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## **Graphing the Urban Health Impacts of Rising Temperature, Air Quality and Increased Pollen**

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### **Introduction**

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Climate change is a global issue that has a varying degree of impact on different regions and populations of people. Rising temperatures as a result of increased production of greenhouse gasses is the central contributing factor to the impacts experienced on our earth. Regions of the globe are impacted by climate change in different ways. My school is located in an urban area, and this unit will cover topics related to the impacts in our cities, with a specific focus on climate-associated increases in respiratory illnesses.

As stated in the Fourth National Climate Assessment, “While urban areas are hubs for economic growth, they continue to face several challenges that include social inequalities, aging and deteriorating infrastructure, and stressed ecosystems. These challenges affect exposure and susceptibility to climate change effects for urban populations.”<sup>1</sup> For instance, African Americans suffer from higher rates of asthma, asthma hospitalizations, and asthma associated deaths than the overall US population.<sup>2</sup> In predominantly African American communities, such as the one where my school is located, there can be multiple explanations for this. Genetics, socioeconomic status, and access to quality medical care and education are topics that are being explored to further understand the disparity.<sup>3</sup> Research also shows that there exist inequities resulting from historical redlining practices that situated poor and African American families in areas that were deemed undesirable and closer to environmental factors that are proven to exacerbate respiratory illnesses and asthma. To further compound this issue, vulnerable populations who suffer the most from the urban heat island effect, are not often included in urban heat management and mitigation efforts.<sup>4</sup>

This unit will immerse students in graphing data that is related to the rise in respiratory allergies or hay fever. This is especially important because individuals living in urban areas are much more likely to experience hay fever symptoms than individuals living in rural areas,<sup>5</sup> and the forms of allergies and asthma that are triggered by allergens like pollen are on the rise. This rise is associated with climate change.<sup>6</sup> In our country, allergies account for over 13 million doctor and medical facility visits in a year.<sup>7</sup> To that end, allergy symptoms and asthma severity are major causes of disruptions to learning and school absenteeism.

A growing body of research has pointed to urban heat islands (UHI) and their impact on air pollution and the ragweed pollen season as two contributors to the rise in allergy and asthma symptoms. In this unit, students

will track and represent weather data like the local daily temperature, pollen count, and the Air Quality Index (AQI) using tally charts, tables, pictographs, line plots, or bar graphs. Students will analyze, interpret, and compare some of the compiled data sets to historical records from 90 years ago to look for and explore trends.

## School Description/Rationale

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Pittsburgh Lincoln Pre-K-5- also known as Pittsburgh Lincoln Elementary or Pittsburgh Lincoln Elementary- is a small neighborhood school situated in the Lincoln-Larimer community of Pittsburgh. It is a Title I School, which is a federally funded program that provides money to schools with students who are at risk of failure or living in poverty. The student population is currently made up of 200 students, of which 92% are “economically disadvantaged”. Of those 200 students, 178 are African American, 16 students are Multi-Racial, less than 5 students are American Indian, and less than 5 students are Caucasian.<sup>8</sup>

At Pittsburgh Lincoln K-5, Mathematics test scores have (in more recent history) fallen below average in comparison to state and local averages on the Pennsylvania System of School Assessment (PSSA), which is the standardized test that is administered in the state of Pennsylvania. I student taught at Lincoln School in 2004 when it was the mission of the principal and staff to reach National Blue Ribbon status. As stated on its website, “The National Blue Ribbon Schools Program recognizes public and private elementary, middle, and high schools based on their overall academic excellence or their progress in closing achievement gaps among student subgroups.”<sup>9</sup> It has been anecdotally stated by numerous staff members that taught there during that time, that the school was very close to obtaining that status on many normed assessments like the PSSA and the Terra Nova. However, school closures and redistricting resulted in the school having to reconfigure to two campus buildings that could accommodate students up to 8<sup>th</sup> grade. This new configuration would include data accountability for its newly combined age groups and students, as well as a completely different set of standards to achieve National Blue Ribbon status. While this new configuration didn’t last very long, it was a huge upset to the goals and progress that the school was perceived to be making. After more reconfigurations in years to come, Pittsburgh Lincoln was changed back to an elementary school. Despite all of this restructuring, for two consecutive school years (2014-2016), Pittsburgh Lincoln was awarded STAR status for placing in the top 15% for academic growth in the district. It became one of the fastest improving schools in the district. However, progress has since declined and the COVID-19 school closure only proved to further impede it.

Prior to the COVID-19 school closure, students experienced daily complications related to respiratory allergies and asthma. Most typically, select students received daily asthma treatments with an inhaler before/after recess or on demand. Many students ask for frequent visits to the nurse, or often return from bathroom breaks with makeshift compresses made out of wet paper towels for itchy eye relief. Throughout the school year, news reports of poor air quality created instances when students cannot go outside for recess. This issue persisted after the shutdown.

Aeroallergens, like ragweed pollen are the cause of respiratory allergies and increase asthma severity. Poor outdoor air quality serves to exacerbate the effects of aeroallergens. In this sense, they both contribute to classroom and schedule disruptions, as well as absenteeism. More than 22% of children in Pittsburgh schools have asthma. The national average is a little more than 10%, so we are above that. Approximately, 60% of

students in Pittsburgh had uncontrolled asthma that caused them to miss school and visit the emergency room.<sup>10</sup>

The district publishes yearly attendance data that tells how many students had more than a 10% absentee rate divided by the total student population. The district's chronic absence rate is 41.7% for the 2021-22 school year. The chronic absence rate is defined by dividing the number of students with a 10% or more absence rate by the total student enrollment. The available data does not specify how many absences are due to respiratory health issues.

In terms of Mathematics scores, the 3<sup>rd</sup> grade PSSA for Mathematics in 2018 (before the Spring 2019 school closure), showed the scoring levels as follows: 0% Advanced, 3.7% Proficient, 44.4% Basic, and 51.9% Below Basic. For the 2021 school year, the 3<sup>rd</sup> grade Mathematics scores showed the scoring levels as follows: 0% Advanced, 0% Proficient, 18.2% Basic, and 81.8% Below Basic. While sobering, the scores show a stark need for an intensive Mathematics instructional response to support all Mathematics standards. The scope of this unit is on the 3<sup>rd</sup> Grade Pennsylvania Standard CC.2.4.3.A.4: Pennsylvania's public schools shall teach, challenge, and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to represent and interpret data using tally charts, tables, pictographs, line plots, and bar graphs.<sup>11</sup> In this unit, students will use technology to research, track, and plot daily and historical temperatures as a daily routine. Students will use this same practice to represent daily pollen counts. Lastly, students will use technology to track the daily Air Quality Index (AQI) using tallies that will later be transferred to pictographs showing the total amount of days for the month that had good air quality and bad air quality.

## Unit Content

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This unit will tackle some of the Mathematics content relative to the climate impacts and climate related health impacts that can affect poor and African American populations who reside in urban environments.

### **Disproportionate Impact of Climate Change on Vulnerable Populations**

A review of the literature shows an increasing number of studies linking historical redlining practices to dire health impacts for vulnerable populations.<sup>1213141516</sup> Historical redlining was the practice of denying access to federal loans and investment opportunities to an area that was predominantly African American. The term is derived from actual red lines that were drawn on maps to identify the neighborhoods as hazardous. This unit will cover specific environmental impacts that affect African American populations who continue to live in parts of metropolitan areas that were deemed undesirable, remain disinvested and are more likely to experience the disparate health outcomes associated with poverty and climate change.

As stated in the Fourth National Climate Assessment, "People who are already vulnerable, including lower-income and other marginalized communities, have a lower capacity to prepare for and cope with extreme weather and climate-related events and are expected to experience greater impacts."<sup>17</sup> We have seen this with climate-related events like the wildfires impact on the elderly and low-income populations in California or the impact of Hurricane Katrina on low-income and African American residents.

Low income and African American populations were, historically, more likely to be redlined into areas that

were deemed as “undesirable”.<sup>18</sup> While redlining has since been made illegal, many of those areas still face disinvestment and are more likely to be in close proximity to industrialized transportation systems, industrial centers, oil and gas refineries, less green space, and more risk related land covers.<sup>19,20</sup> People of color are more likely to live in an urban heat island<sup>21</sup>, and this unit will explore the concept further in the Rising Temperatures and Urban Heat Islands section. Conversely, these populations are often neglected in climate change conversations, and adaptation and mitigation efforts, resulting in an even further impact on health outcomes.<sup>22</sup> New explorations of pollution inequity are also on the forefront of climate justice conversations. These conversations are centered around the difference between the environmental health damage caused by a particular racial group minus the damage experienced. It is possible that African American and Black Hispanic ethnic groups experience more environmental health damage based off of the consumption of goods and services by Non-Hispanic whites.<sup>23</sup> This unit will cover 3 climate related impacts that have disparate impacts on some African American subgroups: (1) rising temperatures, (2) air pollution and (3) ragweed pollen.

### **Rising Temperatures and the Urban Heat Island Effect**

With African American populations being among the vulnerable populations that are more likely to live in an urban heat island<sup>24</sup>, the topic and understanding of daily temperature and its trends are of extreme importance to the students at Pittsburgh Lincoln. Increased anthropogenic contributions to greenhouse gasses certainly contribute to the higher temperatures in urban environments, but there are other contributing factors that are certainly worth noting in more detail.

Besides greenhouse gasses, there are other components and processes that reflect and absorb heat from the sun to create the temperature, such as albedo. Albedo is a surface’s ability to reflect or absorb radiation/heat from the sun. The ability of matter on earth’s surface to absorb heat and reflect heat is dependent on how light or dark the surface is. Lighter surfaces reflect heat better (making the temperature cooler) while darker surfaces absorb it (making the temperature hotter). For example, snow cover on a surface will reflect heat better than asphalt. This is of particular importance for this unit because it informs how the surface areas in urban environments contribute to rising temperatures that have several impacts, including an increase in respiratory illness and asthma severity.

Earth’s surfaces have an ability to either reflect or absorb radiation from the sun. However, in urban areas, many dark surfaces such as buildings and asphalt pavements absorb a high percentage of heat from the sun.<sup>25</sup> They do not have as much reflectivity as green space. The dark surfaces also cannot absorb rainwater, and this causes a problem with the natural cooling system of the earth. Water evaporating from soil helps cool the earth, and so in urban spaces the paved surfaces prevent this from happening. Subsequently, temperatures are increasing at higher rates in comparison to rural areas that have more green space.<sup>26,27</sup>

First gaining attention in 1833, this effect is now commonly characterized as the heat sink effect or urban heat island (UHI) effect.<sup>28,29,30</sup> In addition to dark pavement areas and decreased evaporation function, there are other variables that exist within a causal sequence to contribute to the UHI effect. For example, the industrialized transportation systems and factories in urban areas emit waste heat and CO<sub>2</sub> during operation. These types of emissions are called anthropogenic heat release (AHR) because they are caused by human activities. Because the air and surfaces in cities are hotter, the indoor environment is hotter, resulting in higher usage of air conditioners, ejection of waste heat from buildings, increased energy utilization and contributing to even more AHR.<sup>31</sup>

A 2021 research brief ranked the top 20 hottest metropolitan areas, using an index score rating that took into consideration the following characteristics of the cities: (1) albedo, (2) percentage of greenery (3) population density, (4) building height, and (5) average width of streets and irregularity of the city. The top 5 cities New Orleans, Newark, New York, Houston, and San Francisco.<sup>32</sup> While Pittsburgh was not on the list, we certainly have our issues with rising temperatures as do most metropolitan areas. This unit can be applied to many metropolitan areas, as 85% of people are living in metropolitan areas in the US.<sup>33</sup>

Last year, Danielle Dozier, news staff for a local news station (WPXI) in Pittsburgh, interpreted the National Oceanic and Atmospheric Administration's (NOAA) climate normals assessment, and published that "Pittsburgh is getting warmer and wetter." According to Dozier, the results show that Pittsburgh's average temperature is 0.5 degrees warmer based on the 30 year normal from 1991-2020.<sup>34</sup>

### **Urban Heat Islands and Air Pollution**

There are different types of pollution that include water, land, and air pollution. It is important for students to understand their impacts. This unit will introduce the topic of air pollution and encourage students to think about the indicators of what makes a good air quality day versus a bad air quality day. To help students understand this, it is important to note and explain that there are many indicators or criteria for air pollution and air quality. They include U.S EPA criteria contaminants: carbon monoxide, lead, ozone, particulate matter, nitrogen dioxide and sulfur dioxide<sup>35</sup> Federal government websites like Airnow.gov give detailed information on the pollution criteria that are high for the day. Using this information, students with asthma can become more aware of times that they may need to exercise vigilance and care to manage the condition.

The urban heat island effect combined with air pollution creates a compounded health crisis, especially for vulnerable and marginalized populations, and people who have asthma. The adverse effects of poor air quality include many respiratory illnesses including asthma. Poor air quality has also been linked to school absenteeism and poor academic outcomes.<sup>36</sup> In the American Lung Association's 2020 "State of the Air" report, Pittsburgh was found to have ozone and daily long-term fine particle matter (PM 2.5) levels that were considered failing.<sup>37</sup> Because these are the pollutants of concern for Pittsburgh, PA, this unit will mostly cover these two. These two pollutants are exacerbated by emissions, but sunlight and temperature also have an impact on how they are formed.

Nitrogen oxide gasses can be naturally occurring, but are also emitted when fuel is burned at high temperatures by vehicles or other industrial sources. Volatile Organic Compounds (VOC) are human made chemicals that are emitted as gasses from certain solids or liquids, like paint, cleaning supplies, and pesticides. These gasses react with sunlight and high temperatures to create the majority of ground level ozone, or smog, that we experience.

When ozone levels are high at ground level, it has serious health impacts for individuals with pre-existing respiratory conditions, especially asthma. Individuals who are disproportionately impacted include African Americans and children. <sup>38</sup>

Another U.S EPA criteria contaminant is particulate matter, or PM.  $PM_{10}$  and  $PM_{2.5}$  are small, inhalable particles that form in the air as a result of chemical reactions with the gas emissions from power plants, automobiles, and industries.  $PM_{2.5}$  is also called fine particulate matter because of its size is smaller than  $PM_{10}$ .  $PM_{2.5}$  consists of particles that are generally 2.5 micrometers in diameter. It can include dust and soot, and can have serious health consequences when inhaled. Ground level ozone and airborne particles are the two contaminants that

pose the greatest health risks.<sup>39</sup>

## Ragweed Pollen and Hay Fever

North American pollen seasons are getting worse as a result of climate change. The reason: longer growing seasons and higher pollen counts.<sup>40</sup> In 2011, a study showed a longer duration of the ragweed season for specific latitudes. In that study, the authors identified a delay in frost season in the fall and a ragweed season was between 13-27 days longer than it had been in 1995 (see Figure 1). Due to climate change, the temperatures that used to be considered spring time temperatures are starting earlier and summer temperatures are lasting longer into the fall.<sup>41</sup> In Pennsylvania, the ragweed pollen season starts in mid-August and lasts until mid-September when the temperatures begin to decrease to 60°F. With more extreme temperatures due to the urban heat island effect, the extended growing season is likely greater in metropolitan areas

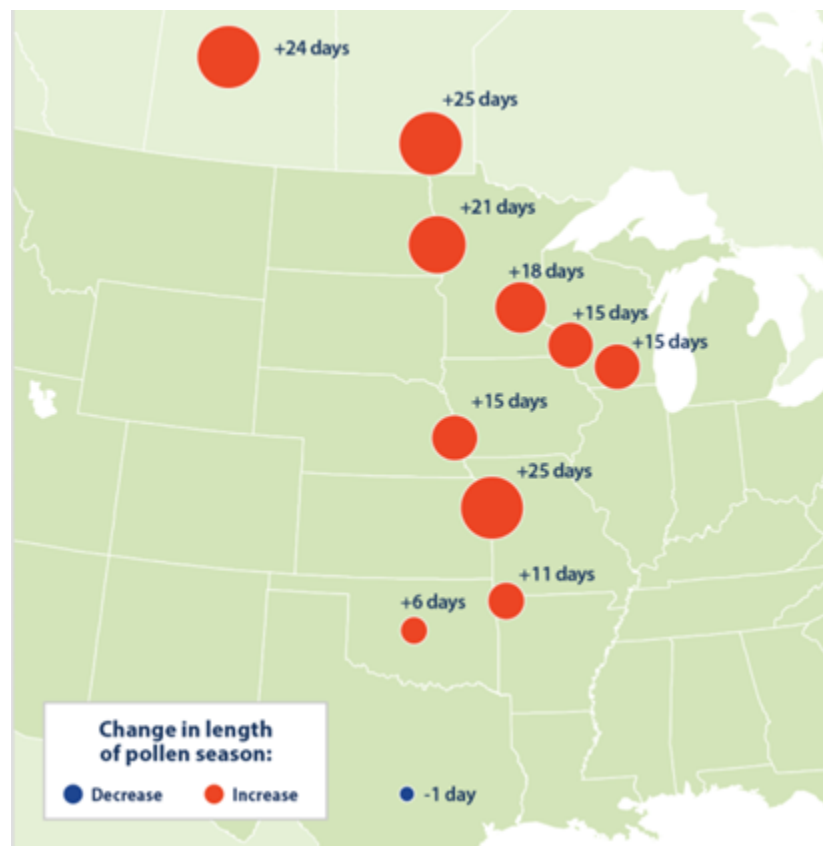


Figure 1-Changes in the length of the pollen season from 1995-2015 <sup>42</sup>

The longer season exacerbates a major health issue for the estimated 10-30% of the population that suffers from hay fever, and the 300 million people affected by asthma.<sup>43</sup> Nationally, allergies account for over 13 million doctor and medical facility visits in a year.<sup>44</sup> Allergy symptoms and asthma are major causes of disruptions to learning and school absenteeism, and they are more prevalent in urban areas than they are in rural areas.<sup>45,46</sup>

Allergy symptoms occur when the body's immune system views a substance as a threat. When the immune system recognizes a foreign substance as potentially harmful, it will create antibodies to attack it, resulting in an allergic response that can include sneezing, watering eyes, and shortness of breath. The antibody that the

immune system creates against allergens is called Immunoglobulin E (IgE), although there can be different allergen specific variants. People who have allergies have high levels of the antibody IgE, and whether or not a person develops these antibodies is based on genetics and environment.

Ragweed pollen, is one of the most common aeroallergens in the United States, and can trigger allergies and asthma attacks. It is produced by the ragweed plant, *Ambrosia artemisiifolia*. It's 17 species grows throughout the United States, but especially in the Eastern and Midwestern States. The weed can produce up to 1 billion pollen grains. Ragweed pollen season typically begins mid-August, when nights are growing longer. With the aid of certain weather elements like windy, warm, or humid days, the pollen can be released from the plant and travel far distances and into the atmosphere. On the contrary, rain and colder temperatures (50° F or below) can slow down the release of pollen.<sup>47</sup>

Another factor that impacts the rise in respiratory allergies due to ragweed are the heightened CO<sub>2</sub> levels from human induced emissions. The CO<sub>2</sub> levels result in higher temperatures and more ragweed pollen is able to be produced physiologically by the ragweed plant than the same plant at lower temperatures. Some questions still remain about whether the pollen's allergenicity, the allergic potency per mass of pollen, is increasing.<sup>48</sup>

Increasing allergies have direct impacts on educational outcomes and health. It is not uncommon for students to make multiple requests to grab tissue for runny noses and after sneezing, or to see students holding moistened paper towels on their eyes to attempt to relieve eye irritations. It is also not uncommon for students to miss school due to allergies and asthma. The content of this unit is especially relevant to my school as it is located in the city of Pittsburgh, listed as 10th out of 100 on the 2020 Asthma and Allergy Foundation of America's list of "Most Challenging Places to Live with Allergies."<sup>49</sup>

## Teaching Strategies

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### **Culturally and Historically Responsive Education<sup>50</sup>**

This unit is designed to be taught as part of a daily Mathematics routine. Laying the foundation for the background knowledge and delving into the key Mathematics skills will be done using a culturally respectful framework.

A critical look is being taken at the ways in which African American students are receiving instruction in the classroom, and alternative frameworks for pedagogy are being presented to not only change instructional delivery, but also to shift the focus away from just test scores. This shift is being offered as a way to respect and acknowledge the historical and cultural strengths and abilities of African American children. In doing this, educational institutions can begin to leverage those strengths to restore the historic excellence of academic and social outcomes for African American children, where there is a need. Dr. Gholdy Muhammad makes a case for making this the way to engage and educate African American students who have been in educational systems that are absent of African American histories, identities, literacies, liberation, and academics.

She offers an alternative framework that is birthed from her research into the African American literary societies of the 19<sup>th</sup> century. As the keynote plenary speaker during Pittsburgh Public School District's Summer Leadership Academy 2022, Dr. Muhammad drew parallels between her 2020 publication *Cultivating*

Genius: An Equity Framework for Culturally and Historically Responsive Literacy and teaching other content areas. She presented the four layers (pursuits) of the Historically Responsive Literacy (HRL) framework with one additional layer. The purpose: to provide educators of African American students with a broader framework and practical methods for planning instruction that is applicable to all content areas. She called it Culturally and Historically Responsive Education (CHRE). The original four layers of HRL are: (1) identity development, (2) skills development, (3) intellectual development, and (4) criticality.<sup>51</sup> The additional layer discussed in the presentation was (5) joy.<sup>52</sup> These five layers were the ways in which she noted that African American literary societies defined and advanced education. She posits them as ways to define, organize and advance education for African American students, today. My unit will utilize this framework to organize the multiple cross curricular intersections and teaching strategies. The classroom activities will provide further detail on each layer and how students will fulfill them within the unit.

### **Depth Of Knowledge (DOK) Alignment<sup>53</sup>**

Norman Webb's Depth of Knowledge publications give guidance to states and assessment makers to consider the depth at which students will be asked to demonstrate and express knowledge they have gained. His work also guides how objectives for learning are crafted to align with the assessments. Throughout this unit, my students will be assessed using formative and summative methods to monitor learning. The assessments will ask students to demonstrate and express various levels of understanding after participating in the various activities to be discussed. Objectives, activities and assessments will be planned to allow students to engage at the various levels of complexities: (1) recall of facts, information, or procedures, (2) use information, conceptual knowledge, or procedures, (3) think strategically, (4) and extend thinking.<sup>54</sup>

### **Educational Protocols**

Educational protocols are a set of guidelines used to structure classroom learning experiences. There are different types of educational protocols, mostly categorized by the purpose they have. This unit will make use of several different protocol categories that will serve 3 purposes: (1) to engage, (2) to check for understanding, and (3) to build academic vocabulary.<sup>55</sup> Some examples of engagement protocols include Think, Pair, Share, Turn and Talk, and Admit/Exit Tickets. Some examples of protocols to check for understanding include Equity Sticks, Fist to Five, and Guided Practice. Some protocols for building academic vocabulary include Semantic Webbing, Word Sorts, and Frayer Models. The online curriculum materials provided by EL Education provides a comprehensive list of different educational protocols that can be used to engage and monitor student understanding.<sup>56</sup>

### **Varied Learning Modalities**

More recently, the widely accepted idea of learning styles has been challenged to be thought of as a matrix as opposed to being fixed.<sup>57</sup> Visual, auditory, reading, writing, and kinesthetic are terms that used to commonly be used to describe learners and their styles, however this unit adopts the theory that human beings can typically switch between these modalities to learn. This unit will present instructional opportunities that allow students to engage using more than one modality. The use of videos, literature, music, and movement will invite students to draw on all of the ways we learn as human beings.



## Activities

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The CHRE framework, that draws on the pursuits of the 19<sup>th</sup> century African American literary societies and other representations of African American genius and joy, will frame the activities for this unit. Dr. Muhammad uses the terms layers, pursuits, and standards, interchangeably, but expressed more affection for the term pursuit when describing the goal that instruction has for students. By using this language, the limitations of learning to simply pass a test become secondary. The idea that learning to improve one's life becomes the primary goal. <sup>58</sup> <sup>59</sup> This unit will also use the terms interchangeably.

### **Pursuit 1: Identity-Advancing Students Knowledge and Affirmations of Self and Others<sup>60</sup>**

Reclaiming identity was an important pursuit of African American literary societies. It was imperative that they re-established their sense of identity that was stripped from them and their ancestors during the enslavement of Africans. To continue in this pursuit, students will consider their community identities and discuss the global and local impacts of climate change in this unit. This will be preceded by the introduction of key concepts and terms through the different modalities.

The following is a list of resources and activities that can be used to introduce the Identity Pursuit:

#### **Visual/Audio Connections**

- Climate Change for Kids<sup>61</sup>
- Climate Change Song<sup>62</sup>
- Dear Future Generations: Sorry<sup>63</sup>
- Discovery Education<sup>64</sup>

#### **Reading Connections**

- This Is Our History: An Inspirational Story about Africans & African American History, Acceptance and Courage<sup>65</sup>
- My City Speaks<sup>66</sup>
- Exploring Meteorology, Earth Systems, and Climate Change<sup>67</sup>
- What Is Climate Change? (What Was?)<sup>68</sup>
- What Every Child Should Know About Climate Change | Children's Earth Sciences Books<sup>69</sup>
- The Lonely Polar Bear (Happy Fox Books) A Subtle Way to Introduce Young Kids to Climate<sup>70</sup>
- A Kid's Guide to Climate Change and Global Warming<sup>71</sup>
- Basher Science: Climate Change <sup>72</sup>

#### **Assessments**

Students will respond to readings and recall key terms/concepts through questioning and discussion protocols, protocols for building academic vocabulary, and protocols to check for understanding.

(DOK Level 1)

## **Pursuit 2: Skills-Advancing Students Content Areas, Skills, and Proficiencies<sup>73</sup>**

The acquisition and honing of skills was a very important pursuit to the African American literary societies. Visitors to their weekly meetings told of how they engaged in, not only the pursuit of literacy, but also in writing processes, that included rigorous peer critiques, with the goal of publishing across genres. Engaging in the pursuit of skills is one of the layers of CHRE. To pursue Mathematics skills, as members of the literary societies pursued reading and writing skills, this unit will present opportunities for students to become proficient in interpreting and representing data.

Using individual climate journals, students will reflect and takes notes on shared literature to document what they know and have learned about temperature, air quality, and allergens. Recording their responses will be part of admit or exit ticket protocols. As part of our daily routine, the class will assess their general health from a given list of symptoms and collect and graph data on 3 relevant health impacts of climate change: (1) temperature, (2) pollen count, and (3) air quality.

### **Representing and Interpreting Temperature Data**

To capture temperature data, students will use the bar graph template (provided in the climate journal) to draw/represent the daily high temperature in degrees Fahrenheit, as found on weather.com. After collecting data for a few days, students will be prompted to compare the data to previous days. We will also perform calculations to compare the daily temperature to the average high temperature in Pittsburgh 90 years ago (1932), when the average temperature in August was 73.4<sup>74</sup> .

We will make use of engagement protocols and calculations to grapple with and answer questions that have starter phrases such as, How many more and How many less. We will also discuss how temperatures are rising all across the globe. This will be especially important when comparing the daily temperature to the high average from 1932. Students often struggle with these types of interpretive questions, so the pursuit of these skills will need to be supported with a protocol like the Catch and Release Protocol. With a protocol of this type, students will grapple with a question or calculation for a given amount of time, and then receive feedback and time to make revisions or corrections to their work. Students will also engage in comparison discussions to average temperatures from many years ago to make a connection to how temperatures are rising.

### **Representing and Interpreting Pollen Data**

Pollen.com provides a scale for interpreting the daily pollen levels on a range from low to high. By entering a zip code, you can get a current allergy report that includes a pollen range for the current day, the previous day, and a prediction for the day after. This data is represented on somewhat of a pie chart. By choosing the 5-day allergy forecast, you will be able to see the pollen ranges for the next five days in bar graph form. By choosing the history report, you will be able to see the 30-day historic pollen levels in the form of a line plot.

As part of the 3<sup>rd</sup> grade standards, students need to pursue the skills of transferring data from one type of representation to another, so students will look at the data and transfer it to the line plotting page in their climate journals to polish this skill.

### **Representing and Interpreting Air Quality Data**

We will collaborate on tallying good air quality days and bad air quality days, on a classroom display.

Airnow.gov provides air quality data by zip code and it is easily accessible to students through the use of technology. Figure 2 shows the basic categories and descriptions for air quality that can be used to help individuals assess the level of concern and care they should exercise on a given day. Individuals who are members of a sensitive group should be more mindful when the values of the index begin to rise above 50. Airnow.gov also gives more specific information on the exact air pollutant criteria that warrants the level of concern.

Daily AQI Color	Levels of Concern	Values of Index	Description of Air Quality
Green	Good	0 to 50	Air quality is satisfactory, and air pollution poses little or no risk.
Yellow	Moderate	51 to 100	Air quality is acceptable. However, there may be a risk for some people, particularly those who are unusually sensitive to air pollution.
Orange	Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is less likely to be affected.
Red	Unhealthy	151 to 200	Some members of the general public may experience health effects; members of sensitive groups may experience more serious health effects.
Purple	Very Unhealthy	201 to 300	Health alert: The risk of health effects is increased for everyone.
Maroon	Hazardous	301 and higher	Health warning of emergency conditions: everyone is more likely to be affected.

Figure 2-AQI Basics for Ozone and Particulate Pollution<sup>75</sup>

Students will refer to this chart daily to categorize days, and at the end of each week, we will make use of the climate journals to represent the weekly data on a pictograph using small cloud bubbles to represent the number of days of each category that occurred. It is not uncommon for students to become confused when interpreting pictographs, where the key represents more than one, so it will be important to grapple, collaboratively with students on what our key should be.

### Reading Connections

- Climate Change and Air Quality <sup>76</sup>
- Dixie Wants an Allergy<sup>77</sup>
- Achoo! Why Pollen Counts<sup>78</sup>
- Every Breath We Take: A Book About Air<sup>79</sup>

### Assessments

Students will be asked to complete graphs and respond to prompts asking them to compare the represented data. These responses will be used to support and inform instruction. Student work artifacts in the climate journals will also provide valuable opportunities to give feedback. During our interpretation of the data, we will discuss comparisons between daily data, but also historical data averages. Students will also solve one and two step problems consistent with the 3<sup>rd</sup> grade Pennsylvania standards eligible content. (DOK Level 2 and 3)

### Pursuit 3: Intellect-Advancing Students' Knowledge Put Into Action<sup>80</sup>

African American literary societies believed in cultivating their intellect, so they could critique and take action on the problems of the world, and engage and argue with other intellectuals. In this pursuit, students are

challenged to think about and take action on world issues. Through read-alouds, independent readings, drawings, and the use of discussion protocols, students will explore actions they can take to do their part to decrease emissions. Students will take part in writing responses to take a pledge to do something that makes a difference.

- Greta and the Giants: inspired by Greta Thunberg's stand to save the world <sup>81</sup>
- The Story of Climate Change: A first book about how we can help save our planet <sup>82</sup>
- This Class Can Save the Planet<sup>83</sup>
- Kid's Guide to Saving the Planet<sup>84</sup>
- Our House Is on Fire: Greta Thunberg's Call to Save the Planet<sup>85</sup>
- Our World Out of Balance: Understanding Climate Change and What We Can Do<sup>86</sup>

#### **Pursuit 4: Criticality- Advancing Students' Understanding of Oppression, Equity, and Anti-racism<sup>87</sup>**

“Criticality is the capacity to read, write, and think in ways of understanding power, privilege, social justice, and oppression, particularly for populations who have been historically marginalized in the world.”<sup>88</sup> Students will identify ways in which unfair housing practices shaped the urban environment, and make connections to the health outcomes for African Americans. This will be done through questioning and discussion protocols. (DOK Level 4)

- The Fair Housing Five and the Haunted House by The Greater New Orleans Fair Housing Action <sup>89</sup>
- The Berenstain Bears New Neighbors<sup>90</sup>
- A Pig is Moving In<sup>91</sup>

#### **Pursuit 5: Joy-Advancing students' happiness by elevating beautiful and truthful images, representations and narratives about self and others<sup>92</sup>**

Dr. Mohammed argues that all five pursuits are linked to education, and that would include the pursuit of joy. Joy is important because historically it was attended to in educational institutions that taught African American children. Restoring this joy to the pursuit of learning can be done by engaging students in activities that allow them to discuss and experience the happiness that can be found in a topic. For this unit, the students will have access to stories, videos, and experiences that bring back the enjoyment that has been and can be found in climate and weather. Some ideas are listed below:

##### **Reading Connections**

- The Meteorologist in Me<sup>93</sup>
- The Wonder of Thunder<sup>94</sup>
- I Like the Sun<sup>95</sup>
- The Sun Shines Everywhere<sup>96</sup>
- Professor Figgy's Weather and Climate Science Lab for Kids: 52 Family-Friendly Activities<sup>97</sup>
- Africa: Tales from Beneath the African Sun<sup>98</sup>
- Usha and the Stolen Sun<sup>99</sup>
- Where Are You From?<sup>100</sup>
- The Camping Trip<sup>101</sup>
- Outside, You Notice<sup>102</sup>

- The Boy Who Harnessed the Wind<sup>103</sup>

### **Culminating Activity**

The Carnegie Science Center of Pittsburgh, is one of the four Carnegie Museums of Pittsburgh, and is designed for children. It offers interactive exhibits and children’s programming. Among its program offerings are STEM programs called STEM adventures. As part of a culminating activity, students will take part in the STEM adventure entitled, Go With the Flow. This STEM adventure will invite students to explore the local effects of climate change on temperature and the rivers. Students will learn about erosion, run-off, and ways to protect the rivers. They will also perform experiments to test the river water for pH balance and other scientific properties. The trip will also include a tour of the many exhibits, including H2O!, an exhibit that shows the intersections and flow of Pittsburgh’s three famous rivers: the Monongahela, Allegheny, and Ohio Rivers.

As students partake in this culminating activity, they will have the opportunity to engage in the synthesis of prior learning and apply it to new problems. (DOK Level 4)

## **Appendix on Implementing District Standards**

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Completing this unit requires that students have met the following Pennsylvania State Standards: CC.2.4.3.A.4 Represent and interpret data using tally charts, tables, pictographs, line plots, and bar graphs. To assist teachers with understanding the depth of the instructional and performance expectations, the Pennsylvania Department of Education defines eligible content. Eligible content can be thought of as the assessment depth or limits for each grade that takes the Pennsylvania System of School Assessment (PSSA). For the Data and Measurement Domain of the state standards, the assessment limits/anchors for 3rd grade are: M03.D-M.2.1.1 Complete a scaled pictograph and a scaled bar graph to represent a data set with several categories (scales limited to 1, 2, 5, and 10); M03.D-M.2.1.2 Solve one- and two-step problems using information to interpret data presented in scaled pictographs and scaled bar graphs (scales limited to 1, 2, 5, and 10); M03.D-M.2.1.3 Translate information from one type of display to another. Limit to pictographs, tally charts, bar graphs, and tables.

## **Resources**

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### **Materials for Classroom Use**

- Focus Wall with designated space for state standards and essential questions aligned to each CHRE pursuit
- Student Journals with space for reflection to writing prompts and graph paper
- Tally Chart or designated board space to keep tallies

### **Annotated Bibliography**

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This resource provides a list of protocols that educators can use to structure classroom experiences.

“Digital Textbooks and Educational Resources | Discovery Education.” 2019. Discoveryeducation.com. Discovery Education. 2019. <https://www.discoveryeducation.com/>.

This resource is available through the Pittsburgh Public School district as part of the education tools made available to instructors. It is also available online and is a great resource library for Science, Social Studies, Mathematics, and STEM.

### **Student Reading List**

All readings below are the suggested readings that can be made available in a classroom library, assigned to students, or used as read-alouds.

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