



It's Easy Being Green: Green Building and Climate Change

By Kate Drake and Kelsey Poole for Earth Day Network

Introduction: This lesson will introduce students to green building practices and their benefits. Students will first discuss what makes a building green and collaborate to design their own green building. Next, the class will conduct an energy audit of their school. Using this data, they can suggest ways to improve the school's energy efficiency and reduce its carbon output. Students will then assess their own impact on the environment by measuring their carbon footprint.

Grade Level & Subject: Grades 9-12. Environmental Science, Earth Science, Mathematics, Social Studies, Civics.

Length: 30-45 minute lecture, ongoing project length of your choice.

Objectives:

- Learn what makes a building green and why green buildings are healthier for the environment.
- Critical thinking on how to reduce the environmental impact of the individual and the community.

Assessment: Students will be assessed on participation in individual activities, class discussion and projects. Understanding of the material can be evaluated by two written assignments.

Standards:¹

- 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 Perspectives
- NS.9-12.7 History and Nature of Science
- NSS-EC.9-12.3 Allocation of Goods and Services
- NSS-EC.9-12.16 Role of Government
- NSS-G.K-12.5 Environment and Society
- NT.K-12.2 Social, Ethical and Human Issues
- NT.K-12.3 Technology Productivity Tools
- NT.K-12.5 Technology Research Tools
- NT.K-12.6 Technology Problem-Solving and Decision-Making Tools

¹ Education World (2008). *U.S. National Education Standards*. Retrieved March 3, 2008, from <http://www.education-world.com/standards/national/toc/index.shtml>

Materials:

- Computers with internet access
- Ecological Footprint Quiz: <http://www.earthday.net/Footprint/index.asp>
- U.S. Environmental Protection Agency Climate CHECK Program, found online at <http://www.epa.gov/climatechange/wycd/school.html>. To download, click on the link found under point 2.

Warm-up: What is Green Building?

Ask the students what the word “green” means to them. If they immediately respond with something environment-related, encourage them to think of different ways people define “being green.” After a few minutes of discussion, ask students what they think a green building is. Encourage more discussion, then present facts on green buildings.

Green buildings and schools are the latest trend in fighting climate change. A “green” building is defined as one designed through architecture, materials, and fixtures to have a minimal impact on the environment.² See **Appendix A** for specific examples of green building techniques.

The numerous benefits of green building include reduced operating costs, lower energy output, improved health and productivity of those using the building, and reduced carbon emissions and impact on climate change.³ These benefits have been demonstrated through studies, which show that green schools have healthier students and staff, higher attendance rates, and students that perform five to seventeen points higher on standardized tests.⁴

Although green buildings are initially more expensive to build, in the long-run one will save more money with a more energy-efficient green building. For example, many office buildings are built with cheaper black roofing. The extra heat these roofs absorb are offset by increasing use of central air conditioning systems, a major source of greenhouse gas emissions and a large portion of a building’s utility costs. One study determined that a particular company was able to save \$16 million dollars a year in air-conditioning costs switching to reflective roofing on its building.⁵ This practice would be especially beneficial in cities like Atlanta and New York that actually create their own weather due to the heat-island effect. This phenomenon, which is a low pressure system, causing higher temperatures and concentrated rainstorms over a particular area, often occurs in cities where there is a dearth of trees, black roofing, and a substantial amount of pavement.⁶

² Global Green USA (2004). *What Makes a Product Green?* Retrieved March 3, 2008, from <http://www.globalgreen.org/gbrc/whatmakesgreen.htm>.

³ Wilson, A. (2005). Making the Case for Green Building. *Environmental Building News*. Retrieved March 3, 2008, from <http://www.buildinggreen.com/auth/article.cfm?fileName=140401a.xml>.

⁴ Tennessee Advisory Committee on Intergovernmental Relations (2003). *Do K-12 School Facilities Affect Education Outcomes?* Retrieved March 3, 2008, from http://www.state.tn.us/tacir/PDF_FILES/Education/SchFac.pdf.

⁵ Chang, K. (Aug. 2000). Scientists Watch Cities Make Their Own Weather. *The New York Times Online*. Retrieved March 3, 2008, from <http://nytimes.com/>.

⁶ Ibid.

Activity One: Designing a Green School

Step 1: Tell the class that they will be designing a new green school. Break the class into small groups and assign them to a particular focus of the green school. For example, students can focus on roofing, windows, lighting, building materials, cleaning supplies, air quality, or general energy.

Step 2: Have the students research how to use the “expertise” in their green design component, to make the new green school more energy and environmentally friendly. See **Appendix A** for ideas and resources.

Step 3: Reconvene the class and put together all the plans to design the hypothetical green school. Which of these ideas should actually be incorporated with the current school building?

Activity Two: How Green is Your School?

According to the U.S. Green Building Council, buildings account for 65% of electricity consumption, 36% of energy use, 30% of greenhouse gas emissions, 30% of waste output, and 12% of potable water consumption.⁷ The following activity will use the U.S. EPA Climate Check and the scientific method to assess how your school compares to the national average (the italicized words indicate steps of the scientific method).

Step 1: Ask students to *observe* your campus and use the information to *formulate a hypothesis* (an educated guess) regarding the school’s total carbon emissions relative to the national average. Tell them to be more specific than “higher” or “lower,” and to be sure to consider the energy use, waste, and land management.

Step 2: Help students *test their hypothesis* by setting up the [U.S. EPA Climate Check](#) spreadsheet for the classroom. Divide the class into teams and assign each a different area to research. The areas are stationary combustion, purchased electricity and steam, mobile sources, landfill_solid waste, wastewater treatment, refrigeration and air conditioning, and land management. Be sure to explain each of the categories before beginning the project. See **Appendix B** for full details on the specific areas. Students can *gather data* on their subject by talking to the school’s administrative staff, custodial staff, or groundskeeper. To *analyze the data*, enter it into the program and the program will calculate the school’s total greenhouse gas emissions.

Step 3: Have students *draw conclusions* by asking them to discuss the results and what they mean for the school and the environment. Ask students to share experiences they had while conducting the audit. Create a chart on the board showing the results of the audit, and discuss these in terms of the students’ original hypotheses.

Step 4: Now that you know the energy consumption of the school, have the students come up with ways to reduce its environmental impact. As a class or in groups, have students design a program that will reduce energy consumption or waste at the school. They must research the costs of the project and estimate the savings in both energy consumption and budget. Students should consider all the elements discussed in Activity One.

⁷ U.S. Green Building Council (2008). *Green Building Research*. Retrieved March 3, 2008, from <http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1718>.

Optional: If you have little time to complete the full inventory, the Climate Check program has an Inventory Snapshot that briefly covers stationary combustion and purchased electricity, mobile combustion, and landfill solid waste.

Assignment: Students can submit their proposal to their principal, school board, or anyone else who would have the power to implement the changes they seek. As an alternative or a supplement to this, students can hand in an outline of the steps of the scientific method with information on how it applied to this project.

Activity Three: Your Ecological Footprint

According to 2020 Vision, “the United States consumes 25% of the world’s oil, yet has only 2% of global reserves.”⁸ As of 2003, the average citizen of the U.S. uses 12,000 kilowatt-hours of electricity⁹ and generates 20 tons of carbon dioxide per year.¹⁰

Step 1: Have students evaluate their own impact on the environment by taking the Ecological Footprint Quiz, found online at <http://www.earthday.net/Footprint/index.asp>. Once they have taken the quiz they can compare their own footprint to others in the U.S. and around the world.

Step 2: Average the individual values to get a total footprint for the class. How does each student footprint relate to how green the school is? Have your students write two paragraphs suggesting ways that they as individuals can help make their school more environmentally friendly. Suggestions include bringing a reusable lunch box and cloth napkin, walking to school, encouraging reusable usage in the cafeteria and teacher’s lounge, using fewer paper towels and toilet paper, and carpooling.

Assessment: Student’s learning can be assessed from their participation in class as well as their proposal in Activity Two, and the written paragraphs from Activity Three.

Conclusion: At the end of this lesson, students should demonstrate knowledge about green building practices from both an environmental and technological perspective, as well as an understanding of the negative and positive ways human society affects the environment. Continue to encourage students to be conscious of their school’s ecological footprint as well as their own.

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⁸ 2020 Vision Education Fund (2007). *Powershift 2007: A National Tour on Energy Security and Global Warming*. Retrieved March 3, 2008, from <http://www.2020vision.org/library.cfm?aId=91>.

⁹ California Energy Commission (2003). *US Per Capita Electricity Use by State in 2003*. Retrieved March 3, 2008, from http://www.energy.ca.gov/electricity/us_percapita_electricity_2003.html.

¹⁰ Union of Concerned Scientists (2006). *What’s your carbon footprint?* Retrieved March 3, 2008, from <http://www.ucsusa.org/publications/greentips/whats-your-carb.html>.

Appendix A- Activity One, Green building suggestions

<i>Part of Building</i>	<i>Greening options</i>	<i>Resources</i>
Building materials	Avoid using PVC; Use sustainably harvested materials	http://www.healthybuilding.net/pvc/PVC-free_house_features.html http://www.greenbuilder.com/sourcebook/EarthMaterials.html
Cleaning	Avoid cleaning supplies that contain harmful chemicals; Use reusable cleaning products	http://www.ogs.state.ny.us/bldgadmin/environmental/GreenGuidelines.pdf , pg. 10-18
Energy Use	Simple habits such as turning off lights can add up to big energy savings; use renewable energy such as wind or solar	http://www.crest.org/index.html http://www.energystar.gov/index.cfm?c=green_buildings.green_buildings_index
Indoor Air Quality	Good ventilation improves health; using natural heating and cooling processes saves energy	http://www.eere.energy.gov/buildings/info/components/hvac/ http://www.epa.gov/iaq/schooldesign/
Lighting	Switch to compact fluorescent light bulbs; Design for daylighting	http://www.lowes.com/lowes/lkn?action=howTo&p=Improve/engefflght.html http://www.newbuildings.org/ALG.htm http://www.lrc.rpi.edu/programs/daylighting/pdf/guidelines.pdf
Roofing	Reflective roofing deflects heat and lowers cost of air conditioning	http://www.greenbuilder.com/sourcebook/Roofing.html
Water	Install water efficient fixtures; encourage conscious water consumption	http://web.archive.org/web/20070502132209/http://www.dep.state.pa.us/dep/subject/hotopics/drought/facts/school.htm http://www.nps.gov/dsc/dsgncnstr/gpsd/ch8.html
Windows	Insulate windows to prevent energy loss	http://www.pathnet.org/sp.asp?id=16591

Appendix B- Activity Two, EPA Climate CHECK Emission Sources

Stationary Sources	Any piece of equipment that uses fossil fuels for purposes other than transportation, such as a boiler, heater, or generator.
Purchased Electricity and Steam	Most power plants use fossil fuels to produce the electricity that powers a school. Some schools also purchase steam for use in heating.
Mobile Sources	Buses, cars, and trucks that use fossil fuels for energy. Includes commuter vehicles and those owned by the school.
Landfilled Waste	Besides other environmental issues, the breakdown of waste in landfills releases greenhouse gases such as carbon dioxide and methane.
Wastewater	It takes energy from fossil fuels to clean and supply your school with water, and matter in wastewater releases greenhouses gases when broken down.
Refrigerants and Air Conditioners	Refrigerators, freezers, and air conditioners rely on cooling agents with high ozone depleting potential.
Land Management	Use of fertilizers, pesticides, and land management devices all release greenhouse gases. Trees, however, absorb carbon dioxide.

Appendix C- Additional resources

Illinois Resource Guide for Healthy, High-Performing School Buildings.

<http://www.healthyschoolscampaign.org/ilhhpsb/#top>

The School Building Association, “Energy and Water Conservation”

<http://www.cefpi.org/pdf/issue17.pdf>

NCEF Resource List: High Performance Green Schools

http://www.edfacilities.org/rl/high_performance.cfm