teachers guide

Soil life 2
Exploring soil

Components

	NAME	DESCRIPTION	AUDIENCE
	Exploring soil teachers guide	This guide shows how to help students explore soil and compost, and discover the diverse range of soil fauna that live in it.	teachers
	Soil safari procedure sheet	This contains procedures for: • taking a standard soil sample, • extracting soil fauna, and • setting up a bait bag.	teachers / students
	Spotters guide worksheet	This image-based worksheet helps students identify and record soil animals.	students
Start	*Soil life explorer* learning object	Students use this learning object to compare relative sizes of soil organisms with a sliding scale, and examine them in more detail with a virtual microscope.	students
	Soil sampling video	The video shows the procedure for taking a standard soil sample.	teachers / students
	Extracting soil fauna video	The video shows how to set up equipment for extracting soil fauna from a soil sample.	teachers / students

Purpose

To enable students to **Explore** a soil fauna community through investigation and identification using microscopes and virtual learning aids.

Outcomes

Students:

- take soil samples and set up an apparatus for extracting soil fauna,
- identify organisms found in soil and compost, and
- appreciate the diversity of soil organisms.

Technical requirements

The teachers guide, procedure sheet and worksheet require Adobe Reader (version 5 or later), which is a free download from www.adobe.com. The procedure sheet is also provided in Microsoft Word format.

The learning object requires Adobe Flash Player version 8 or later (this is a free download from www.adobe.com). It can be placed on a web or file-server and run either locally or remotely in a web browser.

QuickTime version 7 or later is required to view the videos. This is a free download from www.apple.com/quicktime. High quality MP4 versions of movies are available on CD-ROM or download from the SPICE website.

CC The videos contain closed captions.

Activity summary

ACTIVITY	POSSIBLE STRATEGY
For a successful learning experience arrange access to a compost heap, or set up bait bags using the *Soil safari* procedure sheet three weeks before class begins. See 'Notes on advanced preparation' following this table. Five days before the lab, make up plaster of Paris bases for extraction containers (see 'Notes on *Soil safari*, Part II – Extracting soil animals' following this table). Four days before the lab set up compost extractions described on the procedure sheet *Soil safari*, Part II – Extracting soil animals. On the day of the lab collect trays of soil and compost (and dig up bait bags if using).	teacher-led presentation
Students examine trays of soil and compost (and bait bags if using them), first with their naked eye and then under a microscope. Students examine extracted fauna under the microscope. Distribute the worksheet, *Spotters guide*, to help students identify and record their findings, and arrange access to the learning object, *Soil life explorer*.	teacher-led, whole group
Distribute the procedure sheet, *Soil safari*, Part I – Taking a soil sample. Discuss where, in the school grounds, students will collect samples.	teacher-led activity
Distribute the procedure sheet, *Soil safari*, Part II – Extracting soil animals. Students set up their soil sample in an extraction that runs for up to five days.	students work individually or in small groups
Students examine their extractions, identifying and counting soil animals. They use the worksheet, *Spotters guide*, and learning object, *Soil life explorer*, for identification of soil animals.	students work individually or in small groups

Safety note

Consider the use of safety glasses and/or masks during the following procedures, particularly if the soil or compost is dry.

Notes on advanced preparation of bait bags and/or compost heap

Trials have shown that students quickly engage with this topic when they have plenty of soil fauna to examine. Unfortunately some Australian soils yield few animals from an extraction. For this reason we strongly recommend showing students samples rich in fauna before they go outside to collect their own soil samples for extraction. This can be achieved through a combination of bait bags, compost and compost extractions.

Bait bags are a great way of attracting soil fauna, especially when 'planted' in moist warm soil typical of late autumn or early spring. They're best examined when half-decayed, typically after three weeks.

During their initial exploration of compost/soil/bait bag extractions students could be posed the following questions.

- How easy is it to find and count soil animals among compost and soil?
- Where did they find the most soil animals? (They're unlikely to find much in soil, but there should be some in compost and bait bags, especially when they tease apart clumps of organic matter.)
- Where should they take soil samples in the school ground to find lots of soil animals? (Use their suggestions to plan a sampling program, for example half the class samples the school vegetable plot, the other half samples grassland.)

Notes on *Soil safari*, Part I – Taking a soil sample

The best results are obtained by sampling first thing in the morning when the ground is cooler and fauna are nearer the surface (the sun's heat will drive many deeper).

The sampling rings used in the procedure sheet *Soil safari*, Part I need to be a standard size so that students can compare their results. You can use PVC drainage pipe (7.5 cm diameter) cut into 5 cm lengths as this size fits inside the funnel (drink bottle neck) used in the procedure sheet.

Notes on *Soil safari*, Part II – Extracting soil animals

Plaster of Paris and charcoal recipe

The plaster of Paris and charcoal base used in the collecting containers should be made at least a day before the extraction.

- 8 parts plaster of Paris (approximately a tablespoon per container)
- 4 parts activated charcoal
- 5½ parts water (or more, to make a soupy consistency)

Mix dry plaster of Paris and charcoal together, then sieve into water.

Allow to stand for five minutes before stirring into a thick, soupy consistency.

Pour into a container to a depth of 1 cm.

Smooth by tapping on the workbench and swirling, then allow to dry.

When setting up the extraction re-wet the plaster of Paris base so that it's just damp.

Extraction apparatus

Once extractions are running the equipment will need regular checks to ensure soil fauna doesn't cook! Ideally the soil should reach 30-35 °C, with the extraction running for up to five days. As long as the plaster of Paris base is slightly damp then soil fauna should still be alive when students examine their containers.

There's always a danger in leaving an incandescent globe on in an unoccupied area. Make sure the lamp has metal rather than plastic fittings, and if you're concerned about leaving the light unattended, switch it off at the end of each day and run the procedure for longer.

If students find the extracted soil fauna too mobile to identify, they can kill them by tipping them into a Petri dish containing a thin film of 70% alcohol.

Students may be posed the following questions.

- Can they think of any drawbacks to the extraction method? (It's good for mobile animals that can move through the soil, but poor for immobile stages or those that dry out quickly, such as nematodes.)
- If the soil extraction yields low numbers of soil animals does this mean there weren't many in the soil? (Not necessarily – it means that the extraction technique didn't yield many, but other extraction techniques might be different.)
- Why can't they see fungi or bacteria? (Discuss scale – these micro-organisms are far too small to be seen with a stereomicroscope. A mushroom kit may be used to show filaments of hyphae massed into mycelium.)

Notes on the learning object, *Soil life explorer*

For the purpose of this sequence decomposers and detritivores are given the following definitions:

- 'Decomposers' refer to bacteria and fungi. These microbes possess the necessary enzymes to break down certain organic compounds (eg sugars, cellulose and chitin) in dead plant and animal material.
- 'Detritivores' refer to animals that ingest both dead organic matter and their associated bacterial and fungal populations. Most detritivores lack enzymes to break down cellulose and lignin. Instead they make use of enzymes produced by decomposers when they ingest decomposing organic matter and its associated microflora. The chewing and grinding action of detritivores feeding breaks organic matter into smaller pieces, increases the surface area that decomposers can attack, and thereby speeds up the decomposition process. Their partially digested faeces may in turn pass through the guts of several more detritivores and be colonised by various decomposers, before finally reaching an inorganic or mineral form.

Dietrary descriptions in the virtual microscope have been simplified. For example, certain soil animals are microbivores – animals that specialise in feeding directly on bacteria or fungi, without ingesting detritus. It can be difficult to distinguish between detritivores and microbivores. Where a group of organisms, such as springtails, contains both feeding groups, we have classified them as detritivores.

Image credits

worksheet, *Spotters guide*

- mite, pseudoscorpion, springtail, ant, centipede, cricket, earwig, hopper, isopod, millipede, rove beetle, slug, spider and termite all by Honorary Associate Professor Adrianne Kinnear, School of Natural Sciences, Edith Cowan University, used by permission

learning object, *Soil life explorer*

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Associated SPICE resources

Soil life 2: Exploring soil may be used in conjunction with related SPICE resources.

DESCRIPTION	LEARNING PURPOSE
Soil life (overview) This learning pathway shows how a number of SPICE resources can be combined to assist with teaching the topic of ecology.	
Soil life 1: Life in the soil This resource engages student interest in the variety and importance of soil fauna.	**Engage**
Soil life 2: Exploring soil Videos guide students through the process of sampling soil and extracting soil fauna, which they then identify.	**Explore**
Soil life 3: Soil ecosystem Students use worksheets and an interactive learning object to construct food chains and food webs. An animated video explains the concept of energy flow through ecosystems.	**Explain**
Soil life 4: Soil investigation Students investigate the importance of the sampling strategy by using an interactive learning object to see how observed sampling results vary with each organism.	**Explore/Explain**
Soil life 5: Soil scientists Interviews with soil scientists illustrate the importance of different sampling strategies in their research.	**Elaborate**

Acknowledgements

Science advisers: Honorary Associate Professor Adrianne Kinnear (School of Natural Sciences, Edith Cowan University) and Winthrop Professor Lynette Abbot (Faculty of Natural and Agricultural Sciences, The University of Western Australia).

Thanks to Maya Breen, Science Communication student, The University of Western Australia.

Designed and developed by the Centre for Learning Technology, The University of Western Australia. Production team: Anton Ball, Leanne Bartoll, Helen Billiald, Kim Braimbridge, Jan Dook, Alwyn Evans, Bob Fitzpatrick, Dan Hutton, Bec McKinney, Paul Ricketts, Jodie Ween and Michael Wheatley. Thanks to Jenny Gull, Pauline Charman, Charmaine White and Wendy Sanderson.

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