Discover Your Changing Climate

Rangers in the Classroom—Presentation
Lesson Plan

Grade Level(s): 5th & 6th

Setting: Classroom

Duration: 1 hour

Standards Addressed:

5th Grade
° Science—Earth Sciences:
3.a, 3.b, 3.c, 4.a, 4.c
° Investigation & Experimentation:
6.e, 6.h
° Listening & Speaking:
1.1, 1.2, 1.3

6th Grade
° Science—Earth Sciences:
2.d, 3.d, 4.a, 4.b
° Science—Life Sciences:
5.d, 5.e
° Investigation & Experimentation:
7.e, 7.h
° Listening & Speaking:
1.1, 1.2, 1.3

Vocabulary:

5th and 6th Grade
adaptation, atmosphere, carbon sink, climate, ecosystem, fossil fuel, greenhouse effect, greenhouse gas, hypothesis, Industrial Revolution, life zone, scientific method, species, weather

Introduction:

Welcome to the Rangers in the Classroom—Discover Your Changing Climate presentation. This program introduces students to global climate change and the potential impacts to natural ecosystems and the plant and animal species that live within them. It introduces students to the concept of scenario planning. A method scientists use to hypothesize about future impacts of a changing climate.

Objective:

After completing this program, 5th and 6th grade students will be able to:
1. Explain the difference between climate and weather.
2. Identify two methods scientists use to learn about past climates.
3. Explain the role greenhouse effect.
4. List two human activities that contribute to the amount of carbon dioxide in the atmosphere.
5. Explain how carbon dioxide levels in the atmosphere influence the surface temperature of the Earth.
6. Identify at least one potential impact of a warming climate.
7. List three choices human can make to help minimize the effects of global climate change.

Materials:

° Laptop (if the classroom is not equipped)
° Projector
° Speakers
° Extension cord
° Power point climate change presentation (laptop or thumb drive)
° Tree cross-section (3)
° Tree cores (3)
° Rock core sample
° Hey Bear! game pieces (3 bags—Bear, Essential Habitat and Extra Habitat
° Park maps and student fee waivers

Discover Your Changing Climate

Rangers in the Classroom—Presentation
Lesson Plan

Presentation:

I. Introduction
- A. What is the National Park Service? Why does the NPS exist? What do National Parks protect?
- B. The NPS has a mission or a job we do each and every day.
  - 1. Our mission is to preserve natural and cultural resources unimpaired for you and for future generations.
  - 2. What does it mean to leave something unimpaired?
    - a. Have you ever loaned a toy to a sibling or friend and when they returned it to you it wasn't the same; it was dirty or broken? How did that make you feel?
- C. The emblem for the National Park Service tells our story as park rangers and the National Park Service mission.
- D. Each part of our patch tells one part of the story.
  - 1. Bison = Wildlife
  - 2. Sequoia Tree = Plants
  - 3. Mountains = Landscapes/Scenery
  - 4. Lake = Water Resources
  - 5. Arrowhead = Cultural History and the role of people in the national parks
- E. Has anyone here ever been to Sequoia and Kings Canyon National Parks?
- F. If yes, what did you do there? Do you know why it was set aside as a national park?
  - 1. To protect the Kaweah watershed and the Giant Sequoias.
- G. In our Meet Your Watershed program, you learned how the parks are connected to the rest of Tulare County through the Kaweah watershed from the snow in the mountains down the river through the irrigation canals to the agricultural fields.
- H. Today, we are going to learn how we are also connected through the ways we have adapted to survive in our regional climate and on a much larger scale—our global climate.

II. What does climate mean?
- A. Weather v. Climate
  - 1. Weather describes what is happening outdoors in a particular place at a particular time.
    - a. Describes the conditions of the atmosphere over a short period of time.
    - b. Weather can change minute to minute, hour to hour, day to day or week to week.
    - c. Weather includes daily changes in precipitation, temperature, barometric pressure, wind conditions etc.
    - d. Ask students to describe today's weather.
- B. Climate is how the atmosphere behaves over relatively long periods of time.
  - 1. Long-term average of the weather in a particular region.
  - 2. Climate is what it is <u>usually</u> like or what you expect in the place you live.
    - a. Weather is what you get, climate is what you expect.
    - b. Ask students to describe the climate of the Central Valley. What is summer usually like? What is winter usually like?
- C. The primary difference between weather and climate is time.
- D. Central Valley has a Mediterranean climate:
  - 1. Mild, wet winters with hot, dry summers.

2. Desert-like for about half the year.

E. How have the plants and animals adapted to this climate?

1. In our Life in the Zone program, you were introduced to some of the ways plants and animals have adapted to survive in their life zone.
2. Have students name and provide a brief description of the three life zones outlined in the program.
    a. Foothills
        1. Mild, wet winters with hot, dry summers.
        2. Very little snowfall, most precipitation is rain.
    b. Montane
        1. Cold, wet winters with warm, dry summers.
        2. Precipitation is mostly snow.
    c. Alpine
        1. Cold, windy desert-like during the short summer months.
        2. Scarce precipitation, low soil moisture, intense sun and drying winds.

F. How have humans adapted to this climate?

1. Harnessed the annual snow melt for use during the hot, dry summer months when there is little or no rain.

III. The climate is changing.

A. Scientists are telling us that the climate is changing, that it is getting warmer

1. Growing body of scientific evidence predicts that the planet will continue to get warmer.

B. Small climatic changes could have profound impacts on humans, plants and animals.

1. The rate of this change will impact whether or not certain organisms can adapt quickly enough to survive.

C. The topic is complex because the Earth's systems are complex and interconnected.

D. Over the past 100 years, the average global surface temperature has increased by one degree Fahrenheit.

E. Scientists predict the surface temperature of the Earth may increase an additional 2—6 degrees Fahrenheit over the next 100 years.

1. This may not sound like much, but consider that during the last Ice Age (around 18,000 years ago) much of North America was covered by glaciers and the temperature was only 7—9 degrees colder than it is today.
2. What might a temperature swing in the opposite direction look like?
    a. Scientists do not know exactly what will happen, but they have models to help predict what might happen to weather patterns, precipitation patterns, agriculture, biodiversity, sea levels, water supplies and human health if the climate continues to warm.
    b. The general consensus among scientists is that certain places on the Earth will get warmer and drier while others will get warmer and wetter.

F. The Earth's climate is always changing.

1. Natural fluctuations in climate.
    a. During the Earth's 4.5 billion year history, the climate has undergone many changes: there have been Ice Ages when much of land was covered by glaciers and warmer eras when tropical plants and animals lived on almost every continent.

2. What causes these natural changes or fluctuations?
    a. The position of the Earth as it travels around the sun determines the distribution of solar rays around the planet.
    b. Milankovitch theory: Serbian Scientist, Milankovitch hypothesized that long-term changes in the Earth's position relative to the sun influences the Earth's climate.
        1. About every 100,000 years, the shape of the Earth's orbit changes.
            a. From more round to a longer ellipse.
        2. About every 41,000 years, the angle of the Earth's axis shifts between about 22 and 25 degrees
            a. When the tilt is greater, polar regions receive more sunlight.
        3. These cycles result from natural changes in the Earth's movement and/or orientation around the sun and cause variations in the intensity of the solar radiation on various parts of the globe.
        4. Result is cyclical warming (interglacial periods) and cooling periods (Ice Ages).
        5. When we talk about current global climate change, it is the rate of these changes that has scientists concerned.

3. How do we know about these natural fluctuations in the Earth's climate? What is the evidence of these changes?
    a. If we only had temperature readings, our understanding of climate fluctuations would only date back to around 1860 when systematic recording of temperatures began.
    b. Temperature is not the only clue to knowing about past climate changes.
    c. Sediment Cores
        1. Sediments settled at the bottoms of lakes and oceans build up layer-upon-layer. These sediment layers contain bits of soil, ash, plant matter and animal fossils.
        2. Scientists use long, hollow tubes to extract samples of these layers that are like a layer cake and can be read like a timeline.
        3. The types and abundance of plant matter found in each layer of the sample give scientists information to infer what the climate was probably like at the time the sediments were laid down.
    d. Tree Rings
        1. The oldest trees in the world, the Bristle Cone pine, grows in the White Mountains of California and can live to be more than 4,000 years old.
        2. By studying the width of the tree rings, scientists can follow the changes in growth over time.
            a. Wider rings indicate years of optimal growth, which scientists then correlate to climatic conditions.
    e. Ice Cores
        1. Snow is about 90% air, as snow is slowly compressed into glacial ice year after year, small bubbles of air get trapped in the layers along with pollens and dust.
        2. Scientists use these bubbles of air to analyze the composition of the

atmosphere at the time the layer was compressed.
3. Scientists get these samples from cores of ice extracted from ice sheets in Antarctica and Greenland, and glaciers around the world.
4. These Ice Core samples have provided scientists with a 650,000 year history of the composition of Earth's atmosphere.
5. Levels of carbon dioxide are higher now than they have been in the last 650,000 yrs.
a. So what? The Earth's temperature closely follows changes in carbon dioxide levels.
b. When carbon dioxide levels increase, the Earth's surface warms up.
c. Why are carbon dioxide levels so high and why does it matter?

G. A delicate balance
1. The surface temperature of Earth depends on the balance of a heat budget.
a. The budget remains balanced when the amount of energy coming in equals the amount going out.
b. If the balance is upset, the temperature will change.
2. Most influential factor affecting weather and climate is heat.
3. Where does the heat come from? Only a small portion of the sun's energy is intercepted and contained by our atmosphere.

IV. What is the greenhouse effect?
A. Have you ever been in a car that has been sitting out in the sun?
1. What do you do to cool it off? Open the windows/doors, turn on the A/C.
2. If the surface of the earth warms, there are no windows to open to cool it off.
a. How does this warming happen?
B. The Earth is surrounded by a blanket of gases that make up our atmosphere.
1. When the solar energy from the sun strikes our atmosphere, some of the solar rays bounce off particles in Earth's atmosphere and return to outer space.
a. This reflected light makes Earth look like a star from other places in the solar system.
2. Some solar rays penetrate our atmosphere and reach the surface of the Earth.
a. The solar radiation that strikes the Earth's surface is converted to heat energy (infrared) that warms the planet.
1. When the Earth is warm it also radiates infrared light energy.
b. Some solar rays bounce off the surface off the earth as Infrared light energy.
1. Some of these infrared rays escape back to outer space.
2. Some infrared rays are absorbed by gases in our atmosphere called greenhouse gases resulting in additional warming.
3. This infrared energy that is trapped by greenhouse gases contributes to the warming of the planet.
a. The higher the concentration of greenhouse gases, the more heat energy that is trapped and re-emitted to further warm the surface of the earth and lower atmosphere.
3. Greenhouse gases allow the Earth to be just the right temperature for life.
a. Are all greenhouse gases bad? No, without these gases temperatures on Earth would be intolerably cold (about 0.4F or –18C)

b. An overabundance of greenhouse gases is having a warming effect and could make the planet intolerably hot...too much of a good thing.

1. Ask a student what is their favorite food. Has s/he ever eaten so much of it that they got sick?
2. Idea is that some is good, but too much of a good thing can make you sick.
3. Same idea with the greenhouse gases: we need food to survive, but too much is making the planet sick.

C. What are greenhouse gases and where do they come from?

1. A greenhouse gas is any gas that can absorb infrared radiation in the atmosphere.
2. The Earth's atmosphere is composed of 78% nitrogen, 21% oxygen and 1% argon by volume with lesser amounts of greenhouse gases including water vapor, carbon dioxide, methane, nitrogen oxides and halocarbons.
3. Natural cycles have maintained these gases at a level that is tolerable for life.
   a. What has changed?

V. Human Contributions to Climate Change

A. How have humans influenced the changes scientists are observing? (i.e. how have human activities and choices changed the composition of the atmosphere?)

1. Since the start of the industrial revolution (around 1760), human activities have changed the concentrations of these gases.
   a. The Industrial Revolution was a time of great change: hand tools started to be replaced by machinery and manufacturing became more automated with the use of the coal fired steam engine.
2. Most greenhouse gases are emitted to meet the needs of the modern industrial world.
   a. The most industrialized nations in the world contribute the most greenhouse gases into the atmosphere.
3. Carbon dioxide accounts for almost half of global warming.
   a. Carbon dioxide can remain in the atmosphere for almost 200 years.
   b. Carbon is an essential element of the natural environment—all living things are mostly composed of carbon.
      1. Carbon is moved through the environment as it is absorbed by the oceans, plants and soil organisms and then released as waste and through decomposition in a process known as the carbon cycle.
   c. Changes in land use disrupt the balance of carbon.
      1. When trees are cut down and burned the carbon in the trees is transformed into a gas called carbon dioxide and released into the atmosphere.
      2. Trees are considered carbon sinks or places where carbon is absorbed and removed from the atmosphere, so fewer trees = fewer carbon absorbers.
4. Carbon dioxide is also released into the atmosphere by burning "fossil fuels."
   a. Fossil fuels are formed over millions of years as heat and pressure work on the fossilized remains of plants and animals deep within the Earth's crust.
   b. Can you name any fossil fuels? Examples: gasoline used by cars and trucks, coal and natural gas used by power plants to create electricity.

c. Fossil fuels currently provide 85% of the energy used in the United States, two thirds of our electricity and almost all of our transportation fuels.

5. Methane and nitrous oxide are more effective at trapping heat than carbon dioxide, but constitute much smaller quantities of the atmosphere.

a. Methane is around 20 times more efficient at trapping heat than CO2

1. Methane lasts in the atmosphere for about 12 years

2. Methane is produced naturally in the environment when bacteria breaks down organic materials in anaerobic conditions.

b. Man-made production of methane comes from rice cultivation, coal mining, livestock (especially cattle) and landfills.

c. Nitrous oxide is around 300 times more effective at trapping heat than CO2

1. Most nitrous oxide comes from the agricultural industry—nitrogen based fertilizers and livestock manure.

6. More greenhouse gases in the atmosphere means more heat is radiated back towards the Earth's surface.

1. Global air temperatures have risen one and a half degrees in the last hundred years.

a. And the Earth has warmed twice as fast in the last fifty years as in the fifty years before that.

b. The Earth's temperature rise coincides with the Industrial Revolution.

c. Nine out of ten of the hottest years on record have occurred since 2001.

d. 2010 was the hottest year on record.

7. Humans influence the climate with the choices we make. Could better choices about energy consumption lead to different predictions about the future?

1. The current rate of global climate change could have devastating impacts.

VI. Possible local and global effects of a warmer climate.

A. There is no doubt that climate change is a significant issue and may be the central environmental challenge during your lifetime.

B. Scientists are learning all the time. While they do know that things are heating up, they are not certain about how warming will effect the Earth's complex systems and the interrelationships between these systems.

C. Change in precipitation patterns

1. What do you see when you look up in the mountains in the winter? Snow.

2. If it rained in the mountains instead of snowed during the winter, how would that impact your life?

a. Recreation: Do you play in the snow?

b. Biodiversity: What type of tree grows up in the mountains?

1. Sequoias are thirsty trees and depend on that annual snow pack for water. The soil is capable of absorbing enough snow melt to last the entire summer.

c. Agriculture: When do farmers need the water for crops? Summer/dry season

1. The annual snowpack is like a reservoir of water. It slowly melts and flows down to the valley when it is most needed.

a. California's agricultural industry has been built around having this snow melt in the summer for irrigation.

2. If the winter snow came as rain, it would just flow down and out and would not be available during the hot, dry season.
    a. Lots of precipitation, that is no longer held in the mountains as snow, would likely cause flooding during the winter months.
3. Plants, animals and humans have all adapted to this environment. We all take advantage of the snowpack. If is disappears, how will we have to change?

D. Changes in biodiversity
1. The changes scientists are predicting could happen within the next 100 years
2. Do you think all creatures, plants and humans will be capable of adapting?
    a. What features would help an organism to adapt quickly? some ideas...
        1. Ability to migrate.
        2. Short reproduction cycle.
        3. Wide range of tolerances for water, sunlight, food etc.
        4. Ability to think critically.
3. Throughout the Earth's history, the climate has gone through cyclical changes that happen over thousands years. These slow cycles provide plenty of time for plants and animals to adapt to their new environment.
    a. Some species will not be able to keep up with the changes and face extinction.
    b. Some species may benefit as climate change increases their range.
4. Climate change has the potential to stress or even alter ecosystems beyond repair.

CLIMATE CHANGE GAME—Hey Bear! (adapted from Project Wild—Oh Deer!)
Instructions:
1. Conduct a quick review of habitats: What is a habitat? Place where an animal lives.
What do all organisms need to survive in their habitat? Food, water, shelter and space.
2. Explain to students that they will be participating in a process called scenario planning to predict or hypothesize about what might happen to a population of black bears in a changing climate.
3. Scientists use scenario planning to make predictions or to hypothesize about future events. The predictions are not just guesses. They are based on scientific evidence and understanding.
4. Each student will have a role to play in our habitat.
5. Select 8 students to play the role of black bears in our habitat.
6. Each black bear will be given a photo of the bear they will be playing attached to four cards that are colored and numbered for each round of the game.
8. Have the black bears line up in front of the class to establish a visual image of the size of our black bear population.
7. Each remaining student will be given a ring with four pieces of colored paper numbered for each of the four rounds of the game. Each color corresponds to an element required for survival: blue=water, yellow=space, green=food and pink=shelter. **Make sure to pass out the rings from the bag marked, "The Habitat—Essential" first. These rings have a special mark. All of these rings must be in play for the rounds to work. Use the rings from "The Habitat—Extra" bag for the rest of the class.
8. Each bear will be looking for one of these elements to survive. The bear must find this element within the habitat or it will die.
9. Explain to the class that we will be playing four rounds of Hey Bear! The amount of food, water and shelter available to the bears in our population will change each round based on different scenarios resulting from a rapidly changing climate.
10. The students will be asked to predict how these changes might affect the black bear population and to track the changes what actually happen to the populations.

Discover Your Changing Climate

Rangers in the Classroom—Presentation
Lesson Plan

Scenario #1—25 years into the future and the climate is similar to current conditions. Bear population: 8.
1. Explain current climate conditions: no weather extremes and no major resource limitations.
2. Ask the students to predict what they think will happen to the black bear population under these conditions and why.
3. Escort the black bears into hibernation—out of the room.
4. Have the black bears flip to the card labeled "1" so they know which resource they will be looking for in this round.
5. Explain to the bears that when they come out of hibernation (back into the classroom) that they are to slowly and quietly search their habitat for the element they need to survive.
6. Only one bear can use each available element (e.g. if two bears are looking for food/green cards, and there is only one food/green card in the habitat, they cannot share and one will die).
7. Within the habitat, have the students place the card set with card "1" in plain view on top of their desks.
8. The bears are then escorted back into the room to search for what they need to survive.
9. Emphasize that the bears are to move slowly and carefully through the environment, so as not to give away their position to other bears. The elements of the habitat should remain quiet and still.
10. One black bear will not be able find food/green card and will die in this round.
11. The black bear becomes part of the habitat.
13. Review the student predictions for this round and the actual results.
14. Explain that even though one bear died in this scenario, the remaining bears found everything they needed and one bear will have two cubs this winter.
15. Select two different students to play the new bear cubs. The bear population is now 9 (one died, but two cubs were born).
16. Before sending the black bear population back into hibernation, explain the new scenario for the next round.

Scenario #2—50 years into the future and there is a major drought. Bear population: 9.
1. Explain current climate conditions: hot with very little precipitation resulting in a major drought.
2. Ask the students to predict what they think will happen to the black bear population under these conditions and why.
3. Escort the black bears into hibernation—out of the room.
4. Have the black bears flip to the card labeled "2."
5. Within the habitat, have the students flip the card set to "2" and place it in plain view on top of their desks.
6. Proceed as with Scenario #1.
7. Two black bears will not find food and two will not find water.
8. These four dead bears become part of the habitat.
9. The bear population is now 5.
10. Review the student predictions for this round and the actual results.
11. Before sending the black bear population back into hibernation, explain the new scenario for the next round.

Scenario #3—75 years into the future and there is major flooding. Bear Population: 5
1. Explain current climate conditions: hot with exceptionally high levels of precipitation. Rain is falling in the mountains instead of snow resulting in a major drought.
2. Ask the students to predict what they think will happen to the black bear population under these conditions and why.
3. Escort the black bears into hibernation—out of the room.
4. Have the black bears flip to the card labeled "3."
5. Within the habitat, have the students flip the card set to "3" and place it in plain view on top of their desks.
6. Proceed as with previous scenarios.
7. Two black bears will not find food.
8. These two dead bears become part of the habitat.
9. The bear population is now 3.

10. Review the student predictions for this round and the actual results.
11. Before sending the black bear population back into hibernation, explain the new scenario for the next round.

Scenario #4—100 years into the future and there is a major drought with increased numbers of intense forest fires. Bear population: 3.

1. Explain current climate conditions: hot with very little precipitation resulting in a major drought and numerous, intense forest fires.
2. Ask the students to predict what they think will happen to the black bear population under these conditions and why.
3. Escort the black bears into hibernation—out of the room.
4. Have the black bears flip to the card labeled "4."
5. Within the habitat, have the students flip the card set to "4" and place it in plain view on top of their desks.
6. Proceed as with previous scenarios.
7. Two black bears will not find food.
8. These two dead bears become part of the habitat.
9. The bear population is now 1.
10. What might happen to the bear population with only one bear left?

Wrap-up:

Scenario planning is not about forecasting the future...it is about using our current understanding of the natural world to make predictions about things might change in the face of our changing climate.

E. Should anyone care about climate change?

1. After the game, ask students how they feel about the potential futures predicted with a changing climate. Ask them why they think it is important to study how and why the climate is changing.
2. The NPS and scientists around the world think it is important to study our changing climate as it will affect all people.
3. The NPS has decided to set an example and make different choices regarding energy consumption and greenhouse gas emissions.
    a. The NPS wants to share our knowledge with our neighbors and community members...to be part of the solution.
4. A warming climate is predicted to raise sea levels and change precipitation patterns. It may alter the variety of trees in our forests, the types of crops grown and harvest yields, and local water supplies.
5. Many types of ecosystems, human health, plant and animal biodiversity and features of some of our National Parks may be permanently altered.

VII. Climate Friendly Park—NPS Climate Change Response Program

A. When the NPS was created in 1916, it was given the job of protecting and preserving these unique places "unimpaired" for future generations.

B. As scientists learn more about climate change, the NPS has realized the need to develop management practices, engage in conservation efforts and educate NPS staff and the public on climate friendly practices.

C. The goal is to protect not only the resources within park boundaries, but to be actively involved in the protection of the natural environment on a global scale

D. Sequoia and Kings Canyon is a Climate Friendly Park trying to reduce our carbon footprint.

1. Why do they think a park ranger is here to talk about Global Climate Change?

a. As stewards of these unique natural and cultural treasures, the NPS is trying to understand and learn how to mitigate the impacts of a changing climate.

1. What is your carbon footprint?
   a. A **carbon footprint** is a measure of the impact our activities have on the environment, and in particular climate change.
   b. It relates to the amount of greenhouse gases we produce in our day-to-day lives through burning fossil fuels for electricity, heating and transportation etc.
2. Efforts to reduce our carbon footprint at Sequoia and Kings Canyon.
   a. Hybrid cars
   b. Recycling
   c. Replacing incandescent light bulbs with energy efficient compact fluorescent light bulbs, which use 60—80% less energy than incandescent bulbs and save about $30 in energy costs over the life of the bulb.
   d. Restoration projects to restore natural habitats
   e. Replaced regular toilets with low-flow toilets

VIII. What can you do to minimize the effects of global climate change?

A. Learn more about your environment and what it needs to be healthy.
B. Plant a tree.
C. Turn off lights, TVs and computers when you do not need them.
D. Unplug appliances when you're not using them. Even though they are "off" they still use power.
E. Walk or ride your bike instead of taking a car.
F. Use water efficiently
G. Recycle or reuse whenever possible.
H. Get involved in making changes in your home or school.
I. Rethink what is possible for you and the planet.
J. Every little bit helps: Current national recycling efforts reduce greenhouse gas emissions by 49.9 metric tons of carbon which is equivalent to the emissions from about 39.6 million passenger cars.

IX. Conclusion

There is a great deal we still don't understand about the future of the Earth's climate and how climate change will affect humans and the ecosystems we rely on. We still don't know exactly how these changes will impact water supplies, sea level, human health or the number and intensity of forest fires. The good news is that we know humans play a part in the process. We have the power to make a difference. Our hope is that you will take what you have learned today and spread that message of hope. Learn more about the possible effects of a changing climate so you can contribute your ideas to finding solutions to a complicated process. Encourage students to visit the park and pass out park maps and fee waivers.

Discover Your Changing Climate

Rangers in the Classroom—Presentation
Lesson Plan

Vocabulary

Adaptation—noun—a change or adjustment in structure or habits that allow a species or individual to improve its condition in relationship to its environment

Atmosphere—noun—the whole mass of air surrounding the earth

Carbon Sink—noun—a natural or artificial reservoir that accumulates and stores carbon-containing chemical compounds for an indefinite period.

Climate—noun—the average condition of the weather at a place over a period of years

Ecosystem—a community of organisms and their environment functioning as an ecological unit.

Fossil Fuel—noun—any naturally occurring carbon or hydrocarbon fuel, such as coal, petroleum, peat and natural gas formed by the decomposition of prehistoric organisms.

Greenhouse Effect—noun—warming of the surface and lower atmosphere of a planet that is caused by the conversion of solar radiation into heat in a process involving selective transmission and short wave solar radiation by the atmosphere, its absorption by the planet's surface, and reradiation as infrared which is absorbed and partly reradiated back to the surface by atmospheric gases.

Greenhouse Gas—noun—any gas that can absorb infrared radiation in the atmosphere.

Hypothesis—noun—a tentative assumption made in order to draw out and test its logical or empirical consequences.

Industrial Revolution—noun—the totality of changes in economic and social organization that began about 1760 in England and later in other countries, characterized chiefly by the replacement of hand tools with power-driven machines, as the power loom and the steam engine, and by the concentration of industry in large establishments.

Life Zone—noun—a geographic region characterized by a distinct set of plants and animals, usually associated with a particular elevation.

Scientific Method—noun—principles and procedures for the systematic pursuit of knowledge involving the recognition and formulation of a problem, the collection of data through observation and experiment, and the formulation and testing of hypotheses.

Species—noun—a class of individuals having common attributes and designated by a common name

Weather—noun—the state of the atmosphere with respect to heat or cold, wetness or dryness, calm or storm, clearness or cloudiness.

Bibliography

Dow, Kristen and Thomas E. Downing, *The Atlas of Climate Change*. Berkley and Los Angeles, CA: University of California Press, 2007.

Grant, Tim and Gail Littlejohn, *Teaching About Climate Change*. Gabriola Island, British Columbia, Canada: New Society Publishers, 2008.

Knox, Joseph and Ann Foley Scheuring, *Global Climate Change and California*. Berkley and Los Angeles, CA: University of California Press, 1991.

Clean Air Kids
http://www.clean-air-kids.org.uk/globalwarming.html

Department of Energy
http://www.energy.gov/energysources/fossilfuels.htm
http://www.education.arm.gov/studyhall.stm

Environmental Protection Agency
http://www.epa.gov/climatechange/kids/cc.html

National Aeronautics and Space Administration
http://climate.nasa.gov/kids/

National Geographic
http://environment.nationalgeographic.com/environment/?source=NavEnvGlobal

National Wildlife Federation
http://online.nwf.org/site/PageNavigator/ClimateClassroom/cc_about_climateclassroom

The Climate Institute
www.climate.org

The National Park Service
http://www.nps.gov/climatechange/at parks.cfm

Skeptical Science
http://www.skepticalscience.com/

Tiki the Penguin—One world.net's Kid Channel
http://tiki.oneworld.net/global_warming/climate_home.html