ANSWER KEY.

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Road Salt and Duckweed

Biology | ANSWER KEY

Sample answers and data. Accept answers that match the group's own data and reasoning.

Draft lab. This lab has not been tested in a classroom yet. Your teacher may change some steps, times or amounts.

The Puzzle

Every winter, salt spread on roads washes into streams and ponds. **Duckweed** is a tiny floating plant that grows by budding off new leaf-like **fronds**. Its population can double in a few days. How much salt can duckweed tolerate before its population stops growing?

Question

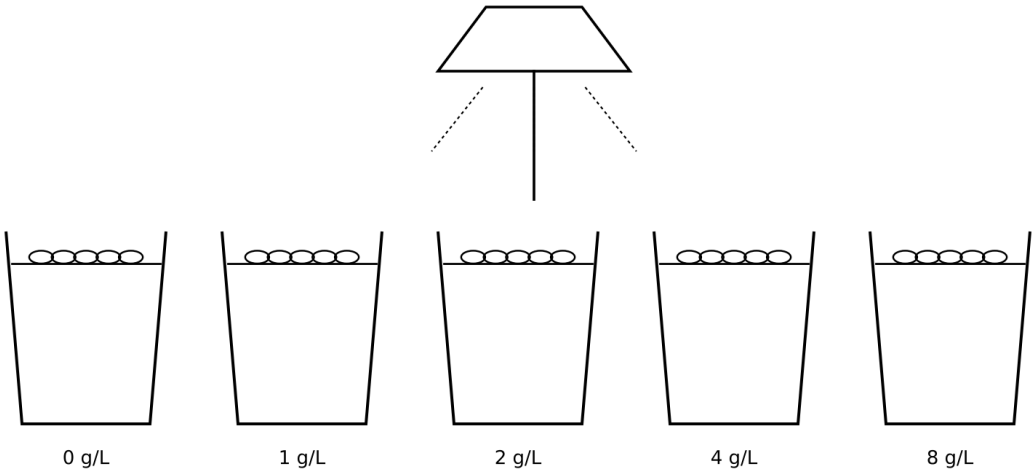
How does salt concentration affect the growth rate of a duckweed population?

Safety

- Wash your hands after handling duckweed and pond water.
- Never pour duckweed down the drain or outdoors. Your teacher will dispose of it.

Materials (per group)

- 5 clear cups labeled 0, 1, 2, 4, and 8 g/L
- 1 L of aged tap water with plant fertilizer (from your teacher)
- Non-iodized salt, balance, spoon, 250 mL graduated cylinder
- 50 duckweed fronds, toothpick or plastic spoon
- Hand lens, lamp



Five cups, each starting with 10 fronds, under the same lamp.

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Before the Lab

1. Calculate the grams of salt for 200 mL of each solution. (Hint: 200 mL is 0.2 L.)

   0 g/L: 0 g; 1 g/L: 0.2 g; 2 g/L: 0.4 g; 4 g/L: 0.8 g; 8 g/L: 1.6 g.

2. Predict the shape of a graph of growth rate (y) against salt concentration (x). Sketch it in the space.

   Answers vary. Expected: highest growth at 0 to 1 g/L, then falling as salt increases, near zero or below zero at 8 g/L.

Procedure

1. Measure 200 mL of fertilizer water into each cup. Add the salt you calculated and stir until dissolved.
2. Use a toothpick to move exactly 10 healthy green fronds into each cup. Count each frond, even small ones attached to a bigger one.
3. Place all five cups side by side under the lamp, about 20 cm away.
4. Every 2 days, count the fronds in each cup and note any yellow or white fronds. Do not count fronds that are fully white.
5. Continue for 7 to 10 days.

Data

Table 1. Frond counts

Salt (g/L)	Day 0	Day 2	Day 4	Day 7	Growth rate (final ÷ 10)	Notes
0	10	**15**	**24**	**48**	**4.8**	**all green**
1	10	**14**	**22**	**42**	**4.2**	**all green**
2	10	**13**	**18**	**32**	**3.2**	**a few pale**
4	10	**11**	**14**	**18**	**1.8**	**smaller fronds**
8	10	**10**	**9**	**7**	**0.7**	**many yellow**

3. Graph the growth rate (y) against salt concentration (x). Label both axes with units.

   Expected graph: growth rate falls as salt rises, from about 4.8 at 0 g/L to below 1 at 8 g/L. The steepest drop is between 2 and 8 g/L. A value below 1 means the population shrank.

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Analysis

4. Describe the trend in your graph in one or two sentences, using numbers.

Growth rate dropped as salt increased: from about 4.8 at 0 g/L to 1.8 at 4 g/L and 0.7 at 8 g/L (sample).

5. Identify duckweed's **optimum range**, a **zone of stress**, and where the **limit of tolerance** appears to be.

Optimum: about 0 to 1 g/L (fastest growth). Zone of stress: about 2 to 4 g/L (still growing, but slowly). Limit of tolerance: near 8 g/L, where the population shrank.

6. A growth rate below 1 means the population got smaller. Which cups, if any, were below 1? What does that mean for births and deaths?

Only the 8 g/L cup (sample). Fewer new fronds budded off than died, so deaths were greater than births.

7. Is salt a density-dependent or density-independent limiting factor? Explain.

Density-independent. It slows growth no matter how many fronds are in the cup.

8. The 0 g/L cup grew fastest. Predict what would happen to it if you kept counting for 4 more weeks. Name the kind of growth.

It would slow down and level off as the surface fills and nutrients run low. That is logistic growth toward a carrying capacity.

9. Claim, evidence, reasoning: Could winter road salt act as a limiting factor for duckweed in a local pond?

Claim

Yes. If road salt raises a pond's salt level into the range of a few grams per liter, it would slow or stop duckweed growth.

Evidence

Growth rate fell from 4.8 at 0 g/L to 1.8 at 4 g/L and below 1 at 8 g/L (sample).

Reasoning

Every species has a tolerance range for abiotic factors. Outside its optimum range, fewer new fronds are produced and more die, so the population grows slowly or shrinks.

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