



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

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**Introduction:** This lesson will introduce students to green building practices and their benefits. Students will first discuss what constitutes a green building 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, and Civics.

**Length:** 30-45 minute lecture and an ongoing project of your choice.

### **Objectives:**

- Learn what a green building is and why green buildings are healthier for the environment.
- Explore methods on how to reduce the environmental impact of individuals and the community.

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

### **Standards:**

- 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<sup>1</sup>

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<sup>1</sup> Education World (2008). *U.S. National Education Standards*. Retrieved March 3, 2008, from <http://www.educationworld.com/standards/national/>.

## 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 two.

## 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 believe is a green building. 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.<sup>2</sup> 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.<sup>3</sup> 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.<sup>4</sup>

Although green buildings can be more expensive to build, one will save more money with a more energy-efficient green building in the long-run. For example, many office buildings are built with cheaper black roofing. The extra heat these roofs absorb are offset by increasing the usage 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 by switching to reflective roofing on its building.<sup>5</sup> 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, causes 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.<sup>6</sup>

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

<sup>3</sup> 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>.

<sup>4</sup> 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](http://www.state.tn.us/tacir/PDF_FILES/Education/SchFac.pdf).

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

<sup>6</sup> 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:** Now, have students research how to make their designated component 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? Why or why not?

### **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.<sup>7</sup> The following activity will assess how your school compares to the national average.

**Step 1:** First, utilize the EPA's [Climate Check](#) spreadsheet for the classroom's efforts. Then, 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 find information on their subject by talking to the school's administrative staff, custodial staff, or groundskeeper. Once the data are entered, the program will calculate the school's total greenhouse gas emissions.

**Step 2:** 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.

**Step 3:** Now that you know the energy consumption of the school, have students devise methods to reduce the school's environmental impact. As a class or in groups, have students design a program that will reduce energy consumption or waste at the school. They should research the costs of the project and estimate the savings in both energy consumption and budget.<sup>8</sup> Students should consider all the elements discussed in Activity One.

**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. For

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

<sup>8</sup> For more information, examine Earth Day Network's Sustainable Alternatives for School Fundraising. <http://ww2.earthday.net/~earthday/files/SCHOOL%20FUNDRAISING%20-%20FACT%20SHEET%20FINAL.pdf>, or the Campus Climate Challenge's toolkits for success: <http://www.climatechallenge.org/resources/wikibooks>.

instance, Earth Day Network's National Civic Education Project has several successful examples.<sup>9</sup>

**Assessment:** Student's learning can be assessed from their participation in class in addition to their proposal in Activity Two.

**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. Students should also comprehend their school's environmental impact and potential methods to reduce their footprint.

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<sup>9</sup> Earth Day Network's National Civic Education Project. <http://ww2.earthday.net/~earthday/node/12>.

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

**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](http://www.edfacilities.org/rl/high_performance.cfm)