

Wisconsin-Upper Peninsula of Michigan Junior Science and Humanities Symposium

2021 JSHS PARTICIPANT LIST

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Judges

- Jennifer Docktor, Ph.D., Physicist
- Megan Litster, Ph.D., Biologist
- Lisa Pitot, Ph.D., Science Educator

Speakers

- Ahmad Abdel-Azim
- Lieutenant Colonel Erik Archer

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- Heidi Masters, Ph.D., Regional Director
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Jaden Quinn*
Harry Williams*
Kathleen Williams

*PosterPresenter
** OralPresenter



Join us again next year for the Wisconsin-Upper Peninsula of Michigan JSHS, January 22–23, 2022 at Treehaven in Tomahawk, WI

JSHS OBJECTIVES

- To Promote** research and experimentation in the sciences, humanities, mathematics, and engineering at the high school level.
- To Recognize** the significance of research in human affairs, and the importance of humane and ethical principles in the application of research results.
- To Search Out** talented youth and their teachers, recognize their accomplishments at symposia, and encourage their continued interest and participation in the sciences, humanities, mathematics, and engineering.
- To Expand** the horizons of research-oriented students by exposing them to opportunities in the academic, industrial, and governmental communities.
- To Increase** the number of future adults capable of conducting research and development.

The Wisconsin-Upper Michigan Junior Science and Humanities Symposium is presented annually by the University of Wisconsin-La Crosse, School of Education, and Department of Military Science in cooperation with the National Science Teachers Association and the United States Army Research Office, Office of Naval Research, and Air Office of Scientific Research.

The Symposium is one of 48 similar regional programs conducted by the National Science Teachers Association.

Outstanding students from regional symposia will be chosen to participate in the virtual 58th National Symposium, April 14–17, 2021.

Wisconsin-Upper Peninsula of Michigan Junior Science and Humanities Symposium

January 23, 2021 | A Virtual Event



Morning

- 8–8:45 a.m. Welcome to JSHS and Military Presentation by Lieutenant Colonel Erik Archer
- 8:45–9 a.m. Break
- 9–10 a.m. Oral Presentations
- 10–10:10 a.m. Break
- 10:10–11:05 a.m. Oral Presentations
- 11:05 a.m.–Noon Lunch

Afternoon

- Noon–1:30 p.m. Poster Review by Judges
- 1:30–1:45 p.m. Break
- 1:45–3:15 p.m. Poster Session for Participants
- 3:15–4 p.m. Break and JSHS Survey
- 4–4:30 p.m. JSHS Alumni Presentation by Ahmad Abdel-Azim
- 4:30–5 p.m. Awards Ceremony

www.uwlax.edu/ex/JSHS

Sponsored by the National Science Teachers Association and the U.S. Armed Forces;
Co-sponsored by the University of Wisconsin-La Crosse

Oral Presentations

ROHAN ANNE University School of Milwaukee

The Potential Pathophysiological Role of STING in the Development of Hypertensive and Diabetic Nephropathy

Hypertension has been considered a pandemic disease affecting various age populations. Approximately 75 million American adults (32%) suffer from hypertension. Having hypertension puts one at a risk for heart attack and stroke, which are the leading causes of death in the world today. High salt diet, obesity, excess consumption of alcohol and tobacco products, and gender are all well established risk factors for hypertension. Males are more prone to develop hypertension than females until approximately the age of 64 years of age . The bidirectional/ tri-directional impact of kidney nephropathy and hypertension has been a major area of study for many years. It has been shown that recruitment of inflammatory cells in the kidney plays an important role in the pathogenesis of renal damage and development of hypertension. cGAS (cyclic AMP-GMP synthase) – STING (stimulator of interferon gene pathway) is a newly discovered pathway involved in innate immunity. The present study investigates the hypothesis that the activation of the cGAS-STING pathway causes and/or promotes human auto- inflammatory disease, therefore inhibition of the cGAS-STING pathway could potentially decrease levels of hypertension and subsequent diseases caused by hypertensive stress. 8 weeks old salt sensitive (SS) rats were kept on 4% NaCl diet for 3 weeks. The kidneys were isolated and stored in -80 °C freezer. The present experiment tested differential STING, IRF3 and TBK1 expression among males and females fed on high salt diet, along with rats with type 2 diabetes. In addition, histological experimentation was done on kidneys of Male PKD (Polycystic Kidney Disease) to test for the expression of STING. Results showed approximately 2 fold increase in STING expression in male group compared to the female. The results for the expression of IRF3 and TBK1 show similar increased expression levels in males fed on a 4.0% high NaCl diet compared to their female counterparts fed on the same diet. Additionally Histological imaging show STING expression in the kidneys of rats suffering from polycystic kidney disease (PKD). Additionally to further investigate the hypothesis, rats were injected with STING inhibitor CS-176 to test levels of hypertension before and after inhibition of the STING pathway. Results show an increased spike in hypertension after the addition of CS-176, these results are the opposite results than predicted in the original hypothesis. In addition, Microalbuminuria and electrolyte analysis was performed on SS rats on high salt diet (4% NaCl) for one week and then very high salt diet (8%) for another week and were treated with STING inhibitor CS-176. The total findings from this study show that the cGASSTING pathway could play a major role in the development of hypertensive nephropathy, as well as potentially providing additional insight into the sexual dimorphism of the pathology of the development of hypertension in males and females. Further research regarding STING’s affect on hypertensive nephropathy could be beneficial in decreasing the morbidity and mortality of these diseases.

Poster Presentations

HANNAH BERTRAND Verona Area High School

Encoding Using the Loci Method vs. Stimuli Method in Geriatric Patients to Determine Memory Formation and Retention

Much of the population for the older generation have problems encoding new memories and retaining the ones they already have. Based on multiple cognitive psychology studies on memory improvement, My study analyzes whether or not stimuli is better for retaining information, or if the loci method is. The loci method is a memorization technique that involves inputting new information or objects in specific locations that are visually encoded for the particular individual. Stimuli consists of anything new or exciting, however it’s often encoded for longer as episodic memory. Both methods will utilize semantic information, recall, as well as visual memory, however what this test will determine is if my hypothesis is true: stimuli or using the loci method can enforce the patients' memory, and therefore reduce their rate of forgetting new information. These methods could be used as an alternative to normal or regular memorization techniques, and implemented in order to prevent memory deterioration for people suffering from dementia, alzheimers or other memory impairment.

JENNA BEAUDOIN Lake Linden High School

Comparison of Growing and Harvesting Microgreens in Hydroponic and Aquaponic Systems for Use in Restaurants and Produce Markets

The objective of this project was to compare the growth of microgreens using aquaponics or hydroponics. This study was completed because a local farm and business expressed interest in setting up a system where customers could select their own microgreens. The systems were set up such that a small business, farm or restaurant could use a similar configuration. Both systems used tubing, fittings, separate timers to cycle the grow lights and water, pumps, water circulation bins, grow bed containers, and hemp microgreen grow pads. Additionally, the aquaponics system had 8 comet goldfish, fish tank, aeration stone, ammonia test kit, water thermometer, and ammonia removal chips, while hydroponics had a hydroponic growing solution and container. Overall, the aquaponics system resulted in larger plants with a higher mass than either the control or hydroponics. The hydroponics system had evidence of mold on the growing media, less germination and smaller plants. Once set up, aquaponics was simpler to operate because to keep the system going, just the fish needed to be fed. In hydroponics, the hydroponics solution container and the microgreen beds required weekly cleaning to avoid molding. In conclusion, the aquaponics system is recommended for use in small commercial settings due to higher plant growth and less maintenance.

RIJU DEY Shorewood High School

Discovery of Novel Eukaryotic-like Dual Phosphatase Kinase Regulating Secretion of the Toxin Pyocyanin in *P. aeruginosa*

The bacterium *Pseudomonas aeruginosa* causes many human and plant diseases. Despite the enormous research that has been conducted at the genomic and proteomic level, mechanisms of disease pathogenesis of *Pseudomonas* remain unclear. Here, we focused on an uncharacterized protein containing a eukaryotic-like protein kinase and phosphatase domain, referred to as the dual-phosphatase kinase 1 (Dpk1). Deletion of the *dpk1* gene from the genome did not affect its normal growth, suggesting that Dpk1 provides nonessential functions. *In silico* modeling of the Dpk1 protein shows that it contains a bonafide eukaryotic-like protein kinase at the C-terminus and a phosphatase domain at the N-terminus. We found that overexpression of the wild-type kinase domain, but not its kinase inactive mutant, was toxic in the budding yeast. The *in vivo* data was further confirmed by an in vitro kinase assay. We also found that the Dpk1 phosphatase domain could dephosphorylate ATP, suggesting that both the kinase and phosphatase domains were functional. Interestingly, we observed a robust secretion of the toxin pyocyanin when the dpk1 gene was deleted from the genome, whereas the same strain became deficient in pyocyanin secretion when complemented with the Dpk1 gene. Collectively, our data suggest that Dpk1 has a significant role in the secretion of pyocyanin.

ADITHYAN University School of Milwaukee

V-Rehab: Novel Rehabilitation Method for Joint-Related Hand Injuries

Finger and joint injuries are common among children. This may come from a strain, fracture, or just overuse of the different joints. These types of injuries may occur in the three joints of the hand: the metacarpophalangeal joint (MCP), interphalangeal joint (PIP), or the distal interphalangeal joint (DIP). The key medication for these types of injuries usually involves long term rehabilitation. However, a child with these injuries often finds conventional rehabilitation methods boring and uninteresting, which may affect the speed of the rehabilitation process. In this project, the Unity game development engine is used to design a game for children with these types of joint injuries to boost up the process of rehabilitation. Additionally, an Oculus Rift is used as the VR headset, and a Leap Motion Controller is used to measure the hand movements and angles of the patient throughout the experiment. A child may find the game more interesting than the normal set of exercises and, therefore, may be keener on winning the game, which will speed up the rehabilitation process. The method has experimented with ten healthy adult volunteers, and all the data are stored to establish a benchmark for healthy or recovered patients.

ABIGAIL CHASE Verona Area High School

Future Remyelination Therapies for Multiple Sclerosis

Multiple sclerosis and other neurodegenerative diseases can ravage the central nervous system, inhibiting and even eliminating efficient communication between neurons. This process, which ultimately leads to physical and neurological impairments of varying severity, is a result of deterioration of the myelin sheath that effectively insulates the neuron’s axon, impairing its ability to allow electrical signals to pass through brain and nerve cells. Though the last two decades have seen the emergence of many viable treatment options for this disease, most are accompanied by a slew of side effects and carry less than optimal success rates. None of the medications or therapies currently on the market are able to reverse the effects of multiple sclerosis¹, as they simply aim to slow the progression of the disease. In recent years, natural myelin regeneration has been observed in many small mammals, a promising finding that will lead to deeper study of remyelination. There are multiple methods currently being explored as to how to encourage regrowth of myelin sheath, including manipulation of gut microbiomes, promoting generation of oligodendrocytes, and earlier biomedical intervention in cases of widespread neurodegeneration². Such methods will evolve into the primary form of treatment of demyelination disorders.

CALEDONIA GRANT Ripon High School

Modeling the Effects of Social Isolation on Serotonergic Neurons by Upregulating Calcium-Activated Potassium Channels

With the recent quarantine (2020) caused by the novel coronavirus pandemic, social isolation stress (SIS) has been significantly affecting a large number of individuals, leading to depression-related symptoms and disorders (Peng et al., 2020). The monoamine hypothesis predicts that the underlying pathophysiologic basis of depression is a depletion in the levels of certain neurotransmitters, including serotonin (5-HT), in the central nervous system. Most of the 5-HT is produced in the dorsal raphe nucleus (DRN), and it is known that SIS causes the firing rate of serotonergic neurons to decrease through the upregulation of calcium-dependent potassium channels (Jesulola et al., 2018). To model the effects of 5-HT regulation seen in animal trials of SIS, we modified a computational model of a dopamine neuron in the DRN to include Ca2+ activated SK channels that are expressed in 5-HT neurons. The model’s behavior was then validated with vitro neurophysiological data. SIS influence on the excitability of 5-HT neurons was simulated by increasing SK3 channel concentration, as well as Ca2+ ion currents. The computational model suggests a link between the downregulation of SK3 channels and increased 5-HT neural activity, suggesting a potential treatment for depression caused by SIS and other mood disorders. Current treatment options for depressive disorder include selective serotonin reuptake inhibitors (SSRIs) which may not be entirely effective in individuals under SIS conditions. Our current study proposes the use of calcium-activated SK channels as a new therapeutic target for depressive and mood disorders.

ADITYA PILLAI University School of Milwaukee

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MORGAN GRIGNON Verona Area High School

Examining Risk Factors within Genetics, Lifestyle, and Environment that Can Lead to the Development of Breast Cancer

Breast cancer is said to be a common disease and I will explore what the chances are that each and every person ends up getting the disease. It will be explored that genetics is potentially a factor in having a family member that developed breast cancer can put someone in the same family at a higher risk for developing it as well. Not only do people with certain genetics in the family affect the possibility of getting breast cancer but certain environmental factors and lifestyle choices increase the probability of developing breast cancer for the people without someone in their family being affected (Breast Cancer: Mayo Clinic). A couple broad reasons that breast cancer develops is due to genetics, lifestyles, and environment factors. We will look closer into these categories of factors throughout the rest of the project to further explore what causes breast cancer whether that be due to genetics, lifestyle, or environment.

JADEN QUINN Verona Area High School

Bone Marrow Grafting in Accelerating the Healing Time of Nonunion or Delayed Union Fractures

Bone fractures and injuries cause millions of people a year to become partially immobilized for weeks to even months. The healing process for fractures can take time to completely repair, which can be stressful for athletes, professions that utilize the entire body, or the general population. Research has been done with multiple different variables to observe if the healing time can be accelerated, yet bone marrow grafting is said to be the most relied on, mainly in nonunion and delayed union fractures.³ This project will be further explored through extensive research findings written by experts in the field of orthopedics that will be discussed and analyzed further.

ETHAN WANG Homestead High School

From Data Clouds to Analytical Functions: Understand Neural Networks Through Artificial Intelligence and Machine Learning

Experiments and data analysis have been crucial to the discovery of many fundamental laws in science and engineering. For simple one or two variable functions, MATLAB has a curve fitting toolbox which can correctly predict the relationships between inputs and outputs; however, more complex equations with multiple variables still have no reliable approach to extract a function from given data. Neural networks are excellent at making predictions, but they lack the ability to produce an analytical function from data. This study attempts to use a neural network based classifier to study the differences across different neural networks. Through this method, a neural network is trained from experimental data and then a pre-trained classifier sorts it into one of many potential functions. In a feasibility test, the pre-trained classifier was able to identify three variable functions with a 90% accuracy rate. When used in experimental science, this approach can give researchers the ability to reliably draw concrete analytical functions from experimental data processes. The research findings could provide farmers useful information in applying biosolids to their fields.

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KYLE SHANLEY Galesville-Etrrick-Trempealeau High School

Behavioral and Social Science of Homicidal Tendencies

The scientific research of prolific killers throughout the centuries has evolved immensely due to increased interest within the psychology community. Genetics and childhood development may be key factors to an individual’s personality, behavior and empathy for others. It’s quite a mystery why certain children grow up to be murderers while others grow to be strong and compassionate. The clue might be in the genetics and the brain functions to discover effective treatments and preventions for future crime rates to be decreased. What are the specifics of a serial killer’s creation?

ADITHYAN University School of Milwaukee

HARRY WILLIAMS Verona Area High School

The Relationship Between Sleep and GPA in Adolescents

I sought to determine whether a lack of sleep affects how adolescents function, concentrate, and perform in school. To gather information on the topic, I researched studies about how sleep affects work performance, engagement in school, and how much sleep adolescents get on average; to name a few. Taking this information into account, I hypothesized that a lack of sleep would negatively affect an adolescent’s function. In order to procure data to confirm or deny my hypothesis, I created a survey to gather results about the respondents’ sleep habits, and questions about their performance in school as well. Specifically, it asked questions about how many hours of sleep they got per night, bedtimes/times they woke up, how they feel in school, and how school’s starting times affected their feelings of wakefulness or sleepiness.