Abstract: Science and Engineering Fair of Houston

3024

Early Detection of Devil Facial Tumour Disease Using a Low-Cost ctDNA Diagnostic Kit

Christopher Dai, Calvin Dai

Houston ISD/DEBAKEY HIGH SCHOOL FOR HEALTH PROFESSIONS - HS

Category:

Animal Science

Transmissible cancers are extremely rare, but in Tasmanian devils they have caused catastrophic population declines due to Devil Facial Tumor Disease (DFTD), a contagious cancer spread through biting. Current diagnostic methods rely on visual examination and invasive biopsies, which often detect the disease only after tumors become advanced. Early, accurate, and accessible detection tools are critically needed to support conservation efforts and prevent further spread. This project aimed to develop a highly specific, mutation-based molecular assay to detect DFTD by targeting unique tumor-specific DNA fusion junctions that are absent in healthy devil cells. Using synthetic DNA sequences to model these junctions, the assay combined mutation-specific primers, isothermal DNA amplification, and fluorescence-based signal detection to evaluate whether cancer-specific DNA could be reliably identified in vitro. The detection system demonstrated high specificity, successfully distinguishing tumor-derived sequences from wild-type controls, and showed strong sensitivity at low DNA concentrations, supporting its potential for early detection. This proof-of-concept highlights the feasibility of non-invasive, molecular diagnostics for transmissible wildlife cancers and offers a scalable framework for conservation-focused disease surveillance. Broader applications of this work include improving wildlife health monitoring, informing containment strategies, and extending similar diagnostic approaches to other rare or emerging transmissible cancers.

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Abstract: Science and Engineering Fair of Houston

3025

Polygenic Prevention: Exploring Genotype-Phenotype Relationships of Canine Hip Dysplasia

Leile Ebert

Friendswood ISD /Friendswood High School

Category:

Animal Science

Canine hip dysplasia (CHD) is a complex polygenic condition affecting large-breed dogs, presenting as loose or improperly formed hip joints. This eventually leads to erosion of the articular cartilage and synovitis (Pfahler & Distl, 2012). By conducting machine-learning aided secondary data analysis, this study initially aimed to map singular nucleotide polymorphisms (SNPs)-- single-nucleotide substitutions of one base for another (Making SNPs Make Sense, n.d.) that can serve as predicted markers for quantitative trait loci (QTL)-- to specific phenotypes associated with CHD. However, due to a lack of primary data, the Orange machine learning tool was unable to be trained or used in a predictive capability, and the null hypothesis of the research question (how are the quantitative trait loci of canine hip dysplasia comparable or distinct?) was unable to be rejected. That said, while not statistically significant, data trends for chromosomal SNP frequency and comparable -log10 p-value significance are visible in the results, and could be used to enable continuing research. All data used are publicly accessible, results are listed graphically, and tabular results are available upon request.

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Abstract: Science and Engineering Fair of Houston

3026

Category:

Animal Science

Comparison of Bioinformatic and Morphologic Methods for Taxonomic Identification of Dragonflies from Charlton, Massachusetts

Esther Levin

Home School/Homeschool

Dragonflies (infraorder Anisoptera) are extremely important for humans and for the environment, primarily for their role as great bioindicators of environmental pollution of aquatic habitats [2] and natural controllers of pests including human disease vectors [1]. But in order to understand their behavior and lifestyle scientists need to identify the dragonflies first which may be tricky with both morphological and genetic identifications. In this project I compared accuracy and precision of three different identification platforms using key identification as a reference: NCBI GenBank with BLAST, BOLD Systems, and iNaturalist. Identifications of organisms done by BLAST and BOLD are done through DNA barcoding, identifications done by iNaturalist are morphological. To achieve that, I collected 20 dragonflies, took detailed photos of them, and performed DNA Barcoding. DNA sequences were obtained for 19 of 20 samples, 18 having both forward and reverse sequence reads. They were uploaded to BLAST and BOLD which gave me their sequence search results and identifications based on those with percent of confidence. At the same time the detailed photos of the dragonflies were uploaded to iNaturalist where the scientist and citizen scientist users gave me their suggested identification. All identifications were correct, the average percent ratio of identifications for all taxonomic ranks (species, genus, family) for each method was as follows: BLAST 100%, BOLD 96.49%, iNat 94.74%, leading to a conclusion that BLAST was the most precise identification method, as well as being most accurate at the species-level identification.

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Abstract: Science and Engineering Fair of Houston

3027

Protecting Man's Best Friend: A Heartworm Prevention Study

Samuel Gandara, Jordan Lopez, victoria quintanilla

Conroe ISD /ASHP: Academy for Science and Health Prof

Category:

Animal Science

This project investigates what types of preventatives for heartworm work better for pet owners, helping them decide on one that not only tends to their needs, but is also successful and reliable. It is hypothesized that long-term preventatives would be more effective because people are less likely to lose consistency when administering medication to pets. To start with, we made a survey, had it reviewed by a psychologist and made a matching flyer. The survey was printed out and posted in veterinary clinics as well as shared through family and on social media. After 30 days, we collected a total of 83 responses: 58 of those responses were considered reliable and met the criteria for our analysis. After collecting the data, the responses were organized into a categorical table based on the type of preventative used and positive or negative test results. Then we looked for possible relationships and ran a Chi-square test of independence to come to a statistical result. In conclusion we failed to reject our null hypothesis meaning that there is no statistical difference between the effectiveness of heartworm monthly or yearly preventative. Therefore, our initial hypothesis was incorrect, thus, monthly vs yearly has no beneficial difference.

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Abstract: Science and Engineering Fair of Houston

3028

Category:

Animal Science

Assessing Planarian Lipid Raft–Enriched Extracellular Vesicles as a Therapy to Restore Biochemical and Behavioral Rescues in a D-Galactose –Induced Neurodegeneration Model in Drosophila melanogaster

Yash Bhoda, Joyce Ma

Conroe ISD /TWHS: The Woodlands High School

Neurodegenerative diseases (NDs), including Alzheimer's, Parkinson's, and Huntington's disease, affect over 55 million globally and cost $1 trillion in economic burden. These disorders are defined by progressive biochemical dysfunction: oxidative stress, lipid peroxidation, mitochondrial failure, and behavioral decline. A shared driver across NDs is disruption of lipid-raft microdomains essential for channel clustering and synaptic signaling, preventing biochemical repair and promoting cognitive decline. In contrast, planarians regenerate functional brain structures through extracellular vesicles (EVs) enriched in lipid rafts. This study examined whether lipid-raft-enriched planarian EVs could restore biochemical and behavioral function in a 6.5% D-galactose–induced neurodegeneration model in Drosophila melanogaster. Male flies (n=432) were assigned to Control, Neurodegeneration, Lipid-Raft EV, and PEG groups. EVs were isolated via PEG precipitation and characterized by Brownian motion, with lipid-raft enrichment confirmed by cholesterol quantification. The neurodegeneration model was validated using toluidine blue and ImageJ. After seven days of treatment, EV-treated flies exhibited behavioral rescue, with climbing performance at 82.4% compared to 38.6% in untreated neurodegenerative controls ($p < 0.0001$).This recovery was supported by biochemical rescue, including 42% reduction in ROS ($p = 0.002$), a 63% reduction in FTC ($p < 0.001$), 38% restoration of mitochondrial activity ($p = 0.004$), and 15.5% reduction in vacuole size ($p = 0.008$). One-way ANOVA and post hoc Tukey's HSD confirmed statistical significance. STRING analysis revealed enrichment of lipid-raft-dependent recovery pathways. These findings demonstrate that lipid-raft-enriched planarian EVs enable biochemical repair and behavioral rescue, identifying a potential therapy for reversing neurodegenerative damage and disease progression.

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Abstract: Science and Engineering Fair of Houston

3029

Category:

Animal Science

Year III: Development of M. mercenaria Neoplastic Hemocytes as a Novel Alternative Experimental Model for BCL-2 Interactions in Blood Cancers: An Application for Targeted Drug Studies

Iris Shen

Conroe ISD /AST: Academy of Science and Technology

Anti-apoptotic B-cell leukemia/lymphoma (Bcl-2) family proteins are overexpressed in around half of all human cancers, linked to tumorigenesis, chemotherapy resistance, and poor prognosis. Effectively modeling this complex molecular interaction in leukemia is essential for its progression as a therapeutic target, yet the costliness and time-intensive nature of current models limit study. However, disseminated neoplasia (DN), a transmissible cancer naturally occurring in the hemocyte "blood" cells of bivalve mollusks, shares notable molecular similarities to human leukemia. To develop M. mercenaria as an alternative leukemia model for Bcl-2 interactions, this study examined neoplasia transmission between bivalves, yielding increased tumor cell fractions of up to 0.25 in healthy clams after 3 months of exposure. Heightened lipid staining area in neoplastic tissue was found, characterizing excess lipid accumulation as a new potential biomarker aiding in future study and disease identification. M. mercenaria disease progression was monitored after exposure to Bcl-2 inhibitors at varying concentrations, evaluating functional similarities between human and bivalve Bcl-2. Significant changes (p=0.0209) in relative protein expression were observed in SDS-PAGE, suggesting a combined ursolic acid and piperine treatment downregulated BCl-2 family protein expression. Clams treated with concentrations of 0.3 mg/kg or higher maintained suppressed tumor progression in the months following exposure. Results show promise for M. mercenaria as naturally occurring in vivo cancer models for BCL-2 family protein interactions, with analogous biomarkers and physiological responses being identified. Potential applications include high-throughput drug screening, minimizing vertebrate testing, and reducing cost per specimen over 50-fold for early novel drug candidate screening.

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Abstract: Science and Engineering Fair of Houston

3030

Category:

Animal Science

A Transcriptomic Lens Reveals Disrupted Metabolic Pathways in Liver Cells Exposed to Food Dyes

Aditya Jetti, Kavish Mehta

Fort Bend ISD /Dulles High School

This project investigates whether short-term exposure to the synthetic food dye FD&C Yellow 5 causes measurable gene-expression changes in mammalian liver cells. Established mouse hepatocytes (AML12) were cultured and treated with a 1 mM Yellow 5 solution for 24 hours, while untreated cells served as controls. Total RNA was extracted using a Qiagen RNA isolation kit and prepared for bulk RNA sequencing. Sequencing data will be analyzed using established bioinformatics tools, including quality control (FastQC), alignment (HISAT2 or STAR), gene-count generation (featureCounts), and differential expression analysis with DESeq2. The study aims to identify differentially expressed genes and altered pathways related to metabolism, detoxification, oxidative stress, and inflammatory signaling. Pathway enrichment (GO, KEGG, Reactome) and visualizations such as volcano plots, heatmaps, and PCA will be used to interpret results. This research provides insight into the molecular effects of a widely consumed food dye and may help inform scientific understanding and public awareness regarding potential cellular impacts of dietary additives.

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Abstract: Science and Engineering Fair of Houston

3031

Comparative Evaluation of Polystyrene Degradation by Tenebrio molitor Larvae and Adult Darkling Beetles

Ava Hatchell, Siya Adur

Conroe ISD /AST: Academy of Science and Technology

Category:

Animal Science

The objective of this science fair project is to find a biological solution for managing polystyrene waste and reducing microplastic pollution. This polystyrene pollution poses a major environmental threat due to its resistance to degradation and accumulation in landfills, ecosystems, and people. The structure of polystyrene is very difficult to break for several reasons, its stability, hydrophobicity, its phenyl groups, benzene rings, and its large size. This study investigates the biodegradation efficiency of Tenebrio molitor (mealworm) across its life stages to determine whether larvae or adult beetles more effectively process polystyrene. The Tenebrio molitor has been shown in recent studies to possess the ability to biodegrade polystyrene. The larvae of the tenebrio molitor contain gut microbes capable of breaking down polystyrene into simpler organic compounds. The experiment measured the percent mass loss of polystyrene samples over 12 days in three environments: larval, adult, and control. Percent mass loss was calculated using the percent mass loss formula, percent mass loss = [(initial mass – final mass) / initial mass] x 100. Results showed that the larval group achieved an average reduction of 5.39%, while the adult group demonstrated minimal degradation at 0.63%. The highest-performing larval sample reached 8.70% degradation. A one-way ANOVA produced an F-statistic of 4.385 and a p-value of 0.067, indicating a strong biological trend but not statistical significance at the 0.05 level, likely due to high variance among samples. These findings demonstrate that larvae are substantially more effective at degrading polystyrene due to their higher metabolic demands and the presence of specialized gut microbes. This suggests the larval stage could be utilized in sustainable bioremediation systems. Overall, this research highlights a promising biological solution for managing polystyrene waste and reducing microplastic pollution.

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