TEACHER PREPARATION GUIDE.

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Road Salt and Duckweed

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 2: Populations. Lessons: Niches and Tolerance Ranges, Limiting Factors, Exponential and Logistic Growth
Class time	One 50-minute setup period, then 5-minute counts every 2 days for 7 to 10 days, and one analysis period
Groups	3 to 4 students
Cost	About $2 to $4 per group; one duckweed culture serves the class
Standards	HS-LS2-1, HS-LS2-2. SEP: Using Mathematics and Computational Thinking; Analyzing and Interpreting Data. CCC: Cause and Effect; Scale, Proportion, and Quantity.

Big Idea

Students build a real tolerance curve for an abiotic factor with a local connection (winter road salt in Illinois streams). The data shows an optimum range, a zone of stress, and a limit of tolerance, plus logistic growth if the control runs long.

Materials for 8 Groups

Item	Amount	Notes
Duckweed (Lemna minor) culture	About 500 fronds	Pond and aquarium stores or a biological supplier. Order 2 weeks ahead and grow it out.
Clear cups, 9 to 12 oz	40	Same size and shape for every cup.
Non-iodized salt	About 30 g	Canning or pickling salt. Rock salt contains grit.
Liquid houseplant fertilizer	A few mL	About 0.5 mL per liter of water.
Aged tap water	8 L	Let it stand 24 hours to lose chlorine, or use dechlorinator.
Shop light or LED grow light	2	On 14 to 16 hours a day.

Advance Preparation

1. Two weeks ahead: order duckweed and grow it in a shallow tub of fertilizer water under the lamp so you have plenty of healthy fronds.
2. Two days ahead: fill jugs with tap water to age, and add fertilizer.
3. Pilot one 0 g/L and one 8 g/L cup so you know the counts are workable.

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Running the Lab

- Setup takes most of a period. Counting takes about 5 minutes per group every 2 days.
- Agree on a counting rule before Day 0: every separate green frond counts, including small daughter fronds still attached.
- Groups can choose their own five concentrations instead of the standard set, as long as one is 0 g/L.

Expected Results

In good light, the 0 g/L cup can grow from 10 to about 40 to 60 fronds in a week. Growth slows noticeably at about 2 to 4 g/L, and 8 g/L often shrinks, with yellowing fronds. Published tolerance values for Lemna vary with strain and conditions, so treat these as estimates and use your pilot.

What Can Go Wrong

- Chlorinated water stunts all cups. Age the water or dechlorinate it.
- Too little light makes all growth slow and hides the salt effect.
- Algae can bloom in fertilized cups. Keep fertilizer low and cups out of direct sun.
- Counting disagreements. Have the same student count each cup every time.

Misconceptions to Listen For

- "Organisms can adjust to anything." Individuals have limits; the population shrinks beyond them.
- "A limiting factor only matters if it kills." Salt slowed growth long before it killed fronds.

Debrief Questions

- Road salt reaches streams mainly in late winter and spring. Why might timing matter for the species living there?
- How could a town reduce road salt runoff while keeping roads safe?

Differentiation and Extensions

- Support: provide a pre-labeled graph with axes and scale. Sentence frame: "Duckweed grew fastest at ___ g/L. Above ___ g/L, the population ___."
- Extension: add a second factor (fertilizer level) to build a two-factor niche.
- Extension: test a water sample from a local storm drain or ditch in late winter.

Safety and Disposal

- Duckweed spreads easily. Freeze or bag it and put it in the trash. Never release it outdoors or down the drain.
- Salt solutions can go down the drain with water.

Standards

This lab builds toward these NGSS performance expectations:

- **HS-LS2-1:** Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
- **HS-LS2-2:** Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

Disciplinary core ideas: LS2.A Interdependent Relationships in Ecosystems; LS2.C Ecosystem Dynamics, Functioning, and Resilience

Science and engineering practices: Using Mathematics and Computational Thinking; Analyzing and Interpreting Data

Crosscutting concepts: Cause and Effect; Scale, Proportion, and Quantity

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