TEACHER PREPARATION GUIDE.

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Do Dead Leaves Breathe?

Biology | TEACHER GUIDE

Planning notes for teachers: materials, setup, expected results, and what to watch for.

Not yet classroom-tested. This is a new lab design that has not been tested in a classroom yet. Expected results, times and costs are estimates, not measured values. Run the full lab yourself before you use it with students or grade it, and adjust amounts to match your materials.

Item	Details
Unit and lessons	Unit 1: Matter and Energy in Ecosystems. Lessons: The Carbon Cycle, Producers, Consumers, and Food Webs
Class time	One 50-minute period, with an optional reading the next day
Groups	3 to 4 students
Cost	About $2 per group; jars are reusable
Standards	HS-LS2-3, HS-LS2-5. SEP: Planning and Carrying Out Investigations; Constructing Explanations. CCC: Energy and Matter; Cause and Effect.

Big Idea

Decomposers return carbon to the atmosphere by respiration. The microwaved litter control separates "the leaves" from "the living things on the leaves", which is the key idea students miss.

Materials for 8 Groups

Item	Amount	Notes
Pint (500 mL) jars with lids	24	Canning jars seal well.
Small cups for BTB	24	Film canisters, medicine cups, or 1 oz condiment cups.
Bromothymol blue, 0.04% solution	About 150 mL	Dilute with tap water until clearly blue (see below).
Moist leaf litter	About a grocery bag full	Collect from the bottom layer under trees, where leaves are damp and partly broken down.
Microwave (teacher only)	1	For the M litter.
Color card	8	Print or paint 5 swatches from blue to yellow.

Advance Preparation

1. Collect litter 1 to 3 days ahead. Keep it in an open bag in a cool place, damp but not soggy. Litter that has dried out will barely respire; mist it and wait a day.
2. Make the BTB blue. Many tap waters turn BTB green or blue already. If it is green, add a drop or two of baking soda solution until it is a clear blue.
3. Day of the lab, before class: put each group's M pile in a microwave-safe bowl, cover loosely, and heat on high for 2 minutes. Let it cool for 10 minutes.
4. Pilot one L jar. If it takes longer than 40 minutes to reach green, use more litter or a smaller jar.

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Expected Results

With about 50 g of moist litter in a pint jar, the L jar should move from blue to green within about 20 to 30 minutes and toward yellow by 40 minutes. The M jar changes much more slowly. The E jar should stay blue. Warm rooms speed everything up. These times are estimates; your pilot sets the real times.

What Can Go Wrong

- BTB that starts green makes changes hard to see. Start every cup at the same clear blue.
- Leaky lids let CO_2 escape. Check that lids are tight.
- Litter falling into the BTB cup ruins the reading. Use a cup with a wide base and set it on a flat leaf.

Misconceptions to Listen For

- "Rotting just makes things disappear." The atoms leave as a gas.
- "The leaves are breathing." The leaves are dead. The organisms living on them respire.
- "Decomposers are only bacteria." Fungi and tiny animals matter too. Have students look at a pinch of litter with a hand lens.

Debrief Questions

- How would a forest's carbon cycle change if decomposers stopped working? (Dead matter would pile up; less CO_2 would return to the air.)
- Why does a compost pile get warm? (Respiration releases energy as heat.)

Differentiation and Extensions

- Support: give the color scale with color names and a photo of each color. Sentence frame: "Jar ___ turned yellow first because ___ released ___."
- Extension: test temperature by putting one L jar in a refrigerator and one in a warm spot.
- Extension: compare litter from a lawn, a garden bed, and under a tree.

Safety and Disposal

- Goggles and gloves. Students with mold allergies should not handle litter.
- BTB can go down the drain with plenty of water. Return litter outdoors.

Standards

This lab builds toward these NGSS performance expectations:

- **HS-LS2-3:** Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
- **HS-LS2-5:** Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.

Disciplinary core ideas: LS2.B Cycles of Matter and Energy Transfer in Ecosystems

Science and engineering practices: Planning and Carrying Out Investigations; Constructing Explanations

Crosscutting concepts: Energy and Matter; Cause and Effect

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