Meet Your Soil Community:

A Guide to DIY Microbe Testing

by

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Simple, affordable ways to monitor soil microbial communities on the farm.

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Why?

- May cost less, particularly with repeated use.
- Usually faster than laboratory testing.
- In-house testing may be customized to address your soil needs.

When?

- **As often as you like to better inform management.**
  - Wondering how tillage really impacts your soil?
    - Microbial populations respond rapidly to change
    - Analyze soil microbes before and after tilling to see how they are affected.
  - Does my cover crop really change my soil health?
    - Measure microbial populations every two weeks on land with and without a cover crop.
  - Does that great new product the sales rep *says* I need really help my soil?
    - Gather a soil sample. Divide it in half.
    - Add the amendment to ½.
    - Wait 6 – 24 hours.
    - Examine microbial diversity in both halves.

What is “affordable” differs for all of us.

Options let you choose a strategy that matches your budget.

What budget?

If you cannot afford tools for looking at microbes, look for visible animals that eat microbes.

Look for fungivores

These will only proliferate when microbial life in your soil thrives.

- Earthworms

- Pill bugs

- Springtails (*Collembola sp.*) These are very small.

- Pleasing fungus beetles (More common in wooded areas)

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Pitfall traps can be used for quantitative monitoring.

For qualitative monitoring, observe the biology in a shovel full of soil.

A slake test, designed to measure aggregate stability, also indicates the presence of soil biology.

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For a small budget:

- Buy a compound microscope and a few supplies **~ $1000 - $2000**
- Look at soil under the microscope.
- Microbial analysis for Growers Course – Udemy
  - Describes the type of microscope
  - How to sample soil
  - How to prepare wet mounts
  - How to identify prokaryotes, fungi, etc.

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Microscopic Examination Pros and Cons

Pros	Cons
Direct measure of microbial abundance.	Requires Training and Comittment
Direct measure of microbial diversity (at the Kingdom and Phylum levels).	Won't distinguish species, genera, or even classes.
All analysis can be performed in-house.	Labor intensive
Same day analysis is possible.	Results vary with user experience.
Costs <$1/sample	

What you might see under the microscope:

Prokaryotes-Most diverse group. Includes two taxonomic domains (Bacteria, Archaea). Can only be distinguished by morphology (shape)

Fungi-Consider these a keystone group. When fungi are present, protists and animals follow.

Protists – Unicellular eukaryotes, including algae. These will be large under the microscope.

Plant remains – These are often decayed tissues.

Animals – Arthropods, nematodes, tardegrades, springtails

The goals are diversity and abundance

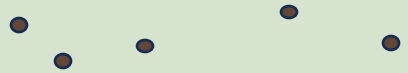
Dis-ease is not caused by microbes/germs.
Dis-ease is caused by too many of the same kind of germs.

Soils with rich, diverse microbial populations can:

- extract nutrients from parent material
- convert atmospheric N and C into plant food
- build soil
- minimize pathogens
- add valuable genetics

Prokaryotes

These are the first life, and the last to be lost from an eroded soil. Include extremophiles. Add resilience, metabolic function to your soil.

Prokaryote morphologies	Illustration
Coccus (spherical)	
Bacillus (rod-shaped)	
Spirillum (rigid spiral)	
Spirochete (flexible spiral)	
Vibrio (comma-shaped)	

Size: All are less than 10 uM in size. Most are less than 2 uM in size.

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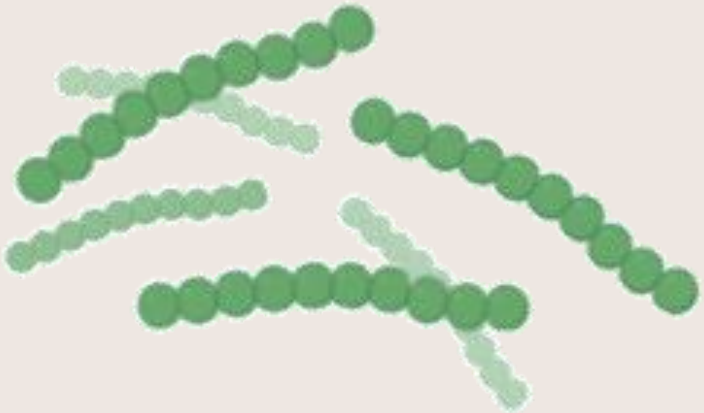
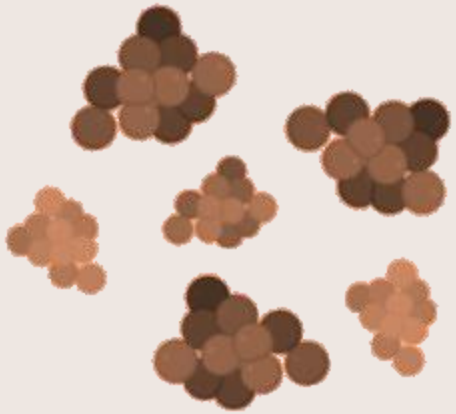
Prokaryotes (continued)

Arrangements lend additional clues to diversity.

Diplo – pairs



Strepto – chains



Staphylo – clusters

Filamentous

Sarcina – cube like, in groups of 8

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Fungi

Penicillium sp.

Fusarium sp.

Alternaria sp.

Neurospora sp.

Not to scale. Sizes are not relative. Generally 10-100 uM

Aspergillus sp.

germinating hyphae

budding yeast

hyphae

budding yeast

hyphae

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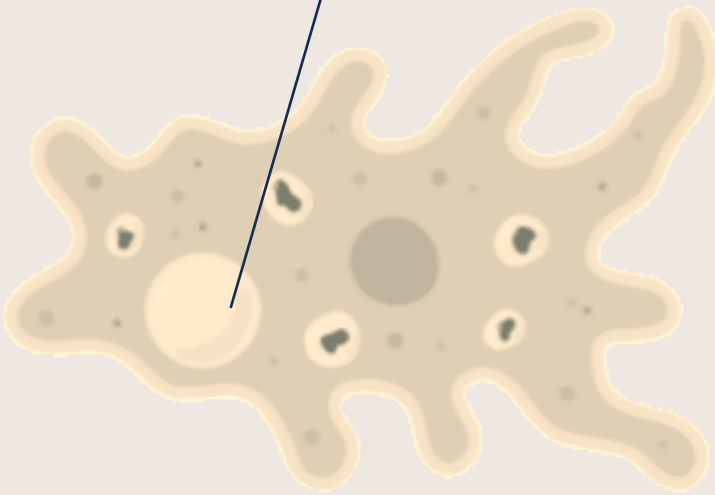
Protists

Not to scale. Sizes are not relative. Generally 10-100 uM

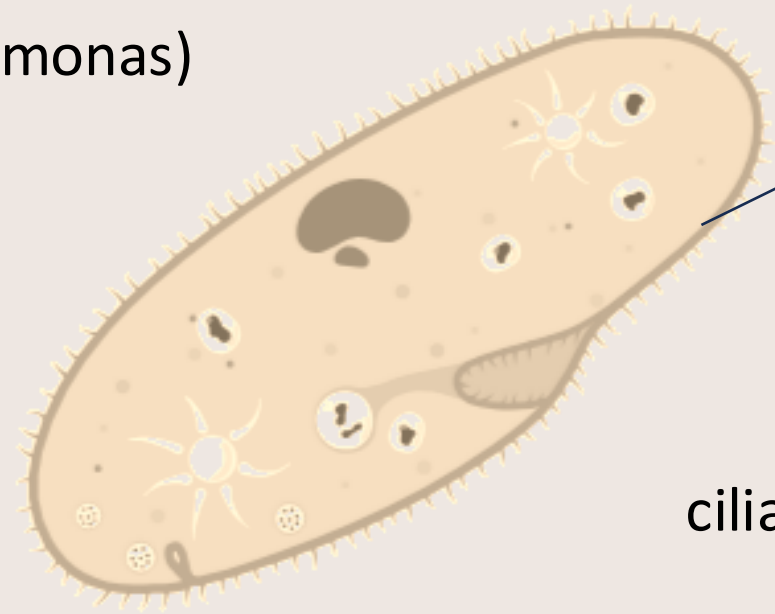
Green

green algae (chlamydomonas)

Visible organelles



amoeba



Mobility

ciliate

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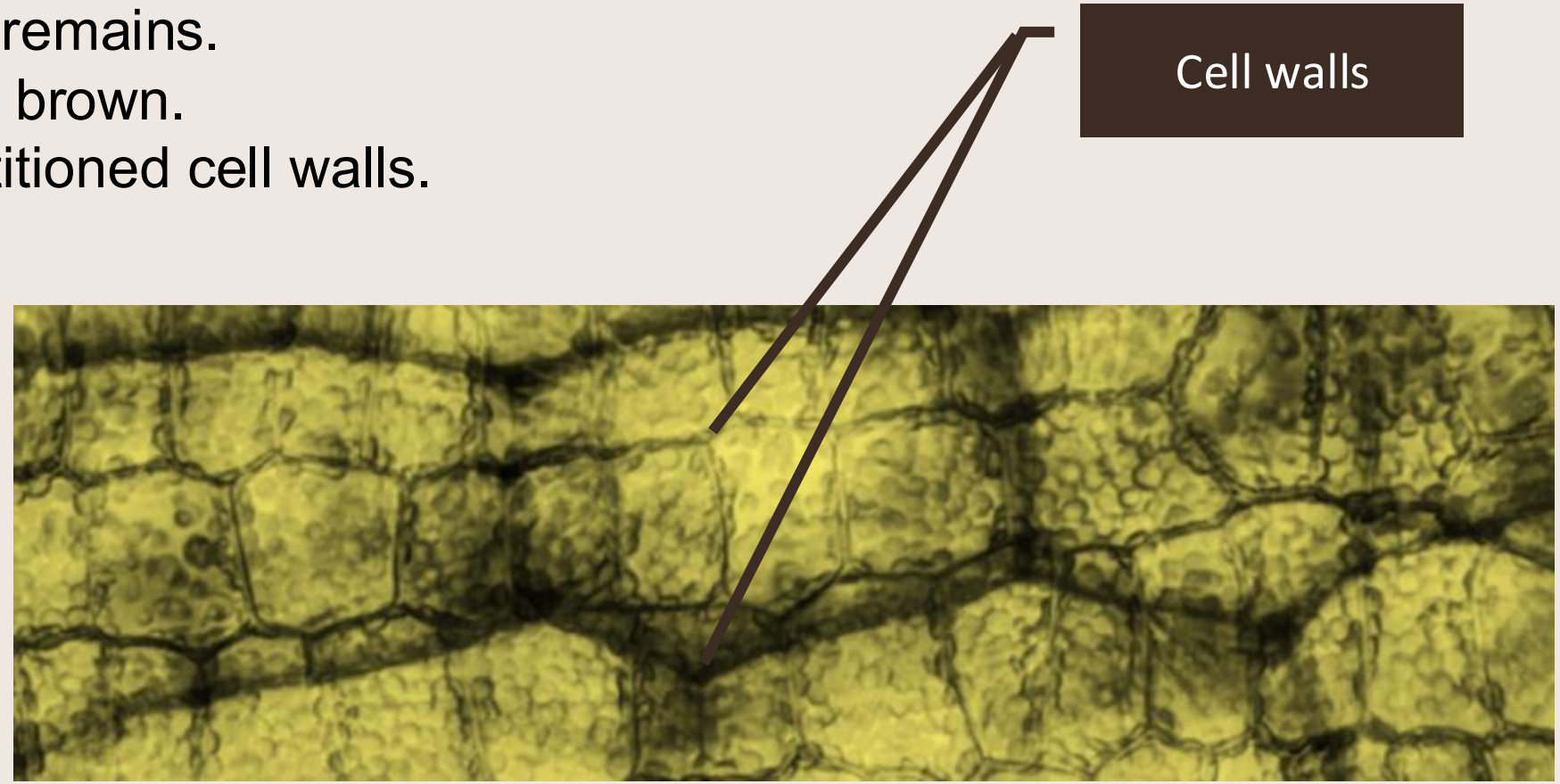
Plants

Often present as remains.
Usually decayed, brown.
Look for well-partitioned cell walls.



Animals

nematodes

tardegrades

rotifer

springtails

Require less magnification to see.
Presence suggests higher levels of diversity.

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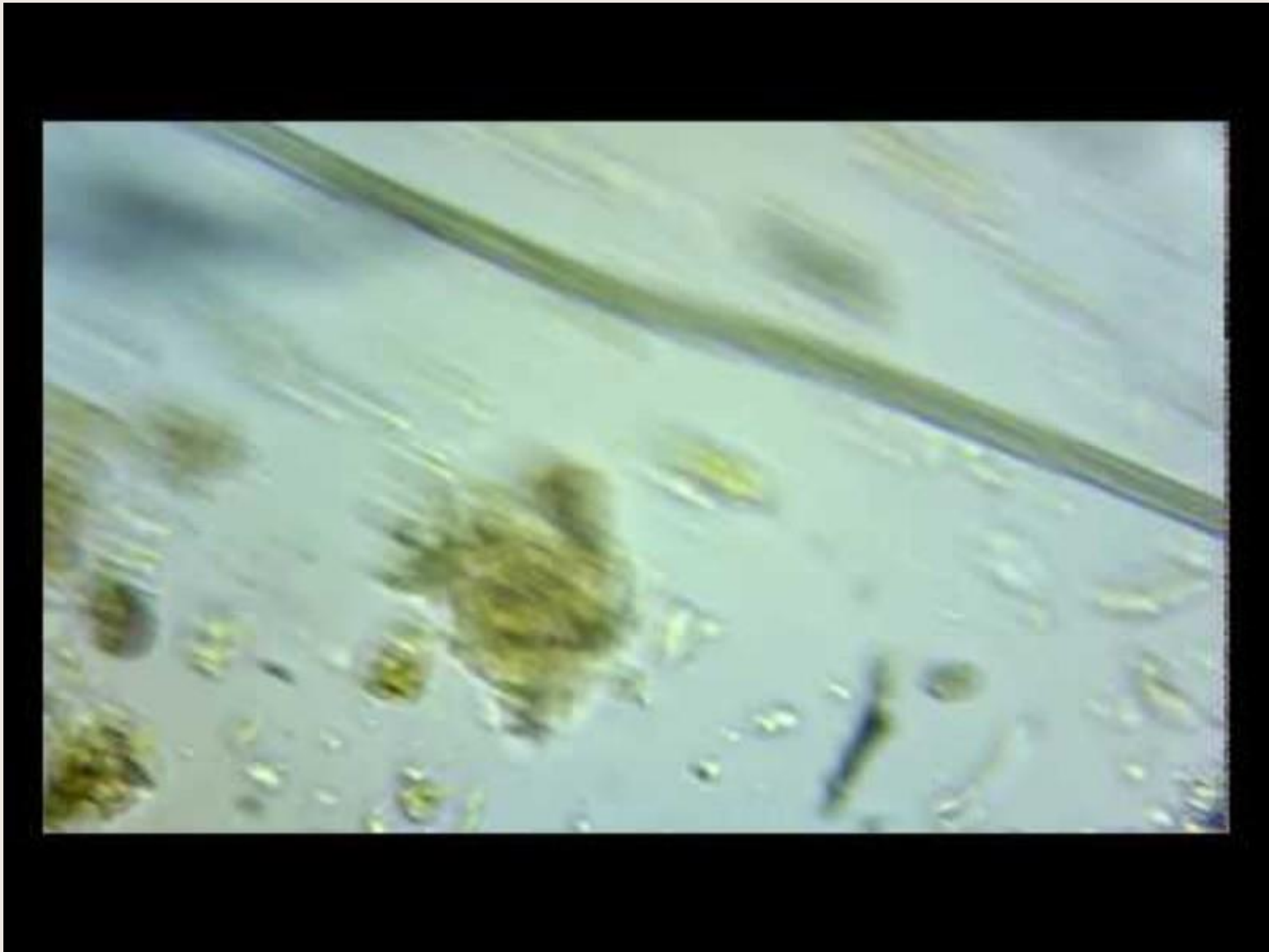
Putting it all together



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Microbial Respiration

- Indicator of microbial abundance
- Measured as biologically produced CO_2
- Can be used in combination with a variety of organic substrates to assess “functional diversity”
- Functional diversity looks at what the microbes in your soil are doing.

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Substrate Induced Respiration Offers Potential as DIY for Large Growers, Crop Consultants

- Demonstrates microbial ability to cycle nutrients
- Rapidly detects changes in microbial populations.
- Can be used in presence of prescribed soil amendments to test before applying to field.
- Technically challenging-training required
- Same-day results possible

New frontiers:

- DNA and RNA offer best evidence of what is in your microbial community.
- Analysis is currently complex, slow, and expensive for routine use.
- New tools are increasingly user-friendly, and may one day prove valuable for routine soil health assessments
  - May also help with quality control of composts, biostimulants.

Using microbial testing to guide production:

- **Microbes are one component of healthy soil.**
  - Test soil before and after management changes
    - Different crop?
    - Different fertilizer?
    - Different pest management strategy?
  - Optimize management to increase microbial diversity and abundance.

Microbial communities respond more quickly to change than your crop plants. They are sensitive early indicators that let you know you are moving in the right (or wrong) direction.