

Climate Change

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Climate change is a global environmental challenge that directly impacts Ohioans. Increase your knowledge about climate change and learn how you can make a difference.

BACKGROUND

Earth orbits the Sun at an average distance of about 93 million miles. Energy comes from the Sun in the form of light. While most of the light that reaches Earth reflects into space, a portion of it is absorbed by Earth's surface and is converted to heat. Although that heat eventually escapes into space, some of the gases in Earth's atmosphere slow its escape. **This causes the atmosphere to heat up.** This process is called the greenhouse effect. The gases that contribute to the **greenhouse effect** are called **greenhouse gases**.

The greenhouse effect is natural. If it did not exist, the temperature on Earth would be too cold to have liquid water! Greenhouse gases include water vapor, carbon dioxide, methane, and a few other trace gases. Since the Industrial Revolution began around 200 years ago, humans have burned large amounts of **fossil fuels** like coal, oil, and natural gas. Burning these fuels **emits** one particular greenhouse gas, carbon dioxide. The amount of carbon dioxide in the atmosphere has greatly increased in a very short period of time.



Words in **bold** are highlighted in the glossary at the end of this Idea Starter

PLAN YOUR PROJECT

Use this idea starter AND publication 4-H 365 *Self-Determined Project Guide* as the starting place for your 4-H self-determined project. The *Self-Determined Project Guide* is available from your county OSU Extension office or on the Web at **ohio4h.org/selfdetermined**. You may choose to do a little or a lot depending on your level of interest. Be sure to register your project with your county OSU Extension office.



Earth's Energy Budget

Climate is highly dependent on Earth's **energy budget**. The energy budget is the balance between the energy from the Sun entering Earth and the energy that returns to space. As long as the two are in balance, the temperature generally remains the same. But very small changes in the energy budget can drastically shift temperatures, resulting in large shifts in climate. Natural processes, such as volcanic eruptions, decomposition of plants and animals, and even weathering of rocks, slowly change Earth's energy budget over long periods of time. Greenhouse gas emissions from humans burning fossil fuels have become an important factor in changing Earth's energy budget. The carbon dioxide emitted from burning fossil fuels does not change the amount of light entering Earth from the Sun, but it does slow the release of heat from Earth's surface and atmosphere to space. This imbalance is causing the planet to warm.



Photo courtesy of Jacob Fields, The Ohio State University

A weather station collects data on conditions near the surface at The Ohio State University's Waterman Farm.

Scientists have known for decades that the rise in the carbon dioxide level in Earth's atmosphere is causing global temperatures to rise at a faster pace than previously seen in human history. During the 20th century, the average temperature on Earth rose about 1.8 degrees Fahrenheit. Depending on how much we continue to burn fossil fuels, scientists estimate Earth's average temperature could rise by an additional 2.5 to 7.9 degrees Fahrenheit by the end of the 21st century.

These temperature changes may not sound like a lot. In many places the temperature changes 20 degrees or more from one day to the next. But a 5-degree change in the average temperature of the entire planet is significant. Climate change is an important topic, because a warmer planet means a different planet from the one we know. It poses challenges for plants and animals inhabiting Earth, including humans.

Effects of Climate Change

Climate describes the weather occurring in an area over a long period of time. When the climate changes, temperature and precipitation also change. These changes can be damaging. Areas that were once habitable may become less so over time, potentially damaging human health and infrastructure. In the Midwest, humans are most at risk from extreme heat events, droughts, floods, and worsening air quality. Climate change affects all areas of life including (1) agriculture, (2) natural resources and ecosystems, (3) health and well-being, (4) infrastructure including roads, rail, and dams, and (5) water quality and quantity. See NCA5 Chapter 24: Midwest at cleanet.org/clean/literacy/tools/nca/nca_2023_midwest.html. These impacts cause us to think differently about how we build urban and rural communities to avoid even worse outcomes in the future. Strategies include maintaining a more robust energy grid, creating more green spaces, and using/storing water resources more efficiently.

Another global effect of climate change is the melting of glaciers and thawing of **permafrost** in mountains and polar regions. This contributes to sea level rise, impacting people and living things around the globe. Climate change also causes sea levels to rise directly. As ocean water warms, it expands. A 5-degree Fahrenheit increase in global average temperature is expected to raise global average sea level about 2 vertical feet by 2100. For families living along the ocean, their homes and ways of life will be dramatically altered as land disappears underwater. For families living inland, the changing water cycle causes local erosion and flooding.

Agriculture is an area of concern for the Midwest. We currently have an inexpensive and abundant food supply. This is mainly due to farmers' knowledge of the crops and livestock that thrive in their area. As the climate changes and weather patterns shift, agriculture will adapt to better manage (1) rapid

oscillations between extreme wet and dry conditions, (2) more extreme heat events, (3) greater weed and insect presence, and (4) reduced planting times. These changes could affect the amount and types of food that can be produced. Like humans, plants and animals all over the world have survived by adapting to the environments around them. Living things adapt more easily to gradual changes than to sudden changes. When change takes place quickly, over years or decades, gradual adaptation is often not possible. Some animals, and even some plants, can migrate to survive, but living things that are not able to adapt or migrate may face extinction.



Drought effects on a field of corn.

Individual and Group Actions

So, what can we do about climate change? While scientists continue to improve our understanding of climate change impacts and ways to respond, there is no need to wait to take action. The longer we wait, the worse the problem will get. There are many actions we can take today. These include things like altering our diet and reducing food waste, limiting plastic use, supporting climate-friendly infrastructure, promoting energy efficiency, and using renewable energy.

While we can reduce our personal use of fossil fuels and greenhouse gas emissions, individual actions are not enough to address the problem. Group actions are needed. There are many community, nonprofit, and business leaders taking group actions. While addressing climate change alone can be challenging, it becomes much easier when we work as a group.

Surveys of U.S. populations show we are overwhelmingly interested in taking actions and educating youth. Learning the science behind climate change and understanding practical responses is an important first step. You can play a role in advancing important conversations by using your knowledge about climate change to correct misconceptions and by sharing practical solutions. Become a climate leader in your community!

AREAS OF INTEREST AND THINGS TO DO

Every self-determined 4-H project can be broken down into areas of interest. These are the specific things members want to address during their project adventures. Using 4-H 365 *Self-Determined Project Guide*, identify at least three areas of interest with at least three activities per area to explore. Take your ideas from the list below or make up your own.

Climate vs. Weather

- Keep a weather data table for three weeks. Compare your data to records online or from the evening weather report.
- Design a “travel brochure” inviting tourists to sample the various climates in the United States. Share your brochure with your club or group.
- Compare the **climate normals** for the Ohio cities of Cincinnati, Columbus, and Cleveland. Go to ncei.noaa.gov/access/normalsPDFaccess and select Ohio. Then select a weather station from each city. Record the maximum and minimum temperature normals for each month from 1981–2010. Create a line graph for each city showing the maximum and minimum temperature normals across the year and compare the three graphs.
- Select four of the satellites used to gather climate data and make a poster comparing the area each satellite covers and the frequency with which it scans Earth. Include additional information such as its main features and the types of information each satellite provides. For NOAA satellites, visit nesdis.noaa.gov/our-satellites/currently-flying. For NASA satellites, which do not all measure climate data, visit climate.nasa.gov/nasa_science/missions.

- Create a table comparing four advantages and four disadvantages of using satellite data, weather balloons, and ground-based stations for climate and weather analysis. Share what you learned with your project helper.

History of Climate

- Research the history of U.S. weather records—how long records have been kept, what measurements are recorded, and where the oldest records are found. Share your findings with your club or group.
- Research how much of the Earth’s surface is covered by ocean in the Northern and Southern Hemispheres. Explain which hemisphere has a larger landmass and why the land/ocean differences might be important.
- Draw a timeline to show the glacial and interglacial periods in North American history. Add photos as evidence glaciers existed in Ohio long ago.
- Learn about one of these natural processes that provides information about past temperatures—ice cores, coral reefs, tree rings, seafloor sediments, lake [varves](#), [packrat middens](#), or stalactites and stalagmites. Mark locations on a world map to show where these kinds of data have been gathered. Share what you learned with your project helper.

Greenhouse Effect

- Explore details of the greenhouse effect and the science of how it works, including the impact of human emissions using the PhET simulation at [phet.colorado.edu](#).
- View the graph of carbon dioxide levels on Earth since the 1960s at [gml.noaa.gov/webdata/ccgg/trends/co2_data_mlo.pdf](#). Mark important years on the graph. Include the years your parents or guardians were born, the year you were born, the year you started school, and this year. How much have levels changed?
- Create an illustration or a table comparing and contrasting the inputs and outputs of energy from Earth’s energy budget, both naturally and with human impact.
- Make a collage with photos or pictures illustrating human activities which contribute to the greenhouse effect. Share your collage with your club or group.

Predictions of Change and Climate Change Impacts

- Learn how climate change impacts the Midwestern United States by reading one chapter of the 5th National Climate Assessment at [toolkit.climate.gov/NCA5](#). Write a paragraph about what you learned.
- Explore the predicted impacts of climate change at [scied.ucar.edu/learning-zone/climate-change-impacts/predictions-future-global-climate](#). Write a brief summary of how climate change might impact different regions around the globe.
- Examine the maps and predictions for sea level rise at [coastal.climatecentral.org](#). Write a brief summary of what you would tell the General Assembly of the United Nations about the predictions for rise in sea level in the next century if you were the ambassador for an island nation, such as the Bahamas or Papua New Guinea.
- Create a poster of four impacts of climate change on the ecosystem and share it with your family, friends, club, or group. For information, check [epa.gov/climate-indicators/ecosystems](#).
- Research the impact of climate change on human health. Write a brief summary about what you learned and share it with your parents, grandparents, club or group, health or biology teacher, school athletic trainer, or doctor. For information go to [epa.gov/climate-indicators/health-society](#) and [cdc.gov/climate-health/php/effects/index.html](#).

Polar and Alpine Regions

- Write a summary of the impact of climate change on Indigenous Peoples in the Arctic and sub-Arctic regions of North America.
- Research websites showing the effects of thawing permafrost on the local ecosystem and on the climate system. Make a poster with ten pictures showing these changes and write captions for each.
- Compare and contrast changes happening to the water cycle and ice in the Arctic, Antarctic, and alpine regions of the world. For more information, visit [epa.gov/climate-indicators/snow-ice](#) and [usgs.gov/special-topics/water-science-school/science/ice-snow-and-glaciers-and-water-cycle](#).

Take Action in Your Home and Community

- Read the *Climate Action Handbook* by Dr. Heidi Roop. Select and implement three actions from the book over the next three months. Write a summary of your journey implementing them. Include what went well and what challenges you encountered.
- Go to drawdown.org/solutions and create a list of ways families can reduce their impact on the environment. Include descriptions of each activity's carbon-reducing features.
- Compare and contrast what other countries are doing and what NGOs (non-governmental organizations) in the United States are doing to reduce greenhouse gas emissions. Share your findings with your club or group.
- Work with your family to complete a self-energy audit. Then, make a plan for five actions you can take to reduce energy use. For guidance, visit energy.gov/energysaver/do-it-yourself-home-energy-assessments.
- Watch a movie that explores a community impacted by climate change and explore injustices of what that community is experiencing. Educate others about what you learn. Select a movie yourself or choose from the list at earth.org/climate-change-movies/. Two additional films to consider are *Anote's Ark* and *The Ants & The Grasshopper*.
- Research ways climate change will impact your family's crops, livestock, or gardens. Identify actions you can take to change the way you produce food to reduce the negative impacts of climate change.

Arts and Humanities

- Create a piece of art showing a climate hopeful action you could take to make your community more resilient. For inspiration, look through the Art x Climate Gallery at toolkit.climate.gov/NCA5. Your work can be a painting, drawing, sculpture, digital, mixed media, or another format of your choice.
- Select a one act play from Artists & Climate Change at artistsandclimatechange.com/2014/11/01/creating-a-list-of-climate-change-plays. Read the play and perform it for your club or group. Discuss the piece's significance following the performance,

- Write a poem expressing your thoughts and feelings about climate change. For ideas check out the American Academy of Poets at poets.org/poems-about-climate-change.
- Create a dance representing some part of climate change. Record the dance or perform it for your club or group. Briefly explain to your audience what inspired your creative process.
- Research and write an article about climate change, its impacts, or a hopeful action that can be taken to address it. Share your article with your club or group.
- Research and write an [op-Ed](http://op-ed.com) for your local newspaper describing a meaningful action your community could take to reduce greenhouse gas emissions or adapt to emerging climate impacts.
- Watch a few interviews at un.org/en/climatechange/voices-of-change, where young people from around the world describe the impacts of climate change on their communities and share how we can respond. Create your own personal video to share with your club or group.
- Host a climate café in your community, at your school, or in your place of worship. For guidance, go to climatepsychologyalliance.org/index.php/training-events.



Permafrost is a layer of soil that remains frozen throughout the year.

GLOSSARY

climate. The weather occurring in an area over a long period of time.

climate normals. The 30-year average for climate variables like temperature and precipitation.

emits. To produce and release something, like gas or pollution.

energy budget. The balance between energy from the sun that reaches Earth and the energy that goes back into space from Earth.

fossil fuels. The fuels of coal, oil, and natural gas formed from organic matter that undergoes heat and pressure deep underground. Fossil fuels take millions of years to form.

greenhouse effect. The process by which heat is trapped near Earth's surface by greenhouse gases.

greenhouse gases. Gases in Earth's atmosphere that trap heat.

op-Ed. An article expressing an opinion, found in a publication's editorial section.

oscillations. Movement back and forth between two positions.

packrat middens. Collections made by packrats that consist of debris like plants, rocks, bones, and other items. Middens preserve environmental information and help us understand how climate change affects the environment.

permafrost. A thick subsurface of soil that remains frozen throughout the year. Found mainly in polar regions.

varve. A pair of thin layers of clay and silt deposited each year in the bottom of lakes. Varves are used to determine the environmental and climate history of a lake and its surroundings.

RELATED RESOURCES

A Student's Guide to Global Climate Change. **archive.epa.gov/climatechange/kids/index.html**

Byrd Polar and Climate Research Center. **byrd.osu.edu**

Center for Climate and Energy Solutions. Climate Basics for Kids. **c2es.org/content/climate-basics-for-kids**

Yale Program on Climate Change Communication. Yale Climate Change Opinion Maps 2023. **climatecommunication.yale.edu/visualizations-data/ycom-us**

State Climate Office of Ohio. **climate.osu.edu**

NASA Climate Kids. **climatekids.nasa.gov**

UCAR SkySci for Kids. Climate Change. **scied.ucar.edu/kids/climate-change**

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