

BASIS Lesson Plan

Lesson Name: Green Roofs
(A catchy lesson name can help attract teachers to the lesson!)

Grade Level: 5

Presenter(s): Cindy Hsu, Sachiko Matsumoto

Standards Connection(s):

CA Standards: Earth Science

NGSS: Earth Science, Engineering

**Note to teachers: Detailed standards connections can be found at the end of this lesson plan.*

Teaser/Overview

Planting on a rooftop? You read that right! In this hands-on lesson, students will explore the science behind green roofs and some of their environmental benefits, then try their hand at designing their own model green roof!

Lesson Objectives

Students will explore reasons why green roofs are beneficial for the environment, as well as some of the scientific and engineering principles behind those benefits. Students will then practice building models, working in teams, and using their own creative problem solving by designing their own model green roofs.

Vocabulary Words

- Irrigation- artificially adding water to land for agricultural purposes
- Insulation- material that is used to stop the passage of electricity, heat, or sound from one conductor to another (eg to prevent heat from traveling through a roof into or out of a house)
- Passive heating and cooling- use of natural sun energy and ventilation (air transfer) techniques to control the temperature inside a building



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- Run-off: Excess water that flows through streets and landscapes after a storm or major snowmelt

Materials

Scientist Volunteers will bring:

For activity:

- Cardboard squares to serve as base of roof models
- Different colored felt shapes to represent different layers that make up a green roof
- Recycled and basic craft materials to be used in green roof models (paper, pipe cleaners, cotton balls, toothpicks, egg cartons, etc.)
- Elmer's glue

For runoff demo:

- Measuring cups
- Liter bottles with various materials to test soil percolation (pebbles, sand, dirt, etc.)
- Containers to catch water

Other:

- Printed pictures of examples of green roofs on different buildings
- PowerPoint presentation with examples of green roofs

Materials teachers should provide:

- Pencils/pens

Classroom Set-Up

- Access to waters
- Access to outlet
- Access to projector if possible for photos

Classroom Visit

1. Introduction (_5-7__ minutes)

Role Model Introduction: (2-3 minutes)

- "13th/14th graders" in science-y fields. Planned careers?

- Here to share: the dual beauty and functionality of green roofs because of their benefits, both to the environment and people (you can grow food on the roof and you'll be able to harvest fresh produce from time to time)

Topic Introduction: (3-4 minutes)

- Ask what they think a green roof is
- Ask for kids' favorite vegetables; ask if they know where those vegetables come from (a farm/garden); ask if there is enough space for a garden in their neighborhood or their school's neighborhood; ask how else we might find space for a garden; whether they've thought of putting a garden on the roof?
- A green roof can help us to grow our own food! (write "edible garden" on board)
- There are other problems that green roofs help us to solve. For example, what happens when it rains, and all that water rushes off a roof into the street? Can we use that water for anything? What if we're in a drought, how can we trap some of that water and use it for what we need? That's right – a green roof can help with runoff collection! (Write "runoff collection" on board)
- What about recreational space? Do you like hanging out in places that are green, safe, relaxing, like a park? What if there were more spaces like that? Green roofs can help with that, too! (write "recreational value" on board)
- Now, we're going to explore those benefits together!

1. Learning Experience (_40__ minutes)

Part I: Why green roofs? Demos and activities (15 minutes)

1. Edible gardens: show photos of edible gardens and discuss in more depth, eg what kinds of food can be harvested from a rooftop (2 minutes)
2. Runoff collection: Now, we're going to do an experiment together! We're going to split you up into small groups, and each group is going to get a cut-open liter bottle with a different kind of material in it: pebbles, sand, or dirt. Using the measuring cup, one person is going to slowly pour a cup of water into the open liter bottle; one person is going to time how long it takes the water to trickle through the material; and one person is going to record the data. (If groups of 4, one person will hold the bottle). [Repeat 3 times for data accuracy.] Then, we'll come back together as a class and discuss the data: which type of material did the water run through quickest? Which was slowest? So which kind of material would we want on top of our roof, if we want to keep the water from flowing onto the street and use it for a better purpose – like an edible garden? [answer: soil]. (5-10 minutes)
3. Aesthetics/recreational use: return to images and have students discuss how a green roof might improve the quality of life of the people who use the building or the roof. (2 minutes)

Part II: Engineering Design Activity (20-25 minutes)

1. We've just explored some of the ways that green roofs can help us solve problems in our neighborhoods. Who can share with us some of the things we've learned about why green roofs are beneficial?
2. Great! Lots of reasons, having to do with edible gardens, runoff collection, temperature control, and recreation. If we're going to keep finding better and better solutions to these types of problems, we need lots of minds to come together to help us figure out good ways of doing it. So with our remaining time, what we're going to do as a class is figure out how we would all choose to design a green roof, so that it helps address some of these problems in creative and useful ways.
3. Pass out materials
4. Here are a couple of things that engineers take into account when designing things like green roofs: [show a chart, or draw on board, the layers of a green roof]
5. Now, for the next 15-20 minutes you're going to work in your groups to design a green roof that meets some or all of the four criteria we've been talking about: providing food, collecting runoff, regulating temperature, and providing recreational space. If you can think of any other problems it can help solve, that's great too! While you're doing it, make sure you're filling out the worksheet to explain each piece that you're adding and what problem it helps address
6. Groups work on models

3. Wrap Up: Review and Discuss the Learning Experience (_5__ minutes)

Now that you've finished working on your models, who can share for us one of the things you did to your green roof model, and what problem it helps us to address?
[take lots of answers and record on board]

Great! Lots of good ideas, and very nice work on those models.

4. Connections & Close (_3-5__ minutes)

Connections to the real world around students:

[Bring in connections to the real world – reiterate how it could help in a drought, etc.
– though most of this will be done in the previous section]

Close:

Does anyone have any questions about green roofs, or about the issues we talked about today? Does anyone have questions about science and becoming a scientist?
Thanks! Goodbye!

Follow Up: After the Presentation

- The American Society of Landscape Architecture has some great (free!) online resources for teaching green roofs. The resources are geared toward middle school students, but can be adapted for 5th grade.
<https://www.asla.org/greenroofeducation/teacher-resources.html>
- The American Society for Engineering Education offers resources for K-12 teachers on green roofs: <http://teachers.egfi-k12.org/green-roof-resources/>
- If you want to extend the lesson, here's another sample lesson plan about green roofs: <http://www.kidsgardening.org/sites/www.kidsgardening.org/files/KGN-LessonPlan-GreenRoof.pdf>
- If your school or neighborhood has a garden, consider a visit or field trip to discuss connections between green roofs and urban (or suburban) gardens
- Have students write a letter explaining "how we learned about green roofs"

Standards Connections

California Science Standards:

- Earth Sciences: Water on Earth moves between the oceans and land through the processes of evaporation and condensation. As a basis for understanding this concept:
 - Students know that the amount of fresh water located in rivers, lakes, underground sources, and glaciers is limited and that its availability can be extended by recycling and decreasing the use of water
 - Students know the origin of the water used by their local communities

NGSS:

- Connections by topic
 - Earth & Space Science: 5-ESS2 Earth's Systems
 - 5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact
 - Engineering: 3-5-ETS1 Engineering Design
 - 3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost
 - 3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem
- Connections by scientific & engineering principles
 - 1. Asking questions and defining problems



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- 2. Developing and using models
- 6. Constructing explanations and designing solutions
- 8. Obtaining, evaluating, and communicating information
- Connections by crosscutting concepts
 - 4. Systems and system models
 - 5. Energy and matter: Flows, cycles, and conservation
 - 6. Structure and function