Seedling

Life Science | Engineering Design Process

Engineering Challenge

Visible Elements in Photo

- A dark glass bottle (appears to be a plastic or glass beverage container) lying horizontally on a tan/beige surface
- A green plant seedling with three leaves and a thin stem growing from inside or near the bottle's opening
- A window with white and tan trim in the background
- Dense, overgrown vegetation (shrubs and weeds) visible through the glass window
- Red metal cap or band visible on the bottle's opening

Reasonable Inferences

- From the seedling in the bottle: The bottle is being repurposed as a growing container, suggesting a need to create a closed or protected environment for plant growth using recycled materials.
- From the overgrown vegetation outside: Plants grow readily in this outdoor setting when given space and sunlight, implying that controlled indoor growing conditions (like this bottle setup) might serve a purpose—perhaps for space-limited environments, water conservation, or seed starting.
- From the bottle's placement indoors on a surface near a window: This is a deliberate growing setup designed to provide light and stability while containing soil, water, and roots in a confined space.

Engineering Task

K-2 Challenge:

Design a water home for a plant using a bottle. Your bottle home must:
- Hold soil and a baby plant safely
- Let water reach the plant's roots
- Sit steady on a shelf or table without tipping
- Get sunshine through a window

Show your teacher how your plant home works and keep a picture to see if your plant grows after one week.

3-5 Challenge:

Design a self-contained plant-growing system using a recycled plastic bottle that maximizes plant growth while minimizing water waste over two weeks. Your system must:
- Use only one 500 mL or larger plastic bottle as the main container
- Support a seedling or seed using soil (max. 2 liters of soil per system)
- Retain water efficiently (measure soil moisture daily with a simple moisture test—e.g., finger depth or paper towel check)
- Remain stable on a flat surface and not leak onto surfaces
- Receive consistent indirect or direct light

Success is measured by: seedling height (in cm) after 14 days, soil moisture consistency (recorded daily), and zero spillage or structural failure.

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EDP Phase Targeted

Ask / Define Problem

This photo shows a real-world solution already in place (a bottle used as a planter), which makes it perfect for the Ask phase. Students can observe the setup and define the underlying need: "How can we grow plants in small spaces using recycled materials?" This mirrors the problem-solving thinking visible in the photo itself—someone identified a constraint (limited space or resources) and reused a bottle to solve it. Students must first understand why this design choice was made before improving or iterating on it.

Suggested Materials

1. Clear plastic bottles (500 mL–2 L, clean and dry)
2. Potting soil or garden soil
3. Small seedlings, seeds, or cuttings (bean seeds, herb seedlings, or fast-growing plants like lettuce or radish)
4. Water (for daily watering)
5. Measuring tape or ruler, small cups or syringes (for consistent water measurement)

Optional: Pebbles or gravel for drainage, markers for labeling, paper towels for moisture testing.

Estimated Time

Single session: 45–60 minutes (setup, planting, initial observations).
Full challenge (if observing growth over 2 weeks): 45 minutes initial setup + 5 minutes daily maintenance checks + 20 minutes final documentation and reflection.

Why This Works for Teachers

This task directly addresses NGSS 3-5-ETS1-1 (Define a simple design problem reflecting a need or a want) and K-2-ETS1-1 (Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through engineering) by having students identify the real-world constraint (limited growing space) and engineer a scalable, measurable solution using waste reduction.

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