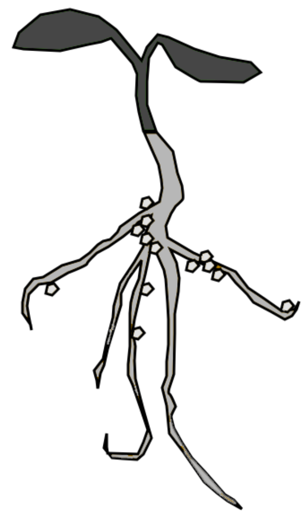
Nitrogen-Fixers: Friends or Foes?

Plants can't live on sunlight alone. They require many nutrients found in the soil. Nitrogen is among the primary nutrients essential to healthy plant growth. Plants need nitrogen to build proteins, nucleic acids, and DNA. The earth's atmosphere is made up of 79 percent nitrogen. Despite this abundance, most plants can't access it in its most common, gaseous form (N2).

Bacteria play an important role in harnessing atmospheric nitrogen. Bacteria are small, single-celled organisms that inhabit nearly every environment on Earth. From arctic poles to North American hot springs, these organisms can tolerate extreme environments and have many amazing capabilities. Some species of bacteria turn milk into cheese while others reproduce overnight.



With help from bacteria, some plants are able to draw nitrogen from the air. After infecting a plant, the common bacterium, *Rhizobium leguminosarum*, converts nitrogen into a usable form. *Rhizobium leguminosarum* attaches itself to the roots of the plant. It forms little growths called nodules where nitrogen is stored. Both organisms benefit from this symbiotic relationship. The bacteria receive nutrients and protection; the plant gets its fill of nitrogen. Legumes, such as peas, beans, and clover, readily form this relationship with bacteria and are known as nitrogen-fixing plants.

Nitrogen Fixers

Hawai'i has several native nitrogen-fixers, including *koa* in the wet forest and *wiliwili* in the dry forest. But when nonnative nitrogen-fixers appear on the scene, they can cause dramatic problems.

Myrica faya is a nitrogen-fixing tree from the North Atlantic. Introduced to Hawai'i in the late 1800s, it invades new lava flows. Under normal circumstances, plant growth on barren lava plains in Hawai'i is limited by a lack of nitrogen. It's a hot and inhospitable environment where few plants succeed. Native Hawaiian species, such as *'ōhi'a* and ferns, have evolved to endure this environment. They find footholds in the cracks where debris has collected and start the slow process of forest building.

When a bird drops a *Myrica faya* seed onto the lava, the scene quickly changes. *Myrica* can quadruple the amount of nitrogen available at a site. It captures nitrogen directly from the atmosphere and stores it in its root nodes. When the plant decomposes, nitrogen is released into the soil. Since nitrogen is natural fertilizer, its presence rolls out the welcome mat for weeds—plants that otherwise wouldn't have survived. The *'ōhi'a* and other native pioneers tend to be conservative in their use of resources such as nitrogen. They don't respond to rapid pulses or increases in nutrients, whereas weedy species capitalize on them. As a result, the natives get crowded out. Instead of endemic Hawaiian forest plants, a rag tag collection of invasives takes over the lava plain.

You will be conducting a lab to observe how plants interact with bacteria to capture airborne nitrogen.

Ecosystem Engineers Lab Report

Group Name: ______________________ *Date:* __________

1. Hypothesis (State in "If….Then" format): ______________________

2. Procedure (Control, Variable, Materials, Steps): ______________________

3. Methods of Data Analysis: ______________________

4. Results ______________________

5. Conclusion ______________________

Lab Report Guidelines

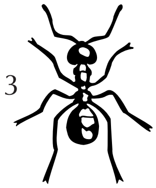
Lab reports include the following elements:

Introduction:
Background information justifying why you are testing your specific hypothesis. The introduction should end with a clear statement of your hypothesis and expectations.

Methods:
Detailed description of how your experiment was conducted. It should be detailed enough that someone else could read it and recreate your experiment.

Results and Data Analysis:
Clearly describe your results and what you did to make sense of the data. This includes talking about how and why you made each graph or table.

Conclusions:
Interpret your results and make some conclusions about your research. If no clear conclusions can be made, talk about how you could improve the experiment. Include discussion of future experiments that could be done based on the knowledge that you obtained through your experiment.



Daily Data Sheet

This data is for (circle one):

control *Rhizobium leguminosarum* nitrogen fertilizer

Date	Pot #	Number of Seedlings	Nitrogen	Height #1	Height #2	Notes	Name(s)