



Sustainable Materials

Diana Bowen and Maraline Ashley

INTRODUCTION

This lesson explains alternative building supplies that are not only better for the environment but also healthier for the occupants of the building. Students will discover the cost difference between conventional wood and FSC-certified wood.

LESSON OVERVIEW

Grade Level & Subject: Grade 6-8; Mathematics and Science

Length: One class period (45 minutes)

Objectives:

After completing this lesson, students will be able to:

- Calculate the financial and environmental costs and benefits of several types of building materials.
- Compare the costs associated with traditional building materials and sustainable materials.
- Predict what happens to construction materials when something is demolished or destroyed.
- Discuss the health benefits of green building.
- List materials that make up a house and find green alternatives that could be used.

National Standards Addressed:

This lesson addresses the following National Education Standards¹

- **Content Standard: [NM-NUM.6-8.1 Number and Operations](#)**
 - Work flexibly with fractions, decimals, and percents to solve problems;
 - Compare and order fractions, decimals, and percents efficiently and find their approximate locations on a number line;
- **Content Standard: [NM-ALG.6-8.3 Algebra](#)**
 - Model and solve contextualized problems using various representations, such as graphs, tables, and equations.
- **Content Standard: [NS.5-8.6 Personal and Social Perspectives](#)**
 - Personal health
 - Populations, resources, and environments

¹ <http://www.education-world.com/standards/>

- Natural hazards
- Risks and benefits
- Science and technology in society

Materials Needed:

- **Reproducible #1 - Railroad Tracks** (image to be copied or projected for class)
- **Reproducible #2 - Railroad Tracks Discussion Questions**
- **Reproducible #3 - Sustainable Building Material Reading Handout** (2 pages)
- **Reproducible #4 - Calculating FSC Certified Wood Costs**
- **Reproducible #5 - Sustainable Materials Homework**

Assessment: Students will be assessed through the following activities:

- Class participation in discussion
- Written discussion questions
- Homework questions
- Calculations of FSC Certified Wood Cost
- Optional: Completion of extension activity

LESSON BACKGROUND

Relevant Vocabulary:

- **Sustainable** – able to be continued indefinitely with little or no impact on the future.
- **Energy efficiency** – obtained when the least amount of energy is consumed to do the most amount of useful work; when energy is not wasted or released as useless heat.
- **VOC** – Volatile Organic Compound – organic chemical compounds which have high vapor pressures under normal circumstances; capable of entering the gas phase in normal conditions; participate in atmospheric photochemical reactions.
- **Byproduct** - a secondary or incidental product often generated as a consequence of an industrial or manufactured process.
- **Impermeable** – the quality of being impenetrable to liquids.
- **Estuary** – semi-enclosed coastal body of water with a free connection to the open sea; the wide part of a river where it nears the sea and fresh water mixes with salt water.
- **Consumer** – one who uses goods and services.
- **Formaldehyde** – an organic chemical compound with the formula H_2CO ; colorless odorless gas made by the oxidation of methanol.
- **Conventional** – traditional or common; conforming with or meeting accepted standards.
- **Certified** – endorsed by an authority as having met certain requirements.

Information:

See **Reproducible #3 - Sustainable Building Material Reading Handout** (2 pages) for Sustainable Building Material background information.

Resources:

- <http://www.un-documents.net/ocf-02.htm> - UN Documents on Sustainable Development.
- <http://www.cap-e.com/ewebeditpro/items/O59F9819.pdf> - *Greening America's Schools: Costs and Benefits*, Gregory Kats, 2006.
- <http://www.un-documents.net/wced-ocf.htm> - UN Documents - Report of the World Commission on Environment and Development.
- <http://www.greenerbuildings.com/news/2008/08/29/big-growth-spurt-us-schools-going-green> - *Big Growth Spurt in U.S. Schools Going Green*, GreenerBuildings, 2008.
- http://www.9wood.com/articles/leed_and_fsc.html - US Green Building Council, LEED and FSC.
- *Green Flooring* Background, Earth Day Network, 2008.

LESSON STEPS

Warm-up: *Reduce, Reuse and Recycle*

(To save paper, display the handouts and picture on an overhead or SMART Board and then email your students copies of the material!)

1. Display the visual in **Reproducible #1 – Railroad Tracks**. Ask students to imagine that the tracks are no longer used and are going to be torn out and demolished. You can hand out **Reproducible #2 – Railroad Tracks Discussion Questions** and have the students answer questions individually, in small groups, or as a class. You may want to lead a class discussion without handing out the sheet. Try to guide the students towards answering that the wood and metal from the railroad tracks could be recycled or reused in another capacity. These discussion questions should be used to encourage brainstorming and to get students to begin thinking about alternative building options.

Activity One: *Sustainable Building Materials*

1. Share **Reproducible #3 - Sustainable Building Material Reading Handout** with the students. Read aloud or have the students read independently and discuss the presented information as a class.
2. Discuss the points risen in the handout: the health benefits of green building, the environmental conservation provided, what prevents most people from building sustainably, what could be done to encourage people to buy sustainable materials instead of conventional materials.

Activity Two: *Calculating FSC- Certified Wood Costs*

1. Share **Reproducible #4 - Calculating FSC Certified Wood Costs** with the class. (You can also create an overhead transparency of the sheet in order to help facilitate directions.)
2. Go over directions and first example together.
3. Have students complete sheet independently, then review answers.

Wrap Up: *Sustainable Homework*

Hand out **Reproducible #5 - Sustainable Materials Homework** and go over directions.

Send students home with assignment of choosing a sustainable material to research. Have them keep in mind the class discussion when answering homework questions. You may want to assign a material to each student, or have them research and choose their own. Consider having students present their materials to the class after completing the homework.

Extension: “*Don’t stop here....*”

Continue the learning by having students research your state’s incentives for going green. When schools rebuild or make improvements does your state offer any incentives? What about when homeowners remodel or build? What rebates are available to them? Share your findings with the class. Consider having your class make a presentation to the principal or district administration.

CONCLUSION

Students should now be comfortable having a discussion about the pros and cons of green building. They should be able to give suggestions for greener alternative to traditional materials and site examples of not only the environmental benefits they provide, but the health ones as well.

Railroad Tracks



Earth Day Network
1616 P Street NW, Suite 340 • Washington, DC 20036
(P) 202-518-0044 • (F) 202-518-8794
www.earthday.net/education • education@earthday.net

Railroad Tracks Discussion Questions:

1. What materials were used to create these tracks?
2. Where do the extra materials go when the track is torn up?
3. Do you think the materials could be used for something else? If so, what?
4. List some materials used to make a house.
5. What are examples of alternatives that could be used to build a healthier or more sustainable house? (Example: bamboo instead of hardwood flooring)
6. What effect would using these materials have on the environment? Health?

Sustainable Building Materials

What does “sustainable” mean?

Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs.² Basically, it’s another term for “green” or “environmentally friendly”.

There are sustainable alternatives to most (if not all) construction materials. A building can be called sustainable depending on its energy efficiency, water use, waste creation and reduction, toxins in the material, sustainable materials, and indoor air quality.

Why choose sustainable materials?

It’s Healthier. Buildings built using sustainable materials provide occupants with good lighting, acoustics, and air quality for a more comfortable, healthier, and a more productive work environment. In the context of green schools, more than 70% of executives believe that buildings made of sustainable materials enhance student performance and the ability to retain teachers.

To name a few examples, most conventional paints contain high levels of VOCs (volatile organic compounds) which produce a gas that can be inhaled by occupants. Most conventional insulation contains the toxic element formaldehyde.

Asthma is the most common chronic disorder in childhood currently affecting an estimated 6.2 million children under 18. It costs three times more to provide health care for a child with asthma than for one without. A recent review by Carnegie Mellon of five separate studies evaluating the impact of improved indoor air quality on asthma found an average reduction of 38.5% in asthma in buildings with improved air quality. Therefore it is safe to assume that the transition from a conventionally built to a green school reduces asthma attacks by 25%.³

It’s Green. Sustainable materials are also more environmentally friendly than ordinary building materials. Byproducts of conventional building materials can cause harm to the building’s occupants and infect the surrounding natural habitat due to runoff from the building. Choosing to use sustainable and efficient materials reduces our footprint on the environment as it saves trees and manages waste, water, and energy production.

Buildings and parking lots are built with impermeable materials that replace the natural surfaces of the ground. Therefore, runoff from the building pollutes the surrounding environment, including water resources. In fact, it has been recognized as the second leading source of impairment in estuaries, third in lakes, and fourth in rivers.⁴

² UN Documents Cooperation Circles: Our Common Future, Chapter 2: Towards Sustainable Development. <http://www.un-documents.net/ocf-02.htm>

³ Katz, Gregory. Greening America’s Schools: Cost and benefits. <http://www.cap-e.com/ewebeditpro/items/O59F9819.pdf>

⁴ EPA: Green Building FAQ. <http://www.un-documents.net/wced-ocf.htm>

Calculating FSC-Certified Wood Costs

The Forest Stewardship Council (FSC) is an organization that certifies wood that has been forested in a sustainable manner. This label allows consumers to make an eco-friendly choice when buying wood products. Because of the extra effort needed to ensure sustainable practices, FSC and formaldehyde-free wood products typically add a premium of between 5%-25% to the final installed price.¹

Using the above information, complete the rest of the chart to determine how much extra you would pay for FSC-certified wood over other kinds. Don't forget to show your work on the bottom and/or back of this worksheet.

Example: If you spent \$100 on conventional wood, in what range would you expect to pay for the same amount of FSC-certified wood?

First, calculate the lowest estimate (conventional + 5%)

$$\$100 + .05(\$100) = \$100 + \$5 = \$105$$

Repeat the same steps for the mid-range and high estimate

$$\$100 + .15(\$100) = \$100 + \$15 = \$115$$

$$\$100 + .25(\$100) = \$100 + \$25 = \$125$$

Conventional wood cost	Low estimate FSC cost (Conventional + 5%)	Mid-range estimate FSC cost (conventional + 15%)	High estimate FSC cost (conventional + 25%)	How much extra would you pay?
\$100	\$105	\$115	\$125	\$5- \$25
\$1,000				
\$20,000				
\$50,000				
\$100,000				

On the back of the paper, answer the following questions:

1. What are some benefits of using FSC certified wood?
2. Do you feel the extra cost is worth the benefit of buying FSC certified wood? Explain.
3. How would you convince someone to buy FSC certified wood for their project if they did not want to spend the extra money?

¹ 9wood.com. FSC, LEED, & Sustainability. http://www.9wood.com/articles/leed_and_fsc.html

Sustainable Materials Homework

Research one sustainable building material or topic. You may use an example or find one on your own. Answer the following questions.

Examples: Denim, cellulose, hemp or other material for insulation
Marmoleum
Bamboo
Cork

1. What material did you choose?
2. How does its cost compare to its more traditional counterpart?
3. Where does it come from?
4. How is it made?
5. Why should we use sustainable materials?
6. What prevents people from doing so?

Resources or Websites: