

POLARIS

CHARTER ACADEMY

WHERE LEARNING HAS NO BOUNDARIES

WATER QUALITY REPORT

2023

MOVING TOWARD EQUITY IN
CHICAGO'S DRINKING WATER

www.PCAchicago.org

Prepared by:
7th & 8th Grade Students

773-534-0820
620 North Sawyer Avenue
Chicago, Illinois 60624



TABLE OF CONTENTS

INTRODUCTION	2
ATTRIBUTES OF WATER	3
WATER CONTAMINATION	3-4
WATER QUALITY STUDY	5-6
TEST RESULTS	7
IMPLICATIONS	8
DISCUSSION	8
APPENDIX A Key Terms and Abbreviations	9
APPENDIX B References and Resources	10



Polaris students on Fieldwork at the Eagan Metropolitan Water Reclamation District

INTRODUCTION

During the 2022-2023 school year, seventh and eighth grade students at Polaris Charter Academy focused on learning physics and chemistry through multiple lenses. By the end of the year, students were tasked to apply their scientific knowledge to examine a pressing issue of environmental and social justice: **water quality**. Chicago has almost 400,000 Chicago homes with lead water pipes—far more than any other U.S. city¹. An analysis by The Guardian of Chicago’s water quality data from 2016-2021 evidenced one in twenty tests found lead; one third of tests were above the limits allowed for bottled water. Furthermore, this analysis identified, “Nine of the top ten zip codes with the largest percentages of high test results were neighborhoods with majorities of Black and Hispanic residents².”

During the third trimester, Polaris students were challenged to demonstrate a deep understanding and mastery of the following questions and targets:

Guiding Questions

- How do we measure the quality of our water?
- Is access to clean water a human right?
- How can I advocate for change using science?

Learning Targets

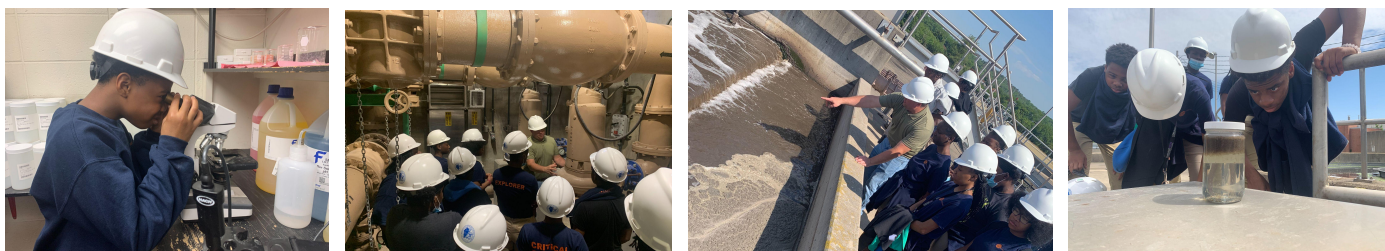
- LT 1: I can describe contaminants found in water.
- LT 2: I can explain the attributes of water quality.
- LT 3: I can evaluate the quality of water.



Expert Chemist, Ms. Cynthia Chapple

To this end, students dove into understanding water quality over two month, engaging in fieldwork at different Metropolitan Water Reclamation District facilities, gathering authentic research by testing different sites across the city, analyzing open-source data sets on Chicago’s water quality, and collaborating with an expert chemist, Ms. Cynthia Chapple.

The subsequent report was written by students and will be sent to Chicago’s new mayor, The Honorable Mr. Brandon Johnson, for review.



Polaris students on Fieldwork at the Lemont Metropolitan Water Reclamation District

ATTRIBUTES OF WATER

ALKALINITY	Alkalinity is a measure of the acid neutralizing capacity of water. The total amount of alkalinity can be measured by collecting water samples and identifying the amount of acid needed to bring the sample to a pH of 4. High alkalinity levels in water will increase acid rain and other acid waste preventing pH changes that are harmful to the life organisms in the body of water affected by the shifting levels of alkalinity.
HARDNESS	Hardness is the amount of dissolved calcium and magnesium in water. Hardness is measured in grains per gallon and parts per million. Hardness levels in water are not a health risk, but can cause mineral buildup in pipes.
pH	The pH scale is a measure of hydrogen ion concentration; it shows the acidity or basicity of a solution. The range on the pH scale goes from 0-14 with 7 being neutral. Below 7 is acidic and above 7 is basic. High pH in water causes a bitter taste and low pH water will corrode or dissolve metals and other substances.
Salinity	Salinity is the dissolved content in a body of water. A way to measure salinity is by putting an electric current between two electrodes of a salinity meter in water samples. Salinity affects the quality of water as high levels of salts can affect the taste of drinking water.
Turbidity	Turbidity determines the clarity of water. Turbidity is measured by Nephelometric Turbidity Units (NTUs). High turbidity means the water is not clear and therefore low quality water. Low turbidity means the water is clear and thus high quality.

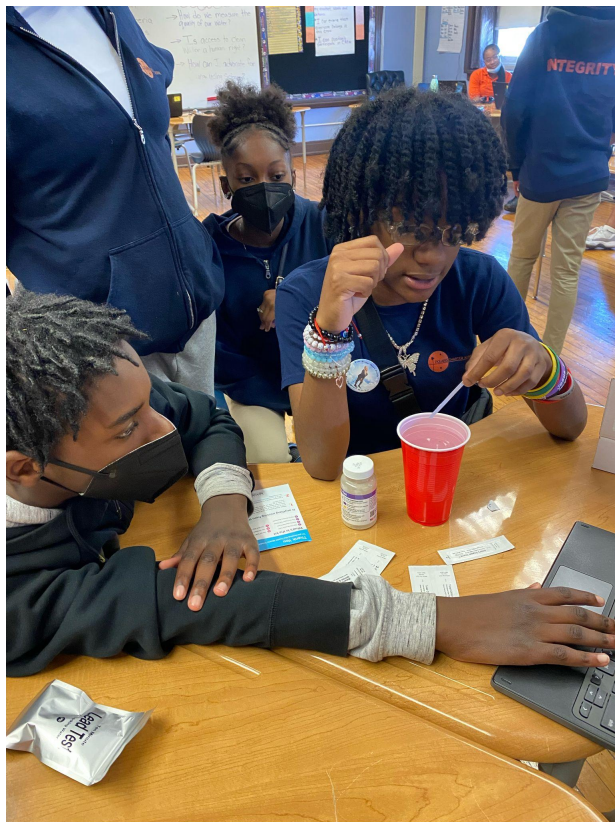
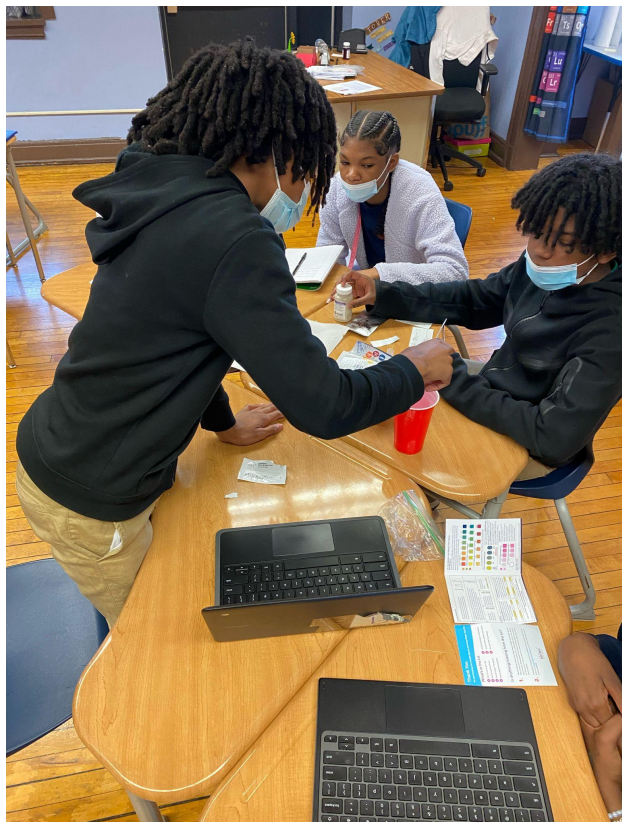
WATER CONTAMINATION

BIOLOGICAL CONTAMINATE	Biological contaminants are a way to see all living organisms in a water source and can be used to determine if it is safe to drink. How this contaminant can impact water quality is that scientists use the organisms in the water to get clues on the quality of the water; this can help keep the water clean and safe by looking at the biological indicators in the water. Some common examples are frogs, plants, fish, bacteria, viruses, and protozoa.
CHEMICAL CONTAMINATE	Chemical contaminants are sometimes found in food or a water source. Chemicals in water can harm aquatic life; it can shorten their life span and stop them from being able to reproduce. Examples of chemical contaminants are pesticides and heavy metals.

PHYSICAL CONTAMINATE	Physical contaminants are contaminants like Chlorophyll A, which is found in algae and other organic materials. Physical contaminants can change the color of water and also the clarity of water overall. Physical contaminants can be caused by natural events such as storms and floods as well as human interaction like construction and land development.
BACTERIA (e.g., Chlorophyll)	Coliform bacteria, specifically E coli, can be found in water. Water with E coli contains pathogens that can cause diarrhea, vomiting, cramps, nausea, headaches, fever, fatigue, and even death. E coli enters water sources from sewage or animal waste and has been found in waterways and beaches.
CHLORINE	Chlorine is a chemical contaminant. The common cause of Chlorine is through household products like bleach and in pools. Chlorine heightens the pH balance of water and is very poisonous for humans to drink.
COPPER	Copper is a chemical element that is often found with other metals like lead, zinc, gold, and silver. A significant amount of copper in your drinking water can leave a metallic or bitter taste and may not be safe to drink. High levels of copper can even negatively impact soil and plant growth.
LEAD	Lead is a toxic metal that is persistent in the environment and can accumulate in the body over time. It is a chemical contaminant. Lead can contaminate water from lead pipes, faucets, and plumbing fixtures. People, particularly children, exposed to lead can damage the brain and nervous system, delay growth and development, cause learning and behavior problems, and impact hearing and speech. Additionally, lead can cause cardiovascular effects such as increased blood pressure and incidence of hypertension as well as decreased kidney function and reproductive problems in adults.
NITRATES / NITRITES	Nitrates/Nitrites are a chemical contaminant. Together with phosphorus, nitrates in large amounts can cause an over-enrichment of water. This can lead to a dramatic increase in aquatic plant growth and changes in the types of plants and animals that live in the stream. High levels of it can turn skin to a bluish or gray color and cause more serious health effects like weakness, excess heart rate, fatigue, and dizziness.

WATER QUALITY STUDY

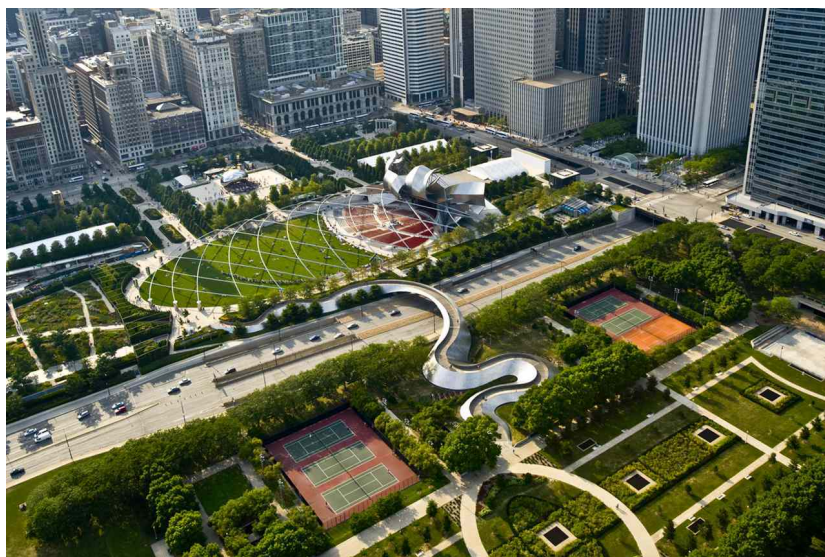
Polaris students used Health Metric drinking water test kits to assess the following water contaminants and attributes: Chlorine, Copper, Lead, Nitrate, Nitrite, Coliform bacteria, pH, Hardness, and Alkalinity. Students first tested the quality of the drinking water on each floor of their school. Then, they evaluated the water quality of four different parks on each side of the city (outlined below).



Polaris students testing water quality from each floor of our school as well as parks across Chicago

Testing Site #1 MILLENNIUM PARK

Millennium Park is located in the heart of Chicago's downtown. The park opened in 2004 and consists of almost 25 acres featuring public art, outdoor concert and food venues, and has been a top ten tourist attraction for over 25 million annual visitors.



**Testing Site #2
HUMBOLDT PARK**

Humboldt Park is located on Chicago's West Side and encompasses almost 200 acres. Amenities at Humboldt Park include a historic fieldhouse with a fitness center and two gymnasiums as well as an inland beach and boat house.



**Testing Site #3
CALDWELL WOODS**

Caldwell Woods is located on Chicago's far North Side. The park features picnic groves, activity areas, a warming shelter, sledding hill, and access to the popular North Branch Trail.



**Testing Site #4
PULLMAN NATIONAL
HISTORICAL PARK**

The Pullman National Historical Park is located on Chicago's far South Side. First named a National Monument in 2015 by President Barack Obama, the park is celebrated for its significant influence on the labor movement and legacy of African American/Black leadership as well as industrial innovation and urban planning.



TEST RESULTS

WATER QUALITY TEST RESULTS: POLARIS CHARTER ACADEMY					
CONTAMINANT/ATTRIBUTES	EPA STANDARD MAXIMUM	BASEMENT SAMPLE	FIRST FLOOR SAMPLE	SECOND FLOOR SAMPLE	THIRD FLOOR SAMPLE
Chlorine	4 ppm	0.2 ppm	0 ppm	0.2 ppm	0 ppm
Copper	1.3 ppm	0 ppm	0 ppm	0.05 ppm	0.05 ppm
Lead	0.015 ppm	< 0.015 ppm	< 0.015 ppm	< 0.015 ppm	< 0.015 ppm
Nitrate	10 ppm	0 ppm	0 ppm	0 ppm	0 ppm
Nitrite	1 ppm	0 ppm	0 ppm	0 ppm	0 ppm
Coliform bacteria	0 ppm	0 ppm	0 ppm	0 ppm	0 ppm
pH	6.5-8.5 (ideal)	8.5	8.5	6.5	6.5
Hardness	10-100 ppm (ideal)	120	50	50	120
Alkalinity	75-150 ppm (ideal)	240	240	120	240

WATER QUALITY TEST RESULTS: CHICAGO PARKS					
CONTAMINANT/ATTRIBUTES	EPA STANDARD MAXIMUM	MILLENIUM PARK SAMPLE	HUMBOLDT PARK SAMPLE	CALDWELL WOODS SAMPLE	PULLMAN NH PARK SAMPLE
Chlorine	4 ppm	0 ppm	0 ppm	0 ppm	0 ppm
Copper	1.3 ppm	0 ppm	0 ppm	0 ppm	0.05 ppm
Lead	0.015 ppm	< 0.015 ppm	< 0.015 ppm	< 0.015 ppm	< 0.015 ppm
Nitrate	10 ppm	0 ppm	0 ppm	0 ppm	0 ppm
Nitrite	1 ppm	0 ppm	0 ppm	0 ppm	0 ppm
Coliform bacteria	0 ppm	0 ppm	0 ppm	0 ppm	0 ppm
pH	6.5-8.5 (ideal)	6.5	6.5	8.5	6.5
Hardness	10-100 ppm (ideal)	120 ppm	100 ppm	120 ppm	120 ppm
Alkalinity	75-150 ppm (ideal)	180	240	240	80

ppm: parts per million, or milligrams per liter (mg/L)

pH: a measure of how acidic/basic water is ranging in scale from 0-14 in logarithmic units

IMPLICATIONS

All tests from both Polaris and selected parks across the city were under EPA standards for contaminants with the exception of hardness and alkalinity. Both hardness and alkalinity do not pose a health risk. However, they can impact mineral buildup in pipes and the pH level of water. Overall, the tests evidenced good water quality.

DISCUSSION

While our tests did not produce any concerning results, we did find data that highlights the problem of high lead levels in Chicago's water. There were open-source test results from years of testing done by Chicago Public Schools (CPS) linked in the Chicago Tribune article "Murky Waters: With no state funding and shifting guidance, schools' action on lead in water vary widely." When we analyzed the data, schools on the West Side of the city had the most frequent and largest amounts of lead in their water.

The EPA's action level for lead in water is 15 µg/L with the goal of 0 µg/L because all lead exposure should be avoided. The FDA's standard is 5 ppb in bottled water. The 2016 lead tests performed by CPS at Leif Ericson Elementary Scholastic Academy recorded an alarming 2,300 ppb of lead from a classroom sink. However, tests from 2019 and 2020 were within the acceptable range; over these two years, CPS performed 82 tests with the average level of 1.2 µg/L, suggesting that lead remediation was conducted to address the issue. There is a similar story at Al Raby High School. In 2016, 204 ppb of lead was detected and tests as recent as 2021 have fallen to acceptable levels. Yet, tests from the bottle fill station at Genevieve Melody Elementary School in 2022 recorded 130 µg/L, which is over eight times higher than the EPA action level.

Access to water is a human right. Our analysis is proof that there is still more work that needs to be done to ensure the safety of students, particularly on the city's West Side. Our call to action is for the City of Chicago to prioritize the continued testing and systematic lead remediation efforts in our schools. Polaris is fortunate to have clean water and we implore Chicago's incoming Mayor to make sure all students have the right to clean water.

APPENDIX A: Key Terms and Abbreviations

Bioindicator: an organism that is sensitive to and impacted by environmental changes (example: frogs).

EPA (Environmental Protection Agency): The EPA protects people and the environment from significant health risks, sponsors and conducts research, and develops and enforces environmental regulations.

FDA (Food and Drug Administration): The FDA is responsible for protecting the public health by ensuring the safety, efficacy, and security of human and veterinary drugs, biological products, medical devices, our nation's food supply, cosmetics, and products that emit radiation.

MCL (Maximum Contaminant Level): The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available technology.

ND (None Detected): Below analytical method detection limit.

Nonpoint-Source Pollution: pollution that cannot be traced back to one location (example: road salt run-off).

Point-Source Pollution: pollution that can be traced back to one location (example: factory site).

ppb (parts per billion or micrograms per liter mcg/L): One ounce in 7,350,000,000 gallons of water.

ppm (parts per million or milligrams per liter mg/L): One ounce in 7,350 gallons of waste

Remote Sensing: collecting data from a distance (example: satellite photos).

SDWA (Safe Drinking Water Act): A set of federally mandated regulations that ensures the quality and safety of water provided by public water systems.

> An abbreviation meaning "more than."

< An abbreviation meaning "less than."

APPENDIX B: References and Resources

¹ Brad Edwards and Paige Tortorelli. (2022, September 21). *Revealed: The “shocking” levels of toxic lead in Chicago Tap Water*. The Guardian.

<https://www.theguardian.com/us-news/2022/sep/21/lead-contamination-chicago-tap-water-revealed>

² Erin McCormick, Aliva Uteuova, and Taylor Moore. (2022, September 21). *Revealed: The “shocking” levels of toxic lead in Chicago Tap Water*. The Guardian.

<https://www.theguardian.com/us-news/2022/sep/21/lead-contamination-chicago-tap-water-revealed>

[NPR: *New Report Finds ‘Shocking’ Levels of Lead in Chicago Water*](#)

[PBS News: *Why American Cities Are Struggling to Supply Safe Drinking Water*](#)

[Chicago Tribune: *Murky Waters*](#)

[EPA: *National Primary Drinking Water Regulations*](#)

[TED-Ed: *When Is Water Safe to Drink?*](#)

[AmericanWaterWorks: *Together, Let’s Get the Lead Out*](#)

[Built World: *How Does Chicago Get Its Water?*](#)

[NPR: *Do You Have Lead Pipes in Your Home?*](#)

[EPA: *Basic Information about Lead in Drinking Water*](#)

[City of Chicago: *Water Treatment Education*](#)

[City of Chicago: *Lead-Safe Chicago*](#)

[Svalbardi: *What Are the Common Contaminants in Water?*](#)