Gateway Greening
The Power of Growing Food

Ecosystem Engineering

Connected Next Generation Science Standard

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.
5-LS1-1 Support an argument that plants get the materials they need for growth chiefly from air and water.

Featured Science and Engineering Practice

Constructing explanations and designing solutions

Featured Cross-Cutting Concept

Cause and effect

Local coffee companies (like Ronnoco) give away free, used coffee sacks. Use multiple layers of burlap sacks to block light.

This lesson works best on a garden bed(s) that is very weedy or overgrown. Smothering weeds is also a great way to suppress weeds on unused garden beds over the summer.

Overview

Students will discover that farmers and gardeners are engineers and work to solve problems. They will work through the engineer design process to better understand the garden ecosystem. This lesson involves two separate days to complete the project.

Students will

- Identify what an engineer does and tools to solve a problem in the garden.
- Create a solution to an overgrown or weedy garden bed using their ecosystem knowledge.
- Observe the importance of abiotic factors like sun, air, and water, in the garden ecosystem.

Teacher Preparation

- Choose a weedy or overgrown garden bed for the experiment. A raised garden bed or a patch of lawn you want to plant in later works well.
- Find enough material to cover the garden bed - tarps, coffee sacks, or cardboard with rocks, mulch, or sod staples to weigh them down.

Guiding Question - How can we stop garden weeds from growing in the garden?

Explore

- On your way out to the garden, ask students to reflect on what they have learned about the garden ecosystem. *What do you think is the most important part of the ecosystem?*
- Get a few student responses and their reasoning. Ask, *what abiotic/nonliving things do the plants in the garden need to grow?*
- Write a list of their responses on a whiteboard. Gather around the weedy garden bed or lawn.
- *Would this area be a good place to grow vegetables or flowers?* Have students turn and talk, then share a few responses.

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Materials

- Teacher - small whiteboard or chalkboard
- Garden notebooks or worksheets and clipboards
- Cardboard (works best), tarps (a variety thick enough to block light) or burlap sacks
- Rocks, bricks, or sod staples to hold the material down
- Pencils
- Magnifying glasses
- Trowels
- Optional: thermometer, soil thermometer, insect field guides, and other materials to implement student designs

Setting

- School garden or green space
- This lesson is 2 different lessons, at least 4 weeks apart. Ideally, start the experiment at the beginning of a semester and revisit at the end.

- Guide students to understand that in a garden bed with weeds, plants will have to compete for resources and have a hard time getting the abiotic/nonliving things they need to grow (sun, water, and nutrients).
- Optional: Lay out a variety of resources students could potentially use to suppress plant growth, including a tarp, cardboard, or burlap sacks.
- Break students into small groups or pairs to investigate the soil and weeds either with magnifying glasses or pulling up 1 or 2 plants. Point out to students the seeds on the weeds or seeds that they may find in the soil. *What could happen to the seeds if we just pull up the existing plants*? (They will now have space to grow in the garden bed.)
- Have groups brainstorm how they can get rid of the weeds and keep them from growing back. Remind them to apply what they know about plants' needs and ecosystems to their solution. They can write or draw out their solution.

Digging Deeper

- Bring the group back together to share out their designs and ideas. Either students choose one design that will work the best or give each group a part of the weedy or overgrown garden bed(s) to install their design. Make sure any fabric or cardboard is weighted down.
- If possible, lift up the barrier and observe the plants weekly. Record what the decomposing plants and animal activity is like with photos, drawing, or written descriptions. Record the air and soil temperature if you have a soil thermometer. If implementing different student designs and materials, observe underneath all methods.
- At least 4 weeks later, most of the plants underneath the barrier should be completely decomposed. Uncover the beds and have students again record what they notice about the decomposing plants, soil temperature, and decomposers. Encourage students to pull up the plants and dig in the soil for their observations.

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"I wanted to know the name of every stone and flower and insect and bird and beast. I wanted to know where it got its color, where it got its life.."

- George Washington Carver

Occultation - This method works well for annuals but will not get rid of perennial weeds like bermudagrass. Grasses could even come back stronger. Use frequent tilling to get rid of grasses. Turf lawn typically does not have as deep of roots and occultation will work on it.

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Making Connections

- Compare observations between different weed suppression methods or to a raised bed with garden plants growing.
- *How did the plants and soil change during our experiment? Why do you think the plants died? What abiotic (nonliving) parts of the ecosystem did the soil under the tarp not have?* Popcorn student answers.
- What the class just did is call occultation, a technique farmers have used for generations. **Occultation** is when the soil is cut off from view and the sunlight cannot reach it. The plants are not able to make food for themselves and will eventually die. *Do you think this area is now a good place to grow flowers and vegetables?* Worms and other decomposers eat the weeds, fertilize the soil, and add oxygen to the soil.
- Farmers, like us, are **engineers** and use tools, observations, and their knowledge to design solutions to a problem. *How were you an engineer in the garden this year? What are some other ways we can be engineers in the garden? What problems do you see in the garden that the class could design a solution for?*