

Weather & Climate



Department of
Environmental
Conservation

Topics: Climate, climate change, erosion, weather, weathering

GRADE LEVEL: High School

Big Ideas:

- Weather is short term conditions of the atmosphere.
- Climate is the average daily weather for an extended period of time.
- Weather and climate are related but different.
- Water has a big role in the earth's surface processes.
- Weathering, erosion, and deposition act together in a cycle to wear down and build up the earth's surface, consequently these forces shape our landscape.
- Our climate is changing.
- Humans have impacted Earth systems.
- Environmental justice is the fair treatment of people of all races, cultures, incomes, and educational levels with respect to the development and enforcement of environmental laws, regulations, and policies.

Learning Objectives: *students will be able to...*

- Differentiate between weather and climate.
- Collect, organize, and analyze data on various types of weather and climate.
- Model how greenhouse gases influence Earth's temperature.
- Explain the causes and effects of climate change.

New York State Science Learning Standards:

HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.

HS-ESS2-4. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.

HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.

HS-ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

HS-ESS3-5. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth's systems.

HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

HS-LS2-5. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.

HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

HS-LS4-7. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.

Key Understandings:

- Winds, landforms, ocean temperatures and currents are major determinants of local weather patterns.
- Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things.
- Understand that atmospheric gases affect the air and water temperature at the Earth's surface.
- Weather is the combination of sunlight, wind, snow or rain, humidity, and temperature in a particular region at a particular time.
- Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over time.
- Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of average and extreme weather might happen next.
- Weather scientists forecast severe weather so that the communities can prepare for and respond to these events.
- Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate.
- Human activities affect global warming. Decisions to reduce the impact of global warming depend on understanding climate science, engineering capabilities, and social dynamics.

Essential Questions:

- How are climate and weather related?
- What regulates weather and climate?
- How does weather change over time?
- How do weather and climate affect our lives?
- How do human activities affect weather and climate?
- How do we know our global climate is changing?
- How have living organisms changed the earth's climate and how have earth's changing climate conditions impacted living organisms?
- How is the availability of needed natural resources related to naturally occurring processes?
- What are some of the environmental justice issues and solutions around climate change?

Students will know...

- People measure wind, snow or rain and temperature to describe and record the weather and to notice patterns over time.
- The Sun powers Earth's climate, radiating energy at very short wavelengths, predominantly in the visible or near-visible (ultraviolet) part of the spectrum.
- Key vocabulary terms.
- How to analyze and interpret weather data.
- Difference between weather and climate.
- Scientists record patterns of the weather across different times and areas so that

Vocabulary:

- Albedo: the amount of sunlight (solar radiation) reflected by a surface.
- Carbon: a widely distributed element that forms organic compounds in combination with hydrogen, oxygen, etc., and that occurs in a pure state as diamond and graphite, and in an impure state as charcoal.
- Climate: "average" weather for a given area.
- Climate change: the result of changes in Earth's atmosphere (the layer of gas that surrounds Earth).

they can make predictions about what kind of weather might happen next.

- Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts.
 - Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities.
 - The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources.
 - Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation.
- **Environmental justice:** The fair treatment of people of all races, cultures, incomes and educational levels with respect to the development and enforcement of environmental laws, regulations and policies.
 - **Erosion:** the process by which the surface of the earth gets worn down by forces such as water, wind, or ice.
 - **Modeling:** the act of representing something (usually on a smaller scale).
 - **Greenhouse gas:** a gas that absorbs and emits radiant energy within the thermal infrared range. The primary greenhouse gases in Earth's atmosphere are water vapor, carbon dioxide, methane, nitrous oxide, and ozone.
 - **Sea level:** the level of the sea's surface, used in reckoning the height of geographical features such as hills and as a barometric standard.
 - **Weather:** the set of current atmospheric conditions, including temperature, rainfall, wind, and humidity at any given place.
 - **Weathering:** Weathering is the breaking down of rocks, soils, and minerals as well as wood and artificial materials through contact with the Earth's atmosphere, water, and biological organisms.

Learning Plan: We recommend doing these lessons in sequential order; however, they can be done as individual lessons. Lessons have multiple links (videos, songs, diagrams, activities) that can be used at the teacher's discretion depending on class time. Most of these lessons will be done over several class periods.

Pre-assess: How are weather and climate different? Is our climate changing? Use informational surveys/questionnaires/inventories to assess students' prior knowledge, have students write or draw in response to the essential questions.

Progress Monitoring: Formative assessment and teacher feedback should be ongoing throughout the lessons. Teachers should develop assessments based on their individual class needs. Think-pair share, exit tickets, interactive discussions, questions and listening, informal observations, quizzes and student work samples can all be used.

Lesson 1: Climate vs. Weather- Students watch a video, investigate key processes in weather and climate and identify changes that have occurred since the ice age.

- Video: [Weather and Climate](#)
- How is Earth's Climate Changing [Reading and Online Quiz](#)

- [Visualizing and Understanding the Science of Climate Change](#) (there are many lessons in this unit. We recommend doing lesson 1 or choose what's best for your classroom).
 - Teacher Background: [What is Climate?](#)
 - Exploring the Estuary and Climate Change [Student Interactive](#)
 - Climate Change in the Hudson Valley [Student Booklet](#)
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Lesson 2: Causes and Effects of Climate Change- Students watch videos, then build a model and gather evidence to support explanations of climate change. Students explore how increased carbon dioxide levels affect temperature. Note: watch video(s) first, show STEM demonstration, then have students work through the carbon cycle activity.

- Video: [Causes and Effects of Climate Change](#)
 - Video: [How Global Warming Works in Five Minutes](#)
 - STEM demonstration: [Carbon Dioxide Gas](#)
 - Carbon Cycle [Activity](#) & [Teacher Reference](#)
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Lesson 3: What Climate Change means for the Hudson River- Students watch a video, then examine how temperature changes impact organisms and ecosystems. Students discuss several climate change related impacts on the Hudson River ecosystem.

- Video: [Fish and Climate Change](#)
 - What Climate Change Means for the Hudson River [Activity](#)
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Lesson 4: Investigating Sea Level Rise in the Hudson Valley- Students watch a video, then use Scenic Hudson's sea level rise mapper to investigate the potential impacts of sea level rise on their communities. Follow up with an optional field-based lesson.

- [Measuring Sea Level Rise](#)
 - Investigating Sea Level Rise in the Hudson Valley ([Lesson Plan/Web Quest](#)) & [Sea Level Rise Mapper](#)
 - New York Explores Sea Level Rise: [A Field Based Activity](#)
 - Video: [Sustainable Shorelines](#)
 - Extension: Hudson Marshes & Climate Change [Activity](#)
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Lesson 5: What is the Future of Earth's Climate? - Students watch a video, then are introduced to the unanswered question about the future of Earth's climate. They explore and evaluate data showing temperature changes over the past 120 years and data illustrating climate trends over different time scales.

- Video: [Three Seconds](#)
 - Earth's Changing Climate [Student Activity](#)
 - What did Earth Look Like? [Dinosaur Database Interactive](#)
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Lesson 6: Environmental Justice- Students are introduced to the basic concepts of environmental health and environmental justice. Students examine how pollution disproportionately affects some communities.

- Video: [Climate Justice: Working Together for An Equitable Future](#)
 - Environmental Justice: [Peggy Shepard at TEDxHarlem](#)
 - [Climate Safe Neighborhoods](#) & [Adaptation and Resiliency Student Activity](#)
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- Environmental Justice & Environmental Health [Student Activity](#)
 - Analyzing Environmental Justice [Student Activity](#)
 - Extension: [Intro to Climate Justice](#)- Great resources, need to create a free account to access materials
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Lesson 7: Scientific Consensus and Solutions- Students create their own scientific consensus on climate change through direct interpretation with climate data and explore climate solutions and actions that work in their community.

- Scientific Consensus [Lesson One](#)
 - Opinion Maps: [Yale Climate Communicator](#)
 - Climate Solutions [Lesson Five](#)
 - Video: [Adapt: The Key to Climate Resilience](#)
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Teachers: Would you like to visit us at Norrie Point environmental education center, or have an educator visit your classroom in-person or virtually? Contact us to schedule a program: hrteach@dec.ny.gov

Resources:

Websites:

- [Climate and Climate Change \(NOAA\)](#)
- [Signs of the Seasons: A New England Phenology Program](#)
- [STEM Teaching Tools](#)
- [Conservation in a Changing Climate](#)
- [What's the Difference between Weather and Climate \(NASA\)](#)
- [Lead with Listening: A Guidebook for Community Conversations on Climate Migration \(from the Climigration Network\)](#)
- [Teaching Climate Change- What Educators Should Know and Can Do \(AFT\)](#)
- [ZINN Education Project- Teaching People's History](#)
- [NY Climate Change Science Clearinghouse](#)
- [Climate Change Curriculum \(Groundwork Hudson Valley\)](#)
- [Climate Change Education: A Model of Justice-Oriented STEM Education](#)
- [Young Voices for the Planet](#)
- [Celebrating Youth Climate Activists \(Scenic Hudson\)](#)
- [Youth Climate Program \(The WILD Center\)](#)
- [Teaching about Climate and Energy \(CLEAN\)](#)
- [Alliance for Climate Education](#)
- [Environmental & Climate Justice NAACP](#)
- [National Science Teaching Association Climate Change](#)
- [Climate Change Education Module \(NYCEP\)](#)
- [The Globe Program](#)
- [Exploring the Estuary and Climate Change Connection \(NOAA\)](#)
- [What did Earth Look Like? Dinosaur Database Interactive](#)