UCONN

NEAG SCHOOL OF EDUCATION

Grade 5 Unit Plan

Authors: Aaron Richardson, Jannatul Anika, Todd Campbell
Unit Title: Corsi-Rosenthal Box Learning Modules
Science Area Focus: Engineering, Earth and Life Sciences

Note: These instructional materials were co-developed by two graduate students and a professor/researcher in science education and in the Neag School of Education

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STAGE 1: PLANNING FOR ENGAGEMENT WITH IMPORTANT SCIENCE IDEAS

PART A: Unpack the Standards. *This is completed by reviewing the Framework for K-12 Science Education to identify the Disciplinary Core Ideas (DCI), DCI Progressions, and Performance Expectations that will make up the student learning targets of the unit.*

STEP 1. Based on the science area focus above, identify the appropriate **disciplinary core idea(s)** (DCI) [include both DCI (e.g., MS-LS2) and applicable **sub-DCIs** (e.g., MS-LS2A)]

3-5-LS4.D: Biodiversity and Humans: Populations live in a variety of habitats, and change in those habitats affects the organisms living there.
3-5-ESS3.A: Natural Resources: Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not.
3-5-PS1.A: Structure and Properties of Matter: Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model shows that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon; the effects of air on larger particles or objects.

STEP 2. Identify the relevant **performance expectations** that you are working toward.

3-LS4-4–Populations live in a variety of habitats, and change in those habitats affects the organisms living there
5-ESS3-1–Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.
3-5 ETS1-1–Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

PART B: Identify a Scientifically Rich, Complex Anchoring Phenomenon. *The anchoring phenomenon will serve as the real-world event that students work to explain as the purpose for engaging in the unit.*

STEP 1. Describe a **scientifically rich, complex environmental phenomena** that will require students to use multiple science ideas that are central to the DCI(s) to explain.

Residents of the Waterfront South neighborhood of Camden, NJ have never been able to safely open their windows; the air is too filled with pollutants and debris, sometimes making it hard to breathe or be outside for extended lengths of time. Despite neighboring tourist areas and business centers in the

surrounding cities such as Philadelphia, Waterfront South residents have the highest risk for asthma, COPD (Chronic Obstructive Pulmonary Disease), and certain cancers due to the pollution in the air. The neighborhood is also home to an illegal dumpsite, owned by developers and construction companies. Most of the residents (94% of them) of Waterfront South are nonwhite and low income. As a result of trash-to-steam plants and other polluting bodies, the residents of Waterfront South were also at increased risk for Covid-19 than the rest of Camden.

News Report (video): https://6abc.com/environment-inequity-race-racial-disparities/11152688/

STEP 2. List **resources** (websites, articles, books, etc.) that help you (i.e., the teacher) better understand the anchoring phenomenon:

1. AIR QUALITY/C-R BOX RESOURCES:

a. **Corsi's video for UC Davis on how to construct a C-R Box:** Corsi DIY Video

b. **Article on the efficacy of the Corsi-Rosenthal box:** https://www.tandfonline.com/doi/full/10.1080/02786826.2022.2054674

c. **Activities found on the topic of air quality (from this unit https://learn.concord.org/resources/626/will-the-air-be-clean-enough-to-breathe) :** https://activity-player.concord.org/?runKey=ad1fe27d-d6b8-4a08-b092-26d985ba1b75&sequence=https%3A%2F%2Fauthoring.concord.org%2Fapi%2Fv1%2Fsequences%2F389.json&sequenceActivity=0

d. **Human health:** https://www.youtube.com/watch?v=d9Ojbx3WgBM

2. AIR POLLUTION RESOURCES:

a. **Air Pollution for Kids**: https://www.youtube.com/watch?v=Yjtgu2CxtEk

b. **Task 1 Introduction Video**: https://www.youtube.com/watch?v=e6rglsLy1Ys

c. **Hazardous Air Pollutants**: https://www.epa.gov/air-quality-management-process/managing-air-quality-air-pollutant-types

Urban Air Toxic Pollutants: https://www.epa.gov/urban-air-toxics/about-urban-air-toxics

3. AIR FILTERING RESOURCES:

a. MERV Rating: https://www.youtube.com/watch?v=lT7oi-Yx0fg

b. Filters: https://www.youtube.com/watch?v=WhiTlkZlwl4

4. JUSTICE-CENTERED RESOURCES:

a. **Waterfront South's differing air quality from surrounding towns (Phenomenon):** https://6abc.com/environment-inequity-race-racial-disparities/11152688/

b. **Health disparities:** https://www.lung.org/clean-air/outdoors/who-is-at-risk/disparities

c. **Effects of Covid-19 based on race:** https://www.mayoclinic.org/diseases-conditions/coronavirus/expert-answers/coronavirus-infection-by-race/faq-20488802

d. **"Black communities are sacrifice-zones":** https://diversegreen.org/air-pollution-black-communities-are-sacrifice-zones-shaila-vester-skinner/#:~:text=There%20is%20a%20high%20volume,poses%20an%20even%20greater%20threat.

e. **Exclusionary zoning practices (and embedded links)**: https://www.whitehouse.gov/cea/written-materials/2021/06/17/exclusionary-zoning-its-effect-on-racial-discrimination-in-the-housing-market/
   i. https://tcf.org/content/facts/understanding-exclusionary-zoning-impact-concentrated-poverty/?agreed=1
   ii. https://law.stanford.edu/wp-content/uploads/2018/03/mangin_25_stan._l._poly_rev_91.pdf

https://tcf.org/content/facts/understanding-exclusionary-zoning-impact-concentrated-poverty/?agreed=1

STEP 3. Identify **technologies** (CS, AI, machine learning, etc.) related to the phenomenon and describe how the technologies listed above are used in solving the environmental problem:

1. **EDUCATION TECHNOLOGIES:**

   a. **Videos:** Task 1 Introduction Video: https://www.youtube.com/watch?v=e6rglsLy1Ys

2. **MATERIAL TECHNOLOGIES:**

   a. **For C-R Box:**
   - 20-in. portable box fan–**Corsi recommends keeping the cardboard from packaging; this will be used to block holes that can cause air leaks**
   - 4 MERV 13 2-in. air filters
   - Duct tape
   - Scissors

   b. **For models:**
   - Large paper pad
   - Markers
   - Pencils/pens
   - Sticky notes
   - Tape

STEP 4. Develop a **driving question** to frame the anchoring phenomenon for the students. State your driving question below.

How do we make clean air accessible?

PART C: Provide a Target Written Explanation. *The target written explanation serves as a resource for identifying which science ideas are important for explaining the phenomenon.*

After identifying the important science ideas, you can consider when and how these ideas are introduced and explored across the unit.

Provide a **target written explanation** of the phenomenon. This should be written at the appropriate grade level. (Note: the explanation should identify how science ideas are coordinated to explain the occurrence or event that happened in the world).

Residents of the Waterfront South neighborhood of Camden, NJ cannot open their windows because the air is filled with pollutants, making it hard or even dangerous to breathe or be outside for long periods of time. The air is polluted because factories–such as cement plants, sewage treatment, and trash incineration plants–that are creating pollution are located in this neighborhood. Because industry is centered in this area, neighboring tourist areas and business centers in the surrounding cities are kept relatively pollution free. Waterfront South residents have the highest risk for asthma, COPD (Chronic Obstructive Pulmonary Disease), and certain cancers due to the pollution in the air. 94% of Waterfront South residents are also nonwhite. This higher rate of respiratory problems also resulted in higher rates of Covid-19 in this neighborhood compared to surrounding areas.

Air pollution is caused by gases and particulates that have been created from human activity, such as burning fossil fuels and garbage, by driving cars, or by industrial plants and manufacturers. Many of these particulates and gases can have short and long term health effects on humans when breathed in, including respiratory infections, heart disease, lung cancers, and increased exposure to–and more serious health problems and hospitalizations from–Covid-19. Health problems for people living in highly polluted areas are amplified as these residents tend to be low income and have poor access to healthcare. In many of these cases, these high pollution zones have a high percentage of non-white residents compared to surrounding areas with cleaner air.

The reason for these discrepancies in location of industrial plants is due to the legacy of people in power, often white leaders, creating exclusionary zoning policies that limited places where people of color were allowed to live or, after exclusionary race-based zoning was made illegal, creating policies or laws that allowed companies to avoid regulations meant to protect against race-based zoning (see Resource 4.e.). Additionally, because of the creation of restrictive land use and building codes, many types of neighborhoods and industries were kept out of what would become high value areas, while also relegating most low income people to high poverty areas.

In order for these differences in air quality to be fixed, there need to be steps taken to protect communities of color from being overly burdened by where laws dictating where industrial zones can be built, while exclusionary zoning practices need to be interrogated to further consider how they perpetuate inequality related to where wealth and resources are concentrated. Additionally, access to cleaner energy is needed, and healthcare access needs to be addressed.

PART D: Identify Science Ideas. *(REVISIT AND FINALIZE PART A: UNPACK THE STANDARDS).*

Using the target explanation above, identify the science ideas that are essential for explaining the phenomenon. After identifying the science ideas, identify at least one science task for each science idea as a resource that can be used during Stage #3.

STEP 1. **Identify the science ideas** within the explanation that are central to students explaining the phenomenon.

Science Idea 1: Air Pollution & Air Quality
Science Idea 2: Air Filtration
Science Idea 3: Human Health

STEP 2. For each science idea identified above, **choose one task, reading, video, simulation, or investigation that will help students understand this important idea**

and begin to see its usefulness in explaining the anchoring phenomenon. Do this for each science idea below.

Science Idea 1–Air Pollution & Air Quality: Investigation into what air pollutants are, and video explaining phenomenon.
Science Idea 2–Air Filtration: Construction of a Corsi-Rosenthal box and accompanying questions about how its construction and design related to air pollution.
Science Idea 3–Human Health: Justice 12 graph and discussion of air pollution impact on health.

***(If Applicable)* PART E: Identify Social Justice and Equity Ideas**. *Identify the social justice ideas that are either central to supporting student engagement and connection to science (i.e., identity, diversity) you want to focus on during the unit or essential for explaining and taking action to resolve social injustices related to the phenomenon. After identifying the social justice ideas, identify at least one instructional strategy or task that will help you realize each social justice idea as a resource that can be used during Stage #3.*

STEP 1. Identify the social justice ideas that are central to supporting student engagement and connection to science (i.e., identity, diversity) or essential for explaining and/or taking action to resolving social injustices related to the phenomenon.

Justice 12–JU.3-5.12: I know when people are treated unfairly, and I can give examples of prejudice words, pictures and rules.
Justice 14–JU.3-5.14: I know that life is easier for some people and harder for others based on who they are and where they were born.

STEP 2. For each social justice idea identified above, **choose one instructional strategy, task, reading, video, simulation, or investigation that will help students understand this important idea and begin to see its importance in supporting their connection with science (i.e., identity, diversity) or for explaining and taking action to resolve social injustices related to the phenomenon.** Do this for each social justice idea below.

Justice 12–JU.3-5.12: Picture of graph from 2019 EPA Toxics Assessment of Philadelphia-Camden-Wilmington Area
- Questions about inequity will accompany this activity

Justice 14–JU.3-5.14: ABC News Video of Phenomenon: https://6abc.com/environment-inequity-race-racial-disparities/11152688/

STAGE 2: NEGOTIATING IDEAS AND EVIDENCE THROUGH TASKS

The goal of the second stage is to support on-going changes in students' thinking by providing learning experiences that help coordinate their own ideas with powerful ideas in science to build a scientific explanation of the anchoring phenomenon. This involves designing or adapting a number of purposeful tasks, coordinated with the important science ideas identified earlier, and the construction and use of public records such as a Summary Table to help keep track of ideas over time. Important in this stage is the revision and testing of the

students' models. This stage makes up the majority of the unit as the class works to develop their explanations of the phenomenon through engagement in the practices of science.

PART A: Develop Unit Task Outline. *Provide the outline of each purposeful task that includes the introduction or highlighting of science ideas to reason with, the task launch, the procedures for the main task, and how the summary table will be updated. Each task may take one or more days. For each task, identify target Disciplinary Core Ideas (DCIs), Science and Engineering Practices (SEPs), and Crosscutting Concepts (CCCs) that will guide student sensemaking in that task. Also include an outside of how you will facilitate the mid-unit model revision.*

Purposeful Task	Outline*

Task #**1**:
Introduction to Air Pollution and Air Quality
Day **1**
 	
DCI:
3-5-LS4.D: Biodiversity and Humans
3-5-ESS3.A: Natural Resources
SEP:
- Asking Questions and Defining Problems
CCC:
Cause and Effect
	Agenda:
	Introductory questions:
	- *When you think of air pollution, what comes to mind? (This could be a source, a process, or an effect)*
	  - If students struggle to respond, use eliciting questions such as:
	  - *Can you think of a time in your life when you noticed air felt or smelled or even tasted different?*
	  - *Has anything ever made it hard or unpleasant for you or someone you know to breathe?*
	  - *How does clean air feel to you?*
	- *How have you heard air pollution talked about by the people in your life or in the media?*
	- *Why do you think that people talk so much about the air and air pollution?*
	
	Air pollution:
	- Students will create an initial hypothesis answering the driving question: **How do we make clean air accessible?**
	-
	- Questions to help their thinking:
	  - *How do you think we clean the air?*
	  - *Has anyone ever seen something that is used to clean the air?*
	  - *How would you clean the air? What would you do or use?*
	Backpocket questions:
	- On accessibility**:**
	  - *What do we mean when we say accessibility?*
	  - *Has anyone heard the word accessibility before?*
	  - *What does accessibility mean to you?*
	- *How does accessibility apply to air quality?*
	
	Main task (include backpocket questions):
	Class discussion:
	- **Justice 14**: Watch Camden Air Pollution news report: https://6abc.com/environment-inequity-race-racial-disparities/11152688/
	
	Video: https://www.youtube.com/watch?v=e6rglsLy1Ys

	- *What is air pollution?* - *What are the causes of air pollution?* - *How does air pollution affect the environment?* - *What is the effect that air pollution has on human health?* Accompanying organizer to give students a key for finding information and making sense of the purpose of the C-R box Backpocket questions: - *What does it mean for air to be polluted?* - *How does air become polluted?* - *Can you think of something that explains why tiny particles in the air have such a large impact?* Looking ahead: - Students can be informed that the following class will be a workshop in building an air filtering device where they will learn how they can apply what was discussed this first day Adding to the summary table (see example Summary Table below in Part B): - Direct students to appropriate column and activity. - Students will come to consensus on how the task demonstrates the phenomenon. - Students will come to consensus on why this task is important for understanding the phenomenon.

Task #**2**:
Introducing the Corsi-Rosenthal Box (C-R Box)
Day **2**
 	
DCI:
3-5-ESS3.C: Human Impacts on Earth Systems
3-5-PS1.A: Structure and Properties of Matter
 	
SEP:
- Constructing Explanations and Designing Solutions
 	
CCC:
Systems and System Models
Structure and Function
	Agenda:
	- Air pollution discussion
	- Assembling the C-R Box
	- Discuss how students think this device works to clean the air
	- Creating a model
	
	Main task (include backpocket questions):
	Discussion and warmup of how students think air pollution can be lessened/fixed/solved:
	- Should bring students to the engineering of how to take pollutants out of the air
	- Questions to aid their thinking and to get them to the idea of masks:
	  - *Can you remember some of the things we are told to do with Covid-19?*
	  - *What is something people say to do when you are feeling sick?*
	
	- Once students have grasped the idea of masks:
	  - *Why do you think we wear masks?*
	  - *How do masks affect the air we breathe in?*
	  *This should bring students to the idea of masks as filtering devices. Students should understand that a mask is a type of barrier, and barriers are capable of blocking certain particles of air from getting through
	
	C-R Box assembly according to video: Corsi DIY Video

	Questions to aid student comprehension and deep sense-making:
	- While assembling the filter pads in a specific direction to make sure air particles are trapped on inside of box:
	  - *Why do you think it is important for the filters to face inwards before we attach the fan?*
	  - *What do you think would happen if the filters were facing the other way?*
	- While taping the pads together and checking for any gaps:
	  - *Why do we need to make sure that the corners of these filters are sealed and there are no gaps or see-through areas?*
	  - *What could happen if there were gaps between the filters?*
	- While attaching the box fan:
	  - *Now we have to make sure the fan is facing a certain way, just like with the filter pads. Can anyone think of why this could be?* (Depending of the direction of the fan blades, air can either be drawn in via a drop in air pressure or pushed out)
	  - *Why do you think the fan blades are angled?*
	  If students struggle to understand, a test could be to hold a piece of paper toward the fan to see if it either is blown away or pulled near the fan.
	- Once the box fan is mounted onto the filter pad base:
	  - *Now that we have the box fan attached, can anyone think of anything we should check before we turn the box on?* (They need to seal the edges with cardboard and duct tape to make sure air can't leak out, since the box fan has curved corners instead of straight corners like the filters do)
	  - *How should we plug these holes so that it prevents particles in the air from leaking out, but also doesn't interfere with the fan's ability to work?* (This could be a good opportunity to test to see if they can come up with this engineering solution themselves)
	
	Adding to the summary table (see example Summary Table below in Part B):
	- Direct students to appropriate column and activity.
	- Students will come to consensus on how the task demonstrates the phenomenon.
	- Students will come to consensus on why this task is important for understanding the phenomenon.

Task #**3**: **Justice and Writing Wrap-Up** Day **3 (&4)** DCI: **3-5-ETS1.A:** Defining and Delimiting an Engineering	Agenda: - Reintroduce students to initial hypothesis - **Justice 12**: show students below picture and answer justice-centered questions (larger picture on last page):

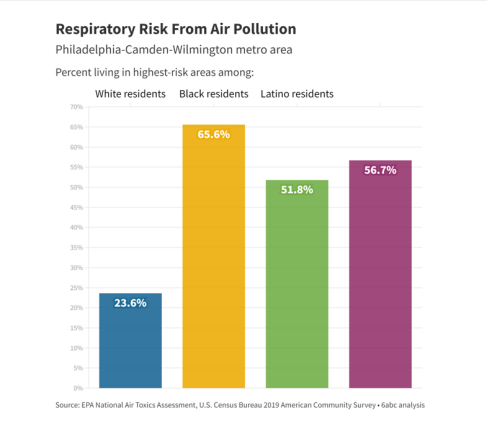
Problem

SEP:

- Engaging in Argument from Evidence
- Analyzing and Interpreting Data

CCC:

Patterns



***Fourth column represents *all* people of color

- Build consensus
- Complete summary table
- Create evidence-based explanation

Handout for students who may struggle to read graphs. This is intended to be practice and application, and can be easily modified for different levels of competency to match where students are in their understanding of graphs and physical representations of data.

Main tasks (include backpocket questions):

Reintroduce students to initial model:

- Questions:
  - *With what you know now, what would you change about your model?*
  - *What do you think your model demonstrated well that you would like to keep?*

Justice 12:

- Show students the EPA's infographic for the phenomenon's location, checking student understanding of the graph components (what does each bar represent?, which group(s) is/are most affected?, which group(s) is/are least affected?, what is the graph measuring?)
- Questions:
  - *What does this graph tell us and how?*
  - *What do you think about these differences?*
  - *What do you think not being able to stay outside for long periods of time, or open your windows, does to a person or community?*
  - *With what we know about air pollution, and from looking at this graph, how might you use one of these C-R boxes, or something similar?*

Build consensus:

- In class, students discuss what they have learned about the phenomenon and technology.
- Facilitate students to construct a "gotta have" list. These are consensus ideas about what must be included in their final evidence-based explanation. Draw on what students discussed when talking about what they would change about their models.

	Adding to the summary table (see example Summary Table below in Part B):
	- Direct students to appropriate column and activity.
	- Students will come to consensus on how the task demonstrates the phenomenon.
	- Students will come to consensus on why this task is important for understanding the phenomenon.
	
	Construct the explanation/analysis and propose suggestions:
	Lead discussion on how concepts learned about the Corsi-Rosenthal box can be used to help communities more gravely impacted by air pollution from industry.
	- Guiding question for instructor:
	  - *How can what we learned in building the C-R box demonstrate how communities are affected by large amounts of air pollution?*
	- Backpocket questions:
	  - *Think back to the video we watched; what were some of the main sources of air pollution?*
	  -
	Evidence-based Explanation:
	- Students will craft a written, evidence-based explanation answering the question: **How do we make clean air accessible?**
	- Students will be given sentence stems to help guide their thinking and to make sure they are using evidence if needed.
	  ○ For example: "Clean air can be made accessible by ____, which we learned by doing ____ which showed _____".
	- Students have the remainder of class period to write their explanations. Otherwise, the teacher can instruct that it be finished for homework.

Task (**Optional**)
Evidence-Based Explanation Workshop
 	
DCI:
3-5-ESS3.C: Human Impacts on Earth Systems
SEP:
Constructing Explanations and Designing Solutions
CCC:
Patterns
	Option One: Writing Analysis
	
	Launch task:
	This can be used to help students in learning to construct explanations, if they are not currently familiar with how to do so, by introducing them to an authentic example of an evidence-based explanation.
	
	Introduction or highlighting of science idea to reason with:
	- Students will be presented with an evidence-based explanation
	- Students can be prompted to take turns reading the passage about the presented scientific explanation
	
	Provide instructions to complete the task:
	- Students will read through the passage
	- Students will partner with a classmate and work to highlight (students could use three different colors, or use an organizer):
	  - Claim–*what is the author trying to say?*
	  - Evidence–*what evidence does the author present?*
	  - Reasoning–*how does this evidence support the author's message?*
	
	Resources:

	- Case Study
	- Evidence-based Explanation Passage
	
	Main task (include backpocket questions):
	Once students have looked through the passage with their partner(s):
	- Begin with question: *What did you learn in this passage? What did you take away from it?*
	- Class discussion–come to a consensus and record on a Docs or other projected document
	  - *What do we feel the author is trying to tell us in their writing?*
	  - *What evidence do they make sure to highlight?* Or *What evidence stood out to you?*
	  - *Do you think this evidence supports/confirms what the author is saying?*
	- Backpocket questions:
	  -
	
	Option Two: Writing Synthesis
	
	Launch task:
	This can be used to help students in learning to construct explanations by introducing a short, easily understood phenomenon related to this learning segment for students to experiment in their writing with.
	
	Introduction or highlighting of science idea to reason with:
	-
	Provide instructions to complete the task:
	-
	
	Main task (include backpocket questions):

PART B: Draft Summary Table. *Construct a draft Summary Table that includes each task, the intended understandings from the task, and how the task helps develop an explanation for the anchoring phenomenon. We suggest that responses are written as full sentences and no more than two sentences are included in each box. Adapt the table based on the number of tasks in the unit. While the goal is for students to come to consensus statements to be included on the table, having already thought through possible responses will make facilitating the discussion easier.*

Task	What we learned about the science ideas	How it helps us explain the phenomenon
Air Quality & Pollution	Air quality is affected by pollutants in the air such as gases and debris.	These pollutants in the air have an impact on human health that can affect their quality of life.
Air Filtration	Devices can be constructed to filter the air of particles such as pollutants.	Air filtration devices can remove pollutants produced by factories and industrial plants that people would otherwise breathe in.
Human Health	Some people live in areas with a higher concentration of air pollutants.	Areas with highly concentrated air pollution often coincide with vulnerable communities, leading to worse health outcomes for residents of these areas.

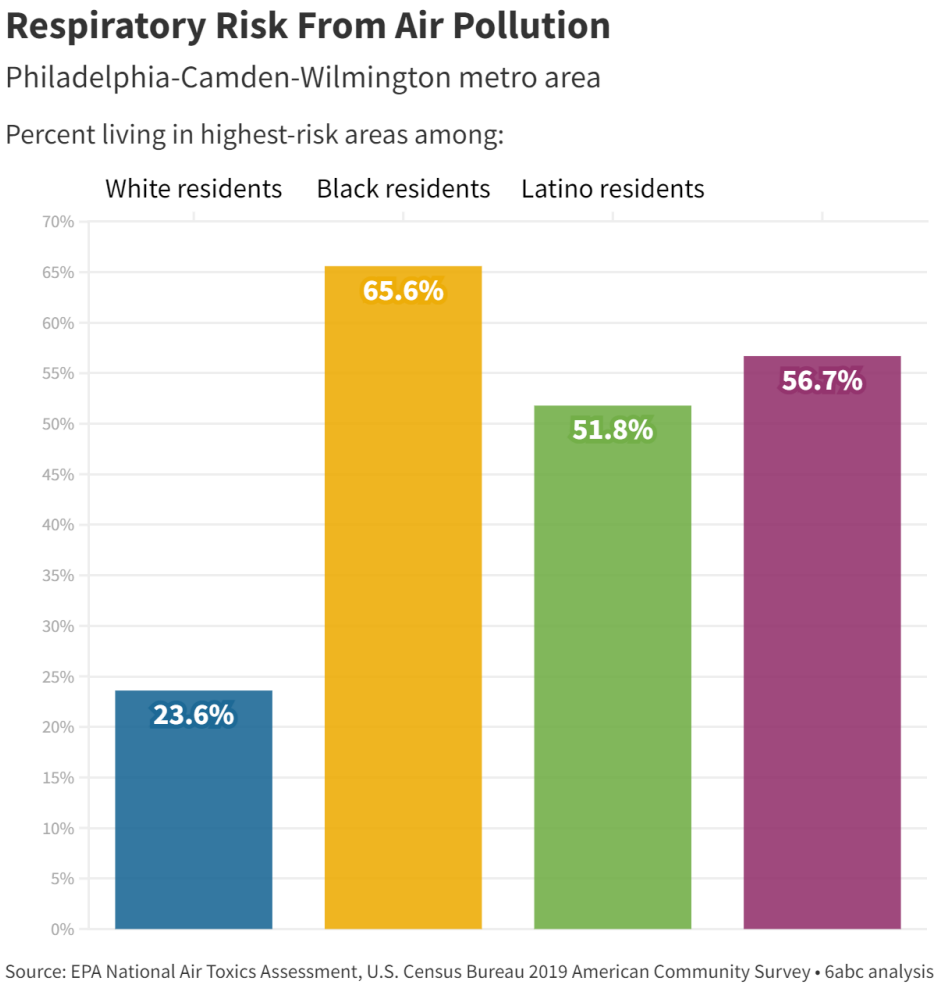


Image source: https://6abc.com/environment-inequity-race-racial-disparities/11152688/

*** The fourth bar in the above graph represents the average percentage of people of color living in highest-risk areas. The website allows the user to hover and see the full description of each bar represented in the graph***