# How Does a Pandemic Cause Less CO2?



## Welcome to NSTA's Daily Do

Teachers and families across the country are facing a new reality of providing opportunities for students to *do* science through distance and home learning. The **Daily Do** is one of the ways NSTA is supporting teachers and families with this endeavor. Each weekday, NSTA will share a sensemaking task teachers and families can use to engage their students in authentic, relevant science learning. We encourage families to make time for family science learning (science is a social process!) and are dedicated to helping students and their families find balance between learning science and the day-to-day responsibilities they have to stay healthy and safe.
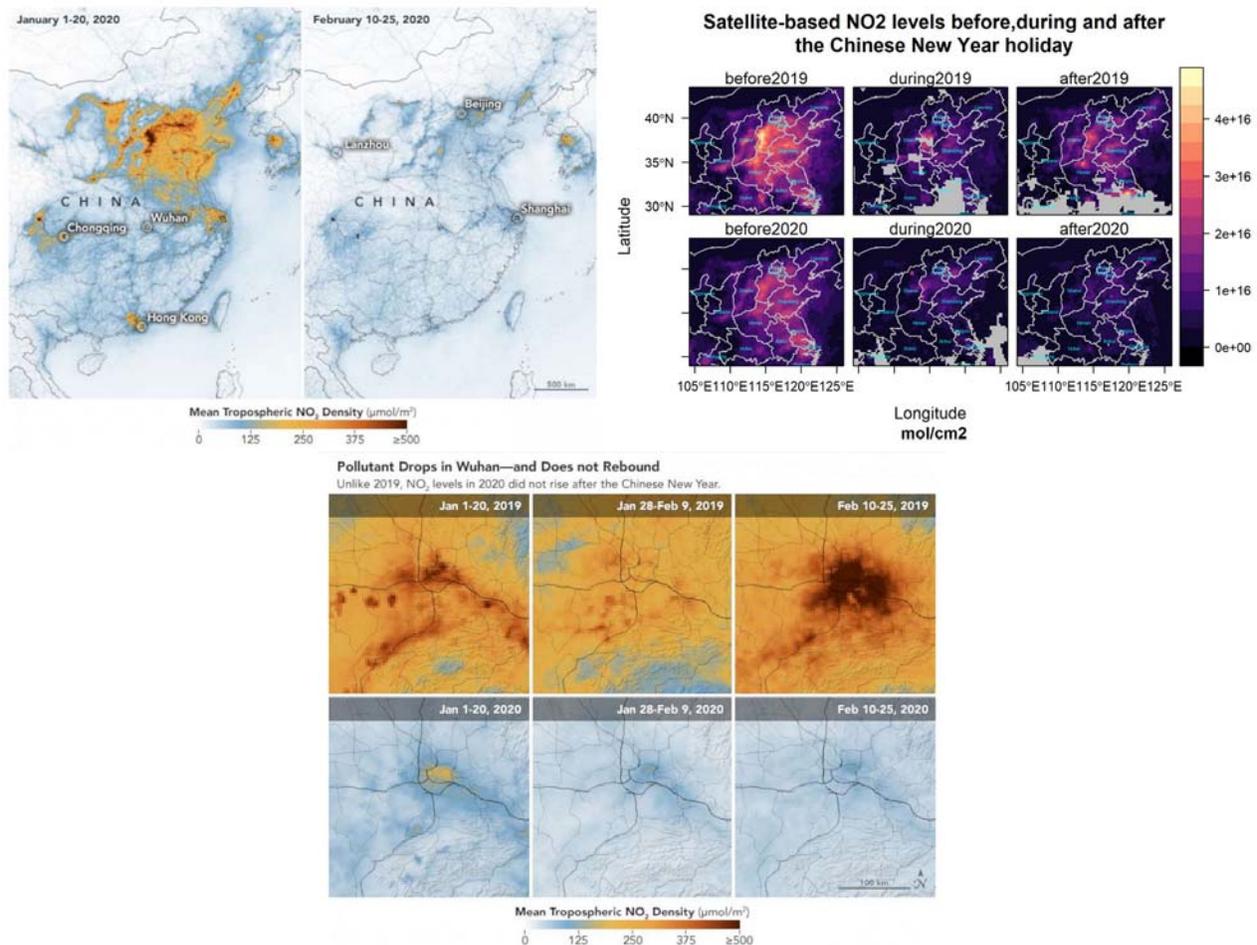
## What is Sensemaking?

Sensemaking is actively trying to figure out how the world works (science) or how to design solutions to problems (engineering). Students *do* science and engineering through the science and engineering practices. Engaging in these practices necessitates students be part of a learning community to be able to share ideas, evaluate competing ideas, give and receive critique, and reach consensus. Whether this community of learners is made up of classmates or family members, students and adults build and refine science and engineering knowledge together.

## Introduction

Closed schools and non-essential businesses and official stay-at-home mandates have kept millions of people at home and across the globe. Will we be able to return to our once-familiar daily routines after the pandemic is over? Will we still want to?

In this task, *How does a pandemic cause less CO2?*, students and their families engage in science and engineering practices to make sense of the phenomenon of concentrations of greenhouse gasses decreasing as the world-wide spread of the coronavirus increases. Students then apply the science ideas they build to design a system or process to decrease their contribution of carbon dioxide to the atmosphere- in other words, reduce their family's carbon footprint. While students could complete this task independently, we encourage students to work virtually with peers or in the home with family members.

This task was inspired by the story, *Satellite images show less pollution over the US as coronavirus shuts down public places,* published by CNN on March 23, 2020.





Satellite-based NO2 levels before, during and after the Chinese New Year holiday



Pollutant Drops in Wuhan—and Does not Rebound
Unlike 2019, NO₂ levels in 2020 did not rise after the Chinese New Year.

## Part 1: Pollution Decreases in China

Share the nitrogen dioxide (NO2) concentration data for greater China and Wuhan, Hubei province, China. Tell students that NO2 is a harmful gas emitted by motor vehicles, power plants and industrial facilities into the atmosphere. These same sources also emit carbon dioxide (CO2).

Ask students, "What patterns do you observe in the data presented in each set of maps?" (NO2 decreased between Jan 2020 and February 2020; NO2 decreases between winter 2019 and winter 2020) Tell students because CO2 emissions are closely related to NO2, we can expect to observe the same patterns (not concentrations) in CO2 data when it becomes available.

Then ask students, "What questions does this raise for you?" Some possible student responses include:

- Why did the numbers go down?
- Why is it in the news?
- Why did the numbers go down more in Wuhan than other cities in China?
- Does this have something to do with the coronavirus?
- Is pollution going down in other places? In the United States?
- Is this because people aren't driving cars?
- Why is NO2 measured?
- Is NO2 going down good for people/the environment?
- What does NO2 do to you/the environment?

Say to students, "We're wondering why NO2 is measured and why it's in the news. Do you think we should investigate this next?"

## Part 2: How does CO2 affect Earth's average temperature?

Say to students, "One reason scientists are excited about the current decrease in NO2 concentrations over China is because it indicates CO2 has also decreased. We're going to shift our focus to CO2 because it is a greenhouse gas while NO2 contributes to the formation of a greenhouse gas (ozone) though a series of reactions at an unknown rate."

Students have probably heard about the greenhouse effect and global climate change but may not be able to explain the difference between them or how they are related.

Ask students to create a model to explain how changing the amount of CO2 in the atmosphere causes Earth's average temperature to change. You may want to provide them with a scaffold.

If students are struggling to begin, ask them, "What absolutely needs to be included in your model? In other words, what are the *components* of the model?" (sun, CO2, air/atmosphere, Earth, CO2 sources). Ask, "How could you show how the components on your model are interacting?" (arrows, lines, labels, text).

Working in pairs or small groups, ask students to compare their models and identify similarities and differences. Allow students to add to/change their models.

Next, ask students to watch the following videos.

- NASA's Earth Minute: Gas Problem (below)
- Greenhouse Gas
- How Carbon Dioxide Warms Planet Earth

Allow students to add to/change their models. Ask student to share why they added to/changed their models with a partner or small group.

Ask students, "Based on your model, what do you predict caused the CO2 (and NO2) to decrease between winter 2019 and winter 2020?"

If students say, "The coronavirus," ask them to say a little bit more about that. (people aren't using their car, factories are shut down, etc.) Students might also say there was less sunlight/more cloud cover during the 2020 winter months.

You might say next, "It seems like we think people sheltering-in-place is causing the decrease in the amount of CO2 (and NO2) being emitted into the atmosphere." (Navigate to the next investigation.)

If students wish to investigate cloud cover, say "We seem to think there was more cloud cover during winter 2020 than winter 2019." (You can find average cloud cover ([Cloud Fraction - 1 Month)](#) on the NASA Earth Observations website.)

## Part 3: How can we measure our carbon footprint?

Students may not be familiar with the idea of a "carbon footprint." Tell them, "A carbon footprint is the amount of greenhouse gases - primarily carbon dioxide - released in the atmosphere by the sum of a person's, family's, community's, or nation's activities."

Tell students they will complete the [Calculate Your Carbon Footprint](#) survey to determine their family's carbon footprint BEFORE the COVID-19 pandemic and AFTER schools and businesses closed. (They will complete the survey twice.) The survey results will give students the total number of pounds of CO2/year emitted to the atmosphere as a result of their family's typical activities (home, travel, eating, and shopping).

NOTE: Students may need to make calls to utility companies or (with the help of adult family members) create online accounts to learn their household's water, electricity and gas usage.

Once students have calculated their carbon footprint pre- and post-pandemic, ask them, "What is the percent change in your carbon footprint from pre-COVID-19 pandemic to post-pandemic?" The percent change will likely be small.

Then ask, "If every household in your community had the same percent change as your family did, what would be the total reduction in CO2 emitted to the atmosphere each year as a result of your community's reduced activities?" (Students will need to look up their community's population).

Next, ask, "If every household in Wuhan, China had the same percent change as your family did, what would be the total reduction in CO2 emitted as a result of the Wuhan, China community's reduced activities?"

Tell students to return to the Wuhan, China NO2 data they observed at the start of the task (Part 1, image at far right). Ask, "Can changes in daily activities explain why the NO2 emissions (remember CO2 is closely linked to NO2) have changed? What is your evidence?"

You might consider asking student to find a partner or join a small group to discuss this questions. The following partner conversational supports can help facilitate the discussion.

Speaker: I think _____ because _____ .

Responder(s): I heard you say _____. I agree/disagree because ___ OR What evidence is that based on?

Ask students to return to their initial models. What would they add to/change to explain how changes in CO2 causes changes in Earth's average temperature. (Look for students to show common activities in both low CO2 and high CO2 but representing fewer people participating in the activities in low CO2 model.)

## Part 4: Engineer a solution to reduce your family's carbon footprint!

Ask, students, "When we go back to our normal daily activities, what might you do to continue to reduce your carbon footprint?"

The Engineering Design Process (EDP) comes in many forms. Engineers enter the EDP to create a new technology - or improve an existing one - to meet a need or want. Engineers on the job may start at any step, depending on the needs of a particular project.

Share the video, A Strict Carbon Diet, with your students to find out how engineer Saul Griffith is helping his family reduce their carbon footprint. Ask students, "As you watch the video, can you identify the steps of the EDP Griffith uses to design a solution to the problem of lowering his family's carbon footprint? What's your evidence?"

Tell students, "Like Griffith, you can use the EDP to reduce your family's or community's carbon footprints!"
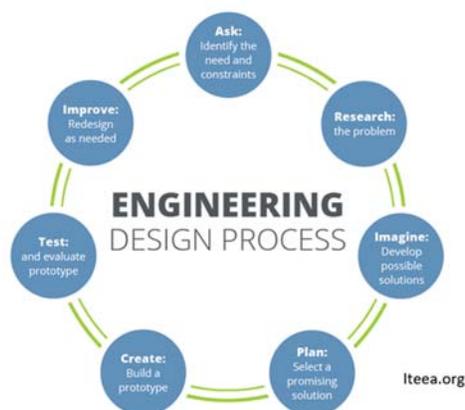
Tell students, "You can really make a difference by getting your friends, teachers, school and district thinking about reducing their carbon footprints! One way is to explore even more changes to make by checking out the Energy Star website.

Students can also track and change their carbon footprint in real-time by trying one of these mobile Apps: *Mobile Carbon Footprinting or Carbon Footprint ACP.*

## Explore STEM Careers: Environmental Engineer

Say to students, "Now that you are engineering ways to help the environment, meet Marielle Thillet and explore her STEM Career as an Environmental Engineer!"

STEM Career Awareness is an important part of educating and preparing our students for the future workforce. Students can explore the challenging and rewarding career in Environmental Engineering by watching and discussing this video.

## NSTA Collection of Resources for Today's Daily Do

NSTA has created a *How does a pandemic cause less CO2*? collection of resources to support teachers and families using this task. If you're an NSTA member, you can add this collection to your library by clicking ADD TO MY LIBRARY located near the top of the page (at right in the blue box).

## Check Out Previous Daily Dos from NSTA

The NSTA Daily Do is an open educational resource (OER) and can be used by educators and families providing students distance and home science learning. Access the entire collection of NSTA Daily Dos.

## Acknowledgements

The information used in this task are part of the story, *Satellite images show less pollution over the US as coronavirus shuts down public places,* published by CNN on March 23, 2020.
Additional images from "Airborne Nitrogen Dioxide Plummets Over China" published by NASA Earth Observatory and "Analysis: Coronavirus temporarily reduced China's CO2 emissions by a quarter" published by Carbon Brief on February 19, 2020.