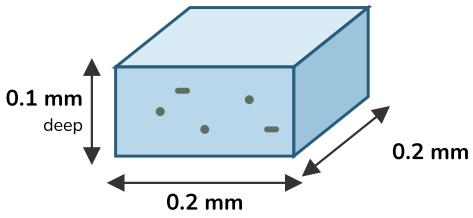
RESEARCHER · AGES 15-99 · SHEET 1

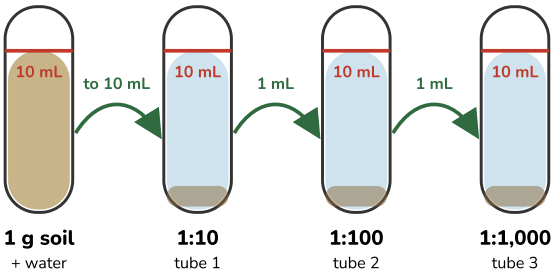
Counting Grid Math: The Full Method

1. Dilute in a series

1 g of soil (about 1 mL) topped up with water to 10 mL is **1:10**; 1 mL of that topped up to 10 mL is **1:100**; once more, **1:1,000**. Read fungi, protozoa and nematodes at 1:10; count bacteria at 1:100 or 1:1,000, whichever leaves a countable number in a square.



0.004 µL = 1/250,000 of a mL



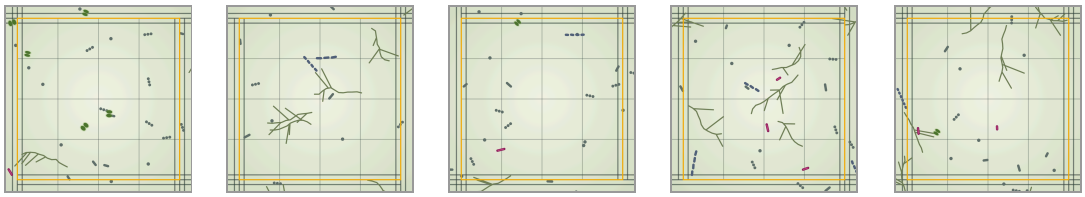
2. Know your squares

The grid is 3 mm × 3 mm, under a cover glass 0.1 mm above it. Shortcut multiplier = squares per mL × the dilution.

Square	Side	Holds	Squares per mL	× at 1:10	× at 1:100	× at 1:1,000
large	1 mm	0.1 µL	10,000	100,000	1,000,000	10,000,000
small	0.2 mm	0.004 µL	250,000	2,500,000	25,000,000	250,000,000
tiny	0.05 mm	0.00025 µL	4,000,000	40,000,000	400,000,000	4,000,000,000

3. Count and scale up: the game's own squares

Finished compost, a 1:1,000 drop, the standard 5 small squares. Top and left lines count; a pair or chain is 1.



1 _____ 2 _____ 3 _____ 4 _____ 5 _____

Finished compost
Count it in the game

1.	_____	Average bacteria per square
2.	_____	Scale up to one full milliliter
3.	_____	Reverse the dilution to find the total in the original soil
4.	_____	Combined shortcut multiplier

Another route to the same number: count 10 random tiny squares on a 1:100 drop, × 400 to fill the 1 mm² centre square, × 100 for the dilution, ÷ 0.0001 mL (1 mm² × 0.1 mm). That is average × 400,000,000, the tiny-square shortcut at 1:100.

Per-Gram Math, Fungi and the Balance



P1. Mixed squares. Healthy garden soil, 1:1,000 drop: 3 small squares held 14, 9, 5 and 4 tiny squares held 1, 1, 0, 1. You can't average squares of different sizes, so divide the total by all the water in the squares. Bacteria per gram?

P2. Fungal length. Forest soil on a 1:10 drop. With the Ruler you measured the true fungal thread in the four corner large squares (1 mm × 1 mm × 0.1 mm = 0.1 µL; 10,000 fill 1 mL): 5,450, 6,560, 5,450, 6,770 µm. Use the four steps, then ÷ 1,000,000 for metres of thread per gram.

P3. Fungi : bacteria by biomass, not by count. A typical soil fungal thread is 2.5 µm wide, so each µm of thread is π × 1.25² ≈ 4.91 µm³. The game gives each bacterium it counts 0.23 µm³ (the cell with its slime coat, and the cells too small to see). Forest soil: 609 m of thread and 1.2 billion bacteria per gram. Work out fungal biomass ÷ bacterial biomass. Vegetables want about 0.3 to 1, berries 1 to 5, fruit trees and forest 5 or more: who would thrive here?

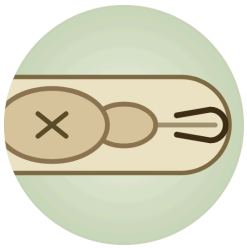
P4. Protozoa. You found 7 protozoa in 30 views at 400x on a 1:10 drop of healthy garden soil. One 400x view holds about 0.0159 µL of the drop. Protozoa per gram? Healthy is about 10,000 or more.

Read it as a food web

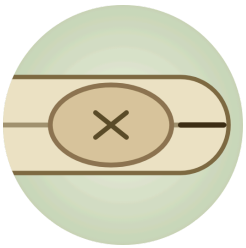
Roots and organic matter feed **bacteria** and **fungi**, which hold nutrients in their bodies. **Protozoa** and **nematodes** eat them and release the extra as plant food by the roots; predators keep the grazers in check. So ask: what is present, what is missing, and who leads? Missing protozoa and nematodes means nutrients stay locked up; many ciliates mean the soil is short of air.

The simulator
Measure your own soils

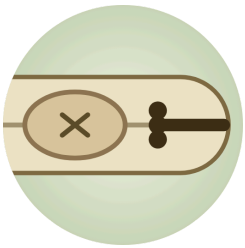
Nematode ID: Dichotomous Key



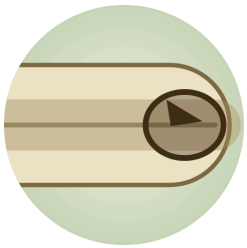
A _____



B _____



C _____



D _____

1a Tail end: body tapers to a point → turn it round. **1b** Head end: the throat (pharynx) runs back from the mouth → 2.

2a A hollow **spear (stylet)** in the mouth → 3. **2b** No spear → 4.

3a Strong spear with **three basal knobs**; muscular middle bulb → **root feeder** (plant parasite). Some have faint or no knobs, so look twice.

3b Thin, small spear, **no knobs**; one big middle bulb (with a valve) → **fungal feeder** (pierces hyphae and drinks them).

4a Open tube mouth (often with fancy lips); throat with two bulbs, the last **round with a valve** → **bacterial feeder**.

4b Wide mouth cavity with a **tooth**; plain, thick muscular throat, no bulb; often a big, thick worm → **predator**.

Omnivores and "switchers" mix these traits and change food with what's around (some fungal feeders turn to roots when plants are stressed). A shape is a strong hint, not proof: being sure takes DNA. Juveniles are hard to name; eggs are smooth ovals, sometimes with a coiled worm inside, and mean the population is breeding.

Count them per gram

On a 1:10 drop, one 100x view holds about 0.254 µL, so per gram = average per view × 10 ÷ 0.000254 mL ≈ average per view × 39,298.

Sample (30 views at 100x)	Helpful	Root feeders	Helpful per gram	Root share	Warning?
Healthy garden soil	32	1			
Wet compacted soil	14	14			

The game warns when root feeders are 30% or more of the nematodes, or above 20,000 per gram; it reads helpful nematodes as low under 20 per gram.

The simulator
Zoom in on a nematode's head

Why do predators matter to a farmer with root feeders?

RESEARCHER · AGES 15-99 · SHEET 3

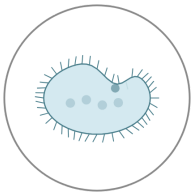
What Am I Seeing?

Sixteen things from the game's slides. Name each one, and mark it **L** (soil life), **T** (trouble if many) or **N** (not the soil life being read).

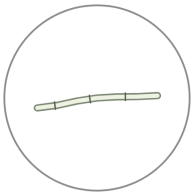
Actinobacteria · Ciliate · Decomposer fungus · Diatom · Disease fungus spores · False fungus (lookalike) · Flagellate · Microfiber · Mycorrhizal fungus · Mycorrhizal spore · Naked amoeba · Nematode egg · Pollen · Testate amoeba · Trichoderma · Yeast



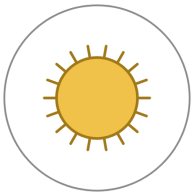
1. _____ L / T / N: ____



2. _____ L / T / N: ____



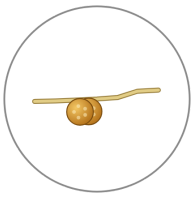
3. _____ L / T / N: ____



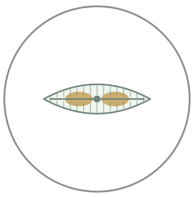
4. _____ L / T / N: ____



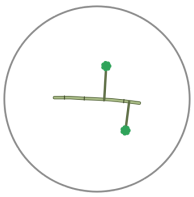
5. _____ L / T / N: ____



6. _____ L / T / N: ____



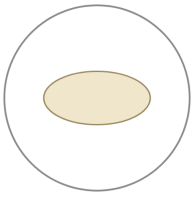
7. _____ L / T / N: ____



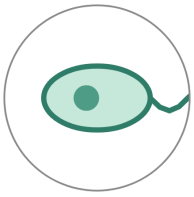
8. _____ L / T / N: ____



9. _____ L / T / N: ____



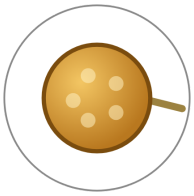
10. _____ L / T / N: ____



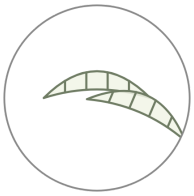
11. _____ L / T / N: ____



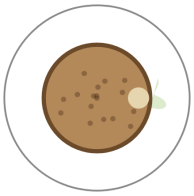
12. _____ L / T / N: ____



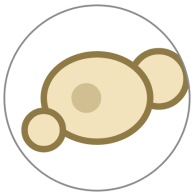
13. _____ L / T / N: ____



14. _____ L / T / N: ____



15. _____ L / T / N: ____



16. _____ L / T / N: ____

Who does this job?

Breaks down woody stuff and builds soil crumbs		Guards roots against disease fungi; right-angle branches, green spore tufts	
Trades water and nutrients for root sugars		Gives soil its earthy smell	
Squeezes into tiny pores to eat bacteria		Grows by budding; common in fresh, sugary compost	

Lookalikes and Protozoa

True fungus or lookalike?

Check	True fungal thread	Lookalikes
Width	Wide and **even** along its length (the game draws them 9 µm)	Actinobacteria are far thinner (1.5 µm) and branch; false fungi are thin and wispy (3 µm)
Cross-walls (septa)	Evenly spaced in decomposer fungi; none in mycorrhizal threads, which carry round spores	Uneven or missing; water molds have none
Shape	Long, smooth, branching	Tangled, broken, with gaps
Colour	Not a test: many true fungi are clear, some brown. A clear or tan plastic microfiber can pass for a thread; under epifluorescence plastic flares neon orange.	



Good fungus | False fungus | Actino | Myco thread | Fiber

The protozoa

Kind	Size in the game	How it moves	What it tells you
Flagellate	16 µm	Whips about with one or two tails; the smallest	Eats bacteria, releases nitrogen; usually the most common
Naked amoeba	30 µm	Creeps by changing shape	Reaches bacteria in the tiniest pores
Testate amoeba	60 µm	Slow, in a shell, a soft foot out of the opening	Tough; common in forest soil and moss
Ciliate	70 µm	Fast, covered in short hairs (cilia)	Many (25,000+ per gram in the game) means short of air

A drop has threads that are thin, tangled and have uneven walls, plus many ciliates. What would you suspect about the soil, and what would you check next?

RESEARCHER · AGES 15-99 · MYSTERY LESSON

Soil Detective: Gather Clues



1. Scan a mystery code. On the **Hard** level, make a slide, count bacteria in the counting grid and measure fungal threads. Find protozoa and nematodes.
2. Write your numbers in the table (the results page shows them per gram).
3. Turn each number into a clue with the Clue Key, then cross out the suspects that don't fit.
4. Name the soil. Look at more drops to be surer: one drop can be off.

Mystery A
Scan to open

Mystery B
Scan to open

Mystery C
Scan to open

Mystery D
Scan to open

My readings

Mystery	Fungi : bacteria	Bacteria (billion/g)	Fungal thread (m/g)	Protozoa (thousand/g)	Ciliates (/g)	Helpful nematodes (/g)	Root-feeders (/g)	Drops
A								
B								
C								
D								

Clue Key (the game's own clues)

Measure	When	Clue	Soils like this
Fungi : bacteria	3 : 1 or more	Fungi far ahead	Forest floors, mulched orchards, woody compost
	1 : 1.7 to 3 : 1	About even	Gardens fed with compost, old pasture, finished compost
	1 : 3.3 to 1 : 1.7	Bacteria a little ahead	Soils starting to struggle, compost tea
	under 1 : 3.3	Bacteria far ahead	Young hot compost; dug, packed, soggy, sandy or bagged soil
Fungal thread	under 10 m per gram	Almost none	Subsoil, packed paths, beach sand, bagged mixes
	300 m per gram or more	Lots	Forest, orchard, fungal compost
Bacteria	under 1 billion per gram	Few	Sand, sour ground, bagged mixes
	1 to 4 billion	Normal for soil	Most living soils: read the other clues
	4 billion or more	Very many	Compost and castings, or worn-out ground with nothing else
Protozoa	under 30,000 per gram	Not many	Packed, deep, sandy, bagged or salty ground
	200,000 or more	Lots	Compost and worm castings
Ciliates	25,000 per gram or more	Lots: short of air	Soggy or trampled soil, sour or young compost
Helpful nematodes	under 5,000 per gram	Hardly any	Packed, deep, sandy or bagged ground
	35,000 or more	Lots	Healthy, mature soils and finished compost
Root-feeding nematodes	30% or more of the nematodes	Warning	Stressed soils: waterlogged or salty

RESEARCHER · AGES 15-99 · MYSTERY LESSON

Soil Detective: The Suspects



One of these is each mystery sample. Cross out a suspect when a clue doesn't fit.

Fresh bacterial compost

Comes from: A young, hot pile with lots of greens.
Smell and feel: Warm, with a whiff of ammonia. Coarse, still has leaves.
Under the microscope:

- Packed with bacteria and yeast.
- Few fungi; few protozoa and nematodes (the heat keeps them down).

Mulched fruit orchard

Comes from: Under fruit trees kept mulched with wood chips.
Smell and feel: Earthy and woody. Loose under the mulch.
Under the microscope:

- More fungi than bacteria: brown threads in most views.
- Mycorrhizal threads and spores.
- Fungus-eating and predatory nematodes keeping things in check.

Packed path / dirt road

Comes from: A path walked and driven on until it is hard.
Smell and feel: Smells like dust. Hard as a brick; water runs off.
Under the microscope:

- Billions of bacteria and actinobacteria, but almost nothing else.
- Hardly any fungal threads, very few protozoa, no nematodes.
- Pale minerals and very few organic bits.

Wet compacted soil

Comes from: A patch that floods and gets walked on.
Smell and feel: Sour or rotten-egg smell. Sticky and grey.
Under the microscope:

- Ciliates zooming around (they like low air).
- Thin, clear "false fungi" and few real fungi.
- Root-feeding nematodes with a spear (stylet).
- Algae and diatoms from standing water.

My verdict

Mystery	It is...	The clue that proves it
A		
B		
C		
D		

1. Two soils can both have billions of bacteria. Which other clues tell compost apart from worn-out, packed ground?

2. Your readings came from a few drops. Which clue would you re-check with more drops before you were sure, and why?

3. Pick one mystery soil and say what would grow best in it (vegetables, berries or fruit trees) from its fungi : bacteria.

Compare the Samples



Each person measures each sample. Then the class shares its numbers and writes the **class middle** (the middle number when they are put in order).

A: Healthy garden soil
Scan to open

B: Forest / fungal soil
Scan to open

C: Lifeless subsoil / construction fill
Scan to open

D: Finished compost
Scan to open

Measure	A: Healthy garden soil		B: Forest / fungal soil		C: Lifeless subsoil / construction fill		D: Finished compost	
	Me	Class middle	Me	Class middle	Me	Class middle	Me	Class middle
Fungi : bacteria								
Bacteria billion/g								
Fungal thread m/g								
Protozoa thousand/g								
Helpful nematodes /g								

Who is there? (tick)

Sample	Bacteria	True fungi	Protozoa	Bacteria-eating nematodes	Fungus-eating	Predatory	Root-feeding
Healthy garden soil							
Forest / fungal soil							
Lifeless subsoil / construction fill							
Finished compost							

1. Which sample is missing the nutrient cyclers (protozoa and nematodes)? What happens to the food the bacteria hold?

2. Plants want different balances (fungi : bacteria): Vegetables 0.3 to 1; Berries & shrubs 1 to 5; Fruit trees & forest 5 to 100. Match each sample to what would grow best.

3. Good compost usually holds 2 to 4 times more life than good soil: do the class middles agree? Is the spread between the class's lowest and highest reading a mistake, or what you'd expect?

Rules of Thumb and the Game's Ranges



Rules of thumb for reading a slide

1. **Hold conclusions lightly.** Shapes have lookalikes; a microscope tells you who is probably there, not their species.
2. **One drop is a peek.** Look at drops from the top, middle and bottom of the tube, and average them.
3. **Count bacteria on a 1:100 or 1:1,000 drop** with a counting grid; read fungi, protozoa and nematodes at 1:10.
4. **No protozoa and no nematodes means the main nutrient cyclers are missing**, however many bacteria there are.
5. **Good compost holds more life than good soil**, often 2 to 4 times more.
6. **Ratios beat raw numbers.** Drop size and lens change counts; the balance between groups travels better.
7. **Keep a control.** Compare with another sample, an earlier date or a reference, and note dilution, lens and where the sample came from.
8. **Read it in context:** water, air, food, minerals and disturbance shape what you see. Combine it with other soil tests.

The game's approximate healthy ranges (per gram)

Bacteria	soil about 1-3 billion per g (about 40-120 in a small 0.2 mm square at 1:100); compost about 4-10 billion (16-40 a small square at 1:1,000)	low below 1 billion per g
Protozoa	healthy about 10,000 per g or more	low below 10,000 per g
Ciliates	a caution only alongside low redox (ORP under about 150 mV)	caution above 500,000 per g
Beneficial nematodes	about 20 per g or more	low below 20 per g
Root-eating nematodes	a small share of the nematodes	high at 30% or more, or above 20,000 per g
Fungal thread	a few tens of metres per g or more for fungal plants	low below 30 m per g (fungal plants) or 10 m per g (vegetables)
Lookalikes and disease spores	only a few	many above 60,000 lookalike threads or 900,000 spores per g

The game's Clue Key thresholds

Fungi : bacteria	3 : 1 or more	Fungi far ahead
	1 : 1.7 to 3 : 1	About even
	1 : 3.3 to 1 : 1.7	Bacteria a little ahead
	under 1 : 3.3	Bacteria far ahead
Fungal thread	under 10 m per gram	Almost none
	300 m per gram or more	Lots
Bacteria	under 1 billion per gram	Few
	1 to 4 billion	Normal for soil
	4 billion or more	Very many
Protozoa	under 30,000 per gram	Not many
	200,000 or more	Lots
Ciliates	25,000 per gram or more	Lots: short of air
Helpful nematodes	under 5,000 per gram	Hardly any
	35,000 or more	Lots
Root-feeding nematodes	30% or more of the nematodes	Warning

RESEARCHER · AGES 15-99 · ADULT GUIDE

For Teachers and Parents



Five sheets that go with **Dr. Dirt's Microscope**, a free soil-microscope simulator (drdirt.earth/game/?mode=microscope; no sign-in). Children use the **Hard** level. Every organism picture and counting square on these sheets is drawn by the game itself, so it matches the screen, and every number in the answer key is worked out from the game's own soils.

The QR codes

- **The simulator** opens the microscope.
- **A named sample** opens the microscope straight on that soil.
- **Mystery A to D** open a soil with its name and story hidden, for the detective sheet.

The simulator
No sign-in needed

The sheets

1. Counting Grid Math (2 pages)	Dilution series, square geometry and shortcuts, the game's own squares, mixed squares, fungal length to m/g, fungi : bacteria by biomass, protozoa per gram.
2. Nematode Key	A dichotomous key from stylet, knobs and throat bulbs; per-gram nematodes and the root-feeder warning.
3. What Am I Seeing? (2 pages)	Sixteen things from the slide; true fungi vs lookalikes; the four protozoa and what they say.
4. Soil Detective (2 pages)	Four masked soils; the game's clue thresholds; evidence and confidence.
5. Compare the Samples	Class middle and spread; who is present at each trophic level; plant fit by fungi : bacteria.

Running it

- One device for one or two students; 30 to 45 minutes a sheet. Counting is an estimate, so students' numbers will differ from each other and from the key; averaging several drops, and the class middle, brings them closer.
- **Teachers:** in the **Teacher Microscope**, the **Print worksheets** button prints these PDFs and a Soil Detective and Compare sheet with QR codes for *your own* class set (named or mystery).

The four steps, worked: a 1:1,000 drop, small squares (0.004 µL each, so 250,000 fill 1 mL; × 1,000 for the dilution = 250,000,000).

1.	**(6 + 3 + 8 + 8 + 6) ÷ 5 = 6.2**	Average bacteria per square
2.	**6.2 × 250,000 = 1,550,000**	Scale up to one full milliliter
3.	**1,550,000 × 1,000 = 1,550,000,000**	Reverse the dilution to find the total in the original soil
4.	**6.2 × 250,000,000 = 1,550,000,000**	Combined shortcut multiplier

Answer Key (1 of 2)



Sheet 1: The Full Method

The game's squares: 19, 13, 17, 20, 17.

1.	**(19 + 13 + 17 + 20 + 17) ÷ 5 = 17.2**	Average bacteria per square
2.	**17.2 × 250,000 = 4,300,000**	Scale up to one full milliliter
3.	**4,300,000 × 1,000 = 4,300,000,000**	Reverse the dilution to find the total in the original soil
4.	**17.2 × 250,000,000 = 4,300,000,000**	Combined shortcut multiplier

4.3 billion; a careful count of the whole slide in the game gives 4 billion. Five squares is a small sample, so ±10-20% is normal.

Sheet 1: Per-Gram Math

P1: (14 + 9 + 5 + 1 + 1 + 0 + 1) = 31; 31 ÷ 0.000013 mL ≈ 2,384,615; 2,384,615 × 1,000 = 2,384,615,000 (2.4 billion; careful value 2.5 billion).

P2: (5,450 + 6,560 + 5,450 + 6,770) ÷ 4 = 6,057.5; 6,057.5 × 10,000 = 60,575,000; 60,575,000 × 10 = 605,750,000; 6,057.5 × 100,000 = 605,750,000 µm per gram; ÷ 1,000,000 = 605.75 m per gram (careful game value 609 m; the game's clue for 300 m or more is "lots of fungal thread").

P3: fungi 609.1 million µm × 4.91 ≈ 3 billion µm³; bacteria 1.2 billion × 0.23 ≈ 282.9 million µm³. Ratio ≈ 10.6 : 1, the game's 10.6 : 1: fungal, best for fruit trees and forest.

P4: 7 ÷ 30 = 0.23 per view. Shortcut: 10 (the dilution) ÷ 0.0000159 mL ≈ 628,760, so 7 ÷ 30 × 628,760 ≈ 146,711 per gram (careful value 156,876): healthy.

Sheet 2: Nematode Key

A bacterial feeder (4a), B fungal feeder (3b), C root feeder (3a), D predator (4b). Healthy garden: 32 ÷ 30 × 39,298 ≈ 41,917 helpful per gram, root share 3%: no warning. Wet compacted: ≈ 18,339 helpful per gram, root share 50%: warning (the game's careful values: 44,799 and 16,505 helpful per gram). Predators eat root feeders, so a full food web keeps them in check without poisons.

Sheet 3: What Am I Seeing?

1. Actinobacteria (L); 2. Ciliate (L); 3. Decomposer fungus (L); 4. Pollen (N); 5. Naked amoeba (L); 6. Mycorrhizal fungus (L); 7. Diatom (N); 8. Trichoderma (L); 9. False fungus (lookalike) (T); 10. Nematode egg (L); 11. Flagellate (L); 12. Microfiber (N); 13. Mycorrhizal spore (L); 14. Disease fungus spores (T); 15. Testate amoeba (L); 16. Yeast (L). Jobs: decomposer fungus; Trichoderma; mycorrhizal fungus; actinobacteria; naked amoeba; yeast.

Lookalikes question: likely short of air (waterlogged or compacted): false fungi and ciliates both point to low oxygen. Check how wet and packed the ground is, look for root-feeding nematodes, and look at more drops.

Answer Key (2 of 2)



Soil Detective

A = Fresh bacterial compost. A careful reading: fungi : bacteria 1 : 7.4, bacteria 6.2 billion/g, fungal thread 39 m/g, protozoa 311 thousand/g, ciliates 37,726/g, helpful nematodes 62,483/g, root-feeders 1,179/g. Clues: Bacteria far ahead of fungi (fungi : bacteria 1 : 7.4). Very many bacteria (about 6.2 billion in a gram). Lots of protozoa. Lots of ciliates (the fast swimmers covered in hairs). Lots of helpful nematodes.

B = Wet compacted soil. A careful reading: fungi : bacteria 1 : 7.4, bacteria 3.4 billion/g, fungal thread 21 m/g, protozoa 57 thousand/g, ciliates 30,180/g, helpful nematodes 16,505/g, root-feeders 18,863/g. Clues: Bacteria far ahead of fungi (fungi : bacteria 1 : 7.4). A normal soil amount of bacteria (about 3.4 billion in a gram). Lots of ciliates (the fast swimmers covered in hairs). Many root-feeding nematodes (with a spear in the mouth).

C = Mulched fruit orchard. A careful reading: fungi : bacteria 5.2 : 1, bacteria 1.9 billion/g, fungal thread 456 m/g, protozoa 165 thousand/g, ciliates 5,030/g, helpful nematodes 56,588/g, root-feeders 1,179/g. Clues: Fungi far ahead of bacteria (fungi : bacteria 5.2 : 1). Lots of fungal thread (about 456 m in a gram). A normal soil amount of bacteria (about 1.9 billion in a gram). Lots of helpful nematodes.

D = Packed path / dirt road. A careful reading: fungi : bacteria 1 : 30.1, bacteria 6.1 billion/g, fungal thread 9.4 m/g, protozoa 27 thousand/g, ciliates 1,258/g, helpful nematodes 0/g, root-feeders 0/g. Clues: Bacteria far ahead of fungi (fungi : bacteria 1 : 30.1). Almost no fungal threads (about 9 m in a gram). Very many bacteria (about 6.1 billion in a gram). Not many protozoa. Hardly any nematodes.

Q1: protozoa and nematodes. Compost is full of both; packed or dug-up ground has billions of bacteria but hardly any protozoa or nematodes (the food web stops at bacteria). Q2: one drop is only a peek; numbers vary drop to drop, so average several. Q3 (re-check): the clue nearest its cut-off (for example a fungi : bacteria near 0.6 or 3, or ciliates near the "lots" line). Plants: vegetables 0.3 to 1, berries 1 to 5, fruit trees and forest 5 or more.

Children's numbers vary around these: one drop is a peek, and counting is an estimate.

Compare the Samples

Sample	Fungi : bacteria	Bacteria (billion/g)	Fungal thread (m/g)	Protozoa (thousand/g)	Helpful nematodes (/g)	The game's plant
Healthy garden soil	1 : 1.1	2.5	112	157	44,799	Vegetables (about 0.3 to 1)
Forest / fungal soil	10.6 : 1	1.2	609	138	44,799	Fruit trees & forest (about 5 to 100)
Lifeless subsoil / construction fill	no fungi	5.4	0.0	0.0	0	Vegetables (about 0.3 to 1)
Finished compost	1.1 : 1	4.0	197	269	66,020	Vegetables (about 0.3 to 1)

These are careful readings of each sample (what the game works out from a whole, well-counted slide); the class middle should land near them. Most fungal: Forest / fungal soil; most bacterial: Lifeless subsoil / construction fill. Billions of bacteria but a poor soil: Lifeless subsoil / construction fill: almost no protozoa or nematodes to eat the bacteria and release their food to roots, and few or no fungal threads. Different numbers for the same soil are expected: each drop and each count is a small sample; the middle of many readings is steadier than any one.

Who is there (on a careful look at a whole slide): Healthy garden soil: bacteria, true fungi, protozoa, bacteria-eating, fungus-eating, predatory, root-feeding. Forest / fungal soil: bacteria, true fungi, protozoa, bacteria-eating, fungus-eating, predatory. Lifeless subsoil / construction fill: bacteria. Finished compost: bacteria, true fungi, protozoa, bacteria-eating, fungus-eating, predatory. Missing the nutrient cyclers: Lifeless subsoil / construction fill; the nutrients stay locked in the bacteria. Plants: match each sample's fungi : bacteria to the plant ranges in the table above.