Our activity for primary school, a living sponge Kit

Introduction

In this 90-minute session, 10-year-olds measure how well different soils hold water and discover the soil bacteria that do the same job underground, including the one behind Vinesys, our iGEM UPF 2026 project. We ran this activity on 10 June 2026 at Col·legi Badalonès (Badalona), in Catalan, with a 5th-grade class who had just visited the Besòs river. In this guide, you will find:

1. Driving question and objectives.
2. Session plan.
3. Organiser guide.
4. Materials and preparation.
5. Safety.
6. Tips from our session.
7. Printables.
8. References and credits.

Driving question and objectives

Can an invisible organism save a vineyard from drought?

By the end of the session, students will have:

1. Connected something they already know about water with water scarcity in farming. In our case this was their visit to the Besòs river.
2. Discovered soil as a living ecosystem, home to bacteria that help plants.
3. Measured how much water different soils hold.
4. Met synthetic biology through a real project led by young scientists.

Session plan

The session runs in five phases and changes format every 15–25 minutes.

Phase	Time	What happens
1. Activation	15 min	Introductions, recall of a previous activity, each student writes a hypothesis on a post-it.

Phase	Time	What happens
2. Exploration	20 min	How small and how many bacteria are, why most are not harmful, meet *Bacillus subtilis.*
3. Experiment	25 min	Groups pour 50 ml of water on three soils and measure how much each one keeps.
4. Connection	20 min	Meet the team and its project, peer teaching with character cards.
5. Closing	10 min	Students revisit their hypothesis: "Now I think… because…"

Organiser guide

Phase 1: Activation (15 min)

Goal: start from what students already know and set the driving question.

1. **Introductions (5 min).** Ask: *"What do you want to be when you grow up? Would anyone like to work in science?"* Then explain in one or two slides who you are and what you do in the lab.
2. **Recall (5 min).** Ask what they remember from a previous activity about water. Ours was the class's visit to the Besòs river. If answers are thin, bring up the topics they covered yourself, then talk about drought and how it affects living things (3–4 slides).
3. **Hypothesis (5 min).** Write the driving question large on the board. Each student writes *Yes*, *No* or *Maybe* and one short sentence on a post-it, then sticks it on the board. For this part, we did it in groups, since there were a total of 70 children and this way it was easier to review each statement.

Why we did it this way: new ideas stick better when anchored to prior knowledge (Ausubel, 1968) and a driving question is the starting point of inquiry-based learning (NRC, 2000).

Phase 2: Exploration (20 min)

Goal: explain soil as a living ecosystem, talking about what students can see and what they can't.

1. **A spoonful of soil (8 min).** Show a cup of garden soil and tell them: *"A teaspoon of healthy soil can contain more living things than there are people on Earth."* Use visuals comparing scale (a grain of sand, a hair, a bacterium) and numbers (3 to 4 slides). An optional extension of this part that was not run in our session would be using a microscope or magnifying glasses so students can look at the soil, draw what they see, then add how they imagine the bacteria, which are too small to see even this way.
2. **Soil bacteria (7 min).** Most bacteria are not harmful and many do important jobs. Introduce a few soil bacteria with fun names, then *Bacillus subtilis*, which lives around plant roots (the rhizosphere) and makes a matrix that holds water. Analogy: *"an invisible water tank around the roots."* This is also the moment to show how you work with bacteria in the lab (5 to 6 slides).
3. **Back to the prior activity (5 min).** We said: *"Remember how water quality affected the living things in the river? Soil works the same way because with drought and pollution helpful bacteria disappear and plants are left without help."* Then link drought to farming and vineyards (4 to 5 slides).

Phase 3: Experiment (25 min)

Goal: measure which soil keeps the most water. The sponge plays the role of the water-holding matrix made by *B. subtilis*.

1. **Set-up (5 min).** Each group gets three prepared cups (Dry soil, Normal soil and Soil with sponge, see Materials), each standing on a second cup to catch drainage.
2. **Water and measure (10 min).** Each group pours exactly 50 ml of water into each cup at the same time. While they wait 5 minutes, ask which cup they think will keep the most water and count hands. Then measure the water collected below each cup and work out what stayed in the soil (50 ml minus what was collected). Groups fill in Printable 1 and write their results on the board.
3. **Discussion (10 min).** Each group shares its result. Ask: *"Which cup is most like a vineyard soil with water-holding bacteria? Which is like a vineyard in drought without them? Why does the soil with sponge keep more water?"* Let students reach the conclusion before you confirm it.

Why we did it this way: We based this part of the activity on the structure of Kolb's experiential learning cycle (1984), that goes from concrete experience to reflection and then to the concept. Also, designing and running simple experiments is a primary-school competence in the Spanish curriculum (Real Decreto 157/2022).

Phase 4: Connection (20 min)

Goal: explain that young scientists are working with real bacteria that produces what students have just simulated.

1. **Meet the team (5 min).** Show a photo of the iGEM UPF team and the Vinesys logo, and explain: *"These university students designed a bacterium to help the vineyards of Penedès and Priorat. It does what you saw the sponge do, but for real, in the soil."* Add a short, age-appropriate introduction to synthetic biology.
2. **Character cards (10 min).** Hand out Printable 2 so that half the class gets each card. Students read their card, then explain it to a classmate holding the other one.
3. **Questions (5 min).** Leave time for their questions about the project or about being a scientist.

Phase 5: Closing (10 min)

Goal: consolidate learning by revisiting each student's own prediction.

1. Hand back the post-its. Each student reads their first hypothesis and decides whether to keep or change it, writing on a post-it of a different colour: *"Now I think… because…"*
2. Stick the new post-its next to the first ones, compare the two columns together and answer the driving question as a class.

Materials and preparation

Everything can be bought at a supermarket or found at school and the preparation takes about 15 minutes.

Per group (for the experiment):

Item	Quantity	Preparation
Clear plastic cups (of about 250 ml)	3	Make a small hole in the bottom with a heated toothpick (don't let the children do this).
Cups or dishes to catch drainage	3	To be able to count the drainage.
Tray	1	Keeps the table clean.
Garden or potting soil	Around 200 g	Dry one third in the oven for about 30 min (with really low heat!).
Kitchen sponge	Half of it (or less)	Cut into 1 cm pieces and mix into the Soil with sponge cup

Item	Quantity	Preparation
Measuring syringe or measuring cup	1	To measure the drainage.
Labels	3	Dry soil, Normal soil, Soil with sponge.
Water	150 ml	Make sure the water is clean and safe for children.

For the whole class

- Post-its in two colours, 2 per student.
- Printable 1, one per group.
- Printable 2, one card per student (half of each).
- Projector and slides.
- Optional: kitchen scale to weigh the collected water instead of measuring its volume (1 g is more or less 1 ml).
- Optional: microscope or magnifying glasses for the Phase 2 extension.

For a fair comparison, put the same amount of soil in each cup (weigh it or fill to the same line) and make the holes the same size.

Safety

No living or engineered organisms are used during this activity.

- Use bagged potting soil when possible and have students wash their hands after handling soil.
- Holes in the cups are made by an adult, before the session.
- If students ask, make clear that you didn't bring engineered bacteria with you (they actually ask about this).

Tips from our session

- **Build on something the class has already done.** The Besòs visit gave us a bridge to drought. Ask the teacher what the class has studied recently. A local river, a school garden or a drought in the news works just as well.
- **Send the plan to the teachers first.** We shared the full sequence with the class teachers for review before the session, which let us adjust the level and the links to what they had covered.
- **Don't be put off by the 90 minutes.** We worried it was too long for 10-year-olds, but the class stayed engaged and completed every phase.

- **Let them interpret the results.** Groups worked out for themselves that the soil with sponge kept more water and you should only confirm it once they have said it.
- **Keep the post-its.** Comparing first and final hypotheses is the quickest way to see what students took away.

Printables

Printable 1: Results sheet (one per group)

Group name: _____

Our prediction: which cup will keep the most water? _____

Cup	Water poured (ml)	Water collected below (ml)	Water kept in the soil (ml)
Dry soil	50		
Normal soil	50		
Soil + sponge	50		

1. Which soil kept the most water? _____
2. Was our prediction right? _____
3. Which cup is most like a vineyard with helpful bacteria? Why? _____

Printable 2: Character cards (cut out, one per student)

Both are natural soil bacteria. Our project works with *B. subtilis* and *P. putida* shows students that different bacteria help plants in different ways.

Bacillus subtilis
Role ? Sponge builder. Lives in the soil around plant roots, an area called the rhizosphere.
Superpower ? The matrix. It makes a special material, like a natural sponge, that soaks up and stores water around the roots, so the soil doesn't dry out as fast.
Did you know? A single gram of soil can hold up to a billion bacteria.
Mission ? Keep water in the soil so vineyards don't go thirsty in dry summers.

Pseudomonas putida
Role Removes the stress of the plant. An expert in plant chemistry that lives right next to the roots and "talks" to plants.
Superpower The enzyme ACC deaminase. When a plant is very hot and dry, it's stressed and its leaves fall. This bacterium breaks down the ingredient the plant uses to be stressed, so the plant stays calm and keeps its leaves.
Did you know? It can live in heavily polluted soils that would kill many other bacteria.
Mission Keep plants calm during heatwaves so they don't lose their leaves or their grapes.

References and credits

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