



Up on the Roof (Learning Experience #2) Lesson Plan



Overview

The green infrastructure plans presented by the student teams may have included vegetated or “green” roofs for many of the city’s large buildings. During *Up on the Rooftop*, students are tasked to design a model that will be a fair test of the claims made for green roofs. After the teams have completed their tests, teams will plan for a presentation of the results of the tests in one of two venues: (1) during a meeting of city residents and business leaders or (2) participation in a class debate that presents the pros and cons of gray infrastructure and green infrastructure.

Lesson Essential Question

- Why is it important for planners and engineers to test an idea before making a recommendation for its use to a client?
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Objectives

The students will:

- work productively as a part of a project team.
- use a variety of resources to investigate the background information necessary for this project.
- research and summarize information about gray and green infrastructure techniques used to reduce stormwater produced by flow from impervious surfaces in urban and suburban areas.
- research and summarize information about GIS, LiDAR and GPS technology and data.
- research and summarize information about the history and current problems faced by municipalities required to meet new federal clean water standards.
- discover the advantages and disadvantages of green infrastructure techniques.
- plan a project that will result in management of stormwater in a sustainable way using data from new technologies.
- design and carry out a fair test of part of their plan using a model.
- keep accurate, complete records in a journal.
- communicate their ideas and results to classmates.





Materials for *Up on the Roof* (Learning Experience #2)

One packet containing a copy of each of the following documents per group

- *A Lawnmower in the Attic* (Student Sheets #1A and 1B)
- *Trust but Verify* (Student Sheet #2)
- *Goin' Green Everywhere?* (Student Sheet #3)

Lab materials needed per group

- three or four disposable aluminum baking pans (approx. 25cm x 25cm x 6cm)
- one large graduated spray bottle
- metal scissors with pointed blades
- one graduated cylinder or graduated cup measure
- spoon or scoop
- ruler

Lab materials needed for the class (* denotes examples of materials for Student Sheet #2)

- gravel
- water
- grass sod
- thin sponges
- thermometers *
- lamps with 100 watt bulbs *

General Supplies

- notebooks or small binders to be used as journals (one per student)
- chart paper or markers
- computer with internet access for each group





Target Student Grade Level: 8-12

Subject Areas

Environmental science, ecology, biology, geography, history, language arts, social sciences

Timeline

Teacher preparation: 45 minutes

Student Learning Experience: 90 minutes

Setting: Classroom lab with a sink; library or computer lab

Skills

Research in print materials and on web sites; organize information; problem-solve as part of a team; communicate to team and classmates; design and carry out an experiment

Vocabulary

Load; gray infrastructure; green infrastructure; pervious surface; impervious surface; combined wastewater collection system

Procedure

- I. Invite student teams to raise their hands if the team had included vegetated or “green” roofs in their initial plans for reduction in stormwater flow volume in the City of Lancaster.
 - a. Instruct students to summarize the following in their science journals:
 - i. a description of a vegetated roof, and
 - ii. a list containing at least three (3) claims that are commonly made for these unusual structures.



2. Instruct students to read *Lawnmower in the Attic* (Student Sheet #1a) and answer the first two questions listed. After students read item #3, student teams should proceed to Student Sheet #1b, for guidance in experimental design.
3. Challenge students to design and run a test of at least three kinds of roofing using materials that have been provided for their use (more if you want them to try others). Remind students to control all variables except the type of roof, and tell them to run more than one trial if they have time, imitating several rainy days in a row. Teams should check the proposed designs with the teacher before conducting the test to avoid wasting time and materials.
4. The materials listed will model three types of flat roofing structures for an industrial building: metal only, metal with gravel, and metal with soil and vegetation. Students will tilt their pans to produce a slight pitch (no more than 3%) which will provide a more accurate simulation of how the roof may perform upon installation. A hole at the lower end of the pan will allow runoff water to be captured and measured after each simulated rain event.
5. Collect and compile team results from the simulations. Ask students to review the data and arrive at a conclusion regarding the best type of roofing material in order to limit the volume of runoff into storm drains. If there are any discrepancies in the class data, ask students to provide possible explanations. Instruct students to reflect upon the experimental results of their team and the class in their science journals.
6. Inform students that businesses and homeowners will be reluctant to spend extra money on a green roof unless they know that it will pay off in the long term. While a lower tax bill may help, lower energy costs will also be an incentive. Instruct students to complete *Trust but Verify* (Student Sheet #2). If time allows, teams may conduct the experiments they designed.
7. Now that teams have some experimental data, direct the groups to return to the original team plan for Lancaster.
 - a. Were green roofs listed in part of the team's original green infrastructure plans?
 - b. If teams had not originally included this option, do they wish to include this option now? If so, then the team should revise green infrastructure plans to reflect this addition.
8. Instruct student teams to complete *Goin' Green Everywhere* (Student Sheet #3).