

## CASE STUDY: CELF CIVIC SCIENCE

# West End Secondary School, NYC

Students Investigate Air Quality in  
Urban Communities Impacted by  
COVID-19



CELF's Civic Science Program is made possible in part with the support of the National Geographic Society, Linde PLC, & the San Diego Foundation.



*West End Students pose with their Air Quality Research Project Awards.*

## BACKGROUND

Emily Hollyday is an Earth Science teacher and 9th grade team leader at the West End Secondary School in New York City. Ms. Hollyday was first introduced to the Children's Environmental Literacy Foundation (CELF) in the winter of 2020. As a result of CELF's partnership with District 3 and NYC DOE, a parent from West End's Sustainability Committee shared an email about CELF's Civic Science program.

"I knew that, despite my Zoom fatigue, it was an opportunity I did not want to pass up," recalls Ms. Hollyday. "Through the program, I learned how to integrate CELF's Inquiry to Action framework into my teaching, no matter the unit of study."

CELF's professional development sessions helped her to understand the broader context of her air quality unit as it relates to Civic Science, as well as environmental and racial justice.

Ms. Hollyday was first introduced to the idea that schools can play a central role in disrupting injustices within society by her college professors. When Ms. Hollyday became an educator at West End Secondary, she focused on teaching students about society and the environment through experiential learning, making learning both practical and compelling. Ms. Hollyday has observed that students develop a deeper and more lasting understanding of academic concepts when they are taught through real-life context.



Founded in 2015, West End Secondary School (WESS) is a combined middle and high school located in New York City. WESS is an Expeditionary Learning School where learning expeditions are an integral part of the curriculum at every grade level. Students engage in research and field work to solve complex problems in their community, presenting their work publicly through cumulative products, public presentations, and portfolios. Expeditionary learning emphasizes collaboration, creativity, discovery, and resilience. It is a model that "prioritizes real world application as a means to ignite a joy for learning and discovery in [its] students." Some of the topics Ms. Hollyday and her students have explored through expeditions were sewage pollution in New York Harbor and air quality management.



## Air Quality Civic Science at West End Secondary School

Although switching to online learning in 2020 was hard for students, teachers and parents, Ms. Hollyday saw the unprecedented circumstances as an opportunity to learn through place- and project-based learning conducted virtually. "In November 2020, at a time when all of my students were fully remote, I began my unit on air quality with a gallery walk in which students observed images and graphs that showed significant improvements in air quality during the COVID-19 shutdowns."

Using CELF's Inquiry to Action framework, students explored who had long been exposed to poor air quality, and the implications of poor air quality in terms of higher rates of respiratory illnesses and susceptibility to severe complications from COVID-19.

"Exposure to air pollution increases the risk of respiratory diseases creating pre-existing medical problems that the virus takes advantage of. This only comes after years of living in these environments. We came to choose the focus on this project because while learning about aerosols in class, we read an article about COVID cases and air pollution going hand in hand. It interested us, and we wanted to know more about the subject, hence the decision to do our project about it." - Anya (student)

Ms. Hollyday noticed very quickly that this topic resonated with many of her students. "As I popped into virtual breakout rooms, I heard some of the most rich conversations I had heard all year. This topic immediately felt relevant to my students even though they were not surprised about the varying rates of asthma and COVID hospitalizations across NYC neighborhoods."

## Student-driven collaborative research

Students began their research by reading about the correlation between long-term exposure to toxic air and communities' susceptibility to the severe effects of COVID-19. After exploring a variety of resources on this topic, students discussed their findings with each other in virtual groups.

"Being able to work on a long-term project with peers helped students create much needed bonds during their year of remote and hybrid learning," says Ms. Hollyday. "Some groups started text chains with one another and could joke and laugh together over Zoom; other groups developed roles and effectively divided up tasks; and other groups learned from the real-life experience of conflict resolution in group work."

Why is the air quality bad in some parts of the city and not others?

How long will it take to make the full transition to electric powered vehicles in New York?

What will New York's plan to reduce air pollution look like?

Students posted these discussion topics and others during a virtual session on Padlet.



To introduce the air quality project, Ms. Hollyday shared this image from CBS News showing how Los Angeles air quality improved dramatically with the economic slowdown and stay-at-home orders resulting from the coronavirus pandemic.

## Data collection and representation

Students started data collection by taking photos of the sky then quickly taking a screenshot of real time PM 2.5 data from the PurpleAir website. PM2.5 (Particulate Matter 2.5 microns) is the most harmful urban air pollutant, small enough to penetrate deep into the lungs and enter the bloodstream resulting in adverse respiratory and cardiovascular health outcomes and contributing to an increased risk of death and lower life expectancy. PurpleAir sensors are stationary air quality monitors that measure PM2.5 and other air pollutants. Ms. Hollyday developed a protocol for obtaining and recording PurpleAir and sky data.

After a week of collecting data, they developed experimental questions inspired by interesting patterns that they saw in their data and then designed visual graphs.




"This topic immediately felt relevant to my students even though they were not surprised about the varying rates of asthma and COVID hospitalizations across NYC neighborhoods."

*Emily Hollyday*



"During our Purple Air data exploration, we noticed the sky had different interesting colors every day. On December 10th in the morning we noticed that the clouds in the sky looked like cotton candy and were pinkish. We want to further research on this question and learn more about it and if maybe there is a connection to air pollution."

*Avital, student*



"After conducting extensive research about air quality in our neighborhoods and identifying sources of pollution, we have concluded that certain factors pertain to air quality, such as car traffic and pollution. Our group had three data collection points in New York City: the Upper West Side which averaged 16.90 PM2.5, Washington Heights which averaged 17.53 PM2.5, and University Avenue in the Bronx which averaged 20.75 PM2.5. Data from the Bronx had by far the worst air quality, which can be attributed to the many major roadways and bridges it is near, as well as being home to much of the city's sanitation department, which is an additional detriment."

*Myles, Barron, Zayan, and Leo (students)*



## Research Question: How does precipitation affect air quality?

**Hypothesis:** If there is precipitation, the air quality would worsen because aerosols are falling from the clouds.

**Key Term:**  
Aerosol



### Tools We Used:



WEATHER  
UNDERGROUND



## ABSTRACT



- **Hypothesis:** When air pollution is higher, then cloud cover will be greater and temperature would be higher.
- The data we collected during that very week was right after a massive snowstorm caused by a cold front, which could very heavily cause high cloud cover and alter the air quality.
- Our data was collected by observing the sky outside, and using the Purple Air website to deduce the air quality in raw PM 2.5 levels of the area around us.
- Our objective was to collect data on a daily basis over the course of a week.

## Abstract

**Research Question:** what is the connection between cloud coverage and air quality?

**Objective:** observe each day to not only find the correlation between air quality and cloud coverage but to also see how they affected New York as a whole.

**Results:** No correlation between cloud coverage and air quality.

PurpleAir Website



GLOBE Cloud Observer App



## THE IMPORTANCE OF COMMUNITY PARTNERSHIPS

CELF's Civic Science Program encourages and supports establishing community partnerships. For West End students, this meant students shared and revised their research with guidance of atmospheric scientist, Dr. Margaret Pippin and science educator, Angela Rizzi. The partnership between students and scientists, and content exchange among them, proved to be invaluable. "One student group wanted to



look for a correlation between PM 2.5 measurements and numbers of deaths caused by COVID-19 in two different NYC neighborhoods. Dr. Pippin and Ms. Rizzi explained that there is a lag time when comparing COVID-19 deaths and PM 2.5. People can be exposed to poor air quality for several years which can lead to asthma and consequently cause them to be at a higher risk of experiencing severe effects from COVID-19 if infected. This was a helpful lesson because the students thought poor air quality directly led to higher COVID-19 deaths.

---

## STUDENTS MAKE AN IMPACT

Once the project was completed, Ms. Hollyday's students created websites that displayed their air quality research along with other projects that they worked on in class. As part of their websites, students created a "Make an Impact" page in which they described actions their audience could take after learning about their research. Along with that, Ms. Hollyday's students were given the opportunity to share their findings with middle school students from Syracuse, New York to share their discoveries with a broader audience.

One of Ms. Hollyday's students became passionate about exploring how his neighborhood in the Bronx has been disproportionately impacted by poor air quality. "Both the CELF Staff, along with Dr. Pippin and Ms. Rizzi, expressed to me that Carlos stood out to them because of his passion and dedication to use scientific findings to improve his community. After Carlos presented it to them, Dr. Pippin followed up by sending scientific articles to Carlos to help him deepen his research."

As a result of his work with Ms. Hollyday in the CELF Civic Science program, Carlos interned with NASA's GLOBE Program. "I suggested the internship to Carlos because I recognized his peerless maturity and desire to continue working with NASA. From there, he independently applied for the internship. I can imagine that his involvement with GLOBE may have helped him stand out as a candidate; however, he is a one-of-a-kind student who would be an obvious choice for any extracurricular activity."

Ms. Hollyday had four groups of students present at the CELF's 2021 Student Symposium in May, where they shared their findings with a virtual audience of over 150 students, educators, and professionals within the fields of environmental health (NYC Dept. of Health), air quality monitoring (Plume Labs) and city government. "I am so grateful that CELF designed a live online experience where my students could feel pride in presenting their research to experts and recognize the importance of air quality research." These same groups of students also presented their findings at the GLOBE International Science Symposium and received high honor badges for their authentic and thorough research.





## TIME TO CELEBRATE

When it was time to return back to school, Ms. Hollyday and her students had an in-person pizza party to celebrate the work they had done. She said, “It was an extra special moment because students felt pride in having accomplished an in-depth research project and they had an enormous appreciation for getting to be with one another in person.”

---

## WHAT'S NEXT FOR MS. HOLLYDAY'S CLASS?

Looking towards the future, Ms. Hollyday plans to expand and improve on her student projects. “Now that we are fully back in person, I’m excited to support my students in taking action more locally, within New York City or even within our school community. I would like to give students opportunities to explore resources on urban planning and environmental racism as inspiration for their research questions.”

Additionally, Ms. Hollyday has worked on creating materials that her students can use to more easily visualize their data using ArcGIS Online. She also will be connected with three organizations to allow her students to gather, revise, and present their data. “One of my classes will work with Dr. Pippin and Mrs. Rizzi to prepare for the GLOBE International Science Symposium,” says Ms. Hollyday. “And one of my classes will prepare for the next CELF Student Symposium!”

Ms. Hollyday plans to continue using experiential learning as well as integrating CELF’s teaching concepts and applications to ensure her students have a deep understanding of the world around them and the knowledge and confidence to create positive change within their communities and around the globe.