TEACHER PREPARATION GUIDE.

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The Root Growth Map

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 7: Cell Division. Lessons: The Cell Cycle, Mitosis
Class time	Two short sessions 24 hours apart (about 25 minutes, then 20 minutes)
Groups	2 to 3 students
Cost	Under $1 per group
Standards	HS-LS1-4. SEP: Developing and Using Models; Analyzing and Interpreting Data. CCC: Systems and System Models; Patterns.

Big Idea

HS-LS1-4 asks students to use a model of how division and differentiation build an organism, not to memorize phases. This lab locates growth on a living root: division near the tip, elongation just behind it, and differentiated cells (root hairs) farther back.

Materials for 8 Groups

Item	Amount	Notes
Dry beans or peas for sprouting	About 40 seeds	Pea, pinto, or mung. Soak overnight before sprouting.
Paper towels and clear cups	20 each	
Fine-tip permanent markers	8	Or cotton thread and India ink for cleaner dots.
Graph paper (mm), hand lenses	8 each	

Advance Preparation

1. 4 days ahead: soak seeds overnight, then roll them in wet paper towels inside cups, in a warm dark place.
2. Check daily. You want straight roots 2 to 3 cm long on lab day. Start extras; some roots curl.
3. Practice marking one root. Dots must be tiny; big blobs hide the spacing.

Expected Results

Pea and bean roots at room temperature often grow about 5 to 15 mm per day. Growth should be concentrated in the first 5 to 10 mm behind the tip, with little or no change farther back. The key's numbers are sample values.

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What Can Go Wrong

- Roots dry out during marking. Work quickly and keep the towel wet.
- Ink smears on a wet root. Blot dry first.
- Roots curl sideways. Keep cups upright and roots pointing down; gravitropism helps.

Misconceptions to Listen For

- "All cells divide everywhere." Division is concentrated in meristems.
- "Growth is just cells dividing." Much of the length comes from cells elongating.
- "Each daughter cell gets half the DNA." Mitosis copies DNA first, so each daughter cell gets a full set.

Differentiation and Extensions

- Support: a pre-drawn root diagram with zones to label (division, elongation, maturation). Sentence frame: "Most growth happened ___ mm from the tip because ___."
- Extension: squash the tip region and a region 15 mm back and compare how many cells are dividing (pairs with the virtual Mitosis Detective lab).
- Extension: compare growth at room temperature and in a refrigerator.

Safety and Disposal

- Permanent markers in a ventilated room.
- Seedlings go in compost or trash.

Standards

This lab builds toward these NGSS performance expectations:

- **HS-LS1-4:** Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.

Disciplinary core ideas: LS1.B Growth and Development of Organisms

Science and engineering practices: Developing and Using Models; Analyzing and Interpreting Data

Crosscutting concepts: Systems and System Models; Patterns

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