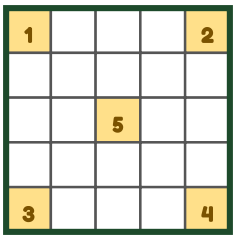
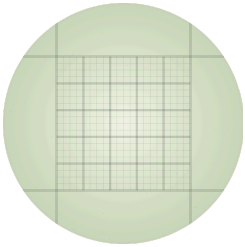
EXPLORER · AGES 5-8 · SHEET 1

Counting Grid Math

Bacteria are too tiny and too many to count one by one. Dr. Dirt puts one drop on a **counting grid**: glass with tiny squares. He counts **5 squares** (the 4 corners and the middle), then does one big multiply.

Healthy garden soil
Scan to open it

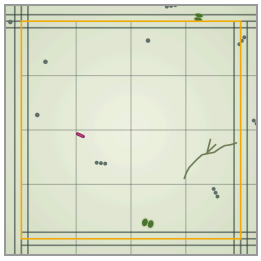




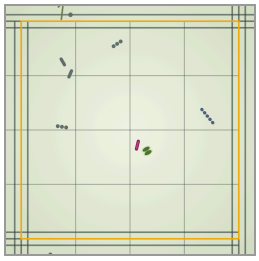
Left: the 5 squares Dr. Dirt counts. Right: the grid in the game.

1. Count the bacteria in each yellow square

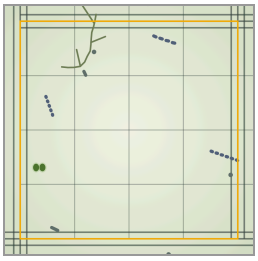
Every dot, rod, pair or little chain counts as **1**. On the **top** or **left** line? Count it. On the bottom or right line? Don't.



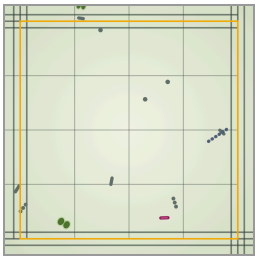
1. Top left ☐



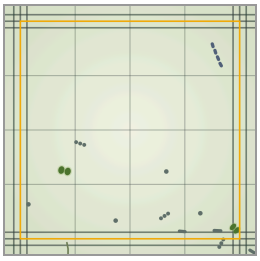
2. Top right ☐



3. Bottom left ☐



4. Bottom right ☐



5. Middle ☐

2. Add them up

___ + ___ + ___ + ___ + ___ = _____

3. Share the total into 5 equal piles

_____ ÷ 5 = ___ This is the **average**: how many in one square.

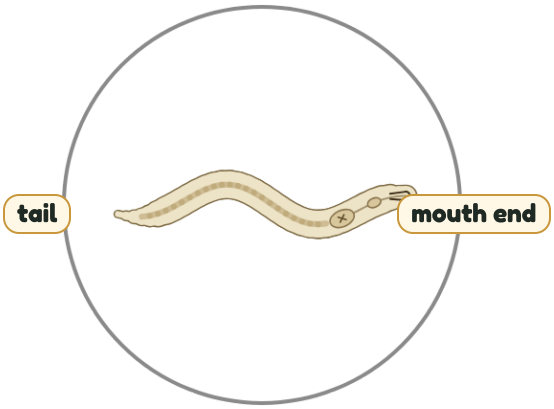
4. Dr. Dirt does the big multiply

Find your average. Dr. Dirt multiplied it by 250,000,000 for you: that is how many bacteria live in 1 gram (a pinch) of this soil!

Average	6	7	8	9	10	11	12
Bacteria in 1 gram	1.5 billion	1.8 billion	2 billion	2.3 billion	2.5 billion	2.8 billion	3 billion

Nematode Mouths

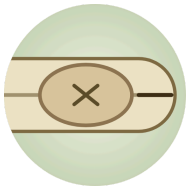
Nematodes are tiny worms. Most of them help plants. Look at the **mouth end**: the mouth tells you what a nematode eats.



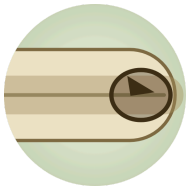
The simulator
Find a nematode, then zoom in on its mouth

A **tube** slurps up bacteria. A **thin needle** pokes fungus threads. A **strong needle with knobs** stabs roots. A **big mouth with a tooth** eats other nematodes.

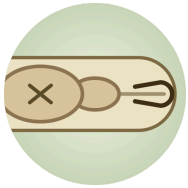
Draw a line from each mouth to its food



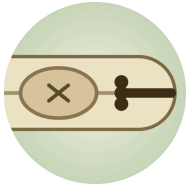
A. Thin needle ●



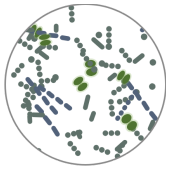
B. Big mouth with a tooth ●



C. Open tube ●



D. Strong needle with 3 knobs ●

● 

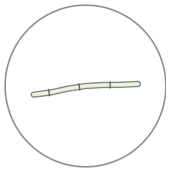
Bacteria

● 

A plant root

● 

Another nematode

● 

A fungus thread

Color the helpers green. Color the trouble-maker that hurts plants red. Which letter is the trouble-maker? ____

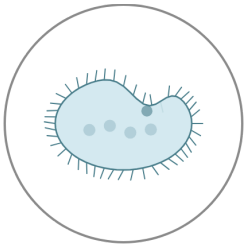
EXPLORER · AGES 5-8 · SHEET 3

What Am I Seeing?

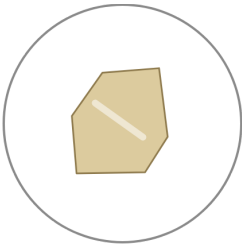
These pictures come from Dr. Dirt's Microscope. Write the name under each one. Use the word bank.

Amoeba *a blob that changes shape*
Bacteria *tiny dots and rods*
Ciliate *a hairy swimmer*
Flagellate *swims with a tail*
Fungus thread *with little walls across it*
Nematode *a tiny worm*
Pollen *from a flower, not alive*
Sand grain *not alive*

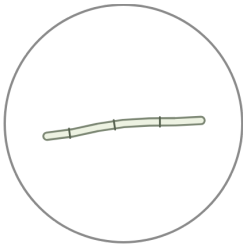
The simulator
Find them in the game



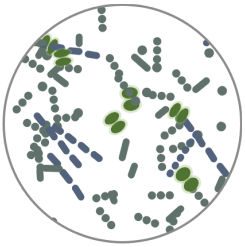
1. _____



2. _____



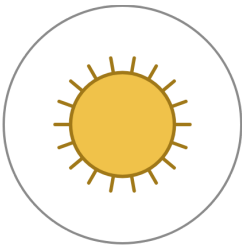
3. _____



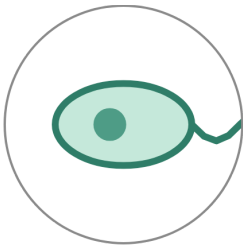
4. _____



5. _____



6. _____



7. _____



8. _____

Two of them are not alive. Write their numbers: ____ and ____

Which one would you most like to find? Draw it!

EXPLORER · AGES 5-8 · MYSTERY LESSON

Soil Detective



Four mystery soils. Which is which? Scan a code. Look closely. **Circle** what you see.

Mystery A
Scan to open

Mystery B
Scan to open

Mystery C
Scan to open

Mystery D
Scan to open

Mystery	Fungus threads	Nematodes	Spear with 3 knobs?	Dr. Dirt's bacteria count
A	lots some none	lots some none	yes no	____ billion
B	lots some none	lots some none	yes no	____ billion
C	lots some none	lots some none	yes no	____ billion
D	lots some none	lots some none	yes no	____ billion

Fungus threads grow where leaves and wood rot slowly for years without digging. Compost is full of life. Soggy or salty ground can have root-eaters with a 3-knob spear. Packed or deep ground has almost nothing but bacteria.

The suspects

Fresh bacterial compost
Comes from: A young, hot pile with lots of greens.

Mulched fruit orchard
Comes from: Under fruit trees kept mulched with wood chips.

Packed path / dirt road
Comes from: A path walked and driven on until it is hard.

Wet compacted soil
Comes from: A patch that floods and gets walked on.

My answer

Mystery A is _____

Mystery B is _____

Mystery C is _____

Mystery D is _____

EXPLORER · AGES 5-8 · CLASS LESSON

Compare the Samples



Look at each soil. How much life can you find?

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

Fungus threads in one look (100x)

Color one box for each fungus thread you see. More than 12? Color them all!

A: Healthy garden soil	☐☐☐☐☐☐☐☐☐☐☐☐
B: Forest / fungal soil	☐☐☐☐☐☐☐☐☐☐☐☐
C: Lifeless subsoil / construction fill	☐☐☐☐☐☐☐☐☐☐☐☐
D: Finished compost	☐☐☐☐☐☐☐☐☐☐☐☐

Nematodes in 5 looks (100x)

A: Healthy garden soil	☐☐☐☐☐☐☐☐☐☐☐☐
B: Forest / fungal soil	☐☐☐☐☐☐☐☐☐☐☐☐
C: Lifeless subsoil / construction fill	☐☐☐☐☐☐☐☐☐☐☐☐
D: Finished compost	☐☐☐☐☐☐☐☐☐☐☐☐

1. Which soil had the most fungus threads? _____

2. Which soil had almost no life at all? _____

3. A tree loves fungus. Which soil would a tree like best? _____

EXPLORER · AGES 5-8 · ADULT GUIDE

For Teachers and Parents



Five short sheets that go with **Dr. Dirt's Microscope**, a free soil microscope simulator (drdirt.earth/game/?mode=microscope; no sign-in). Every picture on these sheets is drawn by the game itself, so it looks just like the screen.

The QR codes

- **The simulator**: opens the microscope. Children pick the **Easy** level.
- **A named sample** (Sheet 1, Sheet 5): opens the microscope straight on that soil.
- **Mystery A to D** (Sheet 4): opens a soil with its name hidden, for the detective game.

The sheets

1. Counting Grid Math	Count bacteria in 5 squares from the game, add, share into an average. Dr. Dirt's table does the big multiply (average × 250,000,000).
2. Nematode Mouths	Match each mouth to its food. In the game, zoom in on a nematode's head.
3. What Am I Seeing?	Name eight things from the slide; spot the two that are not alive.
4. Soil Detective	Four mystery soils: circle what you see, then match each to a suspect.
5. Compare the Samples	A class lesson: color a box for each thread or nematode, then talk about which soil has the most life.

How the big multiply works (for grown-ups)

One small square of the grid is 0.2 mm × 0.2 mm × 0.1 mm deep = 0.004 µL, so 250,000 squares fill 1 mL. The drop was diluted 1:1,000, so the soil held 1,000 times more: 250,000 × 1,000 = 250,000,000. For example:

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

Tips

- Every drop is different, so children's counts differ. That is real science: the answer key gives what the game's soils really hold.
- Teachers: the **Teacher Microscope** has a **Print worksheets** button that prints the Detective and Compare sheets for your own class set.

Answer Key



Sheet 1: Counting Grid Math

Counts: 8, 7, 9, 10, 11 (these are the game's own squares). 2. 8 + 7 + 9 + 10 + 11 = 45. 3. 45 ÷ 5 = 9. 4. 9 × 250,000,000 = 2,250,000,000 (2.3 billion) bacteria in a gram. A careful count of the whole slide in the game gives about 2.5 billion; healthy soil holds about 1 to 3 billion.

Sheet 2: Nematode Mouths

A thin needle → a fungus thread. B big mouth with a tooth → another nematode. C open tube → bacteria. D strong needle with 3 knobs → a plant root. Helpers (green): A, B, C. Trouble-maker (red): D, the root-eater.

Sheet 3: What Am I Seeing?

1. Ciliate; 2. Sand grain; 3. Fungus thread; 4. Bacteria; 5. Amoeba; 6. Pollen; 7. Flagellate; 8. Nematode. Not alive: 2 (sand grain) and 6 (pollen).

Soil Detective

A = Fresh bacterial compost. Fungus threads: some. Nematodes: lots. Spear with 3 knobs: no. Bacteria: about 6.2 billion.

B = Wet compacted soil. Fungus threads: some. Nematodes: some. Spear with 3 knobs: yes. Bacteria: about 3.4 billion.

C = Mulched fruit orchard. Fungus threads: lots. Nematodes: lots. Spear with 3 knobs: no. Bacteria: about 1.9 billion.

D = Packed path / dirt road. Fungus threads: hardly any. Nematodes: hardly any. Spear with 3 knobs: no. Bacteria: about 6.1 billion.

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

Compare the Samples

Fungus threads in one 100x look, about: Healthy garden soil 4; Forest / fungal soil 23; Lifeless subsoil / construction fill 0; Finished compost 8. Nematodes in 5 looks, about: Healthy garden soil 6; Forest / fungal soil 6; Lifeless subsoil / construction fill 0; Finished compost 8. Every drop differs, so look for the pattern, not the exact number.

1. Forest / fungal soil. 2. Lifeless subsoil / construction fill. 3. Forest / fungal soil (the most fungus).