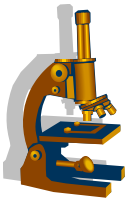
Marine Academy of Technology & Environmental Science

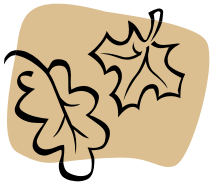
Fourteenth

Research Showcase

Abstract Guide

February 26, 2020





February 26, 2020

This is the Fourteenth year of the Research Expo! We had a strong 2018-2019 student research year outside of MATES with 30 projects selected for the Delaware Valley Science Fair and posters presented at the New Jersey Terrapin Meeting in October 2019. There will be approximately 80 projects competing at Stockton University's Jersey Shore Science Fair in March 2020. All freshmen and transfer students are required to conduct an independent experiment. Once completed, the students prepared a poster culminating in the poster session on February 26, 2020. Many hours went into the projects as the first year MATES students will be presenting their posters. All posters will be displayed in alphabetical order of their last names in nine categories. They will also be judged based on a category that is common to their project type.

We would like to thank the students for their project presentations this year. The students worked hard and it will show in the following abstracts, and during their poster session. Mr. Jason Kelsey, fellow research coordinator provided the students with tremendous insight on research. Mr. Kelsey has been and will continue to be a tremendous advisor to the MATES students.

Thanks to the MATES Parent-Teacher-Student Organization that was generous in providing funds for materials for numerous projects. We wish to thank our Ocean County Vocational Technical School Board of Education, Administration (Ms. Homiek, Dr. Michael Maschi, Mr. Frazee, and Mr. Biscardi, MATES Principal). A special thanks to the MATES Staff, especially Mr. David Werner (research advisor), Dr. Michael Bixler, Mr. Brian Jones, Ms. Maryann Minnier, Ms. Mia Dill, Ms. Jennifer Hudak, Mrs. Kelly Kelsey, Mr. Adam Sprague, Ms. Michele Colon, Mr. Joseph Arfin, Mr. Brian Coen and Ms. Melissa Wolleon who contributed to the success of the project. Also, many, many thanks to Ms. Katie Manna, Ms. Esther Gallacchio, and our dedicated maintenance staff for all of their support and assistance. Our lunch was prepared by Ms. Deborah Dimm and Ms. Linda Burton.

Thanks to the parents who have contributed much time and effort in making the projects possible. Without parental support, this research would not be possible. This year's Research Class helped to organize the Expo, and a special thank you to our Research Assistance and Development (RAD) Team for helping the young researchers for outside fairs and this Expo. RAD met over the summer and throughout the school year by providing our students with assistance! Thanks to the RAD senior coordinators Ariel Baiano and Rebecca Mastrola. And, last, but not least, a very special thank you to all of our judges who volunteer to provide our students with constructive feedback about their projects. We greatly appreciate your time and expertise in making the 2020 MATES Research Expo a true success. Thank you first year research students and good luck!

Sincerely,

John Wnek, Supervisor,
Science and Research

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BEHAVIORAL AND SOCIAL SCIENCE

101. EFFECTS OF SOCIAL MEDIA ON SOCIAL SKILLS

Kian Adams, Block 3 Science Class, Marine Academy of Technology and Environmental Sciences (MATES), Advisors: Mr. Jason Kelsey

Throughout recent years, social media has had a huge increase in modern day society. Almost anyone that you may encounter will probably have some platform of social media on their phones. With these options of communication arose the question on whether or not social media has effects on any of our in-person social skills. To try and find an answer, a survey was created asking questions about the takers social media usage and their personal rankings of their own social abilities. This survey was then distributed by hand or by online messaging to get people to take it. Overall, 94 responses were turned in for the project for 2 months from December 2019 - January 2020. Overall, the responses showed a majority of survey takers spend 1-3 hours on social media, and most of the survey takers answered saying that they had good social skills. From these results, it can be concluded that there is no correlation between social media and social skills.

102. AN EXAMINATION ON HOW MUSIC AFFECTS MATH EXAM RESULTS

Ryan Breen, Block 1 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisors: Dr. John Wnek and Mr. David Werner

Music is vocal or instrumental sounds (or both) combined in such a way as to produce beauty of form, harmony, and expression of emotion, and it is all around the world. Humans have incorporated music into their everyday lives, and some listen to it even while doing work, and some teachers even play it during tests (usually classical). This begs the question if it is beneficial or not during test taking. This study focuses on the answer to that question. In the experiment Participants took four math tests all on the order of operations, and each test was timed for two minutes, and graded on amount answered, and percentage correct of answered questions. Each test was given with a different genre of music playing (Classical, Pop, no music, and preferred music). Results showed that when listening to classical music, the amount of questions answered decreased, and the percent correct decreased. For pop music, the percent correct was the same, but the amount of questions answered significantly dropped compared to no music. Finally, when listening to their preferred music, participants answered slightly more questions, and had the same percentage. These results point to preferred music and no music being the best things to listen to during a test, and the worst would be classical, which is what people normally listen to if any music during tests.

103. THE EFFECT OF SOCIAL MEDIA ON TEENAGERS

Kyle Cousens, Block 4 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisers: Dr. John Wnek and Mr. David Werner

Social media is a type of online communication in which users can share and view content with a community of people. There has recently been much concern for the mental health of teens that use social media. This study examines the use of Instagram. High schoolers ages 14-18 from the Marine Academy of Technology and Environmental Science, Toms River High School South, and Old Bridge High School were used to determine the effects of social media on the mental health of teenagers. The subjects went one week without social media and filled out a survey, and then were exposed to social media for a week until filling out another survey. The surveys showed that teens were more likely to be depressed or anxious when using social media. When not using social media, only 12.0% of the subjects reported feeling depressed. After being exposed to social media this number increased to 17.8%. The rise in anxiety was similar. When not using social media, 26.7% of the teens reported feeling anxious. This number jumped to 31.6% after being exposed to social media. At the beginning of the study only 9.3% stated they would consider permanently quitting social media, but this number became 19.3% by the end. The results suggest that social media can have negative mental health impacts.

BEHAVIORAL AND SOCIAL SCIENCE

104. HOW MEDITATION AFFECTS STRESS ON MIDDLE SCHOOL STUDENTS

Isabella Funaro, Block 3 Science Class, Marine Academy of Technology and Environmental Science (MATES). Advisors: Dr. John Wnek and Mr. Jason Kelsey

Mental stress is a significant part of the day for many school students. Meditation is a way to train the mind into a relaxed state that can help reduce that stress. This research examines whether or not meditation can actually help lower stress levels in average middle school students. A survey was constructed to gather data on the change of stress levels, about a test or quiz, before and after meditating. This survey was distributed to math students at Manchester Township Middle School, where their teachers had them complete the questions. The responses showed that stress levels were reduced in some, but there was also a significant amount of students that claimed that the meditation had no effect on their stress. In the survey, the students explained why they thought the meditation did or did not help with lowering their stress. This showed that meditation is more effective when it is enjoyed and taken completely seriously, but it is a valid stress- reduction technique for those that do.

105. THE EFFECT A CROWD OF PEOPLE HAS ON AN INDIVIDUAL

Claire Gosse, Block One Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisors: Dr. John Wnek and Mr. Jason Kelsey

Humans have demonstrated the tendency to stick with the crowd all through history; however, scientists have struggled to find the correlation between the individual thought process and the group thought process. Scientists believe people prefer to say with the majority to not be noticed when they fail which is why very few people are successful. The performed experiment compared the results of the test with and without people's answers influencing them. The test was an obstacle illusion, so there were more than one possible answers. There was always a crowd around the people, but the first test there was prepared people with varying answers, but the second test the prepared people had the same answer repeating them before the person being tested answered. Glancing over the results, there was a significant decrease of the answers stayed the same with the person being tested with the crowd influence. All in all, the t-test and results demonstrated there was a difference between the test with only the individual thoughts and the crowd's influence.

106. THE EFFECTS OF FOOD DYE ON THE ATTRACTIVENESS OF FOOD

Parker Gutierrez, Block 3 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisor: Mr. Kelsey

Food dyes are chemical substances that were developed to enhance the appearance of many foods. Companies that produce food products will often use dyes such as Yellow 5 and Red 40. Since Yellow 5 is one of the most used dyes it was used to dye the foods in this experiment. This study examines the effect that food dyes have on the attractiveness of a variety of foods in the market. Samples of mustard, peanut butter, salmon, pancakes, and mac and cheese were put into a survey and compared against their dyed versions. The survey asked participants to answer which food they found more attractive without knowing which food is the dyed version. One hundred people took the survey which was delivered electronically through Google Forms. The survey results showed a strong trend in dyed foods being more attractive. These results are important because they give food companies assurance that the food dye they put in their products actually makes the food appear more attractive helping give their product an edge against their undyed counterparts.

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BEHAVIORAL AND SOCIAL SCIENCE

107. PREVALENCE OF THE CAUSES OF ECONOMIC DOWNTURNS IN THE LAST CENTURY

Ethan Johnson, Block 2 Science Class, Marine Academy of Technology and Environmental Science (MATES),
Advisors: Dr. John Wnek and Mr. Dave Werner

Economic downturns are simply believed to be the result of a weak economy, although they have much more variation. Over the most severe downturns of the past century, many similarities align, including a global downturn in the late 2000's as well as many unique circumstances depending on the country. This research was conducted in order to get a better sense of why downturns, which is where a country's economy takes a "turn" for the worst, occur. My research also discovered how they occur, and, based off of what has plagued the global economy, what to do to help prevent in the future. The Great Recession of 2008 showed us that it is important on who gets loans, and in the future, the loan process must be tight and highly regulated. For the data collection, low points for five of the world's largest economies (based on GDP) were recorded and analyzed, and they fell into one of 6 categories. These included inflation, political issues, stock crashes, high interest rates, bubble bursts, and an others category. The collected data from the downturns and their respected causes was compiled, thus suggesting the prevalence of each cause. The research showed that stock crashes accounted for 40 % of the recessions, of which 3 of the 4 were from the financial crisis of 2008. Based on the conducted research, stock market crashes are the most prevalent cause of a nation's economic downturns.

108. THE RELATIONSHIP BETWEEN SALARY AND PERFORMANCE IN THE NBA

Mostafa Khedr, Block 1 Science Class, Marine Academy of Technology and Environmental Science (MATES),
Advisors: Mr. Jason Kelsey and Dr. John Wnek

Did you know that a professional athlete can make upwards of 100 times the salary of the President of the United States? My research project aims to answer the question of whether or not these exorbitant salaries are given out fairly to players who deserve them, or whether it is based more off of social influence. I hypothesized that the hundreds of millions of dollars given out to certain NBA players are not proportionate when compared to their actual skill and usefulness to their team. I use the Value Point system or "VPS" for short, which is a formula that can calculate a basketball player's usefulness on a team rated by a number. I conducted two trials with five current NBA all-star players in each. For each player I calculated the VPS rating of their average performance this season, and included their salary for this season. When all the ratings and salaries are collectively compared, it is not hard to tell that often the salary of the players who are the most useful to their team pales in comparison to that of players who have more social influence and cant back it up with as much skill. This could potentially negatively affect those who bet money on sports because if one were to assume that the higher a player gets paid then the more skill they have, they would sadly learn otherwise and could lose money. High salaries are paid to people who play a sport for entertainment; therefore, a more equitable system can ensure that players who rightfully deserve higher pay get it.

BEHAVIORAL AND SOCIAL SCIENCE

109. SCIENCE AND ACTING: STRESS DURING AUDITIONS

Abigail Ostapovich, Block 4 Science Class, Marine Academy of Technology and Environmental Sciences (MATES), Advisors: Dr. John Wnek and Mr. David Werner

Performance anxiety is a common psychological problem among musicians and performers. It causes negative thoughts, worry and doubt. It also causes changes in heart rate and impairs other biological functions. Stage fright, or performance anxiety, can also be described as temporary insanity, as it causes you to lose control of mental and physical energy and power for a short time. This study shows how nervous young actors feel during an audition and under what circumstance they would feel more comfortable in an audition. Surveys were taken by a total of 59 students from Central Regional Middle School and Central Regional High School after their auditions. The survey asked them to do things like rank their stress and/or anxiety during their audition on a scale from 1 to 5 and also gave them the choice between some different audition circumstances, in which they selected the one they think they'd be the least nervous in. The data suggested some interesting results. The most common level of nervousness was a 3, right in the middle of the scale. The data showed that the higher numbers on the scale selected were mostly selected by the high school students and the lower numbers were mostly selected by the middle school students, showing that the high school students actually felt more nervous than the middle school students. Overall, a singing audition was chosen as the most desired circumstance in an audition.

110. CORRELATION BETWEEN AGE AND THE ABILITY TO DISTINGUISH FALSE INFORMATION FROM FACT

Patrick David Pagdatoon, Block 2 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisor: Mr. Jason Kelsey

Fake news has been prominent since the coming of the internet and online news sharing websites. Such fake news is often spread due to lack of research and taking advantage of those who cannot differentiate fact from fiction. This study looks into how age affects the ability to determine fake news. At the start of the study, six articles of varying topics were found and fact checked to be used as examples for participants to read. A survey was made on Google Forms asking the participant whether or not they believe the article, the credibility of an article on a scale of 1-10, and any words of phrases that made them believe that it was fake. The articles and surveys were put on a folder in Google Drive to allow easy access. The participants were split into two different age groups, that being ages 14 to 39 and age 40 and up. T-Tests were run on the results, and found that there were no significant differences between the answers of the two groups. Both groups shared a similar ratio of "yes" to "no" regarding the believability of each article. Participants stated that use of slang and other informal language caused them to believe an article was false. Religious and political beliefs also played a role in the evaluation of the articles.

BEHAVIORAL AND SOCIAL SCIENCE

111. THE EFFECTS OF GENDER ON PARTICIPATION IN THE CLASSROOM

Arliana Torres, Block 3 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisors: Dr. John Wnek and Mr. Jason Kelsey

Gender roles in the classroom have been negatively impacting the student environment, causing pupils to feel insecure during class throughout the school day. In science conferences and other academic events, it has been observed that men tend to participate and answer questions more often than women. This is providing men with a better opportunity to learn and will eventually give them a better chance of getting a well-paying job in the science or math field. The purpose of this study is to 1) see if males participate more often than females and 2) find out why males might be more involved in class discussions. To conduct the experiment, participation was kept track of during class. For example, whenever a boy or girl would raise their hand to answer a question, the amount of students raising their hands and each of their genders would be recorded. This was done for all classes (Math, Science, Spanish, and English). Seventy students were also given surveys that asked for their gender and age and asked a variety of questions relating to how often they participate in class. From the results, it can be observed that fear to answer a question has a large impact on students. In the surveys, a variety of students claim that, even in their favorite class, they are afraid to answer questions asked by the teacher. From the information collected in the classroom, the data suggests that women do not participate as much as men; the average of women raising their hand for a question is less than the average of men.

112. HOW DIFFERENT DEMOGRAPHICS PREFER E-READERS VS. PAPER BOOKS

Arianna VanTrease, Block 1 Chemistry, Marine Academy of Technology and Environmental Science (MATES), Advisor: Mr. Jason Kelsey

Reading is very important to everyone. It can improve and benefit memorization, mental health, intelligence, and much more. Two different mediums of reading are paper books and e-readers. E-readers or electronic book readers, are mobile, handheld devices designed to display different reading material, such as Kindle. Paper books are physical books, and the way people have been reading for centuries. There are pros and cons to each, such as, comprehension, retention, and availability. This study shows different demographics's preference of the two mediums and reasons why, as well as their purpose of reading on either medium. A survey was created asking takers their age group, preferred genre of reading, purpose of reading, their preference of e-readers or paper books, and reasons for that preference. The two main demographics are gender and age. The two age groups that were focused on are students from grades nine through twelve, and adults eighteen and older. 208 survey results were collected, mostly from takers ages twelve to eighteen, or nineteen to forty-five. The overall results suggest that people prefer paper books. In students there was an overall preference of paper books and in adults as well. An open-ended question shows that it is mainly due to ease and efficiency.

113. DO DIFFERENT TYPES OF MUSIC AFEECT THE ABILITY TO MEMORIZE SYMBOLS?

Iliana Vasslides, Block 3 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisor: Mr. Jason Kelsey

Music is something that is present in almost everyone's life. Depending on the rhythm and beats of the music genre, it can have different impacts on the brain and the person's performance. Since the temporal and parietal lobe in the cerebrum in the brain both deal with memory, musical rhythm, and hearing, the brain is forced to "multitask". This can result in lower performances on assessments if music was listened to while studying. Fifty students from the Marine Academy of Technology and Environmental Science participated in this experiment to see if different genres of music would have any effect on the scores of a memorization test. The participants listened to no music, classical music, rock music, pop music, and slow-tempo music before and during memorizing ten symbols. An ANOVA and t-test showed that the averages of all the different types of music were not statistically different. Although there was a 9.4% difference in average scores between the highest and lowest averages, there wasn't a big enough gap to say that they were statistically different. In addition, there was no statistical difference between the averages of scores between boys and girls, even with a 3.9% difference in averages.

BOTANY

201. EFFECTS OF RADIATION ON SEED GERMINATION AND PLANT GROWTH

Danny Bacsik, Block 4 Science Class, Marine Academy of Technology and Environmental Science (MATES),
Advisor: Mr. Jason Kelsey

Wisconsin Fast Plants were bred to have shorter life cycles by Dr. Williams, a professor in the Department of Plant Pathology at the University of Wisconsin-Madison, as a research tool that could be used for improving disease resistance of cruciferous plants. I planted sixteen Wisconsin Fast Plant seeds in eight small pods. Eight of the seeds were exposed to ionizing radiation from the sun in the form of alpha and beta particles for three to four minutes. The seeds were cargo on an Orion Terrier-Improved Sounding Rocket out of NASA's Wallops Flight Facility at a maximum height of 97 miles. The other eight were the control seeds. The eight irradiated seeds were sent up to space by the Cubes in Space™ program. Each pod contained the same amount of soil, two fertilizer pellets, and two seeds. I used a water mat/waterwicking system to water the plants, and a LED growing light was hung above. Growth was measured on Mondays, Wednesdays, and Fridays for four weeks, and the results were tracked in a spreadsheet. Five of the control seeds germinated, with an average height of 23.55cm, while only two of the irradiated seeds germinated with an average height of 21cm. The results suggested that the irradiated plants are more likely to fail to germinate, but if successful, grow a couple of centimeters shorter.

202. THE NUTRITIONAL VALUE AND FLAVOR OF HERBS GROWN WITH AQUAPONICS COMPARED TO TRADITIONAL GARDENING

Amber Conley, Block 3 Science Class, Marine Academy of Technology and Environmental Science (MATES),
Advisor: Mr. Jason Kelsey

Aquaponics is a type of farming that uses fish waste to provide nutrients for plants as the plants act as a filter. In this project, the nutrient density, flavor intensity, and preferred flavor is compared between aquaponics and traditional growing. In each trial, three *Ocimum bacilicum* (basil) and three *Petroselinum crispum* (parsley) plants were grown using each method. A BRIX refractometer was used to measure the nutrient density of the herbs and a blind taste test was conducted to find what the flavor intensity and preferred flavor was for each method (based on participant opinions). Participants were asked to rate the flavor intensity for samples of parsley A (aquaponically grown), parsley B (grown in soil), basil A (aquaponically grown), and basil b (grown in soil) on a scale of one to ten and then asked to circle the sample they preferred the flavor of for each herb. T-tests showed that there was a significant difference in the average flavor intensity of herbs grown with aquaponics compared to herbs grown in soil. Aquaponically grown herbs had a greater average flavor intensity 75% of the time. Aquaponically herbs were also generally preferred over traditionally grown herbs.

203. HOW THE GROWTH OF ALGAE DIFFERS IN VARIOUS BODIES OF WATER

Lisa Hunt, Block 4 Science Class, Marine Academy of Technology and Environmental Science (MATES),
Advisor: Mr. Jason Kelsey

Algae commonly grow in lakes, ponds, and even pools; It reproduces quickly and needs few conditions to grow such as light, nutrients, and warm temperatures. Algae are known to make up algal blooms, an environmental problem occurring across the US. One of the main elements that encourage algae growth is phosphorus. The aim of this research was to take samples from different water bodies in New Jersey (lakes, river, etc.) and test for phosphorus in the water. This would determine which bodies of water would have a higher chance of algae growth. The results showed that most phosphorus was found in one of the lakes (Lake of the Lillies) and Barnegat Bay. An ANOVA test was run and it showed that there was a difference in the data. In order to decrease the appearance of harmful algal blooms, prediction methods are being developed. Removal methods such as using oxidizing bacteria or ultrasound are being used in areas with high amounts of excessive nutrients in the water, such as the Great Lakes. Results suggest that algae will most likely grow in lakes and bays, so scientists should focus on those bodies of water when trying to locate harmful algal blooms.

BOTANY

204. ANALYZING POTENTIAL HUMAN USE OF LOCAL MOSSES IN HOUSEHOLD PRODUCTS

Erica Keklak, Block 4 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisors: Dr. John Wnek and Mr. Jason Kelsey

Several native species of bryophytes in Ocean County are well-known for their flammability and absorbance. Many environmentalists believe that natural fuels and absorbents may be more beneficial to the environment than their synthetic counterparts. This study involved mosses in the *Sphagnum* genus, *Rhytidiadelphus squarrosus*, *Rhytidiadelphus triquetrus*, and *Leucobryum glaucum* species for studying their properties of resistance to aridity, flammability, absorbance capacity, and absorbance speed as these are the most useful in the aforementioned products. By taking live samples in Berkeley Township to observe their ability to combust from matches and moisture retainment over periods of 2 hours at a time, anova and t-tests were taken to determine the significance (if any) of the averages, per species, to perform such tasks. Each species had different strengths compared to others, and revealed that using a mixture of them in an absorbent or fuel will be most effective. Results suggest that mosses from the *Sphagnum* genus are able to absorb a far larger capacity of liquid at a much faster rate than the other species and are able to retain liquid within its cell structures for longer durations. These *Sphagnum* specimens, though not dried out into peat, are able to catch fire significantly faster.

205. THE EFFECTS OF DIFFERENTIATING SALINE SOLUTIONS ON GERMINATING AND SPROUTING *LACTUCA SATIVA* AND *SOLANUM LYCOPERSICUM*

Qian He Li, Block 3 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisors: Dr. John Wnek and Mr. Kelsey

Water with a lower overall salinity has been used for agricultural purposes for a long period of time, yet, with the increasing water level due to climate change, more coastal areas are prone to using saline water for irrigation. This experiment was conducted to test tolerance levels of sensitive plants to different amounts of salt. Lettuce and tomato seeds were germinated over a three week duration to see how seedlings varied in length. The control seeds grew the longest. The color of the plants changed and the differences in length became more defined. Within the first week, the stem length differences were approximately 2% shorter than the solutions with lower salinity. When the third week ended, the plants stems' length of the highest salinity was approximately 4.1% shorter than the control seeds. Lettuce growth was stunted due to higher salinity, plants watered with lower salinity water didn't suffer as much damage to growth. Tomato plants didn't suffer as much stunting as lettuce seedlings. The solutions used were measured by ppt. The highest salinity solution was 12 ppt. The control was freshwater. Results show sensitive crops, such as lettuce, will be affected by even a 3 ppt change in salinity.

206. HOW DOES GRAVITROPISM AFFECT THE ROOTS OF LIMA BEANS?

John Lin, Block 1 Science Class, Marine Academy of Technology and Environmental Science (MATES),
Advisor: Mr. David Werner

Gravitropism is the gravity-directed growth process that dictates upward shoot growth to ensure proper positioning of the leaves for efficient photosynthesis and gas exchange. It also directs roots to grow downward into the soil. This allows the roots to reach out to take up the water and mineral ions required for plant growth and development. The aim of this experiment is to demonstrate how gravitropism works. This experiment started with planting 24 lima bean seeds in plastic containers. Approximately 10 out of the 24 lima beans sprouted. The plants were grown upright for about a month. The purpose of growing the plants upright for a month was for the plant to establish some roots to be able to receive the water. Six out of the 11 plants were then turned onto their sides to demonstrate how gravitropism works. The remaining five plants were grown in their natural upright position as the control for the experiment. They will be compared to the six plants that were grown sideways.

BOTANY

207. EFFECT OF DIFFERENT SALT SPRAY SALINITIES ON THE GROWTH OF *LUPINUS POLYPHYLLUS*

Nicholas Pape, Block 3 Science Class, Marine Academy of Technology and Environmental Science (MATES),
Advisors: Dr. John Wnek and Mr. Jason Kelsey

Lupinus polyphyllus is a species of plant that has a waxy coating on its leaves which is an adaptation for salt spray. Salt spray is the salt and water reacting at the surface to form "bubbles" that contain the salt. These bubbles are then swept away by the wind affecting a lot of plant life along the way. The wax on the leaves of many seaside plants stops the salt from ever coming in contact with the plant as the salt would burn straight through it. The study was testing whether the salinity of the salt spray would affect the height the *Lupinus polyphyllus* grew. Thirty of the *Lupinus polyphyllus* plants were set up at the south side of a well-lit den with grow lights on for 12 hours each day. The 30 *Lupinus polyphyllus* plants were split into three groups: ocean, bay, and tap water. Each of the plants were sprayed everyday with water that corresponds with its group name as well as being watered with tap water every four days to simulate rain. Every week, the height of each plant was measured and placed into a table. The experiment went on for 14 weeks. An ANOVA of the average heights each week per group showed that there was not a significant difference in the height of *Lupinus polyphyllus* throughout each group. With there being no significant difference, this shows that the adaptation of waxy leaves really works which allows coastal citizens to plant *Lupinus polyphyllus*. The results did not support the hypothesis as no salinity of salt spray affected the height any more or less than a different salinity.

208. DETERMINING AND UTILIZING THE BEST HYDROPONICS SYSTEM FOR GROWING *FRAGARIA ANANASSA*

Jade Ricany-O'Brien, Block 1 Science Class, Marine Academy of Science and Technology (MATES),
Advisors: Dr. John Wnek and Mr. Jason Kelsey

Hydroponics is a very eco-friendly way of growing plants. Hydroponics makes fresh crops more accessible to everyone, even in countries where the land is not fit for growing plants. Hydroponics is not just one system, it is actually six different types of system designs. This project compared three very different hydroponic systems to soil. Some of the comparisons were yield and size of plants. Yield for this project would be the amount of strawberries grown. The systems use different methods of watering the plants that can work for different plants and different ways of watering require different tools. For this project I had soil for my baseline (control). Since soil is what we have used for so long and we are transitioning into hydroponics it would be a good idea to test it against the original way to see if it is really better. The plants are grown in a tent and since the tent has no resemblance to nature there have to be adaptations. For example there needs to be an LED light in the tent to represent the sun and the light has to have different stages as well to represent the transitions of day there also has to be fans to keep mites off the leaves and to regulate the temperature. The results are mixed because the systems are quite different and some have advantages over the others. Hydroponics is a relatively simple process and it is great for the environment today because having access to fresh crops everywhere can decrease use of fossil fuels and that can make a cleaner world.

BOTANY

209. THE EFFECT OF EXCESSIVE ARTIFICIAL LIGHT ON THE GROWTH RATE OF ALGAE

Ashley Springer, Block 1 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisor: Mr. Jason Kelsey

Global warming is a major contributing factor to algae blooms. When algae is exposed to an excessive amount of light, the growth of it may change due to the heat coming off of the light. Ten samples of a mix of creek and tap water were put under different levels of light everyday: Two-12 hour LED lights, two-16 hour LED lights, two-12 hour heat lamps, two-16 hour heat lamps, and two-24 hour natural light. While five of the samples were only creek and tap water, five others got extra help to grow with complete algae nutrients**.** Over the course of three months, these ten samples stayed under the lights and followed the schedule every hour of the day. At the end of the three months, it was discovered that the 16 hour heat straight creek and tap water grew the fastest and grew the most green algae, followed by the 12 hour heat straight creek and tap water. The four LED light samples all evaporated and left salt at the bottom of the mason jars. The 24 hour natural light straight creek and tap water also evaporated and left only salt. The two heat samples that had the complete algae nutrients grew a slight amount of brown algae on the bottom. The 24 hour natural light sample with the complete algae nutrients did not grow anything by the time of the conclusion of this experiment.

210. THE EFFECT OF HIGH AND LOW pH LEVELS AND CONDUCTIVITY ON *OCIMUM BASILCUM* GROWTH

Sean Young, Block 3 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisor: Mr. Jason Kelsey

Since the beginning of agriculture, most farmers have watered their plants with rain water, and once it became available, tap water or water from their public water system. Obviously, these types of waters allow plants to grow successfully, as it is still being used today. However, high and low pH and conductivity levels could have different effects on plant growth. The definition of pH is the measure of how acidic or basic a substance is. Conductivity in water is its ability to pass electrical flow. To test this hypothesis, sixty *Ocimum basilcum* (basil) plants were planted and watered. After a month of regular, unmodified growth, the surviving fifty plants were grouped into five groups of ten. These five groups were all watered with different types of water: rain water, basic water, acidic water, high conductivity water, and zero conductivity water. After two more months of growth, results were calculated. The results show that water with zero conductivity actually yielded better plant growth. The plants watered with zero conductivity water not only demonstrated a healthy growth over time, but they also grew taller than any of the other categories. The results collected in this experiment can be useful to farmers all across the world, as this type of water could yield better crop production.

EARTH AND ENVIRONMENTAL SCIENCE

301. DOES RUNNING TAP WATER LOWER THE QUANTITIES OF LEAD IN THE WATER?

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In some cities and towns around the world, lead contamination in tap water is a serious issue. This is especially the case where the water supply is contaminated with lead or if the house has lead pipes. Most houses built before 1986 have lead pipes which can increase the amount of lead in the water. This study tested the concentration of lead in tap water and saw if the lead was reduced when the tap was run for a minute as to if the sample had been sitting overnight in the pipes. Samples were taken from houses several towns in New Jersey including Bordentown, Stewartville, Hasbrouck Heights, and Little Ferry. At each location, two samples were taken. First, a first draw sample that had been in the pipes overnight. The other sample was collected from water that had been running for one minute after the first sample was collected. The 300 mL samples were then concentrated to 25% of the original amount of water. The water samples were mixed and reacted with calcium nitrate at 1ppm in 75mL of water to produce lead nitrate, which was tested in a spectrophotometer. It was hypothesized that if two samples were collected from each location, then the first sample would have a higher concentration of lead because the water would have more time to leach in the water from the pipes. The results from an ANOVA and a T-test showed that there was no significant difference between the concentration of lead between the locations or the two samples at the same location. However, there was a slight increase of lead in all of the second samples which could be attributed to various factors.

302. COMPARING GERMINATION OF SEASIDE GOLDENROD PLANTS IN DREDGED AND NON-DREDGED SAND

Brodie Michael Best, Block 3 Science Class, Marine Academy of Technological and Environmental Science (MATES), Advisor: Mr. Jason Kelsey

Seaside Goldenrod (*Solidago sempervirens*) is a plant located on dunes, essential for species migrating across coastlines or living there year round. This Goldenrod is well suited to the dune environment and provides food for many insects on the beach; it provides a habitat for birds that live near coastlines year round. This study is to determine the germination of the Seaside Goldenrod in dredged and non-dredged soils to establish if the nutrients (phosphorus and nitrogen) help the plant grow faster or differently. The two specimens were planted at different times, the duration of growth for each was tracked, and they were kept in a controlled environment with plenty of sunlight. The resulting data showed that the Goldenrod planted in dredged sand remained at one height for a longer duration than the Goldenrod planted in the natural sand which grew continuously. Unlike the initial hypothesis, non-dredged sand grew at a faster rate than dredged sand. During the experiment, water leaked from the containers. It was deduced that the dredged sand leaked more water than natural sand. Lettuce was used in different containers to help solidify the result which suggested similar results as the Goldenrod.

EARTH AND ENVIRONMENTAL SCIENCE

303. COMPARISON OF THE RESISTANCE TO ACID PRECIPITATION IN *PHASEOLUS VULGARIS* VARIETIES

Darren Bonifacio, Block 4 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisors: Dr. John Wnek and Mr. Jason Kelsey

Precipitation with acid components is known as acid rain. Over the recent decades, the acidity of precipitation has greatly risen among vast areas due to, primarily, the burning of fossil fuels. Acid rain can harm plants and soil, especially in some parts of the Midwestern United States, where varieties of *Phaseolus vulgaris* are grown commercially. This research was carried out in order to determine the optimal variety of *Phaseolus vulgaris* out of three varieties grown in the U.S. (black turtle, dark red kidney, and pinto beans). This variety must have the greatest resistance to low pH water conditions to grow. To achieve this, three varieties each with two groups were planted: one group was watered with distilled water with the average pH of rain (5.6) and the other with the average pH of acid rain (4.3). After 50 days, black turtle beans were shown to have the least difference between the average heights of their groups. Research was also performed by measuring the average chlorophyll fluorescence of the leaves of each of the groups. There was no significant difference between the differences of averages for the two groups of each variety.

304. THE EFFECT OF LOWER pH ON *AZOLLA CAROLINIANA*

Robert Eckert, Block 3 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisor: Mr. Jason Kelsey

Azolla caroliniana is a plant native to the southeastern United States. These plants, and others, can be affected by pollution from runoff and acid rain. These producers feed the bottom of food chains, which keep an ecosystem in balance. This study focused on the number and health of *Azolla caroliniana* in different pH conditions. White vinegar was used to change the pH of three dishpans of *Azolla caroliniana* and one dishpan was left untouched, with about 250 sample plants in each. Each affected dishpan was given an initial pH of 6.79, 6.85, and 6.87, in addition to the control being at 6.93. Each dishpan was left out for two weeks, with daily pH and numerical checks. The samples were exposed to natural light and local pond water, with the only changes being the addition of the vinegar and the addition of the plants themselves. The plant samples showed little negative impact, however, natural changes caused the pH to lower to, at the lowest, 5.79, before climbing once again. The plants died after the water pH had climbed to around 7.07 in each dishpan, and the control tank died not long after.

305. INVESTIGATING WHICH SALT MARSH VEGETATION ACTS AS THE BEST NATURAL NITROGEN AND PHOSPHORUS FILTER

Abigail Meyer, Block 3 Science Class, Marine Academy of Technology and Environmental Sciences (MATES), Advisors: Dr John Wnek and Mr, Jason Kelsey

Harmful Algal Blooms (HABs) are an apparent problem inBarnegat Bay. These form when excessive nutrients that promote the growth of phytoplankton, such as nitrogen and phosphorus, enter the watershed from runoff. Before the runoff hits Barnegat Bay, it goes through salt marsh vegetation first. The salt marsh vegetation acts as a natural filter for excess nutrients. In this project, two types of salt marsh vegetation were used: *Spartina patens* (Salt Meadow Cordgrass) and *Pancicum virgatum* (Switchgrass), along with a comparative coastal plant, *Carex Appalachica* (Sedge). Two flower pots of each type of plant were watered with a solution of water and fertilizer twice a week. The fertilizer-water solution was tested before and after it was filtered for nitrogen and phosphorus, as well as the soil. The data was collected using LaMotte Phosphorus Test Kits, LaMotte Nitrate Nitrogen Test Kits, and a LaMotte Deluxe Turf Lab. Switchgrass was found to filter out phosphorus the best, Salt meadow cordgrass and were found to filter nitrogen about the same but in different ways, through the soil and Salt meadow cordgrass through the water.

EARTH AND ENVIRONMENTAL SCIENCE

306. HOW DOES THE DEVELOPMENT OF LAND AFFECT THE WATER QUALITY OF TIDAL PONDS IN MONMOUTH AND OCEAN COUNTIES?

Julia Salmon, Block 4 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisor: Mr. Jason Kelsey

A tidal pond is a shallow coastal inlet or bay that's water level rises and falls with the tide. Tidal ponds that are directly connected to the ocean or rivers are breeding grounds to species of plankton, fish, crabs, and other saltwater organisms. Poor water quality of ponds such as these can directly affect species and surrounding land. Amount of developed land can play a large part in the water quality of these ponds. Wreck Pond is an example of a tidal pond surrounded by development. This pond is known to be dangerous to the surrounding towns. Wreck Pond regularly causes beach closings in the summer. Another pond in a highly developed area is Twilight Lake in Bayhead. With many busy roads surrounding it this pond does not have the best water quality. One pond that has no development surrounding it is a tidal pond located in Island Beach State Park. This is a protected area, so while there is no development to harm it directly, it suffers many of the same problems as Barnegat Bay. In general, areas with less development have better water quality. Results of my testing are found to be inconclusive. Only a few factors of water quality were tested. If others had been tested the results may have shown a greater difference.

307. THE EFFECTS OF TEMPERATURE AND WEATHER ON BODIES OF WATER IN OCEAN COUNTY, NEW JERSEY

Beth Stephens, Block 3 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisors: Dr. John Wnek and Mr. Jason Kelsey

There are many factors that create a healthy marine environment, but the most important are: dissolved oxygen, pH, salinity, nitrates, and turbidity. These five factors are very important when keeping a water source healthy because when they are affected the environment would suffer, which could affect civilization, humans, and wildlife. Bodies of water can be affected and harmed in many ways, but this study explores how temperature and weather changes affect the water. Ten different river, creek, or bay locations in Ocean County were used to examine the effects of temperature and weather on water. Dissolved oxygen tests and water samples were taken from each location twice during separate months to see how the temperature and weather changes affected the samples. Each sample was tested for pH, salinity, nitrates, and turbidity in the MATES Biology Laboratory. After analyzing the data using ANOVA: Single Factor tests for temperature, dissolved oxygen, pH, salinity, nitrates, and turbidity, the results varied. Overall, the results of the significant data showed that mild to high temperature and/or weather range increases the levels of key factors of a healthy environment.

EARTH AND ENVIRONMENTAL SCIENCE

308. THE EFFECT TANNIC ACID HAS ON THE pH OF FRESHWATER AND BRACKISH WATER CONTAINING *GRACILARIA TIKVAHIAE*

Kristen Weppler, Block 4 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisors: Dr. Wnek and Mr. Werner

Ocean acidification is a direct effect of climate change that is causing the pH levels of ocean water to decrease globally. Increasing the acidic content in ocean water and freshwater can have unfavorable effects on the marine environments; therefore, affective solutions are being researched in order to assist this growing problem. This study determined how the presence of *Gracilaria tikvahiae* in brackish water affected the pH level in comparison to freshwater when tannic acid powder was added. All samples were tested for pH, salinity, and tannins before and during the addition of tannic acid powder. Tannic acid powder was added to all samples daily. Every four days, all samples were tested again for pH, salinity, and tannins. After the first four days, a pH meter revealed a noticeable decrease in the pH level of the freshwater sample and a minimum decrease in the brackish sample containing *Gracilaria tikvahiae*. The freshwater pH level had dropped from 6.5 to 4.9, the brackish water samples had dropped from 7.3-7.4 to 7.1-7.2, and salinity showed slight decreases in all samples. Tannins increased to 37.56 ppm in all samples after starting at 0 ppm. In the following days, results were similar. After 13 days of adding tannic acid powder, the freshwater pH level dropped the most. Ultimately, the brackish water samples ended the experimentation being less affected than the freshwater sample because brackish samples contained *Gracilaria tikvahiae* and the freshwater sample did not. These results support the idea that seaweed presence reduces the effects of acidic conditions in brackish water.

309. A COMPARISON OF BIODEGRADABLE PLASTIC AND POLYETHYLENE DEGRADATION IN INCREASING SOIL ACIDITY AND ALKALINITY

Victoria Yakes, Block 4 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisors: Dr. John Wnek and Mr. Jason Kelsey

Biodegradable plastic (BP) was presented as a solution to plastic pollution; however, BP has its own set of problems. For example, most biodegradable plastics will only biodegrade under extremely specific conditions and must be sent to a specialized compost plant. This study attempts to understand the effects of increasingly acidic and alkaline soil environments on the degradation of polyethylene plastic (PE) and BP, to better understand the conditions plastics must be exposed to in order to decompose. During this study, small samples of PE and BP were buried in soil and treated with increasing volumes of an acid (acetic acid) and a base (ammonium hydroxide), to slowly increase the acidity or alkalinity. Samples were left for eight weeks in the soil to ensure sufficient time for degradation by microorganisms. After the eight weeks of treatment, the plastics were uncovered and measured with an electric micrometer to determine the amount of degradation based on the thickness compared to the original, untreated plastics. T-tests showed that the degradation of BP was significant in both acid and base; while PE showed no degradation. The data indicated that the greatest rate of decomposition was found in BP in increasing soil alkalinity. Results suggest that BP degrades at a significantly greater rate than PE and will have faster degradation rates in basic environments.

HEALTH, MEDICINE AND SPORTS

401. IMPROVEMENT OF A NOVICE RUNNER COMPARED TO AN EXPERIENCED RUNNER

Charles Burton, Block 1 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisor: Mr. Jason Kelsey

Improvement is a major component to any sport. The process of improving requires the team, and the individual to practice their skills as a group, and independently. There are many factors of improving, but also many factors that can prevent the individual from improving. Running related injuries are very common reasons why a runner is not able to improve throughout the season. Experienced runners and novice runners each have separate workouts that help the individuals in that group. A novice runner would not be able to complete the more intense workouts of an experienced runner, on the contrary, an experienced runner would not be able to improve if they performed the easy workouts for the novice runners. This research can help determine which demographic of runners is more likely to improve, and motivate individuals who want to improve themselves. With the averages of all the runners of the Southern Regional Boys Cross Country Team, it can be determined that novice runners improve more than the experienced runners. This is due to the fact that novice runners have more room to improve than the experienced runners. Experienced runners may be running times that are faster, but they are not improving as much as the novice runners.

402. WHICH NATURAL HOME REMEDY IS BEST FOR PREVENTING GROWTH OF *CANDIDA ALBICANS* COMPARED TO AN ANTIFUNGAL

Katherine Elmer, Block 4 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisors: Dr. John Wnek and Mr. Jason Kelsey

Candida albicans is a bacterial yeast found in almost everyone. Normally the yeast remains dormant, without causing any damage, but in some cases, it can cause harmful infections. These infections can also be called Oral Thrush. People who are most at risk are those that wear dentures, have diabetes, are immunocompromised, or take medications that lower immune response. Once someone has a *Candida* infection, they can develop numerous unpleasant symptoms such as painful white patches and a loss of taste. This study was conducted to determine the best natural home remedy for preventing the growth of *Candida* bacteria. Twenty-four Petri dishes were impregnated with *Candida albicans*, set up and left to grow in the incubator for twenty-four hours. The following day they were taken out and swished with one of the seven solutions (saltwater, baking soda, vinegar, lemon juice, mouthwash, distilled water, and Nystatin) for either 15 seconds, 30 seconds, or 1 minute, to replicate swishing out a mouth with a solution. Two plates were left without a solution as a control, to compare the growth of infections left untreated. Twenty-four hours later the data was analyzed. Based on the experiment, the nystatin covered the bacteria preventing further growth but left a viscous coating on the dish. The baking soda was the most effective of wiping out the *Candida* compared to all other home remedies. The average amount of bacteria was the least after swishing for a full minute.

403. THE EFFECT OF HYPOXIC TRAINING ON THE HEART RATE OF COMPETITIVE SWIMMERS

Joseph Victor Flores, Block 1 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisor Mr. Jason Kelsey

Swimmers are able to train and improve their bodies in many ways to become faster. This is partly due to the fact that swimming exercises most muscle groups. One of these various ways is hypoxic training. Hypoxic training drills are drills that limit the amount of breaths a swimmer is allowed to take. Training in low oxygen environments can aid in the increase of lung capacity and endurance. The aim of this experiment was to observe the effects of this type of training on heart rate. The data of this experiment can show the cardiological effects of hypoxic training. Subjects were split into two groups determined by gender. The boys were split further into three groups. Each group swam 4-50s with increasing breath intervals ranging from 3 to 9. Their heart rates were measured shortly after by counting the beats in a 10-second time frame and multiplying the value by 6. The results showed an initial increase in heart rate from the control to around the second trial for the most part. Some data, however, showed a decrease from trial 2 to 3. Overall, there were no statistical differences between the means of each group in all four trials.

HEALTH, MEDICINE AND SPORTS

404. THE EFFECTS OF BALLISTIC, ISOMETRIC, AND PASSIVE STRETCHING ON INDIVIDUAL'S FLEXIBILITY

Madison Fossa, Block 4 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisors: Mr. Dave Werner and Dr. John Wnek

Stretching can vastly increase the health of individuals in many different ways, and has been proven to influence both mental and physical health. Stretching increases the quality of life because it allows individuals to do everyday tasks with more ease. There are several types of stretches, and they each accomplish different goals. Isometric stretching is used generally to strengthen muscles. Ballistic stretching has temporary effects on flexibility and is best used when warming up. Passive stretching has the best effect on flexibility and gives lasting benefits. These methods cannot be used to accomplish the same goal. This study examined the use of these three different types of stretches to determine and prove which increases overall flexibility. Twelve individuals were split into three groups based on the three types of stretches. These individuals stretched for 3 weeks and the effect on their flexibility was measured after the end of these 3 weeks. The results showed that passive stretching and ballistic stretching were the most effective in increasing flexibility, but only by a very little bit. The data showed that the outcomes for each stretch weren't that different. The averages of the ballistic and passive forms of stretching were only separated by 7 degrees and also by 0.9 inches (22.86 cm). This difference is not significant overall.

405. HOW MUSIC EFFECTS FATIGUE IN EXERCISE

Christopher Frielinghaus, Block 1 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisors: Mr. David Werner and Dr. John Wnek

When exercising, one of the most prominent feelings the person exercising will experience is fatigue. The fatigue a person feels will mostly determine the duration and stop time of their workout. I hypothesized that when listening to music while exercising a person will feel less fatigue, therefore allowing them to exercise longer. I gathered 5 males from the freshman class (ages 14-15) at M.A.T.E.S., and had them each run on the treadmill one at a time. A FitBit recorded their heart rate during the test, and after each trial their rate of perceived exertion (RPE) was recorded. Each participant ran for 10 minutes on the treadmill without music as a control, while their heart rate was being monitored by the FitBit. After each participant was finished I recorded their max heart rate, average heart rate, and RPE. Then two days later, they performed the same experiment, but this time while listening to music of their choice. I compared the data from all trails, and as predicted results indicated that while listening to music a person's average and maximum heart rate were lower, compared to without music. Longevity and duration are important to all who exercise and this experiment shows a possible and valid method to improve a successful exercise session. A trend was demonstrated; however, the small sample size needs to be expanded to make more concrete conclusions

HEALTH, MEDICINE AND SPORTS

406. THE EFFECT OF PHARMACEUTICAL EXCIPIENTS ON THE DISSOLUTION OF COMMON MINERAL SUPPLEMENTS

Sarah Grenz, Block 4 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisors: Dr. John Wnek and Mr. Jason Kelsey

A controversial issue is whether or not companies should include pharmaceutical excipients as ingredients in supplements. Excipients have no medicinal values but can act as fillers, binders, flow agents and more. Some companies try not to include them as an appeal to all audiences such as vegetarians or vegans. The purpose of this research project is to determine if the use of excipients has an effect on the dissolution of common mineral supplements. The chemical-aspect of the human stomach was mimicked using a solution of hydrochloric acid, sodium chloride, potassium chloride and bicarbonate. Temperature, movement and chemical profile of the human stomach were mimicked as best as possible. Three minerals were tested (magnesium, selenium, and iron), each of which had two supplement representatives; one supplement with excipients and one without. Each supplement was tested three times, so there were a total of eighteen trials. Although there was no statistical significance derived from comparison between supplements with and without excipients, a visual trend is discernible in the bar graph. For each mineral, the supplements with excipients clearly took longer. Therefore, there is a qualitative trend that supplements with excipients have a longer dissolving time than without, suggesting that supplements without are easier to digest and metabolize. Overall, companies should be concerned about the excipients put in their supplements because supplements should dissolve as fast as possible to ensure the majority of the contents are absorbed into the bloodstream.

407. HOW CARDIOVASCULAR EXERCISE AFFECTS MEMORY

Logan Gross, Block 4 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisor: Mr. Jason Kelsey

Every day students are asked to remember various topics. This can be very difficult and overwhelming, so students need memorization techniques. The purpose of this study is to analyze students' ability to remember information with and without exercise. This study analyzed students' scores on memory tests after they had exercised to students' scores on memory tests without any exercise prior to the tests. These tests were taken by five freshmen students ages 14 and 15. The students' test scores after they had exercised were found to be higher than their scores without any exercise prior to testing. In this study exercise was shown to be a useful resource for students to use in order to retain more material, as well as stay physically fit. Further studies are needed to determine the validity of this statement.

HEALTH, MEDICINE AND SPORTS

408. COMPARING PROBIOTIC FOODS AND COMMERCIAL PROBIOTICS TO INCREASE THE AMOUNT OF *LACTOBACILLUS* SPP.

Bethany Suliguin, Block 1 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisors: Dr. John Wnek, Mr. Jason Kelsey, Dr. Renato Alberto, M.D., Dr. Priscilla Alberto, M.D., Dr. Timothy Gabriel, M.D., Dr. Martin Jimenez, M.D., and Sheila Alberto

The incorporation of probiotics into people's diets has been happening for many centuries and has been rising due to their potential health benefits. *Lactobacillus*, a common genus of probiotic bacteria, is found in many forms, mainly dairy products and supplements. Supplements and foods were tested to see if one group would have more *Lactobacillus* spp. production and if there was one standout product. It was hypothesized that supplements would do better in producing *Lactobacillus* spp., while Nutricost, the supplement with the highest labeled colony-forming units (CFU), would do the best. Each product was placed in a water and hydrochloric acid solution, swabbed onto MRS Agar plates, and incubated for 24 hours. After experimentation, it was found that Yakult, a probiotic food, produced the most bacteria, and all the foods produced more bacteria than the supplements; Contrastingly, Nutricost, the predicted highest producer of *Lactobacillus* spp., produced the least. This result could be due to the erroneous labeling of live bacteria in each supplement. The only significance in the number of bacteria produced was between Nutricost and Yakult; the other combinations are insignificant. This research could help patients and doctors develop a better understanding of which products are best-fit for a consumer.

409. AROMATHERAPY: THE EFFECT OF *LAVANDULA ANGUSTIFOLIA* ESSENTIAL OIL ON QUALITY OF SLEEP

Megan Thomas, Block 4 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisors: Dr. John Wnek and Mr. Jason Kelsey

Getting good quality sleep is a very vital part in overall health during adolescence. High school and middle school students often experience declines in sleep quality due to factors such as stress and anxiety. Poor sleep can cause a multitude of health problems as well as decrease a student's ability to stay awake, focus and comprehend during school the following day. Aromatherapy is the practice of inhaling or topically applying essential oils to improve a person's health. *Lavandula angustifolia* essential oil is a commonly used oil in aromatherapy to improve sleep because it has sedative and anxiolytic properties. The chemicals linalyl acetate, linalool, and caryophyllene are responsible for these properties due to how they heighten the effect of acids on the amygdala. The aim of this research was to see if sleep quality would increase in students when inhaling lavender before going to sleep. To understand the short-term and long term effects, 26-29 male and female students participated in the experiment for 7 consecutive days while 26-29 male and female students participated in the experiment for 21 consecutive days. Each student was asked to complete the Pittsburgh Sleep Quality Index (PSQI) before and after the experiment. Data was also collected on how each student slept for each day of the experiment. The results show that the students who slept poorly benefitted more than good sleepers and had a greater difference between the scores of the pre and post PSQI.

MARINE SCIENCE

501. CONTRASTING THE EFFECTS OF WATER SALINITY AND TEMPERATURE ON *TETRASELMIS*

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Throughout Earth's bodies of water, fluctuating temperature and salinities break up the water flow with physical-acting barricades. Phytoplankton, the most abundant and important food source along the marine life food chain, rely on ocean currents to disperse the water. These microorganisms supply nutrients to some of the largest beings on the planet. From the smallest mussel to the largest whale, phytoplankton makes a full circle around the food web. The motive for this research was to see how different temperatures and salinities affect the growth rate of phytoplankton colonies containing *Tetraselmis.* The experiment was conducted using six containers each equipped with aerators to ensure air flow, three with varying temperatures and three with varying salinities. Specimens were exposed to a growth light for 10 days while optical density was recorded daily using a secchi stick. The results of this experiment revealed how adaptive this species of phytoplankton turned out to be. Most of the data resembled each other, not showing much difference between temperatures and salinities. On a global warming scale, these results could mean that microorganisms similar to *Tetraselmis* will be able to withstand rising ocean temperatures.

502. HOW DOES CHANGING THE AMOUNT OF CARBON DIOXIDE IN WATER AFFECT THE HATCHING AND GROWTH RATES OF BRINE SHRIMP

Alanna Costello, Block 3 Science Class, Marine Academy of Technology and Environmental Science (MATES)
Advisors: Dr. John Wnek and Mr. Jason Kelsey

Many organisms in the ocean rely on a hard exoskeleton to protect them from predators and other dangers in the waters. Others rely on their size for hiding from predators or attacking prey. But due to ocean acidification, these organisms are slowly beginning to lose their ability to have a well-grown exoskeleton and body. Ocean acidification is the amount of carbon dioxide in the water, mainly from the air surrounding it. However, it can be detrimental to some of the organisms within the ocean. Ocean acidification can have many effects on organisms but can differ depending on the species. Some effects it may have on organisms include deteriorating of their exoskeleton, or not allowing them to even grow them completely. For my experiment, I hatched brine shrimp eggs in five different tanks, each with a different acidity level. One was the average amount in the ocean currently, and then two with higher amounts of carbon dioxide, and two with less carbon dioxide. I observed and calculated the hatch rates, along with the size of the shrimp, and any observations that I had made. Specific observations that I was looking for had been color differences, major declines in mortality, and any noticeable mutations or changes to the shrimp. The concluding data displayed that the tanks that had less carbon dioxide in them, had the most shrimp alive in the end, along with the greatest sizes.

MARINE SCIENCE

503. THE EFFECTS OF VARIOUS PESTICIDES ON *PALAEMONETES SP.*

Sophia D'Arienzo, Block 1 Science Class, Marine Academy of technology and Environmental Science (MATES), Advisors: Dr. John Wnek and Mr. Jason Kelsey

Pesticides are used for killing insects in order to save surrounding plant life. However, they can also disrupt the physical, biological, and chemical conditions of the water. As a result, the water is deemed toxic and unfit for life. In this research, BioAdvanced, Sevin, and Dr. Earth insect killers will be used. The experiment will focus on grass shrimp (*Palaemonetes sp.*) and how this species is affected by pesticide runoff as a representative for all marine invertebrates. Active ingredients in BioAdvanced Insect Killer include imidacloprid and cyfluthrin in which both are harmful and possibly deadly to aquatic invertebrates. In Dr. Earth Yard and Garden Insect Killer, active ingredients include glycerin, lecithin, and various natural oils. Large glycerin spills have caused large amounts of aquatic populations to die but toxicological studies have shown that lecithin has a very low toxicity level. Sevin Insect Killer has the active ingredient of Carbaryl, a man-made pesticide, that is highly toxic to aquatic invertebrates, such as shrimp. If pesticides enter a body of water, then surrounding marine life, such as shrimp, will be harmed due to the various chemical products found in pesticides. Results have shown that overall, water levels, such as dissolved oxygen, phosphates, and nitrates, were unaffected by the introduction of pesticides. As the amount of pesticides that were added to the water lessened, the mortality rate lessened as well. Therefore, *Palaemonetes sp.* are greatly affected by the toxic chemicals used in everyday pesticides.

504. THE EFFECT OF DIFFERENTIATING SALT LEVELS ON THE INCUBATION AND GROWTH OF BRINE SHRIMP

Bryce Davenport, Block 1 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisors: Dr. John Wnek and Mr. Jason Kelsey.

The presence or absence of salinity in salt marsh in extreme variations commonly leads to instability, and loss of function , throughout the environment. At the center of this environmental change, are the base organisms that relay energy all throughout the food chain. Included here, are the shrimps and plankton that are heavily affected by even the slightest change in water parameters. In this project, extreme salinities and Brine Shrimp (*Artemia* golden lake) were used to examine the ongoing effect on salt marshes. Some characteristics observed, such as activity and the behavior of the shrimp, such as their observed movement, correlated better with lower salinities. Furthermore, this point can be accompanied by support from the highest salinity tank, at 40 ppt, such as the varying colors along with about 29 grams of unhatched and/or dead eggs in the end. In other words, the lower salinity environments, such as the tank at 20 ppt, correlate with greater activity and growth of base organisms; meanwhile, the highest salinity environment showed little to no signs of life, activity, and growth. This project showed the measurable effects that salt has on a base organism such as Brine shrimp, and therefore, the effect it will eventually have on other organisms up the food chain.

MARINE SCIENCE

505. ANALYZING THE EFFECTS DIFFERENT SODIUM CHLORIDE CONCENTRATIONS HAVE ON *MICROCYSTIS AERUGINOSA*

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The major cause of algae overgrowth, climate change, has exponential negative effects- one of which is harmful algal blooms. Harmful algal blooms (HABs) are algae colonies that are produced in eutrophic conditions that become toxic to the surrounding environment. One of the most common harmful algal blooms is *Microcystis aeruginosa*. With climate change being a constant change, this leaves *Microcystis aeruginosa* to grow infinitely, with little to nothing to do about it; which allows its negative effects, including oxygen depletion, sickness to seafood and humans, and even death, to take over the environment. The purpose of this study is to grow *M. aeruginosa* in different salinities and observe in which salinity the algae stopped and/or grew significantly less in. The organisms were all grown in 1 part algae to 3 parts distilled water under fluorescent lights for 12 hours a day to see if there was a significant difference within their appearance and chlorophyll-a content based on their salinity level. In an ANOVA test, comparing the slopes within each salinity, it concluded that the average growth rates were significantly different from each other; the average growth of algae in greater than or equal 9 ppt having significantly less growth rates than lower salinities.

506. THE EFFECTS OF MICROPLASTICS ON PHYTOPLANKTON

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Microplastics in our oceans have become an enormous problem for all marine organisms. Phytoplankton are a crucial food source for the rest of the oceanic food chain, and microplastics affecting them would be exponentially detrimental to the food chain. In order to analyze the condition of the oceanic food chain, I decided to start from the bottom and research the effects of microplastics on phytoplankton. To do this, I replicated and grew phytoplankton in an environment extremely similar to that of the ocean. I set up two medium-sized containers with 1500 ml of water in each and added 20ml of phytoplankton to both containers. Aerators were placed in both containers, and nutrigrow was regularly added. One hundred 0.4mm microbeads were added to the second container (Container B). The results of this experiment suggest our worst fears: Microplastics substantially hinder the growth of phytoplankton. This means that phytoplankton will not be able to grow as fast as it is being consumed, thus leading to starving in the marine food chain. Three experiments were conducted to see the effects of different sizes of microplastics and different components of microplastics. The two chemicals in microplastics found to be the most harmful and hindering to phytoplankton were phthalates and polyvinyl chloride, also known as PVC.

MARINE SCIENCE

507. THE EFFECTS OF VARYING NITROGEN CONCENTRATIONS ON THE BIOLUMINESCENCE AND GROWTH OF *PYROCYSTIS FUSIFORMIS*

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One of the most challenging environmental problems in the world today is nutrient pollution. Excess nutrients can cause an increase in the growth of algae. This study focuses on the effects that excess nutrients have on *Pyrocystis fusiformis*. *Pyrocystis fusiformis* is a non-toxic marine dinoflagellate referred to as the "firefly of the sea" because of its bioluminescent property. Additionally, it was performed to determine if there is a relationship between the bioluminescence and the growth of this specific algae culture. Fifteen cultures of *Pyrocystis fusiformis* were examined. Nitrogen was added to each culture (except the controls) in the form of sodium nitrate in incremental concentrations. Three cultures of each concentration were used to maximize data collection. Cultures were kept in a cardboard chamber with an LED light and a 12-hour timer for approximately five weeks. Chlorophyll content, turbidity levels, and bioluminescence were collected once a week. The experiment proved that group three had the ideal level of salinity and the highest chlorophyll concentration of all the cultures. In this study it is uncertain whether there was a direct correlation between the chlorophyll level and bioluminescence. Lastly, the photometer was not sensitive enough to measure the light emitted by the dinoflagellates.

508. HOW VARYING SALINITIES AFFECT HATCHING RATES OF *ARTEMIA SP.*

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Salinity is a measurement of how much salt is present in the water at a certain time. Salinity is measured in parts per thousand (ppt) and for reference average open sea water is about 35 parts per thousand. The purpose of the experiment was to see how different salinities affect the hatching rates of *Artemia sp.* The brine shrimp cysts (eggs) were put into waters of 15, 25, 35 and 45 ppt for five days. The cysts were filtered out of the water using gravity filtration and then counted to see how many didn't hatch. From there it is possible to find out how many of the eggs did hatch. The trend of the data shows that salinity greatly affects the rates at which eggs hatch. The outcome of the experiment is important because, as the ice caps melt, the salinity of the water will decrease because of the influx of freshwater. Animals will be affected by this change in salinity and spawning rates is just one way on which they will change. They might increase or decrease depending on the species, but the overall change is not good for food webs and/or ocean ecosystems.

MARINE SCIENCE

509. SEASONAL COMMUNITY SHIFTS AND OVER WINTER POPULATIONS OF FISH AND CRUSTACEANS IN NORTHERN BARNEGAT BAY

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Barnegat Bay is a unique estuary ecosystem with many different types of habitats that are home to many different aquatic organisms. The populations of these organisms are more, well known over the summer and warmer months. However, these populations over the winter are known and studied less because of the cold temperature and reduced recreational activity. The purpose of this project was to survey different boat basins of northern and southern Barnegat Bay to sample what the fish and crustacean population is like in two different parts of New Jersey. To do this, I deployed three Gee's® G-40 minnow traps at 3 different locations in the Northern Barnegat Bay. Those sites were the boat basins of Lavallette Yacht Club, Seaside Park Yacht Club, and Mantoloking Yacht Club. Once a week from early October to late January, the traps were pulled and the species were counted and measured, and then released back into the study area. The same methods that were used here are used by Rutgers University to do the same study at at the Rutgers University Marine Field Station (RUMFS), located in Little Egg Harbor at the far-southern end of Barnegat Bay. I took my data and the data from the RUMFS survey and compared them both. The results of my study showed that Lavallette Yacht Club had the most diversity out of all four locations. RUMFS's data had very little to show. Seaside Park and Mantoloking Yacht Clubs also had consistent amounts of fish and shrimp pulled every time like Lavallette did. In the winter months, the only species pulled up were two shrimp types: *Palaemonetes spp.* and *Crangon septemspinosa*. From the results, it can be determined that aquatic populations move farther north as the winter goes on and fish travel elsewhere as shrimp populations tend to stay. Factors that affected these results were the varying temperatures and salinities of the water throughout the testing period.

MICROBIOLOGY

601. THE EFFECTS OF COMMERCIAL VERSUS NATURAL HAND SANITIZER INGREDIENTS ON THE BACTERIA GROWTH OF *ESCHERICHIA COLI*

Tia Argento, Block 1 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisor: Dr. John Wnek

The use of hand sanitizer has increased over the years and is used by millions of people. However, scientists have been trying to find replacements for the alcohol content in these sanitizers due to ingestion problems and the long term effect they have with destroying the natural oils of skin. Scientists are trying to reinstate the main alcohol ingredient with replacement ingredients so in turn the hand sanitizers are more natural. In this study, the batericia growth of *Escherichia coli (E. coli)* was compared by different ingredients from both natural and commercial hand sanitizers. Treatment in this study included isopropyl alcohol which is commonly found in commercial hand sanitizers. Furthermore, this study also included witch hazel, aloe vera gel, and vitamin E oil which are found in natural hand sanitizers. *E coli* is a very dominant bacteria and was the control variable due to the relationship it has with the human body, just as hand sanitizer does. An ANOVA test was run comparing the data produced by all types of hand sanitizer tested. A p-value of 0.8666 was calculated, meaning there was no significant difference between the ingredients. However, the data produced showed that Vitamin E Oil worked the best out of all of the natural ingredients tested. This means that Vitamin E Oil could possibly replace the substantial amount of isopropyl alcohol contained in future hand sanitizers.

602. THE EFFECT OF INVERTASE EXPOSURE IN VARIOUS BEVERAGES

Hailey Hart, Block 2 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisors: Dr. John Wnek and Mr. Jason Kelsey

Invertase is an enzyme that is produced naturally in the human body and can be found in saliva. Invertase is one of the enzymes that is responsible for breaking down sucrose molecules into either glucose or fructose. This process of breaking down and rearranging the molecules is called hydrolysis. The aim of this research was to observe how efficiently invertase was able to break down the sucrose in different beverages. Ten different beverages were used in this experiment and are as follows: Shoprite Apple Juice, Pepsi, Monster Blue, Arizona Sweet Tea, whole milk, Minute-Maid Lemonade, Tropicana No Pulp Orange Juice, Orange-Flavored Gatorade, Vitamin Water Focus, and C2O Coconut Water. Each beverage was poured into a cup. Each drink's glucose level was tested using a urine glucose test strip before the addition of invertase. Invertase was added into each of the cups. The beverages were allowed to rest for one minute and then tested again. This process was carried out four times with each beverage. After all the data was collected, a T-Test was run. The results of the T-Test showed that the beverage's glucose content was significantly higher in certain beverages like Pepsi had increased more so than the drinks that did not contain as much artificial sugars. All 40 tests showed a significant increase in glucose levels across the board.

603. DOES TIME EXPOSED AFFECT BACTERIA GROWTH IN WATER

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Bacteria are found on every surface that one has ever and will ever touch. Even humans are completely covered with bacteria. The surfaces that bacteria are found on even encompass food that one eats and liquid that one drinks, though food and drink should have significantly fewer bacteria when prepared well. This investigation shows that if water is left out in a contaminated household environment for varying periods there is no correlation to the number of bacteria present in the water to the amount of time that has passed since the water was left out. This is supported by the number of bacteria colonies found in samples of the water that were grown in nutrient agar. The number of bacteria colonies found randomly spiked and fell from trial to trial. This is most likely because common tap water does not contain excessive amounts of nutrients. Since bacteria naturally move in the direction of nutrients and other chemical stimuli in a process called chemotaxis, a lack of nutrients in the water means that the bacteria would not move towards it. The hypothesis that water left out in contaminated household air for longer periods would contain more bacteria was not supported.

MICROBIOLOGY

604. ANALYZING THE AMOUNT OF BACTERIA ON THE SURFACE OF PHONE CASES

Scott Miller, Block 4 Science Class, Marine Academy of Technology and Environmental Science (MATES),
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Bacteria is a life form present around the world and is found on surfaces like phone cases. Since phones are something that many people use and depend on, it would never come across someone's mind that their phone is covered with bacteria. If people were aware about the amount of bacteria on their phones they could clean them more, preventing the spread of germs. The three main types of phone cases that were tested on during this project include: smooth, rubber, and engraved surfaces. Throughout this study the three different types of phone cases were swabbed and tested for bacteria, using an agar bacteria test which uses Luria broth agar to create bacteria growth. An ANOVA test was conducted and produced a p-value of 0.734. The rubber surfaces on average had a larger amount of bacteria coverage, then the engraved surfaces, and the smooth surfaces had the least amount of bacteria coverage. Bacteria have capsules that surround them which allow them to attach to surfaces. If an object has a greater surface area, the percentage of bacteria on that object will increase. Overall, phones with rubber surfaces had a larger amount of bacteria coverage which was unexpected.

605. THE EFFECT OF DIFFERENT SWEETENERS ON THE ANAEROBIC RESPIRATION OF *SACCHAROMYCES CEREVISIAE*

Brianna Suliguin, Block 1 Science Class, Marine Academy of Technology and Environmental Science (MATES),
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Yeast is a common ingredient in baked goods such as bread, as it contributes to aeration, flavor, and color of these products. Scientists use yeast in order to simulate and understand cellular processes. The most common species of yeast is baker's yeast, or Saccharomyces cerevisiae, which breaks down sugars during aerobic and anaerobic respiration to survive. Saccharomyces cerevisiae was tested to find differences between the metabolism of monosaccharides and disaccharides. A total of ten different sugar derivatives were used. In order to quantify the yeast respiration, the amount of gas released by the yeast was recorded every two minutes via water displacement from the gas, and each trial lasted 30 minutes. The data was separated into two groups: simple or complex sugars and natural sugar derivatives; Subsequently, a graph was created of the average respiration of yeast with each sugar derivative. The study revealed that while most of the sugars had similar gas output by yeast, light corn syrup and maltose did not have statistically similar gas output to maple syrup and honey. This research suggests that light corn syrup and maltose are not easily metabolized by yeast, while maple syrup and honey are quickly digested by the organisms.

606. TESTING THE SUSCEPTIBILITY OF *E. COLI* TO PENICILLIN USING VARIOUS BIOENHANCERS (HERBAL EXTRACTS FROM THE *ZINGIBERACEAE* & *CAPRIFOLIACEAE* FAMILIES

Julia Takla, Block 4 Science Class, Marine Academy of Technology and Environmental Science (MATES),
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Antibiotic resistance is the ability of microbes to resist the effect of medication. This has become a global concern for the reason that 2.8 million people are affected yearly. A bioenhancer is an agent capable of enhancing bioavailability and efficacy of a drug with which it is co-administered, without any pharmacological activity of its own at therapeutic dose used. Several conducted studies showed that bioenhancers can reduce the development of antibiotic resistance. In this experiment, various bioenhancing agents were used synergistically with penicillin to test their combined effect against *Echerichia coli.* Bacteria were applied onto petri dishes and herbal extracts from the *Zingiberaceae* and *Caprifoliaceae* families were added to 10-mcg5 penicillin sensitivity discs. The extracts included Japanese honeysuckle, valerian extract, and *Alpinia galanga*. These discs were added to the plates and after being left for 72 hours, developed a ring of clear area. The diameters of the zone of inhibitions were recorded and then compared to those of the penicillin exclusively. The general trend of the data showed that there was a slight increase of the zone of inhibition with bioenhancers (specifically the Japanese honeysuckle) as compared to without it. This indicates that there could be more plant-based antimicrobials that can serve as a temporary aid against antibiotic resistance.

SCIENCE, TECHNOLOGY, MATH AND ENGINEERING (STEM)

701. THE EFFECT HEAT EXPOSURE HAS ON PLASTIC WATER BOTTLES CONTAINING BISPHENOL A

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Plastic can be found everywhere--from car parts to your shower curtain. Unfortunately, although plastic is revolutionary and useful in many ways, it is made with chemicals; some of which are detrimental to human health. One of these chemicals is Bisphenol A, also known as BPA. Bisphenol A has been used in the manufacturing of plastic water bottles since the 1960s. It has been theorized and commonly believed among people that Bisphenol A leaks from the plastic when it is heated, and therefore contaminates the water, which can be harmful to humans. In my research, I set out to find the amount of Bisphenol A contained in water from common-brand plastic bottles; both normal and heated. To calculate this, an ultraviolet-visible spectrophotometer was, which transmits a wave of light through the water, and calculates how much light was absorbed by the substances in the water. Bisphenol A absorbs the most light at the 230nm-270nm ultraviolet light range, so 260nm was used to ensure the results were accurate. It was found that before the plastic was heated, there was virtually no Bisphenol A contaminating the water sample. However, after microwaving the water bottles for ninety seconds, the amount of Bisphenol A found was significantly greater. In conclusion, drinking from room temperature plastic water bottles should not have any detrimental health effects on you; but be sure not to drink from plastic bottles that were in a hot atmosphere, such as your car on a hot summer day.

702. BRAINWAVE TECHNOLOGY FOR CONTROL OF 3-D PRINTED PROSTHETICS

Emma Engle, Block 3 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisor: Mr. Jason Kelsey

Through this experiment, 3-D printing, brain computer interface technology, and programming will be applied for the design and development of a low-cost prosthetic arm that can perform movements even more similar to regular body functions than other designs. Each of the individual pieces forming the prosthetic will be designed, 3-D printed, and pieced together. The brain computer interface technology in the form of a research-grade bluetooth EEG headset will be incorporated with arduino-compatible programming softwares through a serial communication port at 9600 baud rate to test if brain wave signals can control the custom-designed prosthetic in this experiment. The data recorded by the headset will wirelessly transmit the brainwave recordings to the computer or laptop where it will be sent through the communication port on the laptop to the arduino board. The arduino board will then send the programming for a specific function that the arm will perform corresponding to the nerve impulse signals recorded. The program sent to the motors will allow the arm to carry out the specific function such as opening the hand. If successful, this could create an easier, more convenient and more enjoyable lifestyle for people with life-changing conditions such as paralysis. It can provide them with the capability to perform a wide range of motions or actions that had been lost and to perform them with more ease than that of most other prosthetic models.

703. AN ANALYSIS OF WHAT MAKES A CHART-TOPPING SONG USING STEM

Thomas Hagan, Block 1 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisors: Dr. John Wnek and Mr. Jason Kelsey

Popular music is a broad spectrum with seemingly endless variations of melodies, chords, and lyrics among other things. While yes, these songs can differ widely and almost no two songs will ever be the same, similar aspects can be found throughout. The objective of this analysis was to look at music's core elements and see if any particular factors are common in music on the "Billboard Hot 100." For this case, the study focused on genre, tempo, key, and time until the lyrics came in. To give context, beats per minute is calculated by counting the amount of quarter notes (beats) that occur in a one minute interval. The data set includes 16 weeks worth of "Hot 100" lists. After analysis of the data, several conclusions could be made. The most popular genre was hip-hop/rap, the most common interval of tempo (in beats per minute) was 91.6 BPM to 99.8 BPM, the most common key was C major with more major keys than minor keys in general, and the most common interval of time before the lyrics came in was 10-12 seconds.

SCIENCE, TECHNOLOGY, MATH AND ENGINEERING (STEM)

704. THE EFFECT OF DIFFERENT COMMON LIQUIDS ON DENTAL EROSION OVER TIME

Blake Austin Jankowski, Block 3 Science Class, Marine Academy Of Technology and Environmental Science (MATES), Advisor: Mr. Jason Kelsey

Dental (enamel) erosion is an issue that affects over two billion people all over the world. The term dental erosion is defined as "the irreversible loss of tooth structure due to chemical dissolution by acids without the involvement of microorganisms". This study examines the loss of mass along with the discoloration of teeth due to common household liquids over a period of time. This study was done with five liquids, those liquids being distilled water (control), coke, diet coke, a kombucha drink, and orange juice. A total of 30 teeth were used in the experiment (six teeth per liquid). The study was conducted by immersing each tooth in its selected liquid for increments of 24 hours for 7 days. After every increment was completed the teeth were removed from their liquid and thoroughly dried then measured and placed back in their liquid. The average loss of mass (in grams) was 0.011 as compared to coke which was 0.022, diet coke which was 0.038, a kombucha drink which was 0.041, and orange juice which was 0.020.

705. THE EFFECTS OF AIR FLOW IN COMPUTERS RELATING TO DUST BUILDUP

John Kim, Block 3 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisors: Dr. John Wnek and Mr. Jason Kelsey

Computers contain many heat-generating components. They are usually cooled by pushing cool air over them with at least 1 fan. Dust-laden air gets pushed in by the case fans of a computer, but once it is inside the case, it slows down and produces a suitable environment for the dust particles to settle on the surfaces of many computer components. As dust builds up, the temperatures of the components rise and performance can drop. It can also be a safety hazard because it can catch fire. This study examines how pushing air in with the fans in different ways affects the amount of dust buildup. Temperatures while idle and while under load were recorded. To test the CPU and GPU's performance, the programs Cinebench and Heaven were used. Scores from these programs were recorded. However, the data gathered and recorded does not show any significant correlation between each setup. The test scores and temperatures do not vary much, and this can likely be attributed to the fact that not enough dust was collected in each setup to see any variation between the temperatures and scores.

706. AN ANALYSIS OF HOW MODERN TECHNOLOGY HAS DIRECTLY IMPACTED MUSIC: WHAT DO THE NUMBERS SAY?

Matthew McWeeney, Block 1 Chemistry 1 Class, Marine Academy of Technology and Environmental Science (MATES), Advisors: Dr. John Wnek and Mr. Jason Kelsey

Music, ever since its first conception, has been evolving for a variety of reasons. One notable and relatively recent cause for change is the introduction of modern technology, which made its forever-lasting impact in four primary ways: how music is made, what music is made with, how music is distributed, and how it has impacted music through everyday technology. With an objective to show that modern technology has a direct relationship with music's six unique elements, a total of 134 of the most popular songs of varying genres from 1970-2019 were analyzed. Various data regarding the evolution of technology were collected as well, such as the units of something sold or amount of influence during a specific period in time, which the songs were subsequently sourced from as well. The six characteristics of music that were rated are the following: melody, harmony, dynamics, time signature, tempo, and form. Using T-tests, linear regression, observations, and various other methods of data processing, it was shown that technology itself has not made a very substantial direct effect on music; however, other patterns and trends were discovered along the way regarding the general evolution of music, regardless of if it was a direct result of technological advances or not.

SCIENCE, TECHNOLOGY, MATH AND ENGINEERING (STEM)

707. THE EFFECTS OF RADIO WAVES ON CO-CHANNEL INTERFERENCE

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Advisors: Mr. David Werner and Dr. John Wnek.

Co-channel interference (CCI) is when two WiFi signals overlap and devices can be detected by both WiFi signals. CCI is an issue because it can cause serious WiFi speed reductions. WiFi blocking paints are most commonly used to prevent CCI. This study seeks to prevent CCI using radio waves. The radio waves were created by 2 Arduino UNOs along with 20 nRF24L01+. The Arduinos and transmitters were affixed to 2 5ft (076 m) tall wooden stands and placed 5 feet apart. All nearby electronic devices were unplugged. On one side of the posts was a WiFi source and on the other was a computer. The goal is the computer being unable to detect the WiFi. For each trial, the arduinos were turned on then the WiFi ping, upload speed, download speed, and connection statuses were tested 3 times and noted. This process was then repeated with the Arduino boards having a smaller and smaller delay between signal transmission. The results were recorded in a table. According to the table, as delay length decreased there was noticeable drop in upload speeds and a minor drop in ping; however, download speed and connection status remained unchanged. Results suggest that stopping CCI using radio waves is possible but it will require more radio waves.

708. EFFECTS OF BUILDING PLACEMENT ON WIND FLOW AND TURBULENCE

Gavin Ramins, Block 1 Science Class, Marine Academy of Technology and Environmental Science (MATES),
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Building placement can have many adverse effects on how wind flows through a city. In order to combat this, cities have to be designed in order to maximize efficiency while putting the safety of pedestrians as the number one priority. There were two phases used during this research project. The aim of this project is to see how to best arrange a small city, and this was accomplished in the first phase by making a model city using a ratio to scale it down, then putting it in the MATES wind tunnel. The model was kept in the tunnel at various speeds until a stable reading was obtained. After results were taken from each wind speed and various city designs, phase two of research began. Phase two used a Computational Fluid Dynamic Model (CFD) to see what the windflow between each building and how turbulent the wind would get. The results specify that #3 was the best city design in terms of minimizing turbulence, with wind flow of 6.5 miles per second.

709. THE EFFECT THAT DIFFERENT AMOUNTS OF VARIOUS SPF LEVELS OF SUNSCREEN HAVE ON PROTECTION AGAINST ULTRAVIOLET RAYS

Emilia Savich, Block 3 Science Class, Marine Academy of Technology and Environmental Science (MATES),
Advisor: Mr. Jason Kelsey

Ultraviolet (UV) rays are split into three categories: UVA, UVB, and UVC. UVA rays play a major part in skin aging and wrinkling and may initiate the development of most skin cancers. UVB rays are the main cause of skin reddening and sunburn, and they play a key role in the development of skin cancer. UVC rays are blocked by the ozone layer and do not reach the Earth's surface. Sunscreen protects against UV rays by either reflecting them or absorbing them. A sunscreen's SPF (Sun Protection Factor) number indicates what percentage of UVB rays it is able to block. A larger SPF number protects against more UV rays. This study analyzed how the SPF number and the amount of sunscreen used affected the length of time the sunscreens were able to protect against ultraviolet radiation. Different sunscreens with SPF values of 15, 30, 50, and 100 were sprayed on plastic pony beads that changed color when exposed to UV rays. This was repeated with one spray, two sprays, and three sprays. The beads were placed underneath a UVB lamp and later a UVA lamp. The length of time it took for the beads to change color was recorded. ANOVA tests mostly showed that there was a significant difference in the SPF level of sunscreen and the amount of sunscreen used. The results show that a larger SPF value and a greater amount of sunscreen used increases the duration of protection against UV radiation.

710. A ROBOTIC ANKLE INVERSION CORRECTION DEVICE USING A FLEX SENSOR AND A SOLENOID ARTIFICIAL MUSCLE

Karen Tsang, Block 3 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisor: Mr. Jason Kelsey

The ankle is extremely unstable after a sprain and re-injury must be prevented for a full recovery. Traditional methods of preventing re-injury, such as compression, lace-up, and semi-rigid ankle braces, are linked to immobilization and muscle weakness. The objective of this device is to detect a potential ankle sprain and evert the foot, preventing an ankle sprain while remaining cost-effective and simple. The flex sensor detects the ankle's plantarflexion. Circuit I is a comparator circuit using a LM234 IC chip comparing the voltage transmitted through the flex sensor and potentiometer. The circuit outputs 6V when the sensor is straight and 1.5V when flexed. Circuit II is an inverter circuit using a 2N7000 transistor that outputs 6V when it receives 1.5V from Circuit I and about 0.6V when it receives 6V. Circuit III is an amplifier circuit using a TIP102 transistor that outputs 15V when it receives 6V from Circuit II. The 15V drives a copper wire solenoid with a magnetized piston which rises and everts the ankle, mimicking the fibularis longus muscle. Traditional ankle devices stabilize the joint by holding it in a fixed position; however, this device simulates the body's natural muscle contractions to prevent injury.

ZOOLOGY

801. THE EFFECTS OF REEF SAFE AND OXYBENZONE CONTAINING SUNSCREENS ON *PALAEMONETES VULGARIS*

Jonathan Beck, Block 3 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisor: Mr. Jason Kelsey

Oxybenzone is a chemical compound commonly used in sunscreens to protect the skin from UV rays by absorbing the rays and turning them into heat. There have been concerns in the past that oxybenzone, being a carbon-based compound, could be harming marine ecosystems, such as the coral reefs. Therefore, "reef safe" sunscreens, which contain such active ingredients as zinc oxide or titanium oxide are accepted as "better for the environment." This study examines the effects that oxybenzone containing and reef safe sunscreens have on shore shrimp (*Palaemonetes vulgaris*) to determine which type of sunscreen is better for the environment. These shrimp were exposed to 15ml of sunscreen being added to their tanks every other day for the course of a week. One tank was exposed to Coppertone, an oxybenzone containing sunscreen, the second, Sun Bum, a reef safe sunscreen, and finally, one tank was not exposed to any sunscreen as a control. The oxybenzone containing sunscreen had a significantly higher mortality than the reef safe sunscreen. Both sunscreens caused a higher turbidity in the water, and left an oily layer on the surface. Results suggest that oxybenzone containing sunscreens have a greater impact on the environment than reef safe sunscreens.

802. TESTING DIFFERENT VARIATIONS OF LED AND UV LIGHTS TO SEE THE INFLUENCE DIFFERENT COLORS HAVE ON THE BEHAVIOR OF CHICKENS, *GALLUS GALLUS*

Julie Ann Dalton, Block One Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisor: Dr. John Wnek

This experiment was conducted by subjecting 15-17 month old Rhode Island Red pullets to multiple types of LED and UV lights in order to show the behavior and emotional expression of hens in the laying industry. Tests were conducted during the day and at night due lighting fixtures being left on 24/7 in commercial enclosures. Hens in the meat and egg industry are kept in conditions far from ideal causing unwarranted stress and anxiety that may lead to health problems including physical and mental ailments. Furthermore, avian species are not on the Humane Methods of Slaughter Act, meaning that they do not require humane handling or proper treatment of chickens or other birds in the process of their slaughter. The slaughter of broiler (meat) chickens is quite a disturbing process. The process of disposing of "spent" egg laying chickens is often even more inhumane. If the introduction of LED or UV lights can improve their way of living, adding those specific lights may make a more humane environment for the chickens.

803. ANALYZING THE PREFERENCES OF NATIVE BIRD SPECIES IN THE PINELANDS AREA TO CREATE AN EFFICIENT AND WASTE-FREE FOOD BLEND

Tyler Depa, Block 4 Science Class, Marine Academy of Technology and Environmental Science (MATES), Advisors: Mr. Jason Kelsey

Many homeowners and naturalists set up bird feeders and baths in their yard. One problem for them is the wide variety of choices when selecting seeds and nuts. Many store bought seed blends include filler seeds, like millet, that the birds do not eat and toss on the ground. Some seeds can even grow as a new plant! This study analyzed different bird seeds to determine the best mix. In order to reach this conclusion, local birds and their favorite food were researched. The four foods that were the most common, shelled sunflower seeds, safflower seeds, corn, and shelled peanuts, were tested on four tube bird feeders. The first trial included testing an "economy mix", where most of the seed was tossed away by the birds, leaving waste. The second trial tested the four foods individually, where corn and safflower seeds were eliminated. The third trial tested different mixtures of sunflower seeds and peanuts. The result of the experiment was the best mixture, with one-fourth peanuts and three-fourths sunflower seeds.

ZOOLOGY

804. THE EFFECTS OF VARYING CHEM LIGHT COLORS ON *MALACLEMYS TERRAPIN TERRAPIN* ATTRACTION

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Over the years, different colors of lighting, chem light colors, have become popular. Many of these lights attract migrating turtles and hatchlings that are attempting to make their way to the water, and disturb nesting females. The effects of various chem light colors on *Malaclemys terrapin terrapin* in a subaquatic environment have not been previously studied. The aim of this research was to find the chem light color that the terrapins preferred the most and the least, and use this information to change waterfront house lights in a way that will benefit the terrapins in Barnegat Bay. This experiment had three phases, each one unique to a specific part of Barnegat Bay. In phase I of research, all of the color combinations of red, blue, green, yellow, and white were tested against each other. The color that the turtles preferred the most was blue and the least was red. Phase II tested how fast the turtles swam to each color. On average, they swam to the yellow chem light the fastest. Phase III tested the preference of the terrapins in different turbidities. Unlike the other two phases, the color green was preferred the most. All phases of research supported blue, yellow, and green as the colors preferred the most and red as the color preferred the least, therefore, red lights could be the solution to this issue.

805. HOW *MERCENARIA MERCENARIA* FILTER THE WATER IN BARNEGAT BAY

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Hard clams and other filter feeding organisms have a very important place in their environment; these organisms all use different methods, but they all filter water in order to eat. This filtering process inadvertently makes the water these clams live in cleaner. By filtering about one gallon of water every hour constantly, hard clams can have a beneficial impact on the environment they live in. Throughout the course of my study, I tested how different sized clams filter water under different conditions. The clams were separated into three containers per variable, baby clams and bay water, cherrystone clams and bay water, and a container of just bay water for a control. These containers were placed into three different setups/variables, one group was kept at about 65°F (18.3C), one group had each container of bay water pumped with dissolved oxygen, and one group was kept at 70°F (21.1C) Throughout these trials, the baby clams filtered significantly more chlorophyll from the water, and consumed more dissolved oxygen then the cherrystone clams. The two variables of added dissolved oxygen, and higher temperature also both showed more chlorophyll and dissolved oxygen being taken out of the water. These results show that areas with higher concentrations of dissolved oxygen, and have a slightly higher temperature would be better suited to use clams to clean the water.

ZOOLOGY

806. EFFECTS OF EXTENDED PERIODS OF SOCIAL ISOLATION ON *CAMPONOTUS FELLAH*

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Many people today suffer from social isolation, or at least loneliness as a result of perceived social isolation. This perceived social isolation can cause great detriment in humans, and other negative effects can also be found in different types of animals, including social insects, under similar conditions. This paper aims to explore the effects of extended periods of isolation on one such social insect, the carpenter ant (*Camponotus fellah*), based on both existing literature and firsthand experimentation. Ants were separated into three groups: two isolated ones, one of which was grouped individually and the other grouped into small groups of ten, and the third being the original colony which served as a control. During experimentation, many vital signs of the isolated ants, such as body weight and food intake rates, decreased substantially; while these effects were more pronounced in those grouped singularly, they were also certainly present in those placed in small groups as well. Irregularities in movement were also observed among those who were separated. The consistent appearance of unhealthy effects such as these, even in otherwise similar conditions to the control group, highlights the lack of regular social interaction as a primary cause of those effects. Further research such as this can also potentially help us as humans to better understand the effects of loneliness on our own bodies.

807. AN EVALUATION OF FOOD PREFERENCE OF CRABS IN BARNEGAT BAY

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There are many species of crabs in t Barnegat Bay. Many crabbers are fond of crabbing in this area as either a hobby, or commercially. This particular experiment was made to test the food preference of two species of Barnegat Bay crabs; processed food or food occurring naturally. This was done by observing a crab from each species every day as it either decided to eat seitan, a processed food made from wheat gluten, or asparagus, a perennial plant, over a 12 day period. Even after both crabs tried both foods, I found no real food preference present for either crab. This information may be useful for crabbers that want to find a variety of effective baits for crabbing along the Barnegat Bay, and possibly crabbers in general, if this information can be applied to crabs worldwide.

808. COMPARISON OF MOUTH BACTERIA BETWEEN DOGS THAT FEED ON DRY VERSUS WET FOOD

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Canis familiaris, or more commonly known as dogs, can accumulate bacteria from their microbiomes in their mouths. The bacteria can then easily be transferred to humans in many different ways including their toys, food and water dishes, and when they lick people's faces. The purpose of this research was to find a correlation between bacteria found in dogs mouths that eat wet food versus dry food to see if something as simple as a diet change could reduce the risk of a family with dogs getting affected by the bacteria they carry. To look for a correlation two different tests were used, Coliscans and regular scans. The Coliscans looked at types of bacteria including *Escherichia coli* (*E. coli*)., while the regular scans looked at the number of general bacteria found from swabs collected from dog's mouths. The dogs that eat a diet of wet food tended to have more extreme amounts of *E.coli* and more cases of it growing on the plates. While some of the dogs with a diet of dry food did have *E. coli* it was not found as often as dogs that eat wet food. As for the regular scans, the results varied to each dog with some having no growth to lots of growth with both diets.