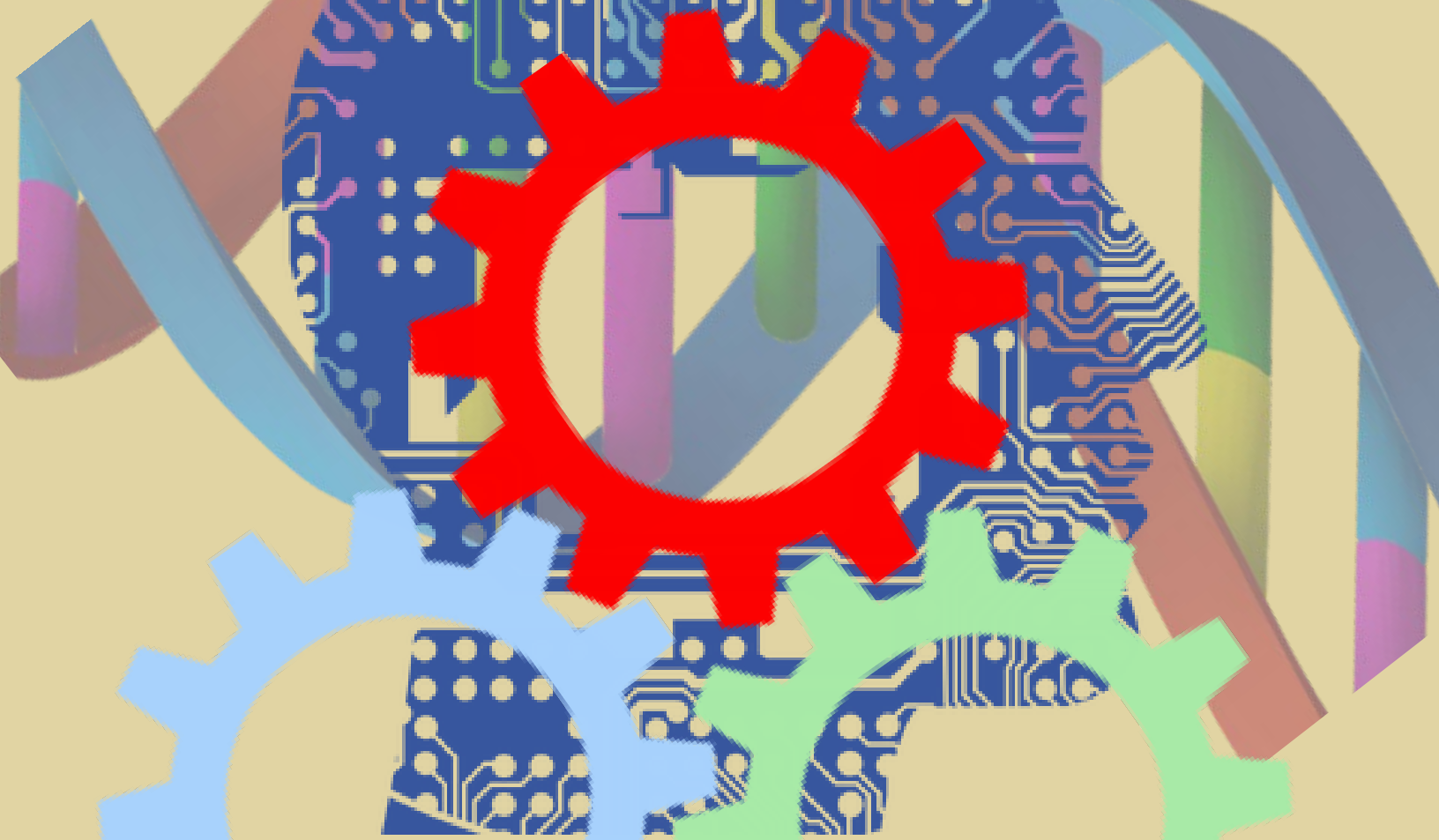
NBT

Science Symposium

"Where Creativity Meets Innovation"



ABSTRACT BOOK - 2024

Organized by
NBT Science Symposium Committee
(A Service Project of Agraj Seva Kendra)

Science Symposium

Sincerely thank

https://intellectionnj.com

for their generous support

Intellection's mission is to provide low-income children with the resources to succeed in STEM careers and give back to the community. Intellection works with local communities to provide under-represented and under-privileged students with the tools, resources, and opportunities to succeed in STEM careers

Sincere thanks
for the generous support from

Blisse Vakkalagadda
Kishore Mitikiri
Rajeev Srivastava
Rajesh Kalasapati
Ramnivas Singh

through their respective employers for their volunteer service

NBT SCIENCE SYMPOSIUM 2024

NBT
Science Symposium
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Gangadhara Rao Vakkalagadda
Chairperson

Surendar Reddy Revuri
Co-Chairperson

Kishore Mitikiri
Content Coordinator

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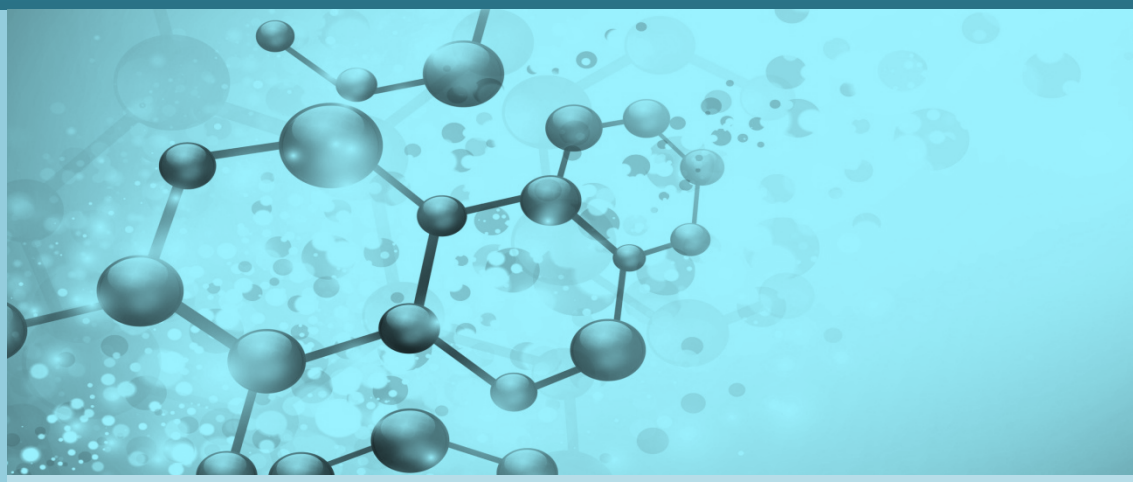

Message from Chairperson

Dear Friends,

I am honored to invite you to the 8th Annual NBT Science Symposium. We are back again to support the young minds in North Brunswick with a platform to present their scientific innovations. It is our responsibility to encourage them to pursue science, keep researching, continue learning and have fun during this process.

In this year's message I want to highlight the significant developments in the field of science and technology in the past five years and bring to light how scientific innovation is revolutionizing the world. I know that there a number of you will go in to be involved in advances like these. Good luck and make everyone proud with your discoveries. Here are some notable ones:

Advancements in Artificial Intelligence: AI has seen significant progress, particularly in deep learning techniques, natural language processing, computer vision, and reinforcement learning. This has led to breakthroughs in various applications such as autonomous vehicles, healthcare diagnostics, and personalized recommendations.

Quantum Computing: Significant strides in the development of quantum computers and quantum computing technologies have been made but there is a lot of scope still. Advancements hold the potential to revolutionize fields such as cryptography, material science, and optimization.

Space Exploration: Significant achievements in space exploration, including the successful landing and exploration of Mars by NASA's Perseverance rover, the launch of commercial crewed missions by SpaceX, and the exploration of distant celestial bodies.

Biotechnological Advancements: Biotechnology has seen remarkable advancements, including the development of CRISPR-Cas9 Gene Editing Technology and mRNA vaccines, those used for COVID-19, and progress in synthetic biology, enabling the creation of new materials, drugs, and sustainable solutions.

I would like to end my message by acknowledging the NBT science symposium team members Mr. Surendar Revuri and Mr. Kishore Mitikiri have worked tirelessly to plan and organize this event and I thank them sincerely for all their support. I would also like to thank Agraj Seva Kendra led by Mr. Govinda Rajan for taking up such novel initiative to support the community. I also want to recognize the continued partnership with the North Brunswick Board of Education and the North Brunswick Township, because their support makes this event a unique and rewarding experience. I would like to proudly acknowledge our partnership with Intellection, NJ. Also acknowledge the efforts of everyone who helped make this event possible.

Good Luck and all the best!

Gangadhara Rao Vakkalagadda
Chairperson, NBT Science Symposium Committee

Messages

Govinda Rajan

Dear Brothers & Sisters,

Welcome to the 8th Annual NBT Science Symposium. Our goal is to encourage the students in grades 3 to 12 to be creative and innovative. Participation in the activities and competition enables the students in problem solving and real-world application. Students learn teamwork research, bring out experiments and proudly explain their projects to the audience.

This project gives the students an opportunity to apply creativity and critical thinking to the solutions of STEM beyond the confines of classroom and excel.

I thank the parents and students for their participation and support. I am grateful to the Board of Education for their help and support in conducting this event. I thank the faculty for encouragement to the students to participate. I thank the sponsors, judges and volunteers for their contribution.

I once again congratulate the NBT Science Symposium Committee for their efforts in making the event a grand success.

Sincerely,

Govinda Rajan
CEO, Agraj Seva Kendra

Janet Ciarrocca

Dear Friends,

On behalf of the North Brunswick Township Board of Education, I would like to welcome you to the 2024 NBT Science Symposium. As in previous years, I encourage all guests to enjoy the creativity, strategy, and passion that our students display in their projects. At NBT Schools, we have integrated STEM education into our PK-12 curricula to make it accessible for all students. We also offer a rich assortment of advanced courses for students with a particular interest in science, technology, engineering, and mathematics. We recognize the value that community events such as this offer our students and appreciate the opportunity for our students to showcase their talents. We extend our gratitude to the organizers of this symposium for their commitment to enriching our students' interests in science. Congratulations to all of our students who are participating in today's event. We are proud of you for exploring your passions and thinking outside of the box!

Sincerely,

Janet Ciarrocca
Superintendent of Schools
North Brunswick Township Public Schools

Dear Friends,

As Principal of NBTHS, it is my pleasure to welcome you to the 2024 NBT Science Symposium being held in our Commons. Today you are coming together to celebrate and share your curiosity, inquiry, and collaborative skills as you worked together in teams to put together the project that you are showing off today. It is through encouraging students to share their scientific knowledge that we hope to prepare a future generation of students and workers who will be ready to tackle the challenges our world will continue to face in the future. I welcome all families who are attending the science symposium and hope that you have a wonderful experience today learning from our future scientists!

Sincerely,

Michael Kneller
Principal, North Brunswick Township High School

Michael Kneller

NBT SCIENCE SYMPOSIUM 2024

Program Schedule

Time	Activity
9 AM to 10 AM	Participants to pick up the registration packages and setup displays
10 AM	Judging Sessions begin **Room 1 Judges** • Kun Yang • Madhusudan Reddy • Anuj Anand **Room 2 Judges** • Barbara Wendell • Saravanababu (Babu) Murugesan • Kelly Sookdeo **Room 3 Judges** • Frank Sweeney • Abhay Navale • Giridhar Thirucherai • Dr. Lucille O'Reilly
12.30 PM Program Moderator: Blisse Vakkalagadda	• Welcome Address • Address by Mrs. Janet Ciarrocca, Superintendent of Schools • Address by Intellection NJ Representative • Raider Robotix Team Presentation • Vote of Thanks • Awards Distribution

Judging Time	Room 1		Room 2		Room 3	
	Team #	Team Name	Team #	Team Name	Team #	Team Name
10.00 AM	IMS1	Science Squad	ES1	Slime Making Geniuses	HS1	Hydro Heroes
10.10 AM	IMS2	R.A.P Science Guys	ES2	The Science Magicians	HS2	Biomedical Besties
10.20 AM	IMS3	Rays of Life	ES3	Germ Busters	HS3	Electric Achievers
10.30 AM	IMS4	WalkTrisity	ES4	Inquisitive Minds	HS4	Lab Ratz
10.40 AM	IMS5	Science Nerds	ES5	XXL	HS5	The Ionic Innovators
10.50 AM	IMS6	SSH	ES6	Brainstormers	HS6	Toxic Titans
11.00 AM	ES12	Builders	ES7	Sparklers	MS1	Innovative Thinkers
11.10 AM	ES13	Electra	ES8	Gene Girls	MS2	Extravagant Engineers
11.20 AM	ES14	Pollution Girls!	ES9	Elemental Explorers	MS3	Lightning Duo
11.30 AM	ES15	The Energy Elves	ES10	Mini Minds	MS4	Brainy-Badgers
11.40 AM	ES16	Seismic Shifters	ES11	Sea Saviors	MS5	The Synthesizers
					MS6	Blind Side

Elementary School Projects (Grades 3-4)

Team: Slime Making Geniuses (ES1)
Title: "Mom's Approved" Slime
Participants: Selia Herrera, Mila Dorjo and Gianna Baskett

Objectives/Goals: This experiment aims to compare the stickiness of three homemade slimes - clear, cloud, butter slime - to determine the safest option for children's clothes, hair, hands, and furniture. Additionally, we will research why slime is sticky and how ingredient additives affect its stickiness.
Materials/ Methods: We created three slimes: Clear, Butter, Cloud. Clear slime was made by mixing glue, water, and borax. Butter slime added shaving cream and clay to Clear slime. Cloud slime included shaving cream and instant snow. After preparation, we tested their stickiness on various surfaces (cotton, human hair, hands, and wood) and observed for residue and ease of removal.
Discussion/ Conclusion: Research shows slime behaves as a non-Newtonian fluid, with varying viscosity. Normally slime feels like a thick liquid with low viscosity, but it hardens upon impact like a solid. Slime forms through a chemical reaction between glue polymers and borax, creating an interconnected network with properties of both solids and liquids.

Slime's stickiness is due to intermolecular forces, where the number of hooked polymer molecules determines stickiness. Clear slime has high stickiness due to weak intermolecular forces, butter slime with added clay has lower viscosity, behaving more like a solid and not sticking to surfaces. Cloud slime, with instant snow, has reduced stickiness due to water-absorbing polymers, but leaves powdery residue.
Summary: This project explores slime stickiness, crucial for parental approval in children's play. We found butter slime to be "mom's approved" as it doesn't adhere to surfaces or leave messy residue on kids' clothes, hair, hands, or furniture.

Team: The Science Magicians (ES2)
Title: Clock Battery Power using Fruits and Vegetables
Participants: Adam Khawer and Devin Blocker
Objectives/Goals: An electrical current can flow through the juices of some fruits/vegetables and operate the clock as a battery. Can the citric acid from fruits and vegetables turn on a battery clock?
Materials: The materials used for this project are Fruits & Vegetables, Copper plates, Zinc Plates, Electrical Wire and Clock.
Method:

- Cut the fruit or vegetable in half.
- Insert copper plate on one side.
- Insert zinc plate on the other side.
- Attach wire from copper plate to the zinc plate.
- Test the clock.

Conclusion/Discussion: We learned there is a chemical reaction between the Zinc plate and the juice of the different fruits and vegetables known as the negative electrode. There is also a chemical reaction between the Copper plate and the juice of the different fruits and vegetables which is the positive electrode. The two chemical reactions push the electrons through the wires. Since the two metals are different, the electrons get pushed harder in one direction. The flow is called electric current, and the result turns the clock on.
Results: The Zinc and Copper plates are called electrodes, and the fruit and vegetables the electrolyte. The clock was turned on for Lemons, Potatoes, Bananas, Lime, Carrot, Onion, Tomatoes, Bell pepper and Strawberry. The clock was not turned on for Grapes.
Summary: Acid in most fruits and vegetables does produce electricity.

Team: Germ Busters (ES3)
Title: Germs Are Everywhere
Participants: Naman Venugopal, Kabir Gupta, Ranvir Gupta and Devyansh Sharma.

Objectives/Goals: To investigate the appearance and connection of germs in our everyday life. We want to raise awareness among people about germs and help them learn to stay healthy.

Materials/Methods: We make special plates with Agar using clean containers. Then we use Q-tips to collect germs from different places in the house, like doorknobs, light switches, and kitchen counters. We put these germs on the agar plates. After some time, we check the plates to see if any germs have grown, confirming that there were germs on those surfaces.
Results: Through the experiment, the project demonstrates the existence of germs in everyday environments, highlighting areas often overlooked in routine cleaning efforts. Microbial growth on the agar plates serve as visual evidence of germ's presence.
Conclusions: The result of this experiment shows how important it is to clean everyday surfaces regularly to keep our surroundings safe from germs. By uncovering the presence of germs, this project teaches people about the importance of cleanliness, hygiene, and hidden spots where germs can be present. It was very surprising to find that sometimes unexpected surfaces have more germs than the most expected surfaces.

Team: Inquisitive Minds (ES4)
Title: Investigating the Magic of Refraction
Participants: Ananya Meda, Dhruva Yarlagadda and Siddharth Ozas

Objective/Goals: Investigating the fundamentals of refraction through experiments to understand how light travels between different mediums.
Materials/ Methods: Glasses, Paper, Pencil, Marker, Coins and Water
Experiment 1 (Arrow behind glass) - We placed an image of an arrow behind glass. When we started filling the glass with water, our observation revealed that the arrow appeared in the opposite direction when viewed through water-filled glass.
Experiment 2 (Pencil in water) - We took a glass of water and placed a regular pencil inside so that a part of the pencil was submerged. Then, we looked at the pencil from the side of the glass, paying close attention to where the water and air met. Our experiment showed that a pencil appears bent or broken at the surface of the water.
Experiment 3 (Coin and Glass cup) - We placed a coin inside the glass and moved back such that we couldn't see the coin anymore. As we started filling the water, we observed that the coin appeared at a different position than its actual position when viewed through water in the glass.
Conclusions: Our experiments showed some cool results! When we looked at objects through water in a glass, they appeared to be in different positions or shapes. This is nothing but refraction: It is the bending of light as it passes through a transparent substance. Light travels at different speeds through different mediums. The change in speed is the reason for the change in direction or change in position.
Summary: Through simple experiments, we explored the science behind everyday marvels like rainbows, mirages and its practical uses in day-to-day lives such as lenses, and cameras.

Team: XXL (ES5)
Title: Bottled Up Buoyancy
Participants: Liliana Morris and London Bourne

Objective: The goal was to see how the submarine goes down and up by testing its buoyancy.
Materials/Methods: We started by using 2 water bottles for this experiment. We used the larger water bottle to make a propeller by cutting slits. Then we got the smaller water bottle and drilled holes through the cap and bottom to put paper clips through the bottom and top. We added a rubber band with a paperclip and made it hook to the clip on the bottom. Next, we put the paper clip through the cap and attached the propeller. We added sealant so water would not come in. Lastly, we added a ruler to make fins. For our first method we used one rubber band, but the submarine wouldn't move so we tried with two rubber bands, and it worked.
Results: The Bottled Submarine was able to glide across the water gently.
Discussion: Based on the research we have been studying on buoyancy and what it means, we learned a lot of things on how to make sure it floats and a bunch more important things to make sure the submarine goes across the water smoothly. In conclusion the submarine was a whole lot of fun to make, and we learned a lot

about buoyancy and how important it is when you're making any water vehicle.

Summary: In summary, between the two methods we tried to build the submarine, which were using 1 rubber band and 2 rubber bands, and we found out that 2 rubber bands worked better. The reason 2 rubber bands worked better than 1 rubber band was because there was more tension, and it helped the propeller spin better and faster so it could move.

Team: Brainstormers (ES6)
Title: Clean Energy for a Better World
Participants: Anay Mishra, Devansh Jiandani and Sanah Premkumar

Objectives/Goals: The objective of this experiment is to explore solar cells as renewable energy sources and convert solar radiation to electrical power.

Materials / Methods: The materials we used are the following: Solar cell unit, miniature motor fan,2 banana plugs and solar light. We performed the experiment as below:

Experiment 1: We are using tools for energy conversion and electrical circuit demonstrations. Solar panels operate on a principle known as the photovoltaic (PV) effect. When this material is exposed to photons of sunlight it releases electrons and produces an electric charge. When photons strike a PV cell, they may reflect or be absorbed by the semiconductor material. Only the absorbed photons provide energy to generate electricity. This is achieved through the creation of an electric field, which arises due to the presence of two different layers of silicon within the cell—one positively charged, and one negatively charged. Here, the solar cell captures energy from the sun and transfers electricity through banana plugs to the miniature motor, operating the fan. Solar Panels have positive and negative terminals. When stringing in series, the wire from the positive terminal of one solar panel is connected to the negative terminal of the next panel and so on. Solar cells are the percentage of solar energy that is converted into electricity. Solar cells synthesis by using silicon cells having the highest efficiency of around 27%. Silicon is the most common material used in solar cells. Silicon comes from sand, and it is the most used material for solar cells because of the strong photo voltaic effect which means it speeds up sunlight's electrons within the cell to create electrical current.

Experiment 2: We observed the operation of solar lights over a period of 30 days. When the solar panel received direct sunlight without rain or clouds, the solar light shone brightly at night. Similarly, when it was cloudy or rainy with a little sunlight, the solar light wouldn't shine as brightly at night, and in the absence of sunlight altogether, the solar light would remain dark.

Conclusions/Discussion: Electricity can be generated by the solar cell when solar radiation falls onto it. The amount of electric current depends on the intensity of the incident solar radiation.

Team: Sparklers (ES7)
Title: Vacuum Cleaner
Participants: Anvitha Gandhaveeti and Dhrithi Puvvada.

Objective: This study aimed at understanding the detailed process how vacuum cleaners work based on Bernoulli's Principle and the importance of suction power, cleaning efficiency of vacuum cleaner.

Methods/Materials: Wood base, fan and a suction cup are used as materials. Vacuum cleaners work by using suction power to pull in larger pieces of dust, pet hair and other objects through intake port. Vacuum cleaners based on Bernoulli's principle, which states that as the speed of air increases, the pressure decreases. A small motor is placed which rotates at high-speed causing the fan to discharge air from the bottle mouth to the outside of the bottle, thereby forming a negative pressure in the bottle. Suction is generated at the mouth of the cup /bottle and the dust is sucked inside.

Results: The suction capacity indicates how powerful the vacuum cleaner is and the air volume indicates how much air the vacuum cleaner is able to move.

Conclusions/Discussion: vacuum cleaner project provided us with valuable insights into the world of vacuum cleaners and their role in maintaining a cleaner home environment. We hope that our findings will help others make

informed decisions when selecting a vacuum cleaner for their households.

Team: Gene Girls (ES8)
Title: Extracting Strawberry DNA
Participants: Ayla Syed, Hawwa Tahir, Inya Ramachandran, Isra Naeem and Sara Mortigo.

Objectives/Goals: To see if the DNA of strawberries could be extracted by using common household items and to observe the DNA once extracted.
Materials /Method: We needed strawberries, salt, rubbing alcohol, dish soap, Ziploc bag, jar, water, skewer, coffee filter, coffee funnel, measuring spoons and cup, a small stick.

To start the experiment, we first made the extraction liquid. We mixed water, salt, and dish detergent in a jar. After that we put strawberries in the Ziploc bag and mashed them up until they turned into liquid. The next step was to mix the extraction liquid into the bag with the strawberries. After doing that we needed to put the strawberry liquid into a glass jar through the coffee filter. We felt that the filter was taking too long to strain the strawberry juice so decided to use a strainer instead. We then poured cold rubbing alcohol into the jar with the strawberries. At this point, the DNA starts to separate from the strawberry and looks like white strings. We used the little wooden sticks to pull out the DNA and looked at it closer.
Results: We were able to extract the DNA of the strawberries easily.
Conclusions/Discussion: Strawberry DNA can be extracted easily using common items. We learned that even plants and fruits have DNA and that it is very easy to extract DNA of fruits like strawberries.

Team: Elemental Explorers (ES9)
Title: BeachCop (Solar and Battery Powered Beach Cleaning Robot)
Participants: Ahaana Naik, Ishaan Mylavarapu, Ishaan Waze and Reena Rao.

Objectives/Goals: This basic solar and battery powered beach cleaning vehicle is a learning experiment to understand design elements of a nature powered 100% electric machine/vehicle which emits no harmful gases and assists in keeping mother nature (beach) clean.
Methods/Materials: A solar power 4-wheeler vehicle (miniature version) constructed by team Elemental Explorers demonstrates that solar power can convert into DC power which can then be used to drive a vehicle without using harmful gases. An attached sand sifting tool filters plastic debris from the sand. An attached siren announces the vehicle's presence. Additionally, a collection box attached to the vehicle collects debris for recycling it later. Materials required for this project are: Solar panel, DC motor, Motor mount, Wooden pieces, Wheels, Chassis, Battery, Axles, Washers, Cardboard, Glue, Broken plastic debris, Sand, Sifting mechanism/tool, Siren/Automatic horn, A little help from mother nature (Sunlight).
Results: A 4-wheeler vehicle constructed by team Elemental Explorers uses sunlight to generate clean power to drive a beach cleaning system which can screen debris buried in shallow sand.
Conclusions/Discussion: A solar power 100% electric 4-wheeler vehicle for screening sand can be extremely useful for keeping New Jersey beaches clean from debris left behind by human beings. It can collect all waste buried on a beach and protect plant and animal life as well. This vehicle will be quiet running and can operate at any time of day or night without using fossil fuel.
Summary: This project is an attempt to prove that we can use nature powered clean machines to keep Jersey Shore beautiful while protecting plants and wildlife and using clean energy.

Team: Mini Minds (ES10)
Title: Erupting Soda
Participants: Arnav Raj and Damian Likakis

Objectives/Goals: This study aimed to determine how many Mentos we need to make the geyser go the highest, and to understand why the mento causes soda to erupt.
Method/Materials: 4 liters of diet coke, mentos, Extreme Geyser Tube, measuring cup, measuring spoons. Mentos was added to soda bottles with and without the extreme geyser tube and with and without the yellow turbo cap that is used with the geyser tube.

Results: Mentos caused the soda to erupt out of the soda bottles with a small geyser. Maybe it was because we didn't put all the mentos in. (We did not put in the whole tube) What was expected: We had a lot of mentos (a tube) we thought that the eruption was going to be big since the bottle was so small. The extreme geyser tube caused a very high geyser. The yellow turbo cap caused the highest geyser. The amount of soda left in the bottle after the eruptions were measured using a measuring cup. What was surprising is that the amount of soda that erupted from the bottle did not increase with the yellow turbo cap even though the geyser was much higher.

Conclusion/Discussion: Mentos have grooves or holes in them that are not visible to the human eye. To see this, you need to look through a microscope. As the mentos is dropped in, the Coca-Cola has carbon dioxide that reacts with the mentos. The mentos make the Coca-Cola make many bubbles and those bubbles create pressure inside the bottle. One question is to determine if this reaction is a physical or chemical reaction. To determine this, we need to know if a new product is formed when the reaction between the mentos and soda occurs.

Team: Sea Saviors (ES11)
Title: Seabin
Participants: Jeevan Sumanth Karnathi and Aaryash Rathor

Description: About eight million tons of plastic waste is added to the oceans every year - equivalent to one garbage truck of plastic being dumped into our oceans every minute -according to a study. This figure is predicted to quadruple by 2050, if no action is taken. And plastic pollution is already having an increasingly devastating impact on our marine ecosystem. Cleaning the oceans is a mammoth task and there can be many answers. A Seabin can be one answer to this problem. It is a floating trashcan that can be used to help rid the lakes, pools and bay areas of plastic and floating pollution. Placed just below the surface of the water, Seabins use a small submersible pump to draw water and any nearby debris into its removable bag, which is made of recycled plastic mesh. The water is then either passed through an optional filter which removes oil and detergents, cleaning the water as it works, or straight back out into the ocean. The bin is designed for use in calm waters, such as those of marinas, yacht clubs, and ports – and because it floats, it goes up and down with the tide. This allows rubbish to be intercepted before it has a chance to travel into larger bodies of water and risk contact with more marine life.

Objectives/Goals: This project aims to showcase how a simple device like Seabin can help control floating pollution in water.

Methods/Materials: Fiber woven cloth/net, Plastic cup, submersible pump, pipe, tubes, tub, battery, water, floating plastic debris, glue gun

To demonstrate a Seabin, a plastic cup is taken, and a net is attached to the cup with a glue gun. A hole is made in the bottom of the cup which is connected to a submersible pump using a plastic pipe. This set up is then placed in a tub of water with some lightweight plastic pieces which will float on the surface.

Results: The floating plastic particles are sucked in the cup and clean water can pass through.

Conclusions/Discussions: A Seabin can be used to filter out floating particles from the surface of water. Although all floating particles will be filtered out, since these can be placed in highly polluted waters, most of the floating particles should be pollutants.

Team: Builders (ES12)
Title: Wind Energy
Participants: Ishan Shrivastava and Varun Mandava

Objectives/Goals: In this project we are going to make a working model of turning wind energy into electricity.

Methods/Materials: In our project we will have a fan that will blow wind and act as a source of wind, six fans connected to generators, copper wire, a model house with LED's and a road with street lights on it. To start, we tested connecting fans with LEDs to see how many LEDs can one fan light up using a breadboard. We concluded that one fan can light two LEDs. Another experiment was done in which three fans would light six LEDs and this was done using series connections as we were not able to make parallel

connections work. But when we tried four fans with eight LEDs it did not work on the breadboard. We did another experiment in which we tried a nine-volt battery connected to an LED, but the led busted, so we put a resistor to reduce the amount of energy going into the led. Then we figured out which resistor to keep in our project.
Results: The result was that we could now connect the fans and LEDs in a series circuit to light a house and streetlights. This is also a form of wind energy getting converted into electrical energy.
Conclusions/Discussion: The fan blades size and shape also matter because in our project there are three fans that have four blades and three fans that have three blades. The one with four blades generates more energy than the fan with three blades.
Summary: We have a working model to show how wind energy can be converted into electrical energy.

Team: Electra (ES13)
Title: Electric Power Generation
Participants: Arpitha Nair, Diya Elizebeth Mathew and Sidithi Vinod.

Objectives/Goals: This study aims to showcase the principles and methods used to generate electricity and its transmission to the consumers.
Methods/Materials: Electricity is a form of energy resulting from the movement of charged particles such as electrons and protons. We are showcasing the generation of electricity using battery, solar cell, and generator.
Battery: Uses chemical rection to convert chemical energy into electrical energy. We have a model measuring the voltage using a voltmeter and the materials used are Battery, switch, electric bulb, voltmeter.
Solar Cell: Solar Cell converts sunlight directly into electricity through the photo voltaic effect. The materials used are solar cell, torch light, LED, voltmeter.
Generator: Electric generator works on the principle of electromagnetic Induction. The model displayed uses copper coil, magnet, galvanometer. We have showcased a wind turbine generator and a hydro electric generator which works on the above principle.
Wind turbine Generator: The materials used are wind turbine, electric generator, LED, wire, voltmeter, fan. Hydro electric generator: Materials used are turbine, electric generator, wire, voltmeter, dam model with PoP and pump.
Transmission and distribution: The electricity is generated at a generating station and sent to the consumer through a transmission and distribution network which includes substation, transformers, transmission lines and protection devices.
Conclusion/Discussion: We conclude that in all models there is an energy conversion resulting in generation of electricity which was measured using a voltmeter. Our study shows that power can be generated from Batteries, Kinetic energy of air (wind turbine), Kinetic energy of moving water (Hydro power) and Solar cell. The generated power can be stored and can be used for various purposes like houses, streetlight etc.

Team: Pollution Girls! (ES14)
Title: Pollution Problem
Participants: Akshaya Kanna, Maya Saha and Maha Sheikh.

Objectives/Goals: Our objective is to show lunch staff and our schools how to become more environmentally friendly by separating trash and recyclable items in our schools. It takes plastic about 1,000 years to decompose in the landfill. We are trying to encourage schools to help the Earth and make an impact on our community.
Methods/Materials: For this experiment, we buried plastic, paper, and food items into the ground. We collected items such as plastic bottles, straws, banana peels, paper products, etc. We separated them into co-mingled, non-biodegradable(plastic), biodegradable(paper), and food. Then we took notes on what we placed in each section. We buried the items into the ground in our backyard and in a month, we will check on it and see what is gone, what is still there, and what is partially gone. Our hypothesis is that the food will be gone, the paper will be partially gone, and the plastic will remain.
Results: We plan to keep our items buried in the ground for a longer period however, after doing

a check on it we saw some progress on our items decomposing. The food was partially gone, and we think in a month or years' time it will be gone. The non-biodegradable (plastic) was still there. We think that it will still be there in another thousand years (based on facts we read).
Conclusions: In conclusion it is better to separate recyclables and trash because it will help save the Earth from pollution. We hope that our school will address this problem and try to help pollution by decreasing waste. If we don't our Earth will become a giant landfill. Choose to save Earth (our home) by not polluting!

Team: The Energy Elves (ES15)
Title: REACT - Renewable Energy Activities
Participants: Kiaan Pingle, Visvajit Balaji, and Leilani Jodar.

Objectives/Goals: Demonstrate different forms of Renewable Energy and its applications using Solar, Wind and Water. Also, share awareness and benefits on harnessing these sustainable energy sources.
Methods/Materials: The project team will share simple and engaging methods for Renewable Energy demonstrations such as below:
Wind Turbine: Creating a small wind turbine using recyclable materials. Place the turbine in front of a fan to show how wind can be used to generate electricity.
Energy House: Construct a model house using cardboard and decorate it with energy-efficient features such as solar panels and insulation. Team will discuss how these features can help save energy.
Solar Oven: Building a simple solar oven using a cardboard box, aluminum foil, and plastic wrap.
Energy Conservation Poster: Team will display posters illustrating ways to conserve energy in our daily routine.
Results: Project demonstrations will share results around Environmental Benefits, Energy Independence, Technological innovations, Community Engagement and Education & Awareness
Conclusions/Discussion: Based on the project demonstration, the team will discuss how these renewable energy activities offer learning around a range of benefits and outcomes that contribute to a sustainable and resilient energy future. Project team will outline that such initiatives have the potential to reduce greenhouse gas emissions, improve air and water quality, enhance energy security, create jobs, stimulate economic growth, and drive technological innovation.
Summary: Overall, renewable energy activities & initiatives play a vital role in addressing climate change, promoting sustainable development, and building a more sustainable and equitable future for all.

Team: Seismic Shifters (ES16)
Title: Earthquake Simulation
Participants: Sakhi Mitul Patel and Anika Arun.

Objectives/Goals:
The objective of this experiment is to simulate earthquake tremors and aftershocks that occur due to sudden movement along faults within the earth. The experiment aims to demonstrate the importance of having a strong foundation for structures and the use of base isolation to increase their resilience during earthquakes.
Materials / Methods:
- Jell-O: Represents the earth's crust.
- Marshmallows: Represent the structures
- Toothpicks: Used to construct structures with marshmallows.
- Marbles: Represent the seismic waves generated during an earthquake.
- Cardboard base: Provides stability and support for the structures.

The experiment involves constructing two structures using marshmallows and toothpicks. One structure is built in such a way that it can easily fall with minor shaking, representing a weak foundation. The second structure is modified to have a stronger foundation, making it more resistant to shaking.
To demonstrate base isolation, the second structure is placed on a system of padded cylinders (represented by marbles) that allow it to float above its foundation. This mimics the concept of isolating a building from the ground vibrations during an earthquake, increasing its chance of survival.

Results: The results of the experiment show that having a stronger foundation is essential for earthquake survival. The structure with a stronger foundation is more resistant to shaking and has a higher chance of remaining intact during an earthquake. Additionally, the use of base isolation techniques, such as floating the building on padded cylinders, can further increase its ability to withstand seismic waves.
Conclusion: The experiment demonstrates the importance of having a strong foundation for structures to withstand an earthquake. It also highlights the effectiveness of base isolation techniques in increasing the resilience of buildings during seismic events. By understanding and implementing these principles, communities can improve their preparedness and mitigate the impact of earthquakes.

Intermediate Middle School Projects (Grades 5-6)

Team: Science Squad (IMS1)
Title: Breathe!
Participants: Aryan Vuggini and Pranav Krishna Prasad

Objective: Learn about lung function and the respiratory system, including oxygen intake and carbon dioxide removal. Conduct a science experiment to observe the impact of smoke, dust, and pollution on lung function.
Materials/ Methods: We constructed a simplified lung model using:

- Two transparent bottles
- One ruler
- 2 gold, 2 black, 2 white balloons
- Straws
- Clay
- Utility knife

Cut the bottom off a plastic bottle, leaving 1/3 to 3/4 inch of space below the balloon hanging inside.
Create a straw model resembling lung branching (inverted Y shape) and attach two gold balloons at each end. Carefully insert the straw through a hole in the bottle cap. Flip the bottle over so the top rests on the table, keeping the balloon inside. Knot one end of a white balloon and cut about a third off the opposite end to widen the opening. Stretch the widened end over the bottle's opening, ensuring the knot is on the outside near the middle. Repeat the process with black balloons, adding clay inside the straw to mimic smoke's effect on the lungs.
Discussion/Conclusion: Pulling the knot replicates inhalation, expanding the bottle's space like the diaphragm expanding during inhalation. Pushing the knot simulates exhalation, decreasing the space and deflating the balloon as the diaphragm relaxes to expel air from the lungs. When pulled, the gold balloons expand, enhancing oxygen delivery to the bloodstream. In contrast, the constrained expansion of polluted lungs (black balloons) suggests reduced oxygen transfer, showing reduced lung function that may lead to breathlessness due to airway inflammation and constriction.
Summary: This project helps us understand how the respiratory system works and the impact of smoke and pollution on vital organs.

Team: R.A.P Science Guys (IMS2)
Title: Self Driving Car Model
Participants: Priyansh Patley, Ajitesh Tiwari and Rivan Ghimiray

Objectives/ Goals: The objective of the project is to demonstrate and educate the workings of self-driving cars.
Methods/Materials: The components used in this project are the following:

- Arduino Uno
- Multiple sensors (Ultrasonic / Infrared)
- Motor drivers
- Car chassis
- Jumper wires
- Batteries
- Motors

The ultrasonic sensor will be utilized to detect obstacles within a certain radius and apply the brakes automatically. The infrared sensor will sense the lane and apply corrections for any deviations.
Results: This project will successfully implement self-driving car features like auto breaking, obstacle detection, collision warnings and lane departure assistance.

Conclusions/Discussion: This project is aimed to provide general awareness about self-driving car technology. There are additional functionalities that this project does not encompass such as stop-sign monitoring, traffic lights, and blind spot detection. This technology is intended to guide the driver if there are any errors. However, the driver must not completely rely on autonomous driving since there could be chances of failure. At times, smarter decisions must be taken while operating the vehicle.

Summary: This project attempts to replicate the features and functionalities of self-driving cars.

Team: **Rays of Life (IMS3)**
Title: Solar Oven Cooking
Participants: Nishitha Reddy Yerva, and Dravi Jain

Objectives/Goals: Our goal was to find if a DIY solar oven with darker background colors would cook faster than a solar oven with a lighter background.

Methods/Materials: We built two solar ovens, using two cardboard boxes, aluminum foil, wooden sticks, tape, clear plastic wrap, black construction paper, and white printer paper. We put one uncooked s'more in each and set them both in the sun together, and waited to see which one would cook faster. It wasn't very sunny; it was cool outside, so it took longer to cook than normal.

Results: After about forty-five minutes the solar oven with darker colors was completely cooked. Our hypothesis was proved.

Conclusions/Discussion: We created our hypothesis because we knew that solar ovens took a while to cook, and research proved that black attracted heat. If we put darker colors in our solar oven, would it cook faster than a normal solar oven? This hypothesis was proved. The solar oven with the darker colors did in fact cook faster than the normal one. Except cooking the s'more took so much longer than we expected, even though the solar oven had darker colors. That is the one downside of solar ovens. The solar oven with darker colors cooked faster.

Summary: Our hypothesis was that a solar oven with darker colors would cook faster than a regular one. We tested this. We made two solar ovens using the same materials, but one had darker colors, and the other lighter. We set them in the sun, each had one uncooked s'more in it. We waited to see which solar oven would cook the s'more faster. Our hypothesis was proved, the solar oven with darker colors cooked faster.

Team: **WalkTrisity (IMS4)**
Title: The Thunderstorm Project
Participants: Tristan Russell and Walker Sandler

Objective/Goals: To learn about extreme weather, which encompasses tornadoes (which were once so feared that the government forbade the saying of the word), hurricanes (which are notorious for tearing up the earth as we know it), and, of course, thunderstorms (from single cell to super cell). Once we're through with that, we are going to prove that all of them are connected in one way or another. Our idea? That the three storms produce energy. Once we have proven that through our outline, we will, through research, be able to figure out how to safely harness energy from lightning.

Method: Through research, we'll be able to judge which of the following is the best for harvesting electricity; Tesla Towers, Lightning Rods, OR Super Capacitors? The categories will be as follows: Safety, Efficiency, Strength, Reliability.

Lightning Rods:

- *Reliability:* People have been using lightning rods since Benjamin Franklin invented them in the late 1700's.
- *Safety:* For a thing invented in the 1700's, it's pretty safe. All you got to do is just install it on your house, and then any lightning would be redirected to the rod. Hook up a few wires and you're good to go.
- *Strength*: Depending on the strength of the electrical charge in the lightning, it could be anywhere between pretty weak to burn-your-hair-off strong.
- *Efficiency:* Again, depends on the strength of the lightning. If it's decently strong, then you'll get a good amount of electricity from a few charges.
- *Overall Rating*: 10 out of 10.

Tesla Towers:

- *Reliability:* Very low. They don't produce electricity on their own.
- *Safety:* This seems to be one of the higher aspects of Tesla Towers. The tower was designed to hold and contain electricity. Ergo, it has been quite insulated.
- *Strength:* Not well. It contains electricity better than it produces it.
- *Efficiency:* Don't even BOTHER trying this if you're looking for an efficient way to harvest electricity.
- *Overall Rating:* 3.5 out of 10. Not very nice.

Super Capacitors:

- *Reliability:* It is decently reliable, as it holds electricity better than Tesla Towers, but not quite as efficient as Lightning Rods.
- *Safety:* Incredibly high. The only time that it could be lethal is if you do something incredibly stupid.
- *Strength:* Pretty decent. 2.5 to 2.7 volt can be contained in one of these things.
- *Efficiency:* Quite efficient. Not too bad when it comes to charging.
- *Overall Rating:* 7 out of 10.

Conclusions: Overall, we found that, in the end, the Lighting Rods won this time, with a full 10 out of 10. We figured out that the rods are the safest, strongest, most reliable, and most efficient of all our tests. Best of all, it is the best of the best in harvesting electricity, and it was made by Benjamin Franklin in the late 1700's. So, if you find yourself in need of electricity, thank Benjamin Franklin for inventing the wondrous lightning rods!!!!!

Team: Science Nerds (IMS5)
Title: Homopolar Motor
Participants: Karunya Gujja, Visesha Pasumarthi

Objectives: This project attempts to determine if you can control the speed of a homopolar motor.
Methods/Materials: For this experiment, we needed a AA battery, 20 gauge copper wire, and three rare earth neodymium magnets. First, we needed to construct a homopolar motor by first placing three of the neodymium magnets under the standing battery, where the positive side is up. Then you make a box shape with the coil wire at the bottom side, there should be a hole to put the battery through. Once you put the coil in the way it should be, it should start rotating. For the experiment, we stretched out the wire so it could be farther away from the battery and added arms to it. Then, when we placed the wire back on the battery, it started struggling and moving slower. After that, we placed a higher-powered battery to replace the old one and it started moving faster.
Results: When the wire was wider from the battery, it started to rotate slower and when we added a higher-powered battery, it rotated quicker.
Conclusion: To conclude, since the wire was spread apart more, the inertia was increased. This caused the wire to move slower and struggle to make it go faster. Also, the simpler way of controlling the speed to make it go faster was to substitute the battery for a high-powered one, which did make it faster.
Summary: This study is aimed at determining if the speed of a homopolar motor's wire can be controlled.

Team: SSH (IMS6)
Title: Solar power as source of Energy
Participants: Sia Dixit, Sophia Kim, Haley Young

Objectives/Goals: This project is to show how solar energy can be used to power many appliances. Purifying water, providing hot water and power small appliances with no impact to the environment.
Materials and Methods: Materials that we used to conduct this project are solar panels, battery, power cables, cardboard, D.C motor with a switch, light bulb, wires, natural water, vessels and heating element. These materials are used to build a solar power battery, solar based water purification system, wind turbine to power a small model house. The model house is built using cardboard to depict a small house with lighting.
Results: Solar panels are used to generate power and store in battery pack which lights the house as well as provide heat to boil the water and purify it. A switch is used control the usage of solar powered applications,

Summary: This project shows significance because it shows the efficiency of solar energy. This will benefit the environment because our world today, pollution is a major issue along with carbon emissions. Using solar energy will cost less and well there will be no impact to the environment.

Middle School Projects (Grades 7-8)

Team: Innovative Thinkers (MS1)
Title: Visor Vision Pro
Participants: Ojas Shrivastava, Yaseen Albrolisy

Objectives/Goals: Visors are an important aspect of keeping your vision clear in not only sports, but in driving vehicles like motorcycles. But sometimes people ignore wearing a visor, due to the hassle of cleaning it every minute because of fog, dirt, or other factors. Our objective is to create a perfect solution to solve this problem.
Method/ Materials: Realizing how simple and time-efficient it could be to create an add-on to helmets to just clean a visor with a snap of a finger, we created the Visor Vision Pro.

This is an add-on to a helmet. Using solar powered sheets in the helmet, you can charge the helmet while in the sun. Additionally, there can be a charging station on the bench, or anywhere you want to charge if there is no sunlight. This can help athletes like football, lacrosse, hockey, players etc. on the field to have a clean vision, and motorcycle riders can drive safely without needing to take off their visor to have better vision.

After a survey on middle school and high school football players and experts, we found that over 60% of people use a visor in a sport or while driving a two-wheeled vehicle. A lot of them found an issue with their visors that included: foggy vision, liquid on visor, uncomfortable positioning, and more. Our Visor Vision Pro can diminish all those issues, creating a safer way to play and/or drive.
Results: In conclusion, our Visor Vision Pro is one of the most up-and-coming ways to keep your vision clear with ease and keep yourself safe. So, if you play a sport or drive and need a visor add-on choose the Visor Vision Pro.

Team: Extravagant Engineers (MS2)
Title: Affordable Prosthetics
Participants: Vihaan Shah, Karthik Voruganti, Samik Makam
Objectives/Goals: Our goal is to engineer and create affordable and adaptive leg prosthetics. We will build a couple of prosthetic models to demonstrate our ideas.
Methods: Using research and engineering to create a prosthetic that clearly demonstrates our ideas and checks off multiple functions.
Materials: PVC Pipes, Wood, Metal, Nails/ Screws, Adhesive Tape, Foam
Results: Our results will be presented through our model and extensive research at the symposium.

Team: Lightning Duo (MS3)
Title: Lightning Detector
Participants: Indurupa Pisupati and Anagha Meda

Objectives/Goals: Ben Franklin created the Franklin's bell in the 1700's. It served the purpose of warning people before lightning struck nearby. Our goal is to understand the science behind the way electric charges cause the bell to move between metals.
Methods/Materials: We used the following materials:

- Soda cans
- Alligator wires
- Straw
- String
- Electric fly swatter

First, to make the bell, we used a pull top from the soda can and attached it to a straw using a string. The string should be half the height of the soda cans. Then, we attached the alligator wires to the fly swatter. The green wire was connected to the middle layer and the red wire was connected to the outer layer. The other ends of the wire were connected to each of the soda cans.

We placed the straw on the soda cans in such a way that the pull top would hang in the middle of soda cans. The last step was to turn the fly swatter on.

Results: Once all the components were connected and we turned the fly swatter on, the metal bell moved between the two soda cans and created a ringing sound.
Summary: Franklin's bell worked through the attraction of positive and negative charges. One can was positively charged while the other was negatively charged. The bell had both charges and was attracted to the closest can. When the bell reached the can, it evened out the charges, making the bell more positively charged and thus repelled to the other can. This process repeated, creating a ringing sound to alert people of lightning.

Team: Brainy-Badgers (MS4)
Title: Assistant X
Participants: Ayush Sharma, Daivik Shah

Objectives/Goals: To design and develop a robot that assists elderly people, provides companionship, enhances safety and improves their quality of life.
Methods/ Materials: Our robot uses a board as its chassis. We are going to use 3d-printed joints and boards for the arm. We will have rubber grips on the arm claw. Proximity sensor to measure distance, LED indicators for alarms, speaker and audio amplifier for voice, and an Arduino Uno R3 as our brain.
Results: Our robot was able to pick up a medicine box and deliver it to different spots. It was able to announce the delivery once the job was complete. Buddy robot was also able to remind for the medicine and flash red alarm in case of SOS signals.
Conclusion/Discussion: Our robot shows how automation can change our life. This technology is already in high research and has many implications in real life. It can be used as a robot companion or a buddy robot to do specific jobs. Our robot is a prototype for doing small things but can be scaled to larger projects. It can complete routine work, respond to specific reminders, deliver items and more.
Summary: It will be great to have buddy robots especially for elderly people. Our robot is focused on supporting elderly people and performing tasks for them. It will improve the quality of life of our senior population and be their companion buddy.

Team: The Synthesizers (MS5)
Title: Examining Photosynthesis with Colored Light
Participants: Rishab Patel, Nishchal Polanki, and Samarth Panchal

Objective/Goal: Our group determined what colors of light operate best for photosynthesis and how they affect plants, which can serve as important knowledge for growing plants.
Project Description: With carbon dioxide becoming more common and inducing climate change, people need to put more plants throughout the terrain to turn carbon emissions into oxygen. However, plants can't do this process in all environments because of different factors, one of which being light. Photosynthesis creates glucose and oxygen out of water, carbon dioxide, and light. However, if the light's color is different, results might vary. In this experiment, our group will see which colors work best for growing plants. By testing different colors, we can find out what environments are better for plants to thrive in and produce the maximum amount of oxygen and decrease or absorb the maximum amount of carbon dioxide emissions in its surrounding environment.
Materials:
- Cups
- LED light appliances each with different colors
- Hole puncher
- Leaf material
- Syringes
- Baking soda

Procedure: Punch holes out of leaf material to make leaf disks. Put ten or more in each syringe before adding a small amount of baking soda and some water. Seal the syringe and swirl the leaf disks around it before they start to sink in the water. After the baking soda has caused them to sink, pour the mixture into a cup of water. Repeat three times, then place each cup under a different shade of light, and time how long it takes for all of the leaf disks in each cup to rise. The faster the disks rose, the more effective the color of the light would be.
Results: The tubes with red and blue light photosynthesized more than tubes with yellow and

green light. This is because the colors of plants and their chlorophyll consist mostly of green and yellow. Since the color of an object is the only color that is not absorbed by that object, green and yellow light is difficult for plants to absorb. This is why blue and red light often elongate and vegetate plants well.
Conclusion: Colors that were not green work well because they were absorbed by the chlorophyll in the plant.

Team: Blind Side (MS6)
Title: Vision Headsets
Participants: Dhilan Inamdar, Akhil Yanamadala, Priyasha Shah and Rithvik Chintla

Objective: Our goal is to include everyone in daily activities such as running track, biking, and other tasks. Blind people face challenges in understanding their environment, which is why we have built, tested, and researched our prototype. The glasses will alert users when obstacles are nearby, allowing everyone the opportunity to explore their environment safely.
Materials: The following materials are used:

- Headset
- Distance Sensors
- Arduino board
- Cloth strap
- Aluminum
- Audio Player
- Wires
- Speaker
- Computer
- String

Methods: The Arduino and distance sensor were connected, and coded so that our distance variable would change based on how far away an object was. We downloaded audio files onto the Arduino board and then coded it so that, based on the distance variable, an audio file would play. (Example: If the distance variable was 10, the corresponding audio file would play, "Obstacle 10 feet ahead"). We disconnected the USB cable between the Arduino and computer. Cased our device in aluminum, wrapped it in the strap, and connected it to the headset. We tested the headset by moving an object closer and farther to the glasses.
Results: The glasses were able to play the correct audio files about 85% of the time.
Summary: By building the glasses with the Arduino, distance sensor, and audio player, we were able to create a working warning device. While the prototype worked most of the time, there is room for improvement. With higher-quality wires, the audio files wouldn't disconnect as much. In addition, the audio player code can be adjusted to remove the delays. When these glasses are perfected, they can be utilized greatly. People would complete activities with more comfort. They could do more demanding tasks with safety, bringing larger groups of people together!

High School Projects (Gr 9-12)

Team: Hydro Heroes (HS1)
Title: Aqua Electro Purifier
Participants: Mythri Velagapudi and Virinda Popli
Objective/Goals: We aim to address the problems of both water and energy scarcity by developing a mechanism that filters and repurposes polluted water while simultaneously producing electricity.
Methods/Materials: The primary goal of this project is to address the widespread problem of polluted water bodies close to industry. In order to offer the public water and energy, the primary objective is to first purify the contaminated water and then use that water to produce hydroelectricity. Plastic containers are used to mimic the purification tanks for the water purification portion of the project. After passing through each stage of purification, the water is finally placed in another sizable tank filled with clean water. Afterward, the water goes to the hydroelectric plant where the water falls on the turbine and generates energy. This is primarily due to the speed of the water rotating around the turbines that are powered by a motor, resulting in a source of mechanical energy by water. The energy is converted into electrical energy that is sent to the houses and the purified water is also sent to houses and factories for further usage.
Results: Clean, purified water is produced and the electricity generated lights the bulb.

Conclusion/Discussion: Studies reveal that over 40% of the world's water bodies are tainted, and the remaining coal in the ecosystem will run out in about 150 years. The model's output helps to address both problems by using water to generate power instead of coal and cleaning up contaminated lakes. By substituting rocks and sand for chlorine and other purification chemicals, this project can be advanced to a natural method and higher quantity that helps purify more water in larger amounts.

Team: **Biomedical Besties (HS2)**
Title: Electromyographic Controlled Prosthetics
Participants: Eva Patel, Yashvi Patel, and Sunidhi Mitikiri

Objective/Goal: We will be modeling the use of a prosthetic arm by using digital Arduino simulation software and determine the impact of physical factors that compromise the muscle-prosthesis interface.
Methods/Materials:

- Onshape - Computer Aided Design (CAD) design software system
    - 3D model of prosthetic arm
- Tinkercad - 3D modeling program.
    - Arduino circuit simulation

Results: We were able to construct a graph using the data collected from the Arduino simulations. Limb or tissue damage, perspiration, alterations in motion, and shifts in skin movement led to deviations from the typical transmission of myoelectric signals.
Conclusion/Discussion: Electromyography is a system by which myoelectric signals are transmitted from nerve and muscle movement through electrodes. These signals are collected and displayed as waves, usually on an oscillator. Electromyography can be used to analyze nerve and muscle signals to translate those signals into a prosthetic. Studying the standard movements driven by myoelectric signals in the human body demonstrates the connection of electromyography to the movement of a prosthetic arm. By simulating the transmission of these signals through a digital Arduino circuit, we can analyze the effects of physical interference on the muscle-prosthesis interface.

Summary: Using digital Arduino simulation software, we were able to model a prosthetic arm and investigate factors affecting the muscle-prosthesis interface. In our experiment, we utilized CAD design software, 3D modeling, and Arduino circuit simulation. Through EMG, we explored how nerve and muscle signals can drive prosthetic movement, providing insights into improving prosthetic functionality to enhance wearability and comfort.

Team: **Electric Achievers (HS3)**
Title: Turning Piezoelectricity into Energy
Participants: Adwita Jagannathan, Anvita Malepati and Shriya Parvatikar

Objective: The objective of our project is to determine if piezoelectricity can be a viable replacement for nonrenewable energy sources in the future. We will be analyzing various sources of piezoelectric energy and analyzing their effectiveness in real-world applications.
Methods/Materials: Three methods of harvesting piezoelectricity were chosen for this study: waves, tree vibrations, and roads. We analyzed how each of these forms of piezoelectricity function. Additionally, we took a look at the pros and cons of each method if it were to be applied throughout the real world in various types of environments. Finally we compiled all of our results together and evaluated each method's effectiveness in the real world, as well as whether it would be a practical substitution for nonrenewable energy.
Results: We found that overall, piezoelectricity serves as an effective replacement for nonrenewable energy. As for the results on different methods of piezoelectricity, we look forward to sharing and discussing our results at the Science Symposium!
Conclusion: Piezoelectricity is a unique form of electricity made from applied mechanical stress to the material. Our study analyzes the effectiveness of different forms of piezoelectricity such as waves, tree, vibrations, and roads if they were to be implemented in the real world.

Team: **Lab Ratz (HS4)**
Title: Immune System Memory
Participants: Brianna Sims, Jansi Patel, Kirit Jassil and Nethra Gujja

Objective: This experiment attempts to investigate how memory cells in the immune system help the human body fight off illness.
Methods/Materials: For the "Magnet Antibodies Science Project" experiment, you'll need small magnets (representing antibodies), a magnetic surface (as the immune system), and small objects (such as beads) to represent antigens. Arrange the magnets on the magnetic surface to simulate the initial antibody-antigen interaction. Measure the time it takes for the antibodies to bind to the antigens, representing the primary immune response. Repeat the process to simulate a secondary reaction. Compare the binding times between the primary and secondary responses to assess immune system memory. Record observations and analyze results to understand how memory influences immune systems' ability to combat infections.
Results: There were quicker binding times during the secondary immune response compared to the primary response, indicating a faster and more efficient reaction due to immune system memory.
Conclusion: In conclusion, this experiment demonstrates the concept of immune system memory, showing that repeated exposure to antigens leads to a faster and more efficient immune response. The observed decrease in binding times during the secondary response highlights the role of memory cells in enhancing the body's ability to recognize and combat infections. These findings underscore the importance of vaccination and the development of immunity in protecting against diseases, contributing to our understanding of the intricate mechanisms of the human immune system.
Summary: This study aims to explore immune system memory, revealing how the body's defenses recall and respond to pathogens for faster protection.

Team: **The Ionic Innovators (HS5)**
Title: The Water We Drink and Utilize
Participants: Anusha Vakkalagadda, Aanya Muniyappa and Meenaa Ram

Objective/Goal: This project aims at studying various water samples from the neighborhood and analyzing them for the various chemical and microbiological parameters.
Materials and Methods:
- Water from different sources and commercially available water testing kits
- Water from various sources will be tested for various parameters and trends will be analyzed, if any. Data will be appropriately presented.

Results/Conclusion:
Results and conclusions will be presented at the event.

Team: **ToxicTitans (HS6)**
Title: Bioassay Analysis of Soil Toxicity
Participants: Amruta Jayaganesh and Nishi Patel
Objectives/Goals:
This project aimed to observe the toxicity in soil through a bioassay analysis by uncovering the long-term impact of soil toxicity on surrounding organisms, and ways that scientists can improve local soil conditions to best suit the environment.
Materials and Methods: We used a balance, table salt (NaCl), distilled water, Petri dishes (4), filter paper, seeds, a one-liter container, a 100ml graduated cylinder, and a pipet. First, we made a 0.2M NaCl solution by finding the molecular weight of NaCl and measuring it in terms of molarity. Then, we conducted the same steps to create a 0.1 M NaCl solution and 0.075M NaCl solution. We put filter paper on each petri dish, then added 2 ml of solution to each dish, respective to each molarity (0 M, 0.2M, 0.1M, and 0.075M). We then added a seed inside each of the dishes, closed the Petri dishes, sealed them in plastic bags, and put them in a dark place at room temperature for five days. After 5 days, we measured the length of the root.
Results: As the molarity of the salt solution increased, the seeds began to display stunted growth, depicting a negative correlation between seedling growth and increased concentration of NaCl solution.
Conclusions/Discussion: The seedlings placed in higher molarity solutions of NaCl had decreased growth in comparison to those placed with low molarities of salt. The results of this

study imply that salinity is a primary factor when determining plant growth. Higher salinity in soil may stunt plant growth, encouraging scientists to find ways to regulate the salinity of soil for the development of plants. In this case, the high salt concentration could have inhibited germination or severely restricted root elongation.

Summary: This project attempts to analyze the effect of salinity on plant growth via a bioassay analysis of seedling growth, exploring the consequences of soil toxicity on adjacent ecosystems, and evaluating strategies for scientists to enhance local soil conditions for optimal environmental suitability.

Judges at a Glance

Barbara Wendell

Barbara Wendell has been teaching for 11years and with 4 years at North Brunswick. She started as an 8th grade Science teacher and is currently a 5th grade Science teacher. She received her first Bachelor's Degree in Biology, and went on to receive her Master's Degree in Education Leadership Management, Education Administration and Supervisory, and finally her second Bachelor's Degree in Environmental Science. She is currently on the Environmental Commission in East Brunswick. She is working with the local township Mayors to bring communities together to conserve native pollinators by providing them with a healthy habitat, rich in a variety of native plants.

Kun Yang

Kun Yang Senior Principal Scientist at Clinical Pharmacology, Pharmacometrics, Disposition & Bioanalysis (CPPDB) in Bristol Myers Squibb. At BMS, Kun is developing bioanalytical strategies for various biologics development programs, including cell (CAR-T) & gene therapy (AAV) molecules, antibodies, etc. He is acting as the bioanalytical liaison with clinical, and non-clinical internal cross-functional project teams and external collaborators. He also leads the preparation of regulatory documents including IB, INDs, NDAs, and BLA submission documents and being responsible for responding to Health Authority queries related to bioanalysis. Kun received his Ph.D. in Biochemistry from University of Texas Southwestern Medical Center at Dallas.

Anuj Anand

Anuj Anand, born and brought up in Delhi, India, Graduated with engineering in computer science from Shivaji University. He has about twenty-nine years of experience in capital markets. He is the Head of FX Tech and for the past 14 years has been with various banks, including Wells Fargo. Anuj and his wife have two daughters. As a family, they like to play Chinese checkers and card games. He Loves to play badminton and read nonfiction books.

Frank Sweeney

Frank Sweeney is currently the Senior Process Safety Engineer at LyondellBasell's catalyst manufacturing facility in Edison, NJ. Throughout his career, Frank has worked in many aspects of engineering including research and development, business development, and manufacturing. A NBTHS alumnus, he holds a B.S. in Chemical and Biomolecular Engineering from Johns Hopkins University, where he is currently pursuing his Master's in Engineering Management.

Madhusudan Reddy

Dr. Reddy obtained M.Sc.in Chemistry from Osmania University, Hyderabad and Ph.D. from National Chemical Laboratory, Pune, India in 1990. He has worked at Imperial College, London and University Laval, Quebec as post-doctoral fellow on projects to develop the selective absorbents and catalytic materials for fine chemical processing. He moved to the USA in 1994 and served as a research faculty at Energy & Fuel Research Center, PennState University where he taught a graduate course on catalytic materials and also worked on multiple research projects in the development of catalysts for fuel processing. Throughout his research career Dr. Reddy has published multiple research papers in international journals and filed patents in various countries. The Council of Scientific and Industrial Research (CSIR), India has

recognized him for his patent on the material and process for the selective cracking of hydrocarbons for the dewaxing process of petroleum processing. Dr. Reddy is currently working at the Consolidated Edison of New York.

Saravanababu (Babu) Murugesan

Babu has worked in pharmaceutical and medical device industries with a background combining technical (PhD Chemical Engineering) and commercial (MBA Strategy/Marketing) expertise. He is currently working at Becton Dickinson as the Associate Marketing Director. He is looking forward to conversing with students on their wonderful science ideas. He is also a founding member of East Windsor - Hightstown Science Symposium.

Kelly Sookdeo

Kelly graduated from Montclair State University with my Bachelor's degree (B.A) in Family Science and Human Development with certifications in Science, Math, Special Education, and K-6 Education. She also attended Montclair State University for my Master's Degree (M.Ed.) in Special Education where she graduated in 1.5 years with a 4.0 GPA, was awarded the Graduate Student- Dean's Award, and was the Graduate Assistant to the Chair of the Education Department. Kelly is currently a 5th grade Science teacher and the 6th grade Engineering Challenge teacher at Linwood School and the Head Winter Varsity Cheerleading Coach at the NBTHS. During the summer months, I am the Aquatic Director at a waterpark down the Jersey shore. I love to explore the different fields of STEM in and out of the classroom! She loves to quote"You only fail when you stop trying".

Abhay Navale

Abhay Navale is Global Head of Digital Assets Technology at BNY Mellon. He has worked in Financial services technology across Fintech and Global banks. He has a passion for building great engineering products that solve business problems and delivering improved customer value.

Giridhar Thirucherai

Giridhar Tirucherai is currently Vice President & Head of Clinical Pharmacology at Scholar Rock, a biotech organization, that discovers, develops, and delivers life changing therapies for serious diseases that have high unmet medical need. Giri has been active in the R&D sector of pharma and biotech industry over the last 22 years, and has authored more than 25 peer reviewed publications. Giri obtained an Interdisciplinary PhD in Pharmaceutical sciences and Pharmacology from the University of Missouri-Kansas City. Giri enjoys spending time with his family and friends and is a crossword and sudoku enthusiast.

Dr. Lucille O'Reilly

Dr. Luci O'Reilly is currently a tenured faculty member of the North Brunswick Township High School Science Department, where she teaches chemistry at both the College-preparatory and the Advanced Placement levels. Dr. O'Reilly is also the team teacher for the North Brunswick Township High School's Waksman Student Scholars, a molecular biology and bioinformatics research group associated with Rutgers University, a volunteer for the North Jersey American Chemical Society's sponsored events to promote STEM to K-12 students and a participant on alumni panels to promote a K-12 education career track for graduate school science majors post-graduation. Dr. O'Reilly received her doctorate in Molecular Biology and Biochemistry from The University of Medicine & Dentistry of NJ's School of Biomedical Sciences (Piscataway, NJ), where her research focus was the interaction of retroviral particles with the host cell. Dr. O'Reilly is also an alumnus of Rutgers College (New Brunswick, NJ) and Montclair University (Montclair, NJ). Prior to receiving her doctorate, Dr. O'Reilly worked in both academic and biotechnology/ pharmaceutical laboratories and has taught at the college level.

2023 NBT SCIENCE SYMPOSIUM WINNERS

Team#	Team Name	Category	Participants	Award
ES7	Rock Girls	Elementary School	Hawwa Tahir	1st Place
ES7	Rock Girls	Elementary School	Isra Naeem	1st Place
ES7	Rock Girls	Elementary School	Ayla Naeem	1st Place
ES7	Rock Girls	Elementary School	Sara Mortigo	1st Place
ES7	Rock Girls	Elementary School	Iniya Ramachandran	1st Place
ES3	Curious 4	Elementary School	Naman Venugopal	2nd Place
ES3	Curious 4	Elementary School	Kabir Gupta	2nd Place
ES3	Curious 4	Elementary School	Ranvir Gupta	2nd Place
ES3	Curious 4	Elementary School	Nityam Porwal	2nd Place
ES1	Inquisitive Minds	Elementary School	Ananya Meda	3rd Place
ES1	Inquisitive Minds	Elementary School	Aryan Vuggini	3rd Place
ES1	Inquisitive Minds	Elementary School	Dhruva Yarlagadda	3rd Place
ES1	Inquisitive Minds	Elementary School	Siddharth Oza	3rd Place
ES1	Inquisitive Minds	Elementary School	Taksh Patel	3rd Place
IMS3	RAP Science Guys	Intermediate Middle School	Ajitesh Tiwari	1st Place
IMS3	RAP Science Guys	Intermediate Middle School	Rivan Ghimiray	1st Place
IMS3	RAP Science Guys	Intermediate Middle School	Priyansh Patley	1st Place
IMS5	Science Nerds	Intermediate Middle School	Karunya Gujja	2nd Place
IMS5	Science Nerds	Intermediate Middle School	Ruhitha Anand	2nd Place
IMS5	Science Nerds	Intermediate Middle School	Visesha Pasumarthi	2nd Place
IMS5	Science Nerds	Intermediate Middle School	Kshipra Lakkavajhala	2nd Place
MS4	Brainy-Badgers	Middle School	Nethra Gujja	1st Place
MS4	Brainy-Badgers	Middle School	Ayush Sharma	1st Place
MS4	Brainy-Badgers	Middle School	Subramanium Vignesh	1st Place
MS1	Innovative Thinkers	Middle School	Ojas Shrivastava	2nd Place
MS1	Innovative Thinkers	Middle School	Gaurav Naira	2nd Place
MS1	Innovative Thinkers	Middle School	Anish Sinha	2nd Place
MS5	Math Cubers	Middle School	Nandan Kamalakannan	3rd Place
MS5	Math Cubers	Middle School	Nandita Kamalakannan	3rd Place
HS1	Bio Bosses	High School	Saloni Agshiker	1st Place (Tie)
HS1	Bio Bosses	High School	Akshita Krishnakumar	1st Place (Tie)
HS1	Bio Bosses	High School	Devashree Parambath	1st Place (Tie)
HS1	Bio Bosses	High School	Sk Shadman Abdullah	1st Place (Tie)
HS1	Bio Bosses	High School	Daniel Benimovich	1st Place (Tie)
HS5	Algae RANGers	High School	Rhea Palliath	1st Place (Tie)
HS5	Algae RANGers	High School	Gabriella Seiden	1st Place (Tie)
HS5	Algae RANGers	High School	Naachammai Ramu	1st Place (Tie)
HS5	Algae RANGers	High School	Aruhi Vakkalagadda	1st Place (Tie)
HS2	JayPat	High School	Amruta Jayaganesh	2nd Place (Tie)
HS2	JayPat	High School	Nishi Patel	2nd Place (Tie)
HS4	The Genetic Geniuses	High School	Yashvi Patel	2nd Place (Tie)
HS4	The Genetic Geniuses	High School	Sunidhi Mitikiri	2nd Place (Tie)
ES6	Future Einsteins	Elementary School	Bibodh Shrestha	Outstanding Presentation
ES6	Future Einsteins	Elementary School	Samay Makam	Outstanding Presentation
ES5	Magic Makers	Elementary School	Maya Saha	Outstanding Design
ES5	Magic Makers	Elementary School	Maha Sheikh	Outstanding Design
ES5	Magic Makers	Elementary School	Akshaya Kanna	Outstanding Design
IMS2	Hydroelectric Engineers	Intermediate Middle School	Rishab Patel	Outstanding Presentation
IMS2	Hydroelectric Engineers	Intermediate Middle School	Kandarp Porwal	Outstanding Presentation
MS2	STEMinists	Middle School	Mahati Vemula	Outstanding Presentation
MS2	STEMinists	Middle School	Poorna Thogulava	Outstanding Presentation
MS2	STEMinists	Middle School	Saanvi Singh	Outstanding Presentation

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