

NEW YORK STATE Conservationist



**Investigating
Climate Change**

we learn about climate change and its impacts on weather, oceans, natural resources, and human communities worldwide.

The Earth's atmosphere would naturally be about 0.03% carbon dioxide (CO₂). At this level of CO₂, the Earth's temperature would be about 59° F at the surface. Contrast this with the atmosphere of Venus at 96% CO₂ and a toasty 800° F at the surface. Human activity has raised the level of CO₂ in Earth's atmosphere to about 0.04% - enough to raise the Earth's average temperature by almost 2°F.

The diagram illustrates the greenhouse effect on two planets, Venus and Earth, using energy balance and surface temperature data.

A. Venus

- Incoming solar radiation: 645 W/m^2
- Reflected back to space: 515 W/m^2
- 130 W/m^2 absorbed
- Surface temperature: 460°C
- Greenhouse effect: 285°C
- CO₂ concentration: 96%

B. Earth

- Incoming solar radiation: 342 W/m^2
- Reflected back to space: 100 W/m^2
- 242 W/m^2 absorbed
- Surface temperature: 15°C
- Greenhouse effect: 31°C
- CO₂ concentration: 0.4%

$\text{W/m}^2 = \text{Watts/Meter}^2 = \text{solar radiation}$

Mountain Rescue | Maple Sugaring | Buffalo River

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Magical Light

What is climate change?

Climate change (global warming) is the increase in global temperatures caused by the release of excess greenhouse gases, especially carbon dioxide (CO₂), into the atmosphere. Although greenhouse gases help make Earth a good home for humans when they trap heat, there is now more CO₂ in the atmosphere than there has been in the last 800,000 years. More and more heat is getting trapped in our atmosphere, and 2016 was the warmest year since 1880, about 1.7°F higher than the 20th century average.

Nitrous Oxide (N₂O)

comes from the use of nitrogen fertilizers, from burning fossil fuels, and from disposal of wastes.

Fluorinated gases (HFCs, CH₂FCF₃, NF₃, SF₆)

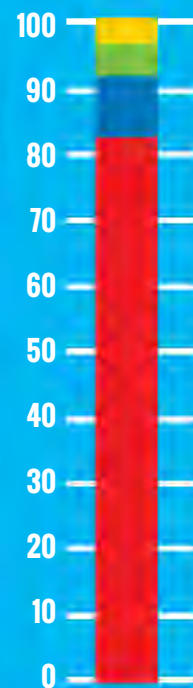
perfluorocarbons (PFCs), nitrogen trifluoride (NF₃), sulfur hexafluoride (SF₆) are man-made industrial gases used in refrigeration, air conditioning and as propellants in aerosols.

Methane (CH₄)

comes from landfills, coal mines, agriculture, and the production of oil and natural gas.

Carbon Dioxide (CO₂)

comes mainly from burning fossil fuels like coal, oil, and gas to make electricity, power cars and trucks, and heat buildings.

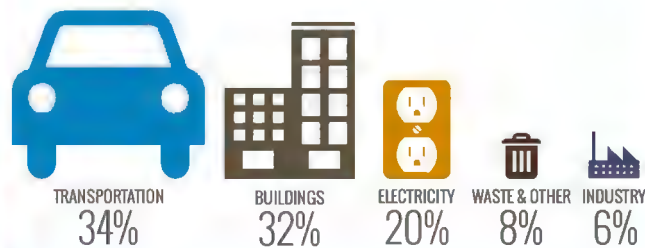


Total Greenhouse Gas Emissions for NYS, 2014 (%)

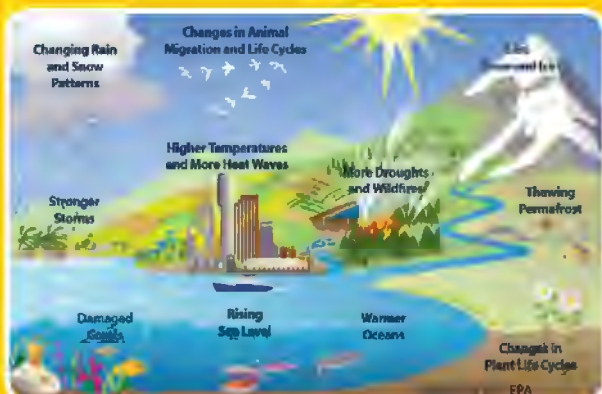
What's the big deal — isn't weather always changing?

Definitely! Look at weather over many years, however, and you will see trends emerge. Those trends are what we call the climate of an area. For example, we say the Arctic has a cold climate (even though some days may be sunny and warm), and the Amazon rainforest has a hot, humid climate (even though some days may be cool and dry). When you average all of the measurements across the globe over many years and observe trends, you are describing the global climate. That's why you can still have really, really cold weather sometimes, even though the Earth as a whole is warming.

Main sources of greenhouse gases in NYS (2014)



Since heat in the atmosphere drives weather and climate, we are already seeing big changes around the globe.



Many changes are happening because of the increase in temperature.

Weather vs. Climate Quiz

People sometimes say, "Climate is what you expect, and weather is what you get." Which of the following are an example of weather and which are an example of climate?

1. I should wear my raincoat because it's raining outside.
2. I wish you could go skiing in the winter around here.
3. Would you believe my hat blew away in the wind!?
4. Why don't I see polar bears when I go hiking?
5. I wish the farm next door could grow oranges and bananas!
6. Let's get ice cream; it's hot today.

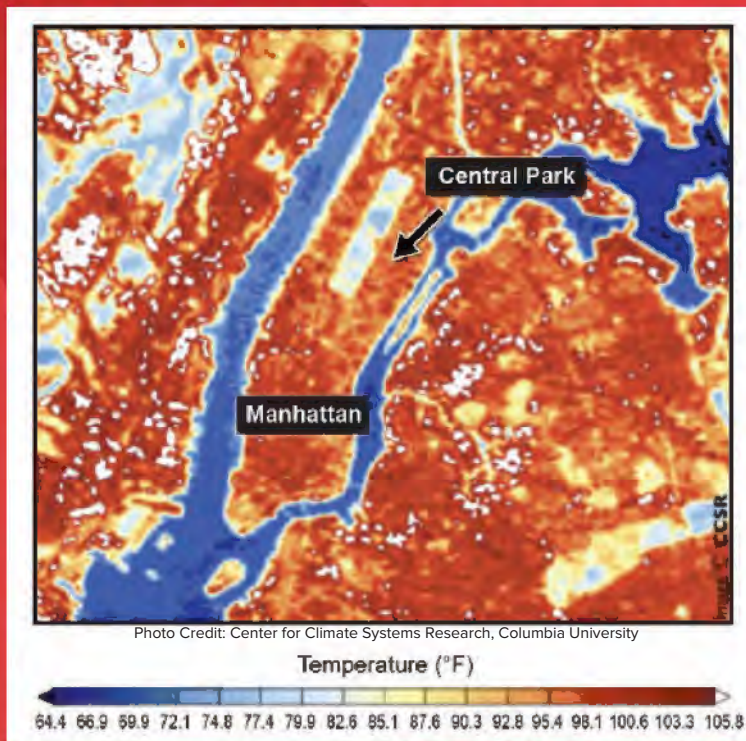
(see answers on page 2)

Impacts of Climate Change

Scientists have been studying climate change for many years, and trying to determine the most likely impacts that it will have on the future. Some of the potential impacts that they are studying include projected sea level rise, changes in precipitation, and changes in temperature.



Urban Heat Island



In urban areas (cities) like New York City (seen here), much of the land is covered by buildings and pavement. These materials absorb the light from the sun, causing their temperatures to raise to levels much higher than trees and grass. This can lead to increased energy usage (such as running air-conditioning) and can be harmful to human health. Planting natural vegetation, using green roofs, or incorporating reflective materials into building projects are all ways of helping reduce the heat island effect.

Sea Level Rise

When water heats up, it expands. As Earth's atmosphere has warmed, so have the oceans. Melting of land-based ice such as glaciers also contributes to sea level rise, and has actually exceeded the expanding of the seas due to warming temperatures. Over the past 100 years, the average sea level around the world rose by about 7 inches. Here in New York, sea level has risen by more than 12 inches in this same period. Why? At the end of the last ice age, ice sheets melted and their massive weight was lifted. In response, the land underneath gradually started to rise while land that hadn't been under the ice (such as the eastern United States) started to sink, in a kind of geological see-saw.



Photo Credit: Flickr/JulieG



DYK?

The National Weather Service defines a heat wave as three or more consecutive days with a maximum temperature over 90°F.

Changes in Precipitation (Snow and Rain)

Warmer air holds more moisture, and scientists predict that New York will get as much as 15% more precipitation by the 2080s. As temperatures increase, it will rain more and snow less, and rain will happen more often as downpours with dry stretches in between. Strangely, over the next couple of decades, as less and less ice covers our Great Lakes, there will be more lake-effect snow; lake-effect events are caused by cold air flowing across large areas of warmer, ice-free water.

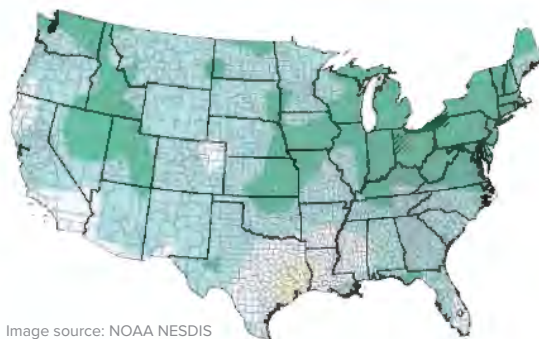
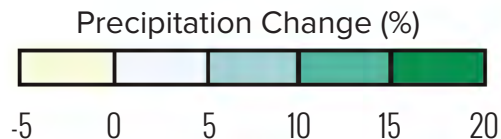


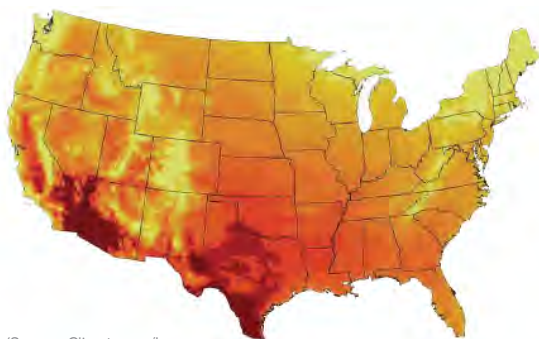
Image source: NOAA NESDIS

Change in heavy precipitation totals by 2050 if the planet continues warming (compared to 1981–2000).



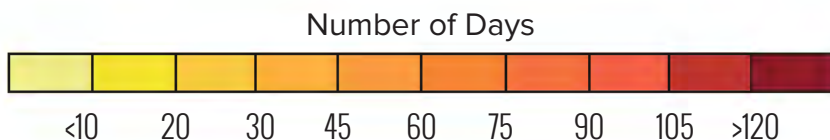
Extreme Heat

The number of sizzling summer days each year is already increasing around the country. The climate models used by scientists predict higher temperatures and more, longer heat waves in the coming decades. By about 2080, downstate New York is very likely to have at least 38 days **above 90°F** per year (18 now); western New York, about 22 (8 now); and northern New York, about 3 (less than 1 now).



(Source: Climate.gov/Image Credit: U.S. Global Change Research Program)

Average number of days per year temperatures may exceed 100°F by the end of this century, if the planet continues warming



Understanding YOUR Carbon Footprint

The total amount of greenhouse gases released into the atmosphere as a result of your lifestyle and actions—for electricity, heat, transportation, food, and the things you buy—is your “carbon footprint.”

Use the carbon calculator at <https://calc.zerofootprint.net> to understand more about your own carbon footprint!

Carbon Footprint Quiz

(circle the image in each pair with the smaller carbon footprint)



Taking your car vs. Taking the bus



Photo Credit: Flickr/Mark Goebel



Photo Credit: Flickr/Porsche Brosseau

Leaving lights on vs. Shutting lights off when not in use



Composting food waste vs. Landfilling food waste



Shopping at the farmer's market vs. Shopping at the supermarket



Using fossil fuel energy vs. Using wind energy





Plug in your car!

Okay, not your family's regular car, but one of the many electric vehicles now available from auto manufacturers. Some can travel 200 miles on a single charge! If your family is shopping for a new car, try to get them to consider an electric vehicle.



Plant trees!

In the summer, shade from trees reduces air conditioning needs, and evergreen trees block cold winter winds, helping to save energy indoors. Trees in cities directly cool the air as water evaporates from leaves, helping to fight the extreme heat of the urban heat island.



Buy clean power!

Your family can buy green power (power from wind or solar, for example) without changing a thing about your home. Check to see what is available where you live.

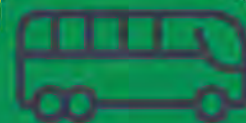


Eat local!

Almost a quarter of the land in New York State is farmland, and home to 36,000 family farms. Buying food from local sources means it didn't travel as far (thus, less gas was burned and less CO₂ emitted).

What Can You Do?

There are many different things that you, your classroom, or your family and friends can do to help reduce your impact on the environment and lessen your carbon footprint. Here are just a few ideas:



Take the bus!

Every gallon of gasoline burned creates almost 20 pounds of CO₂, so we can burn less gas if we all share a ride. If you walk or ride your bike, you won't burn any gas at all!



Get a robot!

Just kidding. But getting a programmable thermostat can help your family save energy.

NASA has a game on its Climate Kids website called Offset, which you can play to see how some of these actions can help to reduce carbon dioxide emissions.

Play the game online at

<http://climatekids.nasa.gov/offset/>.



Be a GLOBE partner!

The Global Learning and Observations to Benefit the Environment (GLOBE) Program, jointly sponsored by NASA and the National Science Foundation, is a science and education network that connects students, teachers, scientists, and citizens from around the world. Through the GLOBE Program, you can conduct real, hands-on science about your local environment. GLOBE students have contributed over 100 million measurements to the GLOBE database! **Find out more, and get the new Climate Storybook at <https://www.globe.gov/web/elementary-globe/overview/climate/storybook>.**

Study Tree Cookies

First Year Growth

Rainy Season

Dry Season

Scar From Forest Fire

Spring/Early Summer Growth

Late Summer/Fall Growth

Image Credit:
NASA/Climate Kids

Trees are some of the best data collectors. Learn about the climate history of your area by observing tree cookies! A tree cookie is a section of a tree that has been sliced across, showing the rings. You can tell how old a tree is by counting the number of rings, and the size/shape of the rings can often tell you about the climate at the time the tree was growing. Because trees are sensitive to local climate conditions, such as rain and temperature, they give scientists some information about that area's past climate. For example, tree rings usually grow wider in warm, wet years and are thinner in years when it is cold and dry. If the tree had a difficult year, like a drought, the tree might hardly grow at all. Often, you can find tree cookies on display at nature centers or museums, but if you know someone who does woodworking, makes furniture, or burns firewood, you could ask to look at their tree rings.

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Conservationist for Kids

Supplement for Classroom Teachers – Investigating Climate Change

October 2017

Why Study Climate Change?

Climate change can be a very challenging topic to cover with students. The media are filled with many stories on the subject, both positive and negative, and many people have formed very strong opinions on the topic. Most scientists agree that humans are having an impact on the global climate. Research conducted in New York State indicates that we are already feeling the impacts. Warmer temperatures, rising sea levels, and changes in precipitation are all ways that the overall climate is changing. By taking steps in our own lives, we may be able to slow some of these changes, if not stop them. Climate change will be an issue of great importance for many years to come; introducing students to the topic and the challenges associated with it will help them to become better informed, which in turn will help them and future generations work towards solutions.

This Issue's "Outside Page"

The "Outside Page" in this issue of *Conservationist for Kids* invites students to take part in the Global Learning and Observations to Benefit the Environment (GLOBE) Program, which is jointly sponsored by NASA and the National Science Foundation. Through this program, students can collect and submit a variety of data, which will be used by scientists doing climate and environmental research. Students are also given information about "tree cookies" and what they mean, as well as how they can use them to learn more about the climate of the past. By looking to the past, we can be better prepared for future changes.

Supplemental Activities for the Classroom

There are many things that students can do as a classroom to lessen the impacts on the climate. A great starting point would be to calculate the carbon footprint of the class. Students can then identify areas to reduce their carbon footprint, and make those changes. This concept is discussed on page 6 of this issue. Based on the carbon footprint for the class, it could be expanded to estimate the carbon footprint for the school. Looking at such things as energy usage, recycling vs. throwing everything away, and water usage, students can find ways that their class and school can decrease the impact on the local environment and global climate. If everyone made just a couple of changes, the negative impacts on the climate and environment could be reduced.

Students can also make observations about changes to the climate by watching nature with their class, and recording what they see. As the climate changes, the availability of food for migratory birds will change, as their food resources will be available at different times. Trees and other flowers might bloom earlier and insects might hatch earlier, and that will greatly affect the success of birds and other animals at raising their young. Birds may change their migratory patterns over



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time, but many species may not be able to adjust fast enough to ensure their survival. Projects like Project Budburst and Journey North allow students to make and enter observations about these topics and more, which help scientists to better understand the changing climate. There are many different online and print resources available to help teach students about climate change, a sampling of which are included below.

Online Resources

NYSDEC Climate Week 2017 www.dec.ny.gov/energy/103221.html

NYSDEC Climate Change Information Resources www.dec.ny.gov/energy/50399.html

NYSDEC Conservationist for Kids, Vol. 2, #3: Climate Change.

www.dec.ny.gov/education/100637.html

NYSDEC Impacts of Climate Change in New York www.dec.ny.gov/energy/94702.html

Climate Change Education <http://climatechangeeducation.org/>

Cornell Climate Change <http://climatechange.cornell.edu/> (includes many teacher resources)

Journey North www.learner.org/jnorth/

NASA Climate Change Resources for Educators <https://climate.nasa.gov/resources/education/>

NASA's Climate Kids <http://climatekids.nasa.gov/>

National Audubon Society Climate Report <http://climate.audubon.org/>

National Center for Science Education: Classroom Resources <https://ncse.com/classroom-resources>

National Science Teachers Association: Climate Science Resources www.nsta.org/climate/

NOAA: Teaching Climate www.climate.gov/teaching

Project Budburst <http://budburst.org/>

U.S. Global Change Research Program www.globe.gov

Books*

A Kids' Guide to Climate Change & Global Warming: How to Take Action! Cathryn Berger Kaye, Free Spirit Publishing, 2009

Basher Science: Climate Change. Simon Basher, Kingfisher, 2015

Climate Change (DK Eyewitness Books). John Woodward, DK Children, 2008

Climate Change (True Books: Ecosystems). Peter Benoit, Scholastic, 2011

Global Warming. Shelly Buchanan, Teacher Created Materials, 2015

Global Warming. Seymour Simons, Collins, 2013

The Magic School Bus and the Climate Challenge. Joanna Cole, Scholastic Inc., 2014

The Down-to-Earth Guide to Global Warming. Laurie David & Cambria Gordon, Orchard Books, 2007

The Teacher-Friendly Guide™ to Climate Change. Edited by Ingrid H. H. Zabel, Don Duggan-Haas, & Robert M. Ross, Paleontological Research Institution, 2017. <http://teacherfriendlyguide.org>

Understanding Global Warming with Max Axiom, Super Scientist. Agnieszka Biskup, Capstone Press, 2008

What in the World Is Happening to Our Climate? Becca Hatheway and Diane Stanitski, University Corporation for Atmospheric Research, 2016. www.globe.gov/web/elementary-globe/overview/climate/storybook

**Please note, the listing of books is not to be considered an endorsement, as not all have been reviewed by the editor.*

Conservationist for Kids and an accompanying teacher supplement are distributed free of charge to public school 4th grade classes in New York State three times per school year (fall, winter and spring). If you would like to be added to or removed from the distribution list, need to update information, or if you have questions or comments, please e-mail the editor at **KidsConservationist@dec.ny.gov** or call 518-402-8047. Limited quantities of some back issues are also available on request. The full archives can be found online at www.dec.ny.gov/education/100637.html