



From Global to Local: Climate Change & Your Local Watershed

Introduction: This lesson explores the connection between climate change and water resources. The lesson begins by examining the amount of freshwater available worldwide and then assesses how climate change will impact freshwater resources through several case studies. Additionally, students will investigate the regional and local impacts of climate change by learning about their school's local watershed(s). Lastly, students will evaluate their individual water usage and discuss methods of conserving water resources under a changing climate.

Grade Level & Subject: 7-12. Earth Science, Environmental Science, Biology, Government, Economics, and Social Studies.

Length: One class period.

Objectives: This exercise will examine the relationship between climate change and water resources from the international to individual scale. Students will understand the concept of watersheds, the effects of climate change on local water conditions, and the individual's impact on water supply and demand.

Assessment: In addition to student participation, research and calculations, a teacher generated questionnaire can be created from the final project to evaluate individual water consumption and identify steps to improve water quality and supply in the local community.

Standards:

- NSS-G.K-12.5 Environment and Society
- NSS-G.K-12.6 The Uses of Geography¹
- NS.9-12.1 Science as Inquiry
- NS.9-12.3 Life Science
- NS.9-12.4 Earth and Space Science
- NS.9-12.5 Science and Technology
- NS.9-12.6 Personal and Social Perspectives²
- NSS-EC.9-12.3 Allocation of Goods and Services
- NSS-EC.9-12.16 Role of Government³
- NT.K-12.2 Social, Ethical and Human Issues
- NT.K-12.5 Technology Research Tools
- NT.K-12.6 Technology Problem-Solving and Decision Making Tools⁴

¹ http://www.educationworld.com/standards/national/soc_sci/geography/k_12.shtml.

² <http://www.education-world.com/standards/national/science/index.shtml>.

³ http://www.education-world.com/standards/national/soc_sci/economics/9_12.shtml.

⁴ http://www.education-world.com/standards/national/technology/k_12.shtml.

Materials:

- One liter bottle;
- Map of watershed where school is located;
- Information on rainfall and water sources for watershed;
- Computers with internet access.

Warm-up: How much freshwater do we really have?

The purpose of this activity is to emphasize the limited supply of freshwater worldwide. Freshwater is in fact a non-renewable resource and climate change is increasing the threat to availability. First, begin by assessing the global availability of freshwater by drawing one liter of water into the bottle (one liter being 34 fluid ounces). Pour roughly 97% or 33 ounces of the water into a second container (don't worry about exact amount – a rough estimate is sufficient to make the point). The water in the second container represents the amount of water on Earth that is salt water in the oceans. The remaining water in the first bottle represents the amount of freshwater on Earth. Next, take roughly 2.2 % or about 1 ounce of the water in the first bottle, and pour that into a third container. This amount represents the amount of freshwater that is locked in ice caps and glaciers. The remaining water in the original bottle, 0.3%, is the amount of freshwater available for everyday use. This is the water found in all the rivers, lakes, streams, and precipitation on Earth. It is also the water needed for 6.6 billion humans. Although Earth is often called the 'Blue Planet,' our relationship to this finite resource deserves re-evaluation.

Activity One: International and Regional Scales

A. How will climate change impact the limited supply of freshwater? This activity explores the relationship between a changing climate and freshwater, focusing on how water issues are central to any climate. Introduce this step by first discussing the Intergovernmental Panel on Climate Change (IPCC) authoritative reports on the topic.⁵ Utilizing an interdisciplinary approach, the IPCC has several reports that examine climate change from multiple perspectives. Ask students what impacts will climate change have on water resources? Some of these include an increase in natural disasters & extreme weather events, sea level rise, as well as changes in agriculture seasons, biodiversity and water quality. These characteristics and several other follow-up questions are further detailed in Appendix A.

B. Case Studies: This step examines six regional case studies of climate and water in the United States: Northeast, Southeast, Southwest/ West, Pacific Northwest, Midwest and Alaska. Divide the regions according to the number of students and have each group research their region to find examples of climate change's impact on the region's water (many of these can be found in the aforementioned IPCC report). A crucial question to be answered is: "Why might the students' findings have greater frequency *and* impact to the specific region?" After researching their regions, students should discuss their results and compare their findings to other groups. What were the similarities and differences? Additional information on the relationship between climate and water can be found in Appendix B of this lesson. For examples of what each regional case study should include,

⁵ Intergovernmental Panel on Climate Change. <http://www.ipcc.ch/>.

visit the following Environmental Protection Agency (EPA):
<http://www.epa.gov/climatechange/effects/water/northamerica.html>.

Activity Two: Local and Individual Scales

Community Availability: Examining Your Local Watershed. First, examine the EPA's website on watersheds (<http://www.epa.gov/owow/watershed/>) including the introduction, maps and additional information on local watersheds across the country.

Step One. Discuss Watersheds

In conjunction with a map of your local watershed, address the following question: "What is a watershed?" Furthermore, where is your watershed? What are the natural barriers to your watershed? What are the major sources of water for your watershed – rain, surface water, or groundwater? Where is your community located in the watershed? Where is your school? Are the boundaries of the watershed the same as the boundaries between nearby towns? This exercise should define and establish the origin(s) of water supply for your local watershed, as well as the boundaries between towns and natural barriers.

Step Two. How Does Your Community Use its Watershed(s)?

On average, agriculture production is responsible for 69% of water demand, industry for 23% and domestic usage 8%, although these vary from location to location. How does your community's water usage compare to national averages? Here, students can locate their school's or district's water bill as an additional assignment to compare results and help the school go green. Lastly, what protections, if any, does your community have for the needs of the aquatic environment? How can this answer fundamentally determine the integrity of your local watershed?

Step Three. Discuss the Difference Between Water Supply and Demand

Identify the tools that scientists use, such as rain gauges, to measure supply and demand of water resources.⁶ How can your community better conserve and protect its water resources? What are some common practices of conservation in your community? Who is responsible for regulating water supply and demand? Why? Who is ultimately responsible for protection? Why or why not?

Assessment: Individual Water Footprint

Building upon the knowledge of supply and demand in relation to climate change, this step will investigate what an individual can do to decrease their water usage and help protect the local watershed. To assess an individual's water footprint, students can take the Water Footprint Quiz at www.H2Oconserve.org. What is the average use per member of the class? Compare this result with the national average. Is it higher or lower? Why or why not? Discuss various methods that students can implement to reduce their water usage (several examples are found in Appendix B). For example, you can discuss the quantity of water availability if everyone in the community reduced their water usage by "X" percentage. Or, what would be the total communal effect of better

⁶ http://en.wikipedia.org/wiki/Hydrology#Hydrologic_measurements.

storm drainage or reduction in personal shower time? How would either scenario better prepare the community for the impacts of climate change? What is needed most to have the best aquatic environment for your local watershed: technology, science or policy? Can they be used together? Why or why not?

Conclusion: By the lesson's end, students should have a firm understanding of freshwater availability worldwide and how climate change impacts this availability. Students will also comprehend how their individual water usage affects local watersheds and what potential impacts of climate change exist for their watershed case studies. Finally, students should address various methods to conserve and protect their local watersheds.

Appendix A: The Relationship between Climate and Water

- Natural Disasters - increase in magnitude and frequency of extreme weather events such as floods and droughts.

What is the difference between magnitude and frequency of a weather event? What impact do natural disasters have communities?

- Sea Level Rise - increase in global sea levels from melting of glaciers and polar icecaps. Due to rising sea levels, salt water will intrude into coastal aquifers, negatively affecting freshwater quality.

What is the albedo effect, exponential change and thermal expansion of salt water? How will these influence glacial melt and sea level rise? How will sea level rise affect communities and freshwater sources?

- Agriculture - decrease in overall agricultural productivity due to increased potential for droughts, floods, and heat waves and the persistent changes in water supply and soil moisture.

Irrigation methods – drip, canal, rainwater. How would climate change's impact on water resources influence different irrigation methods? Relationship agriculture growth seasons – and erratic climate patterns – would more water necessarily be better? How would changes in agriculture production impact communities?

- Freshwater Biodiversity - decrease in biodiversity as a result of habitat loss and fragmentation (or reconnection, as in the case of freshwater bodies) and the introduction of exotic or invasive species.

What is the definition of biodiversity? What are invasive species? How will freshwater biodiversity be impacted by climate change? How could a change in freshwater biodiversity and an increase in invasive species impact communities?

- Water Quality - decrease in water quality resulting from higher water temperatures and changes in the timing, intensity, and duration of precipitation. Higher temperatures reduce dissolved oxygen levels, which can affect aquatic life. Where stream flow and lake levels fall, there will be less dilution of pollutants; however, increased frequency and intensity of rainfall will increase pollution and sedimentation due to runoff.

Appendix B: Climate and Water Regional Online Sources

- All Regions:

USGCRP, Consequences of Climate Variability and Change Regions and Mega-Regions (regional reports also listed in regional subheadings):

<http://www.usgcrp.gov/usgcrp/nacc/background/regions.htm>.

National Geographic News (U.S.). “Climate Change May Hit Southeast Hardest.” (Aug 11, 2005):

http://news.nationalgeographic.com/news/2005/08/0811_050811_climatechange.html

Climate Hot Map, Climate Impacts in the United States:

<http://www.climatehotmap.org/impacts/>.

In March 2008, Earth Day Network will launch an interactive [Water Portal](#) to examine the world’s water supply, including ‘Adopt-A-Water’ Projects.

- Northeast:

University of New Hampshire, New England Regional Climate Variability and Change Assessment: <http://www.necci.sr.unh.edu/>.

Environment Northeast, Climate Change Roadmap for New England and Eastern Canada:

http://environmentnortheast.org/ENE_Climate_Change_Roadmap_New_England_Canada.htm.

NECI, New England’s Changing Climate, Weather, and Air Quality:

<http://www.neci.sr.unh.edu/necywaq.html>.

USGCRP, Potential Consequences of Climate Variability and Change for the Mega-Region, Northeast: <http://www.usgcrp.gov/usgcrp/nacc/northeast.htm>.

The IPCC Report on Global Warming, Localizing a Global Story – Northeast:

<http://www.ipccinfo.com/northeast.php>.

- Southeast:

USGCRP, Potential Consequences of Climate Variability and Change for the Southeastern United States:

<http://www.usgcrp.gov/usgcrp/Library/nationalassessment/05SE.pdf>.

USGS, Effects of Climate Change on Southeastern Forest:

http://www.nwrc.usgs.gov/climate/fs93_97.pdf.

EPA, Global Climate Change: Impacts for the Southeast:

[http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/SHSU5BNJK2/\\$File/atlanta.pdf](http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/SHSU5BNJK2/$File/atlanta.pdf).

The IPCC Report on Global Warming, Localizing a Global Story – Southeast:

<http://www.ipccinfo.com/south.php>.

- Southwest/ West:

USGCRP, Potential Consequences of Climate Variability and Change for the Mega-Region, West: <http://www.usgcrp.gov/usgcrp/nacc/west.htm>.

University of Arizona, Institute for the Study of Planet Earth:

http://www.ispe.arizona.edu/research/swassess/release4_10.html.

University of Arizona, Climas – Climate Assessment for the Southwest:

<http://www.climas.arizona.edu/>.

Southwest Climate Change Impact Partnership (SWCCIP):

<http://www.oursouthwest.com/climate/>.

The IPCC Report on Global Warming, Localizing a Global Story – West:

<http://www.ipccinfo.com/west.php>.

- Pacific Northwest:

USGCRP, Potential Consequences of Climate Variability and Change for the Mega-Region, Pacific Northwest <http://www.usgcrp.gov/usgcrp/nacc/pnw-mega-region.htm>.

Climate Impacts Group: <http://www.cses.washington.edu/cig/>.

Seattle Post Intelligencer, Our Warming World: Effects of Climate Change Bode Ill for the Northwest: http://seattlepi.nwsourc.com/local/148043_warming13.html.

Pacific Northwest National Library, The Cost of Climate Change in the Pacific Northwest: <http://regionaloutreach.pnl.gov/nwtechtoday/article.asp?id=48>.

- Midwest:

USGCRP, Potential Consequences of Climate Variability and Change for the Mega-Region, Midwest: <http://www.usgcrp.gov/usgcrp/nacc/midwest.htm>.

Center for Integrative Environmental Research, Regional Highlight – Midwest: <http://cier.umd.edu/documents/Midwest-Economic%20Impacts%20of%20Climate%20Change.pdf>.

The IPCC Report on Global Warming, Localizing a Global Story – Midwest: <http://www.ipccinfo.com/midwest.php>.

Union of Concerned Scientists, Confronting Climate Change in the Great Lakes Region: Impacts on Our Communities and Ecosystems: <http://www.ucsusa.org/greatlakes/glchallengereport.html>.

- Alaska:

USGCRP, Potential Consequences of Climate Variability and Change for the Mega-Region, Alaska: <http://www.usgcrp.gov/usgcrp/nacc/alaska-mega-region.htm>.

Center for Global Change and Arctic System Research, University of Alaska Fairbanks, The Potential Consequences of Climate Variability and Change: <http://www.besis.uaf.edu/regional-report/regional-report.html>.

Institute for Social and Economic Research at the University of Alaska Anchorage, Estimating Future Costs for Alaska Public Infrastructure At Risk from Climate Change: <http://www.iser.uaa.alaska.edu/Home/ResearchAreas/climatechange.htm>.

The State of Alaska, Alaska Climate Change Strategy, What will Climate Change mean to Alaska? <http://www.climatechange.alaska.gov/cc-ak.htm>.

EPA, Climate Change and Alaska: [http://yosemite.epa.gov/OAR/globalwarming.nsf/UniqueKeyLookup/SHSU5BMRWA/\\$File/ak_impct.pdf](http://yosemite.epa.gov/OAR/globalwarming.nsf/UniqueKeyLookup/SHSU5BMRWA/$File/ak_impct.pdf).

To learn more, contact EDN's Education Dept. at education@earthday.net
1616 P Street NW, Suite 340, Washington, DC 20036
(Telephone) 202.518.0044, (Fax) 202.518.8794
www.earthday.net/education