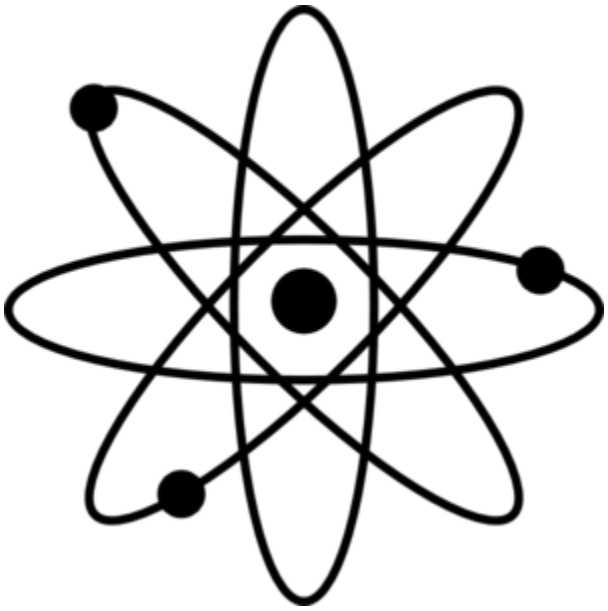
2nd Annual Thomaston High School



Science & Engineering Research Symposium

Overview

This Symposium is a Hybrid Event

Live Event

Poster Presentations by Students
May 25th, 2021, 7:00-9:00 PM
Thomaston High School, Learning Commons

Virtual Event

A pre-recorded virtual symposium video was made that explains the Science and Engineering Cohort program and the purpose of this symposium, then has presentations by a guest speaker, Dr. Andrea Weston of Pfizer, and by the Cohort students where they explain their research projects and their experiences in the Cohort program. Here is the link to this video: https://youtu.be/js4FKWsdo9Q.

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Introduction by Mr. Bryan Holmes and Dr. Chris McMullen

Science Research Teachers, Thomaston High School

Bryan Holmes teaches physics and science research at Thomaston High School. Teaching is his second career after a full career in the US Air Force as an officer and pilot.

"This program booklet gives an overview of the hybrid Research Symposium we are holding this year for students in the Science and Engineering Cohort Program at Thomaston High School, and it provides a video link to the pre-recorded virtual event. There is also a live event where parents, family, and friends can see the students as they present poster presentations on May 25, 2021, 7:00-9:00 PM, in the school's Learning Commons.

The Science and Engineering Cohort Program began last year with its first class of nine 10th graders, and this year we welcomed the second class of seven 10th graders. Next year we will welcome the third class of students to this three-year program. To understand this special program, please watch the video where each student presents his or her research project work, and you will see the wonderful work these students have accomplished."

Chris McMullen teaches UConn biology, anatomy, infectious disease, forensics science, and science research at Thomaston High School. Teaching is his second career after a career in the pharmaceutical industry as an Immunotoxicologist where he studied the immunogenic responses of patients in clinical trials.

"This was my first year facilitating the learning for my students. It was amazing to see them grow and become more independent as the year progressed. I know they will grow as students and more importantly as young adults and scientists as they continue their journey. I am looking forward to next year with my kids and cannot wait for what the future holds for them."

Perspective on Science Research by Dr. Andrea Weston

Senior Director of Cellular, Genomic and Protein Sciences (CGPS) at Pfizer Global Research & Development

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Brief Biography: Andrea Weston is a cell biologist and medical researcher whose interests include genetics and innovation of assays and technologies for high-throughput screening for drug candidates. A graduate of the Brock University of St. Catharines, Ontario, Canada (BS with Honors 1996), she obtained her Ph.D. in Cellular & Molecular Biology from the University of Western Ontario in 2001. After postdoctoral stints at the Institute for Systems Biology (with Dr. Leroy Hood, Seattle WA) and Pfizer Global Research and Development (PGRD, Groton CT), she obtained her first position as a Research Investigator at Bristol Myers-Squibb (BMS) where she was promoted three times to the role of Principal Scientist (2007-2016). After a successful career with BMS, Dr. Weston was recruited back to PGRD where she serves as a Senior Director for the several key labs and programs in CGPS.

During her career, Dr. Weston has led several teams involved in the development of cell-based assays, recombinant cell line development and technologies for platform development for phenotypic screening. She has been the recipient of several awards such as the NSERC Doctoral Prize for most outstanding Ph.D thesis in Canada (2003), Teratology Society Wilson Award (2006) Bristol-Myers Squibb Innovation Award (2012) and the SLAS Innovation Award (2013) and was an elected member of SLAS Americas Council from 2016-2019. Dr. Weston has written over twenty scientific papers and several book chapters throughout her career, as well, she is an invited reviewer for several scientific journals. In addition, her name is on several patents licensed for her work on chondrogenesis.

Research Interests:

Cell-based screening, recombinant cell line development, large scale cell provision, assay innovation.

Students and Their Areas of Study

YEAR 2 STUDENTS

Olivia Grenier	*Infectious Diseases*
Hannah Lawlor	*Water Quality*
Sandra McDonald	*Virtual Reality*
Julia Puprriqi	*Solar Events*
Connor Riley	*Heat Pipes*
Zachary Stevenson	*Jet Propulsion Systems*
Dylan Walmsley	*Dark Matter*

YEAR 1 STUDENTS

Michael Grant	*Neurosurgery*
Daniel Guerrera	*Cryogenics/Dermatology*
Delaney Jose	*Osteogenesis Imperfecta*
Nathan Kowalski	*Quantum Mechanics*
Evelyn Lavertue	*Marine Biology*
Kian Reyes	*Covid-19*

Olivia Grenier

Infectious Diseases (research project)

Ebola virus is one of the deadliest viruses in humans, with a mortality rate between 50 and 90%. Ebola virus infection causes a hemorrhagic fever and massive inflammatory response. Ebola virus is endemic to central and western Africa where natural reservoir animals including non-human primates and African fruit bats reside and can transmit the highly contagious virus to humans when they are hunted, butchered, or eaten. In regions where Ebola is endemic, several common problems can contribute to regional instability. This includes conflict, major crime, economics, and political corruption. These factors can all influence public health both directly and indirectly. This study aims to take a better look at exactly how by using an index to quantify information available about regional instability.

In my past two years taking this course, I have learned countless invaluable lessons. Two that I have found to be the most important and useful thus far have been communication and persistence. With a project as large as those required for this class, setbacks are inevitable. I have learned not to take setbacks as failures, but rather as learning experiences. When faced with challenges, persistence is what gets you through them. Through this course, I have also had the opportunity to send countless emails to professionals in the fields of epidemiology and infectious diseases. While I did not always receive responses, this taught me a valuable lesson in clear communication and professionalism that I would not have otherwise learned in high school. I know I will carry these skills with me and continue to build on them for the rest of my life.

Hannah Lawlor

Water Quality (research project)

The purpose of this research project is to test a handmade, pit fired clay filter in order to clean water for developing countries. While there has been research done in this area, this project is focusing on using a different pot design to see how it will affect the cleaning process of the water. Within this experiment, there are different designs being tested to see which pot is more effective and efficient. The process of pit firing will be used because it is an accessible technology to developing nations. Once the pots have been pit fired, water from a local pond will be filtered, then the turbidity will be tested at a nearby city water department laboratory. A t-test will be used to determine the significance of the sample results.

I learned many things this year within the cohort classroom! I think the skill that stood out to me most was learning how to compete in a science fair as well as learning how to prepare and put together a high standard project submission.

Sandra McDonald

Tracking Hand and Arm Fatigue in Virtual Reality (research project)

The purpose of this project is to explore how hand and arm movements can be tracked in a virtual reality program in order to observe when a user is fatigued and needs a break from the simulation. Subjects will, in the future, use a head mounted display and hand-held devices in a simple, routine experiment, and this program will be created in the engine Unity, and run on virtual reality equipment. The subjects' accuracy will be monitored and data will be collected. The simulation will end around 5-10 minutes. The subject will then be asked if when the study ended, it was seen to be an apt time. There will be a survey asking questions about the comfort and accessibility of the program, and about hand fatigue, before, during, and after the experiment. The answers to the survey will be on a 1-10 scale, 1 being not at all, 10 being yes, greatly. No conclusions have been drawn yet, pending research. This is still in the beginning phase. Results will be based upon accuracy of the subject, and the survey.

In my two years in the cohort thus far, I have learned a couple of important lessons. The first year was more so article research, which has given me critical thinking skills I can now apply to this current project, and will utilize on others in the future. The most important thing I have learned, though, was working through problems and persevering. The coronavirus pandemic limited my research, including not allowing me to work with many in-person subjects, or going to a lab setting. I learned to grow, persevere, and work through adversity in the science and engineering research field, an important lesson I greatly appreciate.

Julia Puprriqi

Limb Darkening (research project)

The astronomical phenomenon of limb darkening is an optical effect seen in stars where the central part of the disc appears brighter than the edge. The limb darkening coefficient plays a crucial role in the surface temperature of the Sun, adding about 330.2 K to the regular temperature can be a catalyst for change. Limb-darkening could also present a possible change depending on the solar event, specifically solar eclipses. Lack of research on the effect of limb darkening on the Sun could hinder scientists' abilities to understand the Sun entirely. The purpose of this experiment is to understand limb darkening and solar events such as coronal mass ejections and solar flares in order to investigate whether the Sun changes at all during these solar events. In order to better understand the effects of limb darkening on the Sun, image processing programs such as the LASCO/C2 instrument from the Solar and Heliospheric Observatory and online observatories will be used to make connections on limb darkening of the sun during solar events such as coronal mass ejections and solar flares. Due to the Sun's 11 year cycle which causes the regular limb darkening measurements to fluctuate, I have decided to focus entirely on the year 2020 in regards to data collection. I will be searching the online observatories for data indicating a large amount of solar activity and matching it with periods of low solar activity to create a before, during, and after to show the possible change in the limb darkening measurement.

After being a part of the Science and Engineering Cohort for about two years now, it is safe to say that I have gained great knowledge in a multitude of areas regarding research. For one, my ability to research and present has improved greatly since the start of the program. I now find it very easy to present to an audience, regardless of how acquainted I am with them. Furthermore, I believe that my reading and writing skills have improved as a result of the constant research I have done and papers I have written on my topic of limb-darkening. Those university level scientific journal articles I once had trouble understanding are now much easier to comprehend and it has drastically improved my education in the cohort and outside as well.

Connor Riley

Heat Rejection Technology on Spacecraft (research project)

Heat is a major problem for spacecraft, as most of the ways currently known for transporting heat do not work in space, as they require a molecule to molecule connection, which would not work in a vacuum environment like space because of the low amount of molecules. This means the only way to transport heat away from spacecraft is through radiation, or the process of turning heat into electromagnetic (EM) waves, and emitting through a radiator. This process is often achieved by using some transportation device that can take the heat, and move it to the radiator. Often, heat pumps are used for this action. Heat pumps have a liquid inside of them, in this paper's case, an absorbent/refrigerant combination, which can take in the heat, and eject the heat when at the designated destination. This paper will show a specific refrigerant, r134a, that will be tested and compared against other common refrigerants, which would be water and ammonia, to see their abilities to hold and transport heat. This will be done by testing the vapor pressures of the refrigerants at fixed temperatures between 0 and 40 degrees Celsius. The conclusions will show if r134a is more efficient at transporting heat through a heat rejection system than the other common refrigerants.

I have learned the importance of continuing with your project. Numerous times this year I have reached a roadblock or a dead end which halted my progress, but I continued to persevere through and get to where I am now.

Zachary Stevenson

Jet Propulsion Systems (research project)

The aviation sector contributes approximately 5% of America's total anthropogenic radiative forcing through toxic emissions such as CO2. Fatty Acid Methyl Ester (FAME) biofuels are a promising solution to this issue, although they are very limited in freeze point and cannot withstand the extremely cold conditions of an airplane at cruise altitude. To test the freeze point characteristics of FAME fuel, a multispectral optical biojet fuel freeze point analyzer (comprised of 3 different wavelength emitting LEDs, a multi-spectral photodetector, a PT1000 RTD temperature sensor, and an Arduino Uno microprocessor) has been developed. Throughout preliminary tests, unexplained variations of the light wavelength intensity were observed with different fuel mix ratios. The goal of this research is to better understand the intermediate freeze point characteristics of FAME biofuels and determine the origin of these unexplained variations.

My second year in the Thomaston High School Science and Engineering Cohort was very successful and I enjoyed it very much. I was able to continue building on my knowledge of aviation and biofuels, and design an experiment about my topic which I have enjoyed. Currently, I am in the control testing phase of my project and I have started to get preliminary results. One thing that I learned throughout my experience in the Cohort was the importance of failure. Throughout my preliminary testing, I had device malfunctions or equipment failures that were discouraging. With help from my mentor and Mr. Holmes, I persevered and learned to overcome these issues. Thank you to Mr. Holmes, Dr. Daggett, and my family for all of the help and support!

Dylan Walmsley

Relationship Between Absolute Magnitude and Mass in Binary Star Systems

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Nearly four-fifths of all observable light comes from two stars which orbit each other in a pair. These binary star systems are not only important to understanding the observable universe, but how life on Earth functions. Calculating the masses of these stars is essential to gain not only the size of these systems, but how they differentiate. Differences are key factors such as Parallax, a displacement or difference in the apparent position of an object viewed along two different lines of sight, and is measured by the angle or semi-angle of inclination between those two lines. Parallax coincides with Parallax error, which could be mechanical, or, which could be the result of outside matter. The SIMBAD, Gaia, and Sixth Orbit Catalogs are all essential to research, using these databases information such as the period of time the stars take to orbit, the star name, semi-major axis of rotation, and finally, using equations to find the mass sum and the difference of the masses, the mass of the binary star system. Using the SIMBAD, the Absolute Magnitude, the magnitude (brightness) of a celestial object as it would be seen at a standard distance of 10 parsecs, was discovered, leading to the question, is there a relationship between absolute magnitude and mass?

So far, my experience in the cohort has been great, I've learned more about the science field than anything I could've predicted. Not only has this class taught me about the science field, but it has also taught me about the real world and professionals. Although my project is not done, the process has taught me more than I could've ever predicted. Pertaining to my research, data collection has been confusing, but my mentor, Dr. Horch has helped me through every step of the process and I can't thank him enough for that. Preliminary research was extremely helpful as it allowed me to understand the databases that I use daily as well as helped me understand how binary stars are measured and how they work. Yet again, I would like to thank Dr. Horch and Mr. Holmes for helping me through this process as a whole.

Michael Grant

Neurosurgery (research project)

Research on measurement techniques for the craniocervical junction is scarce and lax, all neurosurgeons wuse different ways of measuring which is a problem. By creating a universal measurement technique the findings and measurements of other neurosurgeons can more easily be transferred. Instead of different techniques for the craniocervical junction measurements, an easily communicated technique will be created. This will help all neurosurgeons understand each other's measurements rather than using different techniques and having different data.

Over my first year of cohort I have developed skills that without cohort would have been difficult to develop. The cohort has led me down a path that I have never known before, but it is exciting and interesting. It has taught me to analyze data at a higher level, it has taught me to read complex research papers and then present them. Thanks to the cohort I have gained more confidence in my presentation skills, and I look forward to continuing with the cohort next year.

Daniel Guerrera

Cryogenics (research project)

For my research, I am planning to test the efficacy and efficiency of cryogenic materials on medical conditions in a variety of fields. Mainly, I plan on focusing on dermatology, but will continue to study the use of cryogenics on surgical procedures, hematological research, and other fields cryogenics play a role in. I plan on doing my research and data collection in conjunction with my future mentor, who will mainly focus on the fields of dermatology and cryogenics, the two of which work closely together.

This year, I've learned how to effectively gather information from scientific papers, and use that information to create a presentation and demonstrate the data I have collected. Alongside this, I've developed my skills on the art of presenting, allowing me to express myself easier through presentations, or anything which requires such skills. The cohort has also developed my organizational skills, has made me more time efficient, and has generally improved my ability to use difficult information presented to me.

Delaney Jose

Cerebral Palsy (research project)

Cerebral Palsy is a clinical diagnosis based on a combination of clinical and neurological signs. The diagnosis is usually made at the age of 12-24 months. Risk factors include history of conception, pregnancy, birth, and postneonatal period. Neuroplasticity is the brain's ability for neutral connections to change through growth and reorganization. This is essential for infants with cerebral palsy, but neuroplasticity is at its peak before the age of three. Conducting a systematic review, we will develop diagnostic steps to improve the age of identification of cerebral palsy. This will allow for a diagnosis to be made before 12-24 months allowing for intervention to be given earlier. We will also examine the effect of the cerebral palsy diagnosis on the family and how the discovery at different ages affects the families coping abilities.

I have learned so much from this cohort. From reading research papers to presenting 15 minute verbal presentations, I have become a more prepared student. I have learned time management skills, understood so much about the research process, and found my new love for the medical field. But besides all of this, I have become a better person. Throughout this year I have researched many different pediatric illnesses, but mostly orthopedic issues. This has given me a new light into the medical field. It is so much more than just patients getting tests done. These papers are stories of families who are trying to find an answer. Many times this research is a small piece of hope that keeps them going. My hope is that through this cohort I can do a fraction of work to allow for infants to have a better quality of life in the future.

Nathan Kowalski

Quantum Mechanics (research project)

Using a double slit interference pattern that is projected on a wall, researchers will seek to verify the wavelength of a laser. Four different slit configurations will be used to generate four different interference patterns. This experiment examines how a light beam can act as a wave or as a particle. Results will be analyzed to further understand the effects of diffraction.

This year in the Science and Engineering Cohort has taught me how to properly research and gather information. It has helped my presentation and public speaking skills. It has taught me how to properly reach out to scientists in order to gather more information. Overall, it has been a fund and useful educational experience and opportunity.

Evelyn Lavertue

Marine biology (research project)

In my experiment, I plan to make use of phantom echoes and various wall materials to determine whether or not echolocating bottlenose dolphins will experience hearing loss. In order to determine this, I will utilize a phantom echo generator (PEG), 4 bottlenose dolphin subjects, aneuryeirriieiipiriuoyuueietud a functional bite plate, among other devices. Conclusions should show that high frequency phantom echoes cause greater hearing loss in bottlenose dolphins and that the material of whatever surface that echo reflects off of should contribute to how much or how little that hearing loss is.

Thanks to the Science and Engineering Research Program, as promised at the beginning of the year, I have learned and practiced many collaboration, communication, and critical thinking skills, even despite my multiple events of redirection. I have read so many scientific papers, many of which were provided by my mentor, Dr. Branstetter who has helped me a lot recently. I would never have thought I would be able to decipher and understand the papers we are reading. I have learned other things too, such as how to find chi square, to compose a professional email, and to creatively develop my own ideas. Also, I could not have done any of this without the guidance of my instructor and advisor, Dr. McMullen- a big thank you to him. I am so glad to have been given the opportunity to create my own research project. It has also been super fun given that my friends and I have never done anything like this before, and we are having so much fun as a cohort.

Kian Reyes

Covid-19 (research project)

The development of a severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) vaccine is essential during the current pandemic. Vaccines developed by Pfizer and Moderna, within a year, are administered to the public with 94-95% efficacy in preventing SARS-CoV-2. I intend to collect data from clinical trials, focusing my research on the vaccinated individuals in the clinical trials that were still infected, and the effects the vaccine had on the individual, on the intracellular level, in the cells of the immune system.

This experience in this program gave me the opportunity to really learn and research my topic of choice, that I otherwise would not have been able to learn in my regular core classes. I picked up new skills in researching articles that I wouldn't have known how to read had I not taken this program, as well as skills in presenting my research, communication, and professionalism, all of which are skills that will help me throughout my future. My entire life, I have been interested in the medical field, and this experience gave me an insight into what the field is like, and this program really gave me an idea of what I wanted to do in the future. I have been told that "experience is everything" and my experience in this cohort is extremely valuable to me, and I know that it will carry on into my future.

Acknowledgements

Thomaston High School's Science and Engineering Cohort would like to thank the following for their supporting efforts:

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