



Climate Change in my Backyard

Activity Guide for Grades 5–6

Unit 1: Earth as a System

In Unit 1, students assess their current knowledge of and beliefs about climate change. They then explore the various earth systems that create climate including Earth's energy balance and the greenhouse effect. They learn what the natural and human cause are of greenhouse gas emissions and explore how the Sun's energy, greenhouse gasses and Earth's surface interact to moderate global average temperature. They use a NASA data analysis tool to model different energy and greenhouse gas scenarios.

Activity 1.1: Accessing Prior Knowledge: Global Climate Change Survey

Students identify the natural and human factors that they feel are causing global climate change. They provide possible solutions for mitigating climate change including a plan to reduce the impact their personal activities have on the environment. At the end of the curriculum, students take the survey again and compare their results with the results from their first survey.

Activity 1.2: Understanding the Greenhouse Effect

1. Greenhouse Effect Lab: Students complete a lab activity that models the greenhouse effect and then discuss the natural vs. human induced-changes in greenhouse gas concentrations.
2. Earth's Energy Balance: Students create a diagram of Earth's energy balance, answer opinion questions and perform a skit to understand earth's energy balance. Students learn that all energy on earth originates from the sun and what happens to the energy once it reaches Earth's atmosphere. Students are introduced to the concept of greenhouse gasses.

Activity 1.3: Greenhouse Gas Emissions, Natural & Human Causes

Students dig deeper into the greenhouse effect and explore natural and human caused greenhouse gas emissions. Students brainstorm and then research factors that contribute to greenhouse gas emissions. They use the energy balance diagram they completed in Activity 1.2 as the basis for a new diagram that incorporates natural and human causes of greenhouse gas emissions. Students also brainstorm how they can reduce their contributions to greenhouse gas emissions.

Activity 1.4: Albedo and Reflectivity

Students will explore how color impacts reflectivity and heat absorption. Using black and white construction paper, students will measure heat absorption and make connections between the reflectivity (albedo) of different materials, the amount of heat absorbed by these materials, and the temperature of Earth.



Activity 1.5: Micro-GEEBITT (Global Equilibrium Energy Balance Interactive Tinker Toy)

Students use the NASA Micro-GEEBITT climate modeling tool to explore how changing variables in earth systems impact global average temperature. Students model the effects of changes in surface reflectivity and greenhouse gasses in different climate and emissions scenarios.

Unit 2: Identifying the key changing conditions of Earth system

In Unit 2, students learn about the difference between weather and climate. They then look at historical temperature cycles using paleoclimate data, more recent historical climate records and current changes in temperature. They then expand the climate model beyond temperature to look at changes in precipitation and cloud cover in the United States. The unit continues by having students compare regional climate changes with overall global trends to identify similarities and differences in climate by region. Students recognize that climate change does not impact all areas of the globe equally or in the same ways. The unit concludes with a persuasive essay asking students to apply what they have learned about climate and climate change.

Activity 2.1: Weather or Not?

1. Weather vs. Climate: Students learn the difference between climate and weather by using scenario cards and by creating and presenting skits that illustrate climate or weather.
2. Measuring the Weather: Students use thermometers and other weather instruments to make observations and measurements of weather.
3. Our Weather and our Climate: Students compare the weather data they have collected with data on their local climate and consider how closely daily weather patterns match the expected climate.

Activity 2.2: Recognizing Change (Observation vs. Inference)

Students learn the difference between an observation and an inference. Then, they view pictures and graphs documenting evidence for climate change. They will make observations and inferences based on the pictures.

Activity 2.3: Historical Climate Cycles

1. Visualizing Historical Climate Cycles: This activity introduces students to the idea of historical climate cycles. Students will observe temperature data from the past 400,000 years to understand that Earth's climate has changed in the past.
2. Graphing Climate Cycles: Students graph temperature data from 10,000 years ago to the present to create a visual representation of how temperatures have increased at an accelerated pace in the recent past, as compared to the historical climate record. If desired, students can place key events in environmental and human history on the timeline to demonstrate the timeframe of historical climate change. This will help them begin to understand the relationships between humans and climate.
3. Comparing Temperature and CO₂: Lastly, students compare the graph of temperature over the past 400,000 years along with a graph of carbon dioxide concentrations during that time. By analyzing these graphs together, students recognized the connection between atmospheric carbon dioxide concentration and temperature.



Activity 2.4: Climate Change Around the World

1. Global Climate Change: Up until now, students have focused on only on temperature in evaluating climate change. Now students add other climatic factors to their analysis and investigate how climate change includes not only temperature, but can also changes in precipitation levels and cloud cover.
2. Climate Change in my Backyard: Students use the MY NASA DATA website to determine whether U.S. and global patterns of climate change are directly reflected in their city and in cities around the world. They discuss why different locations around the world are impacted differently or to different degrees by changing climates.

Activity 2.5: Causes and Effects of Climate Change (Assessment/Persuasive Essay)

Students use a graphic organizer to identify what they have learned about climate change, its causes and effects. They then use the organizer to structure a persuasive essay to reflect on the causes of climate change and the impacts of natural and human induced change.

Unit 3: Earth system responses to natural and human-induced changes

In Unit 3, students learn about how living things and ecosystems respond to and are impacted by changing climates. Students learn about how plant life cycle events can be used to understand climate and how they have been used in the past. They participate in Project BudBurst, a national citizen science project and study how changing climates impact the timing of plant life cycle events. Students also explore the interactions between plants and pollinators and how those interactions can be impacted by climate.

Activity 3.1: Migration, Adaptation and Changing Climates

Students will discuss the various ways that living things deal with changing climates including adaptation and migration. Later, students will reflect back on these ways and determine which adaptations could benefit a plant that is exposed to a changing climate.

Activity 3.2: Seasons of a Plant

Students are introduced to the concept of phenology, the timing of periodic life cycle events. Students begin by distinguishing between environmental and biological events in an ecosystem (first snow vs. first flower). They place their events on a calendar and then brainstorm what might happen if these biological events didn't happen one year. Students then go outdoors and individually or in small groups make observations of actual phenological events.

Activity 3.3: Preparing for Project BudBurst

This activity serves as an introduction to phenology and project BudBurst will prepare students to start collecting data. In this activity students learn how to use the Project BudBurst website, begin to collect and record data on plant phenology and add that data to the Project BudBurst database (data collection will be ongoing throughout the rest of the curriculum).

NOTE: BudBurst data collection can begin at any point in the curriculum. Before you begin data collection, implement Activity 3.3: Preparing for Project BudBurst and continue



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making observations as often as possible so students are able to observe each phenological event.

1. **Introducing Project BudBurst:** Students explore and become familiar with the BudBurst website through a scavenger hunt. The class, groups, or individual students choose what plants they will collect data on, create a BudBurst site and decide on a data collection protocol and schedule, in preparation for the growing season.
2. **Mystery Plant Identification:** Students make observations of plants unfamiliar to them, create a field guide for their plants and practice identifying other plants by using their classmates' field guides. This activity will exercise students' observation and scientific communication skills and provide students with practice identifying plants in preparation for the other activities. This is an outdoor activity, but can also be done inside on collected or purchased flowers/plants.
3. **BudBurst Data Collection:** Students collect data on their chosen plant species throughout the growing season and enter it into the BudBurst website over a period of weeks or months. Students can write the data on the BudBurst data collection sheets Plant ID sheets and phenophase guides are available on the BudBurst website.

Activity 3.4: Meet the Naturalists

Students will learn the story behind more than 150 years of plant phenology data collected in Concord, Massachusetts and how phenology has been used historically, including examining historic records where available. In some cases, the data is still useful today. Students will explore ways historic data sets can be used for modern purposes.

Activity 3.5: Plant Phenology Data Analysis

1. **Graphing Historical Data:** Students will graph historical plant phenology data and draw conclusions about how climate and climate change affect plant phenology.
2. **BudBurst and NASA Green-up Data:** Students then compare the historical data and their BudBurst data, to NASA Normalized Difference Vegetation Index (NDVI) visualization and graphs. Students will discuss how BudBurst can contribute to our understanding of plants' responses to climate change.

Activity 3.6: Ecological Mismatches

Students begin the class with an activity that illustrates the connections between plants, animals and abiotic factors in an ecosystem. They then read an article that illustrates an ecological mismatch between migratory birds and their food sources caused by changing climates. They answer question about the reading and have a class discussion about the potential impacts of ecological mismatches on natural ecosystems and on agricultural food production.



Unit 4: Predicting the consequences of changes for human civilization

In Unit 4, students learn that individuals have a role in climate change (“are you bigfoot”) that climate change affects people in different ways (“faces of climate change”) and that climate change has many types of impacts (“impacts of climate change”) and that these impacts are different for countries and people around the world. Students begin the activity by calculating their ecological footprint. In a role-playing game, students take on the situations of people around the world who are being impacted by changing climates in different ways. They then consider how their own personal actions contribute to climate change and investigate in more detail its specific impacts on ecological systems and human civilization. Students then choose a region of the world and investigate how this country or area has been impacted. Students present their research to the class. The unit concludes with student reflections on what they have learned about climate change, how it has changed their attitudes and whether they will make any personal changes as a result.

Activity 4.1: Are you Bigfoot? Calculating your Ecological Footprint

Students calculate their ecological footprint and determine how many earths would be needed if everyone on earth lived the same lifestyle as they do.

Activity 4.2: Faces of Climate Change

Students learn how climate change affects individuals in other parts of the world in different ways. In a role-playing scenario, they learn that climate change impacts people differently and that there are economic, social, cultural and political factors that influence each individual’s beliefs about and decisions related to climate change.

Activity 4.3: Impacts of Climate Change

1. Global Impacts of Climate Change: Students begin to make connections between their actions and climate change. Students participate in a jigsaw to teach one another about the global impacts of climate change on humans and the natural world. In the next activity, students will research impacts of climate change in a specific area of the world.
2. Regional impacts of Climate Change: Students research the impacts of climate change for a particular state, region, or country around the world. Students use their research to create a presentation, poster, newsletter, or letter to a government official. Students present their research to the class.

Activity 4.4: Reflection: What I learned about climate change

Students first retake the Global Climate Change Survey they took at the beginning of Unit 1 and compare their answers. Students then look back on their portfolios and reflect on what they have learned about climate change over the course of the curriculum.