# What Does It Mean to Be Green? *Lesson Plan*

*What does it mean to live sustainability? Students investigate options at different scales.*



**Topic:** "Sustainability" is a goal that many strive for, but what does it mean? How can we achieve it? In this lesson, students consider what societies need to survive and prosper, and how individuals and communities can meet their needs in a sustainable way.

**Grade Level:** High School

**Time Allotted:** 3 class periods of 50 minutes each, not including site visit.

## Performance Objectives

*References are to the Next Generation Sunshine State Standards (2007)*

**Science**

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| SC.912.L.17.11 | Evaluate the costs and benefits of renewable and nonrenewable resources, such as water, energy, fossil fuels, wildlife, and forests. |
| SC.912.L.17.15 | Discuss the effects of technology on environmental quality. |
| SC.912.L.17.16 | Discuss the large-scale environmental impacts resulting from human activity, including waste spills, oil spills, runoff, greenhouse gases, ozone depletion, and surface and groundwater pollution. |
| SC.912.L.17.17 | Assess the effectiveness of innovative methods of protecting the environment. |
| SC.912.L.17.18 | Describe how human population size and resource use relate to environmental quality |
| SC.912.L.17.19 | Describe how different natural resources are produced and how their rates of use and renewal limit availability. |
| SC.912.L.17.20 | Predict the impact of individuals on environmental systems and examine how human lifestyles affect sustainability |
| SC.912.N.1 | Define a problem based on a specific body of knowledge, for example: biology, chemistry, physics, and earth/space science, and do the following:<br>1. pose questions about the natural world,<br>2. conduct systematic observations,<br>3. examine books and other sources of information to see what is already known,<br>4. review what is known in light of empirical evidence,<br>5. plan investigations,<br>6. use tools to gather, analyze, and interpret data (this includes the use of measurement in metric and other systems, and also the generation and interpretation of graphical representations of data, including data tables and graphs),<br>7. pose answers, explanations, or descriptions of events, |

8. generate explanations that explicate or describe natural phenomena (inferences),
9. use appropriate evidence and reasoning to justify these explanations to others,
10. communicate results of scientific investigations, and
11. evaluate the merits of the explanations produced by others.

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| SC.912.N.1.4 | Identify sources of information and assess their reliability according to the strict standards of scientific investigation. |
| SC.912.N.1.7 | Recognize the role of creativity in constructing scientific questions, methods and explanations. |
| SC.912.N.4.2 | Weigh the merits of alternative strategies for solving a specific societal problem by comparing a number of different costs and benefits, such as human, economic, and environmental. |

**Mathematics**

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| MA.912.A.2.1 | Create a graph to represent a real-world situation. |
| MA.912.A.2.2 | Interpret a graph representing a real-world situation. |
| MA.912.A.5.7 | Solve real-world problems involving rational equations (mixture, distance, work, interest, and ratio). |
| MA.912.A.10 | Algebra Standard 10: Mathematical Reasoning and Problem Solving - In a general sense, all of mathematics is problem solving. In all of their mathematics, students use problem-solving skills: they choose how to approach a problem, they explain their reasoning, and they check their results. |
| MA.912.S.1.1 | Formulate an appropriate research question to be answered by collecting data or performing an experiment. |
| MA.912.S.1.2 | Determine appropriate and consistent standards of measurement for the data to be collected in a survey or experiment. |
| MA.912.S.2.1 | Compare the difference between surveys, experiments, and observational studies, and what types of questions can and cannot be answered by a particular design. |
| MA.912.S.3 | Statistics Standard 3: Summarizing Data (Descriptive Statistics) - Students learn to work with summary measures of sets of data, including measures of the center, spread, and strength of relationship between variables. Students learn to distinguish between different types of data and to select the appropriate visual form to present different types of data. |

**Social Studies**

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| SS.912.A.1.5 | Evaluate the validity, reliability, bias, and authenticity of current events and Internet resources. |

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| SS.912.G.2.5 | Use geographic terms and tools to analyze case studies of debates over how human actions modify a selected region. |
| SS.912.G.3.3 | Use geographic terms and tools to explain differing perspectives on the use of renewable and non-renewable resources in Florida, the United States, and the world. |
| SS.912.G.4.5 | Use geographic terms and tools to analyze case studies of the development, growth, and changing nature of cities and urban centers. |
| SS.912.G.5.2 | Analyze case studies of how changes in the physical environment of a place can increase or diminish its capacity to support human activity. |
| SS.912.G.5.3 | Analyze case studies of the effects of human use of technology on the environment of places. |
| SS.912.G.5.4 | Analyze case studies of how humans impact the diversity and productivity of ecosystems. |
| SS.912.G.5.5 | Use geographic terms and tools to analyze case studies of policies and programs for resource use and management. |
| SS.912.E.2.2 | Use a decision-making model to analyze a public policy issue affecting the student's community that incorporates defining a problem, analyzing the potential consequences, and considering the alternatives. |

## Prior Knowledge:

No prior knowledge necessary.

## Overview

Perhaps the most popular definition of the term “sustainability” comes from the 1987 United Nations World Commission on Environment and Development. It defined sustainable developments as those that "meet present needs without compromising the ability of future generations to meet their needs." In addition, the World Business Council for Sustainable Development provides this guidance: “Sustainable development involves the simultaneous pursuit of economic prosperity, environmental quality and social equity. Companies aiming for sustainability need to perform not against a single, financial bottom line, but against [this] triple bottom line.”

This lesson addresses sustainability by asking students to consider what human communities require to “sustain” themselves. In particular, it encourages them to think about the ways in which we can most efficiently produce food, water and energy, while fostering productive commerce, ensuring social equity and protecting the integrity of our natural environment. It asks them to examine a commodity that they use and to think about its impacts to the environment and society and how it can be made more sustainable.

## Key Vocabulary

**Biodegradable**
Made of natural materials that can be broken down into simple compounds and absorbed back into the ecosystem without harm, given the presence of moisture, heat, and micro-organisms. The International Standards Organization has established a standard for products claiming biodegradability of 60 percent biodegradation in 180 days.

**Biodiversity**
The variability among living organisms –animals, plants, their habitats and their genes—from all sources including terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are part. This includes diversity within species, between species, and of ecosystems.

**Biomass energy**
Energy produced by combusting renewable biomass materials (biofuels) such as wood. The carbon dioxide emitted from burning biomass will not increase total atmospheric carbon dioxide if this consumption is done on a sustainable basis (i.e., if in a given period of time, regrowth of biomass takes up as much carbon dioxide as is released from biomass combustion). Biomass energy is often suggested as a replacement for fossil fuel combustion, which has large greenhouse gas emissions.

**Carbon neutral**
A process or product which does not result in either an increase or reduction in the amount of carbon present in the atmosphere.

**Carrying capacity**
The number of people, other living organisms, or crops that a region can support without environmental degradation.

**Consumerism**
The theory that an increasing consumption of goods is economically desirable; also, a preoccupation with, and an inclination toward, the buying of consumer goods.

**Eco-localism**
An economic theory that focuses on the economics of the local community. Its goal is to establish a healthy community economy, to preserve the ecosystem on which the economy depends, and to subordinate the health of the economy to other measures of societal well-being. It recognizes the social nature of human beings as well as the importance of a “sense of place” to them.

**Ecological footprint**
A general term indicating the load imposed by a given population on nature. It represents the area of the Earth's surface necessary to sustain levels of resource consumption and waste discharge by that population.

**Ecosystem services**

The benefits people obtain from natural systems. These include, but are not limited to, providing food and water; regulating flood and diseases; spiritual, recreational, and cultural benefits; and nutrient cycling that enables life on Earth.

**Efficiency**

The degree to which a product or process achieves its objective without wasting the resources allocated for its operation or production; for systems, processes or activities, this is expressed as a ratio of useful energy output to energy input.

**Organic**

Produced with fertilizers and pesticides of animal or vegetable origin, rather than synthetic or manufactured chemicals, and free of manmade compounds. USDA Certified Organic foods and farms cannot use most synthetic or petroleum-derived pesticides and fertilizers, any irradiation, or sewage sludge. No genetic engineering is allowed. Organic farmers use crop rotation, tilling and natural fertilizers, such as compost.

**Permaculture**

A land use and community building movement which strives for the harmonious integration of human dwellings, microclimate, annual and perennial plants, animals, soils, and water into stable, productive communities that are environmentally neutral.

**Renewable**

Used to describe a resource that can be replenished by natural processes in the ecosystem at a rate comparable or faster than its rate of consumption by humans. Unlike fossil fuels, which yield synthetic materials, a renewable resource advances sustainability by leveraging natural capital. For example, renewable energy generally refers to electricity supplied from renewable energy sources such as wind and solar power, geothermal, hydropower, and various forms of biomass.

**Social equity**

Fair access to livelihood, education, and resources; full participation in the political and cultural life of the community, and self-determination in meeting fundamental needs.

**Steady-state economics**

An economic model that strives for qualitative improvements in selected measures of the standard of living for a community or society, rather than for an increase in the scale of the economy as a whole.

**Sustainable commerce**

An exchange of products and/or services that creates economic value in a way that also creates value for society by addressing its needs and challenges.

## Materials

- Still and/or video camera (optional)
- Computer with internet access
- Poster board or display stand

## References

*The following references are found in the Digital Library of the Orange County Water Atlas:*

Climate Change Plan for Orange County Government. 2005. Orange County Government.

Orange County Climate Change Plan Implementation Update for 2009. 2009. Orange County Government.

Peart, Virginia. *The Conservation Balancing Act: Leader's Guide.* 2003. University of Florida Institute of Food and Agricultural Sciences.

*Other references:*

Barnett, Cynthia. *Mirage: Florida and the Vanishing Water of the Eastern U.S.* 2008. Ann Arbor: University of Michigan Press.

Belleville, Bill. *Losing it All to Sprawl: How Progress Ate My Cracker Landscape*. 2006. Gainesville: University Press of Florida.

Cook, John. Skeptical Science: Getting Skeptical About Global Warming Skepticism. Website. Accessed June 2011.

Factsheets. University of Michigan Center for Sustainable Systems. (Peer-reviewed, updated annually.)

Intergovernmental Panel on Climate Change. Website. Accessed June 2011.

McDonough, William. 2002. *Cradle to Cradle: Remaking the Way We Make Things*. New York: North Point Press.

Meadows, Donella H., Dennis L. Meadows, Jorgen Randers and William W. Behrens III. 2004. *Limits to Growth: the Thirty-year Update.* White River Junction, VT: Chelsea Green Publishing.

Menzel, Peter. *Material World: A Global Family Portrait*. 1995. San Francisco: Sierra Club Books.

Power Up Florida (website). Orange County Government. (A web portal that provides information on several sustainability initiatives underway in Orange County)

Report of the World Commission on Environment and Development: Our Common Future. 1987. United Nations.

Stanton, Elizabeth K., and Frank Ackerman. Florida and Climate Change: The Cost of Inaction. 2007. Tufts University Global Development and Environment Institute and Stockholm Environment Institute—US Center.

## Procedure

### Engage/Elicit

1. Initiate a class discussion by asking students "What are the things people need to survive?" Make a list as the students give suggestions, without editing it or commenting on their contributions. As a minimum, you should include food, water, energy and housing.
2. Group the items on the list into essentials and non-essentials, discussing as you do so why each item is so categorized.
3. Discuss the ways in which some of the items on each list impact the environment. Questions to consider: Where do the raw materials come from? Are they produced sustainably? Do they travel long distances to reach manufacturing or distribution points? How long does the product last? Is it consumable? Disposable? Biodegradable? Recyclable? Reusable? Does its manufacture require a large amount of energy? Does its disposal create pollution?
4. Write these terms on the board: *Social Equity* and *Commerce*. Discuss with the class what these terms mean. How, generally, are these related to the items on the list? This need not be an exhaustive discussion, but students should understand that social equity in the distribution of basic needs is a worthy societal goal, and that commerce is an essential mechanism for distributing goods and services. Is all commerce good? What do they think "sustainable commerce" means? Do they agree with the definition given in the vocabulary list?
5. Write the definition of sustainability on the board, as shown in the vocabulary list. Do they believe that they are living in a sustainable way? To what degree can sustainability be achieved by the individual or household alone? What sustainability initiatives must, by their nature, be undertaken at the community level? The state level? The national level?

### Explore

Have students form groups of 2 or 3. Ask each group to select a product, service, process or activity of their choosing, preferably something that they or their peers use or do. Tell them that their task will be to investigate its positive and negative impacts with regard to sustainability. If their focus is on an object, they should consider all phases of the product's life cycle: its materials, production, distribution, use and disposal. They should then suggest one or more ways in which its "ecological footprint" could be reduced, in any phase of its life cycle.

Students' investigations should quantify environmental impacts and the potential reductions in those impacts to the greatest extent possible, and students should provide a basis for their estimates and assumptions (quantity produced/sold, impact/savings/cost per unit, etc.). In addition to environmental considerations, they should also consider the societal and economic implications of the object of their investigation. For example, they might ask: Is it necessary? How does it benefit society? What is its contribution to the economy? What would be the approximate cost to make its production, use, or disposal more environmentally neutral? Would that additional cost make it unaffordable to people who need or want it? Would it become unprofitable to make or use as a result?

## Explain

When students have completed their investigations, each group should make a presentation to the rest of the class to report their results. Each student should be responsible for giving a part of the report, so that all students in the group have an opportunity to hone their presentation skills. Their reports may include any or all of the following:

- A sample of the product
- Photograph(s) or video of the product/service/process/activity
- Charts and graphs visually representing resource use or savings
- Videos of people they interviewed in the course of their research
- Photos, videos, drawings or models demonstrating their suggested improvements
- Other media of their creation

## Extend

Arrange a class tour of a "green" building in your community. Some suggestions:

- Orlando Science Center (OSC)
- Orlando Utilities Commission "Reliable Plaza" building
- Valencia College: Allied Health Sciences building, Special Events Center, and University Center
- Darden Restaurants corporate headquarters

All but the OSC have received a Gold rating from the Leadership in Energy and Environmental Design (LEED) program, and the OSC is pursuing LEED certification. Information about these sites, including their locations, may be found on the Orlando County Water Atlas Watershed Excursion.

The Orange County "Orange to Green Development Program" can provide additional suggestions for field trips. To have your field trip site added to the Watershed Excursion, contact the Orange County Water Atlas content manager.

Instruct students to make notes during the trip and to take photographs. Afterward, have them write short essays describing the "green" aspects of the site that most impressed them, and post their writing and essays on the Orange County Water Atlas Watershed Excursion.

## Exchange/Evaluate

Evaluate student presentations using the following criteria, with 0-3 points awarded in each area:

- **Organization**: Extremely well organized (3); Generally well organized (2); Somewhat organized (1); Poor or nonexistent organization (0).

- **Content Depth and Accuracy:** Complete, accurate information that is appropriate for intended audience, with evidence of extensive research (3); Mostly accurate information with no significant errors, with evidence of research from multiple sources (2); Incomplete or inaccurate information that may be too elementary/complicated for the audience, with evidence of

research (1); Information is completely inaccurate, unrelated or unsubstantiated, with little or no evidence of research (0).

- **Research Effort:** Went above and beyond in researching (3); Did a very good job of researching (2); Used multiple sources but did not follow up obvious leads (1); Did little or no fact gathering, or used inappropriate/invalid sources (0).

- **Creativity:** Clever, original approach that captures audience attention (3); Some originality, good blending of materials/media (2); A few original touches, but for the most part lacking creative interpretation (1); Bland, predictable, little creative energy (0).

- **Use of Media:** Varied, interesting media are effectively used to provide interest and organized to increase understanding (3); Media lack variety or interest, or are not obviously connected to the project thesis (2); Media sporadic, poorly prepared, or used inappropriately (1); Media are superfluous and so poorly prepared that they detract from the presentation (0).

- **Language Use:** Poised, clear communication with good eye contact, correct grammar (3); Mostly clear, with appropriate word choices, good flow, few errors, some hesitation and lack of eye contact (2); Lacks polish, may have poor word choices or mispronunciations, little or no eye contact with audience (1); Poor word choice and monotone delivery with no eye contact, grammatical and spelling errors (0).

- **Audience interaction:** Holds audience's attention, encourages interaction and responds confidently to questions with extensive knowledge (3); Holds audience's attention most of the time, encourages interaction, responds accurately to questions but fails to elaborate (2); Loses audience's attention, goes off track, reluctantly interacts with audience, answers questions with rudimentary knowledge (1); Incoherent delivery causes audience to lose interest, avoids or discourages audience participation (0).

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