The fruit flies are timed by how long it takes them to reach the food placed at the end of the mazes. Results are analyzed to determine significant differences in navigation between the two groups. The findings hope to contribute to understanding the potential ecological effects of solar panels and aid in developing strategies for mitigating these potential effects on insect populations and ecosystems as a whole. This research also may lay the groundwork for understanding the impact of polarized light on other light-sensitive animals.

Mathejczyk, T., & Wernet, M. (2019). Heading choices of flying Drosophila under changing angles of polarized light.

Horvath, G., et al. (2010). Reducing the maladaptive attractiveness of solar panels to polarotactic insects.

Horvath, G., et al. (2009). Polarized light pollution: a new kind of ecological photopollution. Frontiers in Ecology and the Environment, 7(6)

LCPS RSEF OFFICIAL ABSTRACT - 2024

Analysis of Bird Wing Morphology in Response to Wildfires

Lana Nukta

Birds that migrate travel along four major flyways due to changes in their environment such as lack of food resources and opportunities to find mates. The four major flyways include the Atlantic Flyway, Mississippi Flyway, Central Flyway, and Pacific Flyway. The Pacific Flyway is located in states along the West Coast such as California and Oregon. The Atlantic Flyway is located in states along the East Coast such as Virginia and New Jersey. California experiences more wildfires annually than does Virginia. Due to high numbers of wildfires that occurred in California between 2000-2020, smoke altered the pathways on which birds usually fly causing them to deviate from the Flyway to avoid the fires. This resulted in an increase in migration distances.

Measurements of wing length and hand wing index of ten of the same species located in Virginia and California were compared to determine whether migratory birds traveling away from the wildfires along altered pathways displayed significant differences in wing morphology, such as wing length and hand wing index. Though no statistical difference existed between wing length and hand-wing index, birds located on the Pacific Flyway exhibited higher average wing and hand-wing index measurements. Lack of statistical significance may have been a result of small sample size. It is concluded, however, that climate change may be influencing wing morphology as a result of migration deviation due to fires. Further research would entail the analysis of birds found along the length of both flyways.

Burke, M., Driscoll, A., & Heft-Neal, S. (2021, January 11). The changing risk and burden of wildfire in the United States. PNAS. Available online at: https://www.pnas.org/doi/10.1073/pnas.2011048118

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Overton CT, Lorenz AA, James EP, Ahmadov R, Eadie JM, Mcduie F, Petrie MJ, Nicolai CA, Weaver ML, Skalos DA, Skalos SM, Mott AL, Mackell DA, Kennedy A, Matchett EL, Casazza ML. (2021, November 6). Megafires and thick smoke portend big problems for migratory birds. NCBI. Available online at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9286671/

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Beetle speed when pulling different weights.

Aakash Sadu

Bess Beetles (Passalidae) are important decomposers in forest ecosystems. They work to break down dead wood and convert them into nutrients to nurture future life. Bess Beetle excrement
contains converted nutrients. This study is testing the Bess Beetle movement speed when carrying different weights. This subject helps test beetles' physical abilities. They will be timed while moving in a straight line while pulling 25, 50, 75, and 100 grams of mass behind them. The abilities of these species are important because they allow us to understand the survivability of an important species to ecosystems.

Ohde, T., Morita, S., Shigenobu, S., Morita, J., Mizutani, T., Gotoh, H., Zinna, R. A., Nakata, M., Ito, Y., Wada, K., Kitano, Y., Yuzaki, K., Toga, K., Mase, M., Kadota, K., Rushe, J., Lavine, L. C., Emlen, D. J., & Niimi, T. (2018). Rhinoceros beetle horn development reveals deep parallels with dung
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Packard, G. C. (2021). Is Allometric Variation in the Cephalic Horn on Male Rhinoceros Beetles Discontinuously Dimorphic? Evolutionary Biology, 48(2),
233+.https://link.gale.com/apps/doc/A717806434/GPSu=light025&sid=bookmark-GPS&xid=626ebac2

Frolov, A. V., Akhmetova, L. A., & Neita-Moreno, J. C. (2023). Phylogenetic analysis of the Neotropical scarab beetle tribe Aegidiini (Coleoptera, Scarabaeidae, Orphninae) with description of new taxa. ZooKeys, (1), 33+.
https://link.gale.com/apps/doc/A751971765/GPS?u=light025&sid=bookmark-GPS&xid=43dd0840

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Investigation of the Non-Caloric Sweeteners Stevia and Aspartame on the Microbiome Relative to Intestinal Permeability

Summer Schwedes

Inflammation and intestinal permeability are connected with the disruption of the bacterial load from dietary choices. The integrity of the intestinal wall prevents exterior agents from entering the portal circulation and disrupting physiological health. Studies have found that high sugar consumption modifies microbiota diversity and degrades the intestinal barrier resulting in increased inflammation (Arnone et al., 2022; Satokari, 2020; Yu et al., 2023). Sweetener substitutes have enticed consumers as an alternative to sugar and their potential implications on the gastrointestinal system should be investigated. This study focused on the effects of consuming non-caloric sweeteners, stevia and aspartame, on the microbiome diversity of the fly midgut relative to intestinal permeability using a Drosophila melanogaster model. Drosophila were reared on diets containing a non-toxic concentration of either stevia or aspartame or a control diet. Their midguts were dissected after two and four weeks to compare the diversity of the intestinal microbiome relative to time. DNA was extracted from the midguts using a commercial DNA extraction kit and quantified before PCR amplification and sequencing of 16s rDNA. DNA sequences will be uploaded to multiple databases for identification of the microbial species in each sample. While data collection is ongoing, the respective bacterial diversity will be analyzed to measure changes in diversity due to the addition of sweeteners. It is projected that the sweeteners will reduce the diversity, diminishing Drosophila's health. By examining the gastrointestinal system following sweetener consumption, potential negative effects can be identified.

Chandler, J.A., Lang, J.M., Bhatnagar, S., Eisen, J.A., & Kopp, A. (2011). Bacterial communities of diverse Drosophila species: ecological context of a host-microbe model system. PLOS Genetics 7(9): e1002272. https://doi.org/10.1371/journal.pgen.1002272

Lee, H.-Y., Lee, S.-H., Min, K.-J. (2022). The increased abundance of commensal microbes decreases Drosophila melanogaster lifespan through an age-related intestinal barrier dysfunction. Insects, 13 (219), 1-9. https://doi.org/10.3390/insects13020219

Yu, J., Liu, T., Guo, Q., Wang, Z., Chen, Y., & Dong, Y. (2023). Disruption of the intestinal mucosal barrier induced by high fructose and restraint stress is regulated by the intestinal microbiota and microbiota metabolites. Microbiology Spectrum, 11(2), e04698-22. https://doi.org/10.1128/spectrum.04698-22

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LCPS RSEF OFFICIAL ABSTRACT - 2024

An Investigation of Commercial Fragrances on Fruit Fly Health

 Sadie Sheets

The research for this project was conducted for the purpose of determining if store-bought fragrance proves harmful or deadly to fruit flies. I also wanted to create a fragrance that is not harmful to the fruit flies. Fragrance testing strips sprayed with a store-bought fragrance were placed into 3 separate fruit fly containers, 1 strip had 2 sprays, another with 4 sprays, and the final strip had 6 sprays. Three other fruit fly containers were prepared the same way, only the testing strips were sprayed with a different store-bought fragrance. This was also done with another set of 6 containers, except the strips were sprayed with a fragrance that I made myself (half of the containers contained a strip sprayed with a different fragrance that I made), without phthalates. 45% of fruit flies in the containers with store-bought perfume sprayed on the testing strips were dead after 1 week. 10% of fruit flies with self-made fragrance on the testing strips died after 1 week. These two pieces of data show a significant contrast between the effect of a store-bought fragrance and the effect of my self-made fragrance. In conclusion, the results of my experiment support my hypothesis that store-bought perfumes and fragrances have a harmful effect on fruit flies. I was also able to create a fragrance with no phthalates that was less harmful than store bought fragrances.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Does the Type of Music Affect Learning in Drosophila Melanogaster?

Lily DeMartin, Navya Suri

Students always have their headphones in while listening to music. Evaluating the effect of tempo on learning ability could uncover the best music to listen to for optimal learning, and if current choices could be hindering learning. Does the tempo of music affect learning in Drosophila melanogaster? In this experiment, groups of D. melanogaster were placed in three music conditions (no music, fast tempo, slow tempo) and trained to complete a y-maze with a stimulus (banana) and then tested, without the stimulus, to observe learning ability. This process was 23 days long (2 reproductive cycles), training and testing every two to three days. Measurements were obtained by counting the number of D. melanogaster in each side of the Y maze during testing and training. The mean number D. melanogaster that showed successful learning (moved to the correct side of the y-maze during testing) was 3.095% (no music) 11.722% (fast), 8.750% (slow). An ANOVA test was run to compare the learning between groups ($p > 0.05$), indicating that there is no significant difference in learning between the music groups. The null hypothesis was accepted. Some sources of error in this experiment are small bits of food in vial when starving, inconsistent amounts of flies in each group, some outside noise with the control group, and release of flies during transfer. Future research could benefit from lengthening the testing process and increasing the number of trials.

Brouček, J. (2014). Effect of noise on performance, stress, and behaviour of animals. Slovak Journal of Animal Science, 47(2), 111–123. https://office.sjas-journal.org/index.php/sjas/article/view/216/204

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Environmental Enrichments on Memory Retention in Aβ42 Expressing Drosophila melanogaster.

Maggie Tirrell

Dementia is a neurodegenerative disease characterized by cognitive impairments that affect over 24 million humans worldwide. Current treatment plans include medications and counseling, but none cure this disease (Dementia Treatments, n.d.). Environmental enrichments have been proven to have heightened effects on brain activity and observable behavior in invertebrates (Dukas, 2019). Aβ42 Drosophila are used to model dementia in humans. The purpose of this research is to examine the effect of environmental enrichments on learning abilities in Aβ42 Expressing Drosophila melanogaster. Wild type and Aβ42 Drosophila were trained to complete a Y-Maze assay, while exposed to three environments with differing levels of enrichments (dark, colorful, and moving). The learning index was calculated as the number of Drosophila that moved to the correct side minus the number in the incorrect side divided by the total. The mean learning index for wild type was 6.54% (dark), 5.77% (colorful), and 8.80% (moving), and for Aβ42 was 0.0% (dark), 12.5% (colorful), and 0.0% (moving). These results indicate that environmental enrichments had a limited effect on learning improvement in either wild type or Aβ42 Drosophila. Future research would benefit from keeping Drosophila in Y-Maze assay for 24 hours when training and testing to maximize participation.

Dementia treatments. (n.d.). Alzheimer's Society. Retrieved October 25, 2023, from https://www.alzheimers.org.uk/about-dementia/treatments

Dukas, R. (2019, March 9). Environmental enrichment improves mating success in fruit flies. Science direct. Retrieved October 25, 2023, from https://www.sciencedirect.com/science/article/abs/pii/S000334720292261X

Testing Drosophila Olfaction with a Y-maze Assay. (2014, June 12). NCBI. Retrieved February 28, 2024, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4189430/

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Behavioral & Social Sciences (200)

Project No.	Student(s)	Project Title
201X12	Doreen Adatsi	What concentration of collagen is optimal to result in the fastest regeneration in planaria worms and/or flatworms of the class Turbellaria (phylum Platyhelminthes)?
202T12	Lex Chapman, Iris Choi	Boosting the Efficacy of Anxiety-reducing Remedies.
203X12	Saumik Das	The effect of koumine on social interaction and locomotion of a traumatic injury induced Drosophila melanogaster offspring model (mimicking preterm birth effects)
204X12	Zoe DeWitt	The Usage of Hericium erinaceus as a Treatment for Conditioned and Genetic Aggression
205X12	Chinenye Ilodianya	The Effect of Sesamin on Reducing Increased Aggression after Traumatic Brain Injury and Decrease of GABA Function in Drosophila Melanogaster
206X11	Sophia Kifayat	The Effect of Different Colored Environments on Cognitive Activity Using Drosophila melanogaster as a Model Organism
207T12	Soumya Kosoor, Saumya Sharma	The Effects of Valeriana Officianalis, Exogenous Melatonin and Matricaria Chamomilla on Reducing the Effects of Insomnia-Induced Aggression in Drosophila Melanogaster
208X11	Kabilan Prasanna	Mastermind: A Novel Ensemble Model Approach to Detecting Mental Illnesses through Natural Language Processing
209X11	Hajer Romdhani	Analyzing Crime using Criminal Profiling and Crime Mapping
210X12	Will Rose	High Risk Decision Making in Hockey: "Pulling the Goalie" Play Implementation
211X11	Melqui Salamanca	Measuring the Effect of Stress on Regeneration in Planaria
212T12	Natalie Hayman, Camden Stafford	Exploring Consciousness in Physarum Polycephalum: Insights from Decision-Making of Oats Enhanced With Varying Sleeping Agents and its Implications on Understanding of Human Brain
213X12	Namitha Tholasi	Investigating How Behavioral Aspects Are Affected by Different Blue Light Intensities in Drosophila Melanogaster
214T12	Ava Tucker, Grace Tucker	The Effect of Neurological Supplements on Fruit Fly Memory
215T12	Leslie Kim, Christina Zheng	The Effect of Aging on C. elegan Neuroplasticity

Category Student Count: 20

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LCPS RSEF OFFICIAL ABSTRACT - 2024

What concentration of collagen is optimal to result in the fastest regeneration in planaria worms and/or flatworms of the class Turbellaria (phylum Platyhelminthes)?

Doreen Adatsi

The objective of my research project is to develop a way in which I can determine the concentration of collagen that will garner the fastest regeneration in planaria worms. According to Healthline, collagen is an abundant structural protein that is found in animals and is composed of amino acids such as proline, glycine, and hydroxyproline, creating a triple-helix structure. In the human body, collagen provides structural support to tissues, plays important roles in cellular processes (including tissue repair), and can be found in skin, connective tissue, and tendons (Kubala 2023). My objective for conducting research is to expedite the regenerative properties of planaria worms by exposing the segments of a worm to a collagen solution of varying concentrations, intending to repair damaged tissue. My research plan is relevant to the medical field and ultimately holds significance, given that many individuals require organ transplants, following degenerative organ diseases and/or failure. My research can be extrapolated to the healing process of humans who experience said organ diseases and failure. More precisely, by determining the optimal concentration of collagen that allows the planaria worms to regenerate in the fastest manner possible, I will be able to make an assumption regarding the most effective ECM protein peptides for faster liver regeneration in humans. For this particular experiment, I can only make an assumption about liver regeneration in humans, due to the fact that the liver is the only organ in the human body that has regenerative properties (Genome BC).

Britannica, T. Editors of Encyclopaedia (2020, June 1). planarian. Encyclopedia Britannica. https://www.britannica.com/animal/planarian

Cao, Z., Liu, H., Zhao, B., Pang, Q., & Zhang, X. (2020, June 11). Extreme environmental stress-induced biological responses in the Planarian. BioMed research international.
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7305541/

Healthline Media. (n.d.). Collagen: Benefits, side effects, and more. Healthline. https://www.healthline.com/nutrition/collagen

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Boosting the Efficacy of Anxiety-reducing Remedies.

Lex Chapman, Iris Choi

Medicine is used to help people, however, increasing the dose can be lethal to the human body[1]. The reason to increase the dosage of a medicine is to reach for that same effectiveness as it was from the original dosage. The overall design of this experiment is to test the external and internal variables that can enhance the effectiveness of the medicine, specifically on anxiety upon fruit flies. To achieve the anxious behavior, the flies will be disturbed externally by lightly shaking the chamber side to side motion during the time they are active. The factors used are UV light and pineapple concentrate to enhance the effectiveness of chamomile syrup, a natural remedy to treat anxiety as the factors contain serotonin to boost the effect[2].

Overall, UV light had shown a better effect on the chamomile syrup based on the fruit flies's anxious behavior. The flies's behavior had shown to focus more into the center of the chamber in a calm movement, compared to the control group as the flies were on the walls, ceiling, or moved in a frantic movement[3]. Placing graph paper on the side of the chambers will reveal the relationship between the anxious behavior and the effect of the variable.

In future studies, increasing the external and internal variables could enhance the frequency of observations and measurements of activity, including more observations that could've been taken during the day as it will strengthen the overall results and conclusion.

[1] De Vries, Theo, and Harshi Dhingra. "Drug Tolerance: definition, causes and risks." The Diamond Rehab Thailand, 22 February 2023, https://diamondrehabthailand.com/what-is-drug-tolerance/

[2] Mao, Jun J., et al. "Long-term chamomile (Matricaria chamomilla L.) treatment for generalized anxiety disorder: A randomized clinical trial." ScienceDirect, 24 October 2016, https://www.sciencedirect.com/science/article/abs/pii/S094471131630188X

[3] Mohammad, Farhan, et al. "Ancient anxiety pathways influence Drosophila defense behaviors." Current Biology 26.7 (2016): 981-986. ScienceDirect, 4 April 2016, https://www.sciencedirect.com/science/article/pii/S0960982216300847

LCPS RSEF OFFICIAL ABSTRACT - 2024

The effect of koumine on social interaction and locomotion of a traumatic injury induced Drosophila melanogaster offspring model (mimicking preterm birth effects)

Saumik Das

Every year, approximately 15 million infants are born prematurely, leading to birth defects like reduced social interaction and locomotion. Drosophila melanogaster, or fruit flies, are used as a model organism due to behaviors mimicking premature birth defects such as anxiety, agoraphobia and impaired motor ability. Maternal flies subjected to traumatic injury through a High Impact Trauma (HIT) device produce progeny with decreased social interaction and locomotion. Maternal trauma serves as a model for premature birth defects among fly progeny. Social interaction is measured using a social space assay where each fly's nearest neighbor is considered a social space. Smaller distances between flies represent higher social interaction with increased aggregation of flies. Locomotion is measured using a climbing assay, where the progeny flies are tested on their ability to perform negative geotaxis successfully. Gelsemium sempervirens (GS) extract administration improves social interaction levels among fly progeny mimicking preterm birth defects, and increased locomotion levels in the mice model for chronic stress. Koumine is a major chemical compound of Gelsemium sempervirens and the study investigates the chemical as the active ingredient driving the increase in social interaction and locomotion. My hypothesis that administering koumine to maternal flies with traumatic injury improves social interaction and locomotion levels in progeny is supported by the significant differences observed. Fly progeny exhibited increased social interaction and locomotion when koumine was administered at the maternal level. The research provides a pathway for novel drug discovery, employing koumine as a treatment for premature birth defects in neonates.

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Das, S. (2023). The effect of Gelsemium sempervirens extract on social interaction of a traumatic injury induced Drosophila melanogaster offspring model (mimicking preterm birth defects). International Journal Life Sciences, 11(2), 165-171. https://ijlsci.in/ls/index.php/home/article/view/768/503

I/We hereby certify that the above statements are correct and the information provided in the Abstract is the result of one year's research. I/We also attest that the above properly reflects my/our own work (digitally signed).

LCPS RSEF OFFICIAL ABSTRACT - 2024

The Usage of Hericium erinaceus as a Treatment for Conditioned and Genetic Aggression

 Zoe DeWitt

Aggression issues are common throughout human history. The social isolation experienced by many during the COVID-19 pandemic only exacerbated aggressive behaviors. The effect of social isolation on behavior is an example of conditioned aggression, while genetic aggression is inherited, such as with bipolar disorder. Mushrooms have an abundance of untapped potential within the medical field. Many possess properties that can support the treatment of cancer, diabetes, depression, or neurodegenerative diseases. Hericium erinaceus, or Lion's Mane, is one such mushroom. Last year, research was conducted on H. erinaceus' effect on socially isolated Drosophila melanogaster, or fruit flies. The results indicated that H. erinaceus caused a statistically significant decrease in social isolation-induced aggression. In this study, ebony mutants of D. melanogaster were treated with H. erinaceus extract, and their aggression level was quantified. The optimal dose of H. erinaceus was evaluated with a toxicity assay last year, and the efficiency of the extract in decreasing aggressive behaviors will be quantified through an aggression assay, where male flies are fought against each other in an arena. Recorded videos of the fights will then be analyzed and the flies' aggression level will be quantified. A Mann-Whitney test will be used to determine if H. erinaceus extract causes a significant decrease in aggression, and a Kruskal-Wallis test will be used to compare the results from genetic aggression to conditioned aggression. Countering genetic and conditioned aggression through natural remedies may offer a more cost-effective solution compared to pharmaceutical medications, which often have adverse side effects.

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Zadeh, Z. T., Rahmani, S., Alidadi, F., Joushi, S. & Esmaeilpour, K. (2021). Depression, anxiety, and other cognitive consequences of social isolation: drug and non-drug treatments. The International Journal of Clinical Practice, 75. doi:10.1111/ijcp.14949

LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Sesamin on Reducing Increased Aggression after Traumatic Brain Injury and Decrease of GABA Function in Drosophila Melanogaster

Chinenye Ilodianya

Every year 1.5 million Americans suffer from traumatic brain injury (TBI). Aggression, defined as violent behavior towards something or oneself, is a symptom experienced by 11-34% of TBI victims (Rao et al., 2010). Previous research determined that loss of functional GABA activity (the main inhibitory neurotransmitter) increased male-male aggression in Drosophila melanogaster (Yuan et al., 2014). Further, it has been proposed that increased aggression in humans is caused by an imbalance between inhibitory GABA and Glutamate, the main excitatory neurotransmitter (Nordman J.C., 2022). To model aggression after TBI in Drosophila melanogaster, a genetic cross was created in which expression of the GABA-a receptor RDL was reduced using RNAi knockdown. These flies exhibit reduced GABA activity. TBI was induced using a High Impact Trauma (HIT) device and aggression was measured by placing two male flies in an "arena" after a period of isolation with a decapitated female. Sesamin, a lignan found in sesame seeds, has been shown to prevent brain injury caused by increased glutamate in mice (Hsieh et al., 2011). It was hypothesized that sesamin would be effective in reducing aggression after TBI in Drosophila melanogaster with reduced GABA. While data collection is ongoing, preliminary results indicate an increase in aggression after levels of GABA are reduced and TBI is induced. Developing a model for the increase of aggression in Drosophila melanogaster after TBI would allow for simpler testing of treatments for behavioral symptoms of TBI.

Hsieh, P. F., Hou, C. W., Yao, P. W., Wu, S. P., Peng, Y. F., Shen, M. L., Lin, C. H., Chao, Y. Y., Chang, M. H., & Jeng, K. C. (2011). Sesamin ameliorates oxidative stress and mortality in kainic acid-induced status epilepticus by inhibition of MAPK and COX-2 activation. Journal of neuroinflammation, 8, 57. https://doi.org/10.1186/1742-2094-8-57

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Different Colored Environments on Cognitive Activity Using Drosophila melanogaster as a Model Organism

Sophia Kifayat

The connection between colored environments and psychological functioning has been more recently researched in regards to public facilities, such as hospital rooms or rehabilitation centers. The research conducted in this experiment explores what the impact of different colored environments would be on the cognitive and motor activity in Drosophila melanogaster. Testing was done by acclimating five separate groups of Drosophila (10 vials each group, approximately 40 flies in each vial)) to their designated colored environment, which were red, yellow, green, blue, and Baker-Miller pink. A climbing assay and Y-maze exam will be performed on the Drosophila, as well as a close examination on each treatment group for 2 hours in a DAM2 activity monitor. Data will be analyzed by observing which treatment group collectively had the highest rate of motor activity over the course of the three tests, indicating which colored environment fosters high cognitive functioning. Data collection is currently ongoing, however, preliminary observation of the flies in their respective color environments indicate that the flies in a yellow environment are more prone to movement in their vials, while flies in the pink and green environments take more of a dormant stance in their vials.

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Costa, M., Frumento, S., Nese, M., & Predieri, I. (2018). Interior color and psychological functioning in a university residence hall. Frontiers in Psychology, 9, 1580.

Wang, X., Amei, A., De Belle, J. S., & Roberts, S. P. (2018). Environmental effects on Drosophila brain development and learning. Journal of Experimental Biology, 221(1), jeb169375.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effects of Valeriana Officianalis, Exogenous Melatonin and Matricaria Chamomilla on Reducing the Effects of Insomnia-Induced Aggression in Drosophila Melanogaster

Soumya Kosoor, Saumya Sharma

Insomnia is a sleep disorder categorized by consistent difficulty in maintaining or initiating sleep despite adequate sleep opportunities. Sleep disturbances are associated with increased aggression [3]. Since the COVID-19 pandemic, insomnia-induced aggression among healthcare workers rose, negatively impacting their interactions with patients [3]. Exogenous melatonin, Matricaria Chamomilla, and Valeriana Officinalis are sleep aids known to decrease sleep latency and insomnia, no literature is specific to the aggression that appears as a result. This study evaluates whether these sleep aids alleviate insomnia-induced aggression in Drosophila melanogaster. The Drosophila underwent insomnia induced by varying light intervals, while treated with sleep aids [1]. Aggression was measured through aggression-instances in fights [2].

The Dunn post-hoc test was conducted on aggression-instances throughout the fights. No significant difference was found between any groups of data collected (Q < the critical value of 4.773 at $\alpha = 0.05$.) There is no significant impact of sleep aids on insomnia-induced aggression in Drosophila Melanogaster.

Errors in data analysis may be attributed to the limited number of fights. In future research, more fights may lead to higher data accuracy. Since the sleep aids had no significant impact, alternative methods such as pharmaceutical therapies may be beneficial to treating insomnia-induced aggression.

[1] Bushey, D. (n.d.). *Sleep and wakefulness in Drosophila melanogaster*. PubMed. Retrieved October 9, 2023, from https://pubmed.ncbi.nlm.nih.gov/18591491/

[2] Certel, S. (2010). *Scoring and Analyzing Aggression in Drosophila*. Retrieved 10 9, 2023, from https://cshprotocols.cshlp.org/content/2012/3/pdb.prot068130.long

[3] Cybulska, A. M. (2023, January 12). *Factors Associated with Insomnia and Aggression among Healthcare Workers during COVID-19 Pandemic*. NCBI. Retrieved October 9, 2023, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9859312/#sec7-ijerph-20-01433title.

LCPS RSEF OFFICIAL ABSTRACT - 2024

Mastermind: A Novel Ensemble Model Approach to Detecting Mental Illnesses through Natural Language Processing

Kabilan Prasanna

Identifying and diagnosing mental health conditions such as depression, anxiety, and suicidal thoughts is growing in importance, with Natural Language Processing (NLP) emerging as a viable key to do so. This research utilizes publicly available, de-identified textual data from Kaggle, which draws this data from X (formerly Twitter) and Reddit. This research focuses on applying and optimizing the following NLP models for mental illness detection: the Naïve Bayes, Random Forest, XGBoost, and K-Nearest Neighbors classifiers. These models are then integrated into a comprehensive multi-output model, aimed to optimize efficiency. Although the individual models displayed a tendency to overfit, they demonstrated high accuracy and effectiveness in mental health detection, specifically the Random Forest Classifier. The tested multi-output models presented an array of ROC-AUC scores ranging from 0.60 to 0.93, leading to promising results overall. This research underscores the potential of NLP in screening people for mental health analysis and support.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Analyzing Crime using Criminal Profiling and Crime Mapping

 Hajer Romdhani

    Crime rates in DC saw a 36% increase in 2023, along with it being the region's deadliest year in decades. The purpose of this project was to examine the causes and patterns of the spike. This was done by looking at the reported crimes in the Metropolitan Police Department database (1) over the years and mixing the two common techniques of criminal profiling (2) and crime mapping to understand the crime in the area. The main type of crime found in the area contained details of thievery, out of the 34,226 reports, 28,892 of those involved theft that clustered around retail and metro areas (1), along with the persistent spike of disorganized violent crime, leads to the finding of opportunities of crime are high within the region. The criminal profiles vary through the type of crime committed, but a persistent type is organized based offenders when dealing with theft (3). The main issue with the project was the lack of detail within the reports, a key aspect of analyzing crime is having access to the small parts of the scene. So it was difficult to make observations without having to go through a second party. Although data analysis is still ongoing through a predictive model, that will give insight into persistent hot-spots that should be focused on. Further studies could be done to understand the unique environment of DC's criminal reform and its parallel to the spike.

[1] Crime Incidents in 2023, MPDC,

https://opendata.dc.gov/datasets/89561a4f02ba46cca3c42333425d1b87_5/about

[2] Douglas, John E., and Mark Olshaker. Mindhunter. Arrow Books, 2017.

[3] Fox, Bryanna., Interview, "New findings–Burglars have one of four personalities, and they're finally getting caught." PhysOrg, 1 Dec 2017

LCPS RSEF OFFICIAL ABSTRACT - 2024

High Risk Decision Making in Hockey: "Pulling the Goalie" Play Implementation

 Will Rose

In almost every National Hockey League game, the "pulling the goalie" play is implemented to provide an extra man advantage when a team is losing at the end of the game. The goal of the high-risk play is to tie the game by having an extra attacker on the ice at the cost of not having a goalie in the net.

The purpose of this research was to determine whether the years of National Hockey League coaching experience and the win percentage of the coach was correlated with the number of goals scored when this play was implemented. In addition, whether the experience of the coach played into the psychology of this decision was also investigated. Analysis of National Hockey League games where the play was implemented, the win percentage of the coach when that game was played, the years of NHL coaching experience, and the goals scored when the play were tracked.

Statistical analysis via Pearson correlation tests indicates that although there was not a significantly strong correlation between the win percentage and goals scored when the play was implemented, there was a small positive correlation between win percentage and the goals scored when the play was implemented. This may be due to the coach's increase of high-stress decision making by the coach throughout the years of coaching. Therefore, the coaches with higher years of National Hockey League coaching experience are more likely to score more goals when implementing the play than coaches with less experience.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Measuring the Effect of Stress on Regeneration in Planaria

Melqui Salamanca

The immune system and the endocrine have been shown to have a role in wound healing, which allow psychological factors to have a role in the healing of some chronic wounds (Cole-King & Harding, 2001). This research investigated how stress affects wound healing as it could have a part in basic human injuries and illnesses. Planaria (Dugesia dorotocephala) were chosen as they have extraordinary regenerative capabilities and show negative phototaxis. This experiment was conducted by setting up a light environment, dark environment, and light & dark environment to simulate the light/dark box test in rodents, in which the light environment would induce stress (Zewde et al., 2018). Planarians were incised, giving a head, body, and tail amputation. Over the span of two weeks, the amputated pieces were observed and recorded to take part in regeneration. Finally, at the end of the two weeks, the planaria were measured and the number of blastema was compared between groups. The one-way ANOVA test was run and showed $p > 0.05$. Although there was less blastema formation in the light environment with average means of 11.5 (dark), 10 (light), 7.5 (light/dark), the difference was not significant and shows that the light had little impact on regeneration. This was likely caused as a result of planaria adapting to the light environment rapidly. Further research can be expanded upon by inducing stress to planaria with the assistance of drugs such as benzodiazepine inverse agonists.

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Zewde, A. M., Yu, F., Nayak, S., Tallarida, C., Reitz, A. B., Kirby, L. G., & Rawls, S. M. (2018). PLDT (Planarian Light/dark test): An invertebrate assay to quantify defensive responding and study anxiety-like effects. Journal of Neuroscience Methods, 293, 284–288. https://doi.org/10.1016/j.jneumeth.2017.10.010

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Exploring Consciousness in Physarum Polycephalum: Insights from Decision-Making of Oats Enhanced With Varying Sleeping Agents and its Implications on Understanding of Human Brain

Natalie Hayman, Camden Stafford

This scientific report explores the emerging field of fungal neurochemical signaling and its relevance to fungal consciousness. As a result of our research, we will be able to connect our findings to the current universal understanding of the human brain in hopes of finding connections between fungal and human consciousness. Fungi, traditionally studied within the context of mycology, are increasingly recognized for their ability to mimic neural behavior in humans. This investigation delves into the current state of knowledge regarding fungal behavior and its implications for neuroscientific research. Fungi have long been considered passive organisms that grow and adapt to their environment without any apparent behavioral complexity. However, recent research has challenged this view. (Bayram, 2023) Fungi exhibit wide ranges of behaviors. Such behaviors are enabled by fungal sensory and communication systems that involve chemical signaling. The human brain operates very similarly, in this regard. Fungal neurochemical compounds often share structural similarities with human neurotransmitters. Understanding the mechanisms of both organisms in respect to their consciousness is an area of active research. (Jacob 2022) Making the study of fungi's neurochemical signaling an impressive step to increasing our knowledge of the human brain. For our research in particular, we will be studying similarities between hypha and neurons. With the ability to compare fungi branching towards regular oats (control) and/or fungi branching towards oats altered with varying sleeping agents (independent variable), we will be able to discover the connection between hypha and neurons in order to make predictions in neural behavior.

Bayram, Ö. S., & Bayram, Ö. (2023). An Anatomy of Fungal Eye: Fungal Photoreceptors and Signaling Mechanisms. Journal of Fungi, 9(5), 591. https://doi.org/10.3390/jof9050591

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Oier Etxebeste, Eduardo A. Espeso, Neurons show the path: tip-to-nucleus communication in filamentous fungal development and pathogenesis, FEMS Microbiology Reviews, Volume 40, Issue 5, September 2016, Pages 610–624, https://doi.org/10.1093/femsre/fuw021

LCPS RSEF OFFICIAL ABSTRACT - 2024

Investigating How Behavioral Aspects Are Affected by Different Blue Light Intensities in Drosophila Melanogaster

Namitha Tholasi

Blue light has harmful effects on our circadian rhythm. The circadian rhythm in our body is our 24 hour internal body clock that regulates our alertness and sleepiness in response to light changing in our environment. Blue light can help increase alertness during the day, because it signals our body to be awake. However, prolonged blue light exposure can reduce the production of melatonin in our body. Fruit Flies were exposed to different intensity levels of blue light for several day, The fruit flies had a noticeable effect in their behavior (data still being analyzed).

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Neurological Supplements on Fruit Fly Memory

Ava Tucker, Grace Tucker

This experiment tests the effects of two non FDA approved neurological supplements (Ginkgo Biloba and Brahmi) that claim clinical studies support the effectiveness of their product. The FDA is responsible for reviewing the safety and functionality of supplements in the United States. They prove the validity of the product through factors such as, clarity or relevance, response range, variability, reproducibility, inter-item correlation, ability to detect change, item discrimination, redundancy, and recall period(Garcia-Arranz, 2021). This is what makes them a trustworthy government regulatory agency. Dietary supplement advertising cannot claim a relationship between their product and a treatment, or cure of a disease without seeking a health claim approval from the FDA. However, it is possible for marketers to make structure-function claims(S-F) without FDA approval. They do this through linking their product to a certain outcome using language like "promotes" and "may help"(Avery, 2017).

Our experiment will focus on products not FDA approved that still claim results based on clinical studies. We want to see if the claims these supplements are making can be backed up through self conducted scientific research. We used fruit flies to determine the effectiveness of ginkgo biloba and brahmi. We used a Y-maze and recorded how many flies followed the path with the food before and after ingesting the supplements. After collecting all of our data we used a t-test to determine if the supplements had a significant effect.

Bouzembrak, Y., Cylus, J., Czepielewska, E., Czinkota, M., Kowalska, A., Manning, L., Marvin, H. J. P., Prandi, B., Premanandh, J., Ruth, S. M. van, Spink, J., Zhang, W., Abels, G., Aczel, A. D., … 432/2012, E. (2019, October 4). Food supplements' non-conformity in Europe – Poland: A case study. Trends in Food Science & Technology. https://www.sciencedirect.com/science/article/pii/S0924224419305229

Center for Drug Evaluation and Research. (n.d.). Patient-reported outcome measures: Use in medical product development. U.S. Food and Drug Administration. https://www.fda.gov/regulatory-information/search-fda-guidance-documents/patient-reported-outcome-measures-use-medical-product-development-support-labeling-claims

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Aging on C. elegan Neuroplasticity

Leslie Kim, Christina Zheng

This study explores the impact of aging on neuroplasticity using *Caenorhabditis elegans* as a model organism. The purpose is to understand how progressive aging affects cognitive functions, such as memory and learning. The independent variable is life stages/aging, with young *C. elegans* as the control group and aging *C. elegans* as the experimental group. The dependent variable is neuroplasticity, measured by the proportion of worms on each side of the plate after exposure to chemical stimuli (cayenne pepper) in a chemotaxis assay. The procedure involves culturing *C. elegans*, conducting chemotaxis assays at different time points, and analyzing the data collected. Findings reveal a gradual decrease in neuroplasticity in older *C. elegans* compared to younger counterparts. At 5, 10, and 18 days, the mean proportion of worms on the non-cayenne pepper side (0.737874, 0.698735, 0.564813 respectively) decreases, indicating a decline in neuroplasticity with age. The ANOVA test results confirmed these findings, as the f-ratio value is 312.9346, suggesting significant differences between the proportions observed at various ages. The alternative hypothesis, stating that aging processes affect neuroplasticity in *C. elegans* by decreasing the speed of cognitive functions, is supported by the data. These results underscore the importance of understanding age-related changes in neuroplasticity to develop interventions for cognitive decline in aging individuals. Future studies could investigate potential interventions to enhance cognitive functions in aging organisms. Additionally, examining the effects of different environmental factors on neuroplasticity in aging *C. elegans* could provide further insights into strategies for promoting healthy aging.

Bozorgmehr, T., Ardiel, E. L., McEwan, A. H., & Rankin, C. H. (2013). Mechanisms of plasticity in a *Caenorhabditis elegans* mechanosensory circuit. *Frontiers in Physiology.* https://www.frontiersin.org/articles/10.3389/fphys.2013.00088/full

Li, Q. (2020, November 24). High neural activity accelerates the decline of cognitive plasticity with age in Caenorhabditis elegans. *ELife*. https://elifesciences.org/articles/59711

Stiernagle, T. (2006). Maintenance of C. elegans. WormBook: The Online Review of *C. elegans* Biology. https://www.ncbi.nlm.nih.gov/books/NBK19649/

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Biochemistry (300) and Chemistry (700)

Project No.	Student(s)	Project Title
1002X11	Prakruti Srikanth	Comparing the Efficacy of Benzoyl Peroxide and Ayurvedic Treatments on Staphylococcus epidermidis
301X12	Brian Austin-Handy	The Effect of Sand on Peptide Bond Catalysis
302T12	Sai Ashutosh Chellarapu, Eswar Pondugula	The Effect of Autoinducer Analogs on the Quorum Sensing Systems of S. epidermidis RP62A
303T12	Miriam Frank, Jahnavi Guddeti	How pH Impacts the Antimicrobial Properties of Eucalyptus globulus Oil
304X11	Reyhan Haider	A Comprehensive LC-MS Metabolomics Approach Identifies a Novel Biomarker Panel Using An apoE4 Mouse Model of Alzheimer's Disease
305X12	Katelyn Simancik	Medication of Yeast to Isolate and Predict Increase of GABA Amounts
701X12	Leen Alawneh	Extraction and Characterization of silica dioxide from Musa acuminata (bananas) via Acid Leaching Method
702X12	Emmy Andberg	The efficiency of filtering Gamma Hydroxybutyric Acid out of alcohol and, as an extension, can a self-filtering straw be created? (aka Project Safe-Sip)
703X12	Lilliana Cocklin	Filtering estrogen in water using a hydrophobic interaction chromatography column
704X12	Charlotte Hannis	Palatable or Population Control: Determination of Inorganic Phosphate (Pi) in LCPS School Lunch Products Through the Use of Thin-Layer Chromatography (TLC)
705X12	Edwin Kyle	Development of a Novel Method for the Retrieval of Precious Metals from Waste Nanoparticle Solutions
706T12	Alex Crabb, Jake Ludwig	What is the best way to efficiently distill seawater
707T12	Sahasra Kakarlapudi, Aadarsini Murugan Ayyappan	The Effect of Chemical Precipitation on Lithium-Ion Battery Runoff Polluted Lake Water
708X12	Soham Sinha	Creation and Implementation of a Semi-Organic Ferrofluid Colloid as an Advancement to Drug Delivery Procedures

Category Student Count: 18

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Comparing the Efficacy of Benzoyl Peroxide and Ayurvedic Treatments on Staphylococcus epidermidis

Prakruti Srikanth

Acne is a common skin condition that affects many teenagers. It can be caused by inflamed pores clogged with acne causing bacteria. One such bacterium is Staphylococcus epidermidis. An acne treatment that specifically targets bacteria is benzoyl peroxide. Benzoyl peroxide can show up to a 99% reduction in acne-causing bacteria [1]. Various ayurvedic treatments have been shown to inhibit the growth of acne-causing bacteria. Azadirachta indica was one such ingredient, and was effective on Propionibacterium acnes and other acne causing bacterium [2]. Both benzoyl peroxide and Azadirachta indica target and break apart the biofilms that acne-causing bacteria protect themselves with. Benzoyl peroxide does this through reactive oxygen species, while Azadirachta indica does this through quorum sensing inhibition.

This project aims to compare the effects of Azadirachta indica and benzoyl peroxide on Staphylococcus epidermidis. This will be done by measuring the zones of inhibition when each treatment is applied. Both zones of inhibition will be compared using 2SEMs, t-tests, and other statistical tests. Data collection and analysis is still in progress, however, based on prior studies, it is hypothesized that Azadirachta indica will inhibit the growth of acne causing bacteria. Acne can result in severe mental health issues. It has been shown to have the same psychological impact as diabetes, cancer, and epilepsy [3]. This emphasizes why this study and further studies could be useful, as they could potentially open an option of an inexpensive yet effective acne treatment that is easily accessible.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Sand on Peptide Bond Catalysis

 Brian Austin-Handy

This experiment investigated whether the presence of sand in clay would increase its capacity to catalyze peptide bonds through wet-dry cycling. Wet-dry cycling on a clay surface provides a promising theory as to the prebiotic catalysis of peptide bonds. Previous studies have shown that the adsorption of amino acids onto a clay surface does show a catalytic effect on the formation of peptide bonds. Additionally, it has been shown that interactions between aqueous amino acids and silica (SO_2) lattices can reduce the activation energy of the formation of peptide bonds. Because sand is almost entirely silica, it was hypothesized that the incorporation of sand into clay a loam mixture would increase the catalytic effect of the sand on the formation of peptide bonds. In theory, while adsorbed onto the clay, the amino acids will be able to interact with the sand crystals, allowing the activation energy of the bond to be lowered. The hypothesis was tested by wet-dry cycling a standardized amino acid solution on clay with wt% of sand ranging from 0% to 25%, for five 8 hour cycles. The trials were run at 80☐ under UV light to simulate early Earth conditions. The results show a diminishing increase in absorbance as wt% sand increases, with an ideal wt% sand being 37.15%. Between the 0 wt% control group and the 25 wt% trial, the final concentration of peptide bonds increased by 300.9%. These findings provide insight into a plausible mechanism for the prebiotic formation of oligopeptides. Possible sources of error include not replicating the solute composition of early Earth oceans, only running trials using glycine to model all amino acids, and not testing data points past the predicted maximum.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Autoinducer Analogs on the Quorum Sensing Systems of S. epidermidis RP62A

Sai Ashutosh Chellarapu, Eswar Pondugula

Virulent E. coli in clinic settings causes UTIs, meningitis, among others. Novel drugs to combat these bacteria are developed, but inevitably a resistant strain will arise. A non-antibiotic approach using autoinducer analogs (AIAs) was taken to inhibit the biofilms of E. coli K12 and S. epidermidis RP62A. The effects of the AIAs N-Acetylglucosamine and S-(5′-Adenosyl)-L-homocysteine on the LuxI/LuxR and LuxS quorum sensing systems of E. coli K12 were studied to determine which quorum sensing system of E. coli K12 is most susceptible to inhibition in addition to AIAs L-Glutamate Oxidase from Streptomyces sp. recombinant, expressed in E. coli and Dextromethorphan hydrobromide on the AgrB and AgrC quorum sensing systems of S. epidermidis RP62A to determine which quorum sensing system of S. epidermidis RP62A is most susceptible to inhibition.
This experiment measured the reduction of biofilm formation of E. coli K12 and S. epidermidis RP62A using AIAs on the strains' quorum sensing systems: LuxI/LuxR and LuxS for E. coli and AgrB and AgrC for S. epidermidis RP62A. E. coli K12 and S. epidermidis RP62A each had a 10-sample control groups along with a 10-sample AIA group for each AIA. Using a microscope, the biofilms were recorded and averaged for the control groups and AIA groups for E. coli K12 and S. epidermidis RP62A. The AIA group with the greatest biofilm inhibition relative to the control group indicated the quorum sensing system of E. coli K12 and S. epidermidis RP62A most susceptible to inhibition.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

How pH Impacts the Antimicrobial Properties of Eucalyptus globulus Oil

Miriam Frank, Jahnavi Guddeti

Eucalyptus globulus (eucalyptus) has historically been used in numerous cultures' homeopathic medicine systems. Recently, studies incorporating E. globulus illustrate its anti-inflammatory, antioxidant, and antimicrobial properties. This experiment aims to determine the optimal pH at which E. globulus oil best inhibits Escherichia coli and Staphylococcus epidermidis growth. This could reveal information about the oil's administration to treat bacterial infection with respect to pH, an area with scarce research. To test this, the pH levels of agar in petri dishes were altered to 4.06, 5.7, 6.87, and 8.9. Antibiotic disks were coated with E. globulus oil, ampicillin, or water, and two of each were placed on each plate. After 24 and 48 hours, the zones of inhibition of bacterial growth surrounding the disks were measured, with large zones indicating the greatest inhibitory power. In the experiment, the largest zones of inhibition created by the E. globulus oil were found on the pH 5.7 plate with E. coli, averaging 9.17 millimeters. This could indicate that a slightly acidic pH is ideal for the pharmaceutical administration of this oil. The zones were unreadable on the 4.06 and 8.9 plates because of the limited bacterial growth. Because of some inconsistency, the swabbing for the E. coli plates could be a source of error. Further research is needed to corroborate these findings and examine the inhibitory function of E. globulus for different conditions that affect administration. This research provides a step toward blending natural products with traditional medicine.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

A Comprehensive LC-MS Metabolomics Approach Identifies a Novel Biomarker Panel Using An apoE4 Mouse Model of Alzheimer's Disease

Reyhan Haider

APOE is a mediator of brain lipid metabolism and allele APOE4 is the strongest genetic risk factor for Alzheimer's disease, accounting for over 65% of patients. Two-copies of the allele increase the likelihood of developing the disease up to 15-fold. However, the effects of APOE4 on the human brain are not fully understood, limiting opportunities to develop preventative therapeutics for carriers. To gain better insights on the molecular impact of APOE4 over time, untargeted metabolomic and lipidomic profiling of cerebellum tissue samples from both E3 and E4 mice was conducted at 6, 12, 18, and 21 months, using both males and females. Results are ongoing and will identify systemic molecular differences across time points as well as between genotype and sex. Pathway enrichment will further elucidate the specific origin of these metabolites/lipids.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Medication of Yeast to Isolate and Predict Increase of GABA Amounts

Katelyn Simancik

Studies have shown that a decreased level of the amino acid GABA within humans leads to signs of autism in humans. Medications such as valproate, acamprostae, and arbaclofen are proven to decrease the severity of autism in humans, this is due to their ability to increase the synthesis of GABA with the human brain. Simple supplements have also proven to increase the synthesis of GABA such as magnesium and zinc. So testing these supplements on less advanced organisms such as yeast or fungi will be able to show and isolate the direct link between increased amounts of GABA to improved severity of autism. This is done by testing the absorbance using a spectrophotometer to measure the absorbance of groups with supplements and without. Following this procedure yeast groups containing magnesium were found to have increased levels of GABA compared to the control, however the zinc group came inconclusive. This link between simple supplements and advanced medications can be later used in studies of autism to later improve and reduce the severity of autism.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Extraction and Characterization of silica dioxide from Musa acuminata (bananas) via Acid Leaching Method

 Leen Alawneh

With the influx of industries and consumerism, the demand for silica is high, making silica the second most consumed raw material in the world. Due to increasing demand, shortages of silica are common. Silica is needed for the production of: glass, ceramics, bricks, cement, and artificial stone. All these materials are imperative for industry use and construction. The need for alternative sources of silica is imperative.

The purpose of this research was to determine if silica could be extracted from bananas as an alternative source. The method of extraction employed was acid leaching. Bananas were burned, ground, and treated with citric acid. This solution was stirred for 90 minutes, distilled, and dried. Presence of silica was determined via stereomicroscopy.

When the dried banana ash samples were observed under the microscope, crystalline particles were scattered amongst the ash. When compared, the small particles within the banana ash possessed similar properties in color and shape to that of crystalline samples. Hence, similarities in physical properties confirmed that silica was extracted from bananas. Further research would entail the development of a purifying process that would totally remove the silica from the ash in the hopes that this could be an alternative source of silica for multiple uses.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The efficiency of filtering Gamma Hydroxybutyric Acid out of alcohol and, as an extension, can a self-filtering straw be created? (aka Project Safe-Sip)

Emmy Andberg

Gamma Hydroxybutric Acid (GHB), orignially designed to treat the cataplexy aspect of narcolepsy, has, along with its analogs, been misused as a date rape drug throughout all of recent history. Due to its molecular size and structure, the filtration of GHB through activated charcoal is not always successful. The aim of this experiment is to find a pore size of activated charcoal that can perform as intended and filter out all of the GHB present in alcohol. This activated charcoal will then be implemented into a 3d printed straw, and used to filter GHB, and hopefully other date rape drugs, out of alcohol.

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"What Is GHB?" Partnership to End Addiction, drugfree.org/drugs/what-is-ghb/#:~:text=GHB%20(Gamma%20hydroxybutyrate)%20is%20predominantly. Accessed 1 Dec. 2023.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Filtering estrogen in water using a hydrophobic interaction chromatography column

Lilliana Cocklin

Synthetic estrogen compounds that can be found in various chemicals, pharmaceuticals, and other industrial products that can become pollutants in water can have many negative effects on the survival and reproduction of marine species. An alternative method for filtering estrogen besides the currently used activated charcoal filters is hydrophobic interaction chromatography, a method that reduces water waste generated. Ethinyl estradiol, a type of synthetic estrogen, will be diluted in water at various levels and each level will be run through a hydrophobic interaction chromatography column. The YES strain of yeast with a receptor for estrogen will be grown and used to measure the level of estrogen still present in the water, after adding a dye that changed colors depending on the amount of estrogen in the water. The data for this experiment is still being collected, but upon collection, the results will be analyzed.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Palatable or Population Control: Determination of Inorganic Phosphate (Pi) in LCPS School Lunch Products Through the Use of Thin-Layer Chromatography (TLC)

Charlotte Hannis

Inorganic phosphate (Pi) is a dietary additive appearing in the form of salt additives or polyphosphates in food products. Pi is highly bioavailable, a function which may result in alteration of essential cellular functions and pathways, resulting in the development of deleterious health conditions including tumorigenesis, diabetes, and obesity, among others. However, the FDA has no regulations regarding nutrition facts labeling. This is especially significant when considering school lunch foods, received by 29.9 million children each year. The project goals for assessing the commonality of Pi in the school lunch are twofold: experimentally verify the presence of Pi in meat products by use of thin-layer chromatography (TLC) and find the percentage of foods containing Pi through the LCPS food catalog. After chromatographic analysis, R_f values were calculated and compared to the expected ranges. A one-way t-test was performed and both meat types were found to have $p > 0.05$ for both orthophosphate (R_f 0.70-0.80) and pyrophosphate (R_f 0.35-0.50). Although it is possible for other polyphosphates to be contained in these products, the reliance on consistency across all chromatograms resulted in the verification of only these two types. With so many children reliant on school lunch for nutrition, it is essential that the ingredients contained in the foods provided be of the utmost quality in order to maintain the health and welfare of the developing generation.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Development of a Novel Method for the Retrieval of Precious Metals from Waste Nanoparticle Solutions

Edwin Kyle

The popularity of research involving nanoparticles has increased in the last few years significantly. Nanoparticles have a wide variety of applications due to their unique physical properties, with uses in electronic conduction, catalysis, bio-imaging, biosensing, and drug delivery (Khan et al., 2022). Precious metal nanoparticles are most commonly composed of pure silver, gold, and platinum. As these become more commonly used, large volumes of nanoparticles will be discarded, especially in biological applications. Currently, the literature lacks documentation on the processing of discarded nanoparticle solutions. Such suspensions with mixed-species composition cannot be disposed of in a traditional manner, as silver nanoparticles are known to be toxic to mammals (Asharani et al., 2010). Large volumes of nanoparticles are also valuable; as such, the metals present should be recycled for repeated use.

To address these issues, a method for the retrieval of precious metals from mixed-species waste nanoparticle solutions is proposed. Au, Ag, and Pt nanoparticles were synthesized and characterized with scanning electron microscopy and UV-Vis spectroscopy. The nanoparticles were combined to simulate a waste solution of unknown composition. Each metal was then selectively retrieved via dissolution and precipitation. Percent yields for the pure metals obtained demonstrate the efficiency of the process. Commonly available equipment and reagents were employed without the need for surfactants or centrifugation, making the process viable on a large scale. Future research would determine the effectiveness of this method for nanoparticles species composed of multiple metals, such as Au-Ag and Au-Pt nanoparticles.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

What is the best way to efficiently distill seawater

Alex Crabb, Jake Ludwig

Currently in the United States, there is no shortage of fresh drinking water. However, in a study done by Harvard University, nearly half of the 204 sources for fresh drinking water will not be able to produce a sufficient amount of water by 2071. Our purpose for this experiment will be to find a way to most efficiently produce sufficient drinking water. We will be attempting to use multiple different methods to distill our water using a distillation kit. Our first way will be with a bunsen burner, followed by a hot plate, and finally we will attempt to use a mirror and sunlight. We are still gathering our findings and cannot come up with a conclusion as of right now.
Sources:
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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Chemical Precipitation on Lithium-Ion Battery Runoff Polluted Lake Water

Sahasra Kakarlapudi, Aadarsini Murugan Ayyappan

Electric cars are becoming increasingly popular; however, they aren't as eco-friendly as one would think. Electric cars are powered by lithium-ion batteries which are also used in many everyday electronic appliances. Unfortunately, there isn't an eco-friendly way of disposing of these batteries and as a result many of the toxins from lithium-ion batteries leech into bodies of water as runoff. Though it is important to actively try to stop the problem at the root, it is also important to clean up the damage already done. Our goal is to find ways to clean these toxins from the bodies of water. In order to do this, we are using a process called chemical precipitation which is commonly used to clean polluted water. We are using chemical precipitation with two different chemical compounds to see which is most effective at removing the toxins from the water that we treated with nickel, cobalt, and lithium. The pre-treated lake water has a pH of 7.5 and an alkalinity of 720. The treated water has a pH of 6.5 and an alkalinity of 120. The sodium hydroxide testing group yielded a pH of 6.5 and an alkalinity of 180. The sodium carbonate test group yielded a pH of 8.5 and an alkalinity of 720. We are still in the process of gathering more data, but with the information gathered, we believe that sodium carbonate will be able to more effectively clean the toxins through chemical precipitation.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Creation and Implementation of a Semi-Organic Ferrofluid Colloid as an Advancement to Drug Delivery Procedures

 Soham Sinha

From 2010 to 2017, clinical trial analyses identified key factors contributing to the 90% clinical failure rate in drug development, with a lack of clinical efficacy between 40 and 50%, unmanageable toxicity at 30%, poor drug-like properties between 10 and 15%, and commercial needs/strategic planning issues at 10% as primary causes (Mittal, 2021). This research focuses on the imperative for drug delivery innovation by creating a biocompatible ferrofluid to enhance precision and efficacy in drug administration. The feasibility of ferrofluids for targeted drug delivery was tested by incorporating magnetic properties, aiming to overcome limitations of conventional methods. Optimization of ferrofluid stability and rheology involves experimenting with iron salts, surfactants, and carrier liquids to ensure applicability in medicine. Initial findings demonstrate the stability of the created ferrofluid under magnetic fields, showcasing potential for targeted drug delivery. Polyethylene glycol was successfully used as a coating for magnetic nanoparticles, validating the intended functionality. Future research aims to refine the ferrofluid composition and to conduct physical trials with a prosthetic to determine the efficacy of the solution in a simulated environment. By employing a multidisciplinary approach integrating materials science, chemistry, and engineering, this project has developed a biocompatible ferrofluid with enhanced durability and rheology by being more dynamic than conventional ferrofluid as well as more reactive. The research concludes that the biocompatible ferrofluid holds transformative potential for drug delivery technology, offering both stability and precision. Next steps include optimizing rheological capabilities through further experimentation, paving the way for practical application in medical practice.

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Biomedical & Health Sciences (400)

Project No.	Student(s)	Project Title
401T12	Omar Abushaban, Tanush Kattamuri	The Impact of Diet Composition on Performance and Climbing Speed in Drosophila Melanogaster
402X11	Anoushka Aggarwal	A Comparison of the Protective Capability of Withania somnifera and Acetylsalicylic Acid on Stress using Daphnia magna as a Model Organism
403T12	Hazim Amireh, Jason Arria	The Effects of Osteonectin on Muscular Hypertrophy Using Drosophila Melanogaster as a Model Organism
404T11	Siri Amperayani, Norah Thomas	The Effect of Artificial and Natural Serotonin on Drosophila Hydei's Ability to Survive in Stressful Environments
405T12	Mckenna Appelt, Lexi Nijkamp	The Effect of Heteractis crispa Venom on the Degradation of Drosophila melanogaster Neurons Modeling Parkinson's Disease.
406X12	Omar Ashraf	The Effects of Loud Music on Cochlear Hair Cells, and its Sensorineural Hearing Loss Implications
407X11	Nishitha Balisetty	Exploring the Effect of Caffeine on Teen Sleep and Physiology using Fruit Flies
408X11	Nishka Bhikha	Cross reactive allergenic effect of Prunus dulcis on Blaptica dubia infected with Schistosoma mansoni
409T12	Pranav Babu, Rushil Challa	The Effects of p-Coumaric Acid on α-Synuclein Aggregate Concentrations in Drosophila Melanogaster with Parkinson's Disease
410X12	Ruthie Dickersheid	The Effect of Different Sleep Agents on the Development of Dementia/Symptoms of Dementia
411T11	Alexandra Ganey, Blaine Wooley	The Effect of Home Remedies on Drosophila Melanogaster Infected With Alzheimer's Disease
412X12	Daniel Garcia-Soliz	Proposing R195 Drosophila melanogaster as a new model for further research in the mutant IDH
413T12	Rishika Goli, Layan Nasef	The Effect of Additives on Glutamate Production in Helix aspersa
414X12	Parv Jani	Assessing Efficacy of Gene Therapy Interventions for Sickle Cell Disease: A Secondary Comparative Analysis
415X12	Maira Khan	Comparative Analysis of Natural Substances on Earthworm Regeneration: An Experimental Study
416X11	Madison Kim	The Effect of Infrared Light on GAL4-UAS Drosophila melanogaster Expressing Human APP
417T11	Jessica Knowlden, Hiba Sharhan	The Effect of Senna extract on the body's ability to regulate blood suga
418X12	Kiley McGee	Bacillus subtilis as a Potential Probiotic Treatment for alpha-Gal Syndrome
419X10	Anishreddy Mummadi	Investigating the Potential Implications of Periplaneta americana as a Cost-Efficient Peanut Allergy Model
420X12	Aarya Paranjpe	The Effect of New Generation Pesticides on Memory and Social Behavior in Drosophila melanogaster as a Model Organism
421X12	Sai Ravva	Examining how the transcription factors, Nurr-1 and ATF4, affect the expression of the dopamine D2 receptor in the kidney.
422T11	Selina Shah, Shivani Sukumar	The Effect of Ginseng on Alzheimer's Disease
423X12	Sanjana Sharvirala	The Web of Diet and Nephrolithiasis: A Laboratory Investigation
424X12	Gabrielle Shelton	The Effects of Different Concentrations of Lidocaine on Spinal Epidural Hematomas Using Periplaneta americana as a Model Organism
425X12	Arsh Singh	Comparison of Omega 6 and Omega 3 Fatty Acids on Human Embryonic Development using Drosophila melanogaster as a Model Organism

Project No.	Student(s)	Project Title
426X12	Isabel Smith	The Impact of Food Insecurity and Malnutrition on Fertility Rates in Drosophila melanogaster
427X11	Seunfunmi Soyannwo	The Effect of Medicinal Herbs on Wolbachia pipientis in Preventing Mosquito Reproduction Using Drosophila melanogaster as a Model Organism
428X12	Raina Tandon	The Effect of Magnesium on Tachycardic Daphnia Exposed to Dopamine
429X12	Olivia Teng	Development of a Bioactive Gel to Inhibit Dental Plaque Formation of Streptococcus Mutans via Quorum Sensing
430X12	An Tran	The Effect of Snail Slime on Staphylococcus epidermidis to Determine Antimicrobial Properties against Acne
431X12	Nimisha Vadlamudi	Exploring the Effects of L-theanine on Teen Sleep and Physiology using Fruit Flies
432X12	Katherine Valentini	The Effect of Amyloid Beta Protein on Cognition in Drosophila melanogaster Following Traumatic Brain Injury
433T12	Olivia McMahon, Mariah Waters	The Effect of Menstrual Cycle Phase on the Blood Lactate Threshold of Eumenorrheic Women during High Intensity Aerobic Exercise: A Meta-Analysis

Category Student Count: 43

LCPS RSEF OFFICIAL ABSTRACT - 2024

The Impact of Diet Composition on Performance and Climbing Speed in Drosophila Melanogaster

Omar Abushaban, Tanush Kattamuri

This research investigates the impact of different dietary components on the climbing abilities of Drosophila melanogaster fruit flies using a climbing assay, specifically looking into diet factors and how it can help performance. It is known that diet affects behavior[2] in Drosophila. Climbing ability will be measured using a climbing assay [1]. We will not only look at the effect initially, but over a 3 day period. Multiple groups, containing around 20 flies each, will be fed specific nutrient-enriched diets, and their climbing performance will be measured over 3 days. The flies will be tested at 9 AM and at 5 PM and then recorded.

The group which was fed sugar had the fastest average climbing performance during the first morning test. Table sugar breaks down quickly in the body by enzymes like sucrase, releasing glucose into the bloodstream. Glucose enters the glycolytic pathway, generating ATP. This explains the sugar group initially performing well due to readily available energy, fueling muscle contractions during climbing. This contrasts with the protein-based diet group, which performed the best throughout the three days, highlighting the sustained energy provided by proteins for muscle function and growth. Statistical analysis is still in progress.

This study's insights into the influence of diet on performance in Drosophila create a foundation for future research with real-world applications for human health. However, further investigations into metabolic similarities and differences between flies and humans are needed. The findings have the potential to improve overall exercise and athletic outcomes.

1. Manjila, S. B., & Hasan, G. (2018, March 5). Flight and climbing assay for assessing motor functions in drosophila. Bio-protocol. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8203865/

2. Edmunds, D., Wigby, S., & Perry, J. C. (2021, July 22). A resource-poor developmental diet reduces adult aggression in male drosophila melanogaster - behavioral ecology and sociobiology. SpringerLink. https://link.springer.com/article/10.1007/s00265-021-03050-z

3. Miller, M S, and T S Keller. (1999, July 6). Measuring Drosophila (fruit fly) activity during microgravity exposure. Journal of gravitational physiology : a journal of the International Society for Gravitational Physiology vol. 6,1 (1999): P99-100. https://pubmed.ncbi.nlm.nih.gov/11543046/

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LCPS RSEF OFFICIAL ABSTRACT - 2024

A Comparison of the Protective Capability of Withania somnifera and Acetylsalicylic Acid on Stress using Daphnia magna as a Model Organism

Anoushka Aggarwal

Around 72% in the United States have reported suffering from chronic stress and its symptoms of feeling overwhelmed, unable to sleep, and using drugs to relax. This dependency on pharmecutical drugs creates addiction problems, and worsens the patients health and mental well being. This research showed the comparison of acetylsalcylic acid (aspirin), a common drug that can lead to addiction to Withania somnifera (ashwagandha), an herbal medicine without harsh side effects. Aspirin was administered to Daphnia magna at a 0.008% concentration and ashwagandha was given at a 0.05% concentration after being exposed to ethanol, a environmental stressor, to test for sustainability overtime. The heartbeat of Daphnia magna was tested as a dependent variable to measure stress due to being comparable to a human heart. The data was collected using 15 groups of 8 Daphnia in each container with 10 treatment groups and 5 control groups over the course of 11 days. It was determined that the herbal medicine was initially not as effective but progressively showed more protection to stress after the synthetic medicine wore off. The data had a p-value of 0.001 through the INOVA test, which is very significant, indicating strong support for the hypothesis. Due to the Ashwagandha lowering the heart rate on the Daphnia magna, there was a higher protection from stress over a longer period of time. Additional trials will be conducted to further support the validity of the data.

Cuiping, H., Na, Z., Limei, H., Tang, T., Yang, Y., & Xiangping, N. (2023). Assessment of ecotoxicity effects of aspirin on non-target organism (Daphnia magna) via analysis of the responses of oxidative stress, DNA methylation-related genes expressions and life traits changes. Ecotoxicology (London, England),137-149. https://doi.org/10.1007/s10646-023-02624-z

Hu, A. M., Zhu, T., Dong, L., Luo, N. F., & Du, G. Z. (2016). Ethanol alters the expression of ion channel genes in Daphnia pulex. The American journal of drug and alcohol abuse, 325-332. https://doi.org/10.3109/00952990.2016.1162168

Hu, K., Sjölander, A., Lu, D., Walker, A. K., Sloan, E. K., Fall, K., Valdimarsdóttir, U., Hall, P., Smedby, K. E., & Fang, F. (2020). Aspirin and other non-steroidal anti-inflammatory drugs and depression, anxiety, and stress-related disorders following a cancer diagnosis: a nationwide register-based cohort study. BMC medicine, https://doi.org/10.1186/s12916-020-01709-4

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effects of Osteonectin on Muscular Hypertrophy Using Drosophila Melanogaster as a Model Organism

Hazim Amireh, Jason Arria

Muscular dystrophy and spinal muscular atrophy are diseases that antagonize muscle cells, crushing the lives of everyday people. Myostatin can help reverse the effects of these diseases. Myostatin sets a limit on how much muscle a human can produce. Just like follistatin, osteonectin/Human SPARC, decreased myostatin in humans leading to the growth of muscle. For this experiment, thirty vials, each containing ten male Drosophila, were used for both the control and the treatment group. For the treatment group, a 2% solution of osteonectin will be administered. On day one, the osteonectin solution will be introduced to the Drosophila. On day seven, after treatment, Drosophila protein levels will be measured using protein electrophoresis to determine the muscle mass present. The same procedure will be duplicated for the control group. In addition, a climbing assay will be used to test muscular endurance and strength. Preliminary results obtained from the climbing assay on the control group averaged a time of 19.86 seconds. It is predicted that the average climbing time will be lower for the treatment group. Data collection is ongoing.

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Huang, Z., Chen, X., & Chen, D. (2011). Myostatin: a novel insight into its role in metabolism, signal pathways, and expression on regulation. Cellular signaling, 23(9), 1441-1446

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Artificial and Natural Serotonin on Drosophila Hydei's Ability to Survive in Stressful Environments

Siri Amperayani, Norah Thomas

The Effect of Artificial and Natural Serotonin on Drosophila Hydei's Ability to Survive in Stressful Environments

The subject of our experiment, D. hydei, exhibits similar performance to an individual with Major Depressive Disorder (MDD) when under stressed conditions; this includes inactivity and a delay in motor skills and motivation. Health professionals often seek medication that aids neurotransmitters into making up for the lack of serotonin in patients with depressive disorder. However, it goes relatively undocumented how natural forms of serotonin compare to traditional supplements that these professionals often prescribe to patients when treating them.The purpose of this experiment is to assess if the supplement, Vitamin B-12, is a viable supplement to improve the health of those with depression by testing D. hydei's ability to survive in stressed environments when given different concentrations of Vitamin B-12.

In order to observe the potency of the Vitamin B-12, groups of 15 D. hydei will be placed in a vibration induced stress environment after consuming different doses of Vitamin B-12.. After the simulation of the stressed environment, the surviving D. hydei will be recorded. An additional part of the experiment is to test the ability of the "depressed" fruit flies to complete a memory maze test with and without the aid of Vitamin B-12. This can exhibit the efficacy of Vitamin B-12 on the symptom of memory loss. It is hypothesized that as the dosage of Vitamin B-12 increases, the number of surviving fruit flies increases as well as the performance of the fruit flies during the maze test.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Heteractis crispa Venom on the Degradation of Drosophila melanogaster Neurons Modeling Parkinson's Disease.

Mckenna Appelt, Lexi Nijkamp

Parkinson's Disease is a disorder that affects a person's nervous system by degenerateing dopaminergic and noradrenergic neurons, worsening a person's mobility. There exist proteins, however, that have exhibited an ability to inhibit the degradation of such dopaminergic neurons, minimizing the spread of neuron death in the brain, called Kunitz-type proteins. The aim of the study is based on finding a reversal treatment for this disease at a stage that is already progressive. By injecting an active form of 6-hydroxydopamine (6-OHDA) into an organism reflecting the neural circuitry of humans, Drosophila melanogaster, the disease can be modeled. With the subsequent injection of venom of the sea anemone Heteractis crispa, which contains Kunitz-type protein complexes, the negative impacts can be lessened. A 0.01 M solution of 6-OHDA was injected into the flies, followed by a venom solution created from the extraction of mucus from a small sea anemone. After 48 hours, the flies movement was tracked with and without a stimuli present. Our data is still being collected at the time of submission. Through the findings discovered in the study, experimental forms of therapy can be further explored. The utilization of the sea anemone venom can be implemented into modern medicine to allow for treatment of patients afflicted with Parkinson's or other neurodegenerative, dopamine based movement disorders.

Kvetkina, A., Pislyagin, E., Menchinskaya, E., Yurchenko, E., Kalina, R., Kozlovskiy, S., Kaluzhskiy, L., Menshov, A., Kim, N., Peigneur, S., Tytgat, J., Ivanov, A., Ayvazyan, N., Leychenko, E., & Aminin, D. (2022). Kunitz-Type Peptides from Sea Anemones Protect Neuronal Cells against Parkinson's Disease Inductors via Inhibition of ROS Production and ATP-Induced P2X7 Receptor Activation. International journal of molecular sciences, 23(9), 5115. https://doi.org/10.3390/ijms23095115

Liu LX, Du D, Wang ZQ, Fang Y, Zheng T, Dong YC, Shi QL, Zhao M, Xiao F, Du J. Differences in brain pathological changes between rotenone and 6-hydroxydopamine Parkinson's disease models. Neural Regen Res. 2018 Jul;13(7):1276-1280. doi: 10.4103/1673-5374.235076. PMID: 30028338; PMCID: PMC6065241.

Sawada, H., Oeda, T., & Yamamoto, K. (2013, March 25). Catecholamines and neurodegeneration in parkinson's disease-from diagnostic marker to aggregations of α-synuclein. Diagnostics (Basel, Switzerland). https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4665535/#:~:text=Catecholamines%20and%20Dopaminergic%20Neuronal%20Death&text=In%20addition%20to%20dopaminergic%20

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effects of Loud Music on Cochlear Hair Cells, and its Sensorineural Hearing Loss Implications

Omar Ashraf

There have been concerns about the rise of hearing loss due to predictions suggesting that 2.5 billion individuals could suffer hearing loss by 2050 [1]. Additionally, researchers suggested that a plausible cause for the rise in hearing loss can be attributed to the increased consumption of loud music by all ages [2]. However, no data for this has been confirmed. The purpose of this study is to calculate a specific volume that causes risk of hearing loss through damage to cochlear hair cells and ear drums for 63 notes. While frequency and pressure values were taken from a dataset, calculations were performed using three formulas related to sound pressure and intensity while further analysis was done using the Hair Cell Analysis Toolbox (HCAT).

Preliminary results suggest that chances of ear drum rupture range from minor, 41.48 dB (B8) to 95.17 dB (C0), to moderate, 47.38 dB (B8) to 101.06 dB (C0), to major at 50.60 dB (B8) to 104.29 dB (C0) [3]. Although analysis using HCAT is required to confirm cochlear hair cell damage and potential hearing loss, it is expected that intensities as low as 50.60 dB, depending on note's frequency, can cause significant damage to cochlear hair cells and lead to hearing loss.

This project's real world applications lie in establishing safe volumes for people to listen to music. Further research includes calculating damages caused by a combination of musical notes or establishing a duration that would cause hearing loss.

"Deafness and Hearing Loss." World Health Organization, World Health Organization, www.who.int/news-room/fact-sheets/detail/deafness-and-hearing-loss.

"How Does Loud Noise Cause Hearing Loss?" Centers for Disease Control and Prevention, Centers for Disease Control and Prevention, 24 Nov. 2020, www.cdc.gov/nceh/hearing_loss/how_does_loud_noise_cause_hearing_loss.html.

"Tuning." Frequencies of Musical Notes, A4 = 440 Hz, pages.mtu.edu/~suits/notefreqs.html. Accessed 3 Oct. 2023.

LCPS RSEF OFFICIAL ABSTRACT - 2024

Exploring the Effect of Caffeine on Teen Sleep and Physiology using Fruit Flies

Nishitha Balisetty

In order to investigate the direct correlation between caffeine consumption and sleep deprivation, a study was conducted. The study uses fruit flies as a model organism due to the major features of sleep shared between flies and mammals. Sleep deprivation prevalent among adolescents in society due to high stress and poor habits, often involves caffeine consumption as a prominent factor. By investigating how caffeine impacts sleep deprivation through its effects on heart rate, this research seeks to elucidate the physiological mechanisms underlying this relationship. Through a series of experiments, including behavioral metrics in response to the caffeine exposure, observations can be drawn. The study begins with the preparation of caffeine solutions with varying concentrations. Then, the fruit flies are exposed to the solutions for a duration of time. Then, fruit flies are isolated and caffeine content can be measured through spectrophotometry. Data analysis aims to explain the relationship between caffeine content and sleep deprivation indicators. The results of the study strive to understand the potential consequences on adolescent health and contribute to our understanding of caffeine's role in exacerbating sleep deprivation.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Cross reactive allergenic effect of Prunus dulcis on Blaptica dubia infected with Schistosoma mansoni

Nishka Bhikha

About six to eleven percent of the entire world population has food allergies. Allergic reactions involve the allergen binding to Immunoglobulin E (IgE), which is the antibody related to allergies as well as parasitic infections. Previously, it has been determined that the IPSE/α-1 and k-5 proteins found in the eggs of Schistosoma mansoni, a parasitic blood fluke, are cross reactive to the peanut protein Ara h-1. The similar structures of Ara h-1 and the IPSE/α-1 and k-5 proteins can be mistaken for each other when introduced into an organism. This cross reactivity has shown to cause an allergic reaction when peanut products are introduced to Dubia cockroaches infected with the Schistosoma mansoni antigen. Dubia cockroaches have immunity with specificity and memory, comparable to the humoral immunity of humans. This past research suggests a possible path of development for food allergies. In order to further examine this possible path of development, the effect of almonds, a peanut cross reactive legume, on cockroaches infected with S. mansoni was tested. The homologues present in almonds and the peanut allergen Ara h-1 are responsible for cross reactivity in humans. Dubia roaches were injected with S. mansoni antigens in order to induce a reaction. They were exposed to peanut products as well as cross reactive almond products. Data collection continues, however, if Dubia respond to the almond in the same way as exposed to peanut products, it would further demonstrate that S. mansoni infection may be a possible cause of peanut allergies.

Sampath, V., & Nadeau, K. C. (2019). Newly Identified T cell Subsets in Mechanistic Studies of Food Immunotherapy. Journal of Clinical Investigation, 129(4), 1431+. https://link.gale.com/apps/doc/A582203102/SCIC?u=va_s_316_479&sid=bookmark-SCIC&xid=212a7a5d

Pillai, U., & Cannon, J. (2022). Exposure to Schistosoma Mansoni Antigen Induces an Allergic Response to Peanuts in an American Cockroach Model. Journal of Emerging Investigators, 5. https://emerginginvestigators.org/articles/22-006

Wensing, M., C. Knulst, A., Piersma, S., & O'Kane, F. (n.d.). Patients With Anaphylaxis to Pea Can Have Peanut Allergy Caused By Cross-Reactive IgE to Vicilin (Ara h 1). The Journal of Allergy and Clinical Immunology. https://www.jacionline.org/article/S0091-6749(02)91323-0/fulltext

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effects of p-Coumaric Acid on α-Synuclein Aggregate Concentrations in Drosophila Melanogaster with Parkinson's Disease

Pranav Babu, Rushil Challa

Parkinson's disease (PD) is the fastest-growing and second-most common neurodegenerative disorder, accounting for 15% of worldwide dementia cases. A hallmark in PD pathology is α-Synuclein (αSyn) aggregation, which occurs directly due to the misfolding of the αSyn protein. In past research, polyphenols have been a target for potential treatments for PD due to their ability to effectively bypass the blood-brain barrier. Within the wide variety of polyphenols, p-Coumaric acid (pCA) has emerged as a potential therapeutic treatment for PD. pCA bioavailability, antioxidative, and anti-inflammatory properties in Alzheimer's research support its use in PD where oxidative stress and neuroinflammation are prevalent symptoms. In this study, we investigated the effect of pCA on αSyn aggregation in a PD Drosophila melanogaster model. αSyn aggregation was quantified using a Western Blot. The results from the study suggested that αSyn aggregation was mitigated by a 500 μM dosage of pCA for 10 days. The produced PD model had aggregates averaging 57 kD while the treated subjects had varying intensities of αSyn aggregation at 19 kD and 38 kD. The data from this study supports that pCA reduces αSyn aggregation as flies with PD had lower relative aggregation when given pCA. In addition to its benefits in treating PD symptoms, this study posits pCA as a promising potential treatment for PD and could be researched further in future studies.

Dolrahman, N., Mukkhaphrom, W., Sutirek, J., & Thong-Asa, W. (2022). Benefits of p-coumaric acid in mice with rotenone-induced neurodegeneration. Metabolic Brain Disease, 38(1), 373-382. https://doi.org/10.1007/s11011-022-01113-2

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Different Sleep Agents on the Development of Dementia/Symptoms of Dementia

Ruthie Dickersheid

Dementia and Alzhimers is a disease that progressively destroys memory and essential mental functions. While many studies have been conducted there is no cure for dementia, researchers are still looking for ways to prevent or delay symptoms of the disease. There is evidence that shows lifestyle choices are key components in the prevention of Dementia. Such as decreasing alcohol use and smoking while increasing mental wellness, being socially active, staying physically healthy, and protecting your head. The most vital aspect of the delay of Dementia currently seems to be the value of a person's sleep. The purpose of the research is to collect information to better understand how sleep can affect onset symptoms of Dementia in elderly. Having observed the movement of Drosophila, a genus flies, and seeing their function and stability after being tested on. Three trials were conducted to assess the impact of these factors on a locomotor activity monitor. Results indicate the differences between testing groups given Passion Flower, Valerian Root, and Melatonin. Exhibiting significant differences in their movement and stability. The findings suggest the potential benefits that sleeping medications can have to offset early symptoms of Dementia. Experimental results will show that the drosophila activity will decrease the alpha plaques that affect dementia.

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U.S National Library of Medicine (n.d.). National Center for Biotechnology Information. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2715168/

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Home Remedies on Drosophila Melanogaster Infected With Alzheimer's Disease

Alexandra Ganey, Blaine Wooley

As of 2021, Alzheimer's Disease is the seventh leading cause of death in the United States [NIH]. Alzheimers is a form of dementia that affects thinking, memory, and behavior. Psychiatrists use prescription drugs to delay the effects of Alzheimer's. Alzheimer's is thought to be caused by a build-up of plaque-forming proteins within the brain [NHS]. This study attempts to try something innovative by using household remedies such as lemon balm, periwinkle, and cayenne to prevent Alzheimer's in Drosophila Melanogaster. Alzheimers develops slowly and eventually interferes with someone completing daily tasks [Mayo]. For many years, doctors have made many attempts to find a cure for Alzheimers. Although a cure has not been found, there has been lots of research on preventing the disease. Medicines exist and there are treatments patients can take, but a lot of times are ineffective. There have been links to herbal treatments slowing and delaying the symptoms of Alzheimers in the brain.

Although data analysis is still ongoing, based on our preliminary analysis and studies on Alzheimers, it is hypothesized that herbal remedies will delay the symptoms of Alzheiemers. Especially the herb periwinkle due to its increasing blood flow to the brain that supports brain metabolism, and it is known to help improve memory. If the herbs help delay symptoms of Alzheimer's, it proves the significance of the study and can give people with Alzheimer's more time to be themselves before the symptoms settle in.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Proposing R195 Drosophila melanogaster as a new model for further research in the mutant IDH

Daniel Garcia-Soliz

The isocitrate dehydrogenase (IDH) gain-of-function mutation is the root of yet another disease: glioblastoma. With one of the lowest five-year relative survival rates within tumors, the mutation's production of the onco-metabolite 2-hydroxyglutarate acid (2-HG) is theorized as the cause of the tumor's malignant tendencies. Although proven problematic in other complex organisms, Dr. Rietman et al. finally genetically mutated a mimicry mutation with Drosophila melongaster (R195). Due to our inability to study the micro functions of the mutation properly, there needs to be a better understanding of what IDH faces in terms of creating NADPH (the enzyme's primary function). Utilizing complex organisms can finally be taken advantage of using the R195 line when feasible in the long term. The goal of this project was to evaluate the feasibility of the R195 as a research model. The mutant was presented under a lifespan and multiple climbing assays, along with changes in the diet, through increased agar solutions. Over time, the drosophila was presented in changing environments, gender separation, and anesthetized observation while the life span assay continued. Prior to introducing a new diet (2% agar solution), the mutant had a passing rate of 35%. Furthermore, cognitive dysfunction and wing disability are supported by a 15% success rate of the climbing assay in male mutants. Further data is being collected on agar solution changes. Providing a minimalist environment and altered diet to adjust for altered NADPH production will allow further use of the R195 mutant to study the IDH on a cellular level.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Additives on Glutamate Production in Helix aspersa

Rishika Goli, Layan Nasef

Glutamate over and under-production is linked to different health issues such as Alzheimer's and Parkinson's. Additives in the human diet could aid in maintaining glutamate levels over time, possibly preventing glutamatergic dysfunction. The independent variable is the different types of additives ingested by the *Helix aspersa* (snails). The three additives are vitamin D, magnesium oxide, and ethanol. The dependent variable is the levels of glutamate (mg/L) in the snails after 1 week of ingesting the supplements. The control group is the snails that consume a regular diet without ingesting any supplements. The subjects are 25 snails with a lifespan of 2-5 years in large and medium sizes. The procedure included setting up four habitats and feeding them the supplements. After one week we grinded the brains of the snails and took note of the glutamate levels present in each snail. The data in this experiment was quantitative and will be tested for statistical significance through the ANOVA test. While data is still being recorded, it is that noticed significant behavioral changes in the snails that are fed ethanol in comparison to the others. Additionally, the introduction of vitamin D will increase glutamate levels while the others will decrease glutamate levels. Further research can explore behavioral reactions that occur due to the additives and see if there are any correlations to the effect of the additives on other neural pathways that improve behavior.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Assessing Efficacy of Gene Therapy Interventions for Sickle Cell Disease: A Secondary Comparative Analysis

Parv Jani

This secondary comparative analysis aims to test the efficacy of various gene therapy interventions for sickle cell anemia targeting the BCL11A, HBB, and HBG genes. This study can be used to identify more promising treatments for further testing. Sickle cell disease is a genetic disorder that affects hemoglobin levels in the red blood cells of humans by inducing the production of sickled hemoglobin (HbS). Unlike the alpha hemoglobin (HbA) traditionally found in adult blood cells, HbS stores a significantly lesser amount of oxygen, preventing its transport throughout the body and deforming red blood cells. Symptoms of this disease include severe pain, fatigue, and swelling. This study involved ex-vivo transfusion using lentiviral vectors to edit or suppress the genes listed above. The BCL11A and HBG genes code for fetal hemoglobin (HbF) suppression, a hemoglobin found in developing fetuses and characterized by an increased ability to store oxygen. By inducing HbF production in patients, the %HbS is lowered thus reducing the effects of sickle cell anemia. Similarly, the HBB gene was edited to induce HBA-T87Q production, an antisickling hemoglobin.
This secondary comparative analysis measured efficacy using mean %HbF six months post-treatment as well as mean time to recurrence of clinical events related to sickle cell disease. Data was found from three different studies, one for each intervention for the BC1LLA, HBB, and HBG genes. After assessing each study for quality, statistical analysis involved the use of t-tests and ANOVA testing to find statistically significant evidence of difference in efficacy.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Comparative Analysis of Natural Substances on Earthworm Regeneration: An Experimental Study

Maira Khan

In this experiment investigating the impact of diverse substances on earthworm regeneration, we examined aloe vera gel, manuka honey, coconut oil, turmeric paste, and ginseng extract, with an untreated control group for comparison. Accurate precision was maintained in the selection of three uniformly-sized earthworms for each substance group, ensuring consistency and reliability in results. A controlled incision of 1 inch was created on each earthworm, and 0.5 mL of the respective substance was applied, while the control group remained untreated. The experiment unfolded over 10 days, during which the regeneration progress of earthworms was closely monitored. Measurements were taken every 48 hours, and detailed observations occurred every 24 hours, ensuring a comprehensive dataset. The mean length of regrowth was calculated for each group, contributing to a thorough understanding of the healing process. Comparisons revealed distinct regenerative effects among substances and the control group. This study drew from three key sources: (1)"Earthworms" (Cooper, E. et al., 2012) providing insights into earthworm biology, (2) "Effect of Earthworm on Wound Healing" (Wang, D. et al., 2021) exploring the regenerative properties of selected substances, and (3) " Injury-Induced Innate Immune Response During Segment Regeneration of the Earthworm" (Bodó K et al.,2021) guiding the structured methodology. The consistent experimental design ensures the reliability of our findings, contributing significantly to the understanding of regenerative attributes in earthworms

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Infrared Light on GAL4-UAS Drosophila melanogaster Expressing Human APP

Madison Kim

Amyloid-β comes from the proteolytic cleavage of the amyloid precursor protein (APP) and is one of the causes of Alzhimer's disease. This project will study the effects of 670 nm infrared light on GAL4-UAS Drosophila melanogaster expressing human APP in order to observe the effects of 670 nm infrared light on Alzhimer's disease. The hope is that the exposure of the Drosophila melanogaster to 670 nm infrared light will reduce the amount of amyloid-β showing that exposure to 670 nm infrared light is a possible treatment for Alzhimer's disease.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Senna extract on the body's ability to regulate blood suga

Jessica Knowlden, Hiba Sharhan

About 38 million Americans have diabetes and 90-95% of them have type 2 diabetes and 1 out of 2 people who need insulin cannot access it. Other common treatments have many negative side effects such as nausea, diarrhea, stomach pains, and loss of appetite.

The purpose of this project is to find out if Senna can be used to help people with diabetes to regulate their blood sugar. Many people with diabetes cannot access insulin due to either the cost being too high or there are insufficient supplies or the location. This project explores other alternate treatment that is less expensive and more readily accessible.

In this experiment blood is extracted from silkworms and test for its glucose levels. Next, silkworms are ejected with glucose at different concentrations and their blood is tested again. The silkworms are then injected with senna and blood is test again to measuring the effect if any that senna has on lowing glucose levels.

Results at this time lean toward a positive effect, but more data is being gathered on this experiment before we can reach the conclusion.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Bacillus subtilis as a Potential Probiotic Treatment for alpha-Gal Syndrome

Kiley McGee

alpha-Gal syndrome is a relatively new allergy to alpha-galactose, a sugar found in red meat. alpha-Gal syndrome, unlike most allergies, is acquired through a tick bite. Ticks found primarily in Australia and southeast United States carry alpha-gal epitopes, which causes an immune reaction. The nearly half million people that are faced with this allergy must avoid red meats in order to avoid reactions as severe as anaphylaxis.

The purpose of this research was to determine whether a probiotic containing Bacillus subtilis could deliver alpha-galactosidase in order to break down alpha-galactose in red meat at varying concentrations. Plates containing ground beef juice (alpha-galactose source) and X-alpha-gal dye, which changes color in the presence of alpha-galactose, were inoculated with Bacillus subtilis capsules. After five days of incubation, blue dots were counted and the RGB concentration of the area surrounding the spheres was found with the Carolina RGB Colorimeter, indicating the alpha-galactosidase production in response to alpha-galactose.

Statistical analysis determined that a significant amount of enzyme could be produced and delivered via encapsulated Bacillus subtilis. Each concentration of meat juice tested exhibited a significantly different numbers of blue dots and RGB concentration in comparison to the control with no meat juice. Hence, a potential probiotic delivery system for an alpha-Gal syndrome probiotic was created. Further research would entail determining the amount of alpha-galactosidase is produced by Bacillus subtilis and whether a significant amount of alpha-galactose is broken down in a short period of time to prevent a reaction in alpha-Gal syndrome patients.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Investigating the Potential Implications of Periplaneta americana as a Cost-Efficient Peanut Allergy Model

Anishreddy Mummadi

Approximately 1 in every 50 people suffer from peanut allergies. Although there is a vast amount of research being conducted in the field, there isn't a treatment for this disorder. Currently, murine models are used during preliminary studies for peanut allergies, but this is very expensive and limits sample sizes. To date, the in vivo treatment models for peanut allergies are depicted in 3 stages: extraction of protein, sensitization of mice to peanuts using an adjuvant, and finally immunotherapy treatment. The most widely used adjuvant to initiate an allergic reaction to allergies is aluminum hydroxide, which increases antigen uptake via dendritic cells. The American Cockroach has been known to have adaptive immunity to many different antigens, and its immune system consists of a type of granulocyte analogous to dendritic cells in mammals. We hypothesized that coadministration of aluminum hydroxide with peanuts will sensitize the cockroaches to peanuts via activating adaptive immunity. We observed that mortality rates between the alum injected cockroaches and the peanut/alum injected cockroaches were roughly the same, indicating that the presence of peanuts during the challenge phase had little to no effect in sensitizing the cockroaches, but it was the aluminum hydroxide that caused mortality. Although the research demonstrates that cockroaches cannot be sensitized to peanut allergens through traditional methods, it opens up new avenues for peanut allergy modeling with invertebrates. The research has the potential to help create novel and inexpensive peanut allergy treatment models for further research in search for a cure.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of New Generation Pesticides on Memory and Social Behavior in Drosophila melanogaster as a Model Organism

Aarya Paranjpe

From the 1990s, neonicotinoids were the most commonly used pesticides for agricultural and commercial use. Research conducted by the EPA and NIH revealed that neonicotinoids have a destructive impact on the ecosystem as well as a neurotoxic impact on people who handle them. As a result of these findings, as well as the research that revealed the ecological harm caused by neonicotinoids, agribusiness began to incorporate other types of pesticides that pose less risk to humans and the environment. This experiment investigates the effect of three new generation pesticides on neurohealth, specifically memory and social behavior. A toxicity assay was conducted to determine the appropriate concentration amount to ensure survival of the Drosophila. It was determined that a 2% 0.5 mL concentration of pesticides was incorporated into the Drosophila media for testing. To test memory, appetitive olfactory conditioning was conducted using a Y-maze constructed by the researcher. Four sessions of memory training were conducted prior to treatment. To test social behavior, a vertical triangle chamber test was constructed and used before and after pesticide treatment. After preliminary testing and reinforcement sessions were conducted, pesticide treatment was incorporated into the Drosophila media for seven days. After one week, the social behavior and memory assay were conducted again, and the results will be compared to determine the effect of the pesticides and to compare which pesticide had the least effect on brain health. Preliminary data shows that biopesticides have a significant impact on memory. Data collection is ongoing.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Examining how the transcription factors, Nurr-1 and ATF4, affect the expression of the dopamine D2 receptor in the kidney.

Sai Ravva

Dopamine is a neurotransmitter known for its crucial role in the brain, and it's also synthesized in various peripheral organs and different cell types, each with organ-specific functions. Recent research has unveiled its involvement in immune response regulation and the inflammatory process. The renal system has a role in controlling sodium transport and blood pressure, exhibiting sensitivity to stimuli that creates oxidative stress and kidney inflammation. For this project I will be examining the factors that regulate the expression of the receptor. I will study how the transcription factors, Nurr-1 and ATF4, that are known to modulate the expression of the receptor in the brain, affect the expression of the receptor in the kidney. Dopamine, conventionally recognized for its neurotransmitter functions, has emerged as a key regulator of inflammatory responses in various organs, including the kidneys. Utilizing immortalized human RPTC, I conducted an experiment involving overexpression and silencing of the gene, Nurr-1 and ATF4. The RPTCs are transfected with plasmids harboring the genes and siRNA. Control groups hold empty vectors and non-silencing siRNA to discover the specific effects. After treatment, we analyzed the changes in the dopamine D2 receptor expression through immunoblotting. The comparisons between the treatment and control groups focus on providing information regarding the roles of Nurr-1 and ATF4 in anti-inflammatory responses in the kidney. This project allows us to deepen our understanding of the dopamine receptor and how it is modulated in the kidney. This contributes crucial insights into renal physiology and the mechanisms of inflammation.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Ginseng on Alzheimer's Disease

Selina Shah, Shivani Sukumar

Alzheimer's Disease is a progressive disease of memory loss, typically due to a combination of genetics, environmental, and lifestyle factors. It is well-known in the science community of the lack of cure for the neurodegenerative Alzheimer's Disease. While there are several treatments to slow the progression of this disease and improve patient quality of life, there is no absolute cure. However, there are a variety of ayurvedic, traditional, and ancient treatments that can help prevent degeneration and strengthen the brain in combat of this disease. Some examples include Ashwagandha, Curcumin, and more. One of the most powerful Asian medicinal herbs is Ginseng. Ginseng contains an inflammatory chemical known as ginsenosides which has the potential ability to prevent memory loss and reduce age-related memory declines. This study focuses on the properties of Ginseng against Alzheimer's Disease (Zlokovic, 2011).

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Web of Diet and Nephrolithiasis: A Laboratory Investigation

Sanjana Sharvirala

With Kidney Stone disease only becoming more prevalent with time, the need to address unanswered questions regarding components of the disease's etiology and subsequent dietary recommendations remains an active area of research (Taylor et al., G.C., 2020). Additionally, drawing upon the knowledge of earlier literature, a clear and significant correlation exists between diet and stone formation risk (Ferraro et al., 2020; Barghouthy et al., 2021). This study investigates the correlation between diet and nephrolithiasis by producing a simulated urinary environment through controlled experimentation. This approach intends to explore how specific dietary components influence different factors of Kidney Stone formation by utilizing plant and animal extracts to see their role in a typical Calcium and Oxalate crystal formation. The methodology embraces a randomized controlled trial design, ensuring unbiased and representative results by examining the crystallization process under varied conditions and parameters. Although research on the pathology and physicochemical interactions of nephrolithiasis is being thoroughly researched, there is a need for further research that can provide insight into dietary management strategies for individuals susceptible to Kidney stones. (D'Alessandro et al., 2019). The primary objective of this research is to bridge that gap and elucidate dietary influences within the urinary system, contributing to the overall understanding of nephrolithiasis. Anticipated outcomes include a nuanced understanding of how diet influences stone formation and potentially guiding targeted dietary interventions.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effects of Different Concentrations of Lidocaine on Spinal Epidural Hematomas Using Periplaneta americana as a Model Organism

Gabrielle Shelton

Spinal epidural hematomas occur when blood pools within a patient's epidural space against the spinal cord. With approximately 1 in 170,000-200,000 cases occurring after the epidural anesthesia administration, the correlation between the anesthesia and spinal epidural hematomas is unclear. This project examines if one of the main components of the anesthesia, lidocaine, directly affects the formation of spinal epidural hematomas. The effects of different concentrations of lidocaine on the hemolymph of Periplaneta americana were observed to model its effects on human blood. Currently, 2% lidocaine is used in epidural anesthesia practices. Five roaches with lidocaine treatment rates of 2%, 1%, 0.5%, 0.25% were used. The independent variables were the various lidocaine rates. The cockroaches were injected with the different concentrations and allowed to rest. Test tubes were prepared with 3.82 mL of 0.9% saline and set aside. In each insect a hole was punctured between the last two abdominal sternites to release the hemolymph and collect 20 microliters of sample. Each sample of hemolymph was added to the saline, and 4 mL of 1% methylene blue for a 1:1 ratio of dye to suspension. After inverting 10 times, 10 microliters were loaded into a prepared hemocytometer. Cell numbers and abnormalities were viewed as dependent variables. Current data shows that as the concentration increases, there are more cells and abnormalities present which represents an increased likelihood of developing a spinal epidural hematoma. Data collection is currently ongoing.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Comparison of Omega 6 and Omega 3 Fatty Acids on Human Embryonic Development using Drosophila melanogaster as a Model Organism

Arsh Singh

Omega 6's and omega 3's are crucial to overall fetal and embryonic development. Over the past 20 years, the standard American diet has favored a diet heavy on omega 6's fatty acids. With a change in the western diet, obesity has been on the rise with nearly 17% of children ages 10-17 being obese. This research aims to see how a change in omega 6 or omega 3 will affect development in obesity in humans. The model organism being used is Drosophila melanogaster with the omega 6 and omega 3 being the independent variable. The dependent variables are the amount of pupae present, the time it takes for flies to die, and the size of flies at death. In order to observe the effects of the treatments on development two male flies and two female flies were placed in a tube with either added omega 6 or omega 3. Flies bred until the first pupae was observed after 6 days. The original four flies were then taken out of each vile only leaving pupae in vile, next me time it took for flies to emerge from pupae. Once flies emerge, the time it takes for all flies to die will be measured. At time of death, Leica microscope software will be used to observe fly size. Preliminary data shows that the group with added omega 3 displayed faster time to pupate, larger count of pupae, and faster time to adulthood.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Impact of Food Insecurity and Malnutrition on Fertility Rates in Drosophila melanogaster

Isabel Smith

Communities throughout the world face the epidemic of food insecurity which harms the lives of many. Food insecurity differs from malnutrition in that when one experiences food insecurity, unknown sporadic access to food exists whereas when one experiences malnutrition, caloric intake decreases.

The intent of this research was to determine whether food insecurity affected fertility rate when compared to malnutrition. *Drosophila melanogaster* were divided into three test groups. Each group was divided into 10 females and 10 males. Group 1, the control group, was provided an adequate amount of food daily. Group 2 was exposed to consistent limited food access to mimic malnutrition. Group 3 was exposed to different amounts of food sporadically to mimic food insecurity. After 12 days, the total number of offspring were counted.

After analysis of reproductive output, it was concluded that there was no statistically significant difference between the control group and the group experiencing malnutrition or between the group experiencing malnutrition and the group experiencing food insecurity. However, a significant difference existed between the control group and the group experiencing food insecurity. In general however, *Drosophila melanogaster* experienced a decreased reproductive rate when experiencing food insecurity and malnutrition compared to sufficient nutrition. This research may help shed light on the impact of food insecurity on reproductive rates. Further research would entail determining how food insecurity affects offspring development, as well as how food insecurity experienced at a young age (as seen in many communities) affects reproduction in later years.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Medicinal Herbs on Wolbachia pipientis in Preventing Mosquito Reproduction Using Drosophila melanogaster as a Model Organism

 Seunfunmi Soyannwo

According to the World Health Organization (WHO), an estimated 249 million malaria cases were recorded in the year 2022, leading to over 608,000 deaths in over 85 countries -- 80% of the deaths being children under five. The World Mosquito Program releases Wolbachia mosquitoes into certain areas to help reduce transmission of mosquito-borne illnesses. This experiment investigates the possibility that two medicinal herb treatments, Vernonia amygdalina (bitter leaf) and Azadirachta indica (neem leaf), may enhance the effectiveness of Wolbachia pipientis in reducing malaria transmission. Drosophila melanogaster was used as the model organism for these studies. Both wild-types and those containing Wolbachia were fed with the herb treatments to determine if levels of Wolbachia were impacted.

Ten vials containing ten Wolbachia genotype w[1118]/Dp(1;Y)y[+] |Wolbachia-wMel2a| Drosophila were used for each treatment; 10 vials containing ten wild-type Drosophila also received treatments; 10 vials containing ten Wolbachia genotype w[1118]/Dp(1;Y)y[+] | Wolbachia-wMel2a| Drosophila was used as a control; and 10 vials containing ten wild-type Drosophila were used as a control. Each treatment group vial received 14 mL of the treatment. Reproductive rate data was collected. Upon completion of data collection, a qPCR assay will be performed to determine the Wolbachia levels. Data collection is ongoing.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Magnesium on Tachycardic Daphnia Exposed to Dopamine

 Raina Tandon

Magnesium is an essential element involved in the heart's electrical system and regulates the movement of calcium, sodium, and potassium ions, which in turn allow for action potentials and thus the beating of the heart. Recent studies have shown that arrhythmias, the irregular beating of the heart, are common in schizophrenic patients. Schizophrenia is a neural disorder that is characterized by higher levels of dopamine found in affected patients. Dopamine, an excitatory neurotransmitter, is known to elevate heart rate, which can pose a risk for adverse cardiovascular events. This research intends to determine whether magnesium supplementation could be used as a viable treatment for tachycardia resulting from high dopamine levels. Daphnia are emerging models in the cardiovascular field due to their ability to portray heart contractions. To test this, the first step is to record the initial heart rate of the daphnia before they are exposed to any substances. This group will serve as the control. Half of the daphnia from this group will then be exposed to dopamine. Once heart rate is counted, the dopamine induced daphnia will be given the magnesium supplement. The final heart rate will then be measured. The average heart rate of the control group is 174 bpm while the average heart rate of the dopamine induced daphnia is 255 bpm. In the next few weeks, the daphnia who have received dopamine will be given magnesium to determine if magnesium can be used to decrease the elevated heart rate caused by elevated dopamine levels.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Development of a Bioactive Gel to Inhibit Dental Plaque Formation of Streptococcus Mutans via Quorum Sensing
Olivia Teng

Dental caries – tooth decay or dental cavities – is a prevalent disease in the public health sphere due to high intake of free sugars in diet, lack of plaque removal when toothbrushing, and inadequate fluoride exposure. Dental caries can lead to difficulty in eating and sleeping, as well as resulting in pain and chronic systems infections. Treatment of dental caries comes at a high cost and may not be successful, requiring more treatment if risk factors are not successfully controlled. Flavonoids in plant extracts are hypothesized to inhibit quorum sensing to inhibit biofilm growth.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Snail Slime on Staphylococcus epidermidis to Determine Antimicrobial
Properties against Acne

An Tran

Snail mucin has been continuously researched and results have shown that it gives benefits
including anti-inflammatory, anti-aging, and anti-wrinkling properties. However, many teens
don't face these issues and instead, suffer from acne. In addition, antimicrobial properties of
mucin have not been deeply explored. The problem that led to the design of this experiment
is the limited and expensive options for skincare products that do not have proven
effectiveness in dealing with acne. Unlike previous studies, this study consists of measuring
the growth or inhibition of Staphylococcus epidermidis, the primary acne causing bacteria,
after being treated with snail mucin, glycolic acid, and neomycin antibiotic discs. Pomacea
bridgessi were probed using ascorbic acid to release mucin. This was plated using a disk
diffusion method against neomycin, a common antibiotic, and glycolic acid, a known
ingredient in the mucin. Data collection continues however, data from trials reveals that the
snail mucin was slightly effective in inhibiting the growth of bacteria but not nearly as much
as the glycolic acid or the antibiotic disk. This is due to the snail mucin being extracted from
aquatic snails whose slime is not nearly as concentrated as land snails Future research
includes quantifying glycolic acid concentration in both types of snail, and determining if there
are other active antimicrobial ingredients. This research demonstrates that in addition to
having established anti-inflammatory properties, snail mucin also has limited antimicrobial
properties which could be used for acne treatment.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Exploring the Effects of L-theanine on Teen Sleep and Physiology using Fruit Flies

Nimisha Vadlamudi

This study investigates the impact of L-theanine consumption on sleep patterns and physiological responses in adolescents, using fruit flies (Drosophila melanogaster) as a model organism. L-theanine, commonly used as a sleep aid or for cognitive enhancement, is increasingly being misused among teenagers, raising concerns about its effects on health. Fruit flies were exposed to various concentrations of L-theanine solutions, including therapeutic and potentially misused levels, and their sleep patterns and physiological responses were observed. After exposure, flies were isolated, homogenized, and their L-theanine concentration was measured using a spectrophotometer. Data analysis aimed to establish relationships between L-theanine concentration and observed effects, offering insights into the potential risks associated with L-theanine misuse among teenagers. This research contributes to public health awareness and informs preventive measures to address prescription medication misuse in this demographic. By elucidating the effects of L-theanine on adolescent sleep and physiology, this study sheds light on the importance of responsible supplement use and highlights the need for education and intervention strategies to promote healthier habits among teenagers.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Amyloid Beta Protein on Cognition in Drosophila melanogaster Following Traumatic Brain Injury

Katherine Valentini

One third of all injury-related deaths in the United States are a result of traumatic brain injury (TBI). TBI is a form of head injury that results in damage to the brain. Depending on the severity of the injury, a TBI could lead to sustained damage to cognition. Amyloid beta (Aβ) is a protein that has been found to accumulate rapidly in the brain after TBI. Aβ is also a derivative of the amyloid precursor protein (APP), which is a large membrane protein that specializes in neural growth and repair. Despite these properties, Aβ has mostly only been investigated in relation to Alzheimer's disease (AD), for it has been found that the overexpression of Aβ can lead to the development of AD through a buildup of protein plaques. The purpose of this experiment is to research the purpose of Aβ in the neural system apart from its contribution to the development of AD. The facts that Aβ accumulates rapidly after TBI and is produced by a protein that's role is to prepare the brain after damage suggest that Aβ itself may have a role in neural repair after TBI. Drosophila melanogaster will be the model organism in this experiment since they model human TBI symptoms and specific lines produce Aβ. Results of this experiment could redefine the role of Aβ in the neural system, as it is often villainized for its role in the development of AD, but has not yet been investigated as a neural protector.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Menstrual Cycle Phase on the Blood Lactate Threshold of Eumenorrheic Women during High Intensity Aerobic Exercise: A Meta-Analysis

Olivia McMahon, Mariah Waters

Background
Multiple studies suggest that hormonal fluctuations associated with the menstrual cycle have a significant effect on the metabolic rate of eumenorrheic females. Through the connection of metabolic rate to lactate thresholds, some studies suggest that the menstrual cycle has a significant effect on lactate thresholds. Conversely, other research has concluded that menstrual cycle fluctuations play little to no effect on lactate thresholds. The present meta-analysis aimed to decipher through these contradictory findings.

Objective
To determine the effects of the menstrual cycle phase on lactic acid thresholds in eumenorrheic women during aerobic based exercise in order to provide possible training insight and performance recommendations to these women

Methods
To obtain data, PubMed was searched to view all freely available studies relating to the review. Once all related articles were identified, these were analyzed in their entirety by two reviewers against specific criteria. Their eligibility was then confirmed or denied. Statistical analysis, through calculation of p values (value P 0.05 considered statistically significant), was conducted manually on eligible studies.

Results
A total of four studies were found eligible against the exclusion criteria with a total of 67 patients. Out of all calculated p values, none were under 0.05 to be considered significant (avg. 0.4797).

Conclusion
There is no statistically significant difference between menstrual cycle phase and lactate thresholds during high-intensity aerobic exercise in eumenorrheic women. Reduction of lactate threshold during specific menstrual phases cannot be used to justify increased or decreased athletic performance in eumenorrheic women.

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Biomedical Engineering (500) and Translational Medical Science (2200)

Project No.	Student(s)	Project Title
501X11	Brian Guzman Fuentes	Effective Joints in Prosthetics
2201T12	Anirudh Balaji, Rohan Bhadange	The effect of honokiol supplementation on tau-mediated degeneration in Drosophila melanogaster expressing tau toxicity (AD)
2202X12	Alisha Bojji	Effects Ataxia Has On Health With Or Without The Help Of Medical Attention/Devices
2203X11	Hanan Farah	The Effect of Frankincense Serrata Oil on Parkinson's Disease Tested on PINK-1 C. elegans
2204X12	Diya Ghosh	Analyzing the Effects of Altretamine Chemotherapy Drug on Drosophila melanogaster Ocular Melanoma Models
2205T12	Deeksha Hanumanula, Krish Maheshwari	The Effect of Citrus bergamia Supplementation on Parkinson's Driven Locomotor Impairment in Drosophila melanogaster
2206T12	Sree Mamilla, Ananyaa Ramaswamy	Natural Food Combinations to Relieve Hyperacidity
2207X12	Vrushali Papaiya	The Effectiveness of Uraria picta in Treating Cardiac Arrhythmia Using Daphnia magna as the Model Organism
2208X12	Sergio Sanchez	The Effect of Various Air Pollutants on Drosophila Activity, Ultimately Drawing Comparisons to Humans.
2209X12	Michael Tartaglione	Investigating the Antiparkinson Effects of the Anti-Prion Compound Ebastine on the Deaggregation of Alpha-Synuclein in Drosophila Melanogaster.
2210X11	Lucas Weatherly	Automated Interpretation of Blood Culture Gram Stains by a Neural Network for Early Sepsis Diagnosis

Category Student Count: 14

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Effective Joints in Prosthetics

Brian Guzman Fuentes

Prosthetics that are designed to be affordable lack the longevity needed because of budget constraints and inefficiencies. These issues make affordable prosthetics unsustainable for long periods of time. This project aimed to solve these issues by creating a prosthetic ankle and foot that is affordable and has a wider range of motion compared to other prosthetics.The first stage of development involved researching and developing a rough draft and determining which materials to use and the time needed for the project. The second phase involved developing the prosthesis on 3D software. The software that was used for this project was Autodesk Fusion. ACL Makerspace facilitator, and Synergy Prosthetics & Orthotics were consulted in order to produce the prosthetics and provide mentoring during the engineering process. During the third stage, printing and testing will be the main emphasis. The ACL Makerspace will be used to do printing and revisions. Once the prosthesis is ready for testing, the focus will be load management at several angles to ensure that the leg will work properly. Another focus is the amount of weight it will be able to handle, and this will be done using a mixture of load management and stress testing using several different weights.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The effect of honokiol supplementation on tau-mediated degeneration in Drosophila melanogaster expressing tau toxicity (AD)

 Anirudh Balaji, Rohan Bhadange

Alzheimer's Disease (AD) is a neurodegenerative disease affecting over 6 million people in the United States. AD has no cure, and is one of the many diseases caused by a protein called tau. An active NF-κB complex yields tau aggregates, causing symptoms of AD by killing neurons. Past research found that Honokiol, a supplement derived from the magnolia tree, helps limit the activation of the NF-κB complex. Based on the past findings, it was hypothesized that Honokiol supplementation could rescue the progression of symptoms related to tau toxicity. Drosophila melanogaster was chosen as a model organism because of its similarity with the human brain. Expression of tau in flies is known to result in ommatidial disorderliness, which occurs when the units of the fly eye defer from their orderly hexagonal structure. The GAL4-UAS model was used to express malignant tau inside the Drosophila eye so that the rough eye phenotype created by tau toxicity and potentially mediated by Honokiol could be studied. ImageJ Flynotyper software was used to analyze SEM images to yield phenotypic scores measuring ommatidial disorderliness. Kruskall-Wallis tests have been run on negative, model, and disease control data. P-values of p>0.05 indicate the standard fly phenotypic scores are similar with and without honokiol, and p<0.001 indicates that phenotypic scores of flies with or without honokiol and diseased flies are significantly different. Full comparisons to the experimental group cannot be drawn yet and statistical analysis will be performed once trial data is completed.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Effects Ataxia Has On Health With Or Without The Help Of Medical Attention/Devices

Alisha Bojji

There are two different ways that ataxia can manifest clinical. In cases of cerebellar infection, which can progress quickly and have disastrous outcomes, or spinocerebellar ataxias, or SCA, which is inherited and has a chronic, slowly progressing clinical course. Immunologic or viral disorders may cause ataxia to develop subacutely. An early management strategy can save the patient's life and lead to favorable long-term outcomes for ataxia caused by treatable conditions. In illnesses, Ataxia could potentially be innocuous. More hereditary causes of cerebellar ataxia have been found since the field of neurogenetics has developed, but there are still many unknown sporadic ataxias, including some with a progressive and long history. Based on this research, my project is getting information from other research articles based on the topic that I chose to research and come to a direct conclusion about it. I've taken multiple research articles and found how they experiment with different trials and different variables. Every article that I have read gave me a treatment solution and I would take the two highly recommended treatments that I would see in every article that I saw and compare the two in an experiment. In my experiment, I had two groups, controlled and experimental, and I gave the control group the placebo and gave the experimental group the medication/devices. This research led me to derive a new conclusion on the best way to level the number of people that suffer with Ataxia.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Frankincense Serrata Oil on Parkinson's Disease Tested on PINK-1 C. elegans

 Hanan Farah

It is estimated that approximately 1 million Americans have Parkinson's Disease (PD). This brain disorder gradually worsens over time; often, around the age of 60, people can get unintended or uncontrollable movements. Parkinson's disease and its dermatological association often go unnoticed. Rosacea an inflammatory condition that results in redness and inflamed skin. 5.4 million adults were observed over 15 years, and results showed a two-time increase in the risk of PD in patients diagnosed with rosacea. Farnesol is a natural sesquiterpene alcohol found in essential oils that relieves inflammation. Recent studies show that mice fed with a farnesol-supplemented diet have twice as many healthy dopamine neurons compared to the mice not fed with the farnesol diet. Farnesol is a natural sesquiterpene alcohol found in essential oils that relieves inflammation. Similar to farnesol, Frankincense serrata oil is a potent anti-inflammatory agent. The purpose of this experiment is to determine if frankincense serrata oil sprayed onto PINK-1 *C. elegans* skin can improve dopamine levels. The *C. elegans* contain PD due to the gene PINK-1 being linked to PD. Frankincense serrata oil will be sprayed on *C. elegans* for one week with different amounts per petri dish. At the end of the week an ethanol test will be conducted to check the mobility of the *C. elegans*. Experimentation is ongoing. Testing whether there is a correlation or frankincense serrata oil to PD may ultimately lead to a lost cost and non-invasive treatment for PD.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Analyzing the Effects of Altretamine Chemotherapy Drug on Drosophila melanogaster Ocular Melanoma Models

Diya Ghosh

Ocular melanoma is one of the rarer types of aggressive cancer. The only option for someone with this cancer is to undergo radiation or surgery. In both cases, there is a high likelihood of vision being lost. However, most patients have no other option than to undergo one of the two treatments because ocular melanomas are aggressive and spread to other areas of the body, most often to the liver. Chemotherapy is the traditional treatment method if the cancer spreads, however it is rarely used to only treat ocular melanomas.

Altretamine is a chemotherapy drug that is currently used to treat ovarian cancer and is untested for other cancers. This drug could allow patients a much brighter prognosis than current options. In this study, Drosophila megalocaster, commonly known as fruit flies, was chosen due to their similar organ structures to humans. The flies were bred to express eye cancer similar to ocular melanomas in humans. To study the change in eye tumors after administering altretamine, the Leica LAS EZ microscope software was used to take images and then are analyzed using ImageJ software to measure changes in the eye tumor size and color. It was determined that the most effective dilutions were 0.53 mM and 0.053 mM dilutions. Preliminary results show that the drug is reducing the tumor sizes of adult flies. Next steps include analyzing if growing larvae in the drug can also reduce tumor sizes in comparison to the control, once they are adults.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Citrus bergamia Supplementation on Parkinson's Driven Locomotor Impairment in Drosophila melanogaster

Deeksha Hanumanula, Krish Maheshwari

Neurodegenerative diseases, particularly Parkinson's Disease (PD), are becoming increasingly prevalent. PD affects more than 8 million people globally today and is expected to increase to between 12 and 17 million by 2040. These people suffer progressive impairments in their movement, tremors, and a significant reduction in quality of life. There is no known cure for PD, and current treatments only target symptoms. PD pathogenesis is characterized by the accumulation of alpha-Synuclein (A-Syn) proteins in the brain, which form neurotoxic deposits called lewy bodies that engender neuronal death and locomotor impairment. Therefore, a Drosophila melanogaster PD model was created by expressing the gene responsible for A-Syn protein accumulation in flies, SNCA-A53T. The locomotor function of the flies was measured with a negative geotaxis assay which quantified the flies' ability to climb 8 centimeters within 10 seconds. To mitigate excess A-Syn and thus mitigate locomotor impairment, the flies were supplemented with d-Limonene and linalyl acetate, molecules found in Citrus bergamia which increase the rate of autophagy, the cellular process of recycling excess proteins. These results will help deliver insights into the potential of autophagy targeting PD therapies, Citrus bergamia's potential to mitigate other autophagy related diseases, and the role of autophagy impairment in contributing to neurodegenerative disease.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Natural Food Combinations to Relieve Hyperacidity

Sree Mamilla, Ananyaa Ramaswamy

While over the counter antacids could potentially help reduce heartburn symptoms, there are studies that support that ayurvedic hyper acidity relieving foods could have the same effect or even better effect to reduce heartburn symptoms. The research project's main objective is to compare how natural antacids help stomach acid compared to over the counter medications. As more people are looking for ayurvedic replacements for over the counter medication, it is the same for heartburn and indigestion problems. We designed an artificial stomach setting using hydrochloric acid (HCl) and distilled water, which is very similar to the setting for a human stomach. We are using various natural foods such as, brown rice, carrots, apple pears, watermelon, lettuce, fennel seeds, milk, celery, aloe vera, and ginger, to test how these naturally ayurvedic foods help relieve heartburn. We are going to find the results by monitoring how the pH of the artificial stomach acid changes over time.We are also going to have control tests using tums in the artificial stomach setting to compare the results. We have a pH meter and pH strips to measure the result of the data. We are emphasizing safety precautions by utilizing the hume hood, so that we can have the most reliable accurate data and results. Further analysis and replication of the experiments are being set in place to ensure accurate and reliable data and conclusions.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effectiveness of Uraria picta in Treating Cardiac Arrhythmia Using Daphnia magna as the Model Organism

Vrushali Papaiya

Uraria picta (Prishniparni) is an Ayurvedic herb that could serve as a natural remedy for tachycardia, an irregular, faster than normal heart rate. The goal of this study is to find the effectiveness of Prishniparni (independent variable) on reducing heart rate (dependent variable). *Daphnia magna* are small crustaceans that, like humans, have a myogenic heart (regulated by electric impulses rather than neural impulses), making them a great model for cardiac studies. In this study, the heart rate of each Daphnia in response to one of four different solutions with varying concentrations of an ethanol-based Prishniparni tincture was immediately recorded. Daphnia placed in distilled water (control), 0.0514% ethanol, 0.0128% Prishniparni tincture, 0.0257% Prishniparni tincture, and 0.0514% Prishniparni tincture, had average heart rates of 248.533 beats per minute (bpm), 235.600 bpm, 225.600 bpm, 211.200 bpm, and 188.400 bpm respectively. The data supports the hypothesis that 0.0514% Prishniparni would decrease the heart rate of Daphnia most effectively compared to other solutions with lower concentrations of the tincture. While ethanol plays a role in reducing heart rate, the presence of Prishniparni reduces the heart rate of Daphnia even further, indicating that Prishniparni could be used to treat people diagnosed with tachycardia. From an ANOVA test, the p-value was < 0.00001 (statistically significant). Seven Daphnia died upon exposure to the highest dose of Prishniparni, indicating a need for further research on safe dosages and long-term effects of Prishniparni on cardiovascular health.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Various Air Pollutants on Drosophila Activity, Ultimately Drawing Comparisons to Humans.

Sergio Sanchez

The Environmental Protection Agency has stated that the number of acres burned by wildfires each year has increased since the 1980's. With global temperatures rising leading to more arid forests and brush, forests have become more flammable leading to larger and longer lasting wildfires than ever before. In my experiment I am looking at the effects of air pollutants produced by different burnt materials such as woods and plastics on Drosophila. The purpose of this is to look into how fruit flies respond to the various pollutants and compare the effects to humans (since fruit flies share similar DNA) and how they may be negatively affected from the smoke from more frequent wildfires and chemical pollutants in the air. Four separate cultures of fruit flies were separated into different jars and exposed to smoke from burning treated wood, pine wood, and plastic while one remained without pollution, data such as the number of fruit fly deaths and observations such as slowed metabolism were identified. Results are still being developed but I am predicting that the burning of treated wood and plastics would have the most significant negative effect on the fruit flies. This means that the pollutants produced from the burning of plastics and treated wood in wildfires may also negatively affect humans the most, but like I said, data is still being collected so the conclusion is not definitive.

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Roychik, R. (2022). Air pollution and your health. National Institute of Environmental Health Sciences. https://www.niehs.nih.gov/health/topics/agents/air-pollution

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Investigating the Antiparkinson Effects of the Anti-Prion Compound Ebastine on the Deaggregation of Alpha-Synuclein in Drosophila Melanogaster.

Michael Tartaglione

Parkinson's disease and Lewy body dementia are debilitating neurological disorders characterized by the aggregation of alpha-synuclein proteins, a prion protein that leads to severe cognitive and motor impairments. Current treatments are limited, prompting research into compounds targeting alpha-synuclein aggregation. This study investigated the potential of ebastine, a compound known for its "anti-prion" effects and its ability to inhibit protein folding activity in deaggregating alpha-synuclein. Using a P{UAS-hSNCA.H50Q}2 Drosophila model expressing mutant alpha-synuclein, the efficacy of ebastine in inhibiting or destroying aggregation of alpha-synuclein was tested. Ebastine was dissolved in an ethanol mixture and administered to adult Drosophila via capillary tubes on a seven-hour feeding cycle. A climbing assay measured changes in motor control before and after ebastine administration. This experiment aimed to demonstrate that ebastine has the ability to reduce the effects of alpha-synuclein aggregation in Drosophila, returning the motor function that was once lost by the Parkinsonian compound. Experimental results are pending and will be processed using a Pearson Chi-square test, hopefully proposing ebastine as a promising candidate for combating alpha-synuclein pathology, offering potential therapeutic avenues for Parkinson's disease and Lewy body dementia.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Automated Interpretation of Blood Culture Gram Stains by a Neural Network for Early Sepsis Diagnosis

Lucas Weatherly

The sepsis diagnosis process relies on a large culturing period and high concentration of bacteria that leave patients waiting for days no closer to regaining their health. This research attempts to analyze the effectiveness of using an automated microscope and neural network to diagnose sepsis before culturing samples. In order to evaluate this method, I constructed an automated microscope and created a training set of images. The images were collected from Gram-stained slides constructed with horse red blood cells and either E.Coli K12 or Stappcoccous Epidermis. These images are currently being used to create a Neural network capable of differentiating between images with only blood cells and images with bacteria and blood cells. The effectiveness of this model will be measured using a separate set of images reserved from the original set. Using the results, the lowest concentration sample that can reliably return an accurate test will be calculated. This lowest reliable concentration combined with the running time of a full slide scan will allow the efficacy of the use of this method to diagnose sepsis to be determined. Training data will be released so that other machine learning models' efficacy can also be tested by future researchers.

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Cellular & Molecular Biology (600) and Computational Biology & Bioinformatics (800)

Project No.	Student(s)	Project Title
601X12	Anushka Asar	A Chemical Parasol: Using Natural Compounds to Prevent DNA Damage in the Skin of UV-Sensitive Populations
602T12	Ananya Balachander, Sreemedha Talla	The Effect of Increased Trypsin Concentration Upon Degranulation in an RBL-2H3 Cell Model of Peanut Allergen-Induced Anaphylaxis
603X12	Madison Philpot	Development of novel allosteric inhibitors to commonly used antibiotics that are resistance susceptible
604X12	Tanishta Potluru	E. coli and Household Chemicals
605X12	Naavya Shah	Intracellular Origami: Refolding Mutated TP53 by PRIMA-1 in Acute Lymphocytic Leukemia
606X12	Sarah Veepujarla	Effects of Music on Cognition and Cell Growth in Fruit Flies
801X12	Akshita Biswas	Using Learning Classifiers in Machine Learning to Predict the Likelihood of Ischaemic Stroke
802X11	Nathan Friend	The Percentage of Wolbachia in Land Related Arthropods Compared to Aquatic Related Arthropods
803T11	Amulya Gottipati, Sreeja Iragavarapu	Forecasting the Spread of Dengue Outbreaks with a Synthesis of Machine Learning Models Utilizing Exogeneous Variables
804X12	Rithika Kamalakannan	Brain Tumor Detection
805X11	Aaryav Walter	The Application of Neural Networking to Analyze the Relationship Between Intensive Care Unit (ICU) Medical Diagnosis and Propofol Infusion Syndrome (PRIS).
1907X11	Rohit Kulkarni	Adversarially-Driven Generation of De Novo Proteins for Therapeutic Drug Design

Category Student Count: 14

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LCPS RSEF OFFICIAL ABSTRACT - 2024

A Chemical Parasol: Using Natural Compounds to Prevent DNA Damage in the Skin of UV-Sensitive Populations

 Anushka Asar

Xeroderma pigmentosum (XP) is a genetic condition characterized by an extreme sensitivity to UV radiation due to defective DNA repair. Common symptoms include severe sunburn, blistering, and skin cancer. Because it is incurable, most research regarding XP centers on therapeutic treatments. This leaves ample room for the development of preventative treatments, such as photoprotective compounds, which could prevent UV damage from occurring with minimal side effects. Potential options, such as the xanthophyll carotenoid astaxanthin and a common form of vitamin E called α-Tocopherol (α-T), show promise. These fat-soluble, photoprotective, bioactive compounds have never been used to treat XP before but have been shown to reduce DNA damage caused by UV exposure and promote cell membrane stability. Additionally, previous research has shown that α-T can increase the antioxidant ability of many carotenoids. The purpose of this research is to determine the preventative effect of these compounds, both individually and combined, measured by cell viability and DNA damage post-UV exposure. It is proposed that as concentration increases, cell viability will increase and cell DNA damage will decrease with the combined concentrations causing a greater effect than either astaxanthin or α-T alone. This experiment hopes to find a more widely available, less invasive treatment for UV damage as well as to show that the same cellular pathways observed with α-T and other carotenoids will hold with astaxanthin.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Increased Trypsin Concentration Upon Degranulation in an RBL-2H3 Cell Model of Peanut Allergen-Induced Anaphylaxis

Ananya Balachander, Sreemedha Talla

The prevalence of food allergies has increased in recent years, with approximately 8% of children and 10% of adults affected by severe reactions (Sicherer & Sampson, 2014). In 2017, a genome wide association study found that the Serine Protease Inhibitor B (SERPINB) gene cluster correlated with the incidence of severe food allergies (Marenholz et al, 2017). Expression of the SERPINB10 gene, an inhibitor of trypsin serine protease, correlated with expression of trypsin, an enzyme that breaks down proteins suggesting that inhibition of trypsin may lead to severe food allergies. Research has shown that many food allergens inhibit trypsin activity which may also contribute to severe reactions. Together these results suggest that inhibition of endogenous trypsin activity may lead to severe allergic reactions. This experiment was created to test whether addition of exogenous trypsin could reduce the inflammatory response of cells experiencing IgE-mediated anaphylaxis induced through sensitization by IgE and exposure to peanut extract. The RBL-2H3 murine basophil cell line was used to model the molecular mechanism of peanut allergies. A beta-hexosaminidase assay was used to determine the severity of the allergic reaction by quantifying basophil degranulation. While additional data is still being collected, initial results display that the addition of exogenous trypsin reduces the degranulation of basophils in this peanut extract allergy model. This study may increase the understanding of the role of genetics on the severity of allergic reactions and the potential for developing gene targeted therapies for those suffering life-threatening anaphylaxis due to food allergies.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Development of novel allosteric inhibitors to commonly used antibiotics that are resistance susceptible

Madison Philpot

Beta-lactamase enzymes may have sufficient allosteric sites that will allow for the binding of an allosteric inhibitor. This would potentially change the shape of the beta-lactamase enzyme and block the binding and hydrolysis of beta-lactam. Beta-lactam antibiotics would be able to continue binding to the Penicillin Binding Proteins with little to no struggle and decrease the resistance of the bacteria. The allosteric sites of the beta-lactamase protein were found using a computer program, AllositePro. Along with this the program also found the most viable site and the structure of the ligand that would bind to it. After the ligand was found and ordered, it was added to a solution of Amoxicillin in order for it to bind to the allosteric site of the proteins. A zone of inhibition test and a t-test were then performed in order to test if there was a statistical difference of growth of bacteria after the inhibitor was added. Through AllositePro 100 compounds were discovered to be compatible. The ligand, endo_3666, was determined to be the most compatible through different scores pertaining to von WilleBrand factor, how hydrophobic it is, its h-bond, etc.. Results show that there are non-competitive inhibitors that are compatible with enzymes in Amoxicillin. This will allow it to continue to fight against bacterial infections and diseases that have become resistant to it. This data shows that it is possible for other antibiotics in the penicillin family to stop their bacterial resistance as well.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

E. coli and Household Chemicals

Tanishta Potluru

This paper delves into an experiment that will measure and observe the effects of different household chemicals such as hydrochloric acid, hand sanitizer, and bleach on their removal of E. coli, and their ability to prevent or cause antimicrobial resistance. The results will show which chemical is most effective and if it does or does not promote antimicrobial resistance. This is significant because antimicrobial resistance can lead to the creation of superbugs and create bacteria immune to antibiotics or household chemicals, making it much harder to eradicate. The approach to this experiment will be a controlled environment to ensure that the results accurately reflect the efficacy of each chemical on the bacteria colonies. Each material will be measured out and measurements will differ based on trial number. Key results will include reduction in E. coli population in comparison to the control group and then the other treatments and chemicals used. Assessing how quickly each chemical eradicates the E. coli colonies by observing them at specific time intervals will help determine which chemical is effective the fastest. The information gathered from this experiment will help in the real world by informing the public on what they can use to quickly disinfect surfaces in their homes so that they can reduce the risk of infection by E. coli safely, using the best chemical for the job so as to not create a superbug in the process.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Intracellular Origami: Refolding Mutated TP53 by PRIMA-1 in Acute Lymphocytic Leukemia

Naavya Shah

P53 is a tumor suppressor protein created by the TP53 gene that is mutated in over 50% of all cancers. Current treatments which include chemotherapy and radiation are harmful to the entire body and can cause major long term side effects. Mutant p53 is strongly associated with drug resistance and late-stage malignance, and has an overall negative effect on wild-type p53 activity by its inability to maintain genomic stability and prevent oncogenesis. These mutants also acquire new oncogenic functions, called gain-of-function properties. PRIMA-1, a genetically engineered small molecule has been shown to refold the mutant p53 protein to restore its wild-type capabilities and properties which prevents superfluous cell proliferation without any known effects to the rest of the body. The possibilities of PRIMA-1 in Acute Lymphocytic Leukemia were tested through measurements of apoptosis; cell viability, Caspase-9 inhibition, TUNEL, and gel electrophoresis. All methods yielded strong results, making gene therapy an important target for the future of cancer research.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Effects of Music on Cognition and Cell Growth in Fruit Flies

 Sarah Veepujarla

This research paper focuses on the development, neuroplasticity, and growth of cells as an effect of music. My research question is "How does music stimulate neuroplasticity and cell growth?" This was inspired by my deep passion for music, knowledge in music theory, and my interest in the therapeutic effects of music on cognitive function and mental health. This paper utilizes several investigations in neuroscience and behavioral studies to understand the connection between music and the human brain, and implement my discoveries into my investigation working with the brains of fruit flies. In "The Neurochemistry of Music," Daniel J. Levitin, a cognitive psychologist, neuroscientist, and musician, explains how music engages parts of the brain and facilitates the release of neurotransmitters, including dopamine and serotonin. Music and the Mind was written by Anthony Storr, a psychiatrist, and explains the benefits of music, how it is able to reduce stress and anxiety in the realm of mental health. Storr also asserts that music provides a healthy environment for neuroplasticity, supporting the brain's growth and health. Ani Patel, a cognitive psychologist, wrote "Music-Induced Brain Plasticity" to explain the outstanding ability of the brain to grow new neurons and reorganize neural pathways after listening to music. The works of Daniel J. Levitin, Anthony Storr, and Ani Patel effectively prove how music can promote structural changes, the release of neurotransmitters, the reduction of stress, and much more in the brain.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Using Learning Classifiers in Machine Learning to Predict the Likelihood of Ischaemic Stroke

 Akshita Biswas

An ischaemic stroke accounts for about 87% of all strokes, and can be debilitating if not treated quickly. Ischaemic strokes are life-threatening, occurring when the brain does not receive a sufficient amount of blood supply, leading to lack of oxygen to the brain and subsequent death of brain cells. People in developing countries rarely have access to expensive means of diagnosis like CT and MRI scans, not realizing they are at a high risk of stroke until it is too late to provide treatment. The average rate of misdiagnoses of the disease is approximately 9% - a concerning rate. This research will develop three machine learning models - Logistic Regression, K Nearest Neighbors, and Random Forest Classifier, and analyze which model has the highest accuracy, to create a means of diagnosis that can be more accurate and accessible. Data of 5,110 patients with and without ischaemic stroke will be preprocessed and split into a training to testing ratio of 80:20. Evaluation metrics will then be used to determine the best model. The Random Forest Classifier model had an accuracy of 0.5 and an F1 score of 0.17, suggesting that this model is only 50% accurate in predicting the likelihood of ischaemic stroke. However, the model will be further improved to make it more accurate. Data collection is currently ongoing for the Logistic Regression and K Nearest Neighbors models. This research may help avoid the issue of misdiagnoses and serve as an inexpensive and highly-accessible means of disease detection.

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Liu Y., Yin B., & Cong Y. (2020). The Probability of Ischaemic Stroke Prediction with a Multi-Neural-Network Model. Sensors (Basel, Switzerland), 20(17), 4995. https://doi.org/10.3390/s20174995

Someeh, N., Mirfeizi, M., Asghari-Jafarabadi, M., Alinia, S., Farzipoor, F., & Shamshirgaran, S. M. (2023). Predicting mortality in brain stroke patients using neural networks: outcomes analysis in a longitudinal study. Scientific reports, 13(1), 18530. https://doi.org/10.1038/s41598-023-45877-8

LCPS RSEF OFFICIAL ABSTRACT - 2024

The Percentage of Wolbachia in Land Related Arthropods Compared to Aquatic Related Arthropods

 Nathan Friend

Wolbachia is a quite common endosymbiotic proteobacteria that is found in many arthropods and nematodes. Due to its incredible ability to spread, it covers somewhere between 40-70% of arthropod species in the world. Wolbachia also has not been researched enough for its origin to be known though it is mainly found in land arthropods. It is thought to have great promise in becoming a block in disease transmission. However, many strains of Wolbachia are parasitic and they could prove to be dangerous to the ecosystem if introduced manually. In this experiment DNA was extracted from several different arthropod species that were naturally caught in Northern Virginia. The species include flies, Drosophila, isopods, and centipedes. After DNA is extracted, PCR will be performed to secure enough Wolbachia DNA to perform electrophoresis. As of this writing, the DNA for Drosophila, isopods, and centipedes has been extracted. Gel electrophoresis will be performed to collect data on the infection rate in the arthropod species listed. Data collection is currently continuing.

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Serbus, L. R., Casper-Lindley, C., Landmann, F., & Sullivan, W. (2008). The genetics and cell biology of Wolbachia-host interactions. Annual review of genetics, 42, 683-707.
https://www.annualreviews.org/doi/abs/10.1146/annurev.genet.41.110306.130354

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Forecasting the Spread of Dengue Outbreaks with a Synthesis of Machine Learning Models Utilizing Exogeneous Variables

Amulya Gottipati, Sreeja Iragavarapu

Dengue fever, a viral mosquito-borne disease, is becoming more prevalent in previously unaffected regions, posing economic and health burdens in developing countries. According to the CDC, about four billion people live in areas with high dengue incidence. South America, one of the most severely affected regions, spends three billion dollars annually on dengue treatment. Unfortunately, there are no antiviral drugs to treat dengue infections, requiring patients to solely rely on palliative treatment. Hence, there is an imminent need for proactive precautions. Forecasting future epidemics will aid public officials in implementing mitigation efforts by predicting the number of dengue cases. The purpose of this study was to develop a machine learning model that forecasts the incidence of dengue outbreaks temporally and geographically by utilizing eco-climatic and socioeconomic factors. Methods included preprocessing monthly dengue cases, precipitation, humidity, and socioeconomic datasets from seven countries (between 2014-2023) before performing a principal component analysis. A novel topographical feature applied to the model was stagnant water, a critical breeding ground for mosquitoes. A ridge regression technique was used to manage multicollinearity within the data before applying it to the seasonal autoregressive integrated moving average (SARIMA) model, which accounts for the seasonality aspect of the variables being examined. This study aimed to create a forecasting algorithm capable of predicting dengue outbreaks six months in advance with high accuracy. Therefore, this algorithm can assist public health officials with planning proactive measures, significantly diminishing economic stress, infections/deaths, and dengue transmission, improving the quality of life in dengue-endemic countries.

Dengue emergency in the Americas: time for a new continental eradication plan. (2023). The Lancet Regional Health - Americas, 22. https://doi.org/10.1016/j.lana.2023.100539

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Brain Tumor Detection

 Rithika Kamalakannan

This project deals with taking MRI brain scans to detect whether patients are diagnosed with having meningioma, pituitary, glioma, or as being healthy. Using Python and TensorFlow, I can use code to classify these images using a Convolutional Neural Network. Furthermore, the steps that take place are the following: image visualization, image processing, data distribution, building the CNN, training the CNN, model evaluation, hyperparameter tuning, and deployment. The goal of this is to reduce the cost of diagnosis while improving the efficiency of Brain Tumor Diagnosis.

Object detection : Tensorflow Lite. TensorFlow. (n.d.). https://www.tensorflow.org/lite/examples/object_detection/overview

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Saeedi, S., Rezayi, S., Keshavarz, H., & R Niakan Kalhori, S. (2023, January 23). MRI-based brain tumor detection using convolutional deep learning methods and chosen machine learning techniques. BMC medical informatics and decision making. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9872362/

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Application of Neural Networking to Analyze the Relationship Between Intensive Care Unit (ICU) Medical Diagnosis and Propofol Infusion Syndrome (PRIS).

Aaryav Walter

Propofol (2,6-diisopropylphenol) remains a popular intravenous anesthetic choice for several surgical procedures (Seger, 2019). Since Propofol has been infamous for causing lethal side effects to vital mitochondrial processes, long term exposure to this agent is strictly prohibited. Likewise, Propofol has also been known to cause Propofol Infusion Syndrome (PRIS), a rare but deadly condition that can severely impair patients. The recent outbreak of Coronavirus has exacerbated the frequency of various medical conditions–due to cardiovascular and immunobiological features–including PRIS.

Researchers, so far, have failed to identify significant biomarkers and explicit causes of PRIS due to the infrequent nature of the condition, however, have addressed a link between its frequency and certain cardiovascular features (Krajcova et al, 2015). Once diagnosed, PRIS accompanies a saturated toxicity level that preys on the mitochondrial functions of the human body. Accordingly, the effects of the condition's high toxicity can be revealed through harsh stress on the body primarily seen in members of the cardiovascular system (Krajcova et al, 2015).

This research investigates the underlying pathology and causes of PRIS through the aberrant lens of machine learning; accordingly, the relationship between influential medical diagnosis in the intensive care unit (ICU) and the rate of PRIS (in real PRIS cases) will be assessed using a neural network system to reveal any correlation impactful for research. The machine will be able to predict PRIS outbreak using medical diagnosis features as inputs (to an extent). So far, the artificial neural network is undergoing development to reach this goal.

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Mirrakhimov, A., Voore, P., Halytskyy, O., Khan, M., & Ali, A. (2015). Propofol infusion syndrome in adults: a clinical update. Critical care research and practice, 2015(260385). National Library of Medicine. https://doi.org/10.1155/2015/260385

Krajcova, A., Waldauf, P., Andel, M., & Duska, F. (2015). Propofol infusion syndrome: a structured review of experimental studies and 153 published case reports. Critical Care, 19 (398). BioMed Center. https://doi.org/10.1186/s13054-015-1112-5

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Adversarially-Driven Generation of De Novo Proteins for Therapeutic Drug Design

 Rohit Kulkarni

Proteins are critical components of life that have shown promising results as synthetic medications. However, the process of developing therapeutic proteins requires immense amounts of time for testing and validation, driving up costs of healthcare and ultimately costing lives. Machine Learning (ML) has shown to be a powerful tool that can understand complex protein sequences and recent research has taken advantage of its capabilities for protein design. However, limited methods exist to do so, and to the extent of current literature, existing models do not ensure that output therapeutics are both feasible enough to prevent unnecessary testing and diverse enough to battle a wide array of conditions. As such, this work develops Cycle-Consistent Conditional Protein Generative Adversarial Network, or CCC-ProGAN, which utilizes secondary structure and primary structure design objectives in order to produce peptide-based therapeutics. After conditioning, CCC-ProGAN is evaluated on a test dataset of 65 samples and 15 randomly generated proteins, showing that CCC-ProGAN is a good candidate for protein generation and a valuable tool for future drug design efforts.

Dara, S., Dhamercherla, S., Jadav, S. S., Babu, C. M., & Ahsan, M. J. (2021, August 11). Machine Learning in Drug Discovery: A Review. Artificial Intelligence Review, 55, 1947-1999. https://doi.org/10.1007/s10462-021-10058-4

Huang, P.-S., Boyken, S. E., & Baker, D. (2016, September 14). The coming of age of de novo protein design. Nature, 537, 320-327. https://doi.org/10.1038/nature19946

 Sun, D., Gao, W., Hiu, H., & Zhou, S. (2022, February 11). Why 90% of clinical drug development fails and how to improve it? Acta Pharmaceutica Sinica B, 12(7), 3049-3062. https://doi.org/10.1016/j.apsb.2022.02.002

Earth & Environmental Sciences (900)

Project No.	Student(s)	Project Title
901T12	Dyuthi Akasam, Nandita Sugasi	Best Soil Conditions for Food
902X12	Jack Arnold	The Effect of Relationships in an Aquatic Community
903X12	Lilly Cameron	Nitrogen Content of Lichens as a Bioindicator of Data Center Impact on Air Quality
904T12	Emily Champagne, Gillian Deal	The Effect of Iron in Pleurotus ostreatus (oyster mushroom) as a Bio Filtration Device
905X12	Nick Clippinger	Effects of Plastic Leachate on Oxygen Production in Aquatic Plants
906X12	Olivia Cohn	The Effect of Zophobas Morio on Breaking Down Polystyrene in Different Environments in the Pursuit of a New Waste Mediation System
907X12	Layla Davis	A Correlation Between Chesapeake Bay pH Levels and Oyster Shell Size
908X12	Sarah Divins	Earthworms Response to Climate Change
909T12	Jordan Chand, Holly Dunn	Are Fiddler Crabs Fit Bioindicators for Microplastic Pollution in the Chesapeake Bay?
910X11	Kaobimdi Ezumah	The Effect of Herbs/Spices on Drosophilas with Spinocerebellar Ataxia
911X12	Nate Garland	Uptake of Heavy Metals via Echinometra mathaei (sea urchins): Aquatic Remediation using Spines
912X12	Ashley Gingerich	An Investigation Comparing Rural and Developed Soil Health in Loudoun County Communities
913X12	Vyasa Hari	A Novel Fruit Fly Repellant
914X11	Arwa Kadri	Removing Perchlorate from Mars Regolith
915X12	Zoe Korff	The Chemical and Physical Effects of Climbing Chalk on Crustose and Foliose Lichen
916X12	Aaron Labatch	An Evaluation on Need and Placement of Category IV Buildings Based on Seismic Hazard Zones in Rural Communities
917X11	Sidney Latta	Analysis of environmental variables on the prevalence of Dreissena polymorpha; an assessment utilizing United States Geological Survey and Geological Information Systems data sources
918T12	Riya Khanna, Sonia Mahboob	The Effectiveness of Natural Oils against UVA Rays: An Environmentally Friendly Alternative
919X11	Nandha Menon	The Effect of Arbuscular Mycorrhiza on the Survival Rate of Plants Susceptible to Flooding
920X12	Lyn Motter	Studying Water Conservation Programs to Enhance Water Security in Drought-Prone Communities
921T12	Deborah Olorunda, Tori Rabinowitch	The Effect of Sunscreen Agents: Homosalate, Octocrylene, Avobenzone, and Zinc Oxide on The Cell Growth and Decay of Nannochloropsis Oculata
922X12	Wyatt Phillips	Testing Different Water Sources that Lead into the Potomac River to see if they Contribute to the Nutrient Overflow in the Chesapeake Bay.
923T12	Nikita Rao, Sanjana Rao	The Effect of Flavonoids on the Growth/Protection of Phaseolus lunatus L. (lima beans) when Introduced with Soil Nematodes.
924X11	Arturo Romero	The Effect of Temperature Spikes and Mild Winter Temperatures on the Germination of Native Species from Virginia
925X12	Emma Rosher	The Effect of Green Roofs on the Energy Usage of Data Centers in Loudoun County
926X11	Jas Sarna	Assessing the Impact of Microplastic Pollution on Fucus Seaweed and Reef Zooplankton

Project No.	Student(s)	Project Title
927X12	Yazhini Sathguru	Azolla Caroliniana's Phytoremediation Effect on Nitrate
928T12	Nardos Mengesha, Veer Sidhu	The Effect of Organic Pesticide Eugenol on the Innexin Genes of Lymnaea Stagnalis
929X12	Siena St. James	The Effect of Oxybenzone on Green Algae Euglena
930T12	Sakthi Senthil Nath, Harshini Thikkalathuru	The Effect of Root Type on the Filtration of Ammonia and Nitrate as a Biofilter
931T11	John Hays, Sammi Tomlinson	Studying the Relationships Between Physicochemical Factors and Phytoplankton as Methods of Determining Water Quality in the Potomac River
932T12	Ankita Kamath, Isha Uppalli	The Prevalence of Microplastic Contamination on Microplastic Abundance Variation Across Different Locations
933X12	Nura Warsame	Which plant grows best in Mars Regolith?

Category Student Count: 43

LCPS RSEF OFFICIAL ABSTRACT - 2024

Best Soil Conditions for Food

Dyuthi Akasam, Nandita Sugasi

This research study carefully examines the intricate relationship between soil composition and the growth of plants used for consumption in Northern Virginia. A meta-analysis done by authors from the Soil Science Society of America Journal reveals that soil and nutrient management is crucial in agriculture due to its direct impact on plant health and yield (Jones et al., 2018; Havlin et al., 2014). Thus, this study addresses the need for tailored recommendations regarding soil and nutrient conditions for common plant species used for consumption in NOVA. The goal is to create a user-friendly web application that provides customized recommendations for optimal growth conditions. An extensive review of existing information about various plant health factors was organized in Google Sheets. Leveraging insights from Jackson Stone's (2016) study, HTML, CSS, Java, and PHP were identified as suitable tools for developing the web application. Our research showed that many plants have certain pH levels, soil compositions, and nutrient concentrations that help them optimize growth. For example, loamy soils are beneficial for fruit trees, perennials, and trees. Silty soils are good for shrubs, trees, and vegetables. Sandy soils support native coastal plants and root crops (Native Plants for Northern Virginia Plant Guide, n.d). There are many more categorizations like these. This categorization technique aids in providing tailored soil/nutrient recommendations for each plant. On the website, users can effortlessly enter their information and navigate through the soil/nutrient conditions returned. Overall, our findings and website help to promote agricultural sustainability in Northern Virginia

Jones, G., et al. (2018). The Impact of Soil pH on Crop Productivity: A Meta-analysis. Soil Science Society of America Journal, 82(2), 451-458. DOI: 10.2136/sssaj2017.08.0303

Native Plants for Northern Virginia. (n.d.) https://www.novaregion.org/DocumentCenter/View/10615/Northern-Virginia-Native-Plant-Guide---FINAL#:~:text=The%20geology%20and%20soils%20of

Stone, J. (2016). Which language(s) are best (for web development) Which language(s) are best (for web development). https://scholar.utc.edu/cgi/viewcontent.cgi?article=1065&context=honors-theses

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Relationships in an Aquatic Community

 Jack Arnold

Looking at the relationships organisms form in communities can assist organisms in captivity. Simulations of communities could lead to better understandings of ecological relationships, benefiting endangered species in captivity, and would be able to help boost their populations. Aquatic communities including Brine Shrimp (Artemia salina) and Copepoda with Coontail (Ceratophyllum demersum) with Phytoplankton were observed to develop an understanding of their relationships and species interactions. Five communities were established: control (all species) and four other communities, each with either Artemia salina, Copepoda, Ceratophyllum demersum or Phytoplankton missing. Each of the organisms have their own role to play; Ceratophyllum demersum or the Phytoplankton act as producers, the Copepods are first tier consumers and Artemia salina act as the predators. Seeing the organism reproduce and fight over resources and eggs being laid and shells being shed shows growth in the community. The control condition showed this type of stable community. The group with no Ceratophyllum demersum lacked a source of oxygen and food, leading to starvation of the consumers. The group lacking Artemia salina had no predator to prevent the Copepoda from becoming the highest in the food chain. Errors included contamination of the environments by foreign organisms through air holes. Observing organisms' behavior we can predict and try to simulate conditions of the wild in captivity, perhaps being able to save organisms that are endangered, by creating a community for them to thrive safely and securely.

Surtini, R. (2021, May 6). ,. , - YouTube. Retrieved February 29, 2024, from https://www.cambridge.org/core/journals/oryx/article/surrogate-rearing-a-keystone-species-to-enhance-population-and-ecosystem-restoration/2CCEEC3514C4077FC0975FEE950A0178

Surtini, R. (2021, May 6). ,. , - YouTube. Retrieved February 29, 2024, from https://academic.oup.com/ilarjournal/article/54/1/41/668841

Surtini, R. (2021, May 6). ,. , - YouTube. Retrieved February 29, 2024, from https://link.springer.com/article/10.1007/s10806-015-9537-z

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Nitrogen Content of Lichens as a Bioindicator of Data Center Impact on Air Quality

Lilly Cameron

Undergoing intense development, Loudoun County has experienced the construction of over 100 data centers in the past 50 years. Data centers commonly produce exhaust containing harmful nitrogenous pollution into the atmosphere which impacts air quality. In the summer of 2019, prior to the coronavirus outbreak, an unusually high number of respiratory illnesses were reported in northern Virginia. Particularly, workers inside of data centers experienced a greater risk of developing a respiratory problem. The intent of this research was to determine the extent to which these pollutants affected the environment.

Lichens are bioindicators of air pollution and can be used to measure harmful nitrogen content in the atmosphere since they absorb nutrients from the atmosphere and therefore air pollutants as well. Lichen samples were ground, digested in sulphuric acid, distilled and titrated via the Kjeldahl method to determine nitrogen content per sample. Preliminary indication shows that samples taken from near data centers contain some degree of nitrogen. This data will be compared to nitrogen content of lichen samples taken from woods away from data center pollution to determine extent of nitrogenous pollution. As people and work continues to increase online, data centers become more integral and their environmental impact should continue to be monitored and regulated.

BYJU's. (2023). Kjeldahl Method for Nitrogen Determination - Detailed Description & Limitations of Kjeldahl Method. BYJU'S. Retrieved October 20, 2023, from https://byjus.com/chemistry/kjeldahl-method/

Kunkle, F. (2019, August 2). Respiratory illnesses in Virginia puzzles health officials. Washington Post. Retrieved October 20, 2023, from https://www.washingtonpost.com/dc-md-va/2019/08/02/virginia-reports-higher-than-usual-number-respiratory-illnesses/

Cummins Inc. (2023, August 11). Data centers are reducing their NOx emissions. Cummins. Retrieved October 20, 2023, from https://www.cummins.com/news/2023/08/11/data-centers-are-reducing-their-nox-emissions

LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Iron in Pleurotus ostreatus (oyster mushroom) as a Bio Filtration
Device

Emily Champagne, Gillian Deal

Oil spills are the biggest cause of environmental pollution in the world, causing millions of dollars of damage and a loss of wildlife. This experiment aims to test if the biofiltration using *Pleurotus ostreatus* (oyster mushroom) can be sped up (dependent variable) with the addition of iron chelate (independent variable). Oyster mushrooms have an enzyme called manganese peroxidase (MnP) that can filter out oil. The project is based on the knowledge that oyster mushrooms can be used as a biologically active filtration medium. Logs were used to grow mushrooms, half with iron, and half without. Data collection is ongoing. One further question would be: could this experiment be used on a bigger scale in real environments such as a lake or ocean after an oil spill?

Kumar, A & Kumar Arora, P. (2022) Biotechnological applications of manganese peroxidases for sustainable management. *Frontiers in Environmental Science*, 10. https://doi.org/10.3389/fenvs.2022.875157

How does NOAA help clean up oil and chemical spills? (n.d.). https://oceanservice.noaa.gov/facts /spills-cleanup.html

National Oceanic and Atmospheric Administration. (2023). https://www.noaa.gov/education/resource-collections/ocean-coasts/oil-spills#:~:text=But %20when%20oil%20accidentally%20spills,and%20help%20the%20ocean%20recover.

LCPS RSEF OFFICIAL ABSTRACT - 2024

Effects of Plastic Leachate on Oxygen Production in Aquatic Plants

Nick Clippinger

The pollution of the world's oceans and waterways by plastic is a growing concern, with millions of tons of plastic discarded into the environment each year. When exposed to sunlight and other natural elements, plastics begin to physically and chemically decompose. Due to the sheer abundance of plastics discarded into the environment, there are potentially millions of tons of plastic slowly leaching hazardous chemicals into the environment. As a result, chemicals used as stabilizers, flame retardants, and processing agents are released into the environment when plastics break down. These chemicals are often unregulated or unknown and their effect on the environment is not fully understood.

The purpose of this research was to determine the effects of plastic leachate on oxygen production. Elodea were placed into ten aquatic ecosystems, which contained squares of polyethylene terephthalate plastic added to the substrate. Statistical analysis of the results indicated that the experimental group (exposed to the plastic) displayed a lower average dissolved oxygen content and a lower average daily change over the course of the research. The continued breakdown of plastics in the environment, even in fairly cool conditions with an average amount of sunlight cause far-reaching effects on the surrounding environment and the environment as a whole, as aquatic plants provide oxygen to aquatic ecosystems. Further research would entail examining leachate effects on low trophic level organism to see how these harmful plastics move up the food chain.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Zophobas Morio on Breaking Down Polystyrene in Different Environments in the Pursuit of a New Waste Mediation System

Olivia Cohn

The amount of waste in landfills has been increasing at an astounding rate in recent years. Alongside global warming, pollution practices, carbon dioxide emissions, and major factory produced waste, the improper disposal of materials is leaving a lasting impact on the earth. Testing will be conducted on Superworms to determine their eating habits in environments with different food sources. In this experiment, Zophobas Morio will be placed in three different environments to test their eating habits. The three environments will include their regular diet of fruits, a simulated compost environment with fruits and trash, and a final environment of only styrofoam. Their eating behavior will be tracked, along with the amount of food eaten, to see whether a garbage mediation system can be created. Zophobas Morio, the larva of the Darkling Beetle, is capable of breaking down polystyrene. This is a plastic commonly found in items such as styrofoam, cd cases, and egg cartons. In recent years, testing has been conducted to collect data on the larva's ability to break down the plastic. Styrofoam and plastics are a major contributor to the Earth's garbage crisis and growing size of landfills. One piece of styrofoam can take up to five-hundred years to decompose.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

A Correlation Between Chesapeake Bay pH Levels and Oyster Shell Size

Layla Davis

Ocean Acidification is caused by an increasing amount of carbon dioxide in the atmosphere dissolving into the ocean. NOAA Fisheries found that dissolved carbon dioxide causes a decrease in pH levels which eats away at the minerals necessary for molluscs to build their shell. The Baltimore Sun then states that this will make it much harder for oysters, clams, sea urchins, and even coral to make their protective shell. That being said, in the view of the fact that the Chesapeake Bay is one of the most productive fisheries and is responsible for a big portion of Americans oyster, clam, and blue crab harvest, according to the Maryland Department of the Environment, a stunt in growth or production of these sea creatures could cause a dilemma.

My project takes this information, and puts it to the test by questioning if there is a correlation between the size of the Crassostrea virginica oysters and the acidity of the Chesapeake Bay waters. I started the search to test my hypothesis by taking twelve oyster shells from selected rivers of the Chesapeake Bay and measuring their length and width. Then, I researched the pH levels of the waters in the selected locations corresponding to my oyster shells.

After finding the mean of both the length and the width of the two groups of oysters, I plugged the information into a graph, along with the pH. Once placed into a graph, it can be seen that the length of the oysters from the location with more acidic waters is smaller, but the width is greater compared to the location with less acidic water.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Earthworms Response to Climate Change

 Sarah Divins

Climate change is an ever growing problem that affects the ecosystem around the world. Many plants have died off and plants remain at the basis of the food chain. Worms, moreover, have been shown to improve soil conditions as they produce "worm castings". Castings are matter disgusted through the worm and contribute Nitrogen, Phosphorus, potassium and other nutrients to the soil. By testing how the worms respond to climate change, farmers or gardeners are able to better understand how to adapt to the rapidly changing climate. To test their ability to cast their bile, I will sterilize soil, then add the worms. The humidity, light index, and temperature will be the variables that will differ from the control group based on their preferred environment, and a container with no earthworms. Every week I will test the pH, Phosphorus, nitrogen and potassium within the soil and compare it to the control and the sterile land. Results are currently in the work, but I intend to have my findings used to benefit crop and farmer yield and use the data for prevention and adaptation for future climate change.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Are Fiddler Crabs Fit Bioindicators for Microplastic Pollution in the Chesapeake Bay?

Jordan Chand, Holly Dunn

The purpose of the study was to evaluate whether or not blue legged hermit crabs are effective bioindicators for microplastic pollution. The goal was to assess whether or not crustaceans as a whole may be a more effective alternative to bivalves as bioindicators. A total of 18 blue legged hermit crabs were fed varying ratios of microplastics by volume. After four days of feeding, the crabs were frozen and their bodies were cut in half, placed on microscope slides, labeled, and analyzed. The analysis showed that when fed higher concentrations of microplastics, blue legged hermit crabs have higher amounts of microplastics in their systems, and when fed lower amounts of microplastics, they have lower amounts of microplastics in their system ($p < 0.05$). This data suggests that blue legged hermit crabs do not selectively ingest microplastics, which means they may be a fit bioindicator for microplastic pollution in marine environments. The study supports the hypothesis that blue legged hermit crabs do not suggestively ingest microplastics. Because there are a diverse number of crab species across the globe it would be beneficial to conduct further research to conclude whether or not all crabs perform similarly as bioindicators. The study was limited in size and therefore further studies should be conducted with larger test groups as well as more various amounts of microplastics. Further research should be done to determine whether the conclusion from the study may be generalized to all crustaceans or exclusively crabs.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Herbs/Spices on Drosophilas with Spinocerebellar Ataxia

Kaobimdi Ezumah

Spinocerebellar Ataxia(SCA) is a neurodegenerative disease that causes a loss of stability, coordination and balance. There is no target cause of this disease because it is a hereditary ataxia. It is caused by an excess gene mutation which binds with another gene.

There has been much research on this disease and its treatments, both therapeutic and physical; but there has been less research on how basic herbs like ginkgo biloba and turmeric can improve these symptoms. Most of the research done on this topic is not prominent or approved; they are done by the people of small villages all over the world. They use turmeric, sage, canola oil, peppermint oil and much more to treat their problems because there are no medical facilities around. Multiple trials were conducted to test how two herbs/spices plus a control group will affect the movement and coordination of the drosophila melanogaster. Turmeric oil, and ginkgo biloba were infused with the food of drosophila. The drosophila activity monitor keeps track of the movements and rests of the drosophila, allowing to know how these spices/herbs affect drosophilas and their activities throughout the experiment.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Uptake of Heavy Metals via Echinometra mathaei (sea urchins): Aquatic Remediation using Spines

Nate Garland

Mining and nuclear disasters have caused an increase in levels of heavy metals in our oceans, such as copper sulfate. Previous studies indicate that sea urchins have the unique ability to absorb substances via their spines. The intent of this research is to explore the possible role of sea urchins as a bioremediator. One gram of sea urchin spines were added to each of 10 samples of water containing 0.15 M copper sulfate. Using a spectrophotometer, samples were analyzed at 7, 14, and 21 days as a means to determine whether the uptake of heavy metals via spines occurred.

It was determined that although the mean difference in copper sulfate concentration between days 1 and 21 was not statistically significant, removal of copper sulfate from the water by the spines did occur. Further research would entail increasing the amount of spines (hence sea urchins) for remediation as well as determining at what point illness and death would occur in the wild since no live urchins were used in this research. Testing the removal of other types of heavy metals is also prudent. Research into the effects of these metals on sea urchins is important as they serve as a food source for some marine mammals and could contribute to bioaccumulation in tissues if eaten. They also contribute to the overall health of ecosystems and could possibly serve as bioremediators.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

An Investigation Comparing Rural and Developed Soil Health in Loudoun County Communities

 Ashley Gingerich

Loudoun County was established in 1757, with the oldest community dating back to 1734. In recent years, there has been an increase in urban dwellers moving to rural areas in Loudoun County, thereby increasing human interaction with soil previously used for agriculture. With such population growth, a study to quantify the effect of human settlement on soil health is imperative to predict the future of Loudoun County's environmental and community health. A wealth of biodiversity in the soil is linked with a stable ecosystem that is capable of suppressing pathogens and healthy soil contributes to better air quality, ensures a sustainable food system, and is linked with enhanced human immunoregulation.

The study utilizes bulk density, water content, aggregate stability, pH, Nitrate/Nitrite, and respiration tests to gain insight into the health of soil in three Historic Communities and three Developing Communities: Old Town Waterford, Historic Bluemont, Middleburg, The Villages at Round Hill, Village Case in Purcellville, and Lansdowne at the Potomac. The objective of this study is to analyze and compare soil health between developed and historic communities within the county

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LCPS RSEF OFFICIAL ABSTRACT - 2024

A Novel Fruit Fly Repellant

Vyasa Hari

Throughout history, the elusive problem of fruit fly infestation has sustained over numerous trials in making an effective repellant. The scientific goal of this project is to determine a flavonoid repellant that will prove to be a withstanding counteragent to fruit fly infestation and eliminate possibility of physical damage to fruit flies. To achieve this goal, three different flavonoids (Naringenin, Kaempferol, and Apigenin) were utilized. After designing an experimental chamber using water bottles and adding fruit flies, cotton balls were placed on both ends. One end held a cotton ball with water and the other end held a cotton ball with one of the flavonoid substances. Then, the chamber was supervised over a period of time to assess which side the fruit flies were attracted by, thus displaying whether or not the flavonoid was effective in repelling fruit flies. After running numerous trials with each type of flavonoid, Apigenin was determined to to be the most effective repellant against fruit flies of various species. Across all trials, there seemed to be a strong indication that fruit flies preferred water over staying near Apigenin found in its chamomile-based substance form. For other flavonoids, such a strong indication was not able to be established. In establishing Apigenin as an effective repellant, it can further be utilized in making commercial products designed to prevent fruit fly infestation and preserving food storage areas. Apigenin can provide needed preservation of our food supply and overall safety.

Daniela M. Ramírez-Moreno, Klaus F. Lubinus, Andre J. Riveros; The flavonoid kaempferol protects the fruit fly Drosophila melanogaster against the motor impairment produced by exposure to the insecticide fipronil, J Exp Biol, Volume 225, Issue 20, 15 October 2022, Pages 1-9.

Michael F Wangler, Shinya Yamamoto, Hugo J Bellen, Fruit Flies in Biomedical Research, Genetics, Volume 199, Issue 3, 1 March 2015, Pages 639-653.

Shah FM, Guddeti DK, Paudel P, Chen J, Li XC, Khan IA, Ali A. Matricaria chamomilla Essential Oils: Repellency and Toxicity against Imported Fire Ants (Hymenoptera: Formicidae), Molecules, Volume 28, Issue 14, 22 July 2023, Pages 1-9.

LCPS RSEF OFFICIAL ABSTRACT - 2024

Removing Perchlorate from Mars Regolith

 Arwa Kadri

In the next 50 years, as NASA prepares for future people who may travel to Mars to make a living there, they have been collecting data and are planning for the ways to make living on Mars possible (Eichler). This involves agriculture on Mars crucial for the survival of humans living on that planet. However, the source of perchlorate residing within the regolith of Mars, prevents that from being safe for humans to consume any plants and also prevents plants from being grown on Mars. However, the filtration of perchlorate through a reverse osmosis system can help clean out the perchlorate when the water is run through the regolith. Figuring out whether the possibility of filtering out perchlorate is possible, functional, and cheap is vital and can be beneficial to the future explorers heading towards Mars. Because NASA and in situ (Resource Utilization) would need to figure out ways to make abundant amounts of needs for these explorers to live off of without it getting too expensive (Kasiviswanathan). The construction of this filtration system is simple with the use of a reverse osmosis filter which can successfully clean water affected by perchlorate.

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2. Kasiviswanathan, P., Swanner, E. D., Halverson, L. J., & Vijayapalani, P. (2022). Farming on Mars: Treatment of basaltic regolith soil and briny water simulants sustains plant growth. PLOS ONE, 17(8), e0272209. https://doi.org/10.1371/journal.pone.0272209

LCPS RSEF OFFICIAL ABSTRACT - 2024

The Chemical and Physical Effects of Climbing Chalk on Crustose and Foliose Lichen

Zoe Korff

Amidst a rise in the popularity of outdoor rock climbing, cliffside ecosystems have displayed signs of increasing disruption and damage to the local taxa. Climbing chalk, magnesium carbonate hydroxide, has been suggested to contribute to this effect. This study examined the extent to which climbing chalk impacts cliffside vegetation by altering the chemical or physical environment. It was hypothesized that climbing chalk will negatively influence the health of local flora through either physical or chemical disturbances. Crustose and foliose lichen are abundant in climbing environments, useful bioindicators, and readily available for laboratory studies. Lichens were subjected to two different conditions of climbing chalk: one in solution to examine the impacts of the chalk's alkalinity, and another with chalk in powder form to examine it as a physical barrier. Lichen health was quantified by measuring changes in surface area and color. Data is expected to indicate an adverse relationship between the application of chalk and the observed health of specimens. However, due to the limited duration of this study, differences between the two chalk conditions are expected to be minor. These outcomes suggest that future research for conservation efforts should focus on longitudinal studies to determine if climbing chalk has a significant effect on the environment and may warrant mitigation.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

An Evaluation on Need and Placement of Category IV Buildings Based on Seismic Hazard Zones in Rural Communities

 Aaron Labatch

Rural communities face unique challenges in the aftermath of earthquakes. Their dispersal, limited infrastructure, and often inadequate communication networks make them particularly vulnerable to the impacts of these disasters. This research endeavored to examine the concept of seismic resilience in rural communities, highlighting the disparities in post-earthquake aid access compared to urban areas. Maps of earthquake-prone rural communities were created using ArcGIS and geospatial data. Geospatial data of population density and existing Category IV buildings (e.g., hospitals, emergency shelters) were analyzed to determine ideal locations for additional Category IV structures. By utilizing ArcGIS software, this study aimed to identify areas prone to seismic hazards in rural communities, assess their specific vulnerabilities, and propose solutions to enhance their resilience.

Priority was given to sites that both address seismic risk zones and improve access to aid for communities that, as past events demonstrated, would struggle with timely assistance. Studied regions include Nippes, Haiti; Kahramanmaras, Iran; Uzunbağ, Turkey; Al Haouz, Morocco; Anamizu, Japan; and Acapulco, Mexico. It was determined that there are numerous potential locations for new Category IV buildings in each studied region. Some locations such as Puerto Rico's Gonaïves Island lack any hospitals altogether, meaning injured people in a disaster would need to be airlifted to the main island–a stark example of inequitable healthcare access. By addressing gaps in disaster response infrastructure through data analysis and mapping, this research offers practical solutions to strengthen the resilience of vulnerable rural communities.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Analysis of environmental variables on the prevalence of Dreissena polymorpha; an assessment utilizing United States Geological Survey and Geological Information Systems data sources

Sidney Latta

The establishment of Zebra Mussel (Dreissena polymorpha) populations throughout the continental United States poses a large threat to the ecological and human populations in the environments in which they are created. However, specific environmental factors impact the likelihood of the establishment of a Zebra Mussel population. Using data collected from the USGS non-indigenous species database, a GIS analysis was performed to determine the ecological factors that can be used to predict possible future infestations throughout the continental United States. The USGS data was cross referenced with ArcGIS data before a statistical analysis was performed in GIS. Data is still being analyzed.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effectiveness of Natural Oils against UVA Rays: An Environmentally Friendly Alternative

Riya Khanna, Sonia Mahboob

Skin damage from UVA rays prompts the use of sunscreens containing harmful chemicals like oxybenzone, posing threats to marine life. In response, using eco-friendly alternatives, like marula and red raspberry natural oils. In the experiment, various oil groups–marula oil, marula oil+lignosulfonate, red raspberry seed oil, red raspberry seed oil+lignosulfonate, and a control group with no oil–were applied to five glass jars to measure UVA light absorption. Seventy-five red wiggler earthworms were exposed to these oils to assess physical damage from UVA rays. Statistical analysis using an ANOVA test revealed a significant difference in UVA light absorption among the oil groups. The red raspberry seed oil+lignosulfonate exhibited the lowest absorption, with a mean of 26.51mW/m^2, challenging the experimental hypothesis that marula oil, with its high SPF level of 50 combined with lignosulfonate, would provide the most effective UVA protection. The control group recorded a mean UVA intensity of 36.55mW/m^2, while red raspberry seed oil had a mean of 36.61mW/m^2. Marula oil followed closely with a mean of 36.75mW/m^2, and marula oil+lignosulfonate had the highest absorption, with a mean of 37.7mW/m^2. The oil groups influenced UVA light absorption, some providing more protection than others. Further research could explore evaluating cellular damage caused by UVA rays for a detailed perspective on the oil's protective effects. Investigating alternatives to skin cells, considering diversity, will offer a comprehensive understanding of skin protection against UVA rays.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Arbuscular Mycorrhiza on the Survival Rate of Plants Susceptible to Flooding

Nandha Menon

Around the world the current issue of flooding has become more concerning. It has severely affected the plants that are native to those regions. Salt water flooding is a common problem in many coastal regions including Florida. There are many types of flooding including flash floods, storm surges, and debris flow. Flooding in coastal regions is especially detrimental to roots and leaves due to salt water intrusion. Fungi, however, can thrive in environments with varying salt concentration. Salt water can affect the availability of quality water when it enters surface or groundwater sources. Some plants have evolved to adapt to salt water flooding. The purpose of this experiment was to test the effect of mycorrhizal fungi on Ruellia humilis subjected to flooding. This experiment was conducted by simulating saltwater and freshwater flooding over a 5 day period. This replicates the duration of a flooding period in order to provide the most accurate data. The saltwater will be used to imitate saltwater intrusion with a salt concentration of 3.5% which is similar to that of the ocean. The data will be collected by measuring the difference in the weight of the soil and the moisture level over the 5 day period and a 1 hour period. There are 30 plant samples in each treatment group. Data collection is ongoing.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Studying Water Conservation Programs to Enhance Water Security in Drought-Prone Communities

Lyn Motter

Scientists have created models to predict water demands focusing on variables such as economic stability, farming technique, and other factors. The purpose of this study was to create a geographic information systems model to determine the factors that contribute to water scarcity in drought-prone areas. The model compiled factors including economics, sociodemographics, and water costs in Chester County, Pennsylvania. Alongside the map, prior research was analyzed and compiled to provide a framework for potential policies in Chester County that would aid in decreasing the probability of droughts and ensure more secure water sources. The most essential comparison was using incentive-based policies versus tax-based policies. Throughout the literature, it was generally agreed that incentive-based policies such as subsidies did not properly motivate farmers and residents to change their ways to more sustainable methods of water usage, especially for farming. However, increasing taxes caused them to change their methods to avoid the negative consequences. The implications of this study were the successful integration of data from the map and literature to establish a recommendation for policymakers to determine policies that would be successful in regulating water supply usage.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Sunscreen Agents: Homosalate, Octocrylene, Avobenzone, and Zinc Oxide on The Cell Growth and Decay of Nannochloropsis Oculata

Deborah Olorunda, Tori Rabinowitch

Studies show that the chemical makeup of sunscreens are disrupting the biodiversity of marine ecosystems. (Chatzigianni) Algae in particular, which are essential to a healthy marine ecosystem as it provides food for nearly all aquatic life, (El Gamal) is at risk of succumbing to this disruption. Sunscreen can also impair its growth and hinder its ability to produce oxygen.(US Department of Commerce) This project investigates octocrylene, homosalate, avobenzone, and zinc oxide and its effect on the cellular concentration of nannochloropsis oculata.

In the preliminary lab 30 groups of algae were tested at differing sunscreen levels. Algal growth was monitored over multiple days via spectrometric measurement of cell count. The least cell decay was in the following groups; 1ml group for Coppertone Sport 4 in 1 SPF 50, the no dilution group for Banana Boat Sport Mineral 50, and the 3 ml group for Banana Boat Sport mineral SPF 50. Data analysis revealed that in the final lab the 1ml group for Coppertone Sport 4 in 1 SPF 50 composed of Avobenzone 2%, Homosalate 6%, and Octocrylene 6% was the least destructive to Nannochloropsis oculata in comparison to all the other groups. With a P-value of 4.885E-15 there is compelling evidence that the data from the group with the least cell decay is statistically significant.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Testing Different Water Sources that Lead into the Potomac River to see if they Contribute to the Nutrient Overflow in the Chesapeake Bay.

Wyatt Phillips

For my project I will be testing water in various sources in the state of Virginia that lead into the Potomac River. This is so I can see how each source contributes to the overflow of nutrients within the Chesapeake Bay. I will be splitting my sources into three categories: industrial, residential, and agricultural. I will take multiple samples from each type of area before I begin testing the water. I will test the different samples for phosphorus and nitrogen levels since they are what heavily pollute the Chesapeake the most. I will test each sample and compare their levels of nitrogen and phosphorus to see which is the most polluted. Afterwards, I will make conclusions on which type of area most heavily affects the Chesapeake.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Flavonoids on the Growth/Protection of Phaseolus lunatus L. (lima beans) when Introduced with Soil Nematodes.

Nikita Rao, Sanjana Rao

Flavonoids, an extensive group of natural polyphonic compounds abundantly found in various plant species, have captured significant attention due to their diverse biological activities and potential health benefits. These compounds, characterized by their antioxidant properties, play pivotal roles in scavenging free radicals, thereby shielding cells from oxidative damage. Present in a wide array of fruits, vegetables, and grains, flavonoids contribute not only to the vibrant colors of these foods but also to their nutritional value. Lima beans, recognized as a rich source of flavonoids, are likely to utilize these compounds as part of their defense mechanisms against environmental stressors and potential pests. Meanwhile, soil nematodes, comprising a diverse group of microscopic worms inhabiting soil ecosystems, pose a considerable challenge in agricultural settings. With their ability to feed on plant roots, certain nematode species can inflict substantial damage to crops, leading to diminished yields and economic losses.

Through meticulously designed experiments involving optimized flavonoid extraction protocols, controlled introduction of nematodes into laboratory settings, and subsequent observation of nematode behavior and viability, we aim to unravel the nuanced relationship between flavonoid concentration and its impact on nematode activity. By elucidating these complex dynamics, our research seeks to provide valuable insights into developing sustainable pest management strategies explicitly tailored to lima bean cultivation. Ultimately, our goal is to reduce dependency on synthetic pesticides, minimize environmental impact, and promote adopting environmentally friendly agricultural practices conducive to long-term sustainability and ecosystem health.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Temperature Spikes and Mild Winter Temperatures on the Germination of Native Species from Virginia

Arturo Romero

Stratification is a treatment where a seed is exposed to cold temperatures for a period of time in order for it to be able to germinate. This happens naturally in the winter, and is why the chilling period is essential for native Virginia species. As global warming progresses, the average winter temperatures in Virginia increase to the point where seeds cannot stratify properly, leading to a decrease in native species populations. Additionally, the winter temperatures fluctuate heavily due to global warming, which is what the experiment focuses on as it can heavily affect species populations. Native species are essential to an ecosystem as they are the species that form symbiotic relationships and sustain the environment as opposed to a foreign or invasive species. The research conducted hopes to help predict species populations and provide key information for environmental conservation, showing the effects of climate change. The experimental procedure consists of seven test groups in different temperature environments, three having warm temperature spikes of 28℃ and three having cold temperature spikes of -12℃. The last test group, also the control group, was exposed to a constant temperature of 5℃, which is also the base temperature for all the other test groups. Seeds were submitted to a seven week stratification period, followed by a growth period of three weeks in order to observe the results of the stratification. Preliminary results indicate lower germination rates as the amount of temperature fluctuations increase.

Bratcher, C. B., Dole, J. M., & Cole, J. C. (1993). Stratification improves seed germination of five native wildflower species. HortScience HortSci, 28(9), 899-901. https://doi.org/10.21273/HORTSCI.28.9.899. (n.d.).

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Green Roofs on the Energy Usage of Data Centers in Loudoun County

 Emma Rosher

Northern Virginia Data Centers used 2.7 GW of energy in 2022, a number that is only going to increase as technology advances. Data Centers are a vital part of data storage, recovery, and backup in today's day and age, and they require constant energy. Data centers are necessary, yet contribute to many environmental issues. They take up land space and use energy for storage, heating, and cooling. Green roofs are able to cut down on energy usage by regulating heating and cooling aspects by using evapotranspiration and shading to cool down the internal temperature of the building thus allowing the server coolers to do less work. Since Data Centers are constantly using so much energy, are green roofs able to help save on substantial amounts of energy both consumed and released? 78 of the Loudoun County data centers were analyzed using ArcGIS for potential green roof space by calculating total square footage and unusable space on each roof. Using potential roof area, building and site square footage, and an approximate annual energy consumption formula, the energy usage of each data center was calculated and put into a green roof calculator. Approximations were made with extensive green roofs, resulting in noticeable energy and cost reductions. Data collection continues, however, with the abundance of data centers in Loudoun county, green roofs offer a considerable way to save energy from such depleting energy sources.

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Voas, J., & Kshetri, N. (2024, January 3). Data Centers in Your Backyard?. IEEE Xplore. https://ieeexplore.ieee.org/abstract/document/10380206

LCPS RSEF OFFICIAL ABSTRACT - 2024

Assessing the Impact of Microplastic Pollution on Fucus Seaweed and Reef Zooplankton

Jas Sarna

This study investigates the effects of microplastic pollution on marine ecosystems, focusing on Fucus seaweed and Reef Zooplankton. The increasing prevalence of microplastics in aquatic environments poses a significant threat to marine life, affecting vital organisms and disrupting ecological balance. The purpose of this research is to elucidate the impact of varying concentrations of microplastics on the physiological health and population dynamics of these organisms, thereby contributing to our understanding of microplastic pollution's broader ecological consequences. Using a controlled experimental design, the presence and concentration of microplastics served as the independent variable, while the health and population changes in Fucus seaweed and Reef Zooplankton represented the dependent variables. The methodology included exposing both organisms to different microplastic concentrations in laboratory settings, maintaining constants such as water temperature, pH, and nutrient levels to ensure experiment validity. Data collection is still ongoing. results thus far have releaved that each time the percentage of microplastics put on the organism increased, the concentration of the water increased. The study concludes by showing that microplastic contamination jeopardizes the survival and well-being of important marine species, highlighting the pressing need to address this environmental problem. The study notes that environmental variables in natural settings are complicated, even though no substantial experimental mistakes were found. To improve knowledge and safeguard marine ecosystems, future studies should examine the long-term effects of microplastics on marine biodiversity and the efficacy of mitigating techniques.

Amelia, T. S. M., Wan Mohd Afiq Wan Mohd Khalik, Ong, M. C., Shao, Y. T., Pan, H.-J., & Bhubalan, K. (2021, January 22). Marine microplastics as vectors of major ocean pollutants and its hazards to the marine ecosystem and humans - progress in Earth and planetary science. SpringerOpen. https://progearthplanetsci.springeropen.com/articles/10.1186/s40645-020-00405-4

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Azolla Caroliniana's Phytoremediation Effect on Nitrate

 Yazhini Sathguru

Many nutrients enter our water systems that could destroy the water ecosystem. Nitrate, a common nutrient in agricultural runoff, can cause serious harm to aquatic life. When nitrate enters water bodies, it can promote algae growth, leading to algae blooms that can deplete oxygen levels and create dead zones. *Azolla caroliniana* is a phytoremediation plant known to reduce metal toxins from water. The purpose of this research is to check and see if Azolla caroliniana can reduce nitrate in water. *Azolla caroliniana* was utilized as the independent variable, while the dependent variable was the change in nitrate concentration–a control group of *Azolla caroliniana* in distilled water. Two concentrations, 0.10 and 0.20, were used, and after two days, nitrate content was measured with a nitrate ion-selective electrode. The results of the experiments had high variability. Overall, the average nitrate level increased rather than decreased for concentrations 0.0 and 0.10. For concentrations 0.20, the overall average nitrate level decreased. The data did not support the hypothesis that *Azolla caroliniana* would reduce the nitrate concentrations in water. Several potential sources of error may have contributed to inaccurate nitrate measurements, including malfunctioning equipment, such as the nitrate ion-selective electrode, and other microorganisms within the plant that could have impacted nitrate levels. More testing is needed on *Azolla caroliniana*. More prolonged exposure to the solution should be examined to understand the impact of time on nitrate levels. Studying the effects of other nutrients like phosphorus in runoff could also provide valuable insights.

Environmental Protection Agency. (2023). Nitrates | Monitoring & Assessment | US EPA. EPA Archives. Retrieved November 30, 2023, from https://archive.epa.gov/water/archive/web/html/vms57.html

Phytoremediation of heavy metals (Ni, Cd, Pb) by Azolla filiculoides from aqueous solution: A dataset. (2018, October 28). NCBI. Retrieved November 30, 2023, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6234267/

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Organic Pesticide Eugenol on the Innexin Genes of Lymnaea Stagnalis

Nardos Mengesha, Veer Sidhu

Organic herbicides are often cited as being less toxic to both the environment and animal & human life than synthetic herbicides, but there is evidence that suggests otherwise (Smith & Perfetti, 2020). This means that organic herbicides are often used under the assumption that they are "better" than synthetic pesticides, putting many non-target species at risk, including those in aquatic environments. Innexin genes play a critical role in the functions of invertebrates due to their role in coding gap junctions, which modulate cell-to-cell communication. If the expression of this gene is inhibited or doesn't operate properly, it would lead to multiple malfunctions and decreased survivability in invertebrates. Therefore, by using Lymnaea stagnalis as a model organism for aquatic species, the genetic effects of a very popular organic herbicide (eugenol) on innexin genes can be analyzed through qPCR. After performing a toxicity assay and finding the concentration of eugenol at which there was maximum survivability and potency, 5 mg/mL, an administration period of 1 week will occur. After that, qPCR will be performed to measure innexin gene expression and compare between snails with eugenol in their environments and control. We predict that the addition of the organic herbicide eugenol in the environment will decrease innexin gene expression because of evidence that innexin gene expression decreases when there are toxins present in the host animal. Investigating whether these organic pesticides alter gene expression of important aquatic organisms would be critical in determining whether or not organic alternatives are safer than their conventional counterparts.

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Smith, C. and Perfetti, T. (2020). A comparison of the persistence, toxicity,and exposure to high-volume natural plant-derived and synthetic pesticides. Toxicol Res and App, 4, 1-15. https://doi.org/10.1177/2397847320940561

Yasser, E., Shawkat, E., Samir, A. (2015). Impact of Organic Contamination on Some Aquatic Organisms. Toxicology international, 22(1), 45-53. https://doi.org/10.4103/0971-6580.172256

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Oxybenzone on Green Algae Euglena

Siena St. James

The reasoning for this study is to explore the effect of different concentrations of Oxybenzone on sample sizes of Euglena, to see which concentrations completely destroys the test population. The goal is to observe the samples daily and record which concretions are the most detrimental to Euglena.

This project is inspired by a 2008 paper by The National Library of Medicine. This study found that low concreations of sunscreen released in a mix of zooxanthellae and coral tissue could completely bleach coral tissues within 96 hours. Knowing this, communities have made progress in the efforts of creating "Oxybenzone Free" sunscreen, even banning Oxybenzone based sunscreen in beaches across the world (Hawaii).

In January of 2023, a research study was directed by Science Direct, which found the first recorded results of Oxybenzone affecting algae density of Symbiodinacaea. Their testing procedures were exposing both genesis (Cladocopium goreaui and Effrenium voratum) of Symbiodinacaea to different concentrations of Oxybenzone (5 μg/L, 50 μg/L, 500 μg/L, and 5000 μg/L) to see if the results was species dependent. The results found that 50 μg L^{-1} of oxybenzone caused a 36.73% decrease of C. goreaui, and when raised to 500 μg L^{-1} and 5000 μg L^{-1}, cell division was completely vanquished. E. voratum was more resistant at the 50 μg L^{-1} group, however declined at 500 μg L^{-1} and 5000 μg L^{-1}. It can be inferred that if Oxybenzone concreations are affecting ocean green algae, they may also affect freshwater green algae.

Danovaro, R., Bongiorni, L., Corinaldesi, C., Giovannelli, D., Damiani, E., Astolfi, P., Greci, L., & Pusceddu, A. (2008). Sunscreens cause coral bleaching by promoting viral infections. Environmental Health Perspectives, 116(4), 441-447. https://doi.org/10.1289/ehp.10966

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Root Type on the Filtration of Ammonia and Nitrate as a Biofilter

Sakthi Senthil Nath, Harshini Thikkalathuru

Maintaining good water quality in aquaculture systems is extremely difficult due to excessive amounts of nitrate and ammonia from organic matter and chemicals in the water. In aquaponic systems, the contaminated water is run through plant roots that convert the ammonia and nitrate into substances, which is called a biofilter. This project's purpose is to discover what type of root best serves as a biofilter: taproot or fibrous root. The independent variable is the type of organism that will be used as the biofilter: *Spinacia oleracea* (Spinach) and *Elymus hispidus* (Intermediate Wheatgrass). The dependent variable is the amount of ammonia (mg/L) and nitrates (mg/L) extracted from each biofilter. The control group is distilled water with added amounts of ammonia and nitrate before biofiltration. A contaminated solution with distilled water, ammonia, and nitrate was made. Nitrate and ammonia levels were tested on the contaminated solution before and after it was poured through the biofilters. The alternative hypothesis is If tap roots from *Spinacia oleracea* (Spinach plants) are used as a biofilter, then they will extract more amounts of ammonia and nitrate than fibrous roots from *Elymus hispidus* (Intermediate Wheatgrass). Data collection is not yet complete. Further research could explore whether plants serve as a successful biofilter, or if fungi would be more efficient in removing harmful substances.

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The role of biofilters in Aquaponics Systems. Go Green Aquaponics. (2023, July 15). https://gogreenaquaponics.com/blogs/news/what-is-aquaponics-biofilter

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Studying the Relationships Between Physicochemical Factors and Phytoplankton as Methods of Determining Water Quality in the Potomac River

John Hays, Sammi Tomlinson

Water is essential for life. Freshwater quality is a key factor in safeguarding human health, protecting the environment, and ensuring regulatory compliance. Numerous studies have looked at either the physical-chemical quality of water or biological qualities such as phytoplankton biodiversity, however few have challenged how interchangeable these two measurements truly are when assessing water quality. Phytoplankton are highly sensitive to changes in environmental conditions, making them great indicators of water quality. In this study, we investigated the relationships between phytoplankton and the physical-chemical water quality in hopes of finding a correlation. Three water samples and three phytoplankton samples were collected from the Potomac River, a major waterway flowing through 4 mid-Atlantic states which has undergone rapid human growth in recent decades. The water samples were analyzed using LaMotte test kits and electronic probes. The phytoplankton samples were preserved and brought back to the lab to measure biodiversity, using a hemocytometer and an inverted microscope. The physicochemical data was then compared to the phytoplankton community using a Canonical Correspondence Analysis (CCA), a statistical test used to analyze two sets of data, one of a species richness at different sites and the other of environmental variables at the same sites. The correspondence between variables were studied and relationships were found. Using these results, only one index will have to be performed to find significant results from the other, cutting down on both the cost and time consumption, allowing for more efficient water quality testing.

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Kozak, A., Budzyńska, A., Dondajewska, R., Kowalczewska-Madura, K., & Chmura, D. (2020). Functional Groups of Phytoplankton and Their Relationship with Environmental Factors in the Restored Uzarzewskie Lake. Water, 12(2), 313. https://doi.org/10.3390/w12020313

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Prevalence of Microplastic Contamination on Microplastic Abundance Variation Across Different Locations

Ankita Kamath, Isha Uppalli

The main purpose of this experiment is to explore the prevalence of microplastic contamination in various indoor environments and assess the impact it holds on human health, specifically respiratory health. Microplastics are tiny plastic particles originating from diverse sources such as the fragmentation of larger plastic items and shedding from objects such as textiles. These particles pose significant environmental and health risks, particularly in indoor environments where they accumulate dust. Inhalation of these microplastics can present concerning issues for human health, which could potentially lead to respiratory problems such as lung damage, asthma attacks, and several other serious health complications. When microplastic particles remain in the lungs, they likely remain there because they are bio-persistent, which could cause inflammation.

To properly observe the effect of microplastic contamination in indoor environments, dust samples were collected from various indoor locations, including the home gym, kitchen, family room, and bedroom closet, using a miniature vacuum cleaner. Each sample collected is labeled, transferred into tightly sealed containers, and mixed with distilled water to create a dust-water mixture. These mixtures will then undergo filtration to separate the microplastics, which will then be examined under a microscope for quantification. This systematic approach will generate data on the prevalence of microplastics in indoor environments and allow insight into the potential respiratory health implications. This experiment seeks to inform effective mitigation strategies and promote awareness of indoor microplastic contamination's impact on human respiratory health.

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Potential health impact of microplastics: A review of environmental…(2023, August 10). https://pubs.acs.org/doi/10.1021/envhealth.3c00052

Uffelen, C.van. (2020, June 18). How damaging is breathing in microplastics?. Plastic Soup Foundation. https://plasticsoupfoundation.org/en/2018/03/how-damaging-is-breathing-in-microplastic

LCPS RSEF OFFICIAL ABSTRACT - 2024

Which plant grows best in Mars Regolith?

Nura Warsame

My research aims to investigate the growth performance of lettuce, radish, and turnips in Mars regolith simulant provided by NASA, with comparative data against growth in standard Earth soil.

(NASA's Veggie Experiment, 2021) Nasa conducted experiments on the International Space Station aimed to grow various crops in space using Mars regolith.

(University of Central Florida's Mars Garden Project) Researchers who attend University of Central Florida have conducted experiments using Mars regolith simulants to grow plants like lettuce and radishes.

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Embedded Systems (1000) and Energy: Sustainable Materials & Design (1100)

Project No.	Student(s)	Project Title
1001X12	Jagadeepram Maddipatla	Performing Optical Fast Fourier Transforms through the use of Silicon Photonics
1003X12	Emily Tran	Mitigating Racial Bias in Automatic Faucets
1101T11	Grady Berlik, Samiya Katoch	Developing a Stochastic Analytical Framework to Assess Storage Needs in Texas
1102T12	Ayan Chowdhury, Prakhyath Srivatsavai	Wave Energy Attenuator Net Design Structural Analysis
1103X11	Sofia Johnson Quinchia	Green Hydrogen through Solar Electrolysis of Sea Water
1104X12	Prescott Noll	Increasing the Economic Viability of Hydrogen Energy through Plasma Enhanced Catalysis
1105X11	Simon Petros	The Power of Karman Vortex Streets: Innovative Solutions for Building Sustainability
1106T12	Natalie Salmin, Leah Silverstein	A New Design for the Pool Umbrella Incorporating Solar Fans
1705X11	Jonathan Mallett	An Evaluation of the Sustainability of "Green" Energy

Category Student Count: 12

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Performing Optical Fast Fourier Transforms through the use of Silicon Photonics

Jagadeepram Maddipatla

Data processing has grown to be increasingly important in our digitized world. A key component of data and signal processing is the Fast Fourier Transform (FFT), which allows for detailed analysis of signal frequency. FFT operations are widely used in the telecommunications industry, where frequency domain analysis is prevents corporations from encroaching on frequency band rights. FFTs also have the potential to revolutionize the training of artificial intelligence (AI) algorithms through batch multiplication. In the past, FFTs have been processed primarily through parallel processors; however, digital electronics cannot scale with FFT needs, and cannot efficiently execute recursive FFT algorithms. This project utilizes a silicon photonics chip with a series of Mach-Zehnder Interferometer (MZI) components to process FFT algorithms. This architecture is inherently analog, allowing for increased scalability and efficiency when processing FFT algorithms.
In order to design this accelerator, the VPIDesignSuite tool and KLayout CAD software were both utilized. The colloquially named "butterfly" operations were specifically explored. The MZI components incorporated two separate input branches to process laser-light inputs. A series of MZI components were arranged in two stages; stage one was designed to feed inputs into two separate MZI components placed in parallel within stage 2, which had a quarter-wavelength time delay. Thermo-optic modulators were implanted within the MZI branches to change the phase of light input. A transmission spectrum revealed that the chip was most active within wavelengths of 1550 to 1600 nanometers. The power intensity of the chip was calculated to 0.024 mW/mm2.

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Elango, Konguvel & Kannan, Mu. (2018). A Survey on FFT/IFFT Processors for Next Generation Telecommunication Systems. Journal of Circuits, Systems and Computers. 27. 10.1142/S0218126618300015.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Comparing the Efficacy of Benzoyl Peroxide and Ayurvedic Treatments on Staphylococcus epidermidis

Prakruti Srikanth

Acne is a common skin condition that affects many teenagers. It can be caused by inflamed pores clogged with acne causing bacteria. One such bacterium is Staphylococcus epidermidis. An acne treatment that specifically targets bacteria is benzoyl peroxide. Benzoyl peroxide can show up to a 99% reduction in acne-causing bacteria [1]. Various ayurvedic treatments have been shown to inhibit the growth of acne-causing bacteria. Azadirachta indica was one such ingredient, and was effective on Propionibacterium acnes and other acne causing bacterium [2]. Both benzoyl peroxide and Azadirachta indica target and break apart the biofilms that acne-causing bacteria protect themselves with. Benzoyl peroxide does this through reactive oxygen species, while Azadirachta indica does this through quorum sensing inhibition.

This project aims to compare the effects of Azadirachta indica and benzoyl peroxide on Staphylococcus epidermidis. This will be done by measuring the zones of inhibition when each treatment is applied. Both zones of inhibition will be compared using 2SEMs, t-tests, and other statistical tests. Data collection and analysis is still in progress, however, based on prior studies, it is hypothesized that Azadirachta indica will inhibit the growth of acne causing bacteria. Acne can result in severe mental health issues. It has been shown to have the same psychological impact as diabetes, cancer, and epilepsy [3]. This emphasizes why this study and further studies could be useful, as they could potentially open an option of an inexpensive yet effective acne treatment that is easily accessible.

Leyden, James J. "Antibiotic-Resistant Propionibacterium Acnes Suppressed by a Benzoyl ..." Therapeutics for the Clinician, 2017, cdn.mdedge.com/files/s3fs-public/Document/September-2017/082060417.pdf.

Kumar, G S, et al. "Antimicrobial Effects of Indian Medicinal Plants against Acne-Inducing Bacteria." Tropical Journal of Pharmaceutical Research, 2007, www.ajol.info/index.php/tjpr/article/view/14651.

Pawin, Henry. "Living with Acne. A Study of Adolescents' Personal Experiences." Dermatology (Basel, Switzerland), U.S. National Library of Medicine, 2008, pubmed.ncbi.nlm.nih.gov/17911988/.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Mitigating Racial Bias in Automatic Faucets

Emily Tran

As society has shifted towards smart technology, there has been an uptick in automatic and touchless technology in public settings. Particularly in restrooms, the use of automatic faucets has increased and is expected to gain additional growth in prospective years. According to estimates by Business Research Insights, the market value for automatic faucets in 2022 was 1.761 billion USD with a projected growth to 2.770 billion USD in 2028.

Automatic faucets, however, have been found to be discriminatory towards higher-pigmented skin types. A large portion of touchless faucets found in public settings rely on infrared technology and light reflection. Darker skin types do not as efficiently reflect the infrared light to the sensor receiver, thus finding it more difficult to use automatic hand washing stations.

Outside of anecdotal evidence and one study conducted by the British Columbia Institute of Technology, there is not a lot of research on racial bias within faucet technology. My project sought to investigate and validate the racial bias that exists within automatic faucet sensors. Using the Fitzpatrick skin type scale, I tested public restroom locations for their bias towards certain pigmentations. The results of the testing supported the hypothesis that darker skin colors had more difficulty activating the faucet sensor, and they generated a longer reaction time from the sensor.

The objective of my project is to address the technological disparity and design a better alternative for commercial usage. It is important to address this issue because everyone should have the opportunity for clean hygiene, and technology should not be discriminatory. By resolving this issue, it promotes a more inclusive and healthier population.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Developing a Stochastic Analytical Framework to Assess Storage Needs in Texas

Grady Berlik, Samiya Katoch

Wind and solar-powered energy transitions are rapidly taking place around the world, primarily to mitigate the negative environmental impacts of fossil-fired power. Given the harmful carbon footprint of fossil-fired energy sources and associated impacts on global warming, there is a drastic push for complete decarbonization and 100% penetration of renewable energy sources. However, renewable energy sources such as wind and solar are intermittent by nature, which can pose technical and economical challenges when integrated on a large scale due to its uncertainty. As energy storage is critical to supplying power grids with a constant flow of renewable energy, stakeholders critically need a comprehensive assessment of storage needs. Texas's power grid is rich in renewable energy production and potential. However, its grid suffers from high instability due to its isolation from other power grids and unpredictable energy generation, making Texas a fitting case study. Past research has emphasized the significance of energy storage in establishing renewable energy sources, but there are limited models predicting the random aspects of this process to assess storage needs. A Monte Carlo Simulation (MCS) was conducted to predict renewable energy generation and grid demand in order to assess storage needs in Texas at different levels of renewable energy penetration. A MCS uses random sampling to predict thousands of possible outcomes, helping to model uncertainty or risk in a system. The results of this study offer a critical evaluation of battery capacity requirements that highlight future renewable goals and reduce uncertainty in clean energy production.

Junlakarn, S., Diewvilai, R., & Audomvongseree, K. (2022). Stochastic Modeling of Renewable Energy Sources for Capacity Credit Evaluation. Energies, 15(14), 5103. MDPI AG. http://dx.doi.org/10.3390/en15145103

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Zakaria, A., Ismail, F. B., Lipu, M. S. H., & Hannan, M. A. (2020). Uncertainty models for stochastic optimization in renewable energy applications. Renewable Energy, 145, 1543–1571. https://doi.org/10.1016/j.renene.2019.07.081

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Wave Energy Attenuator Net Design Structural Analysis

 Ayan Chowdhury, Prakhyath Srivatsavai

 Hydro power and wave energy converters (WEC's) are a highly diverse, competitive, and costly industry. Various private and public companies develop innovative designs, aiming to head the large scale wave energy industry. Shifting focus away from gargantuan large scale energy capture devices our study focuses on a niche of small scale localized WEC's. The wave energy attenuator design serves as a leading contender for large scale wave energy generation. An essential wave energy attenuator design consists of large serpentine segments shifting back and forth over waves. Taking inspiration from the Pelamis, the leading model in the attenuator subsection of WEC's, our study serves as a proof of concept for a small scale net configuration of the Pelamis system. If the smaller attenuator segments are arranged in a net configuration, then the design should compensate for its smaller size with increased structural stability at no cost of the energy producing agitation. Our attenuator net design is meant to aid isolated coastal communities and tsunami/ hurricane relief operations (particularly to aid storm related power outages). A custom wave tank was constructed out of melamine and plexiglass to conduct the experimentation. The attenuator modules were 3d printed and connected with copper wiring and foam pool noodles for the net configuration. Our results demonstrate a consistent and stable amount of agitation present in the net configuration when compared to the pelamis configuration. This discovery illustrates the applicability of wave attenuator nets in small confined spaces particularly for small-scale energy grids.

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Spyros. (2022). Wave energy converters in low energy seas: Current state and opportunities. Sciencedirect.com.

Zheng, S. (2022). Attenuator wave energy convertors. researchgate.net.

LCPS RSEF OFFICIAL ABSTRACT - 2024

Green Hydrogen through Solar Electrolysis of Sea Water

 Sofia Johnson Quinchia

In 2021 the shipping industry consumed 8.7 EJ of non-renewable energy. To meet 2030 renewable energy quotas they will need to decrease fossil fuel consumptions by 87%. Hydrogen is a leading renewable energy candidate. However, the current method of Steam Methane Reforming for the collection of hydrogen creates greenhouse gasses. Electrolysis is an unpopular method of hydrogen production because it takes electricity to start the reaction. Electrolysis of pure water is also not as energy efficient as salt water, because salt water is more conductive. Solar power is a more effective solution but is weather dependent and is often stored in lithium batteries. By coupling solar power with the electrolysis of seawater hydrogen is able to be created more efficiently without the creation of greenhouse gasses. The goal of my engineering project was to create a system that collected hydrogen passively with the sun. My prototype is able to create hydrogen even in inclement sun conditions. While it is not yet as energy effective as solar alone, it creates a way for the solar power to be stored in the form of hydrogen eliminating the need for a lithium battery. It was constructed with one copper and one platinum electrode attached to two 200W solar panels. Hydrogen was measured via water displacement. Out of the 6 tested times 8:30am was when the prototype was most functional creating 50 ml of hydrogen in 15 minutes.

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López González, E., Isorna Llerena, F., Silva Pérez, M., Rosa Iglesias, F., & Guerra Macho, J. (2015). Energy evaluation of a solar hydrogen storage facility: Comparison with other electrical energy storage technologies. International Journal of Hydrogen Energy, 40(15), 5518–5525. https://doi.org/10.1016/j.ijhydene.2015.01.181

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Increasing the Economic Viabiliy of Hydrogen Energy through Plasma Enhanced Catalysis

Prescott Noll

Liquid Organic Hydrogen Carriers (LOHC) are compounds used to safely transport hydrogen for industrial purposes. The dehydrogenation of these substances is an endothermic process, and therefore, a significant amount of heat is required to derive pure hydrogen off of LOHCs, excessively driving up the costs of hydrogen energy and production. This experiment tests a room temperature alternative method of dehydrogenation, through using a catalyst enhanced by an electromagnetic field (plasma enhanced catalysis). By using a magnetic field to control the orientation of the Ni/Al_2O_3 catalysts in a molecular 3D space, over 60% yield of toluene was produced in 3 hours and 45 minutes at room temperature from methylcyclohexane, a statistically significant yield against an equilibrium control yield of 0.0000567% at room temperature. While heat alone is capable of reaching near 100% yield, the rate at which this occurs is much slower and the cost much higher. Initial cost optimization estimates suggest that a dual incorporation of plasma enhanced and heat based catalysis could drop hydrogen production costs by 2 cents per kilogram of H2, increasing the ability of the global hydrogen supply chain to provide more hydrogen energy, blue or green. Future uses of plasma enhanced catalysis could also apply to the rehydrogenation of LOHCs.

Bhattacharya, M., Quan, H., Robinius, M., Gahleitner, G., Zaini, I. N., Zhang, H., Sarkar, A., Aziz, M., Bracha, M., Baker, C. R., Fikrt, A., Hatim, M. D. I., Scherer, G. W. H., Malyshenko, S., Cappelletti, A., & Darmawan, A. (2018, May 29). Highly energy-efficient combination of dehydrogenation of methylcyclohexane and hydrogen-based power generation. Applied Energy. https://www.sciencedirect.com/science/article/abs/pii/S0306261918308304?casa_token=pPp3xF9arfsAAAAA%3AHI5liqq1d8Czj0l9A4bYCmzd1jlrKZ6N5zthWVthMp_zSu0IALA7cgMhXMLGCm3uXAoHDnRzOKA

Ronda-Lloret, M., Wang, Y., Oulego, P., Rothenberg, G., Tu, X., & Shiju, N. R. (2020, November 30). CO2 hydrogenation at atmospheric pressure and low temperature using plasma-enhanced catalysis over supported Cobalt Oxide Catalysts. ACS sustainable chemistry & engineering. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7709469/#:~:text=Therefore%2C%20CO2%20hydrogenation%20to,%C2%B0C%20and%2020%20bar.&text=Yet%20there%20is%20an%20alternative,near%2Dambient%20temperatures%20and%20pressures

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Power of Karman Vortex Streets: Innovative Solutions for Building Sustainability

 Simon Petros

Cleaner energy sources are essential to combat the environmental impact associated with the use of non-renewable sources such as fossil fuels. One innovative way of solving this problem is to harness the energy of Karman Vortex Streets. The Karman Vortex Street is a phenomenon in fluid dynamics where oscillating vortices are formed after fluid passes around an obstacle (1). These oscillating vortices can be harnessed in unique ways, such as with a turbine, to produce clean energy for sustaining buildings. This study tested 5 buildings, each with different shapes, to observe which building would produce the most energy through Karman Vortex Streets. Each building was subjected to a constant wind, and the efficiency of the energy generated was measured by the Strouhal Number (2).

The final results show that buildings with more symmetrical bases generate more energy, which showcases a different cause than the original hypothesis which states that buildings with bases that have less edges will generate more energy. The results are consistent with the visual representation displayed by the Computational Fluid Dynamics simulations (CFD).

Future research to this study could examine where the optimal location to place the energy capturing apparatuses could be. Furthermore, additional research on what the most effective apparatus could be would be beneficial. This study has potential for real world applications, like in cities, where the clean energy source could provide over 90% of the necessary reductions in carbon emissions (3).

Irwin, P. A. I. (2010, September 1). Vortices and tall buildings: A recipe for resonance. Physics Today. https://pubs.aip.org/physicstoday/article-abstract/63/9/68/386630/Vortices-and-tall-buildings-A-recipe-for?redirectedFrom=fulltext

 Katopodes, N. D. K. (2012). Viscous Fluid Flow. In Offshore Structures (pp. 324-426). https://www.sciencedirect.com/topics/engineering/strouhal-number

How to transform energy system and reduce carbon emissions. (n.d.). https://www.irena.org/Digital-content/Digital-Story/2019/Apr/How-To-Transform-Energy-System-And-Reduce-Carbon-Emissions#:~:text=Renewables%20and%20energy%20efficiency%2C%20boosted,in%20energy%2Drelated%20carbon%20emissions.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

A New Design for the Pool Umbrella Incorporating Solar Fans

Natalie Salmin, Leah Silverstein

The clean, pure, and sustainable energy that comes from the sun is important in protecting humans, the ecosystem, and wildlife. Solar energy needs to be more commonly used in people's everyday life. The United States only relies on solar power for 3.9% of its energy, but the use of solar panels is growing each year. In making our product, the main focus was to build something that would be appealing to a consumer, while also incorporating solar energy. A pool umbrella with solar powered fans is a unique product and there is nothing on the market quite like it. It's appealing to buy something original, and if the solar energy works then people will most likely want to buy more products that use solar power. Fans need to have a powerful wind speed in order to be successful in cooling someone down. For people to believe that solar power is just as good as any other energy source, we tested numerous fan placements to find which position will be the most effective and have the greatest wind speed. We wanted to ensure that the solar powered fan umbrella was also able to collapse in the same way that a regular umbrella would in regards to keeping its size. This is necessary to make sure that our product is still functional even with all of the added materials. Through numerous trials and research we have found a way to make the most effective and functional product we can while still incorporating a renewable and clean energy source.

"Fan Testing and Performance | Understanding the Science." Air Control Industries Ltd, 29 May. 2023, www.aircontrolindustries.com/blog/fan-performance-and-testing/#:~:text=Factors %20Th at%20Affect%20Fan%20Output%20And%20Efficiency&text=And%20it%27s%20not % 20just%20the. Accessed 22 Feb. 2024.

Ruiz, Arabella. "35 Latest Solar Power Statistics, Charts & Data." Theroundup, 11 Feb. 2022, theroundup.org/solar-power-statistics/. Solar Energy Technologies Office.

"Solar Energy, Wildlife, and the Environment." Energy.gov, www.energy.gov/eere/solar/solar-energy-wildlife-and-environment#:~:text=As%20a%20r enewable%20source%20of.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

An Evaluation of the Sustainability of "Green" Energy

 Jonathan Mallett

Energy consumption in the United States is on the rise, with the demand for electricity reaching 4.07 trillion kWh in 2022 [1]. However, the sustainability of solar panels as a solution is brought into question because they will produce more than 60 million tons of waste by 2050 [2]. In addition, each kilowatt-hour from a solar panel produces approximately 40 grams of carbon dioxide or an equivalent greenhouse gas [3]. The project began with data on the energy output and carbon emissions of three different technologies–gasoline, photovoltaics, and microbial fuel cells–to calculate their sustainability. In addition, a three dimensional model was created of a design that would include the most efficient technology.

The technology that was calculated to be the most efficient was algae microbial fuel cells. It produced more than five times as much energy per day as solar panels, and it also created lower carbon emissions. Because of this, an ideal technology would be algae solar farms, especially on the ocean for increased solar radiation and a constant water supply.

One of the major sources of error was the inability to locate carbon emissions from the degradation of the microbial fuel cell, as well as the lifetime of the microbial fuel cell. Because of this, the carbon emissions may have been higher than calculated. Future research might include testing the degradation of microbial fuel cells and designing more environmentally friendly versions. Through this research and future applications, increased energy production can be achieved at lower environmental costs.

1.   U.S. Energy Information Administration. (2023). Use of electricity. https://www.eia.gov/energyexplained/electricity/use-of-electricity.php

2.   Weckend, S., Wade, A., & Heath, G. (2016). End-of-life management: Solar Photovoltaic Panels [PDF]. International Renewable Energy Agency. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2016/IRENA_IEAPVPS_End-of-Life_Solar_PV_Panels_2016.pdf

3.   National Renewable Energy Laboratory. (n.d.). Life Cycle Greenhouse Gas Emissions from Solar Photovoltaics [PDF]. U.S. Department of Energy. https://www.nrel.gov/docs/fy13osti/56487.pdf

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Engineering Technology: Statics & Dynamics (1200)

Project No.	Student(s)	Project Title
1201X11	Suhani Dondapati	Recreating a Cupping Wing Movement on a Robotic Butterfly
1202X11	Nehal Elango	Making a Quartz Portable Battery
1203T12	Sofyan Elshaer, Josh Gallagher	Effect of Mars Rover Wheel Design on Maneuverability in Simulated Martian Terrain
1204X12	Cyrus Gop	Construction of a Concrete 3D-Printer to Test Martian Magnesium Oxide Concrete
1205X12	Chetana Gunawardhana	Submersible Aerial Vehicle Design Study
1206X12	Benjamin Kurowski	Designing a Morphing Airfoil to Maximize Flight Efficiency
1207X12	Grant Major	The Search for an Association Between a Tensile Integrity Structure's Bar Count and Impact Force Mitigation
1208X12	Matthew Murray	The Effect of Thermal Paste Design on CPU Efficiency
1209X12	Emmanuelle Mutima	Hair Braid Cooler: A Device to Prevent Pediatric Burns in the Process of Dipping Braids
1210X12	Emily Riesz	Building and Testing a Mechanical Wave Force Tank with Dynamically Adjustable Parameters.
1211T12	Rylan Wells, Severn Welsh	Regenerative Shock Absorber

Category Student Count: 13

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Recreating a Cupping Wing Movement on a Robotic Butterfly

Suhani Dondapati

Many engineers have turned to biomimicry to recreate wing shapes and aspects of flight of animals in nature. With new engineering designs and concepts appearing around biomimicry of insects, specifically butterflies for air vehicles, it is important to understand the application of the wing movements during flight in the area of robotics. Biomimetic flapping-wing micro air vehicles (BMAV) are air vehicles that mimic flight aspects of insects. BMAV research is important to creating a flying synthetic butterfly for usage in aerial monitoring, small-scale transport, and commercial uses. Using the wing shape of Acraea andromacha butterflies and the cupping wing motion that Argynnis paphia butterflies use, an Arduino BMAV butterfly using micro servo motors was created. This was done by using an A70 wing position at an initial 8° of angle of attack to make the forewings and hindwing of a butterfly move in a cupping wing motion. The cupping wing motion was found to have 22% higher impulse and 28% lower wake energy per unit impulse as well as positive thrust in upward wing movements and stability in downward wing movements, creating minimal air loss during flight. This was compared to a flapping wing motion with straight movement up and down. A small scale wind tunnel was used to measure lift and force values of each wing movement. Although data collection continues, the expected results of this study is that the cupping wing motion will result in significantly higher lift factors to indicate better flight performance for butterfly BMAV's.

Ancel, A. O., Eastwood, R., Vogt, D. M., Ithier, C., Smith, M. D., Wood, R. J., & Kovač, M. (2017). Aerodynamic evaluation of wing shape and wing orientation in four butterfly species using numerical simulations and a low-speed wind tunnel, and its implications for the design of flying micro-robots. Interface Focus, 7(1), 20160087. https://doi.org/10.1098/rsfs.2016.0087

Han, J., Hui, Z., Tian, F., & Chen, G. (2021). Review on bio-inspired flight systems and bionic aerodynamics. Chinese Journal of Aeronautics, 34(7), 170–186. https://doi.org/10.1016/j.cja.2020.03.036

Johansson, L., & Henningsson, P. (2021). Butterflies fly using efficient propulsive clap mechanism owing to flexible wings. Journal of the Royal Society Interface, 18(174), 20200854. https://doi.org/10.1098/rsif.2020.0854

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Making a Quartz Portable Battery

 Nehal Elango

Although portable chargers are both widely used and considered extremely useful, they have a major drawback; they need to be recharged. A portable charger made with the use of piezoelectric materials, however, can be used without needing to be recharged. Piezoelectric materials generate electricity through the use of mechanical pressure, which is why a charger made of such materials would not need to be recharged (Erturk & Inman, 2011). In this project, a portable charger powered by quartz, the most common piezoelectric material, will be created (Uchino, 2017). The portable charger will be created by connecting wires to a central quartz crystal using electrodes (Laurens, 2019). A lead adapter will be attached to the crystal with an electrode, which is how the crystal will be connected to the device. Solder will be used to connect the electrodes to the crystal. The crystal will be lightly stricken to create and store a current. Two of the wires attached to the quartz will also be attached to a voltmeter, which will be used to measure the voltage of the crystal. The electricity created through this quartz charger will be measured once a day for a minimum of a week in order to collect sufficient data. The voltmeter will also observe if the current made from the crystal is strong enough to charge the electronic device.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Effect of Mars Rover Wheel Design on Maneuverability in Simulated Martian Terrain

Sofyan Elshaer, Josh Gallagher

As Mars rovers continue to suffer from wheel slippage, impeding exploration in high-risk regions and causing mission failure as in the case of the Spirit rover, reevaluation of Mars rover design is necessary. Mars rover wheel designs are constantly being altered, with each new rover's wheels slightly improving on the last. However, each new wheel design has yet to transition away from the circular form factor used across most land vehicles. Although standard circular wheel shapes work well on even terrain, the hillier, rockier regions of Mars' landscape call for unique adaptations to be made. In order to further understand wheel slippage on Martian terrain and offer effective alternatives, multiple different wheel designs were considered. The study aimed to utilize a scaled down rover chassis and 3D printed wheels on modeled Martian terrain scenarios in order to conclude how to best utilize wheel design to traverse granular media. Each wheel design will be assessed as they undertake courses of increasing incline and declines. Wheel designs that most consistently prove successful at traversing the courses' varied terrains will be deemed the most favorable designs for maneuvering through regions of Martian regolith and varied elevation. Predictions suggest that the "windmill" wheg design will have a greater capability to traverse Martian terrain than other designs, including the control based on current Mars rover wheels.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Construction of a Concrete 3D-Printer to Test Martian Magnesium Oxide Concrete

Cyrus Gop

This research delves into liquid deposition modeling (LDM) of magnesium oxide (MgO) concrete using a modified 3D-printer, aiming to revolutionize construction on Mars. The Martian concrete comprises largely of MgO, which makes up around 7.52% of the Martian surface (JPL, 2012).

In the initial phase, materials including high-grade magnesium oxide powder, Mojave Mars Stimulant, magnesium acetate, and Bentonite clay (volcanic clay) were mixed after being chosen based on their abundance and replicability on Mars. The "Ender 3" 3D-printer, was modified into a concrete extrusion system to print MgO concrete. This modification involves removing the standard filament extruder and integrating a syringe extruder powered by a NEMA-17 motor. The motor drives a threaded rod, extruding the MgO concrete out of a 60mL syringe. The modified 3D-printer was tested for its effectiveness in extruding the MgO concrete, focusing on critical parameters like layer suspension, and structural fidelity.

The results reveal that the MgO concrete exhibits promising mechanical properties, with compressive strengths comparable to casted MgO concrete. Layer analysis reveals that the 3D-printed concrete mix demonstrates low deformation in lower layers and high suspension capabilities of individual layers. When analyzed using a phenolphthalein pH indicator, the printed concrete showcases a strong carbon dioxide sequestration capability, which will result in improved compressive strength over time in Mars' high CO_2 environment. The LDM of the MgO concrete was demonstrated successfully, however, rigorous temperature and radiation exposure testing of the concrete must be conducted to ensure a safe integration on Mars.

Abdullah Khalil, Abstract Reactive magnesium oxide cement (RMC) is gaining increasing attention as a sustainable construction material due to its significantly low carbon footprint during the production as well as the operational phase compared to the conventional Portland, Ngo, T. D., Chen, Z., Nerella, V. N., Turner, L. K., Celik, K., Dung, N. T., Unluer, C., Hay, R., Weng, Y., Kazemian, A., Khalil, A., Paul, S. C., Buswell, R. A., Zareiyan, B., Ballirano, P., Teir, S., & Hollingbery, L. A. (2020, February 25). 3D printable magnesium oxide concrete: Towards sustainable modern architecture. Additive Manufacturing. https://www.sciencedirect.com/science/article/abs/pii/S2214860419321797?via%3Dihub

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Submersible Aerial Vehicle Design Study

 Chetana Gunawardhana

There have been many attempts at creating a submersible aerial vehicle, but these attempts have failed for several reasons. Most notably, these attempts did not perform sufficiently as an aircraft or as a submarine and the transition between mediums was tedious in some cases, and slow in all. This study aims to test a design for a craft for transit three ways: airborne, surface sea, and undersea.

All previous designs had separate propulsion systems for air and water travel. Having two separate propulsion systems not only slows down the transition phase between air and water mediums, but also requires the craft to have enough space for two engine systems and their respective fuels. The design I have built uses one propulsion system on tilt-motors for propulsion in both air and water mediums and a gyroscope for stabilization and correction during flight. The current model is being controlled via a remote controller and arduino; the remote controller commands the H-tail setup and the Arduino manages the gyroscope. The H-tail is made of two rudders as vertical stabilizers and two elevons as horizontal stabilizers.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Designing a Morphing Airfoil to Maximize Flight Efficiency

Benjamin Kurowski

Aviation is one of the leading causes of carbon dioxide emissions, largely due to fuel consumption during flight (Overton, 2022). Currently, the traditional airfoil is rigid and inefficient, resulting in excess fuel consumption during flight. Reducing fuel consumption by optimizing airfoil efficiency during the takeoff phase would decrease the carbon dioxide emissions. A morphing airfoil is optimized for flight efficiency by changing its aerodynamic configuration to meet the aerodynamic requirements for each flight stage. During the takeoff phase, max flight efficiency is achieved by maximizing lift and the lift-to-drag ratio. First, two standard airfoils were created using a 3D design software and then tested in a computational fluid dynamics (CFD) software to determine the baseline data. The better performing airfoil, lg10sc-il, was used as the baseline iteration for the morphing airfoil design. The morphing airfoil was then tested using the same CFD method. Subsequently, an actuation system was designed and prototyped for the morphing airfoil. When tested under controlled CFD conditions, the morphing airfoil demonstrated a 92% increase in the lift-to-drag ratio compared to the baseline airfoil, resulting in significant fuel consumption reduction during the takeoff phase. Actuation results are currently pending, but are expected to demonstrate consistent position results and positive qualitative analysis in stress and actuation. The morphing airfoil design will be able to replace the traditional airfoil designs on commercial aircraft once it undergoes stress testing and testing in various flight conditions. The results can be utilized as a baseline structure for future morphing airfoil designs.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Search for an Association Between a Tensile Integrity Structure's Bar Count and Impact Force Mitigation

Grant Major

Tensile integrity (tensegrity) structures are a unique alternative to conventional probe deceleration methods. Instead of parachutes or landing engines, tensegrity structures absorb the force of impact and redirect it through the tensile network of the structure instead of through the payload. Currently, many impact-resistant tensegrity structures are composed of six bars under compression. This study seeks to discover if additional bars in a tensegrity structure will redirect less force through the payload than a six-bar structure. To test this, a six-bar and eight-bar tensegrity structure were created. These structures were dropped at varying heights and an Arduino-based accelerometer was used to measure the change in acceleration upon impact. With these acceleration values, the impact force of the structure was calculated which was compared between the experimental groups.

Although data collection is still ongoing, preliminary testing suggests that additional bars increase the rigidity of the structure which reduces the height of each subsequent bounce after freefall. It is hypothesized that the lack of bounces following the initial impact will result in more force being directed through the payload. This additional force can damage sensitive instruments or electrical connections within the payload.

Future research should test different structure compositions and utilize accelerometers with a lower write time than the Arduino as each data point takes anywhere from 3.3 to 10ms to write to the Arduno's storage which limits the accuracy of the sensor. Overall, the development of tensegrity structures serves to introduce new, inexpensive methods to deploy probes in hostile environments.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Thermal Paste Design on CPU Efficiency

Matthew Murray

With every new CPU generation that comes out, it seems that the temperatures on them always rise. With old temperatures just from five to seven years ago averaging 40-60 C, the newest generation are averaging around 75-80C. My project is aiming to bring these temperatures down as higher temperatures can lead to overheating of the CPU creating a shorter lifespan, as well as often having lower performance. The approach that I'm going for to combat this issue is from optimizing the Thermal Paste on the CPU, an often overlooked process of computer building could potentially have a major effect on the temperature and efficiency of the CPU as little is tested on the design of it when applied and the efficiency of the CPU. This disregard on the Thermal Paste has led to little data on how much it really does affect the performance and temperature of the CPU. With this in mind, I tested the seven most common applications of Thermal Paste Designs and ran trials with the CPU running no programs at all and then running an intensive program to test the CPU at maximum capacity. After these trials I compared the results of the temperatures and points from the intensive program (higher points mean higher performance) and saw that depending on the design, temperatures can change between different designs. The results of the experiment showed that the circle application of Thermal Paste had not only the coolest temperatures at Idle, but as well as having the highest performance. The results also showed that applications with a smoother and more consistent thermal paste spread on top of the CPU ran cooler and had higher performance than inconsistent spreads.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Hair Braid Cooler: A Device to Prevent Pediatric Burns in the Process of Dipping Braids

Emmanuelle Mutima

Hair braiding has been a fundamental part of black culture for centuries. Braiding is done with a mixture of synthetic hair types. One of these types, Toyokalon, is a polyvinyl chloride (PVC) fiber. To seal the hair after braiding, the braids are dipped in boiling hot water to prevent stiffness. When boiling water is applied to Toyokalon hair and synthetic hair, the hair melts and the hydrogen bonds in the PVC are broken, thus softening it. Once the hair is dipped, it is pulled out of the hot water, thus causing hot water to hit the skin of the person. Many studies have shown that young black pediatric patients tend to contract burns because of this practice. The goal of this engineering project was to make a machine to lower the temperature of the braids at the end of the dipping process to prevent these burns from happening. This prototype cycles the boiling hot water in and out of the dipping chamber, cycling cold water in and out of said container to lower the temperature of the braiding hair. With intervention from the prototype, the temperature at the end of the dipping process was an average of 26.20□ instead of the average end temperature of 61.35□ using the normal dipping method. This yielded a t-test p-value less than 0.0001, thus leading to the conclusion that this change in temperature was statistically significant in regards to the end temperature of the braiding hair.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Building and Testing a Mechanical Wave Force Tank with Dynamically Adjustable Parameters.

Emily Riesz

The increase in wave action due to climate change has drastically damaged seaweed, kelp, and other marine plants. Large areas of kelp forests can be decimated by an increase in wave action which can impact many marine species that depend on them. The goal of this project was to create an accurate and low cost wave tank that could be used in other experiments to test wave force and other variables. Range and speed of the motor can be changed to create waves with different heights and force which can be used to test the effectiveness of wave force dampeners, or other projects. The motor mechanics were connected and attached to a wooden board then fastened to a long and narrow fish tank to allow the waves to travel a sufficient distance. Wave height was measured from a set of numbers that were imputed into the motor and the data was compared with the other trials. After some testing it seems the motor is very concise and each subsequent wave is almost the same height as the others (within 1.6 millimeters). More tests and statistical analysis will suggest whether the waves are the same between trials. Building this wave tank and testing its limitations will hopefully open up new possibilities to test wave force and work to decrease the harm wave action puts on all marine plants and animals.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Regenerative Shock Absorber

Rylan Wells, Severn Welsh

Regenerative Shock Absorber systems harness wasted kinetic energy from the shock absorbers to generate electricity, potentially extending the range of electric vehicles. By exploring magnetic systems for RSA, this study aims to pave the way for more sustainable transportation options and enhance energy efficiency.

The project involved designing and testing a 25 centimeter long shock absorber to generate electricity. A regenerative shock absorber was made from a hollow aluminum alloy cylinder filled with a copper wire coil, with a steel spring and a steel piston rod with a neodymium disk magnet head. The motion of the piston generates an electrical charge, which is measured by an oscilloscope. The experiment's independent variable is the number of compressions, while the dependent variable is the amount of electricity generated.

Fifteen trials were conducted for one compression and another fifteen for two compressions. The data shows that a single compression of the regenerative shock absorber generated a mean electricity of 29.79 mV, while two compressions yielded a mean electricity of 42.80 mV. The significant p-value of less than 0.0001, along with a high t-score of 9.7665 and 14 degrees of freedom, indicate a strong statistical significance. This suggests that the number of compressions significantly impacts the amount of electricity generated, highlighting the effectiveness of the regenerative shock absorber technology in harnessing kinetic energy for electrical power generation. Further research could explore the implementation of the regenerative shock absorber on automobiles and other forms of electricity-based transportation.

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Environmental Engineering (1300)

Project No.	Student(s)	Project Title
1301T12	Elizabeth Brubaker, Mimi Forrester	The Effectiveness of Coffee Grounds as an Aggregate for Mortar
1302T12	Varun Cheedalla, Ananya Gupta	Determining the Compressive Strength Capability of Crosslinked Graphene-Treated Aerogels
1303T12	Nyla Loeu, Eunice Marie-Josee Makassi	The Effect of Auxins on Zinnia Phytoremediation in Oil Contaminated Soil
1304T12	Colin Cox, Hayden Miller	The Effect of Respirator Components on Emissions from Vehicular Exhausts
1305T12	Sarah Benedetta John Kennedy, Shivani Nadella	Evaluating the Filtration Ability of Douglas Fir Xylem for Lead Removal
1306T12	Haley Patel, Katie Phomsopha	The Quantification of Water Quality after Hydroponic Greywater Filtration
1307T12	Siri Kuturu, Niharika Vatsavai	Generating Energy From Benthic Mud Across Loudoun County Using a Microbial Fuel Cell
1308X11	Kayla Welsh	Synthesis and Evaluation of Biodegradable Plastics
1309X12	Cora Wildman	Analysis of the Degradation of Polyester Polyurethane by Pestalotiopsis microspora Aided by UV Exposure
1310X12	Sammie Zerfas	Where Riparian Buffers Should Be Built In The Potomac River Watershed

Category Student Count: 17

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effectiveness of Coffee Grounds as an Aggregate for Mortar
Elizabeth Brubaker, Mimi Forrester

The decomposition of organic materials in landfills produces methane, a greenhouse gas with immensely high global warming potential. Getting rid of organic matter, such as the 60 million tons of coffee ground waste produced annually, in landfills could reduce methane emissions and, consequently, help to slow climate change. Additionally, sturdy and high quality infrastructure relies on sand as an aggregate for concrete. More than 1 million dump trucks of sand is extracted per day, a significant portion of which is used for concrete projects. Often, this sand is taken from banks and river beds, disrupting the natural environment. Scientists at RMIT in Melbourne, Australia noted the adverse effects of mass producing concrete and took into consideration their country's 83,000 tons of waste in coffee grounds to kill two birds with one stone: replacing the use of sand in concrete and implementation of otherwise discarded organic material — coffee grounds. Their process first entailed testing used coffee grounds, pyrolyzing them, and creating a rich biochar. When used in lew of sand at a ratio of 15% of the concrete mix, they found the coffee concrete to be 30% stronger than average. While the methods utilized in this experiment may be implemented on an industrial level to the grave benefit of the environment, the exploration of infusing concrete with coffee grounds with a home remedy is territory unwalked. The purpose of our experiment was to test a possible home method that might produce the same results. Assuming the purpose of pyrolysis was to remove moisture from the grounds, we baked used coffee grounds, both dehydrated (for 24 hours at 75 °C) and non-dehydrated, at varying temperatures: 120°C, 150°C, 175°C, 205°C. Then, we utilized these grounds in mortar mix, partially substituting sand so that the grounds made up 15% of the mortar. Though our testing is still in progress, we are beginning to see a trend in the strength of the different treatments. Thus far, we've seen the most success in the samples containing coffee grounds that underwent 205° and no dehydration, as this was the experimental unit that could most consistently withstand impacts from greater mass (grams).

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Determining the Compressive Strength Capability of Crosslinked Graphene-Treated Aerogels

Varun Cheedalla, Ananya Gupta

Consumption of heavy metal ions through drinking water can cause adverse effects in humans such as kidney damage, neurotoxicity, or even development of different cancers. This study aims to strengthen previously created graphene-treated nanocellulose (GNC) aerogels in order to create a more structured solution to the issue of metal-ion pollution. Aerogels are low-density solids created by removing the liquid component from a gel substance. To begin manufacturing the aerogels, a gel combining nanocellulose, graphene-oxide, and iron (II,III) oxide was made. This gel was proven with last year's study to be significantly beneficial in metal-ion removal, with up to 70% removal rates for copper (II) ions. This year, cross-linkers such as glutaraldehyde and citric acid are being added to the mixture in order to create strong covalent bonds that will increase the structural integrity, thus the filtering ability, of the aerogels. Then, the gel samples are purified by soaking in anhydrous ethanol multiple times, and placed in a supercritical CO_2 dryer in order to fabricate the aerogels. To test their strength capabilities, the aerogels underwent compressive strength tests using the Universal Testing Machine (UTM). Through observation only, it can be seen that the aerogels with the cross-linkers are more intact than those without. The data collected suggests that both crosslinkers do in fact have a greater compressive strength value. Further testing with other cross-linkers as well as different amounts may lead to an even more commercially viable aerogel, thus making it a more effective and efficient solution to metal-ion pollution.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Auxins on Zinnia Phytoremediation in Oil Contaminated Soil

Nyla Loeu, Eunice Marie-Josee Makassi

Oil spills around the globe are a serious concern and solutions are needed. The goal of this research project is to identify if growth hormones have an impact on the effectiveness of phytoremediation in Zinnia elegans, and if so, which ones work best on increasing the effectiveness. Using proper PPE, 107 liters of moist soil was contaminated with common engine oil in a concentration of 4% (1.13 gallons) by weight. The engine oil was poured into the soil and mixed thoroughly with gloved hands. After mixing the soil, we split between four groups of 30 zinnia cuttings. Cuttings were collected from the zinnias using pruners and gloves The first group was the Control with no hormones; Treatment Group 1 was dipped in indole butyric acid (IBA), Treatment Group 2 was dipped in naphthaleneacetic acid (NAA), and Treatment Group 3 group in DipN'Grow (IBA and NAA). The amount of hormones used was calculated by massing the hormones before and after. Oil mass was measured using a hexane extraction. 0.5g of soil was shaken and mixed with hexane; the soil was then filtered out, and the solution was placed into a petri dish. Once the hexane was evaporated from the oil, the petri dish was weighed again. As of now, the cuttings treated with NAA are rooting but browning. The other groups are rooting, green, and firm. Data collection is ongoing. It is predicted that significant uptake in oil from the cuttings treated with DipN'Grow and IBA will occur.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Respirator Components on Emissions from Vehicular Exhausts

 Colin Cox, Hayden Miller

One hundred thousand individuals visit the emergency room each year due to vehicle carbon monoxide exposure. In one year, each car emits approximately 260 kilograms of CO (573 lbs). The escalation of harmful vehicle emissions, notably carbon monoxide (CO), poses a critical global concern due to its adverse environmental and health impacts. Carbon monoxide is a colorless, odorless gas that forms due to incomplete combustion reactions and is commonly present in the combustion of a car engine. This experiment investigated the potential protective role of affordable respirator components on carbon monoxide exposure, providing potentially valuable insights into their effectiveness for future applications. The experiment aimed to introduce a mechanism that filtered CO from vehicular exhaust, decreasing the amount of greenhouse gasses that flow into the environment. The experiment examined the effectiveness of five filters, including particulate, furnace, cheesecloth, charcoal, and carbon filters. A 4 gas analyzer measured which filtration component reduced carbon monoxide emissions most effectively. In addition to carbon monoxide, the analyzer detected carbon dioxide, oxygen, and hydrocarbons, providing additional evidence of other greenhouse gas filtrations. An enclosed container ensured that the analyzer accurately measured emission contents. Across all five filters (fifteen trials each), data showed that the carbon filter reduced carbon monoxide emissions the greatest. Analysis showed a statistically significant difference between the filters through an ANOVA test, with a p-value of <0.01. The control, with no filter present, had an average CO concentration of 0.06065, whereas the carbon filter had an average of 0.02533.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Evaluating the Filtration Ability of Douglas Fir Xylem for Lead Removal

Sarah Benedetta John Kennedy, Shivani Nadella

As of 2021, over 2 billion people live in water-stressed countries with conditions expected to worsen in the future due to climate change and population growth. One of the main solutions to this issue has been to develop point-of-use (POU) filters, which filter water at the point of collection and are geared for use in developing countries. Compared to other POU filters, xylem filters, made from tree xylem, are a promising alternative due to their affordability, ease of maintenance, and simple construction. The objective of this research is to assess the ability of xylem filters made from Douglas fir trees, a tree species widely available across North America, to remove lead from drinking water and be used to manufacture xylem filters. To measure lead concentration, the absorbances of known concentrations of control lead solutions were measured with UV-Vis spectroscopy and used to generate a calibration curve for determining the unknown concentrations of filtered lead solutions. After contaminated lead solutions were filtered through the xylem filters, the concentrations of the filtered solutions were measured using UV-Vis spectroscopy and the calibration curve. The concentrations of filtered solutions were then compared to those of the control solutions to determine the filters' removal efficiency of lead from drinking water.

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World Health Organization: WHO. (2023, September 13). Drinking-water. https://www.who.int/news-room/fact-sheets/detail/drinking-water

I/We hereby certify that the above statements are correct and the information provided in the Abstract is the result of one year's research. I/We also attest that the above properly reflects my/our own work (digitally signed).

LCPS RSEF OFFICIAL ABSTRACT - 2024

The Quantification of Water Quality after Hydroponic Greywater Filtration

Haley Patel, Katie Phomsopha

Water insecurity is a major problem that affects underserved communities around the world. Due to the expensive nature of industrial water treatment, many are unable to obtain the necessary measures to ensure safe drinking water. In addition to lack of clean water, in many communities this essential water is scarce. A proposed and viable solution to this dilemma would be purification of water through hydroponic systems, and previous research has shown that hydroponic filtration of heavy metals is incredibly effective; however, more research was needed for greywater recycling for drinkability. When commencing trials, soapy greywater was run through a deep-water hydroponic system for purification in an attempt to for potability or at least reuse. Water was evaluated at ten daytime intervals to determine the effectiveness of filtration in *Brassica rapa, Lactuca sativa var. capitiata,* and *Lactuca sativa var. Longifolia*. Results may suggest that utilizing greywater in a deep-water hydroponic system is effective in reducing contamination and may be recycled for secondary use. If the research shows that the water was found not to be potable, it may still be utilized in other household tasks.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Generating Energy From Benthic Mud Across Loudoun County Using a Microbial Fuel Cell

 Siri Kuturu, Niharika Vatsavai

Generating energy from renewable sources is essential for several reasons including climate change, reducing air pollution, and minimizing greenhouse gasses. The purpose of this experiment is to see how electricity conducted from benthic mud through building a Microbial Fuel Cell differs depending on which reservoir it is collected from in Loudoun county. Last year, we tested benthic mud from Beaverdam Reservoir, Ashburn VA, which produced an average of three volts of energy. We will be comparing the data from last year to the energy conducted from Goose Creek and Round Hill Reservoir. The method we are using is through an anode and cathode chamber, which in our project are plastic containers. They are attached from a salt bridge and contain electrodes to help produce electricity from the mud placed in the anode. Furthermore, our data is still undergoing at this time of submission. We continue to study this type of cell as it contributes to sustainable energy and also reduces contaminants such as wastewater and carbon dioxide in our environment. Studying different reservoirs is to find the core reasoning behind which organisms and bacteria are fueling the energy created. By having access to this information, we can further explore how to create a resolution to energy problems and hopefully find secure renewable sources. Just as we have created solar panels or hydropower in order to conserve energy, microbial fuel cells can be the next step taken.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Synthesis and Evaluation of Biodegradable Plastics

 Kayla Welsh

   Plastics are being used more and more in our society each year. Unfortunately, nearly 80 percent of this recyclable waste ends up in the landfill. These plastics take 20-500 years to fully decompose and are currently building up our landfills. Biodegradable plastic is a remarkable substitute that is becoming a trend in the sustainable community. Although there are many variations, the optimal bioplastic has yet to be fully available. This project investigates the synthesis of biodegradable based plastic along with the exploration of the most exceptional bioplastic option for our global concerns.

   The biodegradable plastics contained personalized alterations that included the addition and variation of amounts in citric acid, vinegar, glycerol, and multiple types of starches. As a trial-based investigation took place synthesizing each biodegradable plastic alternative, there became prominent pros and cons of each bioplastic. This experiment evaluated the difference between multiple bioplastics and their properties using a water solubility and soil decomposition test along with observations and plasticity tests. Trials that have been conducted resulted in many different variations of plastic. As potato starch created a hard plastic with almost no plasticity. Citric acid added into the bioplastics created a very bendable and stretchy plastic. Solubility, decomposition, and elasticity tests are currently being conducted.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Analysis of the Degradation of Polyester Polyurethane by Pestalotiopsis microspora Aided by UV Exposure

Cora Wildman

The use and production of plastic polymers has dramatically increased the amount of pollution that plagues the environment. Most plastic is not recycled and instead is discarded, where it remains for hundreds of years without breaking down. The durability of plastic polymers damages the ecosystems they reside in, and their production is only increasing (Kemona & Piotrowska, 2020). However, through bioremediation, select organisms can utilize powerful enzymes to break down complex synthetic polymers (Russell et al., 2011). The fungus, Pestalotiopsis microspora, has been proven to degrade a plastic polymer, polyester polyurethane (PUR). Specifically, some bacteria and fungi have shown increased rates of degradation when breaking down plastic that was pre-treated by UV exposure. Samples of PUR were exposed to UV light for 48 hours then inoculated with Pestalotiopsis microspora. The degradation of the plastic polymer was measured through the change in transparency and depth of clearance of the plastic. Using both liquid and solid PUR, control groups included untreated PUR while the experimental groups utilized PUR exposed to UV light. All groups were tested in aerobic and anaerobic conditions. By comparing the rates of degradation of the control and experimental groups, the significance of pre-treated PUR on the efficiency of Pestalotiopsis microspora was determined. Although significance between these groups was not shown, further steps can be taken. An extension of UV exposure or alternative forms of PUR could produce differing results. Furthermore, inoculation of the fungi in greater amounts could encourage more fungal growth and increased visibility of degradation.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Where Riparian Buffers Should Be Built In The Potomac River Watershed

 Sammie Zerfas

Local waterways are negatively impacted from pollutants such as fertilizers, chemicals, oils, garbage, and sediment. These pollutants are washed into the waterways by rain water. One way that water pollution can be mitigated is with a riparian buffer. A riparian buffer is a zone of plants and trees planted next to a waterway to prevent pollutants from entering it (USDA Forest Service). Buffer zones catch the non-point source pollution such as the chemicals, animal waste, and trash. Ideally, every body of water would have at least 60 ft. of buffer vegetation on either side. In this project, I gathered data on soil erodibility and accumulated wastewater as well as research on riparian buffer zones. Using arcGIS, I have identified where in Loudoun County it would be the most beneficial to overall water quality to build riparian buffers.

"Riparian Forest Buffers." n.d. https://www.fs.usda.gov/nac/practices/riparian-forest-buffers.php#:~:text=Riparian%20forest%20buffers%20can%20deliver,providing%20wildlife%20habitat%20and%20corridors.

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Materials Science (1400)

Project No.	Student(s)	Project Title
1401X11	Vanya Angara	Creating Nightlights with Glowing Zoo-plankton and Dinoflagellates
1402T12	Karthik Bose, Rahul Kagalwala	The Efficacy of Carbonized Wood as an Alternative Power Transfer for Fire Prevention
1403X12	Victoria Collins	The Effect of Duct Tape Grade and Surface Type on Trace Evidence Transferability
1404X12	Srikar Kunapuli	Enhancing Tensile Strength of Mycofabricated Leather Derived from Penicillium Chrysogenum
1405T12	Sanvik Medavarapu, Pranav Pendyala	Predicting Electrospun Poly(vinyl alcohol) Nanofiber Porosity from Processing Parameters Using Machine Learning
1406X12	Pranay Rayapati	Carbon Nanotube Air Fiter
1407X12	Alejandro Restrepo	The Development of Conductive Ink via Graphite Powder
1408X12	Tamera Rizvi	Developing a Wearable and Affordable Iontophoresis Device for Hyperhidrosis Management
1409T12	Akhilesh Tammana, Leila Ware	Utilizing Biochar from Pyrolyzed Biosolids and Mycelium for Sustainable Concretes
1410X12	Kayla Waterfield	Finding a safer alternative to remove an acrylic nail.

Category Student Count: 13

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Creating Nightlights with Glowing Zoo-plankton and Dinoflagellates

Vanya Angara

Bioluminescence is a phenomenon that serves the purpose of allowing organisms to emit light naturally. Their light has also been aligned with the belief that it can be harnessed to be used as a more environmentally-friendly alternative to source of lighting. One bioluminescent species known as dinoflagellates, has not been tested whether or not it can indefinitely be used as a source of lighting due to their light being produced in flashes. Past studies have shown that when zooplankton ate bioluminescent bacteria, they glowed, proposing the question of if brine shrimp can glow after feeding on bioluminescent dinoflagellates, and if they can be used as lighting. An experiment involving brine shrimp being able to eat bioluminescent dinoflagellates and dinoflagellates being used as nightlights was conducted in order to determine whether or not they can be used as potential sources of lighting. A tank filled with brine shrimp and dinoflagellates was used to see if the brine shrimp ate the bioluminescent dinoflagellates or not. Three experimental groups (one group of dinoflagellates, one group of brine shrimp and dinoflagellates, and one group of brine shrimp) were set up in "nightlights" filled with seawater, controlled by oxygen, and were measured by their UVB light to see which one emitted the most amount of light. Experiment results revealed that the nightlight with the dinoflagellates emitted the most amount of UVB light (inconsistently), however, the brine shrimp did not eat the dinoflagellates. Thus, dinoflagellates are not favorable when used as a potential lighting source.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Efficacy of Carbonized Wood as an Alternative Power Transfer for Fire Prevention

Karthik Bose, Rahul Kagalwala

A unique property of wood is that when carbonized, it gains a conductive property. When the wood is heated to around 1200°C, the lignin fibers in the wood carbonize into graphene, a highly conductive material that allows for electrical transfer through the wood. As such, we used Cedar wood, a wood with a high density of lignin. We prepared the wood by cutting and sanding it down before carbonizing it to about 1200°C with a blowtorch. We then attached wires and a voltmeter to run current through the wood, and confirmed electrical flow with an ammeter. Flammable cotton balls were placed along the wood as it was being charged to test if the wood could pose a fire hazard as it was being charged, with the results of there being no fire. Wires were then attached to the other end of the wood to a lightbulb to confirm electrical transfer which resulted in the light bulb turning on. This testing proved the potential for carbonized wood as a method of electrical transfer with a reduced fire hazard, and if paired with conventional wires, could reduce the risk of electrical fires.

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Pulido-Novicio, L., Hata, T., & Kurimoto, Y. (1998). Adsorption capacities and related characteristics of wood charcoals carbonized using a one-step or two-step process . The Japan Wood Research Society.

LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Duct Tape Grade and Surface Type on Trace Evidence Transferability

Victoria Collins

In the last several years, Duct Tape has proven to hold more power in criminology than ever thought possible.

Fingerprint transferability on Duct Tape grade and transfer surface material were being investigated. For both variable experiments, the control was a solid black fingerprint on a plain piece of paper. Each experiment followed a similar procedure of placing a fingerprint onto a strip of Duct Tape, sealing the Duct Tape onto the transfer surface, and then pealing the Duct Tape off.

The control for both experiments resulted in 100% transfer. Comparatively, the averages for each Duct Tape grade number are 8979 41%, 5959 49%, 6969 67%, 3939 80%, 3900 57%, 2929 56%, 1900 69%, and 3903 83%. The average comparisons for the surface types to the control are glass 18%, wood 83%, cork 77%, cotton 66%, satin 21%, burlap 56%, iron 34%.

The experimental hypothesis of one Duct Tape grade having higher transferability than the rest was supported by the ANOVA test. If there is no difference in transferability for Duct Tape grade, it is expected to be a difference at least this extreme 0% of the time. The experimental hypothesis of one surface type having higher transferability than the rest was supported by the ANOVA test. If there truly is no difference in transferability for surface type, it is expected to be a difference at least this extreme 0% of the time.

Further research could explore variables involving the perpetrators, for example, fingerprint time and pressure on the Duct Tape.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Enhancing Tensile Strength of Mycofabricated Leather Derived from Penicillium Chrysogenum

Srikar Kunapuli

Leather is a durable, flexible material used in the making of items such as furniture, clothing, bags and watches. A rapid increase in the rate of leather usage is projected over the next several decades. However, traditional animal-hide leather production methods present environmental, sustainable, and ethical issues due to raising cattle for animal hide to be used to make leather and employing chemicals while treating the leather. A proposed alternative to traditional animal-hide leather is fungi-based leather. This leather alternative would harness mycelium grown from fungi, utilizing fewer natural resources and less space while being more environmentally sustainable.

This research aimed to determine whether mycelium from Penicillium chrysogenum could be used as an alternative to traditional animal hide in the fabrication of leather. Mycelium mats harvested from Penicillium chrysogenum cultures were cut into sixteen 2 x 2 cm² sheets which were then soaked in a glycerol solution followed by soaking in a 5% tannic acid solution. Each mat was hot-pressed with an iron and rolled out to produce the mycelium-derived leather. Experimental testing and statistical analysis determined the tensile strength of the treated mycelium displayed substantial increases in tensile strength and flexibility, comparable to that of animal-hide leather. Further research should explore other proposed treatments such as the addition of corn zein or tannins to the mycelial mats. This may further increase the tensile strength of the mycelium. The hope is that this leather could serve as an eco-friendly alternative to existing sources.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Predicting Electrospun Poly(vinyl alcohol) Nanofiber Porosity from Processing Parameters Using Machine Learning

Sanvik Medavarapu, Pranav Pendyala

Wound healing is a complex biological process involving multiple stages, with oxygen playing a crucial role in various healing mechanisms. Electrospun nanofibers, specifically those made from Poly(vinyl alcohol) (PVA), have emerged as promising wound dressings due to their unique properties resembling the Extracellular Matrix (ECM) and high porosity. Porosity, a key factor in oxygen permeability, is influenced by electrospinning parameters such as voltage, flow rate, and needle to collector distance. This research aims to predict the porosity of electrospun PVA nanofibers using machine learning models. Previous studies have successfully utilized Artificial Neural Networks (ANNs) to predict fiber diameter, but porosity, a more relevant metric for wound healing, has not been explored extensively. The hypothesis states that an ANN model will exhibit the highest accuracy in predicting nanofiber porosity. The experimental design involves electrospinning PVA nanofibers with five different parameter sets, each replicated thrice, resulting in 45 samples. Porosity is determined using Scanning Electron Microscopy (SEM) images, and the data is used to train and test machine learning models, including ANNs. Additionally, a method control group to replicate fibers in the dataset is employed for comparison. The experimental procedure is organized into data preprocessing, machine learning model implementation, and electrospinning of PVA nanofibers. Statistical analysis involves measuring the correlation coefficient for each model, with the Kruskal-Wallis test comparing the models' accuracy. This research contributes to the optimization of electrospinning parameters for PVA nanofibers using machine learning, streamlining the fabrication of wound dressings, and resulting in more cost-effective nanofiber bandages.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Carbon Nanotube Air Fiter

Pranay Rayapati

Air pollution is a leading cause of many respiratory illnesses. $PM_{2.5}$ and PM_{10} can accelerate symptoms of COPD and asthma. As people move into more crowded areas, it becomes clear that proper air pollution control is necessary. Carbon nanotubes are able to absorb other particles, such as lunar dust when used as dust shields. Previous research has looked into this ability to determine the possibilities of carbon nanotubes. Due to the lack of research into using carbon nanotubes as air filters, this experiment's goal is to make one to see how well carbon nanotubes would work in air filters. The air filter is comprised of two layers of filter paper with a thin layer of carbon nanotube powder in the middle. This air filter will be tested under a fume hood using an AirKnight Air Quality Sensor. These results will be analyzed using a one sample t-test to find a mean for the amount of $PM_{2.5}$ and PM_{10} there is in the air using the filter. Further research will be on the difference in quality between single-walled and multi-walled carbon nanotubes.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Development of Conductive Ink via Graphite Powder

Alejandro Restrepo

The inflation of housing prices across the nation intimidates potential buyers from investing in real estate. In Virginia's case, inflation caused housing prices to rise by 4.4 percent, decreasing sales activities by 23.6 percent (in 2023). Electrical installation of wires comprise 6.6 percent of the cost to construct a house, with prices varying depending on wire type.

This research endeavored to produce a new electrical conductor in the form of ink using graphite powder in order to create an alternative to current house wires. Graphite powder was mixed with acetic acid and saltwater to form an ink-like mixture. This ink was painted onto chromatography paper strips and were tested for electrical current conduction.

An ammeter was used to determine the amperage the ink produced. Fifteen strips of two centimeter length were measured; the median minimum current produced from the strips was 15.5 milliamps and the maximum current produced was 27.29 milliamps. The measured amperage supports the fact that the ink conducted electricity. However, the light bulb used to indicate sufficient conduction did not light up, indicating insufficient conductivity. Further research would entail differing the composition of the graphite ink to ensure a higher amperage. This could result in the production of a replacement for current non-metallic wires, which is important as the prices of wires as well as the flammability of the wire indicate the need of having alternative options.

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I/We hereby certify that the above statements are correct and the information provided in the Abstract is the result of one year's research. I/We also attest that the above properly reflects my/our own work (digitally signed).

LCPS RSEF OFFICIAL ABSTRACT - 2024

Developing a Wearable and Affordable Iontophoresis Device for Hyperhidrosis Management

Tamera Rizvi

Hyperhidrosis, a condition characterized by excessive sweating beyond what is necessary for regulating body temperature, impacts around 15.3 million Americans, and is notably detrimental due to its multifaceted consequences, ranging from social effects to dehydration (Parashar et al., 2023). While current treatments, including surgery and medications, are available, they exhibit significant drawbacks such as surgical complications and adverse side effects, necessitating alternative solutions. Among the existing treatments, one of those most effective is iontophoresis, a non-invasive treatment showing efficacy rates as high as 80%, however, it faces challenges related to its comfort, requiring users to immerse affected areas into shallow trays filled with water for up to 20 minutes per affected area, which affects user consistency. Another issue with iontophoresis is its price, with a single session ranging from $150-$200, limiting its widespread adoption. My proposed solution draws inspiration from commercially available iontophoresis at home devices and aims to address the drawbacks of the current treatment. The wearable iontophoresis device seeks to provide a convenient and affordable solution for at-home hyperhidrosis treatment. By incorporating design elements prioritizing accessibility and user-friendliness, utilizing 18 volts as the power source for a mild electric current, It aims to empower individuals suffering from hyperhidrosis, bridging existing gaps in accessibility and comfort. By encompassing both the physical and emotional dimensions of hyperhidrosis, this research into an improved design and delivery system of iontophoresis takes a comprehensive step towards significantly improving the well-being of millions of individuals grappling with this challenging condition.

1. Cochrane Database Syst Rev. 2022; 2022(2): CD015135. Published online 2022 Feb 14. doi: 10.1002/14651858.CD015135 Monitoring Editor: Cochrane Skin Group, Louise Dunford, corresponding author Andrew V Clifton, John Stephenson, Kathy Radley, Louise McDonald, Laurice Fretwell, Seau Tak Cheung, Lynne Hague, and Robert J Boyle

2. Parashar, K., Adlam, T., & Potts, G. (2023). The Impact of Hyperhidrosis on Quality of Life: A Review. American Journal of Clinical Dermatology, 24(2), 187-198. doi: 10.1007/40257-022-00743-7

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Utilizing Biochar from Pyrolyzed Biosolids and Mycelium for Sustainable Concretes

Akhilesh Tammana, Leila Ware

The concrete industry is pivotal to modern infrastructure. However, it is a landmark contributor to climate change, producing four billion tons of CO_2 in 2021, contributing to 8% of global CO_2 emissions (Qing et al., 2023). Growing interest rests in pyrolysis as an alternative to landfill disposal, where materials like biochar from pyrolyzed municipal biosolids provide a carbon-sequestering additive in concrete while reducing organic waste. Similarly, mycelium is a renewable alternative to traditional building materials and offsets greenhouse gas emissions.

Biochar ratios ranging from 0.3 - 50% were implemented as a partial weight replacement for concrete fine aggregates to increase compressive strength and carbon storage capacity. The process was mirrored for mycelium: biochar ratios ranging from 5 - 20% by weight partially replaced mycelium substrate to observe the impact of biochar on the strength and density of mycelial networks. Typical concrete and mycelial bricks were developed as a control. A hydraulic press was utilized to test the compressive strength of concrete and mycelium specimens to determine the effectiveness of biochar. Preliminary results show that a fine aggregate replacement in concrete of 5% by weight of biochar roughly doubles the compressive strength in specimens compared to conventional concrete ($P<0.01$). Biochar and sand particles were photographed under a scanning electron microscope for comparison. Biochar ratios producing the strongest concrete and mycelium samples were combined into a single hybrid material, with a partial fine aggregate replacement of biochar and partial coarse aggregate replacement of mycelium to manufacture an optimized eco-friendly concrete alternative.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Finding a safer alternative to remove an acrylic nail.

 Kayla Waterfield

The Intent of this experiment is to research similar chemicals that have shared properties with acetone in order to remove the acrylic nail, (Liquid Monomer and Powdered Polymer, with minimal generic nail polish) in a less invasive way to keep the highest amount of keratin remaining.

The materials I will be studying in this experiment are; Acetone, D-Limonene, Methyl Ethyl Ketone, Ethyl Lactate, and TriKlean. I will use these materials because they all share chemical properties that are similar to Acetone, making them potential alternatives for acrylic nail removal. Meaning these are all possible substitutes to remove an Acrylic Nail. But which is most effective without extensive damage?

To evaluate their effectiveness in acrylic nail removal, I will create a simulated model featuring Keratin Pills and a synthetic acrylic layer (created with liquid monomer and powdered polymer), replicating the human nail bed with an acrylic nail overlay. Testing Acetone, D-Limonene, Methyl Ethyl Ketone, Ethyl Lactate, and TriKlean, I will conduct 5 trials for each chemical.

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TriKlean | Acetone Replacement | Non-Hazardous Solvent Cleaner. (n.d.). Fibreglass Direct. Retrieved February 27, 2024, from https://www.fibreglassdirect.co.uk/triklean-acetone-replacement-non-hazrdous-solvent.html

Mathematics (1500) and Physics & Astronomy (1700)

Project No.	Student(s)	Project Title
1501X11	Ryan Doraiswamy	Applications of the Riemann Hypothesis in Cryptography
1502X12	Taran Srikonda	Mathematical Modeling of Integrated Approaches for Treating Acute Myeloid Leukemia
1701X12	Greyson Dolan	How Well Does Citzen Science Work, A Case Study Using Exoplanets
1702X12	Dani Ingle	The Impact of Small Collisions on Solar Panels in Low Earth Orbit
1703X12	Graeme Johanson	Creating an Affordable and Still Effective Clinostat
1704T11	Sarayu Darapuneni, Lily Lawing	Analyzing gravitational lensing to find the distance (ly) of astronomical objects from Earth
1706X11	Evin Mathen	Optimizing the feasibility of a quantum levitation system through use of a vacuum environment, for application in transportation.
1707X11	Nada Megahed Elhefnawy	Quantum Entanglement and Local Relativity: The Black Information Hole Paradox, Entropy, General Relativity, and the Universe as a Domino Effect
1708X11	Shlesh Sakpal	Forecasting Space Weather Events Through Analysis of Active Region Magnetograms using Artificial Intelligence
1709X11	Cathy Thompson	A Meta-Analysis on the Theories of Dark Matter
1710X12	Ianto Wooldridge	Finding and Assessing the Habitability of Exoplanets using Machine Learning

Category Student Count: 12

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Applications of the Riemann Hypothesis in Cryptography

Ryan Doraiswamy

The Riemann hypothesis is an unsolved problem that details the placement of prime numbers on the critical strip S=-½. It also details the placement of prime numbers on a numberline through its relation to the prime number theorem and prime counting functions.The placement of these prime numbers can be valuable for creating cryptographic sequences Cryptographic sequences using large prime numbers are notorious for being difficult to decrypt due to the immense level of calculation required to do so If the tendencies of the distribution of primes, foretold by the Riemann Hypothesis, are consistent with the distribution shown by the Chebyshev PSI function, then using it to generate cryptographic sequences can show an application of the hypothesis itself.The research began with the definition of the prime counting function, which counts the number of primes less than or equal to a given number. With the use of helpful functions such as the logarithmic integral function and the prime number theorem, the prime density over a specific range was approximated. The tendencies of the prime density of the PSI function with respect to prime density foretold by the zeta function was examined, which allowed for a correlation between the two. From there, a method was developed using the PSI function to generate large prime numbers, which were then used in an RSA-style algorithm to create cryptographic sequences. This has major implications because it could improve the security of the cryptographic algorithm by enabling it to use consistently larger primes.

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Encyclopædia Britannica, inc. (2023, September 12). Riemann zeta function. Encyclopædia Britannica. https://www.britannica.com/science/Riemann-zeta-function

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Mathematical Modeling of Integrated Approaches for Treating Acute Myeloid Leukemia

Taran Srikonda

Leukemia, also referred to as the cancers of blood cells, has proven to be one of the most harmful forms of cancer, with nearly 60,000 new cases and 24,000 deaths per year. Acute lymphocytic leukemia is one type of leukemia that is most apparent in younger children, while Acute Myeloid Leukemia is apparent in older individuals. All subtypes of Leukemia have a five-year survival of 65.7%. Recent research on Acute Myeloid Leukemia cancer cells shows that the search for more effective cancer treatments are necessary. Beyond traditional treatments, such as radiotherapy and chemotherapy, combination therapies should be introduced. The importance of further understanding the efficacy of combination therapies has proven to be critical and with mathematical modeling, the optimal dosages and treatment strategies can be studied. Through our analysis, we will have a better understanding of specific dosages and times between treatment installations that are optimal, and we can predict which combination of therapies will be most efficient. We will explore parameter values and combinations thereof in our model to study how treatment strategies vary in different scenarios, and we will discuss reasonable treatment strategies that can be implemented when two or more therapies are combined suitably.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

How Well Does Citzen Science Work, A Case Study Using Exoplanets

Greyson Dolan

This project goal is to get a better understanding of how useful and accurate citizen science is in the field of astronomy. Exoplanets are planets that orbit stars outside the solar system. The reason exoplanets were chosen for this project is because they are a relatively new part of study in astronomy and with the rapid pace that exoplanets are being detected, it's important to know if a citizen telescope can be useful in helping detect and collect accurate data related to exoplanets. The main method of research of this project is using a citizen telescope to create lightcurves with the program EXOTIC, to obtain the light curves photo of an exoplanet. The star that hosts the exoplanet must have photographs taken of it using a telescope. The citizen telescope lightcurve is then compared to observatory data and put through the EXOTIC program. Comparing the Light Curves would consist of measuring how long the transit dip is, which will help define the orbital period of the exoplanet, and how deep the transit dip is, which will help determine the size of the exoplanet. Which would help obtain a better understanding of how accurate the citizen telescope is. The data collected is of two stars with exoplanets (WASP-82B and K2-373B). The light curves for these planets have numbers that measure the diameter in distance and the orbital period.

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Wright, Jason T., and B. Scott Gaudi. "Exoplanet Detection Methods." arXiv.Org, 10 Oct. 2012, arxiv.org/abs/1210.2471.

LCPS RSEF OFFICIAL ABSTRACT - 2024

The Impact of Small Collisions on Solar Panels in Low Earth Orbit

Dani Ingle

In 2009, the first collision of two satellites in low Earth orbit was recorded between Iridium-33 and Cosmos 2251 (Kelso, 2009). There are an estimated "900,000 small debris objects with a radius of at least 1 centimeter" today (Uriot, 2022). Today, satellites are even more susceptible to damage due to an increase in satellite population and consequential collisions. Attempts are being made to limit satellite collisions, including the ESA's contest in 2019 which utilized machine learning for avoidance of objects over 10 centimeters (Uriot, 2022). Yet, there is still little research or experimentation exploring the effects of small collisions (which do not render the satellite entirely destroyed) on the most vulnerable and vital parts of a satellite: the solar panels. In this research project, the effect of small collisions of objects less than ten centimeters on solar panels is tested in order to determine possible effects to the power source of satellites in low-earth orbit. In order to simulate a high-velocity impact, a ballistic pendulum is utilized in order to test the effects on the current of a charged solar panel into a test circuit over two trials of identical solar panels. Results are still being gathered, but the findings should lead to conclusions on the further vulnerability of satellites as the population of low Earth orbit increases.

Hardy, B. (2020, May 11). Long-term effects of satellite megaconstellations on the debris environment in low earth orbit. *Illinois Library*. https://www.ideals.illinois.edu/items/115612

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Creating an Affordable and Still Effective Clinostat

 Graeme Johanson

As humans further their understanding of other planets and space, it becomes more prevalent for the study of space and zero gravity both professionally and on the amateur level. However, due to the recent interest equipment has become quite expensive and completely removed the idea of amateur study of microgravity and space. This project is to create a completely new 3D clinostat design that is affordable and replicates similar results to expensive options. Clinostats operate by rotating on an axis (or two), negating any gravitational bias by allowing Earth's constant downward pull to act on every direction of whatever you are testing. This prevents one single direction from being "down" and allows for the observation of the little to no gravitational bias on a subject. By creating a 3D printed body and running two DC motors with code on an Arduino Uno r3 board, an affordable and uniquely customizable clinostat is created. While the idea is simple, the implementation required more problem solving and designing than anticipated. Multiple iterations were made to overcome obstacles along the way in both coding and design aspects, with the result being a more refined design.

While the exact testing of the clinostat is still ongoing, the brand new design is significantly more affordable than other options on the market. The pieces for the new are currently being fabricated via 3D printer and everything else is ready to be assembled, and precise measurement of lowest microgravity will be conducted to further compare clinostats.

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Hoson, T., Kamisaka, S., Masuda, Y., & Yamashita, M. (n.d.). Changes in plant growth processes under microgravity conditions simulated by a three-dimensional clinostat - journal of plant research. SpringerLink. https://link.springer.com/article/10.1007/BF02489403

How Effectively Does a Clinostat Mimic the Ultrastructural Effects of Microgravity on Plant Cells?. Academic.oup.com. (n.d.-a). https://academic.oup.com/aob/article-abstract/65/2/213/163767

LCPS RSEF OFFICIAL ABSTRACT - 2024

Analyzing gravitational lensing to find the distance (ly) of astronomical objects from Earth

Sarayu Darapuneni, Lily Lawing

Gravitational lensing is an astronomical phenomenon where gravity bends the path of light, making it appear bent. Gravitational lensing can be used to detect dark matter, black holes, and faint galaxies. By analyzing gravitational lensing, the distance of the object can be determined based on the redshift of the object, which is the phenomenon where the wavelength of light stretches as the object moves away from Earth and appears red. The independent variable is the different equations being used. The dependent variable is the distance of the object causing the gravitational lensing. The constants are the 32″ Ritchey-Chretien telescope at George Mason University and the software used to analyze the data. The control group is the distances of the objects found using the redshifts provided in Harvard's database. The purpose of the project was to obtain pictures of gravitational lenses through observation at George Mason University and to analyze them with computer software, AstroImageJ, to determine the distance of the object being lensed. Data is still being collected at this time. Further research could explore the lensing equations and how they could be used in a computer program to calculate the distance of a lens based on given information or observations.

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https://pweb.cfa.harvard.edu/research/topic/gravitational-lensing

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Kochanek, C. S., Falco, E. E., Impey, C., Lehar, J., McLeod, B., & Rix, H.-W. (n.d.). Castles Survey. Gravitational Lens Data Base. https://lweb.cfa.harvard.edu/castles/

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Optimizing the feasibility of a quantum levitation system through use of a vacuum environment, for application in transportation.

Evin Mathen

Quantum levitation has been disregarded as a feasible alternative to Maglev trains for a few reasons. Foremost of which is its supposed inefficiency and the thermal regulation required to enable the Meissner Effect. In my project, I seek to solve both of these problems by implementing a vacuum for the system to sit within. Within a vacuum, both air resistance and friction are eliminated as factors that slow down the movement of the "train". Additionally, I plan on implementing a property of liquid nitrogen in a vacuum which allows it to turn into a solid. Through this property, as well as the natural thermal insulation of a vacuum, I hope to maintain the temperature required for the superconductor to work for extended periods of time. The success of this project could result in a method for extending superconductivity, as well as a basis for research into alternative powerless and friction-less methods of transportation.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Quantum Entanglement and Local Relativity: The Black Information Hole Paradox, Entropy, General Relativity, and the Universe as a Domino Effect

Nada Megahed Elhefnawy

Bell's theorem, later updated by Clauser and Freedman, was the introduction to the verification of Quantum Entanglement. In Freedman and Clauser's experiment, they "rule out local hidden-variable theories with high statistical accuracy" (Freedman & Clauser 939). This research later got the Nobel prize in 2022 after periods of scientific uncertainty and a refusal to see a concept that would revolutionize how we see the universe. Quantum Entanglement is a rejection of previously accepted conjectures, however, how much can it explain without going back to the roots of these hypotheses? In this theoretical research, it's necessary to explore Quantum Entanglements' effect on the logistics of the universe, by using Einstein's Local Relativity theory, other theories, and data to come to hypothetical conclusions and formulate new theories about the peculiar nature of the concept. Quantum Entanglement proves the universe is an interconnected creation. Everything in this concept seems to be interconnected by postulation, entropy leads into the black information paradox and everything seems to work together like a domino effect in the universe. The formation of new possible theories proves the connection between general relativity and entanglement and the modification of the local relativity theory to fit the real concept of entanglement. The data and theories show that the chaotic nature of the universe may not be chaotic. Quantum Entanglement is the introduction to causes of cosmic disturbances, and the junction between philosophy and science. This helps us understand the previously unexplainable leading to a better understanding of how the universe operates.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Forecasting Space Weather Events Through Analysis of Active Region Magnetograms using Artificial Intelligence

 Shlesh Sakpal

Although space weather events may not directly affect human life, they have the potential to inflict significant harm upon our communities. Harmful space weather events can trigger atmospheric changes that result in physical and economic damages on a global scale. In 1989, Earth experienced the effects of a powerful geomagnetic storm that caused satellites to malfunction, while triggering power blackouts in Canada, along with electricity disturbances in the United States and Europe. With the solar cycle's peak rapidly approaching, there is an ever-increasing need to prepare and prevent the damages that can occur, especially to modern-day technology, calling for the need of a comprehensive prediction system. This study aims to leverage machine learning techniques to predict instances of space weather (solar flares, coronal mass ejections, geomagnetic storms), based on active region magnetograms of the Sun. This was done through the use of NASA's DONKI service to determine when these solar events occur, then using data from the NOAA Space Weather Prediction Center and NASA Solar Dynamics Observatory to compile a dataset that includes magnetograms and feature data of active regions of the Sun 24 hours before the events. By inputting these features into a neural network trained from this dataset, it can serve to predict whether a space weather event will occur, and what type of event it will be. Overall, this project creates a comprehensive prediction system that can be utilized in early warning systems.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

A Meta-Analysis on the Theories of Dark Matter

 Cathy Thompson

This study aims to deduce which theories are the most likely candidate for dark matter. The main category of dark matter theories that will be studied are the Weakly Interacting Massive Particles (WIMPs). This is done through reviewing published research of various galaxies and their properties. The first properties searched for in each galaxy is the fraction of dark matter. In each galaxy where this was found, other quantitative properties were and will continue to be collected. The other quantitative properties are supermassive black hole mass, central wavelength, age, and stellar birth rates. Each quantitative property will be plotted against the fraction of dark matter on a graph. If a correlation is found, the properties of the various WIMPs theories will be investigated to determine whether or not it could be a cause for the correlation.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Finding and Assessing the Habitability of Exoplanets using Machine Learning

 Ianto Wooldridge

In the Milky Way, it is estimated that there are over 100 million exoplanets. To date, humans have discovered less than 6000. Of those 6000, only 69 are optimistically believed to be habitable. One of the methods of exoplanet detection is transit photometry, searching for dips in stellar brightness (a light curve). Data from the Barbara A. Mikulski Archive for Space Telescopes (MAST) was used to create a machine learning algorithm, a Random Forest Classifier that utilizes a star's light curve to determine the presence of an exoplanet.

To determine the habitability of exoplanets, the NASA Exoplanet Archive was utilized, sampling all known exoplanets at the time of this project. To select the habitable exoplanets, the Planetary Habitability Laboratory's Habitable Worlds Catalog was used. Data from the NASA Exoplanet Archive was then cleaned to generate a data set containing an exoplanet's orbital period, radius, and eccentricity and a star's temperature, radius, and mass. This data set contains 1090 non-habitable exoplanets, seven habitable exoplanets, and was used to train a K-Nearest Neighbor model.

The hyperparameters of these models were tuned to maximize performance. Light curves were classified with 94% accuracy across ten folds and exoplanets were classified with over 99% accuracy but low precision, limited by lack of habitable exoplanets in the data. Further research to improve the model by increasing the number of features sampled by the model, more extensive hyperparameter tuning, and a larger data set could strengthen the effectiveness of detection and habitability classification.

Ofman, L., Averbuch, A., Shliselberg, A., Benaun, I., Segev, D., & Rissman, A. G. (2022). Automated Identification of Transiting Exoplanet Candidates in NASA Transiting Exoplanets Survey Satellite (TESS) Data With Machine Learning Methods. New Astronomy, 91, 101693. https://doi.org/10.1016/j.newast.2021.101693

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Vishwarupe, V., Bedekar, M., Pande, M., Bhatkar, V. P., Joshi, P., Zahoor, S., & Kuklani, P. (2022). Comparative analysis of machine learning Algorithms for analyzing NASA Kepler Mission data. Procedia Computer Science, 204, 945-951. https://doi.org/10.1016/j.procs.2022.08.115

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Microbiology (1600)

Project No.	Student(s)	Project Title
1601X12	Sana Aziz	The Effect of 253.7 nm Radiation on the Growth of Mycobacterium smegmatis
1602T12	Kayla Chin, Sarah Orfaly	The Effect of Cistus Incanus Tea and Honey on the Biofilm Production of E.Coli K-12
1603X12	El Cutforth	Inhibition of E. coli growth using Lactic Acid
1604T12	Heaven Ferdinando, Sofiya Iliassov	The Effects of Sine versus Sawtooth Ultrasonic Sound Waveform Administration on Necrosis in Escherichia coli K-12 and Lactuca sativa var. capitata
1605T12	Joseph Johnson, Harshitha Prashanth	Isolation Of Trace DNA In A Household Environment
1606X11	Mishka Kandhari	The Effect of Different Concentrations of Color Additives on the Development of E. Coli K-12
1607X11	Maysoon Khan	The Effect of Combinations of Various Natural Agents on Antimicrobial-Resistant Bacteria
1608X12	Alexa Kluzinski	The Production of Human Insulin In A Microalgae Based Bioreactor
1609T12	Aleeza Khan, Nitya Manikonda	The Effect of Gut Probiotic Intake on the Progression of Intestinal Integrity with Ulcerative Colitis in Drosophila melanogaster
1610X12	Andrew Nguyen	Varying strengths in disinfectant resistance to Escherichia Coli K12

Category Student Count: 14

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of 253.7 nm Radiation on the Growth of Mycobacterium smegmatis

Sana Aziz

Nontuberculosis Mycobacterium (NTM) are most commonly found in water and pose health risks including lung damage, and infections. NTM infection is now one of the most severe waterborne illnesses in the world [1]. Mycobacterium is unaffected by chlorine, the traditional method to sanitize water. An alternative method is UV Radiation. A wavelength of 253.7 nm was applied on a culture of M. smegmatis for 10 seconds. 253.7 nm has been shown as the most effective to kill bacteria [2] and it takes 10 seconds of application to effectively kill 99.9% of bacteria in water supply [3]. M. smegmatis was applied to 48 plates containing Brain Heart Infusion agar and allowed to grow at room temperature. The number of colonies was measured every 48 hours. The experimental group was treated with UV radiation after 7 days of growth. The average change in growth for the experimental group was 107.792 colonies. The average change in growth for the control group was 191.125 colonies. A T-test comparing the change in growth between the control and experimental group showed a significant difference between the experimental and control groups $t(46) = 3.291$, $p < 0.01$, thus, 10 seconds of UV treatment at 253.7 nm did successfully inhibit M. smegmatis growth. It is important to note that the experiment was not conducted in an aquatic environment. Future research may test to see if UV radiation would inhibit M. smegmatis in an aquatic environment to simulate the bacteria's true habitat.

Blakney, R., Ricotta, E., Frankland, T. B., Honda, S., Zelazny, A. M., Mayer☐Barber, K. D., Dean, S., Follmann, D., Olivier, K. N., Daida, Y. G., & Prevots, D. R. (2022). Incidence of nontuberculous mycobacterial pulmonary infection, by Ethnic Group, Hawaii, USA, 2005–2019. Emerging Infectious Diseases, 28(8), 1543–1550. https://doi.org/10.3201/eid2808.212375

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How does UV light kill bacteria. (n.d.). US Water Systems. https://www.uswatersystems.com/ultraviolet-disinfection-faq#:~:text=A.,damaged%2C%20preventing%20it%20from%20replicating.

I/We hereby certify that the above statements are correct and the information provided in the Abstract is the result of one year's research. I/We also attest that the above properly reflects my/our own work (digitally signed).

LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Cistus Incanus Tea and Honey on the Biofilm Production of E.Coli K-12

Kayla Chin, Sarah Orfaly

Effective, non-prescription remedies that are as accessible as tea and honey can begin combating the rise of antibiotic resistance [Passali et al.]. This experiment evaluated the efficacy of the Cistus Incanus [Mandal] tea and honey [Hickle] as anti-inflammatory agents that are said to aid in reducing the progression of bacterial infections. The crystal violet assay was used to quantify the amount of biofilm produced by the E. Coli K-12 when introduced to different doses (ranging from 1/10 to 2 mL) of honey and Cistus Incanus tea.

Both were effective in reducing biofilm production when introduced to 1-2 mL of both treatments, however a stronger effect was shown through the use of honey. The Krusal-Wallis test showed that with 95% confidence there was a significant difference between the control group and both the 1mL and 2mL honey group, each with a p-value $< .01$. It also proved that, with 95% confidence, that there was a significant difference between honey and the corresponding dosage of tea, showing that honey is more effective in decreasing the biofilm growth of E. Coli.

Future experiments should use group A streptococcus to better mimic the real state of tonsillitis as opposed to E. Coli K-12. It should also be noted that due to the high sugar count in honey and tea the E. Coli could have used the treatments as a food source. However the biofilm production was significantly less than the control indicating that, even with an additional growth supply, the treatments' anti-inflammatory properties were still able to reduce the growth of E.Coli K-12.

D Passàli, M Lauriello, GC Passàli, FM Passàli, and L Bellussi "Group A Streptococcus and Its Antibiotic Resistance." Acta Otorhinolaryngologica Italica : Organo Ufficiale Della Societa Italiana Di Otorinolaringologia e Chirurgia Cervico-Facciale, U.S. National Library of Medicine, Feb. 2007, www.ncbi.nlm.nih.gov/pmc/articles/PMC2640020/.

Mandl, Manisha Deb, and Shyamapada Mandal. "Honey: Its Medicinal Property and Antibacterial Activity." Asian Pacific Journal of Tropical Biomedicine, U.S. National Library of Medicine, Apr. 2011, www.ncbi.nlm.nih.gov/pmc/articles/PMC3609166/.

Hickl, J., Argyropoulou, A., Sakavitsi, M. E., Halabalaki, M., Al-Ahmad, A., Hellwig, E., Aligiannis, N., Skaltsounis, A. L., Wittmer, A., Vach, K., & Karygianni, L. (2018, December https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6291084/

LCPS RSEF OFFICIAL ABSTRACT - 2024

Inhibition of E. coli growth using Lactic Acid

El Cutforth

Unlike most bacteria, E. Coli is able to switch between aerobic and anaerobic respiration, which allows it to survive in the changing conditions of the gut. The switch to aerobic respiration is controlled by the Pyruvate Dehydrogenase Complex (PDHC) which activates Acetyl-CoA, which begins the aerobic respiration pathway. PDHC is inhibited by reactive oxygen species (ROS) that are produced during the reduction of oxygen during respiration. While there are many types of ROS, Lactic Acid can mimic some of them. If Lactic Acid (LA) is added to E. coli bacteria in aerobic conditions, the E. coli will be inhibited. Excess lactic acid in E. coli inhibits the PHDC, which switches the bacteria to use an anaerobic respiration pathway, which is much slower when in aerobic conditions. To test this, varying concentrations (0.1M, 0.5M, and 1M) of lactic acid were tested using a disc diffusion assay to E. coli grown in anaerobic conditions. The bacteria were incubated for 48 hours, and the zone of inhibition was measured compared to a control, no treatment, and disks of Neomycin. Data collection continues, however, preliminary data shows that lactic acid had a major effect and caused a greater zone of inhibition compared to the Neomycin disc. This could be significant as a means of causing cell death in antibiotic resistant bacteria.

Partridge, J. D., Sanguinetti, G., Dibden, D. P., Roberts, R. E., Poole, R. K., & Green, J. (2007, April 13). Transition of Escherichia coli from Aerobic to Micro-aerobic Conditions Involves Fast and Slow Reacting Regulatory Components. Journal of Biological Chemistry. https://www.sciencedirect.com/science/article/pii/S0021925820767025#fig1

Lu, Zheng, and James A Imlay. "When anaerobes encounter oxygen: mechanisms of oxygen toxicity, tolerance and defence." Nature reviews. Microbiology vol. 19,12 (2021): 774-785. doi:10.1038/s41579-021-00583-y

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effects of Sine versus Sawtooth Ultrasonic Sound Waveform Administration on Necrosis in Escherichia coli K-12 and Lactuca sativa var. capitata

Heaven Ferdinando, Sofiya Iliassov

Pathogenic strains of Escherichia coli (E. coli) bacteria cause disease and death in severe cases when the E. coli produces toxins that harm the inner organs. It is a global problem that has been especially prevalent in recent decades. Although there are current preventative pre-treatments of E. coli in leafy produce, including sine ultrasound, sawtooth ultrasound is more cost-effective, reliable, and contributes to a lower carbon footprint. 30 E. coli samples were used in each experimental group to test the capacity of two ultrasounds (sine and sawtooth) and in the control group. Then, in another experiment to test cell death caused by the treatment, 60 iceberg lettuce segments were used in the experimental and control groups. As of February 2024, the sawtooth group median was 20.5, the control was 27, and the sine was 25.5. The Kruskal-Wallis test (non-parametric) revealed a p-value < 0.01, indicating an extremely strong confidence that there is a difference between groups. The most inhibitive waveform has yet to be determined. A median of the experimental and control groups and a p-value (Mann-Whitney U test) concerning the iceberg lettuce groups have yet to be established. Research is ongoing with treatment on iceberg lettuce and additional trials of E. coli groups. Further research with larger groups, more extended exposure period for treatment, and utilization of more powerful and refined generators to produce higher ultrasound frequencies would be helpful. This research may help improve the innovation of ultrasonic treatment in food products.

Lim, J. Y., Yoon, J., & Hovde, C. J. (2010). A brief overview of Escherichia coli O157:H7 and its plasmid O157. Journal of microbiology and biotechnology, 20(1), 5-14.

Seithtanabutara, V., Jookjantra, K., & Wongwuttanasatian, T. (2020). Effect of different waveforms and harmonic frequency orders on bubble cavitation in dual-frequency ultrasonic intensification. Chemical Engineering and Processing - Process Intensification, 157, 108134. https://doi.org/10.1016/j.cep.2020.108134

Shantala, & Sudheer, M. L. (2018). Reduction of radiated emission from offline switch mode power supply. 2018 15th International Conference on ElectroMagnetic Interference & Compatibility (INCEMIC). https://doi.org/10.1109/incemic.2018.8704640

LCPS RSEF OFFICIAL ABSTRACT - 2024

Isolation Of Trace DNA In A Household Environment

Joseph Johnson, Harshitha Prashanth

Forensic Science is the application of scientific principles within the criminal justice system. It plays a crucial role in law enforcement due to the providing of physical evidence which often consists of drugs, chemicals, firearm residue, and DNA. In instances where there wasn't direct physical evidence available, we researched and tested for DNA from dust and skin cells found on surfaces. Quantities of dust were collected in 1.5-2 mL centrifuge tubes and were vortexed and centrifuged to collect the DNA. After that, we conducted a Gel Electrophoresis in order to see the bands of DNA within our samples. This allowed us to conclude whether our samples had enough DNA for PCR or not. PCR, or Polymerase Chain Reaction, is a process in which multiple copies of a DNA segment are made in order to increase sample size.Once the gel electrophoresis was finished, we were able to see bands of DNA within each sample.

Allwood, J. S., Fierer, N., & Dunn, R. R. (2020). The future of environmental DNA in forensic science. Applied and Environmental Microbiology, 86(2). https://doi.org/10.1128/aem.01504-19

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Bright, J., & Petricevic, S. F. (2004). Recovery of trace DNA and its application to DNA profiling of shoe insoles. Forensic Science International, 145(1), 7-12. https://doi.org/10.1016/j.forsciint.2004.03.016

LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Different Concentrations of Color Additives on the Development of E. Coli K-12

Mishka Kandhari

Food coloring is a common tool in the culinary world, used to enhance the visual appeal of food and beverages. It is becoming more common for bacterial contamination to be present in our food supplies. This is why the safety of food coloring, particularly in relation to bacterial contamination and how it can be possibly burgeoned by color additives [McClure], should be further explored. This research project investigates the potential link between different types of food coloring and the growth of E. Coli K-12 bacteria. By comparing liquid, powder, gel, and natural food dyes, this study aims to determine which type of food coloring is safest to use to minimize the risk of bacterial contamination. The hypothesis is that the type of food coloring used affects the growth of E. Coli K-12. The expected results are based on anecdotal evidence suggesting a correlation between the type of food coloring and the occurrence of E. Coli infections.

Experimental design error with variations in bacterial growth conditions and food additives concentrations were minimized with multiple trials. Although data analysis is still ongoing, based on preliminary results and other studies [Sijerčić], it is hypothesized that the concentration of food additives will each respond differently to the E. Coli K-12. In preliminary results, the liquid food additive has seen the most bacterial growth followed by the gel additive. The control with no food additive has seen the least amount of growth, which means that the null hypothesis (the concentrations of color additives do not affect the growth of E. Coli K-12.) has initially been rejected. With multiple trials and further examination the information obtained from this study could have significant implications for food safety practices in both professional and home kitchens. Additionally, this underscores the urgency of understanding the potential consequences of food coloring, particularly in the context of microbial contamination and foodborne illnesses [Durazzo].

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McClure, P. J., & Hall, S. (2000, December). Survival of Escherichia coli in foods . Academic.oup.com. https://academic.oup.com/jambio/article-abstract/88/S1/61S/6721483

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I/We hereby certify that the above statements are correct and the information provided in the Abstract is the result of one year's research. I/We also attest that the above properly reflects my/our own work (digitally signed).

LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Combinations of Various Natural Agents on Antimicrobial-Resistant Bacteria

 Maysoon Khan

Antimicrobial resistance is becoming increasingly widespread, posing a substantial threat to public health. Antibiotic misuse/excess use in medical and agricultural settings have contributed to the creation of resistant bacteria strains, leaving routinely used antibiotics inefficient. The research problem -- Can the combined use of different natural agents prevent the appearance of antimicrobial-resistant bacteria? -- is centered on the pressing need to investigate alternatives to standard antibiotics. Natural antimicrobial agents have long been identified, but combinations of natural agents have yet to be examined. The experiment involves preparing agar plates and inoculating them with E. coli K-12, followed by the placement of ampicillin disks to establish a baseline for susceptibility testing. The agar plates are then divided into sections for different experimental groups, each treated with combinations of agar, E. coli K-12, ampicillin, and different natural agents. After incubation, the diameter of inhibition zones around ampicillin disks and areas treated with combined natural agents is measured. Data has been collected for the essential oils blend and plant extracts blend set of petri dishes. The combination of essential oils has so far been the most effective, with no trace of bacteria shown after incubation while the combination of plant extracts have shown apparent bacterial colonies. A control and more data is yet to be collected for an in depth comparison of the natural agents effectiveness. This research has the potential to favorably impact public health and contribute to the well-being of people worldwide by providing alternative techniques for medical and agricultural contexts.

Rao, G. G. (2012, November 27). *Risk factors for the spread of antibiotic-resistant bacteria - drugs*. SpringerLink. https://link.springer.com/article/10.2165/00003495-199855030-00001

Sengupta, S., Chattopadhyay, M. K., & Grossart, H.-P. (2013, February 20). *The multifaceted roles of antibiotics and antibiotic resistance in nature*. Frontiers. https://www.frontiersin.org/articles/10.3389/fmicb.2013.00047/full

Serwecińska, L. (2020, November 25). *Antimicrobials and antibiotic-resistant bacteria: A risk to the environment and to public health*. MDPI. https://www.mdpi.com/2073-4441/12/12/3313

LCPS RSEF OFFICIAL ABSTRACT - 2024

The Production of Human Insulin In A Microalgae Based Bioreactor

Alexa Kluzinski

Manufacturing recombinant proteins requires a host that is capable of completing post translational modifications and protein refolding. Researchers most commonly use E. Coli, Saccharomyces cerevisiae (Brewer's Yeast), and transgenic plants to be able to produce recombinant human insulin because of their abilities to recreate an appropriate environment for recombinant protein production. Being able to use more stable and more accessible organisms, offers a low cost technology for both the oral and injectable versions of insulin approved by the FDA. Microalgae (Chlamydomonas reinhardtii,) are unicellular aquatic microorganisms, they can use water and CO_2 to produce organic substances. Cultivating microalgae is low cost because it can be grown in production conditions, and requires little amounts of water and the system can do secondary protein modification not present in prokaryotic systems. Since the media used to grow Chlamydomonas is mainly salts, protein purification is much easier than other systems. We were able to grow and transform Chlamydomonas using a GFP vector to show that heterologous proteins can be made in this system.

Baeshen, N. A., Baeshen, M. N., Sheikh, A., Bora, R. S., Ahmed, M. M., Ramadan, H. A., Saini, K. S., & Redwan, E. M. (2014). Cell factories for insulin production. Microbial Cell Factories, 13(1). https://doi.org/10.1186/s12934-014-0141-0

Dai, Z., Huang, M., Chen, Y., Siewers, V., & Nielsen, J. (2018). Global rewiring of cellular metabolism renders saccharomyces cerevisiae Crabtree negative. Nature Communications, 9(1). https://doi.org/10.1038/s41467-018-05409-9

Identification product name ethylenediaminetetraacetic acid ... (n.d.-a). https://www.fishersci.com/store/msds?
partNumber=BP2927100&productDescription=JUSTPURE
+ETHYLENE&vendorId=VN00033897&countryCode=US&language=en

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Gut Probiotic Intake on the Progression of Intestinal Integrity with Ulcerative Colitis in Drosophila melanogaster

Aleeza Khan, Nitya Manikonda

Ulcerative colitis is an inflammatory intestinal disease that affects about five million people worldwide. Lactobacillus are a form of probiotic bacteria that are found to be a factor of sufficient gut health. This bacteria regulates the intestinal barrier and promotes resistance to intestinal diseases. Ulcerative colitis is commonly treated with medications that act as tumor suppressors, raising the question of "What is the effect of Gut Probiotic Intake on the progression of Intestinal Integrity with Ulcerative Colitis in Drosophila melanogaster at Different Stages of Life?" Ulcerative Colitis is an autoimmune disorder that increases the permeability of the intestinal system. Drosophila melanogaster serves as an adequate model to demonstrate the effects of this probiotic on intestinal integrity. Genetically modified Esg-gal4, uas-gfp drosophila were used to demonstrate the effects of an increased gut permeability, modeled by an inflamed intestinal tract. To test this hypothesis, wild type and genetically modified flies were split into an adult group, adolescent, and newborn stage. At these different phases, they began to receive probiotics with their medium. After consumption they were given blue dye and put through an imaging process to determine the intestinal permeability. The data recorded demonstrated that the modified flies that consumed probiotics from the start of their life had the highest integrity in comparison to all other groups. Further statistical analysis is pending. These results can aid in developing possible future treatments for this inflammatory disease and allow people to adjust their dietary supplement intakes according to the optimal point in life found.

Dempsey, E., & Corr, S. C. (2022a, April 6). Lactobacillus spp. for gastrointestinal health: Current and future perspectives. Frontiers in immunology. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9019120/

Madi, J. R., Outa, A. A., Ghannam, M., Hussein, H. M., Shehab, M., Hasan, Z. A. K. H., Fayad, A. A., Shirinian, M., & Rahal, E. A. (2021, March 22). drosophila melanogaster as a model system to assess the effect of Epstein-Barr virus DNA on inflammatory gut diseases. Frontiers in immunology. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8019809/

Rera, M. (2012). Intestinal barrier dysfunction links metabolic and inflammatory markers ... https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3535647/

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Varying strengths in disinfectant resistance to Escherichia Coli K12

Andrew Nguyen

The persistence of bacterial strains, such as Escherichia coli K12, and their resistance to disinfectants pose significant challenges in various environments, including healthcare and food processing. This study aimed to assess and compare the resistance of E. coli K12 to different disinfectants, with a focus on Lysol, commonly used in household settings. Through zone of inhibition analysis, I will investigate the susceptibility of E. coli K12 to disinfectants and explore underlying mechanisms influencing variations in resistance. Using BSL1 techniques, sterile filter paper discs will be soaked in disinfectant and placed on inoculated agar petri dishes. The zone of inhibition around each disc will be measured to the nearest millimeter after incubation. To ensure reliability, multiple trials will be conducted and statistical analysis will be performed to assess significance of observed differences. Results around the discs, whether positive or negative control will indicate the effectiveness of various disinfectants against the spread of bacterial growth. This study will provide valuable insights into resistance mechanisms and underscores the importance of understanding bacterial susceptibility for public health and sanitization practices. However, further research is needed to fully understand the molecular mechanisms underlying disinfectant resistance and to develop strategies to mitigate bacterial contamination in various temperature and humidity conditions.

Caselli, E., Brusaferro, S., Coccagna, M., Arnoldo, L., Berloco, F., Antonioli, P., Tarricone, R., Pelissero, G., Nola, S., La Fauci, V., Conte, A., Tognon, L., Villone, G., Trua, N., & Mazzacane, S. (2018). Reducing healthcare-associated infections incidence by a probiotic-based sanitation system: A multicentre, prospective, intervention study. PLoS ONE, 13(7), e0199616.

Giaouris, E., Chorianopoulos, N., Doulgeraki, A., & Nychas, G. J. (2013). Co-Culture with Listeria monocytogenes within a Dual-Species Biofilm Community Strongly Increases Resistance of Pseudomonas putida to Benzalkonium Chloride. (2013). PLoS ONE, 8(10), e77276.

Lassa, H., Jagielski, T., & Malinowski, E. (2011). Effect of different heat treatments and disinfectants on the survival of Prototheca zopfii. Mycopathologia, 171(3), 177+

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Plant Sciences (1800)

Project No.	Student(s)	Project Title
1801T12	Azim Abdulmajeeth, Anirudh Repalli	How Does Microplastics Concentrations Effect Plant Development and Soil Health
1802T11	Sarah Foard, Natalia Shane	How do bleach and peroxide (common biohazard cleaners) affect the way plants grow?
1803X12	Sydney Foxx	The Viability of Spherified Seeds For Farming Process
1804T12	Kamryn Harper, Mia Smith	Eco-Friendly Pesticides on Plant Health and Garden Pests
1805X12	Mia Helveston	The Effect of Mycorrhizal Fungi on Atmospheric CO2 Levels
1806T12	Nina Islam, Faris Wasique	The Impact of the probiotic Lactobacillus plantarum on Apple Decay
1807T12	Nitish Kannan, David Lomelin	Optimizing the Effectiveness of the Bioinoculant Formulation of Bacillus subtilis and Pseudomonas fluorescens in Aquaculture Crop Yields using Machine Learning
1808X12	Eryn Lackey	The Effect of Juglone on Virginia's Invasive Miscanthus sinensis
1809T12	Kritika Kunta, Kailey McGrath	What methodologies of ecological restoration best support soil remediation for native plant growth?
1810X11	Nikhil Midda	Impact of Invasive Plant Species on Native Plant Health in Shared Habitat
1811X12	Abbie Miller	The Effect of Various Wavelengths of Light on the Efficiency of Plant Growth
1812X12	Vaughn Mussmon	Do Venus Flytraps in colder environments exhibit faster sensory hair reaction times when exposed to a rapid increase in temperature or when given ants?
1813T12	Arushi Gadicherla, Anshu Palicherla	Optimizing Hydrogen Concentrations to Enhance N.oculata Amplification for Algae Biofuel Production
1814T11	Saahiti Nareddy, Karishma Suresh	Effectiveness of acid rain buffers on Glechoma Hederacea
1815X12	Aamira Thameem	Analysis of Brassica napus va pabularia's difference in stomate density through biomass to accommodate varying root zone temperatures in hydroponics
1816X12	Natalie Yurish	The Use of Jasmonic Acid to Improve Upon Tomato Plant Resistance to Hornworms

Category Student Count: 24

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LCPS RSEF OFFICIAL ABSTRACT - 2024

How Does Microplastics Concentrations Effect Plant Development and Soil Health

 Azim Abdulmajeeth, Anirudh Repalli

Due to an increase in awareness of plastic pollution, alternative solutions have become increasingly popular. One of the new materials being marketed as "sustainable" and "biodegradable" is polyvinyl alcohol (PVA), a water-soluble synthetic polymer used as a protective film in detergent pods, and as a thickening and coating agent. However, PVA is only susceptible to microbial degradation under specific conditions, which brings concern to the persistence and effects of PVA pollution in the environment.

The purpose of our study is to evaluate the effects of different concentrations of PVA on the growth rate and development of plants. The empty wrappers of laundry detergent pods, composed of PVA, were dissolved in water and then added to soil at concentrations of 2.5%, 1.25%, and 0% (control group). Two different soil batches of each concentration were created, and onion and radish seeds were planted inside each. Data is currently being collected about the growth and development of the plants. Information about plant height, plant size, root structure, and root diameter will be collected.

Rolsky, C., & Kelkar, V. (2021). Degradation of Polyvinyl Alcohol in US Wastewater Treatment Plants and Subsequent Nationwide Emission Estimate. International Journal of Environmental Research and Public Health, 18(11), 6027. https://doi.org/10.3390/ijerph18116027

Alonso-López, O., López-Ibáñez, S., & Beiras, R. (2021). Assessment of Toxicity and Biodegradability of Poly(vinyl alcohol)-Based Materials in Marine Water. Polymers, 13(21), 3742. https://doi.org/10.3390/polym13213742

LCPS RSEF OFFICIAL ABSTRACT - 2024

How do bleach and peroxide (common biohazard cleaners) affect the way plants grow?

Sarah Foard, Natalia Shane

Hydrogen peroxide and bleach are both powerful cleaners that are used on the environment to help clean up biohazards. We used both cleaners to grow plants of varying kinds, (Wisconsin Fast Plants, Aribadopsis, arugula, and wildflowers) in order to see the effect it may have on our environment and to help with forensic botany. The plants are fast growing and are being used to mimic a natural environment. Hydrogen peroxide and bleach were soaked in the soil for approximately four weeks before the seeds were planted. Our plants are being grown in grow towers and being watered multiple times a day. So far, the plants in the hydrogen peroxide pots are growing much quicker than the control or bleach pots, which was not expected, as we only knew that hydrogen peroxide helps eliminate root decay. Our control pots are growing at a fast rate, but not as quick as the hydrogen peroxide. The bleach pots have been allowing some seeds to sprout, but the spouts quickly shrivel and die. We are hoping to see more evidence that plants can, in fact, sprout in the bleach soaked soil, and we want to see if it was only specific plants that had accelerated growth due to the hydrogen peroxide. Arugula seems to be the plant that is growing the best so far, but the plants look very similar when they sprout so it is difficult to tell.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Viability of Spherified Seeds For Farming Process

 Sydney Foxx

When farmers plant seeds they have to prepare for some seeds to not germinate. This causes them to waste time, money and resources on seeds that won't produce. By already having germinated seeds in storage they wouldn't need to worry about wasting resources.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Eco-Friendly Pesticides on Plant Health and Garden Pests

Kamryn Harper, Mia Smith

This study aimed to mitigate the adverse impacts of invertebrates on bean plant growth, focusing on garden snails, brown marmorated stink bugs, and earthworms as a positive control. The hypothesis proposed that the presence of garden snails and brown marmorated stink bugs in a controlled bean plant environment would hinder plant growth. Additionally, it was hypothesized that applying a lime and copper sulfate mixture to snail soil and a hydroquinone and hydrogen peroxide solution to stink bugs would counteract their negative effects. Fifteen bean plants were distributed across six containers with varying contents, including different invertebrates and preventative solutions. Trends in plant growth were analyzed using average plant height data collected over time. T-tests were conducted to evaluate the effectiveness of the preventative measures. Our calculated t-Value for comparing containers 3 and 4 was 2.4 and the calculated t-Value for comparing containers 5 and 6 was 1.65 . Both of these values were below the t-Table value of 2,45, therefore, there was no significant effect on the plant growth by the preventative properties used in either container. Limitations included the necessity of trimming bean plants to contain invertebrates, dilution of preventative solutions to avoid plant damage, and inability to fully replicate the bombardier beetle's defense mechanism. Conclusion suggests that while the preventatives may offer some protection in specific contexts, they are not universally effective solutions. The study underscores the challenges in replicating natural defensive mechanisms and highlights the importance of considering biological complexities in pest management strategies.

LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Mycorrhizal Fungi on Atmospheric CO2 Levels

Mia Helveston

Arbuscular mycorrhizal fungi (AMF) produces an enzyme called glomalin, which essentially stores carbon dioxide. When a relationship is formed between the fungi and a plant's roots, carbon sequestration is enhanced. This, as a result, allows for the plant itself to take in more of the compound and store it in the soil and external mycelium. The ultimate goal of this project was to test if the fungi could lower CO2 levels in the atmosphere.

Cowpeas and legumes were chosen for this experiment due to their fast growing time, locality, and quick root development. Each plant type was divided into two boxes, one with the AMF (grown through 6g of a powder), and one without. Once the fungi synthesized, data was measured with a CO2 meter every three days (in PPM) to see if the new addition made a significant difference in the plant variables. During the first collection, legumes had a reading of 829 PPM with, and 795 PPM without. Cowpeas followed a similar trend. At the end of data collection, levels stayed consistent and the initial hypothesis was proven.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Impact of the probiotic Lactobacillus plantarum on Apple Decay

Nina Islam, Faris Wasique

In the U.S., roughly 35% percent of fresh fruit is wasted due to spoilage. Keeping fruits fresher would combat food scarcity around the world. On average, Red Delicious apples are fully ripe and begin to soften within 4 to 5 days. This research seeks to discover a process to slow this using the probiotic Lactobacillus plantarum as a potential commercial preservative that reduces waste and prolongs shelf life. Lactobacillus plantarum is a probiotic that possesses the enzymatic capacity to break down patulin, a mycotoxin that decays apples, and convert it into non-toxic byproducts like desoxypatulinic acid, extending food preservation by inhibiting the growth of spoilage microorganisms. First, a solution combining 82mg of Lactobacillus plantarum and 15mL of deionized water was created and autoclaved. This was mixed with 10mL of autoclaved MRS Nutrient Broth and incubated at 35⧠ for 4 days. Three groups were created, one with apple chunks and 5mL of the Lactobacillus Broth, one with apple chunks and 5mL of Distilled Water and one with only apple chunks. The initial glucose concentration of the apple sample was recorded using glucose test strips. Following 3 days at 24⧠, data will be analyzed using the plate counting method to measure the amount of aerobic bacteria, test strips to determine glucose concentration and imaging software to determine the percentage of browning in each sample. Spoilage can be observed through bacteria and glucose concentration. Research and data collection is ongoing.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Optimizing the Effectiveness of the Bioinoculant Formulation of Bacillus subtilis and Pseudomonas fluorescens in Aquaculture Crop Yields using Machine Learning

Nitish Kannan, David Lomelin

The application of plant growth-promoting rhizobacteria (PGPRs), specifically Bacillus subtilis and Pseudomonas fluorescens, offers a sustainable alternative to chemical fertilizers in aquaculture, a sector of agriculture experiencing rapid adaptation to soilless systems like hydroponics. This study explores the optimization of PGPR formulation in enhancing plant growth by adjusting environmental conditions (pH, salinity, and temperature) to maximize Indole-3-Acetic Acid (IAA) production, an essential plant growth hormone. Using a factorial design, the study varied the rhizosphere conditions within the optimal ranges for the bacteria—pH levels (6.5, 7.0, 7.5), temperature (30°C to 35°C), and salinity (0.75% to 1.25%)—and measured IAA concentration through spectrophotometry which will quantify the formulation's effectiveness as a tool to boost crop yields in hydroponic systems. A total of 150 trials were conducted (5 trials for each of the 30 randomized conditions), with machine learning models predicting the outcome of IAA production based on these environmental variables. The results indicate that specific combinations of pH, salinity, and temperature significantly influence the effectiveness of IAA production by the PGPR formulation. This research harnesses the potential of machine learning in precision agriculture, particularly in determining the effectiveness of this bioinoculant formulation for different environmental conditions in aquacultures. The machine learning model that will be utilized as part of this project will set a new standard for developing sustainable, efficient, and productive aquaculture practices that minimize chemical fertilizer dependence and enhance food production resilience.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Juglone on Virginia's Invasive Miscanthus sinensis

Eryn Lackey

Miscanthus sinensis is listed as an invasive species in twelve states. Originally brought over from Asia to the United States as an ornamental grass, it has since escaped captivity and has spread throughout the east coast. Juglone is an allelopathic chemical secreted from Juglans nigra in order to reduce competition by killing off other plant species. The purpose of this research is to test whether juglone could be a successful bioherbicide against Miscanthus sinensis. To test the effect of juglone on Miscanthus sinensis seed germination, 84 Miscanthus sinensis seeds were planted and 42 were watered with 5 ml of reverse osmosis water weekly, while the other 42 were watered with 5ml of juglone solution with a juglone concentration of 10-3M. To test the effect of juglone on mature Miscanthus sinensis, the seedlings treated with only water will be allowed to grow to maturity, and then half of them will then be treated with juglone. The purpose for testing the effects of juglone on seed germination as well as on mature plants is the fact that Miscanthus sinensis can spread both through seeds and runners. Data collection is ongoing.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

What methodologies of ecological restoration best support soil remediation for native plant growth?

 Kritika Kunta, Kailey McGrath

Ecological restoration has been a matter of growing importance within the last few decades with many governments and environmental organizations seeking to find a solution to combat the issue. Several studies have proven certain microorganisms show potential in the ability to fix ecological restoration, the primary focus of this study being Mycorrhizal Fungi and Cyanobacteria as a method of soil remediation. While both organisms have been proven to improve the quality of soil, our research seeks to test their ability to combat common soil damage and promote native plant growth. The method we are using is collecting soil samples through a random grid selection software and treating the soil samples by burning, salting, and over-fertilizing to emulate how soil is damaged in the environment. Black-Eyed Susan seeds, which are native to the Northern Virginia area, are bioprimed with Cyanobacteria and inoculated with Mycorrhizal Fungi, and then planted into the treated soil samples. Results are gathered by checking on the overall plant growth every two days, running soil tests to check for nutrient results, and comparing overall root growth at the end of the testing period. While more data is being gathered to solidify our research, both microorganisms suggest a strong ability to counter environmental damage and encourage growth of native plants.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Impact of Invasive Plant Species on Native Plant Health in Shared Habitat

Nikhil Midda

Invasive plant species have become a major ecological concern, disrupting natural ecosystems and altering the dynamics of native plant communities. This study aims to investigate the ecological impact of invasive species using a controlled pot-based structure.The focus will be on invasive species effects on nutrient availability and the growth of native plant communities.The experiment will use the native species Asclepias, a common food source for monarch butterflies and essential for maintaining insect populations; however, the presence of invasive species could disrupt this process and could impact the insect/monarch population. The invasive species chosen for the experiment are Glechoma hederacea and Lythrum salicaria, both known for their rapid growth and robust reproductive capabilities. The experiment will also include a control group of Asclepias by itself, another group with Asclepias and Glehcoma , and lastly Asclepias with Lythrum. To assess the ecological impact of the invasive species, soil nutrient tests will be conducted on a weekly basis, and after sprouting biomass will be conducted on a weekly basis also. This will provide valuable information on how the invasive species affect nutrient availability in the soil and the overall growth of the native plant communities. The results of this experiment will contribute to our understanding of the ecological consequences of invasive grass species and their implications for native ecosystems. Data collection has not been completed and is still ongoing.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of Various Wavelengths of Light on the Efficiency of Plant Growth

 Abbie Miller

A vertical farm is an indoor plant system that has layers to maximize yield per square meter. The primary vertical farming method is hydroponics. Vertical farms, due to their efficiency, have potential in providing supply as population and demand for food grows. Vertical farms have already started to appear to provide produce to urban areas. However, the cost of running vertical farming facilities is a major deterrent in expanding their use. The two highest costs are lighting and HVAC systems but reducing the consumption of energy can cut the cost of energy costs, reducing the price of vertical farming. Some types of light use more energy to produce light but produce heat which expedites the process of photosynthesis. The goal of experimentation is to discover the amount of energy used per centimeter of plant growth to determine the most effective method of vertically farming plants. Tomato plants, after germination, were placed into a vertical farm system with a nutrient solution. The solution contained 6g of Epsom Salt, 12g of Calcium Nitrate, and 12g of 4-18-38 fertilizer diluted in 18.9 liters of distilled water. The system has 3 sections, each lit by a different type of light including: incandescent, fluorescent, and LED. Data is still being gathered.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Do Venus Flytraps in colder environments exhibit faster sensory hair reaction times when exposed to a rapid increase in temperature or when given ants?

 Vaughn Mussmon

This research aims to investigate whether Dionaea muscipula in colder environments exhibit faster sensory hair reaction times when exposed to either a rapid increase in temperature or given insects. This experiment's purpose is to shed light on the knowledge gap between the difference in reaction time of environmental cues and sensory responsiveness for Dionaea muscipula.

Two groups of Dionaea muscipula were subjected to different stimuli: one group experienced a rapid temperature increase. The other was provided with insects, by placing them in the trap with a tweezer. The reaction times were timed, recorded, measured and compared. The independent and dependent variables were the different stimuli and reaction time.

The results were that Dionaea muscipula exhibit faster sensory hair reaction times when exposed to a rapid increase in temperature. Ten different Dionaea muscipula heads were used, five for each stimulus. The results were clear, with the average reaction for the rapid increase of heat being 1.12 s and with the ants, 1.53 s. A T test was performed and P value was equal to 0.0553.

If two Dionaea muscipula are placed in a colder environment, and one group is exposed to a rapid increase in temperature, and one is given insects, then the one exposed to the rapid increase in temperatures sensory hair's will react faster. The independent variable did support the dependent variable.

Further research could explore the relevance of these findings with other carnivorous plant species.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Optimizing Hydrogen Concentrations to Enhance N.oculata Amplification for Algae Biofuel Production

Arushi Gadicherla, Anshu Palicherla

Studies have been conducted showing positive effects on the production of N.oculata. Hydrogen integration into saltwater algae offers potential benefits, including bioremediation, biofuel production, and more. However, there needs to be more studies, which is what this experiment aims to target. By establishing how varying concentrations of hydrogen affect the amplification of N. oculata, the connection may help in considering how to improve algae biofuel production. A colorimeter was used to calculate the algae solution's absorbance to measure the algae's growth. The wavelength of the algae mixture was measured to see the amount of chlorophyll produced to show the amplification of the algae. A higher absorbance measurement showed that the algae amplified at a higher rate, creating more algae in a shorter period. The data collection is still in progress, but initial findings show that the initial diluted algae absorbs 230 au. The measurement will be compared to the absorbance of the new algae after the hydrogen effects have been measured. The experiment's importance is improving Algae biofuel production as the process can make the algae biomass step more efficient. Additionally, it may offer new insight into Biohydrogen production.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Effectiveness of acid rain buffers on Glechoma Hederacea

Saahiti Nareddy, Karishma Suresh

We want to test the buffering capacity of magnesium oxide and calcium chloride on Glechoma Hederacea treated with acid rain (sulfuric acid), to see if we can reverse the damaging effects. Our purpose for this experiment is to help farmers in areas where crops are exposed to harmful chemicals, and if our findings are correct and the buffers do indeed help, then we can show farmers our research and they can save their crops. Glechoma Hederacea, which has antibacterial properties, has been used in traditional medicine for centuries to treat colds, asthma, bronchitis, and other diseases. Through observation and data collection we infer that the calcium chloride was able to balance the acidic PH of the soil which contained sulfuric acid. Observations are still being made along with new data collections. As our plants are still growing, we haven't treated it with any chemicals yet; however, we have tested on already grown Mums plant with acid rain, and we treated it with our calcium chloride and the leaves, which were dry and dying, became softer and regained a little bit of color, which shows that our buffer could work on our Glechoma Hederacea for the actual trials .More data is being collected for this experiment. Although our experiment is not finished yet, we have high hopes for our buffers working on the acid rain infused plants, as our informal test worked in getting the Glechoma Hederacea to get more healthy.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Analysis of Brassica napus va pabularia's difference in stomate density through biomass to accommodate varying root zone temperatures in hydroponics

Aamira Thameem

Though hydroponics has been present since the 1600s, exploration into the field has been a modern task. Looking at the past few decades, it is clear that its implementation into the field of agriculture as a method of sustainable crop growth has been an increasingly accepted idea. Regardless, the numerous fluctuations in a plant species' reaction to its environment have proven to cause several underexplored gaps. This study explores the kale-specific gap in plant organ relations and optimal temperature settings. This is done through the evaluation of Red Russian Kale's abaxial stomate density per biomass by varying root zone temperatures. Throughout the study, several procedures must be taken. After system assembly and germination of seeds, the implementation of materials begins. By using a nutrient film technique (NFT) system, it will be easy to concurrently maintain and measure the root zone temperatures (10℃, 20℃, and 30℃) hydroponically. On weekly intervals, both the biomass and the abaxial stomatal density per cm^2 will be measured per all 36 plants on each trial, implementing both an ANOVA and correlational analysis. Furthermore, the complexity of the data collection allows triangulation. On the topic of quantitative data collection, biomass will be measured through a scale, while abaxial stomatal density will be taken through stomatal peels through the use of clear nail polish. The result will uncover results on Red Russian Kale's development throughout the span of a month. The concluding results will benefit the scientific field. Considering the limitations of unprofessional equipment and a short data collection period, further research can focus on long-term effects, as well as a smaller interval of temperature variance for precise data.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Use of Jasmonic Acid to Improve Upon Tomato Plant Resistance to Hornworms

 Natalie Yurish

Insecticides have been affecting the earth since 1991 when the first insecticide imidacloprid was created. With industrial farming on the rise, farmers use insecticides to help with insect infestation for plants. Although it may work, the runoff of the insecticide harms the environment around it, contaminating water and killing organisms as well. This study focuses on finding a natural replacement for insecticide that would help the environment by decreasing chemical runoff insecticide produces. Jasmonic acid (JA) is an organic compound found in plants such as tomato plants. JA can induce defensive agents, but most importantly can stimulate plant resistance to insects. This reaction promotes the synthesis of defensive PIs, creating a stronger defense for the plants by increasing their defense hormones. In the study, branches of tomato plants were treated with and without Jasmonic acid and then exposed to hornworms for 12 hours. The masses were weighed before and after exposure, and the difference was used to determine the average percent of foliar loss per plant, and the average loss of plants with and without JA. The results showed a significant difference between the average foliar loss on plants treated with and without JA. The plants without JA had a significantly higher amount of foliar loss than the plants treated with JA. We conclude that there is a statistical significant difference between the foliar loss on tomato plants, treated with and without JA. These results can be used to further research the possible use of JA as an insecticide in industrial farming to decrease the use of chemical insecticide

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Robotics & Intelligent Machines (1900)

Project No.	Student(s)	Project Title
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1902X12	Rishi Athavale	Hebbian-Based Meta-Learning for Supervised Tasks
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1911T12	Ankur Gatupa, Aditya Paranjpe	Comparative Analysis of Machine Learning Frameworks LightGBM and XGB
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1914T12	Duc Ngo, Kamal Sangameswaran	Effectiveness of an AI Model on Detecting and Classifying Drosophila Behaviors

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Designing a Low-Cost Robotic Prosthetic Arm: Enhancing Accessibility and Functionality

Ethan Alexander, Sanjay Munagapati

One of the most important innovations in the medical field is the development of a prosthetic arm. This simple idea has recently revolutionized the biomedical field as countless lives have been saved and many people have been able to move in ways they would never have imagined. The project is aimed at developing a prosthetic arm that can enhance accessibility and affordability while maintaining functionality[1]. The main goals outlined in this project are cost-effectiveness, functionality enhancement, customizability, and scalability and replicability.

In the process of designing the prosthetic arm, one of the most important aspects was 3D printing which can significantly reduce the production time compared to conventional methods which allowed for a quicker delivery period[2]. On top of being able to be dispensed at a faster rate than manually modeling and creating the arm, the 3D model is cheaper as it is widely available. 3D printing also includes biocompatible printing filament which is typically non-hazardous which is beneficial for the development and disposing of the material.

The project concluded with minimal errors as the 3D printing process and disposal method was straightforward. In the future this research could be used to simplify the creation process of the prosthetic arm, however, AI could also be incorporated into the model to further enhance the functionality[3]. This study could be useful for most biomedical engineers looking into creating a cheap and effective prosthetic arm, and could be applicable for most amputees or individuals missing an arm.

"A Leg up on the Competition: University of Utah Develops the Most Advanced Bionic Leg Ever Created." Deseret   News, 5 Oct. 2022, www.deseret.com/utah/2022/10/5/23390137/university-of-utah-develops-bionic-leg-ottobock-partnership#:~:text=The%20Utah%20Bionic%20Leg%2C%20developed. Accessed 28 Nov. 2023.

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Tamim, Baba. "Utah Bionic Leg: The Most Advanced AI-Powered Prosthetics "Ever Created."" Interestingengineering.com, 8 Oct. 2022, interestingengineering.com/innovation/utah-bionic-leg-most-advanced-ai-prosthetics.

LCPS RSEF OFFICIAL ABSTRACT - 2024

Hebbian-Based Meta-Learning for Supervised Tasks

 Rishi Athavale

In the development of increasingly powerful AI and deep learning models, modern methods increasingly rely on large amounts of data, which increases both economic and environmental costs for the training process. Training just a single large language model like OpenAI's GPT-4 or HuggingFace's BLOOM can cost over $100 million and produce 25 metric tons of CO2 emissions. Reliance on large amounts of training data is also likely to limit the performance of AI models, as only so much data can be practically collected and stored. This study aims to address this issue by developing a meta-learning algorithm capable of fitting a learning system for a specific range of tasks to enable more efficient training, thereby improving performance without increasing training data. Specifically, this study adapts Hebbian Learning—a neuroscience principle that notes how the human brain learns by having neurons that "fire together, wire together"—to develop a learning scheme that better reflects how the brain generalizes from limited data.

To test the performance of a Hebbian-Learning-based meta-learning algorithm, which this study dubs "HEBBL," a randomized Sine task where a model has to fit a sine function from just 10 data points was used. HEBBL and MAML were evaluated on this task by calculating their MSE for a randomly generated sine function after first training them on 100 randomly generated sine functions. The results show that HEBBL achieved an MSE of 1.257, which was comparable to MAML. The impressive performance of HEBBL shows the potential of Hebbian-based algorithms for meta-learning.

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Nichol, A., Achiam, J., & Schulman, J. (2018, October 22). On first-order meta-learning algorithms. arXiv.org. https://arxiv.org/abs/1803.02999

LCPS RSEF OFFICIAL ABSTRACT - 2024

Comparison and Testing of an N2-inspired k-UpCCGSD to Reduce the Probability of a Barren Plateau

 Brahmjot Chawla

Quantum machine learning (QML) is emerging as an essential tool for developing faster classical and quantum algorithms. Barren plateaus are the flat portions of an error function graph where variability decreases exponentially for the trainable values of the model caused by excess kinetic energy in the quantum computing system.

To work towards reducing barren plateaus, a quantum convolutional neural network (QCNN), a quantum neural network with the standard hardware-efficient ansatz (QNN), and a modified QNN with an N2-inspired k-UpCCGSD (a chemical-inspired ansatz) were developed and tested against the "Iris" dataset which includes 150 datapoints of three types of flowers. The model training time and the model accuracy score were collected for each trial. QNN and QCNN testing showed that the QCNN has a third of the training time and is more efficient than the QNN, taking 25 iterations to train compared to 82 iterations from the QNN, but with lower accuracy. The chemical-inspired ansatz improved the model's efficiency further and had an accuracy score higher than that of the QCNN.

This increased efficiency warrants the typical use of hardware because of this specific ansatz decreasing the overall kinetic energy in the system and preventing the loss of variationally that defines the barren plateau. While this project accounts for the loss of variation in error functions, the testing of this chemical-inspired ansatz can be extended to other QML landscape issues, like local minima in the error function, which potentially can be reduced by this ansatz's reduced kinetic energy.

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Friedrich, L. (2023). The quantum cost function concentration dependency on the parametrization expressivity. Retrieved from https://arxiv.org/pdf/2301.06883.pdf

Pesah, A. (2019). Absence of barren plateaus in quantum convolutional neural networks. Arxiv. https://journals.aps.org/prx/pdf/10.1103/PhysRevX.11.041011

LCPS RSEF OFFICIAL ABSTRACT - 2024

Diagnosing Burn Wounds through Machine Learning

Adrena Gibi, Humera Sayed

In the US, burns are the fourth leading cause of accidental death. Causes of burn related deaths are due to lack of attention and insufficient knowledge about burns [1]. Obtaining a software that informs the burned individual about the type of burn has the potential to prevent burn related deaths. Quick access to diagnosis could be imperative for some lower developed countries, as a lack of money can lead to reduced access to doctors and medical treatments. A CNN model was developed using an open source library, Keras. The study focused on first, second, and third degree burn wounds, totalling to 100 images being evaluated. The images were split into training and testing sets, where the accuracy of diagnosis of the testing sets would determine the precision of the model.

Data analysis is ongoing, although preliminary data has presented a higher rate of positive instances in evaluating second degree burn wounds when compared to first and third degree burn wounds. Through the use of Confusion Matrix the data will continue to be analyzed.

Potential sources of error could be from a discrepancy in the number of images collected so far, as a handful of the total images were not evaluated. As the images were collected from online sources, a false diagnosed wound could also lead to inaccuracies in identification. Treatment options along with the type of burn could be implemented in the software. Knowledge about treatment options for burn types would provide ample information to prevent burn related deaths.

"Analysis of factors associated with mortality in major burn patients." NCBI, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6795231/. Accessed 26 February 2024.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Development of a Photogrammetry-Enabled Drone with Image Recognition and LiDAR Obstacle Avoidance for Optimized Hurricane Disaster Zone Mapping

Abhigya Goel

Post-Hurricane Katrina, disaster response teams spent weeks manually creating 2D maps of the disaster environment using traditional GIS methods. Traversing and mapping the complex environments proved both inefficient and challenging, leading to prolonged first response times. A more advanced GIS mapping approach is essential to increasing spatial awareness and search capabilities, leveraging the use of photogrammetry-based 3D modeling and image recognition for human detection. In response to this need a collision-avoiding aerial search and analysis drone was developed, integrating a Raspberry Pi, Navio2 HAT, Coral USB Accelerator, and a SLAMTEC A1 LiDAR sensor to power advanced sensing and mapping capabilities. This technology showcases the potential to expedite the search and mapping process, providing crucial 3D data while significantly reducing manual labor and improving disaster response efficiency. A dataset of approximately 300 images was created and processed using AliceVision Meshroom, which reconstructed the 2D images into a 3D model representing the structure's state. This model was then compared to pre-existing building models on OSM2World for a qualitative analysis of variation. TensorFlow Lite-powered image recognition capabilities were integrated into onboard camera systems, enabling real-time detection of human presence within disaster areas. Additionally, LiDAR sensing was prototyped with collision avoidance algorithms to ensure vehicle safety within complex environments. While the preliminary prototype features a successful integration of all required subsystems, future development into autonomous function would serve to further increase operational efficiency.

Alicevision. (n.d.). Alicevision/meshroom: 3D reconstruction software. GitHub. https://github.com/alicevision/Meshroom

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Experimentation Into Use Of PIML To Test The Effect Of Rocket Fin Configuration On Its Trajectory

 Niesha Karthik

This experiment tests the viability of utilizing physics-informed machine learning (PIML) as tools for engineers to use when designing rocket components. PIML algorithms work by feeding a machine learning model training data from real world situations in tandem with arithmetic/surrogate equations and methods in order to reconstruct a more realistic prediction. This application was used to simulate different physical environmental factors which affect a rocket's trajectory, while also identifying an optimal design for rocket fin components in order to reduce the risks of rocket testing and streamline the engineering design process. Specifically, the trajectory impact of Elliptical vs. Trapezoidal vs. Clipped-Delta fins given Earth, Lunar, and Martian environments on a standard sounding rocket and payload were being compared.

In order to simulate these aspects, projectile motion equations (where aspects like drag and gravity vary given the IVs being tested) were utilized in tandem with data from sounding rocket mission launch data from public databases such as KiltHub, Kaggle, etc. to train the model. The collected data was prepared (randomized, cleaned, & split) and fed into the algorithm with several projectile motion equations ($dx=(vcos())t$ and $dy=(vsin())t$ for example). After data was fed, the model was trained iteratively, evaluated, & parameters were tuned. Then PIML predictions were run for each environment: Earth, Lunar, & Martian Gravity for each fin type. Vertical Horizontal Range outputs were recorded over a time interval for each environment, and data was analyzed with the conclusion that elliptical fins produce most optimal trajectory results.

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https://www.sciencedirect.com/science/article/pii/S0951832022005154?casa_token=_0IyCvYH-3UAAAAA:eBvStShTRMy3XTPIYfMQ9DoCzZLbXlZqHyVbN9tF8bUbe_hPmkt8TrpxHqqfUxH4N2fgaQ2_pYc

LCPS RSEF OFFICIAL ABSTRACT - 2024

Development of an IA capable of sefl grading Free Response Questions

Jugalsai Mallipeddi, Parth Mehta

AI started as a basic algorithm and was revolutionized through the Turing test. It had a considerable impact on educational commodities such as the first AI program written in 1951 which supported and focused on teaching computers how to play checkers. In current times, AI has changed the way students learn because it mainly enforced an environment of plagiarism and biased information, and many students within educational firms used it to generate essays; it was apparent at the start that if essays were AI-generated, but as AI became more enhanced throughout the years, not many can tell now. We are using translation machine learning technology and BERT and we develop an AI model unbiased and fair for grading of student AP BIO FRQs.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Development of an Autonomous Beach Clean Up Vehicle Utilizing Object Detection

Charlie McClelland

One hundred thousand marine animals die due to ocean pollution each year (Mulhern, 2022). The most harmful type of pollution are single-use plastics which can take over 500 years to decompose leading to the bioaccumulation of toxic chemicals which can affect growth hormones and cause reproductive toxicity (Harris, 2023). To help reduce the pollution epidemic, an autonomous beach clean up vehicle was constructed and equipped with a camera to run an object detection program. A claw and storage unit were added to pick up and store any waste detected along the beach. The object detection model reached an accuracy of 0.66 trained on three classes over 200,000 steps. The annotations for cans, plastic bottles, and cardboard were created in VOC XML format then used to create TF Records to run on the SSD Mobnet V2 model zoo. The Mobnet allowed the model to compress down to a size that could be run on the Raspberry Pi with the assistance of the Coral USB Accelerator to allow the clean-up vehicle to operate autonomously. Next steps are to integrate the object detection program and distance calculations with the Raspberry Pi which will communicate with the encoded motors in order to maneuver to the exact location of the trash and use the claw to dispose of the garbage properly.

Buluswar, S. D., & Draper, B. A. (1998). Color machine vision for autonomous vehicles. In Engineering Applications of Artificial Intelligence (2nd ed., Vol. 11, pp. 245–256). essay, International Federation of Automatic Control. Retrieved May 17, 2023, from https://www.sciencedirect.com/science/article/pii/S0952197697000791?casa_token=HOcPrYKg8_oAAAAA:y-LLIbb0rP-hCZh9VtRfqYVH8uMIkVqD3Cld3b1xmVBQjV6fkShCRQGtpik7n-GIqPymjPVm.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Utilizing Machine Learning to Scout South American Soccer Defenders

 Ryan Moyer

The defender transfer market in South America has become massive over recent years with players like Lisandro Martinez, Thiago Silva, and Christian Romero having signatures worth tens of millions of dollars. All of these players had one thing in common, initially joining a lower level European club for a smaller sum of money and later being sold to a bigger team for a large amount of money. This is obviously an issue for the larger clubs as they are losing millions of dollars to the middle-man. This problem can be avoided by the clubs scouting the South American continent more effectively. A potential way this could be done is to use a machine learning model to scout the players. The model used was a neural network regression model which used the players 2019 season age, defensive stats, and passing stats to predict their transfermarkt value 5 years later in 2024. This model was able to effectively sort the players in order of most potential, with them having the highest predicted market value, to least potential, lowest predicted market value. The model was applied to the 2023 population of players and returned the players with the highest predicted market value to include Alejandro Maciel, Giuliano Cerato, and Gabriel Diaz. Based on these results, these players would be good options for teams looking to add defenders to their club. Future uses of this model include utilizing it on other soccer leagues, as well as modifying the variables used to other positions.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Comparative Analysis of Machine Learning Frameworks LightGBM and XGB

 Ankur Gatupa, Aditya Paranjpe

This experiment focuses on contrasting the comparative machine learning models Light Gradient-Boosting Machine (LightGBM) and Extreme Gradient Boosting (XGBoost). LightGBM and XGBoost are both machine learning frameworks that utilize gradient boosting and tree-based learning; however, LightGBM differs in the regard that it grows its tree vertically, known as a "leaf-wise algorithm". A California housing market dataset is being used to compare LightGBM and XGBoost. Currently, California faces a severe housing crisis which can be characterized by the soaring prices, limited inventory, and widening gap between income level and housing prices.
Analyzing housing data will provide crucial insight for government officials to create effective policies that aim to allow low-income households to afford housing. The solution places a heavy emphasis on analyzing the housing data in California. The two models are compared by parsing the regression dataset through the models, training the models, testing the models, visualizing the deviance graph, and printing the R2 value. In juxtaposing the models, the deviance graphs for both models are examined with respect to the data, model accuracy is contrasted, and the larger R2 values are held superior. The deviance— how well the machine learning model fits to the passed in dataset—and R2—the stronger fit the model is to the regression dataset—will indicate which comparative model is better fit for analyzing large amounts of regressive data. This information can be used in a plethora of real world scenarios that involve the analysis of large regressive data, in our case, the California housing market.

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McKinsey & Company. (n.d.). Closing CaliforniaÕs Housing Gap Full Report . Mckinsey. Retrieved February 18, 2024, from https://www.mckinsey.com/~/media/McKinsey/Industries/Public%20and%20Social%20 Sector/Our%20Insights/Closing%20Californias%20housing%20gap/Closing-Californias-housing-gap-Fullreport.pdf

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LCPS RSEF OFFICIAL ABSTRACT - 2024

A Low-Cost and Durable 3D Printed Prosthetic Finger Driven by Deep Learning

Ankit Rao

Approximately 30,000 people experience finger amputations each year, with young children and elderly adults being most affected. For amputated patients, life is fraught with challenges, from grappling with daily tasks to enduring social stigma and navigating the psychological impact of their condition. Moreover, many face the harsh reality of being denied employment opportunities due to their physical limitations. In order to fix this, prosthetics have been growing rapidly within the healthcare sector, having the potential to greatly improve the lives of amputated patients. However, many prosthetics are still too expensive for people in underdeveloped countries. Therefore, this project proposes a cheap, flexible, and durable prosthetic finger that's powered through a multi-modal sensor system in order to simulate regular finger movements.

The proposed prosthetic underwent initial fabrication using 3D printing technology, followed by training facilitated by electromyography (EMG) sensors. Through a deep learning algorithm, the prosthetic learned from datasets collected by the EMG sensors, enabling it to mimic regular finger movements. The proposed model achieved a remarkable 95% training accuracy on the dataset. However, during testing, the model exhibited a lower accuracy of 55%, indicating some degrees of overfitting, where the model memorized the training data rather than generalizing from it. Nonetheless, this is only an initial result and can be improved through expanding the size of the dataset. Finally, the proposed prosthetic can be applied globally and has applications in the medical field.

Manero, A., Smith, P., Sparkman, J., Dombrowski, M., Courbin, D., Kester, A., Womack, I., & Chi, A. (2019). Implementation of 3D printing technology in the field of prosthetics: Past, present, and future. International Journal of Environmental Research and Public Health, 16 (9), 1641. https://doi.org/10.3390/ijerph16091641

Abbady, H.E.M.A., Klinkenberg, E.T.M., de Moel, L., Nicolai, N., van der Stelt, M., Verhulst, A.C., Maal, T.J.J., & Brouwers, L. (2022). 3D-printed prostheses in developing countries: A systematic review. Prosthetics and Orthotics International, 46(1), 19-30. https://doi.org/10.1097/PXR.0000000000000057

Hassan, A. (2020, May 26). *Fingertip Injuries and Amputations: A Review of the Literature*. Semantic Scholar. Retrieved February 13, 2024, from https://assets.cureus.com/uploads/review_article/pdf/30931/1612430163-1612430160-2021 204-18268-mvwbur.pdf

LCPS RSEF OFFICIAL ABSTRACT - 2024

Saurorover (Sauropod Mechanism)

 Christine Robinson

A robotic design that specifically targets harmful pests will be more efficient than traditional methods because it will eradicate pests while keeping helpful insects out of harm's way and have less of an impact on crops due a lack of pesticides. My experimental design uses a Yolov8 deep learning module that I trained to identify a specific dataset of insects from one another. I use this data to communicate with a vertical moving robot that will move to the position of the harmful insect. After its arm will collect the insect and the chassis that it is connected to will move on to the next plant. Data is still being collected based on how efficient and accurate the insect detection and collection is, but so far the Yolov8 module has an accurate detection rate of 80%. This project will help contribute to finding more cost efficient, and safer ways to protect crops.

Bjerge, K., Alison, J., Dyrmann, M., Frigaard, C. E., Mann, H. M. R., & Høye, T. T. (2023a). Accurate detection and identification of insects from camera trap images with Deep Learning. PLOS Sustainability and Transformation. https://journals.plos.org/sustainabilitytransformation/article?id=10.1371%2Fjournal.pstr.00 00051

Conversation, T. (2023). AI can track bees on camera. here's how that will help farmers. AI can track bees on camera. Here's how that will help farmers. https://aihub.org/2023/02/23/ai-can-track-bees-on-camera-heres-how-that-will-help-farmer s/

Zarley, D. (2023, June 16). Farmers can fight invasive insects with AI and a robotic arm. Freethink. https://www.freethink.com/robots-ai/spotted-lanternfly-robot#:~:text=TartanPest%20is%20built%20off%20an,hard%20surfaces%2C%20like%20tree%20branches

LCPS RSEF OFFICIAL ABSTRACT - 2024

Effectiveness of an AI Model on Detecting and Classifying Drosophila Behaviors

 Duc Ngo, Kamal Sangameswaran

Imagine a world where animals and humans alike could get diagnoses in the blink of an eye, anywhere. This is the future of research to detect and classify various Drosophila behaviors such as hunger or climbing up a test tube. By detecting and classifying the behaviors, slowly, a database of behaviors will emerge for all animals and even humans, ranging from diagnoses of mental conditions or even cancers. Using NumPy arrays in Anaconda in the language Python, position arrays were formed for the locations of the flies for 2 minutes at 120 fps, shot from a camera. These flies were fed chilled and crushed apples that had been dyed red to maintain a red body easily identified by the computer and camera. This allowed for a more straightforward distinction between the conditions the flies were exposed to before the experiment, such as hunger. By forming the arrays, testing sets and training sets were formed and labeled by the conditions the flies were given when born. With a current accuracy of 76% based on the 14,400 frames of 50 drosophila's behaviors, it was clear that the model was able to decipher the behaviors of the flies. A conclusion was made by accepting the hypothesis that the model could predict Drosophila Behaviors at an astounding rate of over ¾ of the time, which will only increase with more data. Through more and more training sets, we could move to more behaviors or step foot into a different species altogether. Further application would be using AI to detect certain behaviors of wild animals such as injuries.

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Milius, S. (2012, August 11). Young fruit flies go cannibalistic: surprising actions may aid future studies of predation. Science News, 182(3), 12. https://link.gale.com/apps/doc/A302110877/GPS?u=sta95509&sid=bookmark-GPS&xid=7ebee650

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Systems Software (2000) and Technology Enhances the Arts (2100)

Project No.	Student(s)	Project Title
2001T12	Hassan Ahmed, Kabir Minhas	Using AI to detect AI
2002X12	Connor Barkman	A Combinatorial Optimization of Elevator Dispatch Algorithms to Cut Down on Energy Consumption
2003X12	Neel Harigopal	Clean Environment Score
2004X12	Joshua Johnson	Biscuit Allergy Detection
2005X12	Dylan Keyser	Using Computer Vision to Analyze and Provide Feedback on Distance Running Form
2006X12	Andrew Liu	Design and Implementation of an On-Demand-Transit Application
2007X12	Sara Mansfield	Implementation of Generative AI into a user-friendly Website Application as an Advancement to the Gamification of Learning
2008X12	Abi Mekuriya	RPC Based Compilation: A Dual Binary Approach for Distributed Languages
2009X11	Zaara Mulla	How can different Mars Rover prototypes best navigate space in a VR simulation?
2010T11	Abhiram Ruthala, Daiwik Sevugan	Assistive VR Technology Utilized In Mental Health Applications
2011X12	Lilly Soska	The Effect of AI Bias on Resume Evaluations
2101X12	Deven Czeszewski	Design and Development of a Virtual Reality Program for Enhanced Home Retail Capabilities
2102X12	Kiersten Engen	3D Open-World Adventure Game in Godot
2103X12	Catherine Joseph	Speech to American Sign Language Translator
2104T12	Krish Kanwar, Nakul Kumar	Music Style Transfer AI
2105X12	Rachael Keller	Utilizing the Imagineering Design Process and Engineering Analysis to Design a Roller Coaster
2106X12	Tristan Raab	3D Voxel Modeling for Visual Simulation of Clouds

Category Student Count: 20

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Using AI to detect AI

Hassan Ahmed, Kabir Minhas

In November of 2022, the world of AI changed with the introduction of OpenAI's ChatGPT. It started a chain reaction of Generative AI being developed: essay writer, image creator, video summarizer, etc. With these new developments the question about whether the media was real or fake started to rise. This project was motivated by the increasing difficulty in distinguishing between computer-generated and genuine visual content, which is crucial for both security and authenticity verification purposes. Utilizing a diverse dataset that includes both types of images (authentic and AI generated), the project consisted of using a machine learning model built on AWS Sagemaker algorithms that have image processing techniques trained to identify any image given. The results demonstrated the model's effectiveness, showcasing a significant success rate passing ninety percent correctly classifying both AIGC (AI Generated Content) and human-made content. Accepting JPEG and PNG images, the model returns a confidence value (probability) for the two classes. This outcome not only highlights the potential of machine learning in the realm of digital image verification but also sets a foundation for further advancements in this field. The study's implications are far-reaching, suggesting that with continuous refinement, such models could greatly aid in the detection and differentiation of digital imagery, thereby enhancing digital media's reliability and integrity.

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I/We hereby certify that the above statements are correct and the information provided in the Abstract is the result of one year's research. I/We also attest that the above properly reflects my/our own work (digitally signed).

LCPS RSEF OFFICIAL ABSTRACT - 2024

A Combinatorial Optimization of Elevator Dispatch Algorithms to Cut Down on Energy Consumption

Connor Barkman

The most effective solution to the vertical transportation problem is elevators. From office buildings to high-rise apartments elevators make over seven billion trips every day. The standard elevator dispatch algorithm fails horribly in handling these masses of people and wastes energy by taking inefficient paths. By using constant combinatorial optimization with an emphasis on energy conservation over an emphasis on speed the billion of people who travel on elevators every day will take more efficient paths and reduce their carbon footprint. Various traffic types and load levels will be tested to ensure an optimal algorithm. Traffic types will be up (majority of people traveling up), down (majority of people traveling down), and meeting (people will be moving between floors). As of this time dating is still being calculated in the search of finding an optimal algorithm.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Clean Environment Score

Neel Harigopal

Having a clean environment is crucial for the health of individuals, especially those who are more susceptible due to their genetics and disease. Being able to score an environment based on its physical qualities, i.e. Air pollution, light index or disease i.e. COVID, can improve decision-making of those affected individuals. The Clean Environment Score will answer the question of how Machine Learning AI models can be used to accurately score and predict future states of the environment. The AI was created using a "Random Forest" which is an ensemble machine learning algorithm that combines multiple decision trees trained on bootstrapped subsets of the data, using random feature selection at each node to create diversity among the tree. Data is still being collected.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Biscuit Allergy Detection

Joshua Johnson

Biscuit packaged foods are notorious for having an ingredients section containing several ingredients that are incomprehensible to the average person. This creates massive implications for the consumer as it can lead to severe allergic reactions such as an allergic reaction to Emulsifier, a common ingredient found in packaged biscuit snacks. This paper describes software that utilizes a conventional neural network to be able to detect the allergic reactions that its user has by consuming a specific biscuit snack through an uploaded picture of the biscuit wrapper. Additionally, the paper discusses the accuracy and F1 score of the conventional model depicting how accurate the model is at identifying biscuit brands. Overall, this paper identifies an efficient solution to the ever-growing issue of allergic reactions occurring due to consumers not being able to thoroughly understand the ingredients list present on biscuit wrappers.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Using Computer Vision to Analyze and Provide Feedback on Distance Running Form

 Dylan Keyser

Running is a common way of getting regular exercise due to its low barriers to entry and accessibility. Unfortunately, many people who run for exercise do so with poor running form. This not only slows them down due to worsened running economy, which is the amount of energy used to run, but also increases their risk of getting injured. This project aims to allow runners to track their movement and provide them with feedback to improve their form. The program uses MoveNet, an open-source, high speed human pose estimation model. The model outputs the positions of the subject's major joints, which are then used to calculate biomechanical variables related to the stride. These variables are then compared to values found in research to either be optimal or contribute to poor running form. Currently, MoveNet has been successfully implemented, with its outputs having been used for two main calculations: that of angular variables and their maximum and minimum values, and an in-progress algorithm for determining the frame in which contact is made with the ground. These particular data points can be used to determine if angles created by the hip and knee could be factoring into the user's running economy or if they could be contributing to possible injuries. To further this research, the analysis of the model's output will be expanded to include more variables, and written feedback will be implemented into a user-friendly interface that will allow the user to import a video of themselves running.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Design and Implementation of an On-Demand-Transit Application

 Andrew Liu

High-Occupancy Vehicle (HOV) lanes on highways are being underused, while regular lanes are routinely congested. This points to the lack of incentive to carpool or take public transportation, given the hassle of the first- and last-mile. In addition to the prevalence of single-passenger programs such as Uber and Lyft, a few cities such as Jersey City, NJ have implemented citywide On-Demand Transit (ODT) vanpooling. Implementation of a reliable web platform for self-organizing ODT would allow its environmental and economic benefits to become widespread without local subsidization.

A web application was built using ASP.Net MVC and MSSQL that successfully returned a list of other opted-in commuters with home and work locations within current user-specified radii, and efficiently matched riders and drivers in real-time carpools from one origin to one destination. As a proof-of-concept, these results show the practicality of connecting riders and drivers with a self-used program, taking empty cars off the road. Further, the optimization of the core user-matching algorithm was successfully implemented using a used-Routes table that took the system off redundant distance-calculation calls.

Further research and development can be done to improve performance and security of the data systems, including updates to the data storage methods that expedite the extraction of route data, and encryption of sensitive columns, such as payment information. As a future step to enhance the safety of users, research shows the viability of calling driving history and background check APIs–such as Accurate and Checkr.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Implementation of Generative AI into a user-friendly Website Application as an Advancement to the Gamification of Learning

Sara Mansfield

This project delves into the complexities of generative AI and prompt engineering by asking it to generate math questions that meet SOL standards, as well as explanations on how to solve them. These questions are integrated into a website application that encourages learning through gamification.

Ruby on Rails, html, and JavaScript were used in the creation of the website, and ChatGPT served as the generative AI. The framework of the website was constructed using Ruby on Rails, and ChatGPT was integrated by using a gem that allowed its answers to be returned in a json format. Then, they were interpreted and displayed using Katex.

Every question generated by the AI is tested against a rubric that includes wording, formatting, solvability, and contribution to understanding of the requested SOL standard. The AI's explanations are also tested to ensure that it arrives at the correct solution with valid procedures.

 Overall, the AI proved ~92% successful in generating questions for the app. The main cause for inaccuracy was the occasional generation of a question that would require a graph to solve, yet included no visual aspect. When prompted to explain how to solve such a question, it would seemingly retrieve data from the non-existent graph, and then base a solution on this data. Future research could be conducted to look into this in further detail, and gain an understanding of how it retrieves data from the theoretical graph.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

RPC Based Compilation: A Dual Binary Approach for Distributed Languages

 Abi Mekuriya

Existing distributed computation systems for scientific computation require "Message Passing Interface (MPI)" which adds an unnecessary level of complexity due to tracking interactions between copies of an undifferentiated binary. In order to get these large scale computations in the hands of regular researchers without significant additional training, a new system of distributed computation built upon common async await is required. In order for the distributed computation aspect to work under one programming language, a compiled approach that creates two separate binary files, designated as one parent and multiple clonable children binaries, was used. A special keyword that designates functions to be run distributed and therefore compile into a child binary was deemed the simplest method for segregating the two binaries.

The preliminary data suggests that the segregation phase of such a programming language would be completely functional according to the creation of a separate "Abstract Syntax Tree (AST)". This indicates that the compilation into binaries will also function as both generated AST trees seem completely normal and uncorrupted. With the integration of C linkage to a TCP C Library for network calls, no perceivable obstacle should present the sending and receiving of function calls using async await syntax.

The next step in this research is to generate a functioning parent binary, after which C linkage is implemented. Once this has been completed, the next steps would be to flesh out the infinite wait time caused by unreturned TCP calls as well as restricting global context within distributed functions.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

How can different Mars Rover prototypes best navigate space in a VR simulation?

Zaara Mulla

In recent years, the exploration of Mars has captivated astronauts and scientists alike. Within space exploration, The National Aeronautics and Space Administration (NASA) has been most prevalent, continuously advancing its space technology. One of the most important technologies are the MARS Exploration Rovers, equipped with scientific instruments and cameras to study and explore the Martian terrain.

In this project, I hope to bring the excitement of Mars exploration beyond professional space experts to young kids as well. I have developed a Virtual Reality (VR) simulation of the Mars Rovers, allowing users to have an immersive experience while also tailoring it specifically for educational purposes. This simulation offers users, especially young kids, a chance to control virtual rovers, navigate terrains, and even conduct scientific experiments. The goal is to have engaging visuals, interactive gameplay, and educational content that the young users will not only be entertained with but also deepen their understanding of Mars exploration missions.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Assistive VR Technology Utilized In Mental Health Applications

Abhiram Ruthala, Daiwik Sevugan

Depression is a key disorder affecting millions of people, with major depressive symptoms affecting about 17.3 million American adults annually. This problem has to be addressed as it could balloon into a worse problem with a greater magnitude. To help the status quo, a VR environment engineering design was introduced to tailor the needs of mental health patients by creating virtual reality environments that stimulate users' senses such as sight, sound, movement, etc. By introducing 6 different environments that account for universal interests (Sports, Music etc.), the environments serve as systems that help patients cope and embrace a new form of interaction, allowing participants to sense different feelings and embrace positive emotions such as contentment, and happiness through the correlation between interests and environments. For example, the music environment stimulates the sense of sound and sight by allowing participants to immerse themselves in a concert hall with recognizable figures and hear iconic songs.

The framework behind this project is using several different 3D-design platforms such as Unity and Blender alongside the dynamic technology of virtual reality to create a final product that will curate different environments. This project didn't consist of any data testing due to human safety but self-reported data was recorded in a data table to connect quantitative and qualitative statistics to form a conclusion. The range of interactive tools as well as the self-reported mood range data demonstrated the use of the virtual reality gadgets in real-time to gain an accurate understanding of the diagnosis process.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

The Effect of AI Bias on Resume Evaluations

Lilly Soska

AI or Artificial Intelligence is becoming increasingly integrated within the global workforce day after day. With the possible displacement of 375 million jobs due to AI it's important this speedy development is worthwhile. (Mordani, S., 2023) Although extreme advancements have been made in the field of machine learning, there are still many faults any complex machine or algorithm may hold. Mistakes that may occur in AI have real-life implications that affect humans, especially when used in judgment or decision-making roles historically performed by humans, like the screening and hiring process for companies using AI-powered tools to evaluate candidates for employment opportunities. Developers can intentionally, or inadvertently, allow a machine to ignore, or amplify, race, gender, or age, as well as reflect the perpetuation of unconscious biases that they hold themselves. To study the potential existence of bias I organized resumes from various sources into categories of three resumes based on race (Black, Latinx, White, Asian) and gender (Male and Female). I then ran all participants through two AI engines designed to rate resumes on a scale of 1-100, a higher score implies a better resume. Following this I edited the resumes to present to the opposite gender and the other three races. These changes were presented through names, qualifications, education, and extracurriculars where the gender or race was specific. I would then compare and analyze the resulting score differentials. My results displayed a minimal effect of AI bias on resume scores. Results revealed that the only resumes that significantly changed value following the adjustments were the average female scores to male. My findings imply that although bias in this instance is minimal, it is possible. As humans enter a new age of technology and continue to integrate it into our daily lives, we must create and invest in tools to mitigate biases, no matter how minimal, that could exist.

LCPS RSEF OFFICIAL ABSTRACT - 2024

Design and Development of a Virtual Reality Program for Enhanced Home Retail
Capabilities

Deven Czeszewski

With the spread of online consumerism, many goods can now be purchased from home with two button clicks. In the 21st century, this has grown to include housing property and real estate. Many websites exist that are dedicated to advertising houses, and consumers often judge and purchase homes based solely on the images and descriptions that the websites provide. These can sometimes lack important information such as the house's full layout, scale of the rooms, or size of the furniture in each room. Furthermore, it is near impossible to communicate details such as how open or cramped a house feels due to its extreme subjectiveness. The purpose of this project is to develop a Virtual Reality program using Unity's 3D development engine which will allow consumers to tour homes virtually and to better understand if they will be satisfied with purchasing them. The user will be able to explore a virtual model of the home and experience what it would be like to actually visit it. The program was created using Unity's XR toolkit and other various libraries that contain models, code, and presets that expedited the development process. The program is able to track the user's hands and head in order to display dynamic menus and images. These can provide the user additional information about the house that they are touring. Testing is currently still ongoing as more bug fixes and optimizations are being implemented. Additionally, furniture customization and more house and terrain styles will soon be in development.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

3D Open-World Adventure Game in Godot

Kiersten Engen

Video games are becoming an increasingly prevalent medium of communication and self-expression in the modern age. Many turn to video games as a means of entertaining themselves, socializing with others, or even of learning something new. Given their widespread appeal, their potential audience is varied and far-reaching. However, creating an entire video game from scratch is no easy feat, even with the aid of video game creation software like Unity or Godot. Many components, such as assets, gameplay mechanics, and storylines must be designed together to create a cohesive experience for the player. The goal of this project was to create a complete open-world adventure game. The game engine Godot was chosen for its approachability and simplicity. Assets and game mechanics were added as needed during the development process, enabling the most essential components to be incorporated first. The primary intent of all development was to craft each part in such a way that would allow for the modular integration of future mechanics and items. As a result, the project can more readily adapt to changing development needs. At present, the project includes features such as interaction with nature, an inventory system, conversation with non-player characters, and quests. Further development would see the expansion of the storyline through the addition of new quests and locations to explore, more sophisticated non-player character behavior, the inclusion of animals, the ability to save the game, and new user interfaces, such as a start menu and settings menu.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Speech to American Sign Language Translator

 Catherine Joseph

More than 38 million people in the US over the age of 12 have some form of hearing deficiency, with many relying on American Sign Language (ASL). Despite many people having hearing problems, the world is still highly inaccessible for the hearing impaired. The solution is an app that translates speech to American Sign Language, displaying videos of people singing using ASL. The app uses a speech to text algorithm that transcribes the speech. The speech is then sent through a word matching algorithm. This word matching algorithm pairs each word with its corresponding video from a library containing videos of people signing ASL symbols. These videos will then be displayed on the mobile device, playing the ASL signs for the entire sentence spoken.

Currently, the application displays videos after being given an input sentence. Going forward, Natural Language Processing (NLP) will be incorporated into the app. The ASL symbols library contains around 83,000 videos, however most of the words in the library are words not commonly used and have synonyms that better fit the meaning of the sentence. To resolve this issue and increase the word matching accuracy from the words in the sentence to the dataset, both the input sentence and the dataset will use NLP to extract the meaning of the input sentence. Using text tokenization and summarization (processes in NLP), the input sentence will be condensed and will remove the "filler" words and replace the words in the dataset with a more commonly used word.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Music Style Transfer AI

Krish Kanwar, Nakul Kumar

Attention has been brought towards the process of music style transfer, where a given song matches the style of the original song or genre. This process would democratize music production by providing a cheaper alternative to creating high-fidelity music. However, the majority of this research has used MIDI files as the input and output, which is significantly limited in fidelity and not practical to produce music in a commercial form. The proposed solution is MST, a diffusion model that trains on spectrogram images. It trains on spectrograms from a certain genre, and then takes in an input song and transfers the trained genre to it. Results are tested by a subjective metric, with both quality of sound and quality of transfer on a scale from 1-5. Current results score a 2 on quality of sound and 1 on quality of transfer, observing limited to no observable change among different content inputs.

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LCPS RSEF OFFICIAL ABSTRACT - 2024

Utilizing the Imagineering Design Process and Engineering Analysis to Design a Roller Coaster

 Rachael Keller

Theme Park attractions blend creativity, art, and engineering principles to create thrilling experiences for diverse audiences. This project demonstrates the necessary balance between providing a fully immersive rider experience, ASTM regulatory adherence, and the studied limitations of the human body through a detailed force analysis of different roller coaster design iterations. The Imagineering Design Process, made famous by Disney's Imagineers, was utilized to create and design the attraction. Using Force Vector Design (FVD ++) software, a model roller coaster was created displaying graphs of the normal and lateral forces generated by the attraction. This model was transferred to NoLimits 2, a professional rollercoaster creation software, for ride simulation analysis and rendering. Current data shows all normal forces on the roller coaster remaining within a defined 0-3 G limit as determined by research performed by Ann-Marie Pendrill. Fluctuations between -0.5 and 0.6 Gs are shown for lateral forces. This requires further consideration regarding safety restraints for riders and the design of the attraction's embankment curves. Anticipated results will provide an attractive model of a roller coaster that can be enjoyed safely by riders having undergone a detailed engineering review. Next steps could include the redesign and modeling of both existing and future attractions with increased focus on safety using similar engineering simulations. The added application of the Imagineering Design Process results in an enjoyable experience based off of existing well-loved media.

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I/We hereby certify that the above statements are correct and the information provided in the Abstract is the result of one year's research. I/We also attest that the above properly reflects my/our own work (digitally signed).

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3D Voxel Modeling for Visual Simulation of Clouds

 Tristan Raab

Clouds have been historically a challenge in real-time rendering. Despite their constant presence in outdoor environments, cloud models are far from perfect and each has their own trade-off. Most current cloud simulation models rely on one of two methods to simulate cloud shapes: procedural functions and fluid simulations. Each method has its own tradeoffs. Procedural functions are cheaper but do not interact with their surrounding features such as planes or buildings. Fluid simulations interact with their surroundings realistically but are expensive. This project aims to create realistic looking clouds using voxels that interact with their surroundings while also not using much processing power. Voxels are used to simplify the cloud into sections, allowing cloud density to be managed in sections. Then, voxels can be modified in real time to simulate interactions with other objects. Ray marching is used to accurately portray the scattering of light in clouds. Ray marching consists of creating a ray that goes a set length and then reflects either randomly or according to a mathematical equation. The light can also be attenuated if it does not exit the volume after a certain amount of bounces, which is similar to the absorption of light in the medium in real life. Ultimately, this model aims to combine the benefits of fluid simulations with the speed of procedural models, creating a new model that allows for more realistic interactions with clouds in games and other real-time applications.

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