



THE WHOLE STORY

A Unit Plan for
Years 7-10

BENEATH OUR FEET

Healthy Soils, Healthy Food

Rabobank



The Whole Story Comic

Keeping Agriculture on the Table

Check out the comic here!



OVERVIEW

This unit is part of a wider comic-based learning series designed to spark curiosity, deepen understanding, and make sustainability in agriculture both relevant and exciting for students. Each comic in the series introduces key concepts through engaging storytelling, connecting students to the real-world challenges and innovations shaping the future of farming in New Zealand.

In this unit, *Beneath Our Feet: Healthy Soils, Healthy Food*, students will explore what lies beneath our feet and why it matters far beyond the paddock. Through hands-on investigations, discussion, and decision-making challenges, students will examine soil as a living system made up of physical structure, biological life, and chemical nutrients. They will explore how these parts work together to support plants, animals, food production, and farm viability.

Cross-curricular by design, the unit links directly to the New Zealand Curriculum in Science, Social Sciences, and English. It's packed with hands-on activities, inquiry opportunities, and career-focused content to help students see how sustainability and innovation go hand-in-hand and shows them how they too, can be part of shaping the future of food.

This unit pairs directly with a student-friendly comic that introduces key ideas and concepts, in a accessible and engaging way. The comic can be used to launch the unit, stimulate discussions, and revisit key ideas as students deepen their understanding.

By the end of the unit, students will understand that soil is not simply "dirt" - it is a living, dynamic system that supports food production, livelihoods, and long-term sustainability.

*For our shining stars, our tamariki, our
rangatahi, the next generation.*

We can't do this without you.

Rabobank

Rabobank – proud supporters of The Whole Story comic book series

Rabobank is New Zealand's only specialist food and agribusiness bank. Food and agri is in our DNA. We were set up in the Netherlands over 125 years ago as a cooperative – by farmers, for farmers. Today we operate in 36 countries and we're among the world's largest financial institutions.

Here in New Zealand, we have a single focus on food and agribusiness. Our four regional Rabo Client Councils are made up of Rabobank's farming client representatives who work with us to address key industry and community challenges in farming and agribusiness, which are linked to six key themes:



Funding support for initiatives identified by our Client Councils is provided by the Rabo Community Fund – a fund set up in 2021 and backed by an annual contribution from the Rabobank Group.

The Whole Story comic book series is closely aligned with several of our Client Council themes and Rabobank is very proud to support this initiative. A great aspect of the comic books is they come with teaching resources that provide opportunities for students to further enhance their knowledge. The books also do a great job highlighting career opportunities in agribusiness, as well as profiling all the exciting work being done to improve sustainable farming practices and to introduce new technology to the sector.

Enjoy the books!

The Rabobank Team

Note for Teachers

Kia ora ngā kaiako

Welcome to the unit "**Beneath Our Feet: Healthy Soils, Healthy Food**". This unit is designed to help students understand soil as a living system that underpins agriculture, food production, and farm decision-making. While soil is often unseen, its health influences everything from plant growth to animal wellbeing, food quality, environmental outcomes, and long-term farm resilience.

As conversations around sustainability and regenerative practices continue to grow across Aotearoa, it is increasingly important for young people to understand the foundational role soil plays in these systems. This unit provides students with opportunities to observe, question, test, and think critically about how soil functions, and how human choices shape its condition over time.

What to Expect:

Conceptual Understanding:

Students will build a strong foundation in understanding soil as a system with three interconnected components:

- Physical structure (air spaces, water movement, compaction)
- Biological life (worms, microbes, decomposition)
- Chemical nutrients (how nutrients are stored, released, and cycled)

The comic supports this learning by presenting these ideas through relatable farm-based scenarios and real-world decision-making.

Systems Thinking:

Students will explore how soil health affects plants, animals, food quality, and farm viability. They will consider how decisions made in one part of a system can have effects elsewhere, developing their ability to see connections rather than isolated facts and information.

Sustainability and Decision-Making:

The unit introduces the idea that successful farming involves balancing productivity with positive soil health outcomes over the long term. Students will examine trade-offs, risk, resilience, and profitability in age-appropriate ways, helping them understand that environmental and economic considerations are closely linked.

People and Future Opportunities:

Beyond the science, students will explore who is involved in soil-related decisions, from farmers and scientists to advisors, food businesses, and financial institutions. The unit highlights the human skills needed to care for soil into the future, including observation, communication, and informed decision-making.

Interactive Learning:

The lessons include soil investigations, worm counts, infiltration testing, structured discussions, and collaborative challenges. Students are encouraged to observe carefully, justify their thinking, and communicate ideas clearly.

Note for Teachers continued

Your Role:

As kaiako, your role is to guide students in noticing, questioning, and connecting ideas. Many of the activities are exploratory in nature and are designed to prompt discussion rather than deliver simple right-or-wrong answers.

You are encouraged to:

- Adapt investigations to suit your local context and available resources.
- Use your school grounds or local environment wherever possible.
- Allow space for student questions and curiosity to shape discussion.
- Emphasise that soil care is about informed choices rather than judgement.

While the unit is designed with a clear progression across lessons, you may choose to use selected lessons independently. Some activities may take more than one session to complete, particularly the practical soil activities.

If you would like to build your Soil Health knowledge prior to teaching this unit then the [Quorum Sense Website](#) has a great range of resources to help you. You can find it [here](#).

There is also a [great document](#) which gives an overview of Soil Health and all the different ways you can measure Soil Health. You can find that [here](#).

Resources:

We have included comprehensive lesson plans, student templates, soil investigation guides, and prompts for discussions. You may also choose to supplement the unit with local examples, guest speakers, or farm visits where appropriate.

We hope this unit sparks meaningful conversations in your classroom - about food, sustainability, and shared responsibility. By helping students understand the living system beneath their feet, you are supporting them to become thoughtful, informed decision-makers who are capable of shaping a food system that is both productive and sustainable.

Ngā mihi nui

Unit Context

OVERARCHING LEARNING GOALS

- Develop an understanding of soil as a living system that underpins food production, farm decision-making, and long-term farm viability.
- Explore how soil health influences plants, animals, people, and farm businesses.
- Consider the roles and skills needed to support good soil outcomes into the future.

ESSENTIAL QUESTIONS

Students will keep considering...

- Why is soil the foundation of food production?
- What is happening in the soil that we can't easily see?
- How do farmers make decisions that affect soil health?
- How does soil health influence costs, productivity, and risk on farms?
- Who shares responsibility for soil health, now and into the future?

DESIRED UNDERSTANDINGS

Students will understand that:

- Soil is a living system made up of biological, chemical, and physical components.
- Healthy soils support strong plant growth, healthy animals, and nutritious food.
- Many important soil processes happen underground but have visible effects above ground.
- Farmer decisions affect soil structure, soil life, and water movement.
- Managing soils well can reduce the need for inputs and support more resilient farm systems.
- Soil knowledge is important across many roles, including farming, science, advisory, and food systems.

KNOWLEDGE TO BE ACQUIRED

Students will know...

- That soil contains living organisms, minerals, air, and water.
- The roles of earthworms and other soil organisms.
- The three components of soil health: biological, chemical, and physical.
- How farming practices can affect soils over time.
- Simple ways to measure and observe soils over time.
- How soil health connects to plants, animals, and human food.

SKILLS TO BE ACQUIRED

Students will be able to...

- Carry out soil investigations and tests.
- Observe and describe soil characteristics.
- Ask questions and make predictions based on evidence.
- Explain cause-and-effect relationships in soil systems.
- Consider trade-offs in farming decisions.
- Communicate ideas about soil, food, and farming clearly.



Connected Curriculum

This unit aligns with the New Zealand Curriculum and supports learning across Science, Social Sciences, and English for Years 7–10. However, it can be adapted for other year levels. The unit develops disciplinary knowledge while also strengthening key competencies, systems thinking, and informed decision-making.

Science

This unit supports students to:

- Develop understanding of Earth systems, including soil as a dynamic system composed of interacting biological, chemical, and physical components.
- Examine interactions between living and non-living elements within ecosystems.
- Investigate how changes in one part of a system influence outcomes in another.
- Use observation, evidence, and reasoning to explain patterns and processes in the natural world.
- Recognise that scientific knowledge is developed through investigation, research, and ongoing refinement.

Students engage in:

- Planning and carrying out investigations
- Gathering and interpreting data
- Using scientific vocabulary appropriately
- Constructing evidence-based explanations

Social Sciences

This unit supports students to:

- Understand how people make decisions about land use and resource management.
- Examine how economic considerations (costs, inputs, risk, long-term viability) influence farming systems.
- Explore the interconnected nature of environmental, economic, and social systems.
- Analyse how different stakeholders contribute to decision-making within food and agricultural systems.

Students consider how choices impact communities, sustainability, and future outcomes.

English

This unit supports students to:

- Engage critically with visual and written texts (including the accompanying comic).
- Analyse ideas, perspectives, and purpose.
- Participate in structured discussion and debate.
- Develop subject-specific vocabulary.
- Create explanatory and persuasive texts for a range of audiences.
- Communicate complex ideas clearly using written, oral, and visual forms.

Literacy development is embedded authentically within scientific and socio-economic contexts.

Connected Curriculum Continued

Key Competencies

This unit intentionally strengthens the key competencies by supporting students to:

- Think critically about cause-and-effect relationships and systems.
- Use language, symbols, and texts to interpret and communicate scientific ideas.
- Participate and contribute in collaborative inquiry and discussion.
- Relate to others when considering multiple perspectives.
- Manage self during investigations and extended inquiry tasks.



Lesson One: It All Starts in the Soil

In this lesson students will begin to see soil as an active system that supports plant growth, rather than seeing it as just “dirt”. They will connect healthy crops to healthy soil and start to understand that farmers observe and manage soils.

SPECIFIC LEARNING OBJECTIVES

Students will...

- Recognise that healthy crops depend on healthy soils.
- Understand that soil is more than dirt and plays an active role in plant growth.
- Begin to view soil as something farmers actively care for and manage.

Learning Experiences	Resources Needed
What do we know about soil? Display the image of the pasture comparing the same paddock, but showing the variation in pasture. Ask students to try and explain why there may be this difference and write their responses on the board. Share that the focus of today's lesson is soil. Ask them to share what they know about soil and introduce the concept that what is happening underground might matter more than what is happening above it.	<u>Image of Pasture</u>
Introducing the Comic Introduce <u>The Whole Story Comic: Soil Health Edition</u> and read Page 1 together. Discuss why the visitor is surprised when the farmer says: <i>“Nah mate, you’re standing on the answer. It all starts in the soil!”</i> Ask the students what this tells us about how people usually think about farming and the soil? Read Pages 2-3 of the comic then looking at the labelled diagram of soil under a microscope on Page 2, discuss what the students notice about what’s happening below the soil surface. Students often think crops grow best because of chemicals or technology, but soil is the starting point. Encourage curiosity, not correctness. Share the image of the 3-legged stool of Soil Health. Briefly discuss the three parts and have students watch this <u>short video from Dr Charles Merfield</u>, where he clearly explains the three legs of soil health. This rest of this lesson will look at the Physical leg of the stool.	<u>The Whole Story Comic: Soil Edition</u> <u>Image of 3-legged stool of Soil Health</u> <u>Short video from Dr Charles Merfield about the 3-legged stool of soil health</u>

Lesson One: It All Starts in the Soil Continued

In this lesson students will begin to see soil as an active system that supports plant growth, rather than seeing it as just “dirt”. They will connect healthy crops to healthy soil and start to understand that farmers observe and manage soils.

Practical Exploration of Soil Texture

For this next part you will need a small range of soil samples. These can be dug from around school and returned back following the lesson. There are two different options to explore soil texture below. They can be both quite fun to do, but if time doesn't allow, just work through the ribbon test.

Soil texture is the composition of the soil in relation to sand, silt and clay. The texture of the soil influences water-holding capacity, water infiltration, nutrient retention, and erodibility of the soil. As a result, soils need to be managed in different ways based on their texture.

It is best to do each of these activities in small groups.

1. The Ribbon Test

Introduce the concept of soil texture and share that all soil is made up of different proportions of sand, silt, and clay. Watch this [short video](#), which gives an overview of soil texture, and how to conduct the Ribbon Test.

The Ribbon Test is a field method that is used to estimate soil texture (percentage of sand, silt, and clay) by moistening a soil sample and squeezing it between the thumb and forefinger to form a ribbon.

Give out samples of soil or go outside and dig up some soil with students, then conduct the Ribbon Test. The [Flowchart to Determine Soil Texture](#) can be useful for students to follow as they are working through this process.

Get them to keep notes or share what they found with their soil samples.

2. The Jar Test

The Jar Test is a simple method for determining soil texture by settling a mixture of soil, water, and detergent in a glass jar. After shaking and settling for 24-48 hours, layers form: sand at the bottom, silt in the middle, and clay on the top.

This can be a good experiment to set up and compare with the findings from the ribbon test.

Clemson University's College of Agriculture in South Carolina has clear instructions for conducting the jar test which can be found [here](#).

Taking photos or writing observations can be useful to keep track of what students notice.

Bring students back together and share this [short video](#) where Dr Charles Merfield talks about why the physical structure of the soil is important. Discuss the idea that farmers observe and understand their soils before deciding how to manage them.

The Ribbon Test Equipment:

- A small range of soil samples (one for each group). Using contrasting soils would be best if possible (e.g., garden soil, sandy soil, clay soil).
- Trays or buckets for soil samples
- [Flowchart to Determine Soil Texture](#).

The Jar Test Equipment:

- Soil sample for each group
- Straight edge glass jars (one for each group)
- Permanent marker
- Ruler
- Watch or stopwatch
- Mesh sieve or old colander
- [Instructions on how to conduct the Jar Test](#)

Supporting Resources:

- [Soil Texture by Feel \(UCDavis\) Video](#) – this video demonstrates in detail a process to determine soil texture.
- For additional information and Soil Health knowledge, see [Soil Health Fact Sheet – Manaaki Whenua](#)

[Short video from Dr Charles Merfield about the importance of the physical structure of soil](#)

Lesson Two: Life Beneath Our Feet

In this lesson students explore soil as a living system and examine how organisms such as earthworms support healthy plant growth.

SPECIFIC LEARNING OBJECTIVES

Students will...

- Identify that soil contains living organisms, including earthworms, insects, roots, and fungi.
- Recognise that living organisms play important roles in keeping soil healthy.
- Explain how soil life supports plants in ways that we cannot easily see.
- Understand that soil is a system where biological, chemical, and physical factors interact

Learning Experiences	Resources Needed
Meet the Soil Organisms Revisit the image of the 3-legged stool of Soil Health. Draw student attention to the biological leg of the stool. Reread Page 2-3 of the comic and share the Soil Cake image. Looking at both images and focussing on the line: <i>"One tablespoon of healthy soil can hold more living organisms than there are people on planet earth!"</i> Discuss why the students think the farmer says the key to healthy plants are the things you can't see? Ask the students what kinds of living things they think might live in soil. Record student ideas, but don't correct yet. This is about gathering their initial thoughts.	<u>The Whole Story Comic: Soil Edition</u> <u>Image of 3-legged stool of Soil Health</u> <u>Soil Cake Image</u>
What's Living in Our Soil? In small groups, students explore soil samples in trays. Students carefully look for: • Earthworms • Small insects • Roots • Visible fungal threads (fine white strands) • Signs of life (worm castings on the soil surface, burrows, tiny holds, decomposing leaves or other organic matter). Students record: • Anything alive or evidence of life • What they think each organism might do in the soil • A quick labelled sketch of what they find. Prompt with the following questions: • "What do you notice that shows this soil has been lived in?" • "What might worms/insects/fungi be doing for the soil?" • "What would soil be like if nothing lived in it?" If possible, use magnifying glasses or look at some soil under a microscope. Taking photos can also be a good way to see things up close.	Soil samples for each group (ideally with visible life). Trays or shallow containers to place soil samples in. Optional: • Magnifying glasses • Digital microscope • Camera

Lesson Two: Life Beneath Our Feet Continued

In this lesson students explore soil as a living system and examine how organisms such as earthworms support healthy plant growth.

Learning Experiences	Resources Needed
Earthworm Count Take students outside to conduct a simple worm count using spade samples. Method: 1. In small groups, dig a spadeful of soil (about 20cm x 20cm x 20cm) 2. Tip the soil onto a tray or tarpaulin. 3. Gently break apart the soil and count the earthworms. 4. Record: ◦ Number of worms ◦ Whether worms were small/large ◦ How moist the soil was ◦ What was growing above the soil where the sample was taken Discuss: • “What does finding lots of worms suggest about this soil?” • “Why might worms be good for plants?” • “What might it mean if you found none?” Bring students together to share findings. Guide discussion toward: • Earthworms make tunnels (air + water movement) • Worm castings add nutrients • Living soil is usually crumbly and easier for roots • Soil life helps plants grow strong Link back to the comic: • Ask: “The farmer said healthy soil leads to healthier plants and better food. Is there anything we saw today that supports that idea?”	Spade/s Trays or tarpaulin for soil
Soil Organisms Discuss the illustration on Page 2 of the comic that shows the key soil organisms (worms, fungi, bacteria, algae, protozoa, nematodes) Ask students: “If these are the workers in soil, what jobs are they doing?” Guide the discussion towards observable roles: • Worms: tunnels + casting → aeration + nutrients • Fungi: break down dead matter → nutrients • Bacteria: cycle nutrients supports roots • Protozoa: eat bacteria → release nutrients • Nematodes: regulate populations → recycle nutrients Tie the discussion back to the comic: <i>“One tablespoon of healthy soil can hold more living organisms than there are people on planet earth!”</i> Share and discuss the image of the Soil Food Web. This shows the connections between the life in the soil. In small groups, get students to read the Soil Organism Fact Sheet and complete the Matching Activity to learn about the jobs of each of the soil organisms.	Soil Food Web Image Soil Organism Fact Sheet Soil Organism Matching Activity Short video from Dr Charles Merfield talking about Soil Biology.

Lesson Two: Life Beneath Our Feet Continued

In this lesson students explore soil as a living system and examine how organisms such as earthworms support healthy plant growth.

Learning Experiences	Resources Needed
Optional Extension: Decomposition Test (Longer-Term Inquiry) Introduce the idea of decomposition as evidence of soil life: • Explain that the tiny organisms in soil break down dead things and turn them into food for plants. This process is called decomposition. The Decomposition Test: Soil Your Undies Soil Your Undies is an initiative where you bury cotton “undies” (or any strips of cotton fabric) and observe what happens over time. It is expected that in healthier soil the soil organisms decompose the cotton faster. If you would like to set this up with your students, there is a great, simple fact sheet on the Beef and Lamb website which can be found here. Alternatively, if you are an EnviroSchool, your EnviroSchools facilitator may be able to help you to set this up. When you dig up the cotton fabric 1-2 months later, discuss the following with your students: • “What does it tell us about soil if the fabric has changed?” • “What might this mean for leaves, roots, and dead plants in soil?” Link the discussion to the following: • Soil is a living system • Soil life recycles nutrients • Farmers care about soil life because it helps feed plants naturally	Soil Your Undies Instructions
Final Reflections and Connecting the Biological to the Chemical: Review with students that they have learned about all the little workers in the soil. Key points to emphasise: • Soil organisms break down organic material. • This decomposition releases nutrients like nitrogen, phosphorus, and potassium, which plants can absorb. • Actively growing plants release sugars which feed the soil organisms. • Without the soil organisms, nutrients stay locked up and plants are unable to use them. • This movement of nutrients is what is depicted by the chemical leg of the stool. • There are natural ways for plants to get nutrients (e.g. soil biology or through natural fertilisers like seaweed) and also artificially (e.g. fertiliser). • The three “legs” are a way of helping us think about different parts of soil health, but in real life they all affect each other. If one leg of the stool is weak, the whole system is compromised.	

Lesson Three: Making Space for Air and Water

In this lesson, students explore how soil structure affects air and water movement, and how changes to soil structure also affect soil life and nutrient availability. They examine how everyday farming decisions can support or damage this system.

SPECIFIC LEARNING OBJECTIVES

Students will...

- Explain how soil structure affects air and water movement.
- Describe how soil structure affects soil life (e.g. worms, microbes).
- Recognise that soil life helps make nutrients available to plants.
- Understand that farming choices affect the whole soil system, not just one part.

Learning Experiences	Resources Needed
Soil Structure Show students a handful of soil and ask them what they notice about the soil. Is it soft or hard? Crumbly or clumpy? Ask: "Do you think plants or worms would like living in this soil? Why or why not?" Explain that how the soil is put together is called soil structure. It's how the soil particles (sand, silt, clay) are arranged and held together into clumps called aggregates. These spaces are super important because they let air, water, and roots move through the soil. Pose the following question to the students and get them to record or share their answers with someone: "What do you think happens to the soil life, and plants, if the spaces in the soil get squashed?"	Image of 3-legged stool of Soil Health
Seeing Water Move: Infiltration How water enters the soil from the surface (via rainfall or irrigation) and moves down the spaces between soil particles, is a good indicator of soil health. This is called infiltration. Allow students to watch the video of a scientist demonstrating infiltration in the lab. If you have the time and resource, it would be a great idea to replicate this infiltration experiment with your students. After watching the video (and/or conducting the experiment), get students to record their findings about soil infiltration. Key points to explain to students: • Water soaks into the soil rather than just running off. • The speed of infiltration depends on soil structure (how crumbly or compacted the soil is and how many pores or spaces there are). • Good infiltration means that roots can access water more easily, soil organisms have space to move and breathe, and nutrients can travel with the water to plants. • Poor infiltration can cause waterlogging or puddles, soil erosion, and stressed plants.	Table Top Infiltration Video Additional Activity (optional): A ring infiltration test can be a good way for students to see infiltration out in the field. More information on how to do this can be found here. You would need to gather the following equipment to do the ring infiltration test: • 150 mm Steel Ring or PVC pipe • Mallet • Wooden block • Small sheet of plastic • Water container • Stop watch or timer

Lesson Three: Making Space for Air and Water Continued

In this lesson, students explore how soil structure affects air and water movement, and how changes to soil structure also affect soil life and nutrient availability. They examine how everyday farming decisions can support or damage this system.

Learning Experiences	Resources Needed
Farmer Choices Get students to watch this video of an Canterbury Arable farmer discussing how he considers soil health when making farm decisions, and the impact these have on his business. Get students to consider the following after watching the video: • What soil health practices did the farmer mention? • How does the farmer know if the soil is healthy? • How do the farmer's decisions affect soil structure, soil life, and nutrients? • Can you identify examples of the 3-legs of soil health (physical, biological, chemical) in what the farmer talked about? • Why do you think the farmer chooses one approach over another? • What could happen if soil life is not considered in farming decisions? • How do these choices affect the plants, the crops, or the wider environment?	<u>Video from Arable Farmer talking about Soil Health on his farm</u> (Note: it is the first video on the webpage).
Scenario Activity The objective of this activity is for students to link everyday farm actions to the health of the soil. <u>Instructions:</u> 1. Students work in small groups to sort the scenarios into two categories (1. Protects soil health; 2. Damages soil health). 2. For each scenario, get students to consider: ◦ How might the farming practice affect the spaces in the soil? ◦ How might soil organisms respond? ◦ How might nutrients become more or less available to plants? Encourage students to justify their choices with evidence from the previous lessons.	<u>Farm Scenario Cards</u>

Lesson Four: From Soil to Food

This lesson connects soil health to plants, animals, and the food people eat.

SPECIFIC LEARNING OBJECTIVES

Students will...

- Understand that soil health influences plants, animals, and people.
- Trace the connections between soil, food production, and human nutrition.
- Recognise that soil decisions have effects beyond the paddock.
- Begin to see food quality as linked to how food is grown.

Learning Experiences	Resources Needed
Building the Soil-Food Connection Revisit <u>The Whole Story Comic: Soil Edition</u>, specifically focussing on Page 7. Discuss the concept that “<i>Soil health goes beyond plant health?</i>” Ask students what they think this means, and what else may benefit from good soil health. Draw attention to the idea that: • Healthy soils = healthier plants • Healthier plants = healthier animals • Healthier animals = better quality food for people Emphasise that soil health goes beyond yield (how much is grown). It affects the whole system.	<u>The Whole Story Comic - Soil Edition</u>
Mapping the Food System Students work in pairs or small groups. Provide each group with large paper and coloured felts. <u>Purpose of the task:</u> To help students visualise how soil connects to the entire food system, not just plant growth, but animals, people, businesses, and waste cycles too. <u>Step 1: Start with the Core Chain</u> Ask students to draw this basic sequence across the page: Soil → Plant → Animal → Human (and/or Soil → Plant → Human) Share that this is the simplest version of the food system. On each arrow, students must label what is being transferred. Encourage words and short phrases rather than sentences. Examples they might include: • Soil → Plant: nutrients, water, minerals, energy stored in soil, support for roots • Plant → Animal: energy, nutrients, fibre, protein • Plant → Human: vitamins, carbohydrates, flavour • Animal → Human: protein, fats, nutrients Encourage them to think about what is actually moving. Is it matter, energy, nutrients, or something else? Prompt students to think deeply about the following: • Where did that nutrient first come from? • Does energy start in the soil? • Is soil giving energy or helping store and cycle nutrients?	Large paper Coloured felts

Lesson Four: From Soil to Food Continued

This lesson connects soil health to plants, animals, and the food people eat.

Learning Experiences

Mapping the Food System Continued

Step 2: Expand the System

Once the basic chain is complete, challenge groups to expand it.

Prompt:

"Is this the whole system? Who else is involved before food reaches a plate?"

- Students add additional boxes around their diagram. Possible additions could include: Farmer, veterinarian, food processor, transport, supermarket, chef, family, waste system, compost, environment.

Students draw arrows showing connections between these parts.

Encourage them to think beyond a straight line:

- Where does money flow?
- Where does waste go?
- What returns to soil?
- Who makes decisions?

Step 3: Add Feedback Loops

Ask students "Does anything go back to soil?"

Students add return arrows such as:

- Animal manure → Soil
- Plant residues → Soil
- Compost → Soil
- Food scraps → Compost → Soil

Encourage them to see this as a cycle rather than a one-way path.

Prompt:

- "What happens if nothing returns to soil?"
- "What happens if waste isn't managed well?"

Step 4: Identify Points of Impact

Ask groups to circle 2-3 places where problems could begin and ripple through the system.

Examples:

- Poor soil health
- Drought
- Overuse of inputs
- Animal illness
- Transport disruption

Then ask: "If something changes here, who else is affected?"

Students draw dotted arrows to show ripple effects.

Lesson Four: From Soil to Food Continued

This lesson connects soil health to plants, animals, and the food people eat.

Learning Experiences

Mapping the Food System Continued

Step 5: Whole-Class Share and Synthesis

Invite groups to briefly present their charts.

As they share, draw a simplified class version on the board, combining strong ideas from each group.

Guide discussion with questions such as:

- Where does everything seem to connect back to?
- Which part of the system seems most foundational?
- Who depends on good decisions early in the system?
- What surprised you about how connected everything is?

Finish by reinforcing:

- The food system is not a straight line, it is a network.
- Soil is one part, but it influences many other parts.
- Decisions made in one place can affect people much later in the chain.

Students should leave this lesson seeing food production as an interconnected system rather than a simple paddock-to-plate pathway.

Where Would the Problem Show Up?

Provide scenarios for the students, such as:

- Soil with very few earthworms
- Soil that stays waterlogged after heavy rain
- Soil that has a hard layer just below the surface
- Soil that dried out very quickly in summer
- Soil with low organic matter
- Soil with very little biological activity

Ask students to discuss:

- Where would the first problem show up? In the plant, the animal, or the food people eat?
- How might this problem travel through the system?

Encourage students to justify their thinking rather than find a “right” answer. Some possible answers of where the first signs might appear could be:

- In the plant (poor growth, shallow roots, yellowing leaves)
- In the animal (lower-quality feed, reduced condition)

In the food people eat (lower yield, different nutrient quality, higher cost)

Science and Evidence

Refer back to the comic’s mention of Lincoln University’s research by Pablo Gregorini and his team.

Discuss:

- Why do scientists study the link between soil, plants, animals, and food?
- How does science help farmers understand what’s happening in their systems?

Reinforce that:

- Farmers’ observations and scientific research work together.
- Soil health can be studied, measured, and improved over time.

Get students to finish the sentence: “Healthy food starts with healthy soil because...”

Lesson Five: Good Decisions = Stronger Farms

This lesson explores how farmers' soil decisions affect costs, inputs, and long-term farm viability. Students learn that success in farming is not only about how much is produced, but also about how resources are used and managed over time.

SPECIFIC LEARNING OBJECTIVES

Students will...

- Understand that healthy soils can reduce the need for inputs such as fuel, sprays, and water.
- Recognise that yield is not the only measure of farm success.
- Explore how good soils decisions can reduce risk and support farm viability.

Learning Experiences	Resources Needed
Soil and Profitability Re-read Page 4-5 of the comic (the farmer and the banker in the field). Ask students: • What does the banker notice about this farm? • What is the banker saying about yield and costs? • Why might the banker still be smiling even though yield is a bit lower? Highlight the key idea from the comic: <i>Healthy soils can mean lower costs, even if yields are sometimes lower.</i> <i>Emphasise that farming success is about balancing production, costs, and long-term soil condition, not maximising one thing at the expense of everything else.</i>	The Whole Story Comic - Soil Edition
What Do Farms Spend Money On? Pose the following question: What do farmers need to spend money on to grow crops? As students respond, group ideas under headings such as: • Fuel • Machinery • Fertiliser • Sprays • Water • Labour Then ask: Which of these might change if soils are healthier? Do not provide answers immediately. Allow students to suggest and reason.	
Comparing Two Farm Systems Explain that students will compare two farm scenarios. For each scenario, students consider the factors that influenced the decision making of the farmers. The activities allow students to apply their understanding that the soil condition influences how many options a farmer has. The Scenario cards and questions can be found here.	Comparing Two Farm Systems Scenario Cards



Lesson Five: Good Decisions = Stronger Farms Continued

This lesson explores how farmers' soil decisions affect costs, inputs, and long-term farm viability. Students learn that success in farming is not only about how much is produced, but also about how resources are used and managed over time.

Learning Experiences

Understanding Trade-offs

Revisiting the comic again, ask students why it states that a farmer may not always harvest as much? Discuss why a farmer might accept a slightly lower yield.

Guide the discussion towards:

- Lower input costs
- Reduced risk
- Less dependence on fuel, sprays, or water
- Greater resilience when conditions change

Introduce the idea that:

Good soil management is about long-term thinking, not short-term gains.

You want students to understand that sometimes producing the highest possible yield also requires higher spending, more machinery passes, or more inputs. Farmers are constantly balancing production, cost, soil condition, and risk.

Decision-making on the Farm

Bring students back to the idea that farming involves constant decision-making. Explain that farmers rarely make choices in perfect conditions. Instead they are responding to weather, soil conditions, costs, pests, timing, and market pressures all at once.

Tell students they will explore how soil condition can influence the choices available.

Present three short statements, one at a time. Read each aloud and give students a few minutes in small groups to discuss before sharing back.

For each statement, students discuss:

- What choices does the farmer have?
- What are the possible consequences of each choice?
- How might soil conditions influence the outcome?
- Would the farmer have more, or fewer, options if the soil was healthy?

Short Statements:

- A paddock is wetter than expected, but planting needs to happen soon.
- Pests are present, but crops are still growing strongly.
- Fuel prices have increased significantly this season.

Encourage students to focus on trade-offs rather than "right answers." Make it clear that farmers weigh timing, cost, risk, and long-term soil condition when making decisions.

After discussion, bring the class together and synthesise the thinking:

- In which situations did soil conditions provide more flexibility?
- When might healthy soil reduce pressure or urgency?
- How could soil structure or soil life influence risk?

Conclude by reinforcing the key idea:

Soil health does not remove challenges, but it can increase stability and expand the range of choices available. Good soil management supports long-term decision-making, not just short-term production.

Lesson Six: People, Skills, and the Future of Soils

In this lesson students explore how soil knowledge is shared across a wider system, including food businesses, science, advisory roles, finance, and communities, and why collaboration matters. The lesson emphasises that caring for soil is not just about science or technology, but about observation, communication, decision-making, and values.

SPECIFIC LEARNING OBJECTIVES

Students will...

- Understand that healthy soils can reduce the need for inputs such as fuel, sprays, and water.
- Recognise that yield is not the only measure of farm success.
- Explore how good soils decisions can reduce risk and support farm viability.

Learning Experiences

Who is Involved?

Revisit the final image in the [comic](#) where everyone is sitting around the table.

Ask students:

- Who do we see in these final pages?
- Who is involved in soil decisions, even if they're not farming?
- Why do you think the comic ends with people around a table?

Highlight the idea that soil connects many people, not just farmers.

Soil Knowledge Beyond the Farm

Explain that while farmers work directly with soil, many other people rely on soil knowledge.

Introduce three broad categories:

- Noticing – observing soils, plants, landscapes, patterns
- Understanding – interpreting what's happening and why
- Supporting Decisions – helping others make choices using soil knowledge

Soil Roles Sorting Task

Students work in small groups. Give each group a set of [Soil Role Cards](#) which can be found [here](#).

Students place each role under one or more of the three headings:

- Noticing
- Understanding
- Supporting Decisions

They must be able to explain why they placed each role where they did.

Encourage students to place some roles in more than one category.

Guiding questions:

- Which roles rely most on observation?
- Which roles turn soil knowledge into action?
- Which roles help others decide what to do next?

This task is not about correct categorisation. It is about recognising that soil knowledge moves through people and relationships, not just data or tools.

Lesson Six: People, Skills, and the Future of Soils Continued

In this lesson students explore how soil knowledge is shared across a wider system, including food businesses, science, advisory roles, finance, and communities, and why collaboration matters. The lesson emphasises that caring for soil is not just about science or technology, but about observation, communication, decision-making, and values.

Learning Experiences

Final Wrap-up

Give students the following prompt:

- I used to think soil was...
- Now I think soil is...
- One thing I didn't realise about food before this unit is...

Get them to share with someone, the class or write their answers in their book.

Bring everyone together and ask:

If soil health changes, who feels it first? And who feels it last?

Does everyone notice soil health?

Who depends on it without realising it?

Final Wrap-up:

As a final wrap-up and short assessment of student's understanding of soil, give them the following task.

"If you only had 30 seconds to explain to someone why soil matters, what would you say?"

You could give options for the audience, for example:

- A banker
- A supermarket owner
- A parent
- A farmer
- A younger student
- Your parents

Summarise the key messages with students:

Soil is not just dirt under our feet.

It is the beginning of our food system.

When soil is healthy, we have more choices.

When soil is damaged, our choices shrink.

Understanding soil helps us make better decisions., no matter where we sit in the food system.



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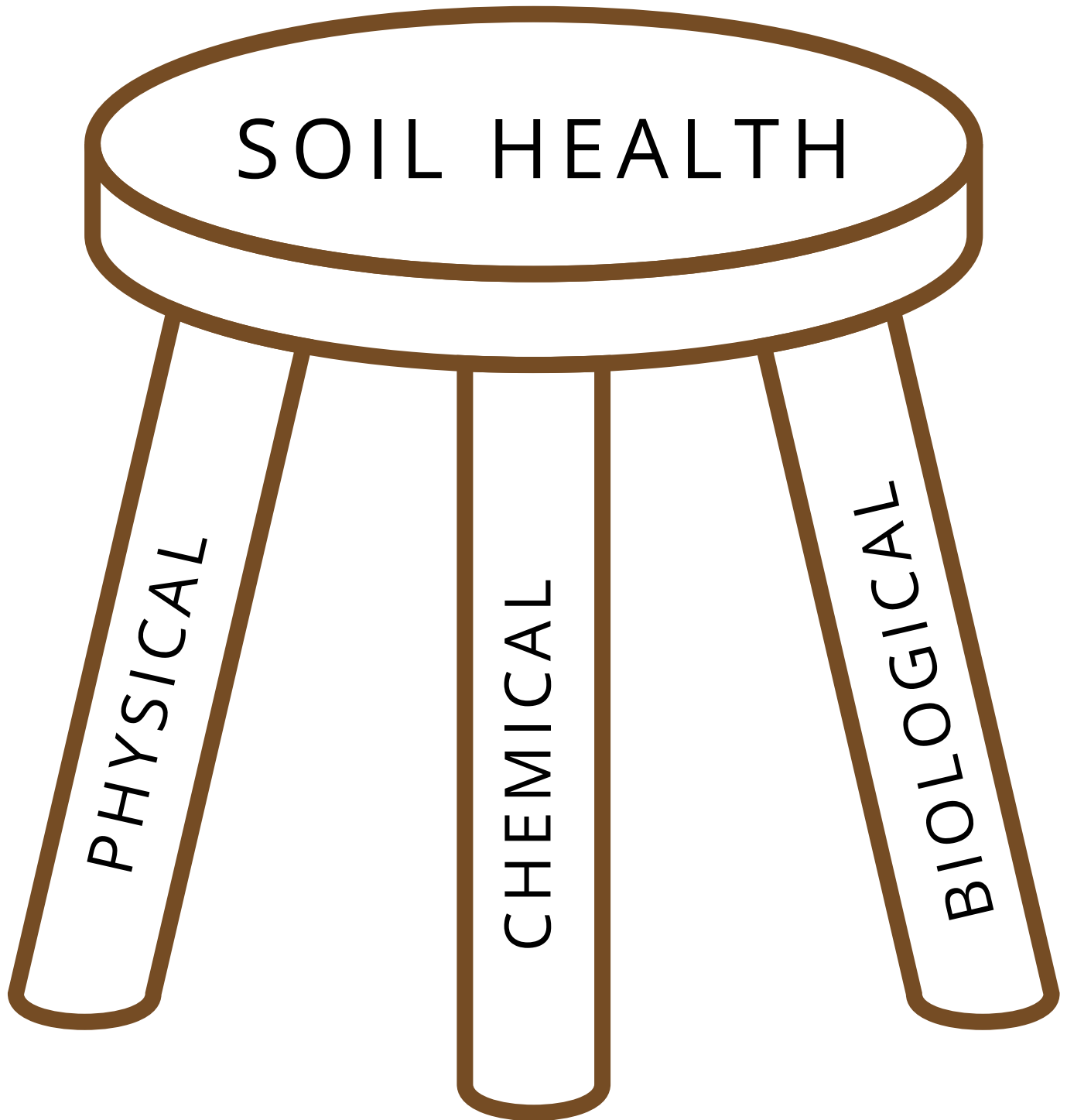
LESSON ONE



Same paddock. Same Day.

What do you notice? What might be causing these differences?

3-LEGGED STOOL OF SOIL HEALTH



Physical: How soil particles are arranged and the spaces between them that allow air, water and roots to move.

Chemical: The nutrients and mineral balance in the soil that plants need in order to grow.

Biological: The living organisms in the soil that break down organic matter, build soil structure, and help make nutrients available to plants.

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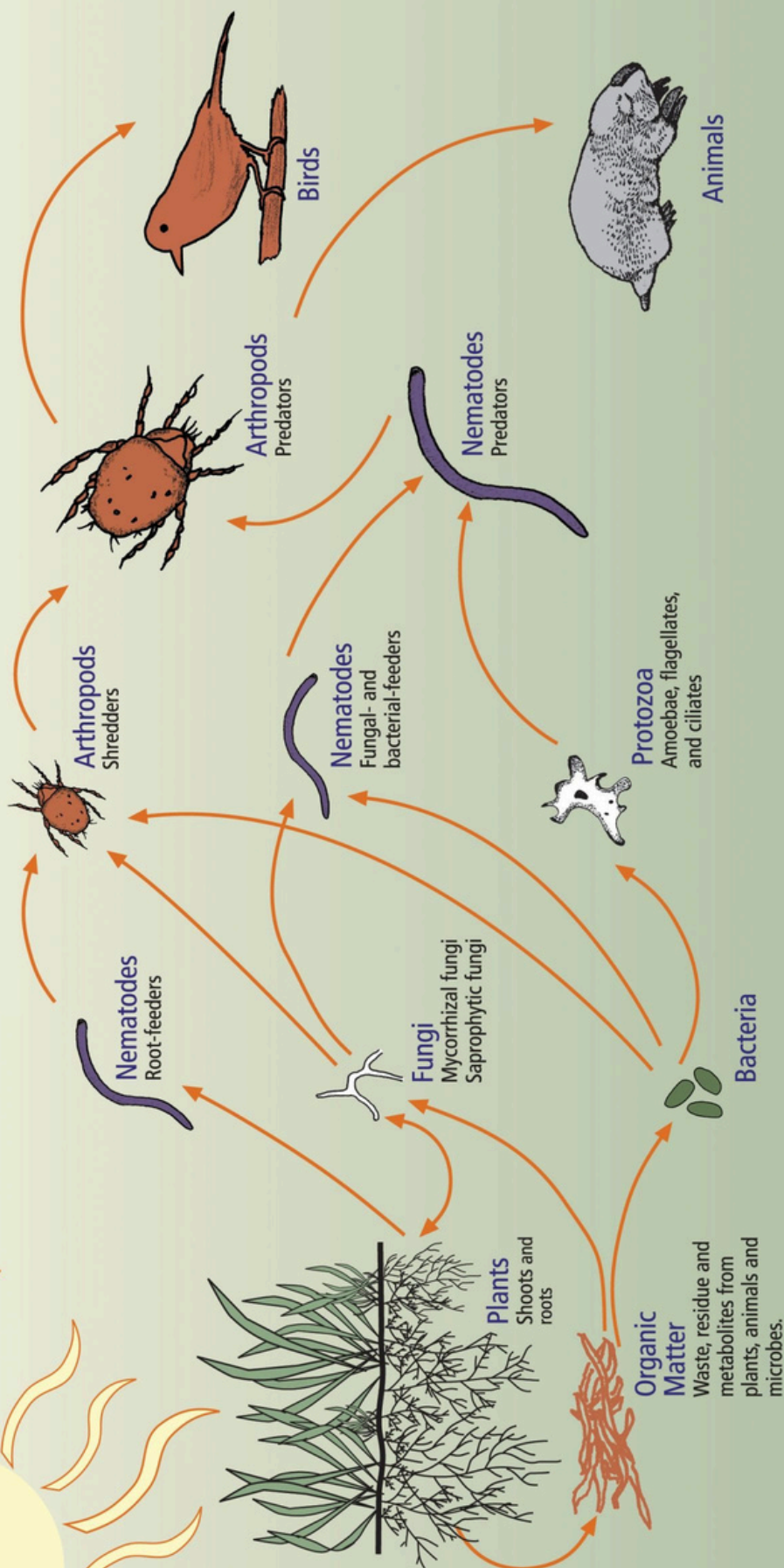
LESSON TWO

UNDERSTANDING THE LIFE BENEATH OUR FEET



[Link to a 3D model of this soil cake](#)

The Soil Food Web



First trophic level:
Photosynthesizers

Second trophic level:
Decomposers
Mutualists
Pathogens, Parasites
Root-feeders

Third trophic level:
Shredders
Predators
Grazers

Fourth trophic level:
Higher level predators

Fifth and higher trophic levels:
Higher level predators

Image source: <https://bokashiliving.com/building-a-thriving-soil-food-web/>

Soil Organism Fact Sheet

Earthworms The Soil Engineers	What they are: Underground invertebrates (animals without backbones) with long, segmented bodies. They move through soil by contracting and expanding their muscles, pushing their way through the ground. Their role in soil: As they burrow, they create channels that improve soil aeration, drainage, and root penetration. By consuming organic matter and soil, they produce nutrient-rich castings that enhance soil fertility and microbial activity.
Fungi The Decomposters and Connectors	What they are: Multicellular (and sometimes single-celled) organisms that live in soil as fine thread-like structures called hyphae, which form networks known as mycelium. Their role in soil: They decompose complex organic matter such as dead plants and wood, releasing nutrients back into the soil. Many fungi also form symbiotic relationships with plant roots (mycorrhizae), helping plants absorb water and nutrients more efficiently.
Bacteria The Nutrient Cyclers	What they are: Bacteria are microscopic, single-celled organisms that are among the most abundant life forms in soil. Their role in soil: They decompose organic matter, transform nutrients into plant-available forms, and drive key processes such as nitrogen cycling. Some bacteria also form beneficial associations with plant roots, enhancing nutrient uptake and plant growth.
Protozoa The Micro Predators	What they are: Protozoa are microscopic, single-celled organisms that live in the thin films of water surrounding soil particles. They are part of the soil microfauna and feed mainly on bacteria and other tiny organisms. Their role in soil: By feeding on bacteria, protozoa help release nutrients, especially nitrogen, into forms that plant roots can absorb. This process plays an important role in nutrient cycling within the soil ecosystem.
Nematodes The Soil Regulators	What they are: Nematodes are microscopic, unsegmented roundworms that move through water films in soil pores. Their role in soil: Depending on the species, they feed on bacteria, fungi, other nematodes, or plant roots. By grazing on microbes, many nematodes contribute to nutrient cycling and help regulate microbial populations within the soil ecosystem.
Arthropods The Soil Shredders	What they are: Arthropods are small invertebrate animals with jointed legs and external skeletons, including insects, mites, springtails, and beetles that live in or on the soil. Their role in soil: They break down larger pieces of organic matter into smaller fragments, increasing the surface area available for microbial decomposition. This activity supports nutrient cycling and improves soil structure.

Soil Organism Matching Activity - Page 1

Instructions: Cut out the following titles and the statements on the next page. Use the information on the Soil Organism Fact Sheet and the Soil Food Web Diagram to match the correct headings with the correct statements about each of the soil organisms.

Earthworms

Fungi

Bacteria

Protozoa

Nematodes

Arthropods

The Nutrient Cyclers

The Soil Regulators

The Micro Predators

The Soil Engineers

The Soil Shredders

The Decomposters and
Connectors

Soil Organism Matching Activity - Page 2

Break down dead plant material into simpler compounds.

Produce castings rich in nutrients that plants can use.

Extremely numerous in healthy soils.

Ingest soil and organic matter as they tunnel.

Help regulate bacterial populations.

Help mix organic matter into the soil.

Form close associations with plant roots (rhizosphere).

Segmented, tubular animals that move through soil.

Nutrients are released as they feed.

Some feed on bacteria or fungi; others feed on plant roots.

Help control microbial populations.

Thread-like filaments called hyphae.

Create burrows that allow air and water to move.

Help make nutrients like nitrogen available to plants.

Include creatures like mites, springtails, and beetles.

Some form close partnerships with plant roots (mycorrhizae).

Release nutrients that plants can use.

Grow as thread-like filaments called hyphae.

Break down organic matter and recycle nutrients.

Tiny single-celled organisms in water films around soil particles.

Microscopic, worm-like animals living in soil.

Feed on bacteria and other microbes.

Invertebrates with jointed legs and an exoskeleton.

Create tunnels that improve air and water movement.

Help mix organic material into soil.

Segmented, tubular animals that move through soil.

Soil Organism Matching Activity - Answers

Earthworms (The Soil Engineers)

- Segmented, tubular animals that move through soil.
- Ingest soil and organic matter as they tunnel.
- Create burrows that allow air and water to move.
- Produce castings rich in nutrients that plants can use.
- Help mix organic matter into the soil.

Fungi (The Decomposers and Connectors)

- Grow as thread-like filaments called hyphae.
- Break down dead plant material into simpler compounds.
- Release nutrients that plants can absorb.
- Some form close partnerships with plant roots (mycorrhizae).
- Can influence soil structure by binding particles together.

Bacteria (The Nutrient Cyclers)

- Single-celled microorganisms living throughout the soil.
- Break down organic matter and recycle nutrients.
- Form close associations with plant roots (rhizosphere).
- Help make nutrients like nitrogen available to plants.
- Extremely numerous in healthy soils.

Protozoa (The Micro Predators)

- Tiny single-celled organisms in water films around soil particles.
- Feed on bacteria and other microbes.
- Release nutrients that plants can use.
- Help regulate bacterial populations.

Nematodes (The Soil Regulators)

- Microscopic, worm-like animals living in soil.
- Some feed on bacteria or fungi; others feed on plant roots.
- Help control microbial populations.
- Nutrients are released as they feed.
- Can influence plant growth, positively or negatively depending on type.

Arthropods (The Soil Shredders)

- Invertebrates with jointed legs and an exoskeleton.
- Include creatures like mites, springtails, and beetles.
- Break down organic matter into smaller pieces.
- Help mix organic material into soil.
- Create tunnels that improve air and water movement.

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LESSON THREE

Farm Scenario Activity

Instructions: Cut out the scenario strips and match them with the correct heading.

PROTECTS SOIL HEALTH

DAMAGES SOIL HEALTH

Tractor driving on a wet paddock

Animals standing on the same muddy area for days

Leaving plant roots in the soil after harvest

Leaving soil bare after harvesting

Cover soil with mulch or crop residue

Compacting soil by repeatedly driving machinery over the same track

Planting diverse crops vs a single crop continuously

Using minimal tillage / no-till farming

Adding organic matter (compost, manure, lying down plant material) to the soil

Planting deep-rooted plants to break up compacted soil

Grazing animals evenly across a paddock instead of in one area

Using heavy machinery on frozen soil

Rotating crops to different paddocks each year

Farm Scenario Activity - Answers

PROTECTS SOIL HEALTH

DAMAGES SOIL HEALTH

Tractor driving on a wet paddock

Animals standing on the same muddy area for days

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Using heavy machinery on frozen soil

Rotating crops to different paddocks each year

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LESSON FOUR

Comparing Two Farm Systems

SCENARIO ONE: A WET SPRING

Two farmers in the same region are preparing for planting after a wet winter. Both are experienced and want to set their crops up for success.

On the first farm, the paddock is still holding a lot of moisture when planting time arrives. The surface looks ready, but underneath the soil is soft. The farmer decides to go ahead and plant, knowing that waiting longer may delay the season. Machinery leaves some visible tracks, and over time certain areas become firmer and harder underfoot. During heavy rain, water tends to sit in low spots. As the season progresses, some crop areas establish strongly, while others are slower. The farmer adjusts by applying additional fertiliser in weaker areas and makes several passes with machinery to manage weeds and pests. At harvest, production is solid, although input use has been steady throughout the season.

On the second farm, planting is also approaching, and soil moisture is high. This farmer chooses to wait several extra days before bringing machinery onto the paddock. When planting begins, the soil is friable and breaks apart easily in the hand. Machinery still travels across the field, but fewer deep tracks are visible. Rain later in the season soaks in more evenly, and crop growth appears relatively consistent across the paddock. Fertiliser and sprays are used when needed, but fewer adjustments are required during the season. Harvest results are comparable to neighbouring farms, and input use has been moderate.

Both farmers are working within the same weather conditions. However, the condition of the soil influences how the season unfolds and how many management decisions are required along the way.

Discussion Prompts

- How did soil condition influence the number of management decisions each farmer had to make?
- Which farm appeared to need more reactive adjustments during the season?
- Which system might have more flexibility if fuel or fertiliser prices changed?
- Which farm might be more predictable year to year?
- What role did soil structure and soil life likely play in these outcomes?

Comparing Two Farm Systems

SCENARIO TWO: A DRY SUMMER

Later in the year, the region experiences a prolonged dry spell.

On one farm, the soil surface dries quickly after rainfall. When digging down, there is a dense layer below the topsoil. Plant roots are present but tend to spread sideways more than downward. As the dry period continues, crops begin to show signs of stress earlier than expected. Irrigation is increased to maintain growth, and nutrient applications are adjusted to support the plants. The farmer monitors conditions closely and responds as needed to maintain production.

On a nearby farm, soil structure allows water to move deeper into the profile after rain. When digging into the paddock, roots can be seen extending further down into the soil. During the same dry period, crops maintain growth for longer before irrigation is required. Management decisions are still made, but fewer emergency adjustments are needed. Production remains steady across most of the field.

Again, both farmers are skilled and attentive. The difference lies not in effort or care, but in how soil condition influences water movement, root growth, and the number of decisions required during challenging conditions.

Discussion Prompts

- How did soil condition influence the number of management decisions each farmer had to make?
- Which farm appeared to need more reactive adjustments during the season?
- Which system might have more flexibility if fuel or fertiliser prices changed?
- Which farm might be more predictable year to year?
- What role did soil structure and soil life likely play in these outcomes?

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LESSON FIVE

Soil Role Cards

Instructions: Cut out the three headings at the top and the role cards below. Place each role under the heading you think fits best. There may be more than one place each role can fit. The key is that you can justify where you have placed each role.

NOTICING

UNDERSTANDING

SUPPORTING DECISIONS

Role Cards:

Farmer

Soil Scientist

Food Producer

Agricultural Advisor

Environmental Planner

Rural Banker

Policy Maker

Community Grower

Educator