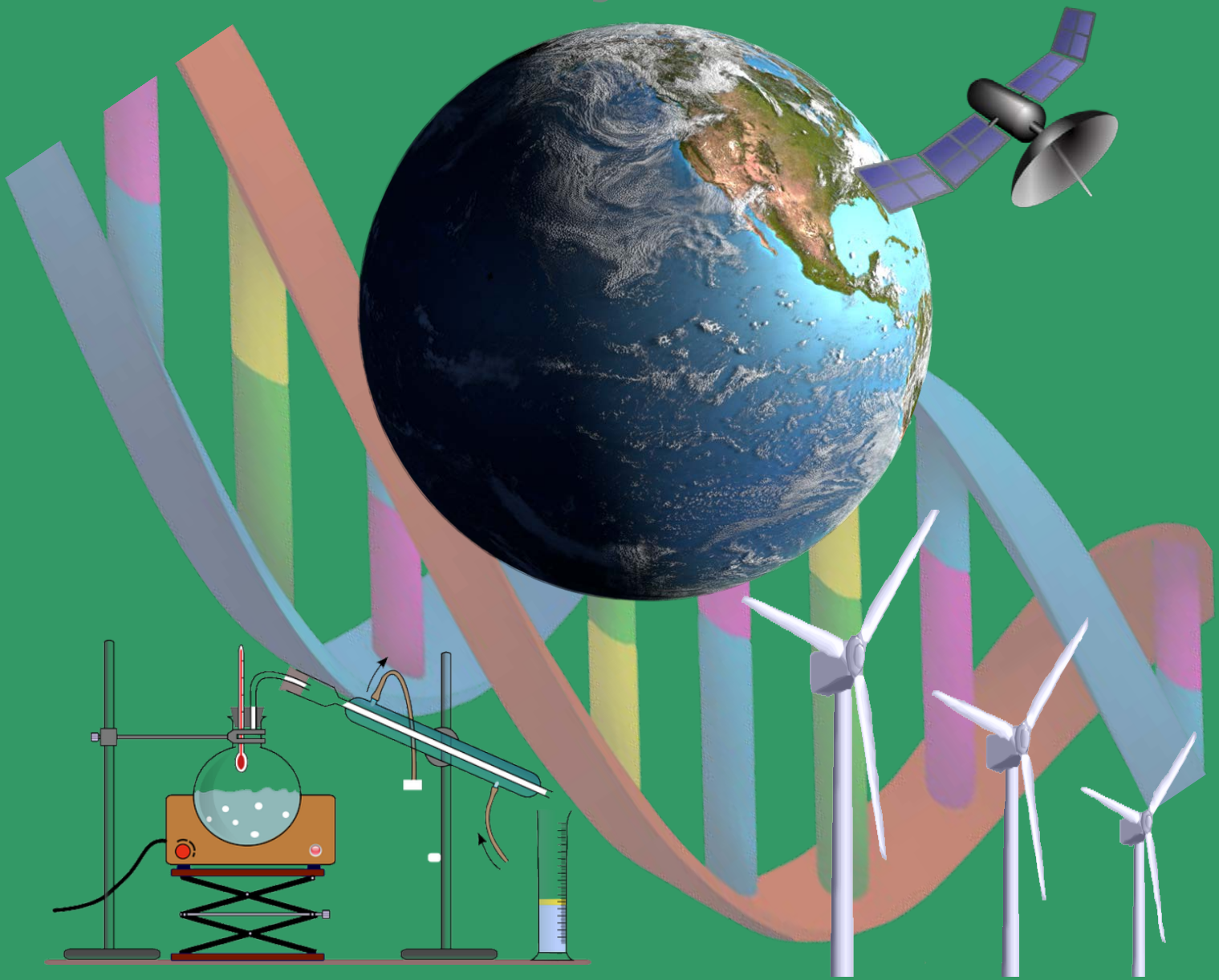
# Science Symposium

## "Where Creativity Meets Innovation"



# ABSTRACT BOOK - 2022

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


We sincerely thank

https://intellectionnj.com

For their generous support

Intellection's mission is to ensure that all low income school children have the resources to succeed from the moment they enter the public education system. Intellection wants to provide assistance at all grade levels to ensure that low income students have opportunities in STEM fields and the necessary skills for them to thrive. Intellection has given over $40K in scholarships since inception in 2013.

# NBT SCIENCE SYMPOSIUM 2022

**NBT**
**Science Symposium**
**Executive Committee Team**

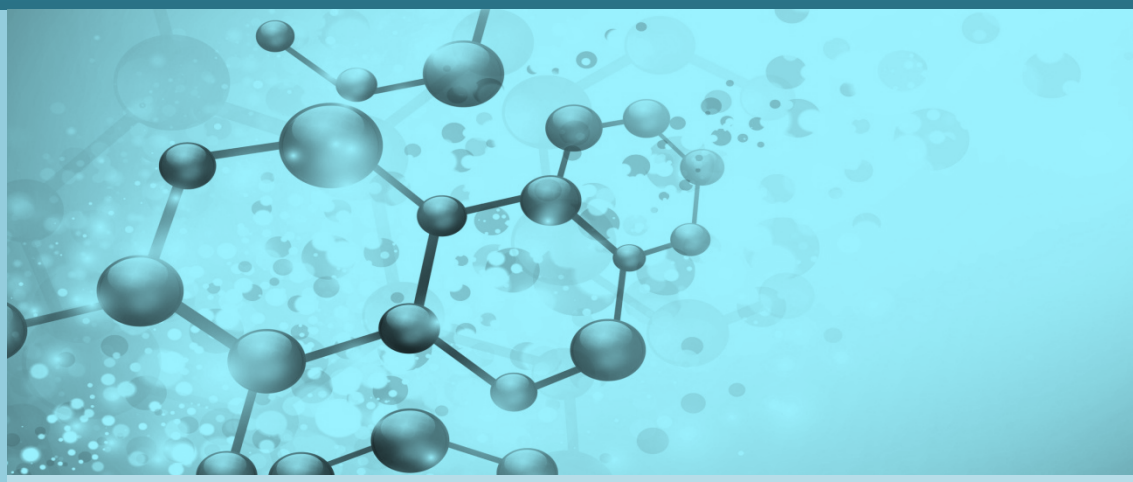
Gangadhara Rao Vakkalagadda
Chairperson

Surendar Reddy Revuri
Co-Chairperson

Kishore Mitikiri
Content Coordinator

Govinda Rajan
CEO-Agraj Seva Kendra





## Message from Chairperson

Dear Friends,

I am honored to invite you to the 6th Annual NBT Science Symposium. After a COVID-19 break we are back again to provide a platform for children Grades 3rd-12th in North Brunswick, an opportunity to present a scientific concept that they have researched, tested with their peers. It is our responsibility to encourage them to pursue science, keep researching, continue learning and have fun during this process.

It is rightly said that necessity is the mother of invention. What we learn or achieve during times of hardship is perhaps not possible during times of smooth sailing. When the COVID-19 pandemic started, no one could imagine what the next steps would be. Nevertheless, throughout the pandemic, science and technology have been the backbone of human progress and sustainability; the panic and fear was calmed with fast scientific research in the form of effective vaccines and other discoveries. A strong scientific background combined with dauntless efforts of scientists helped the world towards normalcy. The developments in medical research to combat COVID are perhaps one of the greatest wonders of human perseverance and a great blessing to the world in the latest context. This was possible only because every day, efforts are made to nourish the youth with concepts of science. Small events like the annual NBT Science Symposium are one of such millions of efforts around the world to strengthen science and give humanity a pleasant and comfortable life.

Rightly goes the proverb, "Science for humanity and humanity for science"

I will end my message by acknowledging the efforts of everyone who helped make this event possible. 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 his support. I would also like to thank Agraj Seva Kendra for taking up such novel initiatives to support the community. I also want to recognize the continued partnership with the North Brunswick Board of Education, North Brunswick Township High School and the North Brunswick Township, because their support makes this event unique and rewarding experience. We would like to proudly acknowledge the partnership with Intellection to support this Science Symposium.

On this occasion I take the opportunity to convey my congratulations, thanks and good wishes to all the participants and their supporters for making this a successful event.

Good Luck and all the best!

Gangadhara Rao Vakkalagadda
Chairperson, NBT Science Symposium Committee

# Messages

## Govinda Rajan

Dear Brothers & Sisters,

On behalf of Agraj Seva Kendra and NBT Science Symposium Committee, I welcome you all to the Sixth Annual NBT Science Symposium.

We conducted five annual science symposiums consecutively from 2016 to 2020. Due to COVID, we could not conduct the science symposium last year.

Thanks for the encouraging response from parents and students; we can conduct Science Symposium this year. The objective of this event is to showcase the talent of our students in STEM. As usual, we expect many brilliant submissions.

I extend my gratitude and appreciation to the Board of Education, staff, parents and students for their help and support in making this event a success. I thank the sponsors, judges and volunteers for their efforts and encouragement. Last, but not the least, I congratulate NBT Science Symposium team for their unstinted efforts in bringing out this event.

Sincerely,

Govinda Rajan
CEO, Agraj Seva Kendra

## Janet Ciarrocca

Dear Friends,

On behalf of the North Brunswick Township Board of Education, it is with great pleasure that I welcome you to the 2022 NBT Science Symposium after a one year "COVID-19" break. Science and scientific research, always a vital area of study, showed its worldwide importance globally, as it helped guide pandemic decisions and led to the creation of innovative and life-saving vaccines. NBT Schools values and emphasizes the study and exploration of the varied fields of science and fully support wonderful community events such as the NBT Science Symposium.

Thank you to the NBT Science Symposium committee for continuing to encourage our students to explore various areas of science. Congratulations to all of our NBT students expanding their horizons through their science explorations!

Sincerely,

Janet Ciarrocca
Superintendent of Schools
North Brunswick Township Public Schools

Dear Friends,

On behalf of North Brunswick Township High School it is my pleasure to welcome the greater North Brunswick School Community to the 2022 NBT Science Symposium! We are very excited that this event can once again be held in-person to show off our students' interests in science across the school district. It is the students' interest in science at an early age that continues to help build the many high school programs we offer for students with an interest in this field. We hope to continue to work together with the community to challenge students to explore this area through events such as this and to consider future careers upon graduation from NBTHS!

Sincerely,

Michael Kneller
Principal, North Brunswick Township High School

## Michael Kneller

# NBT SCIENCE SYMPOSIUM 2022

## Program Schedule

| Time | Activity |
|---|---|
| 9 AM to 10 AM | Participants to pick up the registration packages and setup displays |
| 10 AM | Judging Sessions begin<br><br>**Room 1 Judges**<br>• Dr. Vijay Reddy<br>• Barbara Wendell<br>• Sachin Desai<br><br>**Room 2 Judges**<br>• Dr. Randy C. Dockens<br>• Bryan Sannwaldt<br>• Beth Sweeney Piccolella |
| 12 PM<br>Program Moderator:<br>Blisse Vakkalagadda | • Welcome address by Gangadhara Rao Vakkalagdda<br>• Address by Janet Ciarrocca, Superintendent of Schools<br>• Address by Raj Krishnan, Intellection<br>• Vote of Thanks<br>• Awards Distribution |

| Judging Time | Room 1 | | Room 2 | |
|---|---|---|---|---|
| | Team # | Team Name | Team # | Team Name |
| 10.00 AM | ES1 | Science Guys | IMS1 | A2 |
| 10.10 AM | ES2 | Science Bros | IMS2 | AI Twins |
| 10.20 AM | ES3 | Science Nerds | IMS3 | Science Buddies |
| 10.30 AM | ES4 | Luminous | IMS4 | Contributors to Science |
| 10.40 AM | ES5 | Solar Glowing Minds | IMS5 | Innovative Thinkers |
| 10.50 AM | ES6 | Sonic Boys | IMS6 | $H_20$ |
| 11.00 AM | ES7 | Gravity Goons | IMS7 | ECE |
| 11.10 AM | MS1 | STEMinists | MS5 | The Botanists |
| 11.20 AM | MS2 | TerrificThree | HS1 | Algae RANGers |
| 11.30 AM | MS3 | Food Re-SEARCHers | HS2 | ET |
| 11.40 AM | MS4 | Creative Minds | HS3 | Simple Solutions |

# Abstracts

## Elementary School Projects (Grades 3-4)

**Team: Science Guys (ES1)**
**Title:** Infectious Diseases
**Participants:** Ajitesh Tiwari and Rivan Ghimiray

**Objective/ Goals:** The main objective of this study is to go in depth knowledge of the science of spreading of diseases (germs), demonstration of possible options for protection against it.

**Materials/Methods:** We performed two experiments given below:
**Experiment 1: Bacterial culture method**
**Materials**: - Timer, sterilized cotton Swabs, 24 agar dishes, 6 pencils, sanitizing wipes, Chromebook, door knob, 3 copper sheets, Latex gloves
**Method**: - In first trial we swabbed the surface of pencil, Chromebook, and door knob and streaked on agar plate (control). In second trial we used plain water to clean the surface, third used sanitizing wipes, and in fourth trial we wrapped the surface with copper and swabbed surface area and streaked on agar plates. We kept plates in dark, warm and humid place for 5 days then counted the colonies of bacteria and recorded the data.
**Experiment 2: Optical imaging approach**
**Materials**: -Laser beam, black box, camera, different types of masks (bandana, two-layer cloth mask, surgical mask, M95 mask, N95 mask), hair dryer.
**Method**: - We set up a light sheet enclosure, where light scattering from particles traversing the light sheet was detected with the camera. In the front of the box an 18 cm diameter hole was made for a person wearing a mask to speak into the box. After every trial enclosure was dried by hair drier. We used iPhone 12 camera to record the video of 20 second of speech "why we should wear mask". Each trial we repeated three times. For control we recorded the speech without any mask.

**Results:** We found that sanitizing the surface with sanitizing wipes and using copper surface is the most effective way to decrease the spreading of germs. We found significantly less bacterial colonies in disinfected and copper used surface than control and water wiped surfaces.
In the second experiment we found that N95 and M95 mask were best as we did not see any water droplets in recorded video. Bandana was worst as we saw large water droplets. We saw smaller water droplets in double layer cloth mask and very less water droplets in surgical mask.

**Conclusions:** Our results show that sanitizing wipes and copper are a good method to sanitizing the surface. We can make a self-sanitizing equipment and using copper on door knob or copper key board, utensils etc. to prevent germ spread. Wearing a good quality mask like N95 is also important to stop the spread of germs through sneeze, cough and through speech by the speaker

**Summary**: This project is an attempt to spread awareness about different types of infectious diseases and with the experiments we tried to prove that we should follow some guidelines that wearing good quality masks in public and sanitizing public places can significantly reduce the spread of germs.

**Team: Science Bros (ES2)**
**Title:** Air Trapping in our Lungs
**Participants:** Gabriel Laurent and Eduardo Valdez
**Objective/ Goals:** In this study we will demonstrate how air gets trapped in the lungs.

**Materials/Methods:** The three most common medical conditions chronic bronchitis, asthma, and bronchiectasis were chosen to examine the location of air trapping. An experimental artificial lung was constructed using the materials of a

plastic bottle, straws, and balloons to demonstrate differences between a healthy lung expansion and diseased lung expansion. The trachea was constructed using tape and straws with different diameters. Two balloons were used to represent lungs and stored inside a plastic bottle providing a simulated thoracic (rib)cage framing. The diaphragm was created using a balloon as the base of the thoracic cage. Inhalation and exhalation were demonstrated by pulling the diaphragm (base of the balloon). As the pressure in the bottle becomes less (pulling the diaphragm out) than atmospheric pressure, then the lungs in the thoracic cage will inflate. Reversely when the diaphragm is pressed-in then the lungs deflate and exhalation occurs. Diaphragm contraction speeds were measured by the ability of the air to fill the lungs when the volume of chest cavity increases or decreases. Several sizes of heights of bottles (thoracic cages) and balloon sizes (lungs) were used to examine if there would be a change in lung capacity.

**Results:** The speed of the diaphragm contractions showed less going out regardless of the size of the thoracic cage or lung size. Therefore, very similar to the process that occurs in medical conditions chronic bronchitis, asthma, and bronchiectasis when air gets trapped inside a patient's lungs as they try to breathe out.

**Conclusions/Discussions:** Inhalation and exhalation can be controlled using this experiment's apparatus. However, the results are inconclusive if pressing the diaphragm at various speeds can determine how much air is being trapped in conditions such as chronic bronchitis, asthma, and bronchiectasis.

**Summary:** Many conditions associated with air trapping may be assessed by examining the diaphragms' ability to expand.

**Team:** Science Nerds (ES3)
**Title:** Chic Magnet
**Participants:** Karunya Gujja and Visesha Pasumarthi

**Hypotheses:**

1. Longer bolts with more coils of wire around them produce a stronger magnetic field
2. Bigger batteries with higher voltage produce a stronger magnetic field

**Objectives/Goals:** This study attempted to learn that the physical size of the battery isn't particularly important in determining the strength of the magnetic field. Also, the strength of the magnetic field comes not from the battery's voltage but rather from its current, measured in milliamperes per hour (mAh).

**Materials/Methods:**

- 18 Gauge Copper Wire
- Batteries
  - Size D (1.5 volt)
  - 9 volt
  - 6 volt
- Zinc Coated Hex-Head Bolts (5/16 in)
  - 2 in length
  - 3 in length
  - 4 in length
- Electrical Tape
- Needle Nose Pliers
- Drywall Screws (1 in. fine threaded)
- Pencil (for recording results)
- Spreadsheet (for recording results)

**Conclusion**: We can determine the strength of the Electromagnets

**Summary:** How does the length of the bolt and the strength of the battery impact the force of the magnetic field in a homemade electromagnet?

**Team: Luminous (ES4)**
**Title:** en-Lighted (concepts of light)
**Participants:** Satvik Parvatikar and Yash Helchal

**Objective/ Goals:** This study aims to explore interesting properties of light, its component wavelengths, and how diffraction spectrum differs for different Light sources.

**Materials/Methods:**

- Cardboard box
- CD as diffracting material
- Light sources (CFL, flashlight/LED)
- Utility Knife

An experimental spectrometer was constructed using a cardboard box and CD to study the diffraction of light. Tape the cardboard box so that it is pitch dark inside. Now make 30 degrees cut on one side and slide the CD into this slit with the diffraction side facing up, opposite to the CD slit make a cut for the light source so that light fall on the CD at 30 degrees angle. Make a small hole to view the spectrum on the topside of CD slit. Observe the spectrum for different light sources.

**Results:** *CFL:* We could see a band spectrum of Red, Green, Blue and Violet colors, not all rainbow colors are visible. *Flashlight/LED light:* We could see a continuous full spectrum of all rainbow colors.
**Conclusions:** Light travels in a straight line in varying wavelengths, when white light falls on diffracting objects (like CD) at a 30-degree angle it splits into rainbow colors (red, orange, yellow, green, blue, indigo, and violet) called the Spectrum. The Diffraction Spectrum varies for different light sources. Although CFL, flashlights emitted white light diffraction spectrum observed was different, this means the pattern is dependent on the content of the Light source. The bands observed correspond to Mercury, an element predominantly found in the fluorescent bulb, study concludes that the spectrum pattern helps to study the composition of light sources such as different stars.

**Summary**: This project attempts to understand the composition of the light source based on the diffraction pattern they exhibit.

**Team: Solar Glowing Minds (ES5)**
**Title:** Artificial Photosynthesis, A renewable energy source
**Participants:** Veman Ganta, Kshipra Lakkavajhala, Anika Srivastava and Arjun Lakkavajhala

**Objectives/Goals:** The purpose of studying artificial photosynthesis, as a renewable energy source, is to create an endless, scalable, safe and relatively inexpensive supply of all the clean "gas" and electricity we need to power our lives and also in a storable form. Artificial Photosynthesis seeks to replicate the natural process of photosynthesis. The goal is to make fuel from solar energy, but scaled up to meet the energy demands of a modern technologically driven society

**Methods/Materials:** To recreate the photosynthesis that plants have perfected, an energy conversion system has to be able to do two crucial things - harvest sunlight and split water molecules. Researchers in the US have taken important steps towards the creation of commercially viable "artificial leaf" – a hypothetical device that can turn sunlight into electrical energy or fuel by mimicking some aspects of photosynthesis. The basic component of an artificial leaf is a silicon chip that is coated in chemical catalysts like Cobalt, Manganese or iron, which speed up the water-splitting reaction. In an open vessel of water, when solar energy hits the chip, a chemical reaction similar to photosynthesis occurs—the hydrogen and oxygen molecules of water are split apart, resulting in the separation of protons and electrons. The protons and electrons are captured on the chip and are recombined to form hydrogen gas, which can be used for immediate generation of electricity or stored for later use. Plants do these tasks using chlorophyll, in the presence of sunlight break down $H_2O$ molecules into hydrogen, electrons and oxygen (protons). The electrons and hydrogen are then used to turn $CO_2$ into carbohydrates, and the oxygen is expelled.

**Results:** Artificial Photosynthesis uses sunlight which is abundant and produces a hydrogen fuel that will be energy efficient & carbon neutral. It

will not add any greenhouse gases into the atmosphere. Artificial photosynthesis could offer a new, clean renewable energy resource which also reduces harmful greenhouse gas $CO_2$ from the environment, which is a WIN-WIN Situation.

**Conclusions/Discussions:** Fossil fuels from non-renewable energy sources are in short supply and they're contributing to pollution and global warming. Coal, while abundant, is highly polluting both to human bodies and the environment. Wind turbines are hurting picturesque landscapes and current solar-cell technology is expensive and inefficient. Whereas with Artificial photosynthesis, a renewable energy source, could offer a new, possibly ideal way out of our energy predicament. Water and sunlight would ultimately be the only needed sources for clean energy production. The ability to produce a clean fuel without generating any harmful by-products, like greenhouse gasses, makes artificial photosynthesis an ideal energy source for the environment. Artificial photosynthesis has been devised and investigated in pursuit of solving the 21st century's energy problem.

**Team: Sonic Boys (ES6)**
**Title:** Climate Change (Mangroves Forest)
**Participants:** Yoofi Idun-Acquah, Fiifi Idun-Acquah, Sai Aarush Yalamanchili

**Objectives/Goals:** This study aimed to explain about Mangroves. Planting mangroves can reduce shoreline erosion and can protect coastal communities against coastal flooding, high winds and waves, and tsunamis.

**Methods/Materials:** This method of Mangrove show the ecosystem that helps to avoid extreme weathers like Hurricanes, Tsunami etc. To illustrate this we would need a long water tank, water, Mangrove plants, electric motor that helps in pushing the waves.

**Results:** Restoration of a mangrove ecosystem. The aim is to support livelihood without destroying the mangrove forest.
**Conclusions/Discussion:** Mangroves provide natural infrastructure and protection to nearby populated areas by preventing erosion and absorbing storm surge impacts during extreme weather events such as hurricanes. Mangrove forests capture massive amounts of carbon dioxide emissions and other greenhouse gases from the atmosphere, and then trap and store them in their carbon-rich flooded soils for millennia. This is an important ecosystem service as we face Climate change. This buried carbon is known as "blue carbon" because it is stored underwater in coastal ecosystems like mangrove forests, seagrass beds and salt marshes. Mangrove forests also provide habitat and refuge to a wide array of wildlife such as birds, fish, invertebrates, mammals and plants.

**Summary:** This project attempts to determine how to support Mangrove ecosystem.

**Team: Gravity Goons (ES7)**
**Title:** Gravity Games
**Participants:** Peter Curry and Mark Wilson, Jr.

**Objectives/Goals:** The purpose of this project is to show what gravity is, how it works, and why it matters. The lesson we hope to teach is that gravity is one of the many things that make Earth a unique planet, which we all have a responsibility to protect.

**Summary:** In this project we mix research with experiments to better understand gravity. We start by researching some basic questions: What is gravity? Why is it important? How does gravity help us? What would happen if there were no gravity? Can humans survive without it? Is Earth the only planet with gravity? Why do some balloons float up instead of falling down?
The reason we decided to call our project "gravity games" is because we use games to prove how gravity works. Using a marble and plastic tubes, we can create a maze that guides a marble from the highest point of the tubes, down to the lowest point. In another game, we take two different objects at a time, one light and one heavy, and see which one hits the ground first when we drop them both at the exact same time.

**Team: A2 (IMS1)**
**Title:** Wi-Fi Signal Blockers
**Participants:** Aadya Munigala and Aaryav Narendra

**Objectives/Goals:** This study is aimed to find out the materials that cause the biggest drop in signal strength from a wireless router.

**Methods/Materials:** The materials required for this project include a wireless router, Wi-Fi enabled device like a smartphone, a tablet with Wi-Fi adapter, a program or app to analyze the strength of the wireless signal (preferable in dBm), steel baking pans, glass baking pans, cardboard, plastic, and a notebook. An app or program that measures the strength of a Wi-Fi signal in dBm has been downloaded and installed for our wireless device. On table 1, wireless router and test material were set up at the same height. On table 2, wireless device was setup at the same height as table 1. The recordings were then taken. The experiment was started by measuring the signal strength with no blocking material. Three trials were made and the recordings were noted in dBm. Then other blocking materials such as steel baking pans, glass baking pans, cardboard, plastic was used in three different trials and average signal strength was calculated among different test materials. The calculations in the form of bar graph were made and this helped us determine the attenuation of Wi-Fi signal using different materials.

**Results:** Metal seems to be the top Wi-Fi signal disruptor.

**Conclusions/Discussions:** Based on the literature, some of the major findings include - There's a misconception that clear glass fixtures, such as windows, are the best place to gain access to a signal. While the clear area is ideal for letting in light, they can bounce a signal around or reflect the signal away from the house. Metal roofs as well as metal studs and interior metal will slow down the signal. While metal looks nice on a building, is durable against the elements, and can help with routing electricity and such away from the wall's underneath, it can also route the signal away from the house. Most houses which have metal roofs will find that even if they live in an area where exterior signals are strong, interior signal strength will be weak if not non-existent.

**Summary**: This project attempts to determine which materials can disrupt Wi-Fi signals and the necessary solutions to improve the signal strength.

**Team: AI Twins (IMS2)**
**Title:** ML Playtime
**Participants:** Nandan Kamalakannan and Nandita Kamalakannan

**Objectives/Goals:** This study aims to train the computer app to learn human interaction using Machine Learning (ML) model.

**Methods/Materials:** We want the computer to turn on/off the light making use of the ML models instead of programming. Collected examples of texts to be given as input to our ML model. Two data models “lamp_on” and “lamp_off” were created each containing many sample texts which the user can give as an input. These two data models were trained and converted to machine learning models. These ML models were given as input to our scratch app. Our scratch app makes use of this machine learning model for recognizing the text input given by the user against the ML models and makes the light on or off.

**Results**: Our scratch program makes use of our ML models and Turn On/Off the light based on user input

**Conclusions/Discussions:** Our app was responding to user inputs based on the ML model. However it failed many times initially and the results improved by training the ML model with more data. It also makes the programming simple reducing the no of lines. We can train as many example texts to our ML model without changing the program

**Summary**: This project attempts to train the computer app to respond to human interactions.

**Team: Science Buddies (IMS3)**
**Title:** Energy Generator
**Participants:** Ishita Mhatre, Sahasra Cheruku, Mahek Sharma

**Objectives/Goals:** This study aimed to showcase how to generate energy using magnets (Thermodynamic laws)

**Methods/Materials:**

- Metal shaft (3mm)
- Mini Bearing (3mn)
- Copper Wire (18 gauge)
- Neodymium Magnet (15 x 6)
- Metal shaft (8mm)
- Copper sheet
- Wood
- Electric Bulb
- 12 volt battery

The first law of Thermodynamics, also known as laws of conservation of energy states that energy can neither be created nor be destroyed. This means that the energy that we see around us is always transferred from one state to another. As we are moving towards finding various solutions to solve our energy crisis. Till now we have found many ways to convert wind, water, and sun into energy. There is one more source we explored in this experiment to convert magnetic energy into electric energy.

**Results:** This experiment proves that we can build a simple motor using only magnets. This motor can be installed into cars and homes to generate electricity.
.
**Summary:** Moving a coil of wire around a magnet pushes the electrons in the wire and creates an electrical current. This generator essentially converts kinetic energy (The energy of motion) into electric energy.

**Team: Contributors to Science (IMS4)**
**Title:** Which is the most efficient air purifier?
**Participants:** Anagha Meda and Pranav Oza

**Objectives/goals:** With the pandemic suddenly coming in, breathing clean air is very important. This experiment is aimed to decide which household materials will make the best air purifier. We want people who can't afford expensive filters for themselves to still be able to have clean air.

**Methods/Materials:** For this project the materials we used were a shoebox, hair dryer, paper funnel, graph paper, tape, cardboard, black pepper, and 3 homemade filters, which are made of cotton, tissue, and gauze. Our air source is a hairdryer and the pepper symbolizes a pollutant. We made two holes on the box, the top one was to dispense the pepper and the hole on the side was to put the hair dryer. In the middle of the box we have a slot to collect the pepper getting blown by the hair dryer. Finally at the end of the box there is a collector which catches the pepper so we can examine which filter caught the most and least amount of pepper.

**Results:** Cotton was the best filter and tissue was the worst filter.

**Conclusion/Discussion:** Our hypothesis was that cotton would collect the most pepper out of the three filters. Cotton is a porous material which will allow a good air flow. Even though it is porous it can still catch pepper. After testing the filter made of tissue and gauze we saw that it did not block as much pepper as cotton. We put them next to each other to confirm that cotton was the best filter.

**Summary:** By doing this project we're ensuring that people know how to keep themselves safe in places where the air is not clean. People who learn about this will have a better judgment on how to keep the air clean.

**Team: Innovative Thinkers (IMS5)**
**Title:** Quantum vs. Classical Computing
**Participants:** Ojas Shrivastava and Gaurav Nair

The race to make good on quantum computing is well underway. Millions of dollars have been allocated to developing machines that could cause current computers to become obsolete. But what is the difference between quantum and classical

computing? There are several use cases where both computing models can prove themselves better. Innovative Thinkers will run a few experiments to show how both quantum computing and classical computing can be helpful to us in the future. Innovate Thinkers will also show the concept of quantum computing via games to show fun and educational ways of how it works and solve complex problems of the modern world.

**Team: $H_20$ (IMS6)**
**Title:** Aqua Saver
**Participants:** Aditi Kshirsagar, Chloe Koffke, Sophia Koffke and Saanvi Aluri

**Objectives/Goals:** To study different ways other places clean their drinking water, and to determine which method is the best.
**Methods/Materials:** We researched different methods to clean drinking water. Then we listed the pros and cons, and determined which one had the best pros.
**Results:** In North Brunswick NJ, they limit the number of contaminants in the drinking water by using filters. North Brunswick Township analyzes water for more than 90 contaminants and monitors closely for the presence of bacteria and chlorine.
In NASA, the water on the ISS goes through multiple filters in order to remove particles, debris, organic/inorganic impurities, and bacteria/viruses. Since NASA can't get water from the Earth, they reuse all the water that is stored in the station.
The water in Iceland is filtered through volcanic rocks underground for decades, and the purified water goes straight to the tap. The hot water from Iceland is heated with geothermal heat. Another reason why there are no contaminants in the water is because they have been using 100% renewable energy (no fossil fuels), so that they can't contaminate the water.
The water in Paris goes through many filtration layers to clean out the contaminants. They use activated carbon filters and ultra-filtration.

**Conclusions/Discussions:** We think the place with the healthiest method to clean drinking water is Iceland. In Iceland they use natural filters, the water filters through volcanic rock, leaving this method the healthiest for the environment because it is all NATURAL.

**Summary:** We learned that NATURAL filtration is the best way to filter water even though all places may not have natural filters available. They can make a filter that mimics natural filters and to limit using fossil fuels to make filtration easier.

**Team: ECE (IMS7)**
**Title:** Density
**Participants:** Ethan Dziekpor, Caius Pasignajen - Pormentillia, Earl Dziekpor.

**Objectives/Goals:** This study is aimed to determine the densities of different liquids and solids by their mass and volume
**Methods/Materials:** Density is how much mass (stuff) there is in a space. The density of an object can be calculated mathematically using Density = Mass/Volume. In our experiment, we are going to make a density column using different liquids. We are also going to put small objects into the liquids and then observe what happens. In our experiment we will be using liquids such as water, food coloring, vegetable oil, dishwashing soap, corn syrup and honey. The solids we will be using are coins, Lego bricks and a plastic toy. We will also use a tall glass/ plastic container. This will determine the densities of different liquids and solids.
**Results:** The denser object remained at the bottom of the container followed by the less dense on top.
**Conclusions/Discussion:** Evidenced based research shows that the denser an object is, the heavier it is. Generally, the denser an object is, the heavier it is. If you fill a box with sand and then you fill the same box with cotton wool, the box of sand will feel more heavier and so it has more density.

**Summary:** This project attempts to determine which the density of liquids and solids by examining their mass and volume.

# Middle School Projects (Grades 7-8)

**Team**: **STEMinists (MS1)**
**Title:** The Brain
**Participants:** Mahati Vemula, Poorna Thoguluva and Saanvi Singh

**Objectives/Goals:** Our goal is to expand the audience's knowledge about the brain. We chose this topic because the brain is the most complex and vital organ as it controls the rest of the body.

**Methods/Materials:** The materials we used in this project are playdough (different colors), cardboard, and construction paper.

**Discussion:** The human brain is a complex organ that controls our memory, touch, etc. The brain sends and receives signals throughout the body. The brain and the spinal cord, together, create the central nervous system, which comprises five main parts: cerebrum, cerebellum, brainstem, pituitary gland, and hypothalamus.

- Cerebrum - Have you ever thought about how we can talk, feel, learn, or think? It's because of the cerebrum in the brain. It is the largest part of the brain that initiates and organizes all voluntary movements within the human body, including controlling speech, thoughts, and emotions, and regulating body temperature. It also directs movements within the brain itself to perform the aforementioned activities. At its core, the cerebrum is made up of gray and white matter.
- Brain Stem - The brainstem connects the brain to the spine. It sends signals from the brain to the rest of the body and performs subconscious functions like breathing and maintaining heart rate.
- Cerebellum - What causes muscle movements? It is the cerebellum, which is located at the back of the head. The cerebellum is like a "mini-brain" when it comes to muscle movements. Its function is to operate muscle movements and maintain posture and balance.
- Pituitary Gland- What part of our brain carries out important functions such as growth and metabolism? It is the pituitary gland, the hormone-producing part of the endocrine system, and is located at the bottom of the brain, in a chamber known as the sella turcica. Hormones are produced in the hypothalamus and stored in the pituitary gland. The pituitary gland also instructs other glands in the body to release hormones. The pituitary gland controls the human body's metabolism, growth, reproduction, and blood pressure.
- Hypothalamus-Have you ever thought about what keeps our body stable? The hypothalamus is a gland in our brain that operates the human hormone system and keeps the body stable. Hypothalamus and pituitary gland together are called the endocrine system. The hypothalamus works with the pituitary gland to produce different hormones within the human body.

**Team: TerrificThree (MS2)**
**Title:** Forensic Science - Separating Molecules
**Participants:** Eva Patel, Yashvi Patel and Sunidhi Mitikiri

**Objective:** The study aims to build a gel electrophoresis chamber to separate macromolecules, such as DNA and RNA, for closer examination.

**Materials:** The project requires a plastic box, stainless steel wire, wire-cutters, 9-volt batteries (5), alligator clip leads (2), Styrofoam tray, measuring utensils, bowls, baking soda, deionized water, agar agar powder, a microwave, knife, syringe, and food coloring.

**Procedure:** First, build the gel electrophoresis chamber by attaching two stainless steel wires to the plastic box (the electrodes) and the batteries to each of the electrodes. Next, create a 1% agar gel solution with your homemade buffer solution and agar powder. After removing the electrodes from the gel chamber, make wells in the chamber and pour the agar solution in. After the gel solidifies, pour the buffer solution over the gel and reattach the stainless steel wire electrodes. Fill each well in the solidified agar gel with a different food coloring dye. Now attach the batteries to the electrode and check the dye's progress. Note the separation of the molecules in the different food colorings.

**Results:** The DNA and RNA have visibly separated through the food dye.

**Conclusion/Discussion:** The chemical process of gel electrophoresis separates the macromolecules DNA and RNA by submersion in gel and the application of a current. This works since negatively charged particles, like DNA and RNA, travel in the positive direction of the electric field. Charging the macromolecules within a gel allows the multiple parts of it to travel through the gel in groups based on mass. Observing the patterns of separation helps differentiate between the macromolecules.

**Summary:** The purpose of this experiment is to break down the components of DNA/RNA to identify the similarities and differences in three samples.

**Team: Food Re-SEARCHers (MS3)**
**Title:** Nitrates in Foods
**Participants:** Aanya Muniyappa, Meenaa Ram, Vinuta Ramakrishnan, Anusha Vakkalagadda and Annie Yin

**Objectives/Goals:** Nitrates are naturally present in foods varying in amounts. Nitrates can also be introduced artificially by adding fertilizers. Nitrates have both beneficial and harmful effects. The goal of this project is to understand the effects of nitrates in a human body, measure their amounts in various foods and delineate the trends.

**Methods/Materials:**

- Nitrate Detector and various foods

Various foods will be analyzed for their nitrate content. Trends will be identified for the following: organic vs. nonorganic, location, different foods, etc.
**Results/Conclusions:** Details about our findings will be discussed at the Symposium

**Team: Creative Minds (MS4)**
**Title:** Net Zero Energy Buildings (and how they are amazing and beneficial)
**Participants:** Nikita Venugopal, Charan Ganta, and Jay Pindipol

**Objectives/Goals:** The main objective of upgrading buildings to Net Zero Energy Buildings is to make them energy efficient, making the neighborhood cleaner, healthier and more resilient for all.
**Discussion:** How do Net Zero Energy Buildings (NZEB) Work? Look around your environment, what do you see? You probably see buildings everywhere. But these buildings and NZEB have a key difference, energy. The amount of energy both of them use is substantially different. NZEBs, as suggested by their name, basically use zero energy at the end of the day. NZEBs save up to 50-70% more energy than regular buildings. They rely on renewable energy sources on or around the building to get supply themselves. But you may be wondering, what would happen if unpreferred weather conditions happen? NZEB's are usually connected to an outer electrical grid for these situations. They would use energy from the electrical grid to meet their needs. When weather is more preferable to on-site renewable sources, the NZEB will switch back to them. They will also send excess energy back to the grid to balance the energy they used. By the end of the year, NZEB's have given back as much energy as used.
Why Are They Important?
*Environment*: Compared to present-day buildings, Net Zero Energy Buildings are more friendly to the environment. Renewable energy is considerably less dangerous to the environment. Renewable resources such as solar panels don't emit greenhouse gasses such as carbon-dioxide.
*Sustainability*: Net Zero Energy Buildings make sure future generations have access to resources. Our generation should make sure not to deplete all the resources as a responsibility. Because Zero Energy Buildings mostly use renewable resources, it makes sure we don't deplete all the non-renewable resources like coal.
*Reliability*: Net Zero Energy Buildings provide more reliability. The utility bill for a Zero Energy Building would be $0. During a power-outage, NZEB's can be self-sufficient using their own renewable sources. They are also more comfortable and provide a better environment.

**Conclusion/Discussions:** Overall, Net Zero Energy Buildings have proven to be incredibly

beneficial. They barely use non-renewable resources so the future generations can share them. These houses are becoming a necessity in our environment due to the growing population. The key advantage of living in a Net zero energy building is their sustainability and beneficial to human life. They will change the way we live in a positive way. Net Zero Energy Buildings are an important step towards a cleaner and sustainable future.

**Team: The Botanists (MS5)**
**Title:** Does light affect Marigolds?
**Participants:** Akshita Thakur, Joanne Rajashaker and Mona Farook

**Objectives/Goals:** Our goal is to see which way to grow a plant works the best. Sunlight, light bulb, or no light at all.

**Methods/Materials:** We used marigolds for this experiment as it is easy to grow/sprout. Akshita planted her marigolds in the sun. Joanne put her marigold in a dark room where there are no lights. Mona put hers in a place where the lights are always on. We all used buds to see how they would perform.

**Results:** Putting the flower in the sun is the best option. The other flowers were slowly starting to wilt.

**Conclusion/Discussions:** Sunlight was the better option because it was able to photosynthesise to keep it alive. A plant cannot photosynthesise under a lightbulb or without any light.

**Summary:** We used three marigold plants to see how well it would perform in no light, sunlight, and a light-bulb. While the light-bulb and no light marigolds slowly started to wilt, the sunlight marigold thrived. It was able to produce its own food because of photosynthesis. It was able to produce its own food because of the sun but the light-bulb and no light can provide that for the flowers.


**Nobel Laureates 2021**

Physics

**Syukuro Manabe and Klaus Hasselmann** - "for the physical modelling of Earth's climate, quantifying variability and reliably predicting global warming"

**Giorgio Parisi** - "for the discovery of the interplay of disorder and fluctuations in physical systems from atomic to planetary scales"

Chemistry

**Benjamin List and** David **W.C. MacMillan** - "for the development of asymmetric organocatalysis"

Medicine

**David Julius and Ardem Patapoutian** - "for their discoveries of receptors for temperature and touch"

Literature

**Abdulrazak Gurnah** - "for his uncompromising and compassionate penetration of the effects of colonialism and the fate of the refugee in the gulf between cultures and continents"

Peace

**Maria Ressa** and **Dmitry Andreyevich Muratov** - "for their efforts to safeguard freedom of expression, which is a precondition for democracy and lasting peace"

Economic Sciences

**David Card** - "for his empirical contributions to labor economics"

**Joshua D. Angrist and Guido W. Imbens** - "for their methodological contributions to the analysis of causal relationships"

# High School Projects (Grades 9-12)

**Team**: **Algae RANGers (HS1)**
**Title:** Eutrophication prevention
**Participants:** Rhea Palliath, Gabriella Seiden, Naachammai Ramu and Aruhi Vakkalagadda

**Objective/Goals**: To address the global issue of eutrophication by removing harmful algae from bodies of water, and repurposing it as a biofuel.

**Methods/Materials:** We will be building a machine that efficiently collects algae from the surface of lakes, while minimizing human labor, and maximizing the use of algae. The algae are rich in carbon and can be repurposed as biofuel. We will design a pathway with lab trucks that ferment the algae and allow it to become viable fuel sources.

**Results:** We are working on making a model, and it has not been tested yet, therefore there are no results. However, we look forward to sharing our results at the symposium!

**Discussion:** Repurposing biofuel as fuel to power industrial machines and factories can benefit the environment in multiple ways. By removing harmful algae, we are helping the organisms in the water that compete for the same resources and improve oxygen availability.

**Team: ET (HS2)**
**Title:** Alternate Source of Energy
**Participants:** Eesha Chakravarthy and Tianna Jordan

**Discussion**: Wind Energy is the use of wind turbines to generate electricity. Wind Power has been used in sails and windmills, wind pumps. Wind power is a popular energy source that has a smaller impact on the environment than burning fossil fuels. Wind farms consist of many individual wind turbines, which are connected to the electric power transmission network. Wind Energy is the most competitive energy source. Today's Wind Turbines can be less noisy than a car. This is what wind energy is about. The windmill generator in our project will harness wind power to light a LED bulb.

**Team: Simple Solutions (HS3)**
**Title:** e-Counselor
**Participants:** Isha Shrivastava, Poojitha Kalasapati, Reina Fukahori, and Roshni Raghuraman

**Problem Statement:** Due to climate change and global warming, carbon dioxide and other harmful greenhouse gases like methane and nitrous oxide are constantly being emitted into our atmosphere.

**Objectives/Goals:** We are striving to create an AI tool which organizes and classifies the amount of carbon we emit while going about our everyday lives.

**Methods/Materials:** Steps:

1. Collect data
2. Create an algorithm
3. Apply the algorithm using an AI platform
4. Make our work available to the public

To do all this, we need:

- Knowledge and data collection of the human carbon footprint
- Phone or any electronic device
- Online platforms to create and run our application

**Results:** An effective platform that can identify the hotspots of climate change and identify possible solutions.

**Conclusion/Discussions:** This is our small contribution to reducing human environmental impacts. With the burden of the future of our world put onto the shoulders of our younger generation, we are working on this unique integration of AI with environmental, climate, and weather data. This will be aimed at adapting to and mitigating climate change with accurate analysis of climate risk at scale and precise accounting of carbon emissions.

# Judges at a Glance

## Bryan Sannwaldt

Mr. Sannwaldt is completing his 9th year of teaching in North Brunswick. His first 7 years were spent teaching at Livingston Park, where he also taught and directed the Gifted and Talented Education program, incorporating new and inventive hands-on curriculum which included student participation in the New Jersey School Boards Association's STEAM Tank Challenge. Currently he leads and teaches classes in the Social Studies Department at the Linwood. He is Co-Advisor of the Linwood Student Congress and also works for the township's Department of Parks, Recreation, and Community Service.

## Beth Sweeney Piccolella

Beth Sweeney Piccolella is a Vice President at JPMorgan Chase & Co. A graduate of North Brunswick Township High School, Beth went on to attend The College of New Jersey, graduating with a degree in Applied Mathematics. Prior to graduating, Beth participated in an undergraduate research opportunity at SUNY Potsdam focused on stochastic differential equations and modeling.

## Sachin Desai

Sachin Desai is NBTHS alum, Class of 2007. He went on to pursue a degree in Chemical Engineering and MBA from Rutgers University. During his professional career, Sachin has held roles with increasing responsibilities in Operations & Supply Chain at Catalent Pharma Solutions supporting the development and commercialization of pharmaceutical products. His current role is within Strategic Sourcing as the Associate Director, Analytical Testing Services, Cell Therapy at Bristol Myers Squibb.

## Dr. Randy C. Dockens

Randy C Dockens, PhD, became the Clinical Operations Lead within Innovative Medicines Department, Bristol-Myers Squibb (BMS). Prior to that, he was Group Director for Clinical Pharmacology Scientific Operations (CPSO) at BMS. He led three groups within CPSO. He received his B.S. in Pharmacy and Ph.D. in Pharmaceutics from Auburn University, AL. Before joining BMS, he worked as a PK Reviewer with the Food and Drug Administration (FDA) for 4 years and joined BMS in 1991.

In addition, Randy has a creative side. He earned a doctorate in Biblical studies from Louisiana Baptist University in 2014 and has recently combined this interest with his scientific background into a futuristic fictional literary series called The Coded Message Trilogy with books entitled T-H-B, F-S-H-S, and T-U-L-E. Randy uses science in his writing to add a feel of authenticity to the storyline but still makes the story fun to read. One can learn and be entertained at the same time.

## Dr. Vijay Reddy

Vijay Reddy is a Senior Director at BioXcel Therapeutics Inc., New Haven, CT. Vijay has extensive experience in the areas of drug metabolism and pharmacokinetics. His current research involves the development of therapeutics for the treatment of agitation associated with bipolar disorder, schizophrenia, and Alzheimer's disease.

Vijay obtained BSc from the Osmania University, Hyderabad, MSc from the Kakatiya University, Warangal, and PhD from the Indian Institute of Science, Bangalore. Following post-doctoral research at Oregon Health Sciences University, Portland, Oregon, Vijay joined Merck Research Labs, NJ, where he worked for 19 years with focus on drug discovery. Prior to joining BioXcel, Vijay was a Senior Director at Rafael Pharmaceuticals, NJ, where his research was focused on the development of novel therapeutics for the treatment of pancreatic cancer and leukemia.

## Barbara Wendell

Barbara Wendell has been teaching for 10 years and with 3 years at North Brunswick. She started as an 8th grade Science teacher and is currently Science teacher at Linwood.

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.

# 2020 NBT SCIENCE SYMPOSIUM WINNERS

| Team# | Team Name | Category | Participants | Award |
|---|---|---|---|---|
| 306 | Innovative Minds | Elementary School | Meryl Patel | 1st Place (Tie) |
| 306 | Innovative Minds | Elementary School | Ishaan Iyer | 1st Place (Tie) |
| 305 | NextGen Robotics | Elementary School | Arya Salem | 1st Place (Tie) |
| 305 | NextGen Robotics | Elementary School | Steven Galvan | 1st Place (Tie) |
| 316 | Instinctive Thinkers | Elementary School | Ojas Shrivastava | 3rd Place |
| 316 | Instinctive Thinkers | Elementary School | Pranav Naveen | 3rd Place |
| 606 | The Keen Scientists | Middle School | Prahas Ramidi | 1st Place |
| 606 | The Keen Scientists | Middle School | Aanya Muniyappa | 1st Place |
| 606 | The Keen Scientists | Middle School | Anusha Vakkalagadda | 1st Place |
| 603 | Soil Scientists | Middle School | Anirudh Ramakrishnan | 2nd Place |
| 603 | Soil Scientists | Middle School | Vinuta Ramakrishnan | 2nd Place |
| 604 | The Survivors | Middle School | Nimmat Sukhija | 3rd Place |
| 604 | The Survivors | Middle School | Tisha Subhedar | 3rd Place |
| 604 | The Survivors | Middle School | Mohit Pradhan | 3rd Place |
| 604 | The Survivors | Middle School | Krish Tiwari | 3rd Place |
| 604 | The Survivors | Middle School | Atharv Rege | 3rd Place |
| 903 | Simple Solutions | High School | Isha Shrivastava | 1st Place |
| 903 | Simple Solutions | High School | Poojitha Kalasapati | 1st Place |
| 903 | Simple Solutions | High School | Reina Fukahori | 1st Place |
| 903 | Simple Solutions | High School | Roshni Raghuraman | 1st Place |
| 902 | The Noisemakers | High School | Vedika Shah | 2nd Place |
| 902 | The Noisemakers | High School | Aruhi Vakkalagadda | 2nd Place |
| 902 | The Noisemakers | High School | Gabriella Seiden | 2nd Place |
| 902 | The Noisemakers | High School | Alyssa Mikita | 2nd Place |
| 904 | CPS | High School | Prakash Nayak | 3rd Place |
| 904 | CPS | High School | Justin Chou | 3rd Place |
| 904 | CPS | High School | Sho Kagawa | 3rd place |
| 310 | Slime Detectives | Elementary School | Nishka Ramidi | Outstanding Creativity |
| 310 | Slime Detectives | Elementary School | Diya Sanghvi | Outstanding Creativity |
| 302 | Science Sweet Science | Elementary School | Sofia Kabir | Outstanding Design |
| 302 | Science Sweet Science | Elementary School | Juliana Mars | Outstanding Design |
| 302 | Science Sweet Science | Elementary School | Haylie Park | Outstanding Design |
| 304 | The Master Minds | Elementary School | Aaron Ling | Outstanding Presentation |
| 304 | The Master Minds | Elementary School | Ayaan Narale | Outstanding Presentation |
| 304 | The Master Minds | Elementary School | Om Nangia | Outstanding Presentation |
| 313 | Pollution Patrol | Elementary School | Jay Pindipol | Outstanding Research |
| 313 | Pollution Patrol | Elementary School | Tarun Yamarthy | Outstanding Research |
| 313 | Pollution Patrol | Elementary School | Charan Ganta | Outstanding Research |
| 313 | Pollution Patrol | Elementary School | Vishwa Swamy | Outstanding Research |
| 607 | AJ Squared | Middle School | Amruta Jayaganesh | Outstanding Creativity |
| 607 | AJ Squared | Middle School | Adwita Jagannathan | Outstanding Creativity |
| 313 | Pollution Patrol | Popular Choice Award- 1st place | | |
| 604 | The Survivors | Popular Choice Award- 2nd place | | |


**The NBT Science Symposium Committee would like to thank all the youth and adult volunteers who helped to make this community event a success.**

# NBT INDIA INDEPENDENCE DAY 2022

**Commemorates a Historic World Event – 76th Independence Day of India**

## "Bharat Mata Ke Veer: India's Bravest"

Join us for entertaining and educative event

**Please visit our website at**
**https://www.nbtindia.org/**
**For more information as we are working to celebrate**

***75 years of Indian Independence***

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North Brunswick Township High School

www.nbtindia.org 732-801-4814 nbtindiaday@gmail.com

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