EAST WINDSOR – HIGHTSTOWN SCIENCE SYMPOSIUM 2024

Abstracts

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Elementary School Abstracts (Grade 3-5)

HLG Rockateers (Grade 3)

Title: ROCKET UP!

Submitted by: Lydon Giske , Alex Larane , Wyatt Hilburn

Objectives/Goals
Test different reactions, within an enclosed chamber (rocket), where the pressure from the reaction will pop the cork and send the rocket into flight.

Methods/Materials

- 16.9oz poland spring bottle (using 6oz liquid)
- Rubber stopper
- Stabilizer straws + tape to secure straws on the side
- Baking Soda (Sodium Bicarbonate)
- Vinegar Alka-Seltzer tablets Water
- Diet Coke
- Mentos candy

    - **Baking Soda + Vinegar reaction** yields a chemical reaction in which carbon dioxide will create enough internal pressure to pop the cork and raise the rocket into the air.
    - **Soda + Mentos reaction** yields a physical reaction forcing the carbon dioxide bubbles to escape containment, which will create enough internal pressure to pop the cork and raise the rocket into the air.
    - **Alka-Seltzer + Water** - yields a chemical reaction where carbon dioxide will create enough internal pressure to pop the cork and raise the rocket into the air.

A rocket was constructed using a plastic 16.9oz Poland Spring water bottle with 3 plastic straws (which were affixed to the bottle with duct and masking tapes) and a rubber stopper to seal the reactive contents. We tested three liquids (Vinegar, Diet Coke, and Coke) and three solids (Baking Soda, Alka-Seltzer, and Mentos. Our initial goal was to test which rocket "fuel" would propel our rocket farthest in the air. After several experiments, we realized that we did not have an accurate way to test for height. For each reaction, we decided to test the time that it takes for the pressure to build within the rocket and pop the cork, sending the rocket into flight. We wanted to test the height but did not have a way to measure how high the rockets were launched. Some reactions shot the rocket really high into the air and some failed to launch.

Results
The best combination reaction was baking soda and vinegar, using 1 tsp of baking soda to 6oz vinegar. Second best was Diet Coke and Mentos. Third place was Alka-Seltzer and water which seemed to be the slowest reaction.

Discussion
We selected our experiment because it is a fun experiment. We all have an interest in rockets and what makes them shoot into the air. We wanted to make our own rocket fuel! These experiments are important to us because science is very fun to learn about chemical reactions, how reactions can behave differently and how we may be able to apply them in our everyday
lives. Our funniest experiment was when the rocket launched into the air and one of our parents was videoing our experiment and the rocket came down and landed on them.
We set up our experiment area at our houses when we experimented. We drew a circle on the ground with chalk and placed the bottle rockets in the circle. We thought that we would be safe if we stayed outside of the circle once we put the stopper in and stepped away. We used funnels to add the liquid to our bottle rockets. We were able to drop in the Mentos and Alka-Seltzer, but we found that we had to break up Alka-Seltzer tabs into 4 pieces to put them in the bottle rocket. When we added baking soda, we measured out 1 teaspoon and poured it on a small piece of paper towel and shoved that into the bottle.
We recorded the reaction time for each liquid and solid combination. These times are in the table. We stopped timing the reaction when the rubber stopper was pushed out and the rocket fuel made the rocket go in the air. Average times were found by adding up the time of

each reaction divided by the number of those reactions. The average time it took Vinegar and Baking soda to react was 5.695 seconds. The average time it took for Diet Coke and Mentos to react was 15.123 seconds. The average time it took for Vinegar to react with Alka-Seltzer tabs was 48.075 seconds. We also tested Coke and Baking Soda, Diet Coke and Baking Soda, Coke and Alka-Seltzer, Diet Coke and Alka-Seltzer, and Coke with Mentos.

Conclusion
Creating rocket fuels and testing them with our friends was fun. We all enjoyed figuring out which combination was best. We found that when we combined Vinegar and Baking soda, they reacted faster than the other combinations. We are looking forward to spring and summer days when we can create bottle rockets. And we know which fuel we will use-Vinegar and Baking Soda, because it will react in about 6 seconds!

Science Wizards (Grade 4)

The Germ Killer

Submitted by: Anaira Patel, Reya Vyas

Objectives/goals:
To understand the mechanism of how hand sanitizers kill germs.

Methods/Materials:
The first experiment we performed shows that germs are everywhere. The materials needed for this project are a petri dish with agar, cotton swab, and a heater. We labelled the petri dish with the item we are collecting samples from and swabbed the object with a damp cotton swab. We rubbed the swab onto the agar. We collected samples from an amazon box and a pop-it. We closed the dish and placed it upside down next to a heater that was set at approximately 90°F. Now the germs can grow if there are any in the samples. We observed changes in the petri dish after 48, 72, and 82 hours. For the second experiment, we will use the same method except we will collect samples from our hands before and after using hand sanitizer. We collected facts on how hand sanitizer kills germs from legitimate sources and will present it on a poster using notes and diagrams.

Results:
When we checked the experiment 48 hours later, we could see colonies of germs in form of small dots and carbon dioxide bubbles at the bottom. At the 72 and 96-hour mark, there were a lot more colonies. In some parts, the germ colonies were scattered. While hand sanitizers effectively kill most common germs, they may be less effective against particularly resilient germs.

Conclusion/Discussion:
Hand sanitizers are like superhero germ-fighters! These alcohol-based liquids disrupt germ cell membranes, exposing and killing critical components. To be effective, hand sanitizers need a high alcohol concentration, typically at least 60%.

Summary:
In this project, we attempt to find out how hand sanitizer kills germs, but we should not rely upon it exclusively for hand hygiene.

Super Painter (Grade 4)

The Easter Egg Design System

Submitted by: Vibha Muntha, Ishani, Soundarya Vijaykumar, Sara, Padmaja

Objectives/goals: Creating an egg painting engineering model.

Materials Needed:
Eggs – Plastic Eggs.
Markers - For detailed work or designs.
Egg Holders - Make-shift holders can be made from cardboard or egg cartons.
Protective Gear - Aprons and table covers to keep clothes and surfaces clean.
Decorative Materials - Glitter, stickers, fabric pieces, etc., for additional decoration.

Preparation:
For plastic eggshells, carefully make a small hole at the top and bottom of each egg.

Design Planning: Kids must sketch their designs on paper before painting. This foster planning and creative thinking.

Painting Basics: Kids will draw on the eggs as per their designs.
Advanced Techniques (Optional): Techniques like sponge painting, splatter painting, or using stickers and fabric can be used for mixed media art.

Engineering Challenge:
Creating a holder or structure that can hold the egg without it breaking. Will use materials like straws, paper, or lightweight sticks to create the sturdy egg holders. This fosters problem-solving and basic engineering skills. This activity combines art with basic engineering principles, encouraging creativity, planning, and problem-solving skills in a fun and engaging way for kids.

Engineering Plan:
Building a structure to hold an egg and enable it to draw using a motor is a creative and educational project that combines engineering and art.
Here's our plan on how we intend to implement it:
Materials Needed:
Base Platform: A sturdy base, like a wooden board.
Motor: A small DC motor.
Battery Pack: To power the motor.
Egg Holder: A device to hold the egg, which can be attached to the motor. This could be a small cup or custom-made holder.
Markers: Non-toxic, washable Markers.
Wires and Switch: To connect the motor to the battery pack and control it.
Mounting Supplies: Screws, glue, or tape to secure the components.
Safety Gear: Gloves and goggles for protection.
Building Steps:
Assemble the Base:
Attach the motor securely to the base platform using screws or strong adhesive.
Ensure the motor shaft is accessible and can hold the egg holder.
Egg Holder Attachment:
Create or adapt an egg holder that can be fixed to the motor's rotating shaft. Ensure it can hold an egg securely.
Balance is key; the egg should be centered to avoid wobbling when the motor spins.
Wiring the Motor:
Connect the motor to the battery pack with wires. Include a switch for easy control.
Make sure all connections are secure and insulated.
Attaching the Marker:
Fix a marker in a position where it can lightly touch the egg. Adjust the height for different effects.
Alternatively, the marker can be attached to the egg holder, so it moves with the egg.
Testing:
Place a plastic egg on egg holder.
Test the setup by turning on the motor. Adjust the speed, if possible, to see different drawing effects.
Painting Process:
Experiment with colors and marker types for different patterns.

Summary:
This project not only teaches basic principles of physics and engineering, such as balance, motor operation, and electricity but also encourages creativity through the unique patterns created on the eggs.

Silly Scientists (Grade 5)

Title: Rain Gardens

Submitted By: Defne Dagci and Nathan Shamy

Objectives/Goals

We will test how effective different rain garden designs are at reducing pollution.

Methods/Materials

Our project will consist of five different garden designs: clay (control), clay and stones, clay, soil, and mulch, clay, soil, plants, and mulch, clay, stones, soil, plants and mulch. We will test each garden design by pouring pollutants into the rain garden and observing how much pollution the rain garden absorbs. The pollutants for our first pour; 6 green plastic pieces, 4 white plastic pieces, 200 milliliters of water, 5 milliliters of oil, and one drop of food coloring. The pollutants for our second pour; 5 cheerios, 200 milliliters of water, 5 milliliters of oil, and 1 drop of food coloring.

Results

Garden Design	Trial One				Trial Two			
	Colored Water	Oil	Plastic	Erosion	Colored Water	Oil	Cheerios	Erosion
Pavement	6cm	0.25cm	7	no	6.8cm	0.5cm	5	no
Pavement, Stones	4.1 cm	0.05cm	0	no	7.2cm	0.03cm	0	no
Pavement, Soil, Mulch	1.3 cm	>0.01cm	0	yes	6cm	>0.01cm	0	yes
Pavement, Soil, Mulch, Plants	1.6 cm	>0.01cm	0	yes	7.1cm	>0.01cm	0	yes
Pavement, Stones, Soil, Mulch, Plants	3.7 cm	>0.01cm	0	no	7cm	>0.01cm	0	no

Conclusion

We found that when the soil is already wet, it's less likely to prevent pollution from going through. This explains why the first trials had better results. We know that pavement, soil, and mulch is slightly invalid because it was not already wet from watering plants.

Summary

We found that the pavement, soil, and mulch was the best for this experiment. We averaged all the numbers together and found that this was the lowest.

Middle School Abstracts (Grade 6-8)

Covid-19 Treatment Equipment with Arduino (Grade 6)

Title: Covid-19 Treatment Equipment with Arduino

Submitted By: Mukund Sairakshan Prabakaran and Aatish Mahant Mani Saravanan

Objectives/Goals
This study aimed to help frontline health workers to study the vitals of Covid-19 patients when they cannot reach beyond 6 ft.

Methods/Materials:
The materials used in this experiment are an Arduino UNO (Main Motherboard), a Liquid Crystal Display or OLED Display, a 10K Potentiometer, a Heart Rate / SP02 Sensor, I2C, some Jumper Wires, and a Breadboard. You attach some jumper wires to every component so all the data passes through. When you place your finger on the BPM/SP02 sensor, the BPM and SP02 will appear on the OLED Display. The current prototype device will be mounted on a remote control car. The car shall be operated using remote control. The instrument shall be moved wherever we need to measure patients' vitals. When the patient touches the sensor, it should show the vitals of the patient to the medical assistant.

Results:
The doctor will be able to communicate the patient's medical information without being near each other, such as being at the hospital.

Conclusions/Discussion:
The current prototype is designed for measuring the heart rate and the same will be displayed in the display. In the future, we need to design a device that will show all the vitals from one touch. It includes blood pressure, heart rate, pulse, and etc.

Summary:
This project attempts to communicate without the doctor gaining any of the negative symptoms of the patients, such as getting Covid-19 from the patient.

Legends (Grade 6)

Process of Water Filtration

Submitted by: Aadhav Saravanababu, Kavish Vyas, Kush Patel, Vihaan Sriram

Objectives/Goals:
To test different materials for their efficiency for filtering water and report the most effective material with explanation.

Methods/Materials:
We tested different materials found through our research such as rocks, gravel, sand, and granulated activated charcoal. We performed additional research to form a hypothesis to predict the most effective material. Our experiments included running muddy and dyed water separately through each material to find the most effective material. Other materials required were food dye, cotton and empty water bottles. In our experiment, we used the cheapest materials possible to simulate a real-life situation.

Results:
We started with our hypothesis that the granulated activated charcoal will clean the water the best because the granules can provide more surface area than the other filtration media, allowing more space for dirt to be trapped. Activated charcoal also uses chemical absorption to attract pollutants and separate them from the water. Our testing confirmed our hypothesis that activated charcoal was the most effective medium to filter out both the dirt and the color. On the other hand, the rate of filtration varied due to the different levels of resistance provided by the different filtration media: The filtration rate was the highest for rocks followed by gravel then sand then activated charcoal.

Discussion:
Consistent with Darcy's Law that dictates the flow of liquid through a semi-permeable membrane, activated charcoal with its highest porosity took the longest to filter. Also, consistent with our hypothesis, activated charcoal was the most effective filtration material. It could stop pollutants by simply blocking them as charcoal is porous, and also using chemical absorption to attract pollutants to itself therefore removing it from the water. It is worth noting that once all surface area on the charcoal is filled with pollutants, the charcoal must be replaced with a fresh batch.

TDPD (Grade 6)

Green Energy

Daivik Patel, Tejas Dronadula, Neel Ambre

Objectives/Goals:
This project is to show how green energy can be used to power many appliances. The project will show how renewable sources can be efficient. And very environment friendly.

Materials and Methods:
Materials that we used to conduct this project were cardboard, D.C motor with a switch, light bulb, and wires. These materials were used to build a wind turbine to power a small model house. The model house was built using cardboard. In the model was a light bulb hanging on the top. There was a small opening made to connect the wires to the light bulb. The other side of the wires was connected inside the turbine to the D.C motor.

Results:
When the switch of the D.C motor was flipped, it powered the turbine which then turned on the light bulb in the house.

Discussion:
This project shows significance because it shows the efficiency of green energy. This will benefit the environment because our world today, pollution is a major issue along with carbon emissions. Using green energy will help address this issue because it will not pollute. In conclusion, using green energy is efficient and very helpful to our environment.

THE FLOATR (Grade 6)

Title: Floating Magnetic Train

Submitted By: Kasyap Darbha, Abhiram Chakravartula

Objectives/Goals
The objective of this study is aimed at using magnetic levitation and bi-polar magnetic field to force the train raise over the track without using the wheels.

Methods/Materials
- Legos to build the train and the track.
- Clear double-sided tape
- Scissors
- Pencil
- Ruler
- Lab notebook

Results:
- This experiment tells us the advantages of using magnetic field to move train and reducing friction.
- Cost reduction by using this idea as it reduces the maintenance of tracks and wheels.

- The distance between the train base and the track is dependent on the weight of the entire train. This gives us an understanding of how many passengers can the train carry at a time.
- To calibrate the distance between the magnetic strips on the track, we had use trial and error method to place them so that the train block does not fall and rest.
- We also had to cut the wooden train block a bit to reduce the weight so that the repulsion can lift the block.
- Also, we had to make sure the placement of the plastic angles gives enough width for the train block to stay on the track but levitate a little bit.
- Because floating train essentially lifts, stabilization & roll are a possibility, and planks are required to create stability.
- As we do not have the motor power or magnets to pull the train, we would use gravity to move it a little forward, but in reality, it would be dragged by powerful magnets on both ends.
- Convention train goes slow due to the friction but due to lack of physical contact between track and train, the floater doesn't need roll assistance and can go faster.

Conclusion/Discussion:
How could a train possibly move along the tracks without wheels?
Trains that hover just above the tracks is possible due to magnetic levitation, or maglev for short. These trains use powerful magnets to stay in the air. Magnets generate a magnetic field. This magnetic field can push or pull on other nearby magnets or generate a force. Whether the magnets push or pull depends on the direction in which the magnetic poles are facing. In the case of a maglev train, this magnetic force is used to push against the train's weight. Weight is the force that pulls an object down toward the earth because of gravity. If the magnetic force is strong enough, it can overcome the train's weight and push it up into the air!

Summary:
This project concept is helpful for mechanical engineers who can use this idea for transportation planning.

The Atomic Nerds (Grade 7)

Title: Growing Crystals

Submitted By: Adrianne Ambogo, Meghana Chinthapatla, Pragnyashree Kalidindi, Tithi Patel

Goals/Objectives:
The purpose of this study is to determine which substance is able to form the best crystals, in terms of durability, formation, and speed.

Methods/Materials:
The materials we used were jars, water, sugar, salt, Borax, Epsom salt, cotton string, paper clips, elastic bands, wooden sticks, straws, pipe cleaners, popsicle sticks, and some materials in order to make the crystals like spoons, pots, etc. Crystallization occurs when a solute solidifies from a liquid. Crystallization can also happen when the liquid precipitates leaving behind a newly formed crystal.

Expected Results:
We believe Epsom salt will grow the crystals because it seems the most durable, and we predict it will form faster than the others because of its purity.

Conclusions/Discussion:
This project attempts to determine which material is able to generate the best crystals. To make crystals, you first need a supersaturated solution. The two components in a saturated solution are a solute and solvent. In our case, the solvent is water, and the solute is sugar/salt. This includes your mineral (in our case, sugars and salts) and water which is boiled into a syrup-like solution. As the solution cools, the magnesium sulfate atoms run into each other and join in a crystal structure. Crystals grown this way will be small, thin, and numerous. If you've been to a candy shop, you may have seen those rocky candy sticks. That is what we expect to see when conducting this experiment. However, crystals can form in different ways, similar to minerals. That is why we are researching and conducting our own experiment to figure out how they will be different in terms of durability, speed, and how they formed.

Pioneers (Grade 7)

Gyroscopically Controlled Drone

By: Saarth H, Ishanth K, and Hrishan R.

This project aims to get a deeper understanding of various electric and mechanical components in conjunction with motion-sensing devices like gyroscopes and arduino. We are working on a prototype to apply motion sensor technology to a drone. If successful, this prototype would enable several areas of exploration using wireless motion sensor commands to electronic devices.

This project uses a GY-521 Gyroscope which will be the input, an Arduino Nano Every which will be the “brains” or the processor of the project, and a DIY drone kit that we will be implementing this project on. First, we placed the gyroscope and an Arduino Nano in the custom remote device. We then wired the gyroscope and the Arduino accordingly through jump wires and soldered the output pins to the motherboard. The gyroscope will relay its data to the Arduino Nano which will then decide based on its code about which outputs to send to the drone via the controller's motherboard. This will make the drone follow the remote’s movements detected by the gyroscope’s motion signal.

If this project succeeds, we will have successfully created a drone that is controlled by human hand gestures (motion sensing). It will essentially create a hand-gesture-controlled drone and open several applications to embed it with motion sensors.

In conclusion, we chose this complex topic with the focus toward enhancing our learning about electronics and motion sensing which could be extremely useful to solve several real-life problems for example, machines such as motion-controlled humanoid robots could be used in search and rescue missions, as firefighters or as surveillance drones. This would allow for the mobility and intelligence of a human while not putting life at risk. In short, this project is turning out as a fun collaborative way of learning advanced and difficult concepts of engineering, electronics, and motion sensing.

Unsupervised Scientists (Grade 7)

Title: Mars Exploration Simulation: Integrating VR with Remote Rover

Participants: Kashmala Khan, Sonia Patel, Emilie Fougnies, and Isabella Gonzalez

Objectives:
The objective is to create an immersive Mars exploration experience by integrating a remote-controlled rover with a DIY virtual reality (VR) headset. By simulating the Martian terrain and using a rover equipped with a camera, we aim to provide a first-person perspective of exploring Mars.

Materials and Methods:
To achieve this, we will construct a Mars terrain using cardboard boards, paint, rocks, and other materials to mimic the Martian landscape. A toy car with a remote control will serve as the rover, equipped with a camera to capture real-time video footage of the terrain. We will then create a VR headset using cardboard and plastic bottles, which the recorded video will play on, allowing users to experience the exploration in a first-person view.

Expected Results/Outcome:
We anticipate users will have an immersive experience of navigating simulated Martian terrain through the VR headset. By comparing our simulation data with data from NASA Mars rovers, we aim to demonstrate the accuracy and fidelity of our simulation.

Discussion:
This project provides an innovative way to engage and educate people about space exploration, particularly Mars missions. Offering a realistic experience of traversing Martian terrain provokes interest and curiosity about space exploration, especially among students. Additionally, such simulations can aid in astronaut training and mission planning by providing a virtual environment for testing

equipment and procedures. Ultimately, this project contributes to the broader goal of advancing space exploration and fostering scientific literacy.

Summary:
This project aims to create an immersive Mars exploration experience by integrating a remote-controlled rover with a DIY virtual reality headset, allowing users to navigate a simulated Martian terrain in a first-person perspective.