

Exploring plants and soils: Legume plant root nodules



• EXPLORE
SOILS •

Summary:

Soil and plants have a complex relationship based around roots, this added to by a the range of microbes and other organisms that form soil ecosystems. Roots in situ, within the ground, demonstrate this more complex relationship which is in a state of change from soil conditions but mainly the competition between plant species both above and below ground.

This activity is carried out away from the complexities of multiple factors of the busy below soil habitat and allows focus on just 2 interactions between soil bacteria (called Rhizobia sp.) and Red Clover (*Trifolium pratense*). Clovers and Rhizobia have a symbiotic relationship, which benefits both organisms; the Rhizobia is provided a safe home in which to breed and sugars by the Clover, while the clover receives nitrogen from the Rhizobia which is otherwise scarce as a form which the plant can use but is a by-product of the bacteria's digestion.

Note: this activity draws on the [Cultivating Rhizobia](#) [hyperlink] activity and will need several weeks to complete, this way it is best to be prepared for single events or suited to modular learning, where it can be revisited.

Learning Objectives:

- Further understanding in regards to symbiotic relationships
- See evidence of the presence of bacteria in soils
- Further understanding of nitrogen cycle and microbial activity within it

Equipment:

- Runner Bean as seeds
- Rhizobia containing petri dish
- Compost
- Microwave
- Digital Thermometer
- Glass bowl
- Plant pots x2
- Jar with warm water
- Forceps/butter knife

Preparation:

- See [Cultivating Rhizobia](#) (see website) to ensure you have rhizobia to begin process

Time Required:

Introduction 5mins

Preparing Rhizobia solution - 10 mins

Allowing Rhizobia to populate water - 2 days

Sterilizing compost - 5 mins

Sowing beans - 10 mins

Watering/inoculation - 5 mins

Clover growth time- 6 weeks

Examining root nodules- 15 mins.

Background Learning Needs:

- An introduction to the nitrogen cycle
- Understanding of symbiotic relationships
- Understanding of microbial needs and sterilization

Risk Assessment:

Hazard	Likelihood	Severity	Mitigation
Injury illness from soil ingestion	Low	Medium	Use gloves when handling the soil
Site/local specific risks	Unknown	Unknown	Anyone running this activity is advised to conduct a risk assessment for the specific site and conditions

Description of Activities:

1. Place enough soil to fill 2 plant pots with sufficient compost for sowing the Clover into large glass bowl and heat on full for 3 minutes, rest for 3 and the on full for a further 3 minutes. Use a thermometer (digital preferably) to test the centre of the soil, it should be over 60oc.
2. Allow the compost to cool and place into 2 plant pots, both of which have been washed remaining soil and rinsed in hot water.
3. Sow beans in to them and place both in good sunlight and somewhere which is not too cold. Ensure if the plant pots have holes in base, to place in a drip tray. Water them with tap water.
4. Add warm water to a jar, make the the water is no warmer than 25oc.
5. Remove the lid from the petri dish containing the cultivated Rhizobia, use the forceps of the butter knife to scrape the jelly like white blobs from the surface of the jelly and place what is removed into the water in the jar.
6. Place the lid on the jar and shake well, leave the jar lid on as a cover but not fastened down. Place the jar in a dark warm location for ~2 days.
7. After this period use this solution to water 1 of the 2 pots of beans, label the pot as having been inoculated with the Rhizobia solution.
8. Continue to water both pots, the non-inoculated one with tap water and the other with a dilution of the Rhizobia solution (~1:10).
9. After the growing period of 4-6 weeks, remove the plants that have grown and

examine the roots. You should see small white/pink nodules having formed on the roots of the one that was inoculated and an absence of these on the plants which were not inoculated.