PROCEEDINGS

OF THE

11th ANNUAL UNDERGRADUATE RESEARCH SYMPOSIUM

The 11th Annual Undergraduate Research Symposium is organized by the Undergraduate Research Students' Association (URSA), which was founded in 2010 and is dedicated to expanding access to research for undergraduates at the University of Tennessee, Knoxville. The Symposium provides a space for undergraduates in all disciplines to give oral presentations of their work to an audience composed of the general public, their professors, and their peers. More information about URSA can be found online at www.ursautk.org.

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ABSTRACTS

Alphabetical by Last Name

Suggested and Practiced Interventions Addressing College Student Food Insecurity across the Socioecological Model: A Literature Review

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Major(s): College Scholars: Food Security and Public Health Nutrition. Minor(s): Spanish

A growing body of evidence on the prevalence of food insecurity among college students in higher education institutions across the United States suggests this is a public health priority. Much of the research across U.S. college campuses has focused on coping mechanisms, implications, and the extent of food insecurity, but there is relatively less emphasis on the suggested and practiced solutions. Systematic reviews have found college student food insecurity rates to be significantly higher than US national households and consistently associated with factors such as financial independence, poor health, and adverse academic outcomes. Higher education institutions must not only address the prevalence of the issue but the short-term and systematic solutions that address all levels of the socioecological model (SEM) to mitigate the adverse consequences. Independent researcher (AA) has conducted a review of literature reporting on suggested and practiced interventions for college student food insecurity, and systematically organized solutions according to socioecological construct: policy/system, community, organizational/institutional, and interpersonal. The methods include a primary investigation of databases and a secondary citation review to include peer-reviewed and grey literature that met eligibility criteria. This compilation and review of 17 analyzed literature sources can be utilized as a tool-kit for research-based efforts that reduce the burden of student hunger and represent diverse solutions at various levels of the SEM to address the multidimensional issue of food insecurity. As a comprehensive resource of literature aimed at implementing, recommending, or evaluating anti-hunger initiatives, this research can contribute evidence of the short-term and systematic solutions associated with select individual higher education institutions to mitigate adverse consequences for students.

The Commodification of Care: A Case Study in a Private Long-Term Care Facility in Northeastern China

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Major(s): College Scholars: Global Health Equity

Historically, the main source of support for China's elderly population has been family care-giving, with deep roots in the Confucian tradition of filial piety. This form of elder care is becoming strained by significant socioeconomic and demographic shifts in the past few decades, and the number of private long-term care (LTC) facilities are growing as a response to the need and demand for an alternative form of caregiving for the elderly. Existing research on LTC facilities is limited and focuses on the operations of and circumstances that lead to the placement of Chinese elders in primarily government-run facilities in large cities. This ethnographic research study seeks to contribute to the current research by exploring the psychosocial and emotional needs of elderly Chinese residing in a county-level, privately-owned LTC facility in Northeastern China. Interviews with 10 residents and 4 employees of the facility reveal that addressing both the material needs and the psychosocial and emotional needs of the elderly are limited by the private nature of the facility and the commodification of care. These limitations are further internalized by residents of the facility, who conceptualize their care needs as a burden on their family, facility staff, and society as a whole. These findings demonstrate that the privatization of care contributes to the subversion of the social and relational aspects of care and instead emphasizes the individual responsibility of the elderly to regulate their own needs.

Current Understanding of Gender Dimorphism Regarding Type 2 Diabetes

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Major(s): Nutrition

Today, both type 1 and type 2 diabetes mellitus affects 33.3 million people in the United States, and nearly 500 million adults worldwide, and there is concern that this number may increase steadily in the future. Previous studies have linked the development of type 2 diabetes to multiple lifestyle factors, including physical activity level and diet, and biological characteristics, such as body composition, age, and to race; however, current research suggests that gender may also have an impact on one's risk of developing type 2 diabetes. Variations in type 2 diabetes diagnosis, prevalence, and progression have been found between males and females. These variations stem from distinctions in testosterone, estrogen, and leptin hormone levels, incongruity in health practices, differences in physical size and shape, and factors that only affect those that are biologically female, such as age of menstruation or menopause and the presence of gestational diabetes or PCOS. This literature review aims to summarize the current literature discussing these factors. Using the search engine PubMed, and applicable search terms such as "type 2 diabetes," "gender," "sex hormones," and "diabetes and age of menarche/menopause," we found information about diabetes risk specific to females and general risk factors that vary for both males and females. Through our investigation, we have reason to believe that the probability of developing type 2 diabetes has some association with one's biological sex, and specifically the hormones involved. It is our hope that this work will provide useful information to researchers of basic and public health sciences, physicians, nutritional practitioners, patients, and students in biomedical fields.

EPFL Genes and their Role in Flower Development in Arabidopsis thaliana

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Flowers are composed of four floral organ types: sepals, petals, stamens, and a pistil. In Arabidopsis thaliana, the ERECTA family leucine rich repeat receptor-like kinases (LRR-RLKs) have been shown to regulate plant morphology. Epidermal Patterning Factor-Like (EPFL) genes encode for small secretory proteins that are ligands for ERECTA Family (ERf) receptors. It is suspected that EPFL's act as a signal to coordinate proper lateral organ number, patterning, and spacing. ERf mutants have significant defects in flower development, including difficulty forming anther lobes and pistils, yet little is known about how individual EPFL ligands contribute to ERf signaling. In order to gain a better understanding of the unique roles of EPFLs in cell-to-cell communication during flower development, various epfl mutant combinations were analyzed. Arabidopsis thaliana flowers of different developmental stages were analyzed using Differential Interference Contrast (DIC) microscopy with the goal of utilizing flower development as a model system to understand the distinct roles of the individual EPFL ligands and, ultimately, ERf signaling pathways.

Effect of cognates on intra-sentential codeswitching

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Codeswitching is a common practice among bilingual individuals which involves the switch from one language to another. The intra-sentential codeswitch, a switch within a sentence, is utilized in this study. Cognates are words that have similar sounds or spellings and meanings between two languages and are processed more easily than noncognates by bilinguals. Cognates are also recognized as a trigger for codeswitching between proficient bilinguals. Previous studies have focused on single word codeswitches or on the effects that language dominance has on brain processes during codeswitching. However, this study examines how the special qualities of cognates affect processing across multiple words following the initial switch. To measure possible effects, data from a self-paced reading task and participants' event-related potentials or brain waves will be gathered via the electroencephalogram (EEG) and analyzed. The hypothesis is that codeswitches initiated with a cognate require less processing for the codeswitched words (the initial and following words) compared to those initiated with a noncognate. With this hypothesis, the Late Positive Component (LPC) which indicates sentence-level restructuring should have a smaller amplitude for the codeswitches initiated with a cognate, reflecting that the cognate decreases some processing requirements of codeswitches.

Deification or Demonization: Jesus' Post-Resurrection Body in Luke 24:36-40

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Major(s): Religious Studies and Spanish

There has been much scholarly debate about the mythological category of Jesus, arguing that the Lucan portrayal of his post-resurrection body aligns either with Roman-period beliefs about ghosts or resurrected gods. This paper examines Greco-Roman ghost stories, apotheosis narratives, and academic work from both sides of the debate on Luke 24:36-40 in an attempt to better understand why the passage resists categorization. The paper also introduces theories of liminality and anomy to explain the possible ambiguity in the gospel's portrayal of Jesus' body. The paper concludes that Luke 24 is neither clearly a ghost story nor a deification story. Rather, the overlap in characteristics renders the narrative anomic, perhaps intentionally.

Investigating the cortical expression of perineuronal nets in male mouse model of CDKL5 disorder in hemisphere and sub region specific manner

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Cyclin-dependent kinase-like 5 (CDKL5) deficiency disorder is an X-linked neurodevelopmental disorder, where children exhibit motor, speech, and cognitive deficits during development as well as early onset of seizures and infantile spasms. CDKL5 disorder results from de novo mutations in the CDKL5 gene, which phosphorylates many proteins. How mutations in CDKL5 gene result in these neurological deficits is unknown. Using the mouse as a model system, our project involves characterizing synaptic plasticity deficits in CDKL5 deficient male mice during development. We use perineuronal nets, which are extracellular matrix structures surrounding GABAergic neurons in the cortex, as markers for synaptic plasticity, based on their roles in closing the critical period and plasticity in the developing visual cortex. Using systematic whole brain analysis, we found a decrease in all perineuronal net expression in CDKL5 deficient male mice at P30, compared to WT controls. However, in the V1B subregion, we found an increase in high intensity PNN expression in CDKL5 deficient mice compared to the WT, suggesting subregion specific differences in closure of the critical period. These results highlight the need for systematic analysis of PNN expression in a hemisphere-specific, subregion specific manner.

Leveraging LiDAR to Assess Solar Suitability in Energy Poverty Alleviation

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Major(s): Geography

Energy poverty in the United States is the cost of energy and the strain that this cost places on citizens, especially those living in low-income areas. According to the 2010 census, there were approximately 60,000 people living in poverty in Knox County. The installation and use of solar panels in low-income neighborhoods has the potential to drastically reduce the portion of monthly income that is going towards the procurement of electricity and could play a significant role in alleviating some of the economic stresses felt by families living in poverty. The purpose of this project is to pinpoint census block groups containing houses that would most greatly benefit from the installation of solar panels. We conduct this analysis by taking low-income census block groups; and, using remote sensing, analyze the polygons and corresponding roof angles to determine which block groups will be most positively affected by the installation of solar panels. The results of this analysis measure the impact the installation of solar panels has on low-income block groups. This alleviation could have impacts that range from increasing the quality of life for a large portion of Knox County, to the integration of natural, renewable resources in local and federal policies.

The Role of Demand Characteristics in Facial Feedback Experiments

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According to psychological theories of emotional embodiment, posing facial expressions of emotion can cause people to re-experience those emotions (e.g., posing a happy expression can cause people to feel happy). However, one concern is that these emotional changes are caused by placebo effects. To investigate this possibility, we conducted an experiment where we manipulated participants' expectations about the effects of posed facial expressions on emotion. Participants were either (a) told that their facial poses would influence their emotions, (b) told that their facial poses would not influence their emotions, or (c) not provided with any information about the expected effects of facial poses. Afterward, participants posed happy, angry, and neutral expressions and completed an emotion experience questionnaire after each pose. Regardless of participants' expectations about the effects of posed facial expressions on emotion, we found that posing happy expressions made them feel happier and posing angry expressions made them feel angrier. These results suggest that emotional embodiment effects are not driven by placebo expectations. Additionally, we found that participants that were told the emotional effect is true reported the most happiness after smiling and anger after scowling. Conversely, participants told that the effect is not true reported the least happiness after smiling and anger after scowling.

Novel Insights into the Role of Soluble Epoxide Hydrolase in Adipogenesis

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Obesity is a growing epidemic that presents a major health problem worldwide. The past decade has seen advances in the identification of specific factors that contribute to this condition. However, despite these strides, there is still much to be learned about the underlying mechanisms. Recent studies have shown that targeting brown adipose tissue and increasing its metabolic activity may represent a novel means to alleviate the burden of obesity and its associated disorders. The current study demonstrates that modulation of epoxy fatty acids (EpFA) metabolism in mouse primary and established white preadipocytes alters adipocytes differentiation. In addition, CRISPR/Cas9-mediated deletion of soluble epoxide hydrolase (sEH), a cytosolic enzyme which hydrolyzes EpFA into less active diols, resulted in enhanced expression of brown fat markers in white adipocytes. Similar findings were obtained using a selective sEH inhibitor 1-trifluoromethoxyphenyl-3-(1-propionylpiperidin-4-yl) urea (TPPU). Taken together, our findings suggest that sEH is a physiological modulator of adipogenesis and a potential target for the development of novel anti-obesity therapeutic strategies.

Synthesis of a New Lead-Based Complex

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Perovskite is a mineral with a formula, $CaTiO_3$ (calcium titanium oxide). Materials having same structure, are also called perovskites. Lead-based perovskites have been used for solar cell construction. Perovskites demonstrate competitive performance when compared to traditional silicon-based solar cells. However, they have limitation in their stability. Different factors have been identified for potential stability problems. Structure leads to functionality. Therefore, structural aspects of lead-based perovskites are being studied to determine if perovskite structure is necessary for photovoltaic effect. In order to answer this question, the cation in the lead-based perovskite material has been replaced. Instead of usual methyl ammonium cation, triethylammonium bromide and methyl triphenyl phosphonium bromide are used. Solvothermal method was used for the synthesis of these materials. After synthesis, the products were separated by triturating the reaction mixture with a volatile organic solvent. Suitable crystalline sample was grown from solvent diffusion method. Structure of the compound was determined by single crystal X-ray crystallography. Infrared Spectroscopy data has been collected. Visual photoluminescence properties were observed by irradiating with UV light of 365 nm wavelength. Fluorescence spectroscopy and ultraviolet visible spectrophotometry are also being used to determine luminescent and absorption properties respectively. Triethylammonium cation complex shows a reddish color glow and methyl triphenyl phosphonium cation complex produces a bright yellow glow. Crystal structure determination revealed the structural change compared to perovskite structure. It was found that the size of the cation controls the perovskite structure. Larger cations rupture this structure. Conversely, lead is toxic. So a tin-based perovskite structure is also being studied using similar reaction conditions.

A Genetic Approach to Antibiotic Discovery from Bacteria

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Major(s): Biochemistry.

The soil bacteria Streptomyces is known for its ability to produce specialized metabolites that are commonly used in medicine as antibiotics. These previously discovered antibiotics represent only a fraction of the specialized metabolites produced by the genus Streptomyces. Discovery of new antibiotics from this genus is historically difficult due to the low production of specialized metabolites in laboratory conditions and the lack of isolation and detection tools. To combat this problem, we propose using CRISPR systems to target specific gene clusters in order to reduce or completely stop the production of the corresponding metabolite. Comparison of the phenotypic and metabolic analysis of the generated mutant and wildtype strains may lead us to identification of the metabolite. The results of this project will show that this genetics approach to metabolite discovery in Streptomyces will streamline this process and increase our ability to characterize biosynthetic gene clusters and novel specialized metabolites.

Conceptual Processes that Recover Thorium and Several Rare Earth Elements from Monazite Ore

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Major(s): Chemical and Biomolecular Engineering

Monazite ore is composed of several minerals including several rare earth element (REE) and thorium phosphates. Many past research projects have looked at the extraction of REE from monazite ore but have discarded the thorium phosphate compound as waste. Since thorium could be a possible fuel for state-of-the-art future nuclear reactors, this research focuses on a way to recover thorium from the monazite ore. The overall purpose of this research is to develop a conceptual recovery process that recovers thorium dioxide from monazite ore. In some parts of the world where uranium sources are limited; then, thorium could be used as an important nuclear energy source. The thorium content of monazite varies up to 20% with North American monazite ores containing about 5% thorium. The current process is scaled for a 1000 kg/hr flow of North American monazite ore. The process will start by acid leaching the ore with sulfuric acid at extreme temperatures. The products of this step will be cooled, dissolved in water and filtered so that thorium will be separated. After this filtration, the process is divided into an upper and lower process containing rare earth elements or thorium, respectively. Separate product streams of rare earth oxides and thorium oxide will be achieved as byproducts and products, respectively. The process economics of capital cost and annual operating cost will be evaluated to determine economic feasible of the process.

Acute Social Defeat-Induced Alterations of Microglia/Marcophage: Interactions with Subsequent LPS Challenge

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Major(s): Neuroscience, Microbiology

Social stress is one of the most common stressors experienced by humans, is a risk factor for mood and anxiety disorders, and is associated with elevated neuroinflammation. Microglia are a type of innate immune cell that reside in the central nervous system, where they function as macrophages, engulfing pathogens and cell debris. Ionized calcium binding adapter molecule 1 (Iba-1) is a protein that is specific to microglia and macrophages and is upregulated during activation of these cells. One approach for investigating neuroinflammatory responses in laboratory animals is to treat them with lipopolysaccharide (LPS), which is a component of Gram-negative bacterial cell walls that functions as an endotoxin and invokes a strong immune response. In this study we used a Syrian hamster model because hamsters show elevated fear and anxiety following acute social defeat (ASD) stress, but the contribution of neuroinflammation to these behavioral changes in unknown. This study sought to determine whether ASD either alone or with systemic LPS, leads to changes in microglia morphology and Iba-1 expression, and whether or not these changes persist over time. We hypothesized that social defeat would increase Iba-1 expression in the ventromedial prefrontal cortex (vmPFC) cells and that Iba-1-positive cells would exhibit changes in morphology consistent with activated microglia. In addition, we hypothesized that ASD stress would potentiate cellular responses to LPS treatment. We found that social defeat alone is capable of inducing pro-inflammatory microglia responses in the vmPFC, and there was a significant interaction between ADS and LPS treatment indicating that animals exposed to social defeat followed by LPS injection exhibited greater Iba-1 immunoreactivity compared to others. In another experiment to address the time course of neuroinflammation following ASD, we found that the microglia showed an increased ratio of soma size to total cell size seven days after defeat, indicating that vmPFC cells remain in a pro-inflammatory state for at least a week after ASD. This research documents a role for microglia in responses to acute social stress and extends our understanding of the mechanisms underlying susceptibility to stress-related psychopathologies.

Responses of Juvenile Eastern Garter Snakes (Thamnophis sirtalis) to Own, Conspecific, and Clean Odors

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Major(s): Neuroscience, Microbiology

Chemical cues and signals are essential components in a wide range of behaviors among squamate reptiles, especially snakes. Tongue Flicking allows chemical cues to be transferred to the vomeronasal organ, where perception is activated. Past studies have suggested that several species of snakes can discriminate chemicals deposited by themselves, conspecifics, or clean controls. Is this a measure of self-recognition? Most studies have used visual recognition, using a mirror. However, animals relying on different types of cues may use non-visual means of self-recognition. Calculating the frequency of tongue flicking and the amount of locomotion are measures of behavior and arousal that can be quantitatively assessed in snakes. We conducted a study on 24 juvenile eastern Garter snakes, Thamnophis sirtalis, from a single litter, raised under laboratory conditions. We manipulated substrate chemicals within the cages of juveniles and measured the frequency of tongue flicking and general activity. Each snake was tested under 4 conditions: one's own odor, a same-sex littermate fed the same diet as the target (earthworms or fish), a same-sex littermate fed on a different diet than the target , or a clean cage liner substrate. Trials lasted 30 minutes and were video recorded from an aerial POV observers counted both tongue flicks and activity events for each segment. Tongue flicks were recorded with a manual counter and activity was quantified by measuring numbers of grid crossings. We predicted that tongue flick and movement frequencies will be the lowest under the own odor conditions. Tongue flick and movement frequencies were also predicted to be higher with substrates from litter mates fed a different diet than littermates with same diets. We found that the animals tested showed consistently less arousal in a cage with their own smell than a clean one (control). We also identified an interesting sex difference between males and females in responses to conspecifics with varying diets. This work will help shed light on the abilities of squamate reptiles to chemically discriminate among individuals and perhaps their own identity.

19F-NMR as a Tool for Identifying Potential Inhibitors of the Antibiotic-Resistant Enzyme, R67 Dihydrofolate Reductase

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Folate (vitamin B9) metabolism is a crucial step in processes such as nucleotide biosynthesis and methylation. Because of this, inhibiting the folate pathway has been an important strategy in treating neoplastic disease and bacterial infections. Dihydrofolate reductase (DHFR) is a major target in this pathway as it catalyzes the reduction of dihydrofolate (DHF) to the biologically active tetrahydrofolate (THF). Historically, the antibiotic trimethoprim (TMP) has targeted the E. coli chromosomal DHFR; however, TMP resistance has become widespread via the introduction of the plasmid-encoded R67 DHFR which is structurally and catalytically distinct from its chromosomal counterpart. Currently, there are no FDA approved inhibitors of R67 DHFR. As bacteria continue to develop resistance to various drugs and as infections become harder to treat, the development of new drugs to inhibit both novel targets and known antibiotic-resistant enzymes will become increasingly necessary.

19F-NMR is an efficient method to screen for potential R67 DHFR inhibitors. In order to use 19F-NMR for drug screening, exogenous fluoroindole rings were incorporated into tryptophans by the host cell and ultimately into R67 DHFR during expression of the protein. The apo-enzyme, the enzyme bound to DHF and NADP+, and the enzyme bound to inhibitors produce distinct 19F-NMR chemical shifts because of changes in the local chemical environment. We performed in vitro EC50 assays on multiple molecules in order to identify drugs that inhibit R67 DHFR. We found that acetylsalicylic acid, naproxen, hippuric acid, and phenformin inhibit the enzyme. Ongoing 19F-NMR experiments with these and other drugs suggest that only inhibitors that bind near the pterin subsite can be observed with this method. 19F-NMR is able to be used in vivo, and fluorotryptophan incorporation into R67 DHFR provides a framework for future high-throughput screening to identify drugs that target this antibiotic-resistant enzyme in its natural, crowded environment.

Insulators Interact with Early DNA Damage Response Components to Aid Chromosomal Stability

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Chromosome structure and organization is essential for the proper functioning of cells. Insulators are architectural components of the genome that perform critical functions to aid in chromosomal organization and ultimately transcriptional regulation. Insulators function by binding specific DNA sites, facilitating proper genome folding, which is required for the regulation of gene expression. They are also involved in epigenetic pathways, often preventing the spread of heterochromatin. Recently, data from our lab has uncovered a correlation between insulator proteins and components of the DNA damage response. Previous work in our laboratory has demonstrated that actively dividing neural stem cells lacking the insulator protein Su(Hw) display chromosomal aberrations. Here, we further explore this correlation and found that insulators play a potential role in the mechanisms of DNA repair and genome stability. Our data show that, following irradiation with ultraviolet light, the amount of insulator protein bound to DNA increases. Furthermore, our results show that insulators colocalize with γH2Av, which is an early component in the signaling pathway activated during the DNA damage response. Further testing revealed that interactions between different insulator proteins is required for their colocalization with γH2Av. These findings suggest the presence of a pathway where insulator proteins participate in DNA damage repair. Our results suggest that the two kinases involved in the early activation of the DNA damage response, ATR and ATM, may also play roles in this pathway. In a double mutant line for mei-41^{D5}; tefu$^{atm\text{-}3}$, Su(Hw) levels do not significantly change following ultraviolet irradiation. This suggests that insulator participation in the DNA damage response involves either one or both kinases. The mechanisms behind the interactions between insulator proteins and the DNA damage response are still unknown, and additional experiments are needed.

A Comparative Analysis of High Entropy Ceramics Prepared Via Steric Entrapment and Solid State Synthesis Methods: Structure, Homogeneity, and Grain Size

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This project was designed to compare two different synthesis methods for crystals: Solid-State Synthesis and Steric Entrapment Synthesis. The criteria for comparison are crystal structure, homogeneity, and particle size. The materials studied include two high-entropy oxides: the sesquioxide $(Ce,Pr,Eu,Tb,Y)_2O_3$ and the aluminum perovskite $(Ce,Pr,Eu,Tb,Y)AlO_3$, and two low-entropy oxides: the garnet $Y_3Al_5O_{12}$ and aluminum perovskite $YAlO_3$. These multicomponent compositions are high-entropy because having five or more elements in equimolar amounts increases the configurational entropy and favors the formation of a single phase. The interest in high entropy materials comes from improved functional properties that are not seen in the low entropy oxides. Solid-state synthesis is known to create a single phase in $YAlO_3$, so it is included in the study as a control. Through our research, we learned that the Steric Entrapment synthesis method more reliably produces single-phase ceramics, produces chemical homogeneity, and results in smaller particles. Although the Solid-State method has fewer steps, it requires a longer sintering time and higher temperatures and fails in producing single phase ceramics for some of the low- or high-entropy compositions such as $Y_3Al_5O_{12}$. We also learned that Steric Entrapment and Solid-State methods can form differing results for the same composition. Because Steric Entrapment is more reliable in producing chemically homogeneous single-phase crystals with smaller particles in a shorter amount of time and at lower temperatures, it is therefore the more effective method. The results of this research will be used to inform future precursor synthesis parameters for use in future crystal growth via the Micro-Pulling Down method.

Mapping Food and Infrastructure in Early Medieval Rome: A Critical Analysis of the Fourth Century Forum Boarium

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Major(s): Architecture. Minor(s): Sustainability

Amid the many agendas surrounding archaeological discoveries within the city of Rome, the Forum Boarium has been an area of interest and topic of discourse among scholars. Besides being the present-day location of a popular tourist attraction, it is speculated that the annona, a free food initiative first enacted in the early Roman Republic, was active in the Forum Boarium area into the fourth-century CE if not longer given certain inscriptions found in and around the medieval church of Santa Maria in Cosmedin. The research presentation connects the organization of the annona and the infrastructure of the Forum Boarium, seen in the documentation of streets, bridges, and monuments along the Tiber River and extending towards the Forum Holitorium and Circus Maximus. Specifically, maps of the fourth-century Forum Boarium, derived from Rodolfo Lanciani's 1901 book, Forma Urbis Romae, and Filippo Coarelli's 1988 work, Il Foro Boario, can be created to show the relationships between the imperial distribution of free food using a market and a portico and the other infrastructure that served such distribution including river ports and warehouses. Furthermore, the research attempts to document the church of Santa Maria in Cosmedin through conveying the infrastructure in diagrams, imagery, and writing. By filling in the gaps in our knowledge about Roman topography and the distribution of free food during the fourth century CE, the research seeks the main goal of setting the stage for further exploration about the fourth-century infrastructure in the nearby district between the Arcus Constantini and the Circus Maximus.

On the Outside Looking In: How our Differently Abled and Immigrant Communities Face the Trials and Tribulations of American Society

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Major(s): Language World Business-Hispanic Studies and Global Studies. Minor(s): Latin American & Caribbean Studies and International Agriculture & Natural Resources

My independent research project, completed in the fall of my senior year, was the final module of the Spanish Service Learning Program at the University of Tennessee, Knoxville. Growing up in San Diego, California I learned to speak Spanish and was able to converse with many of my immigrant classmates about their experiences living life as an immigrant in the United States. Throughout high school and my time in university I spent countless hours working with the immigrant populations in San Diego and Knoxville, by teaching English, translating for lawyers during deportation crises, assisting with tax records, assessing available medical care for undocumented immigrants, and more. My 10 page research paper discusses the similarities that our immigrant population and our disabled population are faced with daily; in the education system, the social networking system, governmental stigmas, and more. My younger brother is autistic, which led me to working and volunteering for disability inclusion in various cities. The combination of my experience in working with immigrant and differently abled communities brought me to create my final research paper in comparing what challenges these two groups face and how they combat these difficulties on a daily basis.

Status-dependent Differences in Acute Stress-induced Neuroinflammation and Degeneration in the Hamster vmPFC

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Major(s): Neuroscience

Although 90% of humans experience traumatic stress, only 10% develop psychopathologies such as PTSD. Social status influences stress reactivity such that social dominance can promote stress resilience, representing an environmental factor that buffers individuals from maladaptive responses to stress. The negative consequences of severe and chronic stress include neuroinflammation, which is associated with neuronal degeneration and oxidative stress. We use a Syrian hamster model of social defeat to investigate status-dependent differences in susceptibility to acute social stress. We hypothesized that neuroinflammation mediates susceptibility to a social stressor in a status-dependent manner such that dominant animals show an increased protective neuroinflammatory response compared to subordinates. We paired hamsters for 14 days in daily social encounters to allow them to form a social hierarchy with one another. After dominance relationships were established, the animals were socially defeated in a resident intruder model. Twenty-four hours later, the animals were tested for stress-related behavior using a conditioned defeat test and social interaction test. Brains were collected and analyzed for markers of neuro -inflammation and –degeneration in the ventral medial prefrontal cortex. We found that dominants were more resistant to stress-induced changes in neuroinflammation compared to subordinates, but they still showed increased markers of tissue degeneration similar to subordinates. We also found that while acute defeat stress decreased synaptic density in the ventral medial prefrontal cortex, there were no status-dependent changes in synaptophysin. After CD testing, we found that there was a significant increase in defensive behavior among subordinates in comparison to dominants, which suggests that neuroinflammation corresponds with increased social avoidance behavior. Altogether, this study provides a neurobiological basis for the development of novel interventions that target neuroinflammation for the treatment of traumatic stress exposure.

Oak regeneration after Chimney Tops II fire is influenced by pine seedling neighbors but not fire-altered soil microbes

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Increased global wildland fire frequency has increased the need to understand community dynamics that could change forest composition and how ecosystems function after fires. Following the Chimney Tops II fire in the Great Smoky Mountains National Park, an overwhelming abundance of pine seedlings populated areas disturbed by fire even though historically these areas have been oak-dominated. Using nine GSMNP sites across a patchy burn gradient identified as unburned, low-moderately burned, and high burned areas, the purpose of this study was to determine the effect of the soil microbiome as well as other species (pine) on oak seedling success following fire disturbance. Because a range of biotic interactions, including competitive interactions and soil microbiomes, can alter seedling performance we examined the following hypotheses: 1) Burn severity affects the soil microbiome, 2) fire-induced changes to the microbiome influence oak seedling success, 3) there will be interactive effects when oak seedlings are grown with pine and fire-affected microbiomes, reducing oak performance. We found that while fire does alter soil microbiomes across the fire gradient, the fire-altered microbiome does not alter growth and physiological traits of oak seedlings. Surprisingly, oak seedlings are more successful with pine neighbors than oak neighbors, and there are no interactive effects of soil microbes and plant communities on oak seedling success. Overall, this research aimed to understand the effect of soil microbes and competition on oak seedling success in fire disturbed areas; results indicate that oak seedling performance may not be altered by fire which may indicate future forest composition and be used to inform management strategies within the Great Smoky Mountains National Park.

Comparing HPV Vaccination Rates between Rural and Urban Female Undergraduate Students at the University of Tennessee, Knoxville

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Human papillomavirus (HPV) is a common and highly transmissible infection that spreads through sexual contact. Since 2006, the CDC has recommended HPV vaccination for females aged 11-26 years old, but in 2015, only 40% of women aged 19-26 years reported receiving at least one dose of the HPV vaccine. United States rural residents experience HPV-related cancer incidence and mortality at higher rates than their urban counterparts. An important reason for this disparity is that the rate of HPV vaccination is lower among rural residents. The aim of this study was to determine if there is a disparity in HPV vaccine uptake between female college students in the Southeast from rural and urban areas and to identify factors that are associated with HPV vaccine uptake. A self-selected sample of female undergraduate students completed an online survey. Survey questions assessed personal demographics, sexual history, health care access, uptake of the HPV vaccine, and participant opinions regarding HPV and the HPV vaccine. Of 12,027 eligible female undergraduate students, 1,139 completed the survey. Respondents identified as Freshmen (26%), Sophomores (22%), Juniors (21%), and Seniors (31%), and 25% reported their hometown as rural, 63% suburban, 10% urban, and 2% don't know. About 71% of those who identified their hometown as rural received at least one HPV vaccine, compared to 72% of suburban residents and 69% of urban residents. Of the participants that reported receiving the HPV vaccine, 71% of rural residents, 75% of suburban residents, and 70% of urban residents received the entire course of the vaccine. Unlike previous research, findings from this study suggest that female college students from rural areas have a higher uptake of the HPV vaccine than their urban counterparts. Education about the importance of the HPV vaccine needs to continue to target college students from all areas.

Sullk 'Til You Hulk: An Examination Of The Effects Of Angry Facial Expression Poses On Emotional Experience

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According to psychological theories of emotional embodiment, posing facial expressions of emotion can cause people to re-experience those emotions. In my research, I focused on three questions about the effects of posed angry expressions on feelings of anger: (1) Can posing angry expressions create feelings of anger, or can it only amplify existing angry feelings? (2) Do angry expressions need to closely resemble natural expressions of anger in order to influence emotion? (3) Does posing angry expressions influence feelings of anger even when participants are unaware of the emotional connection? To address these questions, I (a) combined and re-analyzed the results of 15 studies via meta-analysis and (b) conducted an experiment. A meta-analysis of 15 studies provided preliminary evidence that posing angry expressions can both initiate and amplify feelings of anger. In a follow up experiment, participants posed angry and neutral facial expressions and then self-reported how angry they felt. To manipulate how natural the posed angry expressions were, participants were instructed to either (a) mimic the expressions of angry actors (more natural pose), or (b) move their eyebrows down and in towards their nose (less natural pose). To examine whether angry poses could initiate and/or modulate angry feelings, some participants viewed angering images during the poses. Results provided evidence that angry poses can create, but not amplify, feelings of anger. Angry poses could create feelings of anger regardless of whether participants engaged in natural or unnatural anger poses. Furthermore, effects persisted even when participants were unaware of this emotional connection.

Nashville-basin tornadoes: using storm types to elucidate the local climatology and forecast challenges

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Early 3 March 2020 was a devastating morning for many middle Tennessee residents. A strong EF-3 tornado tore through Nashville at 65 mph, and another EF-4 killed 18 in Baxter and Cookeville alone. Studies show that Tennessee residents are especially vulnerable to nighttime tornadoes. This particular study tries to better understand local forecasting challenges by looking at the types of storms that produce tornadoes. Storm types, also known as convective modes, categorize tornado-producing storms into categories by length, shape, multiplicity, and intensity. Distinguishing storms by these modes allows for a broader understanding of their occurrences and impacts. This study specifically evaluates forecasting success metrics, including probability of detection, false alarm ratio, and average lead time, in the Nashville basin for four convective modes: cells in lines, cells in cluster, discrete supercells, and quasi-linear convective systems. The results suggest that false alarms and lead times may be influenced by convective mode, nocturnality, and multi-tornado events, such as the nocturnal March storm that produced 10 destructive tornadoes.

At First Glance: TWRA Winter Trout Stocking at Bicentennial Greenbelt Park, Maryville, TN

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Recently, the Tennessee Wildlife Resources Agency (TWRA) has expanded their winter trout stocking program into Region IV to increase recruitment, retention, and reactivation of anglers. Historically, Region IV has not heavily participated in a winter trout stocking program due to its abundant trout fisheries. However, high, unpredictable flows and cold temperatures leave the region with few winter trout fishing opportunities. Therefore, this past winter (December 2019 - February 2020), Rainbow Trout Oncorhynchus mykiss were stocked into Pistol Creek and Greenbelt Lake of Bicentennial Greenbelt Park, Maryville, TN. A roving creel survey was conducted to evaluate the stocking program and compare creel statistics between Greenbelt Lake and Pistol Creek. The objective of the creel survey was to determine if TWRA should continue stocking these locations and, if so, at what rate. Angler use at Greenbelt Lake (1,754 h) was higher than Pistol Creek (1,124 h), however catch rates were higher for Pistol Creek (1.41 fish/h) than Greenbelt Lake (0.25 fish/h). Angler satisfaction was higher for Pistol Creek (76%) than Greenbelt Lake (71%). Comparisons were made to other Tennessee winter trout stocking locations to determine appropriate stocking rates. Greenbelt Lake was stocked at 125 fish/ha, which is lower than other Tennessee lakes stocked in the winter program. Therefore, based on angler use, satisfaction, catch rates across the state we recommend continued stocking at both locations while keeping the current stocking rate at Pistol Creek and raising Greenbelt Lake stocking rate.

Impact of education on health care providers' knowledge and attitude towards prenatal probiotics

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The human microbiome is the community of 100+ trillion microorganisms dwelling in & on the body, impacting the function of multiple organ systems. Dysbiosis refers to a disruption in the microbiome. Recent studies suggest a connection between maternal gut dysbiosis and excessive weight gain, newborn development of atopic diseases, pre-term birth, gestational diabetes, and pre-eclampsia. Health Care Providers (HCPs) play a major role in educating their clients on methods to promote positive health outcomes, but the literature lacks information about HCPs current knowledge level of the microbiome or their opinions towards recommending probiotics prenatally in the clinical setting. The purpose of this quasi-experimental research project is to determine whether educating current and prospective HCPs' alters their knowledge level and/or opinions regarding recommending prenatal probiotics clinically. Sample (n=8) was determined via convenience sampling of current or prospective HCPs in East Tennessee whose clientele includes pregnant women. The project involved a single-interaction online survey containing a both an educational video presentation and pre-posttest. The pre-posttests evaluated their knowledge level regarding the microbiome and probiotics and likelihood to recommend probiotics to women during pregnancy. At alpha of .05, the paired t-test & Wilcoxon Signed Ranks test results indicate a statistically significant increase in HCPs' likelihood to recommend probiotics prenatally with a large effect size following the educational video presentation ($\bar{Y}$=5.5125, sd=3.137, p<.01, d=1.63, ω2 = .718) but no statistically significant difference in HCPs' mean knowledge based on exam scores ($\bar{Y}$=.75, sd=1.282, p>.05, d=.585, ω2 = .179). Educating HCPs through the use of a literature-based video, student crafted presentation on the microbiome & probiotic use significantly increased HCP's likelihood to recommend probiotics prenatally. Future recommendations include continuing to disseminate research literature by repeating this study with larger, more varied samples and developing a more reliable, valid T/F test to accurately measure HCPs' knowledge levels.

Autoethnographic Implications for Research and Research Teams Focusing on and/or Working with Trans-Identified Individuals

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Research examining the health experiences and possible health disparities that affect transgender-identified individuals in the U.S. is still in its nascent stages. As endeavors to better understand the impacts of systemic oppression against trans people gain more attention, it is necessary to closely examine the methodologies of investigators, lest systemic oppressions be replicated. I engage in such an analysis via an autoethnography completed during my time working with a multi-site study investigating the associations between sociopolitical context and stress and resilience among transgender and gender expansive adults across varying contexts of the U.S. and the Canadian province of Manitoba. I identify my identity as a nonbinary researcher working on a study that is unique in also being led by trans-identified primary investigators as what elevates this autoethnography above reflection. After coding the autoethnography for reoccurring themes, I indicate several key conclusions. The role of trans-identified researchers in trans-focused researcher is indispensable due to the specialized knowledge relegated to both the social category of the 'trans community' and geographically specific trans communities. Furthermore, there are unique emotional, physical, and gender dysphoric impacts that trans-identified participants and researchers may face, when not given adequate attention. This autoethnography indicates that research focused on transgender populations and those researchers looking to work with transgender individuals must be equipped with not only standardized and specialized methodological procedures and skills, but also specific foundational information about transgender issues, and specific understanding of the challenges research activities may present to transgender researchers and participants. I propose the basic findings indicated herein can serve as the cornerstone for drafting and sharing such specialized information.

The Role of Plant Hormone Auxin in Leaf Elongation

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Plants require auxin, a growth-regulating hormone, to develop leaves. Leaves are initiated when auxin is transported to an area of high concentration in the meristem. Auxin accumulation is influenced by kinases called ERECTA family receptors (ERfs) in an unknown manner. ERf receptors are localized in the plasma membrane, and they are activated by Epidermal Pattering Factor-Like (EPFL) ligands. Whether the ERf receptors are nonfunctional or EPFL 1, 2, 4, and 6 ligands are absent, the number of leaf primordia is drastically reduced and those primordia that form are short. In this project, we measured the height of leaf primordia in Arabidopsis Thaliana mutants lacking different combinations of EPFLs, investigating which EPFLs were most critical in leaf elongation. We discovered that the epfl 1,2 mutant had the shortest leaf primordia, suggesting that EPFL 1 and 2 are the most important for regulating leaf elongation. Auxin is important for leaf growth. This led us to investigate how altering auxin concentrations and transport would affect leaf elongation in EPFL mutants. Wild-type and mutant seedlings were treated exogenously with auxin, an inhibitor of auxin biosynthesis, and with an inhibitor of auxin transport. Altered responses of mutants to described treatments allowed us to build the model of auxin's role in leaf elongation.

What are College Student's Opinions on Housing as a Human Right?

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More than 500,000 American residents lack stable housing, and little formal research has been explored whether Americans view housing as a basic right. Thus, this study asked, "What are college students' opinions on housing as a human right?" To answer the research question, the researcher conducted a mixed-methods study approved by the Institutional Review Board. For the qualitative component, the researcher recruited students from her social networks to participate in a focus group (n=5). For the quantitative component, the researcher sought to maximize variability and representation by recruiting participants in University of Tennessee Anthropology, Social Work and French classes, the student union and a dining establishment on the engineering campus. Quantitative data from a total sample of 106 were collected in the form of a QuestionPro survey. Qualitative data were analyzed with basic content analysis; quantitative data were analyzed using SPSS. Focus group results showed that participants largely believed that housing should be a human right, but it is currently treated as a privilege in America. Participants debated whether guaranteed free housing may disincentivize work. Survey results found that 73.7% of respondents identified housing as a right in the U.S., compared to 89.5% who identified voting as a right and 68.4% who identified healthcare as a right. The 26.3% who did not identify housing were more often white and science or engineering majors. The higher percentage identifying housing as a right compared to healthcare might suggest that the right to housing is an important issue for young adults.

Special Kids: An Analysis of Autism on Contemporary Television

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In the past decade, there has been a boom in representations of varied identities on scripted entertainment television, with cable and network stations and streaming services greenlighting shows with creators and writing staffs of diverse racial, gender, socioeconomic, sexual, and ability backgrounds. Fortunately, this includes an increase of characters with mental illness and physical and intellectual disabilities, which had almost no positive representation in the media before the twenty-first century. There has particularly been an increase in television representations of autism spectrum disorders, which has coincided with the reframing of autism in the DSM-5 from a set of related disorders to a spectrum of characteristics that vary widely from one person to the next. As the popular saying in the autistic community goes, "If you've met one person with autism, you've met one person with autism." Exposure to these characters has increased public awareness of what autism actually looks like, but their characteristics are still very narrow and do not represent the full range of people with autism and what their experiences with the condition are actually like. Screen representations of autistic people are still overwhelmingly male, white, and traditionally "genius," leaving a large gap in representation for those who do not fit this description. In this thesis, I explore historic representations of autism on screen, examine how television representations of autism line up with DSM-5 criteria for autism spectrum disorders, and identify where there are gaps in holistically presenting what people with autism look like and how these can negatively affect public understanding of the condition. I argue that it is vital that we present and give our attention to sufficiently diverse characters as a means of education and public understanding of what the people who are represented by them are actually like.

Enhancing Polyketide Synthase Pathways through Cofactor Modification

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Polyketides are known as a subset of building blocks used by bacteria to synthesize various antibiotics and therapeutics through biochemical enzyme assembly lines. These pathways can be biologically modified to create final products with specific stereochemistry and functional groups. These polyketide synthases are composed of modules, with each module made up of smaller catalytic domains that each perform a specific function to the incoming substrate that's passed along through each of the domains. Such domains include Ketoreductases (KRs), Ketosynthases (KS), and Oxidoreductases, entailing catalytic functions that include both oxidation and reduction reactions. Most anabolic enzymes require a cofactor, commonly NADPH (Nicotinamide Adenine Dinucleotide Phosphate) to perform their designated function on a substrate, however this specific cofactor has shown to be more expensive and less efficient. NADH (Nicotinamide adenine dinucleotide) is a cofactor that is much cheaper and has potential to be used as the primary cofactor in Polyketide Synthases. Our project involves using the BL21 E. Coli strain as the host for 6 unique KR's for observation and comparison of reaction kinetics using each NADH and NADPH in the synthesis. The primary substrate of our experiment is 3-Oxopentanoyl-N-Acetylcysteamine Thioester, which is synthesized from through the reaction of Acetylated Meldrum's Acid and N-Acetyl cysteamine. We hope to engineer a more efficient and feasible route to creating polyketides through the success of this project.

The Cost of Big Data: Evaluating the Effects of the European Union's General Data Protection Regulation

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In the 1990's the World Wide Web was created, drastically changing the way we do business, communicate, and live our lives. Ten years later in the early 2000's the dot com boom happened, and several years later, new technology giants emerged—like Amazon, Google, and Facebook. From this, we now face "big data" that promises to solve world problems, but has the potential to create turmoil and malfeasance. My research examines the impact of the General Data Protection Regulation (GDPR) enacted in the EU on firm value using Tobin's Q. Using regression analyses, I observe that Tobin's Q increases post GDPR for firms required to conform to the regulation. Moreover, I find that certain industries see more of an increase in firm value (e.g., Technology Services and Research & Consulting Services) compared to other industries. The implications of this analyses suggest that the GDPR enacted in the EU to ensure data privacy and protection increased consumer trust in business and positively impacted firm value.

Architecture's Narratives

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"Once Upon a Time" is the iconic start to many stories, which impact the discourses of humanity. Everyone can relate to this simple phrase or can recall special memories from their childhood. Storytelling creates emotional bonds and captivates audiences of all ages to understand the past, present, and future.

Stories create a special world around us providing for a new outlook or alter realm. Many people are familiar with this spatial construct but might not realize or comprehend the careful architectural moment it may represent. This spatial realm or imaginary story is unique to each individual, allowing for a new exploration of reality. Architects are natural storytellers where narratives guide or convey stories of the past, present or future. The design process unfolds like the narrative or the plot of a story, determining the usage to help educate the "reader" or audience, while conveying the design. The story begins with the clients and the architect's interpretation of how to effectively communicate the story's setting.

Architectural designs are just like the great magical stories heard from our parents or media from our childhood days. We yearn for it and we never tire to constantly hear the story over and over again; captivating a realm of new wonders. This is what we as architects aspire to – to captivate the stories of our design as reading chapters of a book or a story.

Architecture's Narratives is a thesis set at the intersection of Narrative and Architecture. The collection of spatial narratives showcases how stories and architecture are one in the same. This thesis investigates ways of immersive experiences through architecture storytelling and their effects on the built environment. The collection will become an immersive architecture installation centered around the patron's exploration of spatial narratives with Architecture as the narrator.

Medical Illustrations for Improving Health Literacy

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Major(s): College Scholars: Biomedical Visualization and Health Literacy. Minor(s): Biological Sciences

Health literacy is most commonly described as the ability of an individual to obtain, comprehend, and utilize information related to their health. Including the ability to read, write, speak, and display numeracy in medical situations, rates of health literacy impact the ability of an individual to navigate the healthcare system and make informed decisions. As reported by the National Assessment of Adult Literacy, only 12% of individuals have the proficiency to understand and manage their health. This research identifies problems existing in health literacy and doctor-patient communication, with an emphasis on consumer health information. It explores resources used for science and medical education, both for the patient and the health care professional. One of these resources, medical illustration, is analyzed to determine the role it plays in explaining biomedical concepts and research. A creative project has been created to encompass the research. The end result of this project is a series of biomedical visualization-based materials for consumer health education. Each project utilizes a different medium and focuses on one of the United States' most prevalent chronic diseases: diabetes, kidney disease, cancer, COPD, and heart disease. All products accompanying this research are created with readability, accuracy, organization, and accessibility in mind, and they demonstrate visual communication of scientific concepts and processes.

Understanding the role of perineuronal nets in experience-dependent neural plasticity

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Social experience is known to modulate the structure and function of neural circuits, but the mechanisms underlying experience-dependent neural plasticity are not well understood. The creation of dominance hierarchy leads to changes in aggression, submission, and stress-related behavior in dominant and subordinate animals. A neurobiological factor that may contribute to status-dependent changes in behavior is perineuronal nets (PNN). Perineuronal nets are specialized extracellular structures found around neurons that contribute to synaptic stabilization and experience-dependent neuroplasticity necessary for fear memories. Syrian hamsters are a territorial and aggressive species, and individuals form dominance relationships with one another that require the formation of emotional memories. We have shown that dominant male hamsters exhibit reduced anxiety-like behavior and greater neural activity in the ventral medial prefrontal cortex (vmPFC) following a stressful event compared to subordinate animals. These findings suggest that neural plasticity in the vmPFC is associated with the stress resilience displayed by dominant hamsters. In this study, we predict that dominant hamsters will have greater PNN expression in brain regions that mediate stress resilience including the basolateral amygdala, the infralimbic and prelimbic cortices of the vmPFC, and the ventral CA1 layer of the hippocampus compared to subordinates. We allowed hamsters to form a social hierarchy with one another by pairing them together, collected their brains, and performed immunohistochemistry to visualize and quantify PNNs. Currently we are using a semiautomated method called Perineuronal Net Intensity Program for the Standardization and Quantification of ECM Analysis (Pipsqueak) to quantify optical density and number of cells surrounded by PNNs. Understanding the environmental factors influencing the expression of PNNs is beneficial because several psychopathologies that result in aberrant neuroplasticity are linked to PNN activity, such as Alzheimer's/dementia, anxiety, addiction, and some autism disorders. Potential pharmacotherapeutics could target PNNs to help treat these psychopathologies.

Investigation of cortical perineuronal net expression in rat dams

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Tactile cues are important in the regulation of prosocial and maternal behaviors in rodents and humans. Oxytocin, a hormone released during social touch in rats, is important for the manifestation of maternal behaviors such as pup gathering. Knockdown of oxytocin receptors in the dorsal raphe (DR), an area of the brain with upregulation of oxytocin postpartum, of mother rats has shown deficits in learning new maternal behaviors. Previously, this reduced plasticity has been linked to an increase in the phenotype of perineuronal nets (PNNs), which are extracellular matrix structures surrounding GABAergic interneurons, in the primary somatosensory cortex (S1), the region of the brain responsible for receiving and processing tactile sensory information. Using the rat as a model organism, we hypothesize that there is a misregulation of plasticity in the S1 of rats that have oxytocin knockdown in the DR causing higher PNN expression. We are using PNNs as a marker for experience-dependent plasticity and will present our results on the effects of oxytocin receptor knockdown on PNN expression in S1.