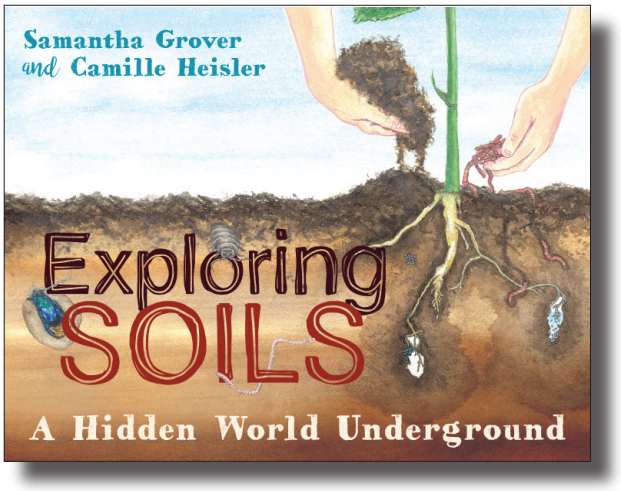
Teacher Notes



Exploring Soils

A Hidden World Underground

Samantha Grover and Camille Heisler (Illustrator)

These notes use *Exploring Soils* as a springboard to launch teachers and their students into the rich and fascinating world of soils. The book touches on a broad range of themes and provides examples of activities that students aged 6–9 could use to deepen their understanding of soils, like the main character James. These notes use four generative questions to help teachers support their students' inquiry-based learning into a variety of those themes. A selection of activities and resources are provided to support student research as they develop their scientific inquiry skills.

The scope for inquiry is immense. Teachers are encouraged to use any element of these notes to assist students to frame and act upon their own questions at their appropriate level.

> *"The soil beneath our feet holds many secrets. Understanding and caring for our soils is one of the most important things we can do. Soil is as important for life as water and air, but how many people know this? Or how to unlock its secrets.*
>
> *This delightful children's book, written by soil scientist Sam Grover and charmingly illustrated by artist Camille Heisler, presents us with a key to do so. Written to introduce exploring young minds to the fascinating world of soils and especially to the hidden world underground, it is packed with interesting facts and colourful images.*
>
> *It deserves a place not only on family bookshelves, but in every preschool and primary school library. Parents, grandparents and teachers, too, will all enjoy the imaginative journey of discovery it offers."*
>
> – The Honourable Penny Wensley AC, National Patron, Soil Science Australia

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What is soil?

Discuss student ideas about what soil is before exploring them with James in the book. What ideas can you add to or change after reading the book? What questions do you have?

What is soil made of? How is soil made?

- Look through the book for examples of what can be found in soil.
  - Think about – solids and spaces, liquids and things that are moving through, things that are breaking down and being built, living things and things that support life.
- Explore the images and definitions for CLORPT in the book. How would changes in each factor affect the soil and how fast it is formed? Think about –
  Climate: temperature, wind, rainfall. What can live in those conditions?
  Organisms: burrows, roots, decomposition
  Relief: sun and weather exposure, water movement, erosion, organic build-up
  Parent material: where do the different parts of soil come from?
  Time: do some processes take longer than others? What happens when things change – or don't change?

Is soil alive? How?

- Think about – soil as a habitat for minibeasts, the roles of micro-organisms such as bacteria and fungi.

How does soil change?

- Soils are always changing as the factors in CLORPT change. Humans both depend on, and significantly alter, the soils they live with. Perhaps we should include **H**umans and say C**H**ORPT!
- How do humans change the soil?
  - Think about – examples from the book, building, gardening, farming, pollution, compaction, salinity, deforestation, climate change
- How can we help to sustain our soils?

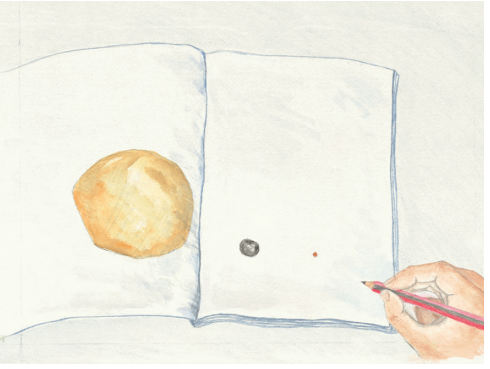
Why is soil important?

- Who and what needs soil to survive?
  - Think about – life cycles, including your own!
- What would happen if each of the components of soil disappeared?
- What do humans use soils for?

How can we find out about soil?

- The book is titled *Exploring Soils* – how does James explore soils?
  - Think about – digging, watching inhabitants, feeling, smelling, using equipment like magnifying glasses and digging tools, observing changes in different environments, modelling with mud/sand/food, exploring with his family including his dog, friends and class.
  - What can these tell us? For example – the colour of soil can give us clues about the minerals and organic matter it contains, the smell of soil can indicate how freely air and water can move through it.

- How does James record and communicate his findings?
  - Think about – talking to his family, measuring his sunflowers, using a learning journal, painting and modelling, using mnemonics and visualisation.
  - Why are these methods useful? Who finds them useful?



- What else could James do to find out more about soil?
  - Think about – experiments to describe, classify and investigate the properties of soils; researching what others have found.

Examples of activities to explore:

- **Soil detective.** How many soil types can you find in the book? How are they different? How many different soils do you think are near you? Explore your area and examine what you find. Remember to look for soil horizons to find new soils in the same location! Some differences may not be obvious to the eye, so collect a sample if you can and compare it to other local samples. How will you keep track of your detective work?

- **Mudshake.** Use this classic test to find out how much sand, silt and clay are in a soil sample: Fill two-thirds of a 2 litre bottle with water, then add 2 cups of soil, secure the lid tightly and SHAKE until all the soil and water are mixed. Leave the bottle to stand for 24 hours. What happens to the soil as it settles out of the water? Why? Use the notes from Soils Ain't Dirt (see Resources) to check your theories and record your results.

- **Bedrock family tree.** Using a map of your target area, hunt down some solid rock and mark it on the map. What is happening to this rock? Is it being eroded and taken away or is it weathering and changing? Maybe both? If this is 'parent' material, can you track down its offspring? Try marking on the map where you think the soils with parts of this rock may be. Do you think they will be on the surface of the ground or deep beneath it? Why?
  Imagine you are a piece of this bedrock. Write a story or song about your journey so far. How did you break away from your parent? Where did you go? What did you see? Have you changed? Where are you now? Who are you with?

- **Scrumptious soils.** Experiment with some food to explore soil formation. For example: larger rocks (see suggestions below) can be eroded (broken/chopped/crushed) into smaller pieces until they form the structural basis of soil (butter/mash/crumbs). Combine different elements to make your own edible soil profile like Nan's sponge cake in the book. See the table below for some tasty ideas.

	Savoury	**Sweet**
Rocks	Biscuits, bread, nuts, beans, chickpeas, olives, potatoes or other vegetables	Chocolate, cakes, biscuits, honeycomb
Smaller pebbles and sands	Seeds (sesame, chia, pepitas), crushed biscuit, couscous or polenta	Sugar, desiccated coconut, crushed biscuit
Sticky clays	Dairy or nut butters, bean or cheese dips, eggs	Icing, cream
Organic material	Herbs, spinach, petals, buds	Dried fruits, cocoa
Bind into layers of	Bread dough, polenta, frittata, clays (see above)	Cake batter, icing, slices, clays (see above)

  What are you impersonating as you break, grind, mix and create solid layers of soil?

- **Minibeast treasure hunt.** Work in teams around a compost or garden bed. Create a treasure hunt for another group or class using photos of your finds. Tally the numbers and compare the results. How diverse are your findings? What does this tell you about the soil habitat? Could other factors be influencing your results like location, time of day or season? How could you find out?

- **Minibeast profile.** Choose a minibeast and investigate how it can live in soil. How does it breathe, drink and eat? How does its body help it survive in soil? Research its life cycle. Does it live its whole life underground? Does it change to adapt to different conditions? Why is your minibeast important to the environment in which it lives? Create a profile card. Collate the cards into an identification kit to help other students who want to know more about the minibeasts they find. What else does the kit need?

  Note: Full identification can be tricky as scientists are still learning about Australian minibeasts. For example, there are over 20 000 species of moths in Australia and up to 30 000 species of beetles! Many of these pupate underground. Maybe you will find something new!

- **The importance of ants.** James and his sister found a city of flying ants in their sandpit. The illustrations show details of an ant's body and life underground. Why do the ants have wings? How does an ant society work? How are ants similar and different to termites?

How is an ant like an earthworm? How can ants help plants and fungi grow? What environments can ants work in that worms can't? Who and what depends on ants living in their environment?

Many people are afraid of ants or dislike them because they can bite. How could you use what you have learned to change their reputation? What about termites?

- **Building with soil.** Everyone loves building sand castles, but have you tried to build anything bigger? What happens when the rain starts or the sand dries out? How can you make the soil stronger? Humans have been building in the soil and with soil for thousands of years. The structures can be enormous, beautifully sculpted and last hundreds of years if maintained. How do they do it? Can you develop a soil recipe for building strong structures that can last? How will you test your recipe? What will you build?

- **Water works.** Water and soil work together. How can soil change water? Is water that comes out of the ground the same as rainwater? Pour out the water from your Mudshake. Does it look the same? Is it all there? Is it still safe to drink? Can you use soil to clean 'dirty' water? Create a funnel by removing the bottom of a clear plastic drink bottle and turning it upside down. Investigate different filter materials by packing the funnel and pouring a set amount of dirty water through.

  How can water change soil? What happens to different soils as they absorb more water? How much water can they hold? What happens when the speed and the spread of water flow change? What happens when there is too much water? Experiment with mini-terrains and applying water in a variety of ways. Search for examples of water changing soil in your local area. What impact does water movement have on plant growth? How does this change the soil further?

There is so much to explore with soils! They are the foundation of life and lots of fun. Hopefully some of these questions and activities have inspired you to delve deeper and challenge your understanding of how soils work to enrich your life. There is a LOT more out there. Enjoy your adventures!

Resources

- http://www.soilsinschools.com.au/learning-resources
  Soil Science Australia does amazing work in schools. Their newer teacher guides (http://www.soilsinschools.com.au/projects) are mainly aimed at high school students, but click on http://soilscienceaustralia.org/soil-resources for fact sheets and primary school materials. The formatting may be old, but the Working with Soil Information Book is an excellent primer for anyone wanting a clear and comprehensive overview of soils.
- http://www.maroochycatchmentcentre.org.au/catchment/wp-content/uploads/2013/10/Soils-Aint-Dirt.pdf
  A Victorian resource with 15 activities for learning about the properties of soils and how they interact with water. Aimed at middle to upper primary students. With lots of structure and simple worksheets, this booklet is a very useful science resource for teachers.
- http://www.fao.org/yunga/resources/challenge-badges/soils/en/
  Enjoy these great infographics from the UN, but be prepared for complex vocabulary. Click on the Soils Challenge Badge icon for the PDF. Yes, it is 124 pages, but it is well structured into manageable chunks of information and the activities are levelled. Go global while acting local!

- http://forces.si.edu/soils/02_01_00.html
  Discover the amazing world of soils with images, information and lots of interactive activities from the Dig It! The Secrets of Soil exhibit from the Smithsonian's National Museum of Natural History. The examples are American, but the principles are accessible and fun.
- https://australianmuseum.net.au/what-are-the-differences-between-ants-and-termites
  Some ant facts including setting up your own ant nests to observe.

Australian Curriculum Content Descriptions for Science Understanding

	Foundation	Year 1	Year 2	Year 3	Year 4
Biological sciences	Living things have basic needs, including food and water (ACSSU002)	Living things have a variety of external features (ACSSU017) Living things live in different places where their needs are met (ACSSU211)	Living things grow, change and have offspring similar to themselves (ACSSU030)	Living things can be grouped on the basis of observable features and can be distinguished from non-living things (ACSSU044)	Living things have life cycles (ACSSU072) Living things depend on each other and the environment to survive (ACSSU073)
Chemical sciences	Objects are made of materials that have observable properties (ACSSU003)	Everyday materials can be physically changed in a variety of ways (ACSSU018)	Different materials can be combined for a particular purpose (ACSSU031)		Natural and processed materials have a range of physical properties that can influence their use (ACSSU074)
Earth and space sciences	Daily and seasonal changes in our environment affect everyday life (ACSSU004)	Observable changes occur in the sky and landscape (ACSSU019)	Earth's resources are used in a variety of ways (ACSSU032)	Earth's rotation on its axis causes regular changes, including night and day (ACSSU048)	Earth's surface changes over time as a result of natural processes and human activity (ACSSU075)

The book also provides a lovely context for the strand of **Science As a Human Endeavour**, giving real world examples of how understanding the science of soils helps people in their daily lives, including when caring for their environment and living things (ACSHE022; ACSHE035) and understanding the effect of their actions (ACSHE062).