



A PROGRAM OF GEORGIA COMMUTE OPTIONS

Emissions Matter: Let's Talk Carbon Dioxide

Georgia Commute Schools 11th - 12th Lesson Plan

Lesson Background

Grades: 11th-12th

Length of Lesson: Three and a half class periods, each approximately 45 minutes

Materials:

- Chart paper and markers or a digital format for students to make their presentations

Student Handouts:

- Handout 1: Analysis Planning Sheet
- Handout 2: Carbon Dioxide Solutions
- Handout 3: How to Use the Drawdown GA GHG Emissions Tracker

Throughout this document, you will see items highlighted in various colors to indicate alignment to specific standards. Each color corresponds to a different framework component—**Disciplinary Core Ideas (DCIs)**, **Science and Engineering Practices (SEPs)**, **Crosscutting Concepts (CCCs)**, or **Georgia Health Standards**. Highlighted text may appear in directions, prompts, or other instructional text to help quickly identify where these standards connections occur throughout the lesson.



EDUCATION STANDARDS

Anchoring Phenomenon	Transportation, agriculture, and other emissions and carbon reduction.
Georgia Standards of Excellence	<u>SEV2:</u> Obtain, evaluate, and communicate information to construct explanations of stability and change in Earth's ecosystems.
	<u>SEV3:</u> Obtain, evaluate, and communicate information to evaluate types, availability,
	<u>SEV4:</u> Obtain, evaluate, and communicate information to analyze human impact on natural resources.
	<u>SEV5:</u> Obtain, evaluate, and communicate information about the effects of human population growth on global ecosystems.
	<u>SEC4:</u> Obtain, evaluate, and communicate information about biogeochemical cycles and how the flow of energy influences ecosystems.
	<u>SM5:</u> Obtain, evaluate, and communicate information about climate and climate change.
Next Generation Science Standards	<u>Performance Expectation: HS-ESS3-4:</u> Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
	Science and Engineering Practices (SEPs): Constructing Explanations and Designing Solutions Design or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. <u>Appendix F Science and Engineering Practices in the NGSS, page 11</u>
	Disciplinary Core Ideas (DCIs): ESS3.C: Human Impacts on Earth Systems Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. <u>Appendix E - Progressions within the Next Generation Science Standards, page 3</u>
	Crosscutting Concepts (CCCs): Stability and Change Feedback (negative or positive) can stabilize or destabilize a system. <u>Appendix G - Crosscutting Concepts, pages 10 & 17</u>



Reading & Writing Skills	<p>Reading Skills:</p> <ul style="list-style-type: none">➤ Analyze and synthesize quantitative and qualitative data from primary sources.➤ Evaluate arguments and identify reasoning in scientific and policy texts about carbon reduction strategies.➤ Integrate and compare multiple sources (text, video, infographic) to determine which carbon solutions are most effective in specific sectors.➤ Interpret graphical data on emissions and feedback systems to support scientific claims. <p>Writing Skills:</p> <ul style="list-style-type: none">➤ Develop arguments and proposals that evaluate the feasibility of different carbon mitigation strategies.➤ Write structured explanations linking data to scientific reasoning.➤ Produce collaborative written plans outlining technological or behavioral solutions to reduce greenhouse gases.➤ Compose reflective analyses on the social, ethical, and health impacts of carbon decisions, citing data and credible sources.➤ Create multimodal products (slides, infographics, short videos) communicating solutions to a public audience.
Health and Physical Education Standards	<p>HEHS.5.b: Develop and apply a decision-making process to a health-related situation.</p> <p>HEHS.5.d: Describe evidence-based choices to health-related issues or problems.</p> <p>HEHS.5.f: Explain how decisions can negatively and positively impact personal health and well-being.</p> <p>HEHS.5.g: Compare and contrast the short- and long-term outcomes of health-related decisions.</p>



Big Idea: Solutions to Climate Change

Overview

Students learn how greenhouse gas emissions contribute to climate change. They use information from Drawdown Georgia to identify which economic sectors generate the most emissions (transportation). They then use the Project Drawdown Solutions Library to learn about transportation solutions that have the potential to save money and preempt pollution, as well as the costs and challenges for those solutions. Students construct a plan for using specific transportation solutions to reduce greenhouse gas emissions in Georgia.

Vocabulary

The vocabulary section of a lesson plan provides key terms and definitions that support student comprehension and engagement with the lesson content. Teachers can reference this section to introduce new words during instruction, reinforce understanding through activities, or provide background information to support differentiated learning.

- **Climate Change:** A change in global climate patterns, in particular a change apparent from the mid to late 20th century onwards and attributed largely to the increased levels of atmospheric carbon dioxide produced by the use of fossil fuels.
- **Mitigation:** The action of reducing the severity or seriousness of something.
- **Carbon Sequestration:** A natural or artificial process by which carbon dioxide is removed from the atmosphere and held in liquid or solid form.
- **Carbon Sink:** Something in nature that takes in and stores carbon dioxide from the air, helping to keep Earth's atmosphere balanced. It is a natural system that takes in more carbon dioxide than it releases, helping to reduce the amount of greenhouse gases in the air. Examples include forests, oceans, and soil.
- **Net-zero:** Resulting in neither a surplus nor a deficit of something specified when gains and losses are added together.
- **Carbon Source:** A carbon source is anything that releases more carbon into the atmosphere than it absorbs (e.g., the burning of fossil fuels).
- **Economic Sector:** An economic sector is a segment of the economy where different businesses engage in the same or similar activity. In this lesson, some economic sectors referenced include transportation, industry, agriculture, electric power, land use & forestry, and commercial & residential.

Engage: Climate Change (25 minutes)

1. Display the carbon cycle image (below) to students. Tell students to recall what they know about the carbon cycle. Give them time to share with an elbow partner some of their initial recollections about what they have previously learned about how carbon moves through Earth's spheres and systems using the following prompts:
 - ➔ Which parts of the carbon cycle demonstrate long-term stability in Earth's systems? Consider reservoirs like the ocean or fossil fuels. How do these stable components help regulate atmospheric carbon levels?
 - ➔ What processes in the carbon cycle show rapid or significant change? Identify at least one human activity and one natural process that alter carbon flow. How do these changes impact the balance of the cycle?
- ➔ Ask for 2-3 student volunteers to share what they discussed with their partner.

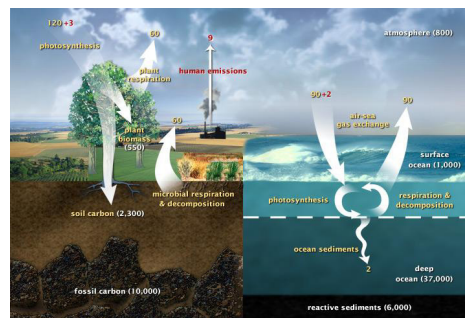


Image from: <https://earthobservatory.nasa.gov/features/CarbonCycle>

2. Show students the following video, "Climate Change in 60 seconds" from the Royal Society. Facilitate a class discussion to probe students' prior ideas about climate change impacts.



Video hyperlink: <https://www.youtube.com/watch?v=n4e5UPu1co0&pp=0gcJCRsBo7VqN5tD>

Video length: 1 minute and 39 seconds



LIVED EXPERIENCES

Connect to students' lived experiences by asking them to refer to social media content related to the topic. Begin the discussion by asking them what content they have seen online about climate. Consider using the following prompts:

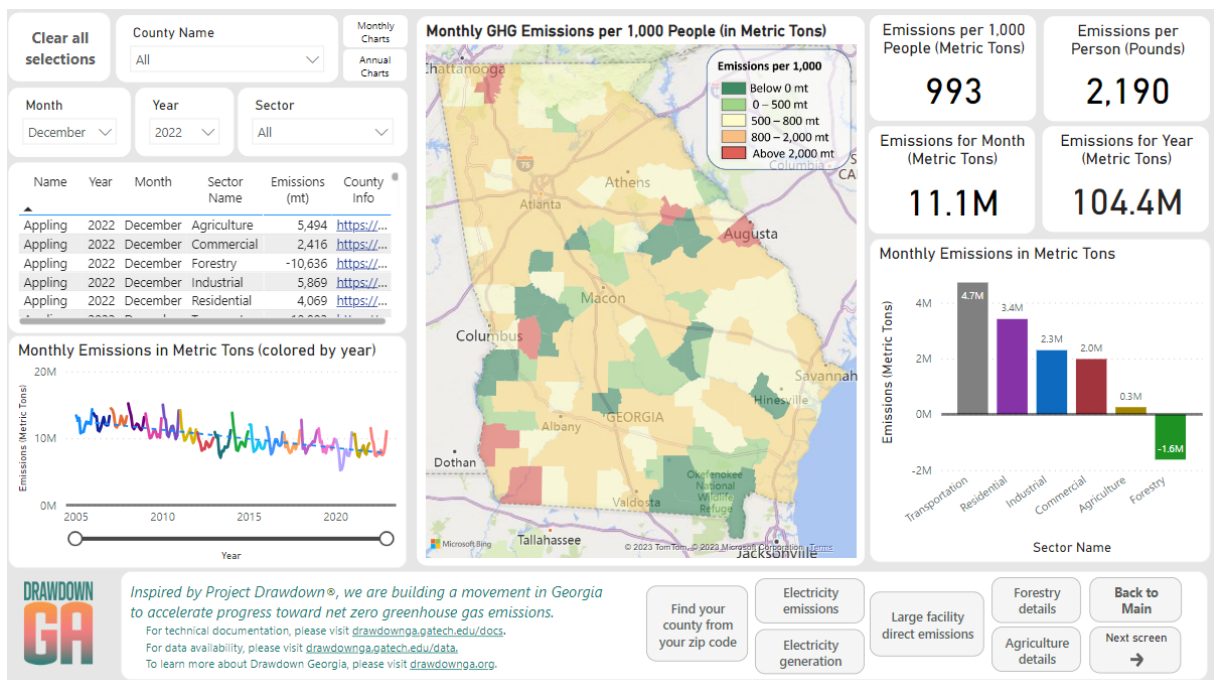
- ▶ Think about a post, video, or meme you've seen online about climate change or the environment. What message was it trying to send—and how do you know if that message was accurate or based on evidence?
- ▶ Have you noticed any trends or challenges on social media related to climate or sustainability (for example, zero-waste challenges, climate protests, or influencer activism)? How do these online trends shape what people believe or do in real life?
- ▶ Different accounts and platforms tell very different stories about climate change—some focus on science, others on politics or personal responsibility. How does where you get your information affect the way you think about climate issues?

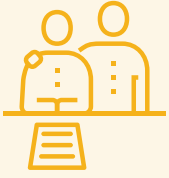
Additionally, students could discuss climate impacts in their local community prior to watching the video, and then be asked to compare local impacts to the global impacts shared in the video. This helps to build their confidence in the subject matter and helps them to understand the connections between local and global issues related to climate dynamics.

3. Introduce the driving question that will be explored in this lesson: How can society lower emissions of greenhouse gases like carbon dioxide?

Explore: Track Greenhouse Gas Emissions in Georgia (30 minutes)

- The Drawdown Georgia GHG Emissions Tracker provides greenhouse gas emissions data at the state- and county-level for Georgia. Emissions are categorized by sector to give us a picture of where emissions are now and how they change as we advance on our goal of drawing down Georgia's carbon emissions. This interactive map was developed by leading researchers at the Georgia Institute of Technology based on publicly available data and is updated monthly.
- Have students open up the GHG Tracker at: <https://www.drawdownga.org/ghg-emissions-tracker>
- Have students use the interaction tracker to:
 - Describe where in Georgia GHG emissions are high.
 - Describe GHG emissions in their county.
 - **Sort by emissions in metric tons, which sector generates the most greenhouse gas emissions?**
 - **Click through the additional pages. What else do you notice? What do you wonder?**





STUDENT SUPPORT

Navigating the Emissions Tracker

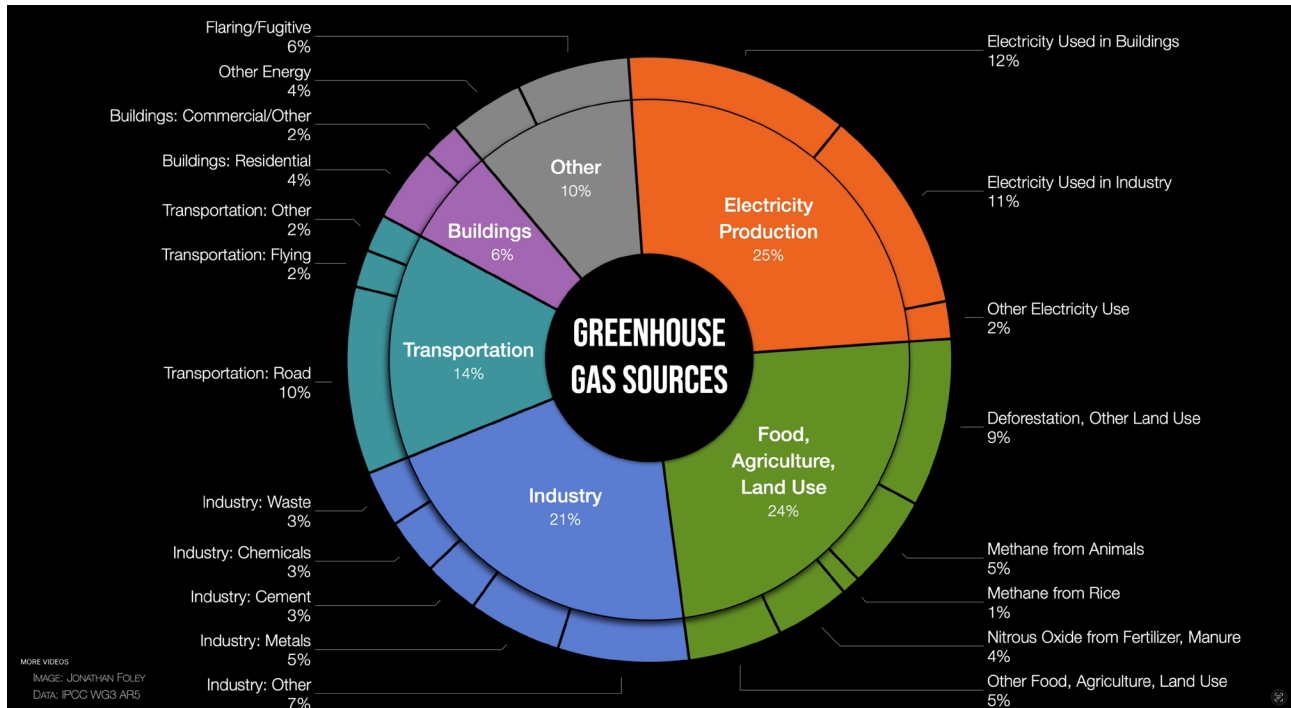
Give clear guidance and directions for navigating the site. You can use the **Student Handout 3: How to Use the Drawdown GA GHG Emissions Tracker** for students who need additional support. You might also consider showing the entire class where to find items as they explore the website. Ask students to follow along and support them in navigating it by answering questions. Alternatively, you can give students time to explore the site on their own by simply clicking buttons before beginning to utilize it for research.

Options for formative assessment might include:

- ➔ Asking students to write down their responses. Collect them to provide feedback or return to students later to update their understanding near the end of the lesson.
- ➔ Give students time to share their responses with an elbow partner. Provide adequate time for comparison and discussion.

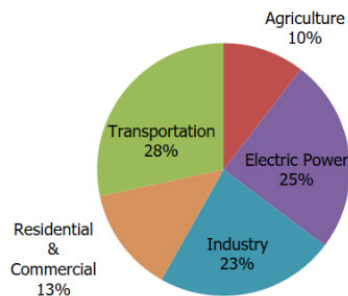
Explain: Global Greenhouse Gas Emissions by Source (40 minutes)

7. Show students Project Drawdown's graphic on Greenhouse Gas Sources. Point out that globally, transportation contributes 14% of all emissions.



Source: <https://drawdown.org/climate-solutions-101/unit-3-reducing-sources>

8. Show students the EPA Total U.S. Greenhouse Gas Emissions by Economic Sector in 2022 graphic from the slides. Point out that, like what they observed in the Drawdown Georgia activity, transportation is the largest generator of greenhouse gas emissions nationally. In the U.S., the transportation sector generates the highest percentage of greenhouse gas emissions (28%).



From: <https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions#transportation>



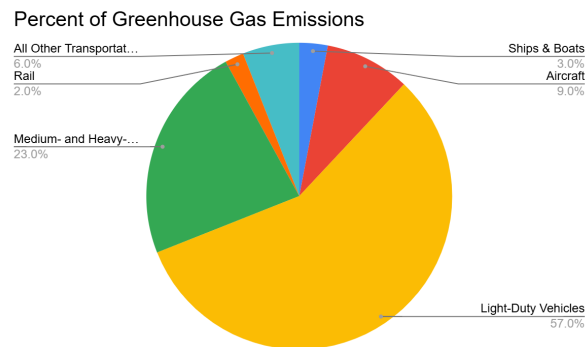
9. Ask students to think about all of the different types of vehicles that contribute to transportation sector emissions in the U.S. Ask for a few volunteers to share their thoughts. Listen for students to share responses like cars, trucks, commercial aircraft, and trains.



HEALTH AND PHYSICAL EDUCATION CONNECTION

To support the development of understanding related to standards HEHS.5.d and HEHS.5.f, consider facilitating conversation among the class related to how transportation choices can negatively and positively impact personal health and well-being. **Ask students to describe what evidence they are familiar with that relates to the connection between health issues and transportation options available among communities.**

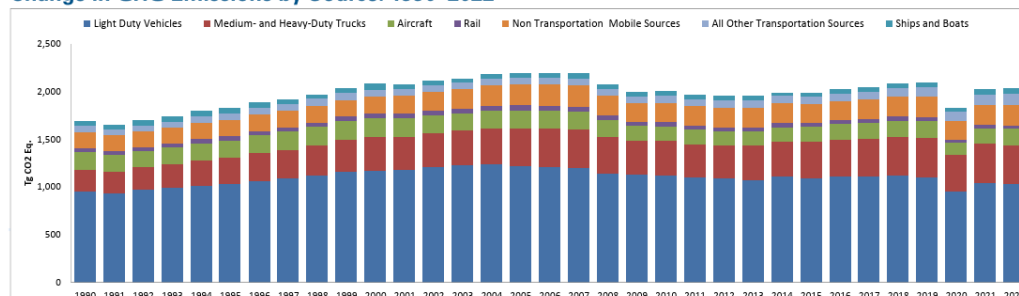
10. Show students the U.S. Transportation by Sector GHG Emission by Source, 2022 graph from the slides. Share that cars, trucks, commercial aircraft, and railroads, among other sources, all contribute to transportation sector emissions. Be sure to point out the definitions of light-, medium-, and heavy-duty vehicles listed on the slide.



From: <https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P101AKR0.pdf>

11. Show students the Change in GHG Emissions by Source: 1990-2022 graph from the slide deck. **Ask students to share what trends they see across the different modes of transportation over time.** Listen for students to share examples like "light duty vehicles have the highest amount of GHG emissions, ship and boat emissions have decreased since the mid-2000s, non-transportation mobile sources still contribute to GHG emissions, air travel has stayed fairly consistent in GHG emissions since 1990."

Change in GHG Emissions by Source: 1990-2022



From: <https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P101AKR0.pdf>



12. Present the following to students: Transportation vehicles (cars, planes, trains, ships, buses, etc.) are accused of being the biggest greenhouse gas polluters. Each type of vehicle will have to defend itself in court.

Choose a type of transportation vehicle. **Prepare an explanation for your case as if you are the vehicle itself or a lawyer defending it.** Decide if your vehicle is:

- ➔ Guilty of being a major emitter
- ➔ Not guilty because there's a bigger culprit
- ➔ Misunderstood because there are reasons behind its emissions

Use evidence from the graphics and your prior knowledge to answer these questions in your argument:

- ➔ How much does your vehicle emit compared to others (grams CO₂ per km per person)?
- ➔ **Why does it emit more or less? What factors like fuel, distance, efficiency, or energy source matter?**
- ➔ **How have the GHG emissions for your vehicle changed over time?**
- ➔ Are there any improvements or alternatives that could reduce its impact?



STUDENT SUPPORT

Use Sentence Starters

For students to get started in developing their case, post the following sentence starters on the board or at the front of the classroom:

- ➔ "A vehicle is responsible for... because..."
- ➔ "The main reason my emissions are high/low is..."
- ➔ "Compared to ____, I..."
- ➔ "If new technology were used, my emissions could be reduced by..."

13. Give students time to present their case to a peer in a short 1-2 minute persuasive statement. Encourage students to critique other presentations and the evidence they offer.



LIVED EXPERIENCES

Not every community has the same choices when it comes to transportation. Some people live in places with buses, trains, or bike paths, while others may only have cars as an option. Cost, safety, and distance also change what's realistic.

Facilitate discussion where students think about:

- ➔ Which transportation options are common where you live?
- ➔ Which ones are harder (or impossible) to use?
- ➔ How does that affect greenhouse gas emissions in your community compared to others?

Elaborate: Uncovering the Parts, Purposes, and Complexities of Reducing Carbon Dioxide in the Atmosphere (35 minutes)

14. **Ask students to think about the challenge of slowing climate change warming by reducing the amount of carbon dioxide in the atmosphere.** How does changing one part of the transportation system affect other parts, such as the economy, public health, or ecosystems? **What actions would we need to take as a society?**
- ➔ Reducing greenhouse gases and sources of carbon dioxide entering the atmosphere
 - ➔ Increasing sinks to remove carbon dioxide from the atmosphere
 - ➔ Improving society through education and health (not shown as part of the diagram)



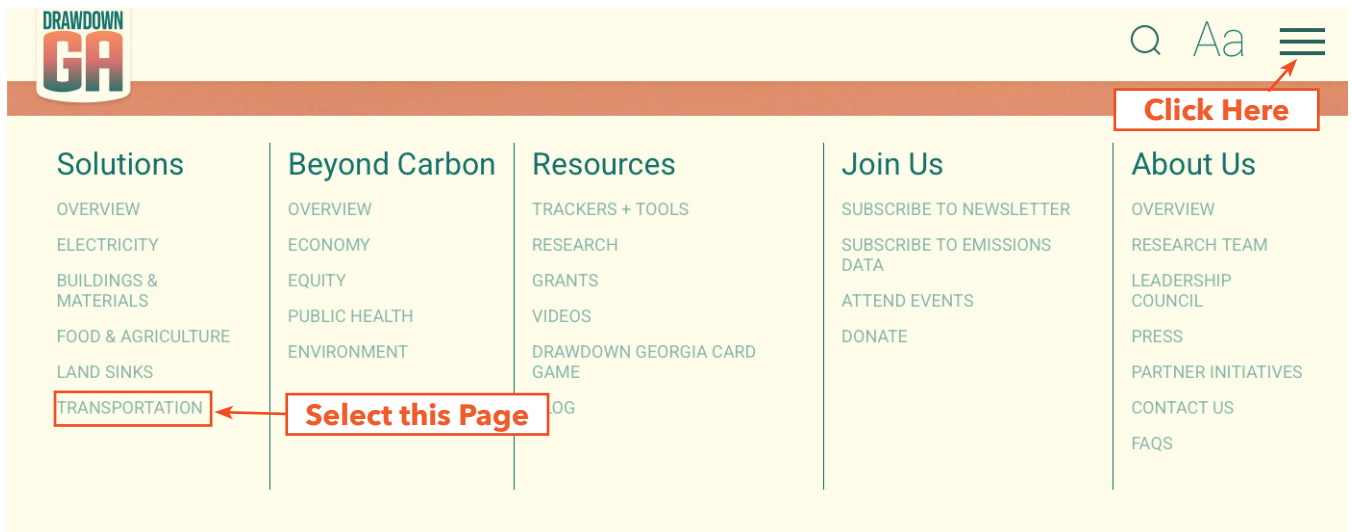
STUDENT SUPPORT

Use Analogies for Student Sensemaking

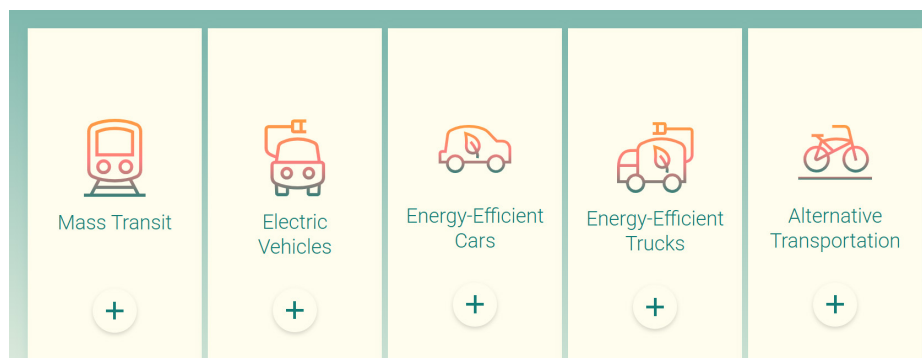
To help students better understand the function and importance of a carbon sink, consider facilitating discussion using the following analogies (or comparisons):

- ➔ A sink is like a carbon dioxide **sponge**. It soaks up extra CO₂ from the air and keeps it stored away in plants, oceans, or soil instead of letting it build up in the atmosphere. This is similar to how a sponge might hold water.
- ➔ Carbon sinks are like a **savings account** for carbon. It stores carbon that has been deposited from the atmosphere, much the same as you put money into a bank account. The only way to keep the carbon stored is to not withdraw it from the account (by cutting down forests or burning fossil fuels).
- ➔ A carbon sink works like an **air filter** for the planet. It traps and holds particles, in this case carbon dioxide, to keep the air cleaner. Just like a filter in your home or your car, if it gets clogged, damaged, or isn't replaced, it can't effectively do its job.

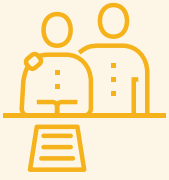
15. Tell students that coming up with solutions to reduce and remove carbon dioxide within each sector is complex, but not impossible. Share this quote from Project Drawdown: "Almost daily, there is promising evolution and acceleration of climate solutions."
16. Create small groups in your classroom, and **assign each group to analyze the specific modes within the transportation sector from the diagram, using information from the Project Drawdown web resources.** Navigation directions are shown below. Be sure to provide these to students so they can see the choices that are available.



Options will include Mass Transit, Electric Vehicles, Energy-Efficient Cars, Energy-Efficient Trucks, and Alternative Transportation (shown below). Students can explore their selected option by clicking the + icon.



17. Give each group copies of the Student Handout 1: Analysis Planning Sheet to use as a place to capture and organize their thinking. Have students use the remainder of the class period to complete their research according to the following criteria:
 - ➔ **Parts:** Define the components of this transportation method. How does it contribute to the problem of climate change? **In what different areas are solutions needed? Provide information to help us really understand this method and how to address it. Include data where possible.**
 - ➔ **Purposes:** **Explain how addressing different parts of this transportation method will help reduce atmospheric carbon dioxide.** What is their role? **Provide 1-2 examples of the type of solutions that are currently being implemented in this, and explain how they will help.**
 - ➔ **Complexities:** What are the challenges with implementing this transportation method in the transportation sector? **What further developments are needed to make reducing atmospheric carbon dioxide successful? What questions do you have?**



STUDENT SUPPORT

Use Sentence Starters

Students should be successful in finding most of the information to complete this part of the assignment from the Project Drawdown website, but encourage them to research further (from reliable sources, such as those listed below) as needed and to spend time learning about any terms or concepts they encounter along the way that are unfamiliar to them. Below is a suggested list of resources to consider sharing with students:

- ➔ GA Estimated Energy CO₂ Emissions: <https://sites.gatech.edu/giscc/energy-co2-emissions/>
- ➔ GA US Energy Information Administration Statistics and Analysis: https://www.eia.gov/state/seds/data.php?incfile=/state/seds/sep_co2/total/co2_tot_GA.html&sid=GA
- ➔ Environmental Protection Division, List of Sources in GA: <https://epd.georgia.gov/list-sources-georgia>
- ➔ Georgia Tech, Climate Solutions: <https://climatesolutions.gatech.edu/transportation>
- ➔ GDOT Carbon Reduction Program: <https://www.dot.ga.gov/GDOT/Pages/CarbonReduction.aspx>

Alternatively, you could suggest that students return to the GHG Tracker at: <https://www.drawdownga.org/ghg-emissions-tracker> and identify the sources of major pollutants in their county. Ask students to explore emissions solutions that relate to post-secondary careers or future initiatives, such as building transit or city planning goals. Ensure that students illustrate emissions reduction using real-life examples that appear in the workforce, particularly in communities in and around Georgia.



Evaluate: Exploring Solutions (30 minutes)

18. Direct students to Student Handout 2: Carbon Dioxide Solutions. Transportation is Georgia's largest source of greenhouse gas (GHG) emissions.
19. Divide students into two groups to develop a potential solution to mitigate GHG emissions. One group will identify ways to remove emissions via artificial or natural sinks. The other group will focus on transportation solutions to reduce GHG emissions. Their plan should include the following information:
 - ➔ What are some of the main sources of carbon emissions?
 - ➔ What are the natural sinks of carbon emissions?
 - ➔ What evidence shows that simply stopping carbon emissions will not stabilize Earth's climate system? Why is removing carbon necessary to reduce long-term impacts?
 - ➔ Explain your group's proposed carbon reduction solution.
 - ➔ **Describe the ways in which your proposed solution may positively impact human health outcomes.**
 - ➔ **What are some pros and cons of your proposed solution (cost, social implications, etc.)?**
20. Students should produce a physical poster or work digitally on slides or another format to create a visual to share with their peers. Format suggestions for presentations include creating a video for the school YouTube channel or an Instagram reel. They should organize the notes and ideas from their analysis as a visual presentation. Have students spend the remainder of the class period developing their parts-purposes-complexities analysis and creating their visual aid.



HEALTH AND PHYSICAL EDUCATION CONNECTION

To support student sensemaking, consider giving them time to make direct connections between their evidence and the potential short- and long-term health-related outcomes that might be impacted by the transportation sector by using the following discussion topics & prompts:

Air Quality & Breathing

- ➔ How might emissions from cars, trucks, or planes affect the air people breathe in cities and neighborhoods near highways or airports?
- ➔ Note: Atlanta is one of the busiest airports in the world. Consider introducing students to studies that discuss air quality and/or health risks, such as <https://pubmed.ncbi.nlm.nih.gov/34931821/>

Noise & Stress

- ➔ What health effects (like sleep, stress, or focus in school) might come from living near busy roads, train tracks, or airports?

Activity & Movement

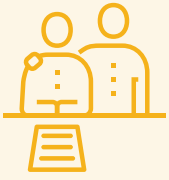
- ➔ How do transportation choices like walking, biking, or using public transit support healthier lifestyles compared to driving everywhere?

Community Differences

- ➔ How might health outcomes be different for people in rural vs. urban communities, depending on which transportation options they have the most access to?

Sharing Plans

21. Have students present their plans to the class. Allow time for rich conversations and exchange of ideas between groups. Hopefully, students will be interested in comparing their own plan to those of their peers.
 - ➔ If students have made posters to communicate their plans, consider holding a gallery walk and encouraging 1-2 group members to remain at their group's poster to answer any questions their classmates might have about their plan. Group members could take turns staying to answer questions and visiting other groups' posters throughout the classroom.
 - ➔ Alternatively, each group could present their plan to the entire class one at a time with presentation slides that share their visuals. Encourage questions and answers following each presentation.



STUDENT SUPPORT

Share Discussion Prompts in Advance

As students share out, provide students with the following considerations to think about. Encourage students to take notes about presentations if needed to be able to participate in class discussion.

- ➔ Common threads: What ideas showed up in more than one group's plan?
- ➔ New sparks: Did you see or hear something during the gallery walk that gave you a new idea?
- ➔ Lingering questions: What do you still wonder about transportation, emissions, or climate change?
- ➔ Looking ahead: Climate change is a big challenge, but there are many possible solutions. What makes you feel uncertain about the future? What makes you feel hopeful about the opportunities we have to make a difference?

22. Hold a wrap-up discussion, asking students to call out commonalities between plans and any new ideas that came up during the gallery walk. Ask students to share any questions they still have, and to consider the uncertainties and the opportunities around climate change solutions and the impacts of climate on human health.

Optional Assessment Questions

The optional assessment questions section offers suggested prompts that can be used to check for understanding, guide student reflection, or spark class discussion. Teachers may choose to use these questions during whole-group conversations, small-group work, or as formative checks throughout the lesson.

Assessment Questions

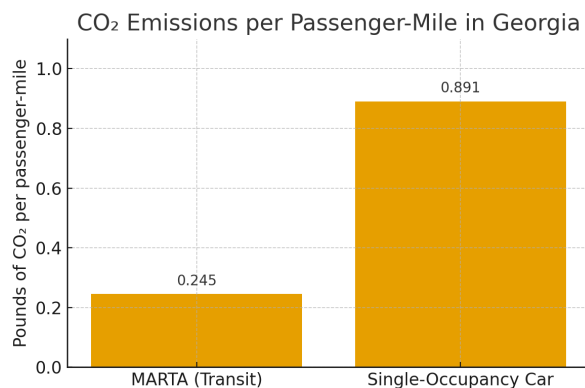
- Q** What are some of the main sources of carbon emissions?
- A** *Answers: burning fossil fuels (vehicles, electricity production, etc.), bodies of water, decomposition, agriculture, respiration.*
- Q** What are the natural sinks of carbon emissions?
- A** *Answers: Plants, bodies of water, soil.*
- Q** Why is it not enough to stop adding carbon to the atmosphere – why are negative emissions needed?
- A** *Answer: Because we are already experiencing climate warming due to increasing the amount of carbon dioxide in the atmosphere, it is not enough to stop adding carbon. We must also remove the excess carbon dioxide from the atmosphere to slow down climate warming.*



Explain your group's proposed carbon reduction solution.

A Possible Answer: I think mass transit is one of the smartest solutions for cutting greenhouse gas emissions in Georgia. Right now, most people drive cars everywhere, but if more of us used buses, trains, or streetcars, the amount of carbon released would go way down. According to Drawdown Georgia, if we planned communities so that about 320,000 more households were built near transit stops, the state could cut up to 1 megaton of CO₂ emissions by 2030. That's a big deal because a bus or train uses way less energy per person than one person driving alone in a car. For example, MARTA only gives off about 0.245 pounds of CO₂ per passenger-mile, while a single person in a car puts out almost 0.9 pounds.

This change doesn't just help the planet—it helps people's health too. With fewer cars on the road, there would be less air pollution, which means fewer cases of asthma and breathing problems, especially for people who live near highways. Riding transit also makes people walk more, which helps with fitness and heart health. And honestly, sitting in traffic is stressful, so having more reliable transit could improve mental health too.



Health Benefits of Expanding Mass Transit



Cleaner Air



More Physical Activity



Less Stress

Describe the ways in which your proposed solution may positively impact human health outcomes.

A Possible Answers: Cleaner air, more walking, and less time in traffic all add up to healthier lungs, bodies, and minds—especially for communities that live near busy roads.

Q What are some pros and cons of your proposed solution (cost, social implications, etc.)?

A Possible Answers: Pros may include low costs, positive externalities (e.g. hybrid cars reducing pollutants in the air, leading to a healthier population), or a sustainable method of production (e.g. using recycled materials to build a net-zero building). Cons may include high costs, negative externalities on third parties (such as indigenous groups), or required infrastructure (e.g. public transit, which only works well in cities).

Potential Local Field Trip Ideas

Volunteer with Trees Atlanta

<https://www.treesatlanta.org/>

Trees Atlanta seeks to increase and maintain Atlanta's tree canopy, an important resource in the fight against air pollution. Trees are also a natural carbon sink for excess carbon dioxide. Trees Atlanta welcomes school groups to assist during planting season (October-March) and maintenance season (April-September).

West Atlanta Watershed Alliance Outdoor Activity Center

<https://wawa-online.org/about/>

The West Atlanta Watershed Alliance Outdoor Activity Center hosts environmental education programming, a nature preserve, and outdoor activity center. Students can learn about the organization's origins as a community environmental justice organization and what they can do to advocate and protect their local environment.

Additional Teacher Resources

Atlanta Regional Commission (ARC) Air Quality Page

<https://atlantaregional.org/natural-resources/air-quality/air-quality/>

This resource is written for adults and provides background information on air quality and air quality standards in Atlanta.

ARC AREES Interactive Map

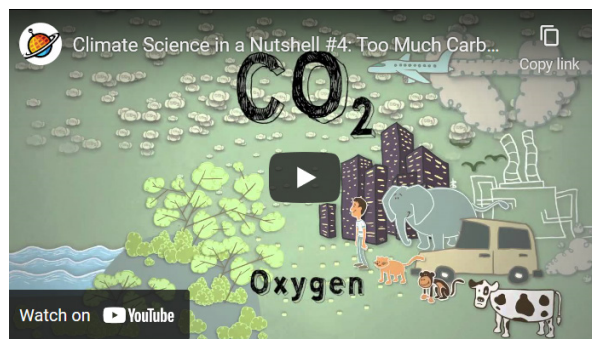
<https://atlregional.github.io/DASH/arees.html>

The Atlanta Regional Commission's Atlanta Roadside Emissions Exposure Study (AREES) has a goal of understanding how local-scale air quality is impacted by changes to the transportation system. This interactive map uses AREES data to spatially depict air quality throughout the 20-county Atlanta region, focusing on particulate matter (one of the six pollutants) concentrations resulting from the transportation system.

Resources on the Carbon Cycle and Climate Change

Use these resources as an introduction if your students need additional context about the carbon cycle. It is helpful for students to understand how carbon dioxide emissions affect climate change. There are many resources available online to give students an overview of the subject.

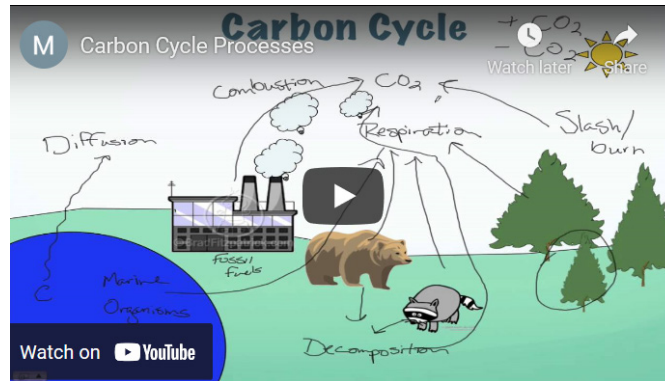
Watch "Climate Science in a Nutshell #4: Too Much Carbon Dioxide":



<https://youtu.be/HK8LLWSIlm4>

Watch "Carbon Cycle Processes." Ask teachers to take notes and write down each of the ways that carbon dioxide is released into and removed from the atmosphere.

<https://youtu.be/Sd8D7WyVS6A>



Visit the following websites:

<https://earthobservatory.nasa.gov/features/CarbonCycle>

<https://scied.ucar.edu/carbon-cycle>

<https://www.climate.gov/news-features/understanding-climate/climate-change-atmospheric-carbon-dioxide>

<https://climate.nasa.gov/news/2915/the-atmosphere-getting-a-handle-on-carbon-dioxide/>

This lesson plan was adapted from a lesson plan from the University Corporation for Atmospheric Research (UCAR) Center for Science Education

<https://scied.ucar.edu/activity/solving-carbon-dioxide-problem>. The UCAR lesson plan provides additional opportunities for students to learn about other sectors' contributions to the problem.

This lesson was designed as a part of K-12 curriculum focusing on the relationship between human activity, transportation, air pollution, and health by Georgia Commute Schools. If you liked the curriculum, please leave a rating and review on our Teachers Pay Teachers page.

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