

# SUSTAINABILITY WORKSHOPS

## for Middle School & High School Teachers

## Local Sustainability Awareness: Building Choices

Argonne’s Sustainability Workshops for Middle School and High School Teachers were conceived, designed and implemented as part of the Laboratory’s educational outreach. The goals of these workshops include knowledge and awareness of alternative energy technologies, their advantages and limitations; the key issues and impacts of technologies related to climate change; to extend the resources of sustainability; and to encourage energy literacy. Participating teachers are asked to synthesize their experiences and knowledge gained into a useable lesson plan. The plans presented in this unit are a compilation of those lessons.

### Grade Level

Middle School

### Time Needed

8-10 class sessions

### Activity Description

In this problem-based inquiry, students respond to teacher-presented ideas (from their “school board”) to explore more environmentally friendly options for building reconstruction. Students will research scenarios related to their school and “green” (sustainable) changes to be made to the building. They will construct their best solution to the posed scenario, documented with research evidence, and present it to the class.

### Goals and Objectives

Students will

- Learn that there are multiple options when one is reconstructing parts of a building
- Observe and describe the current state of their school scenario

- Research multiple reconstruction options for their scenario within the context of initial cost, future cost, maintenance cost, external environmental impact (does it improve the building’s current “greenness”?) and internal environmental impact (e.g., indoor air quality, proper lighting to assist in education, etc.)
- Construct a scale model or drawing of their solution
- Present and defend their solution to the class, using evidence from their research



## Background Information

While many of the issues we hear concerning sustainability are more nationally or globally focused, there can be a bigger impact when sustainable efforts are focused locally. The larger issues can be overwhelming and lead people to think that huge efforts must be made to achieve any results, and that they can't possibly contribute in any meaningful way; or that conservation efforts must be severe and major life changes that can be uncomfortable are the only ways to impact the problem.

However, local, sustainable efforts can be small changes that do not severely impact lifestyles, and still make a beneficial contribution to sustainability. Learning about energy audits of a home, recycling, reusing, repurposing and using products that are made from sustainable, renewable materials are all small steps that can make a big difference. Awareness of impacts and local efforts starting in school or at home can then increase the awareness and actions of families and communities. Many communities and utilities are increasing their efforts to engage residents in sustainable efforts, such as electronic recycling events, curbside recycling, energy audits, offering discounts to encourage home energy reductions, holding farmers markets to sell locally grown produce, and installing more bike lanes and green spaces. Each small step taken by individuals adds up to some major contribution to sustain our communities.

## Materials

Assortment of non-fiction readings, photos, diagrams, and access to the Internet to research (see *Resource* section for more suggestions):

- Bioswales
- Native plant landscaping
- Permeable pavers
- Green roofs
- Dimmer switches
- Sensor lighting in classrooms
- Solar tubes
- Skylights
- Wind turbines
- LED external lighting or lighting powered by solar panels and wind turbines

Materials to create projects and presentations (per team) such as computers with appropriate software (e.g., PowerPoint, blueprint drawing), poster board, markers, foam core board, glue, X-acto knives, scissors, etc. (Alternately, the teacher may ask the students to bring the supplies they need to be able to complete their projects.)

## Vocabulary

Bioswale  
Green roof  
Permeable  
Paver  
Wind turbine  
Sensor  
Skylight  
LED  
Solar panel

## PROCEDURE

### Day 1

#### *Introduce the Lesson*

Invite the school principal, superintendent, head of building and maintenance, or district school board president to talk with the students about any green measures that have already been implemented in the school. The speaker might also want to add a discussion of other options the district is interested in exploring. (You might prepare the speaker ahead with a list of topics you may wish to cover.) Have the speaker use one class period (50 minutes) to explain ways in which energy has been saved in the last 5 years using any resources the speaker has access to, such as charts, graphs, and pictures. Topics to consider are:

- Lighting in rooms, hallways, learning center/library, gyms, cafeteria, etc.
- Lighting controls: timers, switches, motion sensors, types of bulbs or other lighting strategies
- HVAC monitoring to regulate room temperature: timers, thermostats, minimum/maximum temperatures, controls, etc.
- Water usage in restrooms, classrooms, cafeteria, fountains, etc.
- Hand drying in restrooms: sensor paper towel dispensers, devices to limit the amount of paper, blower dryers
- Classroom shades that allow one to look outside, but cut down on sunlight transmission inside
- Plantings, building insulation, doorways and insulation, and other energy-saving measures implemented
- Ideas that are of interest to the district: items and initiatives they are exploring to be more sustainable.

### Day 2

#### *Begin the Activity*

Tell students that they are being asked to assist the school board with some key issues. The school board would like to

repair or replace specific portions of the school and its property. Some of the board members would like to make choices that have less impact on the environment, but they need some assistance in identifying which ones are good choices. The students' job will be to investigate what are the best choices in areas of the school property that are in need of maintenance.

The teacher might post each scenario (described below) on signs taped to the walls in separate locations in the classroom. The teacher can read the scenarios to the class. Allow the students think about the scenario they are most interested in, and then gather at that location. Allow students to form four or five student groups. Each group will be responsible for doing research on their own scenario. Provide each group with pictures, diagrams and access to books, articles, and websites that pertain to their topic. Each member of the group will be expected to assist with research on their topic so that they can discuss it in the next class when they meet. Groups can start looking at the materials for an overview and assign members to different research tasks in preparation for the next class.

### Day 3

Each group meets to discuss their topic. Students reach a consensus and create a list of items they need to learn more about to ensure that they have enough information to address the school board's question thoroughly. During this class session, the teacher will meet with each group and have them explain what they are researching (approximately 5 minutes per group). The teacher can provide other cues if the group has left out important ideas or have diverged off-topic. Once a group has been approved they may continue to research their topic more completely.

After meeting with all groups, the teacher will facilitate a whole class discussion to brainstorm strategies the groups can use to find more information. Some suggestions include e-mailing businesses, use internet searches, call local companies, explore company websites, go to the public library and look up trade magazines, contact parents or friends in the industry, etc. For the next class period, each student will find and explore at least one related resource, and be ready to share it with their group the next day.

### Day 4

The teacher explains the three options for each group's final product for this project:

1. A three-dimensional scale model rendering of their solution with a written description of its details

2. A colored scale drawing of their solution with a written description of its details
3. A blueprint depiction of their solution that includes dimensions of all areas, with a written description of its details

Students in each group should discuss these options and let the teacher know which they are choosing to create. The remainder of the class period should be spent with teams discussing the information they already have, determining if there are any conflicts in the information students have found, discussing what information they still need, and planning how they will decide which option is the best solution for the school board's repair problems. They can also discuss how they will construct their final product.

*Teacher note:* Each student will be given a group cooperation grade, an individual work grade, and a final group project grade (see sample rubrics that follow). The teacher may want to share the rubrics with each group so they are aware of performance expectations.

### Days 5, 6, and 7

Student groups continue to research their topic, doing follow up e-mails and/or phone calls, ensuring that all information is clear and concise. They will determine the key information that will best answer the questions from the school board and construct their models. The teacher continues to meet with groups and monitor their progress.

### Day 8

Students complete their models, written descriptions, and practice their presentation of results. The teacher continues to meet with groups and monitor their progress.

### Day 9 (and 10, if needed)

Student groups present their solution to the class. (See *Teacher Notes* for some comments on student presentations.) The teacher may want to invite the Day 1 speaker or other knowledgeable adult to join the class this day. Allow for other student groups to ask questions for clarification. Teacher will use group project rubric for project assessment and may want to consider allowing each group to select several students to also assess their work. After the presentations, the teacher may want to display groups' projects in a display case, the school board office, or other visible location, and invite others to view the results.

## Teacher Notes

### Scenarios

**A.** The school board has determined that the roof over the 8<sup>th</sup> grade wing of the building will soon need to be replaced.

- Research the types of roof treatments available and advantages/disadvantages of each (including weight, cost, climate or location restrictions). Be sure to include a variety of green roofs to explore, and what advantages each one could provide.
- Determine if the existing roof is strong enough to support a green roof. This may involve a conversation with the head of building maintenance and looking at blueprints. If yes, examine which types of green roofs could be supported. If not, identify what would need to be done to make the existing roof stronger.
- Determine if there are any cost savings or losses that the school would incur, and if so, an estimate of them.
- Determine which option is the best, based on your research.

**B.** The school board has determined that soon, the entire parking lot will need to be redone. They are interested in exploring the idea of allowing more drainage in the lot to avoid future building floods. Should they use cement, blacktop or permeable pavers? Are there other options? If so, what are they?

- Research what is involved in installing each of these parking lot treatments and any other ideas that might be options. What will need to be done to prepare the lot for these choices?
- What are the pros and cons of each surface treatment? Be sure to include what you learn about their cost, longevity, water drainage capability, ongoing maintenance, etc.
- Determine which option is the best based on your research.

**C.** The school board has noticed that there has been an increase in flooding since new home near the school were built. Provide options to help solve the flooding.

- What is currently being done in the district to help with flooding issues?
- What is being used in other places to help with flooding issues? What are the pros and cons of each strategy? Be sure to explore cost, materials, geography limitations, longevity, and other factors.

- Also explore any benefits that native plant landscaping, bioswales and landscaping with rocks might provide. Include your findings in your work.
- Determine which option is the best based on your research.

**D.** The school board would like to lower the school district's electric bill.

- How is electricity currently being used in the district? What is the proportion of usage for each usage?
- Do a visual survey of lighting in your school building and on the outside. Are any of these being used: dimmer switches, sensor light switches, LED lighting, compact fluorescent bulbs, alternate energy sources? Keep track of any energy-saving ideas related to lighting.
- What are the options used in other places to help with lighting issues? What are the pros and cons of each strategy? Be sure to explore cost, materials, geography limitations, longevity and other factors.
- Talk with Group E to learn more about natural lighting.
- Determine which option is the best based on your research.

**E.** The school board has read that students' academic performance is enhanced with natural outdoor light. They wish to see how this could be used to help students at your school.

- How is natural lighting currently being used in the district? How is natural lighting being used in other places?
- Do a visual survey of natural lighting in your school building. Are any of these being used: solar tubes, skylights, windows? (You might want to measure the light levels at various locations as you do your survey.)
- Identify any locations in your school that are too dark, and any classrooms or student spaces that are without natural light sources. What options might work to increase the natural lighting in those locations? What are the pros and cons of each strategy? Be sure to explore cost, materials, geography limitations, longevity, and other factors.
- Talk with Group D to share some of what you learned about natural lighting.
- Determine which option is the best based on your research.

F. One of the school board members was on vacation and saw a school that had a wind turbine on its property. The school board member wondered what the wind turbine could power, and how much money could be saved if a wind turbine was placed on school grounds.

- How do wind turbines work? What are the different types of wind turbines? Be sure to include horizontal, vertical, and other shaped wind turbines in your research.
- What are the pros and cons associated with each type of wind turbine? Be sure to explore cost, materials, building and geography limitations, longevity and other factors.
- How are wind turbines being used in other places?
- What would be needed at your school to be able to install a wind turbine? What locations are best for a wind turbine? (You might want to monitor wind speed at various locations during your research.)
- Talk with Group D to share some of what you learned about wind turbines.
- Determine which option is best based on your research

## Assessment

*See sample rubrics at the end of this document.*

### **Comments on Student Group Presentations:**

Group presentations should begin with a summary of the school board issue, and a brief explanation of all the options that students explored in their research. Each group will then share the option that they determined was the best solution to their scenario. They should provide evidence to explain why this is the best choice. Once the results are shared, the entire class should discuss each of the group's final choices and determine if they could be implemented, while also providing an aesthetically pleasing school for the community

## Extensions

Extend and/or enrich lesson:

- Have student groups make their presentation to
  - School maintenance or grounds supervisor and get his/her personal reflection and feedback on their ideas and findings.
  - Principal, assistant principal, assistant superintendent, and/or superintendent.
  - If the proposal is something that the school board would be interested in, have the groups present their work to the board.
- Have students watch one of the various videos/video resources that help illustrate related topics. Ask the students to discuss what they watched in their groups, and write a personal reflection on the video.
- Work with your art and or math department to better assist the students in creating scale models and accurately reflecting the school's features and colors

## Resources

*Teacher note: A Google image search on each of these sub-topics will result in multiple photos, drawings and diagrams that you may choose to print and provide to each student group.*

### General School Sustainability

- "[Green High Performance Schools](#) (PDF)," Air Quality Sciences, Inc 2009, downloaded 7/13/2013. Document profiles a "poster child" green school, describing all its features.

### Roofing

- "[Garden Roof Assembly](#)," Hydrotech, 2013. Provides excellent information and diagrams of green roofs, overview and advantages of having one.
- [Chicago Green Roofs](#), site created 2006, Viewed 7/16/2013. Very inclusive website, information on green roofs in Chicago, maps, plants to use, links, benefits and more.

### Lighting and Electricity Usage

- "[Commercial Skylights](#)," Velux, no date, viewed 7/12/2013. Photos and descriptions of various types of skylights, explains why and how to use them.
- "[Commercial LED Lighting](#)," US EPA Energy Star, no date, viewed 7/12/2013. Describes EnergyStar-rated LED lighting, how this lighting works, and how they are different from other lighting choices.
- "[Dimmer Switches for Fluorescent Lighting](#)," TWAcomm.com, Inc., no date, viewed 7/12/2013. Commercial grade dimmer switches for purchase with descriptions.
- "[How Motion Detector Sensors Work](#)," Motionlightsensor.com, site created 2009, viewed on 7/15/2013. Explains how motion detectors work and describes several available units.

### Parking Lots and Paving

- "[Uni Eco-Stone family of Permeable Pavers](#)," UniGroup, USA, 2013, viewed 7/15/2013. Describes US EPA context for permeable pavers and some features of the types this company sells.
- "[Green Parking Lot Resource Guide](#) (PDF)," U.S. EPA, Feb. 2008, downloaded 7/14/2013. Comprehensive resource document on green parking lots.

### Flooding/Landscaping

- "[Fact Sheet - Bioswales/Vegetated Swales](#) (PDF)," University of Florida, Program for Resource Efficient Communities, 2008, downloaded 7/13/2013. Comprehensive description and diagrams of bioswales and other green plantings.
- "[Landscaping with Native Plants](#)," U.S. EPA, Dec. 2004, viewed 7/13/2013. One page of many on the site that are valuable resources for green landscaping with native plants.

### Wind Turbines

- "[Wind Generators and Generator Accessories](#)," Wholesale Solar Commercial site, no date, viewed 7/14/2013. Wind turbines for sale with good description of wind power and the future.
- [KidWind Project](#), Inc., 2013, viewed 7/15/2013. Comprehensive site with almost everything a teacher might need to teach about wind power in the classroom.

### Need more information or help with this lesson?

Contact Argonne National Laboratory by e-mailing [SustainabilityEd@anl.gov](mailto:SustainabilityEd@anl.gov).

Find out more about Argonne's Sustainability Program at [blogs.anl.gov](http://blogs.anl.gov).

## Sustainability Workshop for Middle School Teachers

### Local Sustainability Awareness: Building Choices

### Group Collaboration Rubric – 12 pts.

Names of Group Members:

Class Period:

Date:

	1	2	3	4
<b>Contribution AND Completion of group tasks</b>	Does not work, Does not help, Does not care	Works when asked, helps when asked, sometimes shows concern for group	Works some days, helps others sometimes, shows concern for group on most days	Works all days, helps others always, shows concern for entire groups progress on all days
<b>Discussing and listening to others in group</b>	Does not share ideas, or rarely listens to group; complains	Shares and listens to group with respect sometimes	Shares and listens to group respectfully on most days	Shares and listens to others attentively and respectfully always
<b>Helping others in Problem Solving during research and final assessment choice</b>	Doesn't want to help group solve problems	Sometimes tries to help group solve problems	Offers solutions many times for problems	Offers solution and explanations in problem solving
<b>Comments and other information for each category</b>				

Name \_\_\_\_\_ Class Period \_\_\_\_\_ Date \_\_\_\_\_

**Sustainability Workshop for Middle School Teachers**  
**Local Sustainability Awareness: Building Choices**  
**Individual Explanation and Reflection Rubric – 15 pts.**

Each student will be expected to provide one double-spaced, typed page explaining their group’s scenario. The information must include:

- a brief explanation of the School Board scenario and their topic
- at least two new pieces of information that they learned about their topic
- one finding that surprised them about their topic, and why

Remember that a well-formed paragraph should be at least 5 sentences long and should provide evidence to adequately explain your information.

**Writing should include:**

Clearly explained paragraph of scenario and topic	0	1	2	3
One detailed piece of information	0	1	2	3
Second detailed piece of information	0	1	2	3
Piece of information that surprised you and why	0	1	2	3
Writing is free of grammatical errors and spelling errors	0	1	2	3
Extra details and extra credit	0	1	2	

**Comments:**

*Printing your work on the back of this sheet not only saves paper, but it will earn you 1 extra credit point.*

Name \_\_\_\_\_ Class Period \_\_\_\_\_ Date \_\_\_\_\_

**Sustainability Workshop for Middle School Teachers**  
**Local Sustainability Awareness: Building Choices**  
**School Board Sustainability Inquiry - Group Rubric – 18 pts**

Final Project chosen:

- A three-dimensional scale model of their solution to the scenario with a written description of its details
- A colored scale drawing of their solution with a written description of its details
- A blueprint depiction of their solution that includes dimensions of all areas, with a written description of its details

	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>Scenario - overall</b>	Scenario is completed but incorrect	Scenario is poorly or incompletely done	Scenario is done fairly well; details may be missing	Scenario is done well; most details are present	Scenario is excellent; details are all included
<b>Attention to detail is accurate (scale, color, school landmarks)</b>	Project is poorly constructed, no attention to scale or color	Project shows some attempt at scale and color accuracy	Project shows thoughtful, but not all is accurate scale or color	Project shows accuracy in most of the final product	Project accurately portrays scale and color
<b>Evidence of thorough research is present</b>	Project shows no evidence of research	Some attempt at using research is present	Project shows use of either local or general research	Project shows many decisions based on research	Project shows extensive use of general and local research
<b>Decisions made and represented reflect best options for the scenario</b>	Group made very poor or wrong decisions; did not use research or evidence	Group attempted to make choices based on research or other evidence (not best)	Group shows thoughtful choices, based on research <u>or</u> other evidence (some best)	Group analyzed options and chose well based on research <u>and</u> other evidence	Group carefully analyzed options and chose <u>best</u> based on research <u>and</u> other evidence

Extra details and comments: