



Healthy Soil for Healthy Crops and Seeds

Action learning curriculum for small-holder farmers



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Purpose of this curriculum

This curriculum can be used by any educator as a guide to engage farmers to better understand soils and how management of soil impacts the crop.

The action learning throughout this module offers a way to excite learners and create a fun-learning environment. This approach will promote co-learning from teacher to student and peer to peer learning from farmer to farmer. The relationships that develop during this training can lead to a more productive and on-going engagement in soil and crop health.

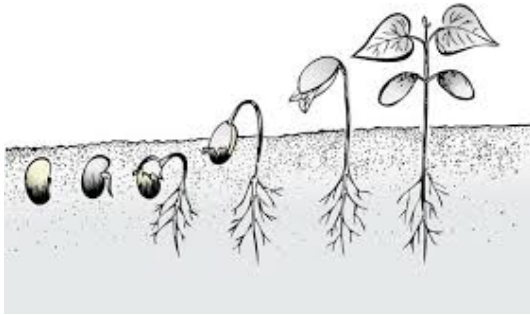
Use this curriculum for ideas it offers or follow exactly as stated, it is up to you. Share it with others and create your own module. You can build on the enclosed module or reduce it to fit your needs. Just consider the following items before you offer an educational program:

The knowledge level of your students?

How much time do you have for the session?

What is the goal or reason for this educational session?

Action Learning to Understand Soil Health



Making Good Observations

Goal: Learn how soil varies with depth and location.
The value to make good observations to make smart improvements.

Overview:

Discuss the following questions.

1. Why are we talking about soil when you came here to learn about seed production?
2. How can soil contribute to better seeds?
3. What are some improvements to soil that will help grow healthy beans?

Activity 1

Time 1 hour (use soil pits from previous day)

Description: Make observations in soil pits.

Before looking-discuss what happens under ground. (Water passing, insects moving, roots growing and getting food and water, soil shifting)

In groups, take turns looking in the pit closely.

- First use just your eyes.
- Then use your hand lens to look closely at specific things in the wall of the soil.
- Share what you see.

Questions:

- Do you see any roots in the pits? The roots are from which plant?
- Do you see anything alive in the soil? Describe/name
- What observations have you made about the soil?
- What differences do you see at different depths?

- What are the different types of things you see?
- ☐ ✓ Dead, ☐ ✓ alive, or ✓ neither (like a rock)?

Action:

What is living in soil (in the root zone)

Needed:

Hoe

Hand lens

1 cup of water

Top to container (~ 10 cm)



- Collect some soil from 20 cm below the soil surface
- Place soil in dish. Look at it with hand lens.
- Now... Place a little water with soil in dish
- Let sit for about 10 minutes
 - Look for:
 - Differences in dry vs wet soil
 - Moving, living things
 - Nothing living/moving? Try soil at a different site.
- Take turns using the hand lens and describe what you see.
- Draw pictures of what you see on flip chart paper hanging in room.

Note: this pit can be used as a pit compost site by the farmer or as a demonstration site.

Soil Texture

Goal: Learn what is soil texture and how to name it in your soil

Question:

Why do some fields hold too much water and others drain quickly?

Action: How to identify the texture (grit) of the soil?

Description: All soil has some sand, silt and, clay. Each soil has different amounts that affect how much water it can hold.

Needed:

Hoe

Water

Hands

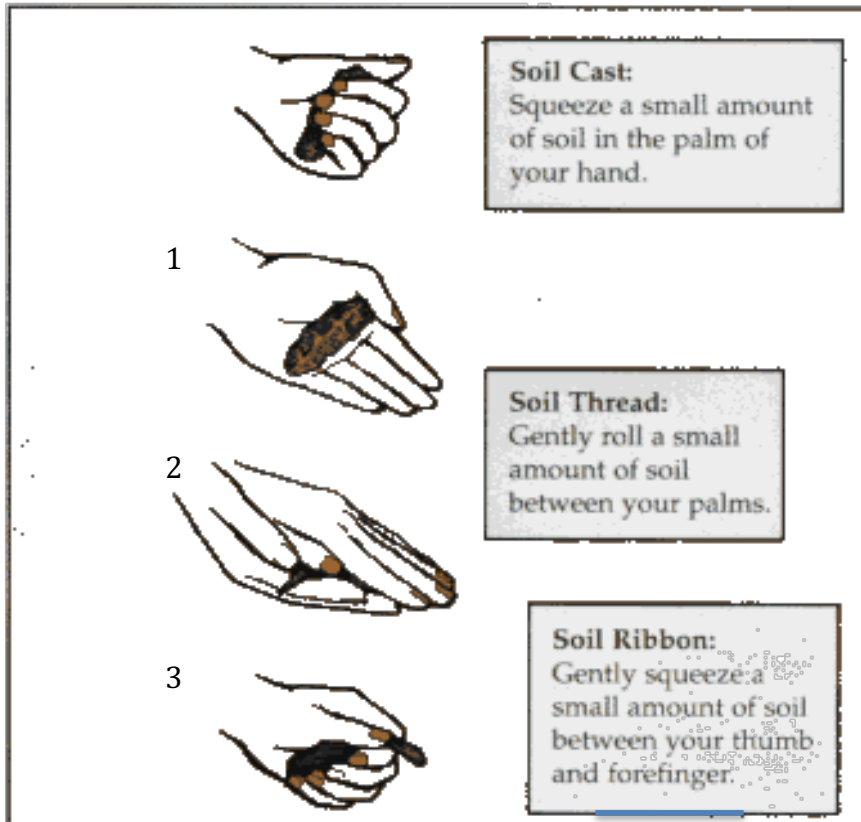
Steps:

1. Use the hoe to take some soil from the top 15 cm of the pit. Remove stones and roots.
2. Place a small amount in your hand (1 tablespoon).
 - a. Add a little water at a time.
3. Mix with finger, add just enough water to make a stiff paste (like nsima).
4. Make a ball from the soil then pinch it between your fingers.
5. Push it between your fingers to making a ribbon as long as possible.
6. Describe what you feel as you squeeze the soil: (gritty, smooth, sticky)
7. What type of soil do you have (Sandy, silty, clay)?

Note the longer the ribbon the more clay in the soil.
The shorter the ribbon the more sand in the soil.

Activities to Identify Soil Texture

TAKING A SOIL SAMPLE



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How to Tell Soil Type?					
Soil Test	Sandy Loam	Silty Loam	Loam	Clay Loam	Clay
1 Soil Cast (shape)	cast will not break when handled carefully	cast will not break when handled carefully	cast can be freely handled without breaking	cast will hold considerable handling without breaking	cast may be shaped easily without breaking
2 Soil Thread	thread is readily broken, thick and crumbly	thread is readily broken, thick and crumbly	thread can be pointed like pencil lead and easily broken	thread is strong and can be rolled to a pinpoint	thread is strong and elastic and can be rolled to a pinpoint
3 Soil Ribbon	soil will not form a ribbon	soil will not form a ribbon soil does NOT feel gritty (sandy)	soil will form a short, thick ribbon that easily breaks	soil will form a thin ribbon that breaks easily	soil will form a long, thin ribbon that does <u>not</u> easily break

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Questions and Review

1. How do you describe your garden's soil? (*each farmer takes a turn*).
Or if do not know, describe this soil from the soil pit.
Consider all the points we discussed in the soil pit.
2. Why is your garden's soil **texture** important to know?
(think about drainage, storing plant food, compost and fertilizer, holding water in drought times, a place for roots to grow).
3. You cannot change soil texture on your farm. So what can you do to improve your soil to better manage water and nutrients?

4. What is an example of a long-term plan to improve soil?
5. Physically, what can you do in your garden to reduce water run-off?
6. How do you balance water availability – not too much and not too little-beyond turning on irrigation.
7. What is meant by improving soil health?

Action: Comparing water drainage in 2 different soils.

Description: Test 2 soils, one that is growing better crops, than the other. Soil drainage is very important in a crop field, especially after heavy rains.

Question: Have you seen crops that sit in water for more than a day? What happens to the plants?

Needed:

1. (2) tins the same size with both ends cut out so they do not have a top or bottom (Nido or coffee tins will work-but 2 of same size)
2. Mallet or hammer
3. Marker

(Note this should be done a week or more after any rain or pour a liter of water in area where tin will be place at beginning of class)

Choose two fields, one with healthy soil and one poor soil.

Question:

1. How can you tell a healthy soil from a poor soil?
2. How does your soil compare to these soils?

Steps:

1. Mark each tin at $\frac{1}{2}$ way mark
2. Place one tin in each field (good and poor soil)
3. Pound each tin into the ground to this mark
4. Fill each tin with water to the very top (don't spill water around the tin).
5. Note what time it is when you fill with water.
6. See which tin drains first and note the time it took to empty (is empty)

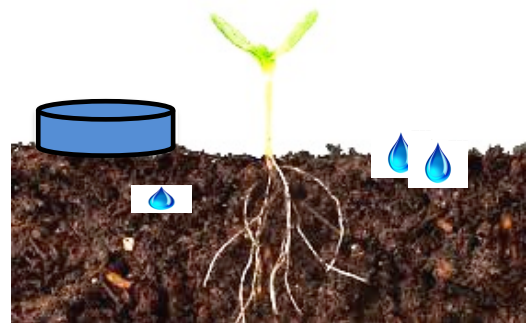


Questions and Review

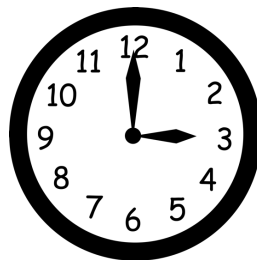
1. Which tin drained first? (it should be in the field with good soil)
2. Discuss why you think that happened.
3. What soil factors should you consider?
4. Compare how each field managed? (what have you (or could) add to your soil, which crops grown each year, how was it managed in the last 5 years).
5. Talk about ways to improve the drainage in your fields.



Field 1



Field 2



Notice how many minutes for each to drain into soil

Importance of Adding Organic Matter to your Soil

Goal: Adding once living things to the soil to help the crops grow

Question:

What is organic matter?

Ask participants and make a list of their responses

(things once living and now can be added to soil (*compost, manure, plant residue*))

Activity 1: Making compost and add to garden/field. (have piles ready)

Description: Note there are many ways to make compost. They are all good ways-just a few differences for each type-but they are ALL provide organic matter for the soil

How do you make compost?

Form list from class input.

How does each compost type differ?

You can try different ways to make compost and note differences.

Which do you like better? Why?

Needed:

- Cut green plants, leaves and grass. (Nitrogen-rich) (1/3 of the pile)
- Manure from animals (any type) and/or bean residue.

AND

- Soil, dry grasses, torn boxboard. (Carbon-rich) (2/3 of the pile)

AND

- Water in watering-can
- A place by the field
- Hoe(s)
- Stick that is longer than the pile is high
- Maize stalks or long grass (to “seal” compost pile)

Steps:

1. Collect what is needed and make 2 piles-
 - a. 1 pile with brown ingredients and other a pile with green ingredients.
2. The brown pile should be 3 x larger than the green pile.

3. Choose a place where the pile will be placed that is convenient to put on field.
4. If you want to teach pit compost then dig a hole about 1m by 1 meter wide.
5. For a pit you can use the one you dug in class or dig a pit near the field that is 1 meter wide x 1 meter deep.
6. Mix the brown and green piles together with your hands and hoes
7. **Add water while mixing the brown and green.** Use a watering can or buckets.
 - a. *Pile should be moist or damp, NOT DRIPPING.*
8. Place the stick in center where pile will be (or in the pit) and put the compost around the stick. Leave the stick in the middles of the pile.
9. This stick will let air into the bottom of the pile to help it make compost (break down plant materials).
10. You can also use the stick to mix the pile.
11. For compost piles, cover well with thatch grass. This helps to keep the pile moist.
12. After 2 days check the center of the pile. Pile should be warm in center. If not add more manure to pile and mix as best as possible.
13. After 1-2 months this compost is ready to apply to garden. Remove thatch and transport to garden. Sprinkle on surface.
14. Mix into soil in row where maize will be planted.
15. Place some compost along the row where you will plant after first weeding if needed.

Review:

- What did we use to make the compost? What is the purpose of each thing we added? (*carbon and nitrogen*)
- Carbon is made of things that were once alive and now dry.
- Nitrogen is a nutrient to feed soil organisms and crops.
- Green plants have the most nitrogen.

Questions:

1. What does compost do for the soil and crops? (*it adds nitrogen like fertilizer AND feeds the soil- with organic matter to increase -all good for crops and the soil.*)
2. Can you have too much compost? (*Probably not since it takes so much time and work to make it.*) *A sprinkle on surface is 1 tonne/acre. Best if you can apply 2 tonnes/ acre.*
3. When do you put on the compost? (*as you begin to prepare your garden with ridges or rows and π after 1st weeding.*)
4. Is there a right or wrong way to apply compost? (wait until its finished making (1-2 months) in pile. But no wrong way of how to put on field.)
5. If you do not have much compost, choose field where you will grow seeds that year.

What else can you add to your field to help the soil?

Action: Adding crop residues to your field

Description:

- Adding compost is good but may not be enough plant food for a healthy crop.
- Its good to add different plant foods.
- You can add leftover parts of plants after harvest.
- The best plant residues are from beans, pigeon peas, and ground-nuts. You can add the roots, stems, leaves, and pod shells. If the plant has a disease you should remove those plants to not keep the disease in the soil. Of course you can add chemical fertilizer WITH compost like DAP or CAN mixed in with plant residues.

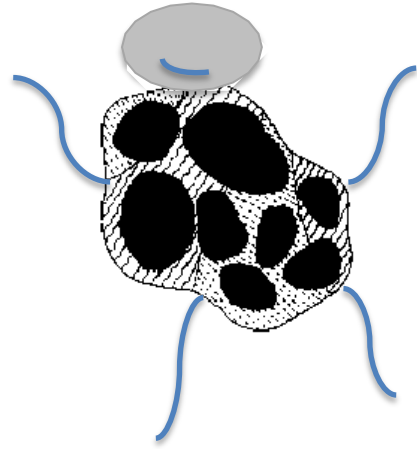
Maths for a healthy soil and strong crop

If you are able the best food to add to the soil:

Crop residues (legumes and maize) +

Chemical fertilizer +

+ Compost



A DIVERSE DIET FOR SOIL!!

Action: Feed soil with crop residues

What is needed:

- Crop residues from beans, soya, pigeon peas and ground nuts
- Hoes
- Cloth/tarp/bag to carry residues to the field

Steps:

1. After harvesting beans, pigeon peas, and groundnuts save all the stems, leaves and pod shells to feed your soil. (best to leave roots in soil)
2. If possible: harvest the beans and groundnuts in the field where they are harvested to reduce carrying residue far.
3. If not then collect the plant pieces after harvest and carry back to your gardens.
4. Add whole plant including the empty pods to the soil
5. Spread the crop residue across the field
6. Turn the crop residue into the soil now before termites eat it all.
7. Leave roots to break down in the soil until the next season.
8. Best to do if there is still some moisture in the soil.
9. The next season the crop residue will be “gone”. It will have been eaten by tiny soil insects and nutrients to the soil .

Review:

- If you do not have bean crop residue or compost what are some other plants you can add to the soil to help improve it? (*list on flip chart*).
- Why are bean, pigeon pea residues and other legumes residues good for the soil? Are they better than other crop types?
- Discuss the value and differences of legume residue, compost, and fertilizers.
- Legumes have more nitrogen in them than maize residues and break down easier
- Green plant residue (grasses) have higher N than dry ones
- Compost will not burn crops like urea but give them more than nitrogen

Questions:

- Can you add plant parts with manure or mix with fertilizer to the soil? (*yes they each add different things to the soil-all good to build organic matter*)
- Is it good to add several different types of organic inputs soil the soil? Does it make it stronger?
- How can you use maize stover if it's low in Nitrogen?
- Add maize stover with manure -that gives your soil what it needs to make plant food so the plants can grow better (*think of compost*).
- Suggest that the learners think of the soil like people. We need different foods to make us healthy. (E.g. If we only eat carrots we can have plenty of Vitamin A but still suffer from malnutrition).

Review

Consider terms below to review

Ask learners to answer how they see the word fitting into “building soil for healthy legumes”

****They can first give a definition of it then tell how it helps or work with the soil**

Words to consider to help build a healthy soil

What do they mean? How can they help your crops?

Soil Texture

Drainage

Carbon

Nitrogen

Organic Matter

Legume

Crop residues

Compost

Manure

Chemical fertilizer

Soil health

Soil aggregate

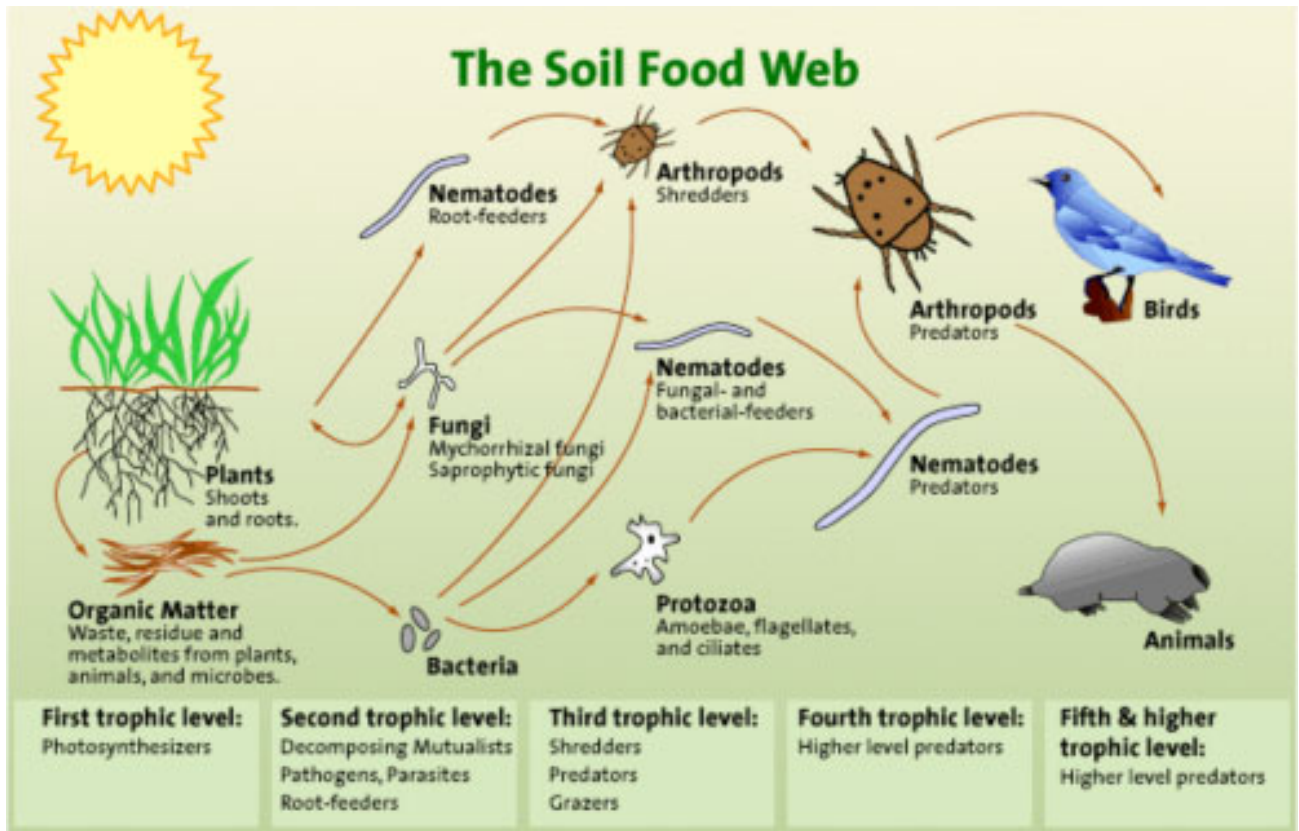
Soil Life (see diagrams on next pages)

Discussion: Diagram to see how soil is alive-Compare the 3 different ones.

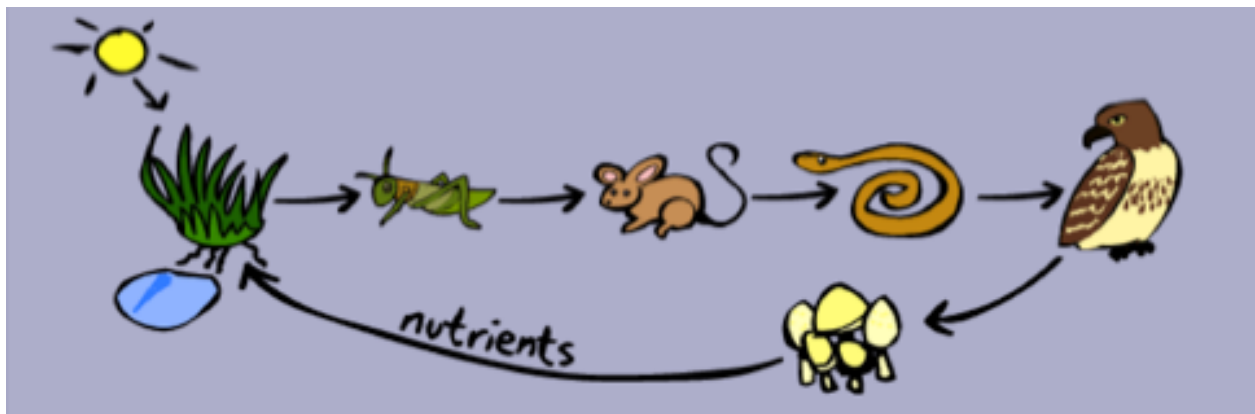
Discuss what the pictures mean and how this information is useful

Suggestion: You can draw the diagrams as a group discussion on flip charts, letting students take turns to draw a different part.

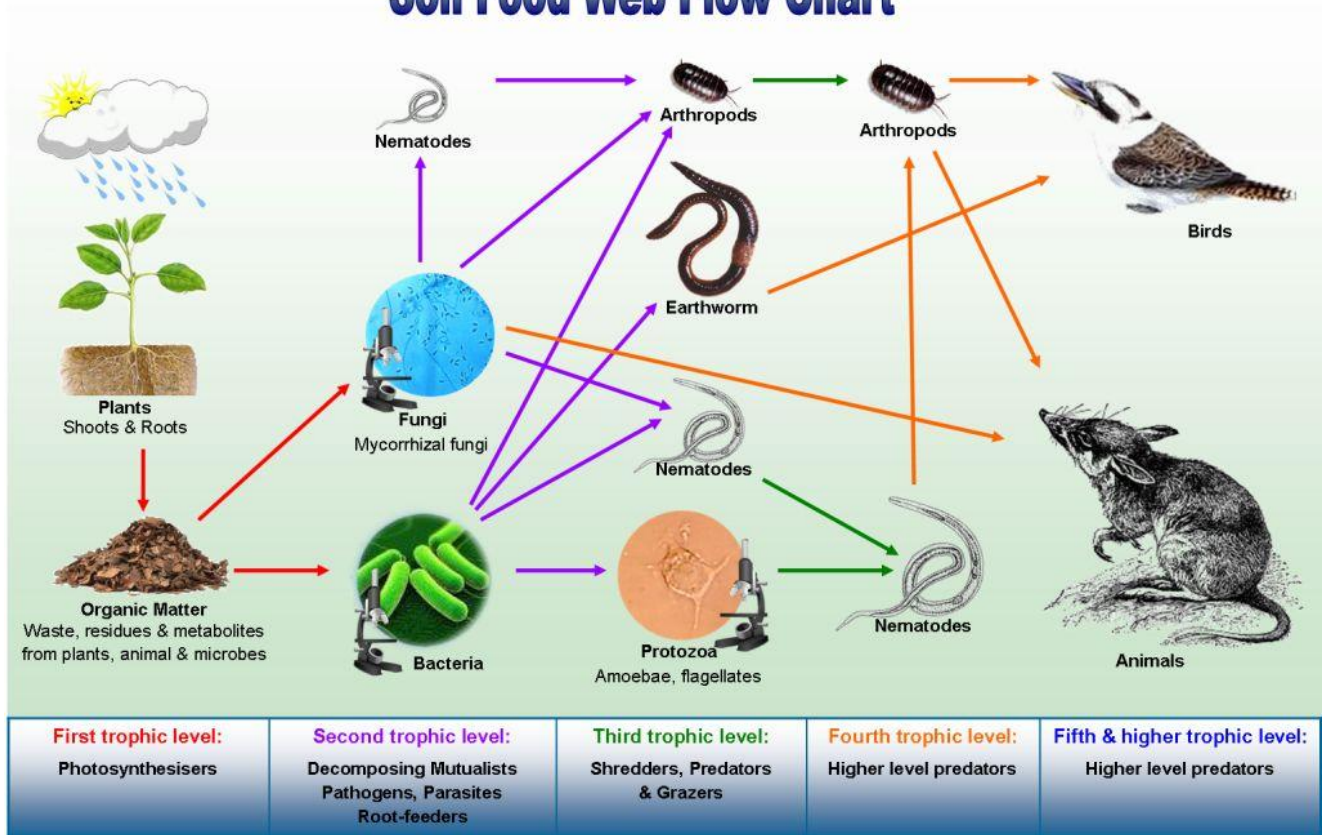
The fun come when the drawing may not look correct but people will remember through the fun and opportunity to laugh!



Did you see any of these in the soil pit? Which do you think are good for plants and which are bad?



Soil Food Web Flow Chart



Who eats who? How does that help the soil?

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