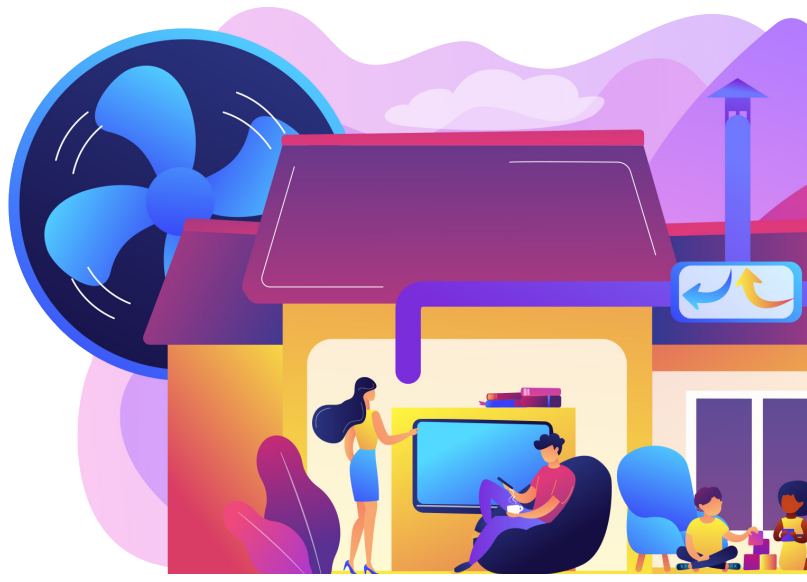
Science MATTERS! ... IN CONNECTICUT

NIE ACTIVITY

Science Matters! is a series presented in collaboration with the Connecticut Academy of Science and Engineering. *For more information, visit **www.ctcase.org** or **call 860.571.7143**.*

SNAKE PLANT
(S. trifasciata)

Experimenting with Houseplants to Reduce Indoor Air Pollution



Patricia Joseph
Junior, Engineering & Science University Magnet School (ESUMS)

Approximately 7 million people die each year due to air pollution as reported by the World Health Organization (WHO) in 2012. Alarmingly, indoor air pollution has caused 4.3 million deaths globally- with greater effects in lower-income nations. In homes, indoor air pollution can take many forms such as over-using cleaning products, poor ventilation, burning solid fuels, or using cheap building materials.

Many **volatile organic compounds (VOCs)** are key indoor pollutants, and long-term exposure to VOCs can cause various respiratory and cardiovascular diseases. After a literature search, I found clashing studies stating that houseplants could potentially purify toxins in the air, but they produce VOCs when interacting with their environment. Thus, my research involves testing the viability of houseplants in reducing airborne VOCs through the use of an **Arduino**-nano **microcontroller,** an SGP30 **multi-pixel gas sensor**, and engineering a chamber to simulate indoor airflow.

THE PEACE LILLY
(S. wallisii)

In this study, I chose three common house plants: The Peace Lilly (S. wallisii), Dragon Tree (D. marginata), and Snake Plant (S. trifasciata). Then, I ran a program through my Arduino that allowed the sensor to collect carbon dioxide and VOC levels in real-time. The structure of the chamber consisted of a repurposed tent, a self-made carbon filter, two small fans for air circulation, and ventilation sockets.

The experimentation included two keys phases: emission and mitigation. The emission phase involved running the carbon filter for 24 hours to purify the air and then placing each of the plants inside the chamber to observe the number of VOCs they produced. The second phase, mitigation, involved filling the air with high levels of VOCs and then determining the rate in which the plant reduces VOCs to safe levels. I did this by connecting paper plates to an internal fan and spraying each plate with bright, green spray paint. Each time VOC levels spiked to 60,000 **Parts per billion (ppb).** The approach I took led me to create mathematical models supporting that the Dragon Tree was the most efficient air-purifier as it produced the least VOCs naturally and reduced up to 70% of VOCs in the ambient air.

DRAGON TREE
(D. marginata)

My comparative study aims to inform public health organizations about the trade-offs of using certain houseplants as natural purifiers. Overall, this year-long research project was very rewarding! It taught me how to push through setbacks and failures in order to gain experience and develop a growth mindset.

Meet the Scientist

From watching caterpillars transform into butterflies to building way too many Rubie Goldberg machines, these experiences back in elementary school fostered my curiosity and passion for STEM. Other than research, I enjoy playing with oddly-shaped 3D puzzles (similar to Rubik's cubes), competing in parliamentary-style debate tournaments, and mentoring younger students at my school's student-led science research club. I am currently a junior at the Engineering Science University Magnet School (ESUMS).

Patricia Joseph was awarded in 2020 the Connecticut Science and Engineering Fair's top Life Science – Senior Division Award and for the honor received from the Connecticut Academy of Science and Engineering the H. Joseph Gerber Award of Excellence for her research project, "Comparative Analysis of the Mitigation and Emissions Rates of Volatile-Organic Compounds in Various Ornamental Plants Using a Monitored Environment." At the time of the award, Patricia was a sophomore.

SKILLS & KNOWLEDGE

My project involved interdisciplinary science skills and fields. The plant science aspect of the project required maintaining the houseplants throughout several weeks of experimentation and examining the production and reduction of VOCs. On the other hand, the technical aspect of monitoring VOCs required further research on microcontrollers, serial data, modules, basic coding, and sensors. Lastly, engineering the plant environment (the chamber housing the plants) involved research on reliable materials, constructing carbon-filters, and many trials.

Words To Know

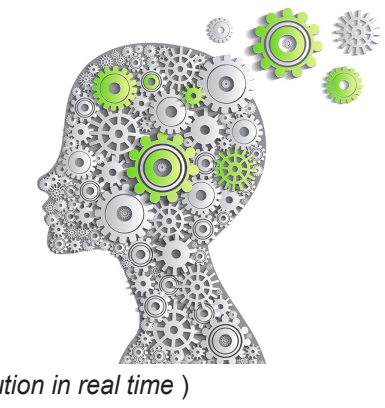
Volatile organic compounds (VOCs): health hazardous organic chemicals in the form of gas; emitted by liquids or solids

Arduino: Arduino is an open-source platform used to build electronics projects

Microcontrollers: single computer all in one integrated circuit/chip; programable and designed to control small electronic devices

Multi-pixel Gas Sensor: an air quality sensor that utilizes metal oxides; measures the concentration of airborne particles

Parts per billion (ppb): unit of measurement representing the concentration of extremely small particles in a given volume of fluid



hyperlinks

https://gispub.epa.gov/airnow/ (*Interactive maps forecasting and showing air pollution in real time*)

https://www.arduino.cc/ (*I used an Arduino-nano microcontroller for my project. Arduino is an electronics software and hardware platform that allows students to create programs and control electronic devices. There are so many cool projects you can do with an Arduino!*)

For Students and Teachers Making Curriculum Connections, see the following:

Connecticut State Department of Education (CSDE) - Common Core State Standards (CCSS): Mathematics

- CCSS.Math.Practice.MP1 Make sense of problems and persevere in solving them
- CCSS.Math.Practice.MP3 Construct viable arguments and critique the reasoning of others
- CCSS.Math.Practice.MP5 Use appropriate tools strategically

CSDE - Next Generation Science Standards: Scientific and Engineering Practices

- Asking questions and defining problems; developing and using models; planning and carrying out investigations; analyzing and interpreting data; using Mathematics and computational thinking; constructing explanations and designing solutions; engaging in argument from evidence; and obtaining, evaluating, and communicating information.

NIE NEWS IN EDUCATION