Arthur Carhart National Wilderness Training Center's

Wilderness Investigations

A Subject-Integrated Curriculum for Grades 9 – 12
High School

Wilderness Applications/Lesson 8
Climate Change and Wilderness

Goal: Students will understand why wilderness areas are important as we seek to understand climate change.

Investigation Objectives
Audience: 9-12 grades
Behavior: Students will explore climate change and climate change adaptations by interviewing a grandparent or elder, reading an article about climate change, discussing climate change adaptation strategies, researching regional climate change adaptations, and reading an article on why wilderness are important to climate change.
Condition: Students will be given a written prompt for an interview, an article about climate change, resources to research climate change adaptations in a geographic region, and an article on wilderness and climate change.
Degree: Students will share their interviews and find similarities within the class, students will share their thoughts and feelings on an article about climate change, students will make a list of climate change impacts and adaptations, students will create a news broadcast to present their research on regional climate change impacts and adaptation, and students will create and illustrate a children's book on climate change and wilderness.

Common Core Standard Connections
NOTE: See Common Core Standards sections to see listed objectives for this and other lessons/activities.

Time Requirement: 50 minutes

Materials/Resources Needed and Pre-Investigation Tasks
- Attached articles
- Computer access
- Supplies for students to create a children's book (paper and art supplies)

Teacher Background:
Before starting this lesson it is important to have a solid understanding of climate change and climate change adaptations as well as the difference between weather and climate.

Note: That this lesson is not meant to launch a debate on whether or not climate change is happening or a debate on the causes of climate change—it is meant to launch a discussion on how the climate has been and continues to change.

In addition, at least a few days before teaching this lesson, give students the assignment of asking a grandparent or senior: Have you noticed any changes in the seasons since you were a little kid? The students should record their answers and be prepared to share them in class.

Climate change is happening

Our Earth is warming. Earth's average temperature has risen by 1.4˚F over the past century, and is projected to rise another 2 to 11.5˚F over the next hundred years. Small changes in the average temperature of the planet can translate to large and potentially dangerous shifts in climate and weather.

The evidence is clear. Rising global temperatures have been accompanied by changes in weather and climate. Many places have seen changes in rainfall, resulting in more floods, droughts, or intense rain, as well as more frequent and severe heat waves. The planet's oceans and glaciers have also experienced some big changes - oceans are warming and becoming more acidic, ice caps are melting, and sea levels are rising. As these and other changes become more pronounced in the coming decades, they will likely present challenges to our society and our environment.

Humans are largely responsible for recent climate change

Over the past century, human activities have released large amounts of carbon dioxide and other greenhouse gases into the atmosphere. The majority of greenhouse gases come from burning fossil fuels to produce energy, although deforestation, industrial processes, and some agricultural practices also emit gases into the atmosphere.

Greenhouse gases act like a blanket around Earth, trapping energy in the atmosphere and causing it to warm. This phenomenon is called the greenhouse effect and is natural and necessary to support life on Earth. However, the buildup of greenhouse gases can change Earth's climate and result in dangerous effects to human health and welfare and to ecosystems.

The choices we make today will affect the amount of greenhouse gases we put in the atmosphere in the near future and for years to come.

Source: http://www.epa.gov/climatechange/basics/

Step-by-Step Presentation Instructions

The teacher will ask students to "think, pair, and share": what is the difference between weather and climate? The class should come to the observation that: The difference between weather and climate is a measure of time.
Weather is the state of the atmosphere at a specific time and place in regards to temperature, humidity, atmospheric pressure, wind, precipitation, etc.
Climate is the measurement of the average pattern of temperature, humidity, atmospheric pressure, wind, precipitation, etc. in a given region over a long period of time.

Next, the teacher will ask students to use their discussion of climate to come up with a definition of climate change. The class should come to the observation that climate change refers to any significant changes in the measures of climate lasting for an extended period of time—over several decades or longer. Therefore, a single hot day or snow storm is not indicative of climate; rather, it is indicative of weather.

Then, the teacher will ask the students to get into groups of 3-4 students and will share the responses from their interview with a grandparent or senior (see teacher background). Then, the groups can share with the class some generalizations or commonalities between the interviews. Once all the groups

have shared, see if there are generalizations or commonalities that can be made about the sum of class interviews.

The teacher should then have students read the attached article on climate change from the Environmental Protection Agency (see teacher background).

After reading the article, the teacher should ask students if they found anything surprising in the article? Then, the teacher should ask students to think of impacts that may/do occur to humans and nature from climate change? The list may look like this:

- Extended drought
- Lack of fresh water
- Reduced crop yields
- Desertification
- Melting glaciers
- Increase in invasive insects and plants

Then, the teacher should ask students to brainstorm any ways in which humans can adapt their landscape and daily lives to minimize the effects of climate change.

Climate change adaptations: a response to climate change that strives to minimize the vulnerability of social and biological systems to the effects of climate change. Even if emissions are stabilized soon, climate change and its effects will last many years, and adaptations will be necessary.

The list may look like this:

- Use less water
- More water storage, such as reservoirs
- Drought resistant crops, dry farming
- Fight invasive insects/plants with biocontrol (competitive insects/plants)

After sharing the interviews from grandparents/seniors, reading about climate change, and discussing climate change adaptation strategies, students should be divided into groups of two. Each group will be given a geographic region of the United States, such as: Alaska, U.S. Islands, Southwest, Northeast, Northwest, Midwest, and Great Plains. If there are more groups than geographic locations, then students could be designated an international geographic region, such as the Amazon, the Sahara, the Himalayas, etc. The students should have time to research the impacts of climate change in their region. Students should not have a problem finding information on climate change and their region on the internet. One example of a regional climate change data base is this EPA site: http://www.epa.gov/climatechange/impacts-adaptation/. If it is not possible to provide internet access during class, then the teacher can

go onto the EPA webpage or a similar webpage and print off the regional climate change impact/adaptation pages and distribute these to the student groups. The students will use their information to create a 2-3 minute news report that they will present to the class—the report should include regional impacts as well as adaptations.

Assessment: Students will focus on why wilderness areas are important to climate change. They will do so by reading the attached article that introduces the topic of wilderness and climate change:

Wilderness Climate Change

As defined in the Wilderness Act, a wilderness "may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value." In 1964, when the Act was written, climate change was not yet on the national or global radar screen. It was not addressed by name, and referred to only by inference—as above, under "ecological", "scientific", "educational" — language of the Wilderness Act. But times have changed. Today, climate change is regarded by many, especially scientists, as the fundamental threat facing our species' continued life on earth. It is definitely a global topic of concern. But what is the connection to wilderness and what is its importance to climate change? Wilderness areas, because they offer the least disturbed habitats, naturally mitigate known factors that affect the climate. The undisturbed habitat which wilderness offers also provides a way for wildlife in these ecosystems to adapt to changes in climate. Human-caused climate change threatens the values for which wilderness areas were designated, such as clean air and water, and wildlife. It can also expand non-climate-related threats to wilderness, such as invasive species and habitat fragmentation. Wilderness does have a natural defense: its mere existence. Wilderness, just by being wild and natural, provides a critical means for animals and plants to adapt to climate change by allowing them to move freely and by reducing the adverse effects of change on ecosystem services and values. In the climate change lexicon, carbon dioxide is a "greenhouse" gas and a leading cause of global warming. Wilderness areas suppress naturally the release of carbon dioxide gas. The trees within forested wilderness areas, aside from providing shade and cool, absorb and lock away carbon dioxide in the wood, roots and leaves. In total, a forest is a carbon storage area, or "sink," that stores carbon, keeping it from becoming available as a "greenhouse" gas. Because water is the most limiting resource in arid ecosystems, changes in global and regional precipitation patterns in desert wilderness areas can result in substantial effects, such as increased soil erosion, shrinking vegetative cover, diminished productivity, invasion of exotics plants and the loss of native species. In further research to help anticipate the advancing effects of climate change, scientists can look to the past. Much of our knowledge about past climates has come from old trees, wood, and pollen cores that increasingly can be found only in undisturbed wilderness lands. Wilderness also protects and connects unfragmented natural areas, allowing wildlife to "adapt" to climate change. As climate change advances, some species of wildlife will migrate to more suitable environments. Species that are unsuccessful at finding suitable environments will suffer increasing extinction rates, resulting in an overall loss of biodiversity. For example, recent research has shown the wolverine to be particularly vulnerable to climate change. Sensitive to the timing and duration of snow cover, the research indicates that wolverine populations will likely become smaller and more fragmented in the second half of the 21st century due to contiguous areas of spring snow cover becoming smaller and more isolated.

Source: http://www.wilderness.net/toolboxes/documents/50th/Wilderness_ClimateChange.pdf

Then students will break into groups of five and will be given the attached document. Students in the group will then each pick an individual topic: understanding ecological systems, sustaining biodiversity, connecting landscapes, providing ecosystem services, and fostering human-nature relationships. As a group, they will create a short children's book on climate change and wilderness. Each individual is responsible for creating 1-3 pages of text and illustrations on their topic. The children's book should be a cohesive work—so groups will need to work together to create an outline for how the individual components are going to flow to tell a unified story. The story must also include 1-3 pages on what individuals, classrooms, schools, and towns can do to minimize their contribution to climate change. This activity is best when students have an actual audience in mind—and either have a chance to spend time sharing their books with elementary students or can donate their books to an elementary school classroom.

Wilderness contributes to climate change adaptation through:

- ***Understanding ecological systems***. Wilderness areas, like all lands, are affected by a host of anthropogenic influences, from fire suppression to air pollution. However, these influences are relatively less pronounced in wilderness and hands-off management is the norm. Therefore, wilderness provides one of the best baselines for understanding how ecological systems, from grassland to alpine tundra, function and respond to a changing climate (4).

- **Sustaining biodiversity**. The large scale and long-term protection of wilderness provides one of the best and most economical opportunities to sustain biodiversity and the dynamism of ecosystems in the face of climate change (5). The legal mandate to protect "the community of life," particularly in wilderness, allows Forest Service wilderness to protect entire ecosystems and the wide range of environmental gradients necessary for species migration, dispersal, and viable populations as the climate changes.

- ***Connecting landscapes***. Wilderness, more than any other land classification, provides the necessary connectivity across large landscapes so plant and animal species have the opportunity to move from one area to another under a changing climate (6).

- ***Providing ecosystem services.*** Wilderness provides many goods and services that benefit people in surrounding landscapes, and such ecosystem services will likely be increasingly important under a changing climate (7). For example, in the western states, more than 50% of the water supply comes from National Forest System land and most headwater watersheds are located in wilderness.

Other examples of ecosystem services include flood mitigation and carbon sequestration.

- ***Fostering human-nature relationships***. Wilderness provides one of the last reminders of the human connection to the natural world, with inspirational, therapeutic, spiritual, cultural, and psychological values that grow increasingly important in a world dominated by urbanization and anthropogenic climate change (8).

  Source: http://www.fs.usda.gov/ccrc/topics/wilderness

  Evaluation Grading Scale: 12 total points

	Excellent (4)	**Good (3)**	**Fair (2)**	**Poor (1)**
News Report Presentation	Cleary highlighted impacts and adaptations of region	Highlighted some impacts and adaptations of region	Impacts and adaptations were not clear.	Incorrect or no impacts and adaptations were communicated.
Children's Book Contribution	Creative, well written and illustrated, clearly understood and communicated the correlation between climate change and wilderness	Well written and illustrated. Understood/conveyed correlation between climate change and wilderness.	Not creative and weak writing/illustrations. Indicative of a lack of understanding between climate change and wilderness.	Not creative and poorly written/illustrated. Indicative of not understanding climate change and wilderness.
Other:				
Other:				
Other:				