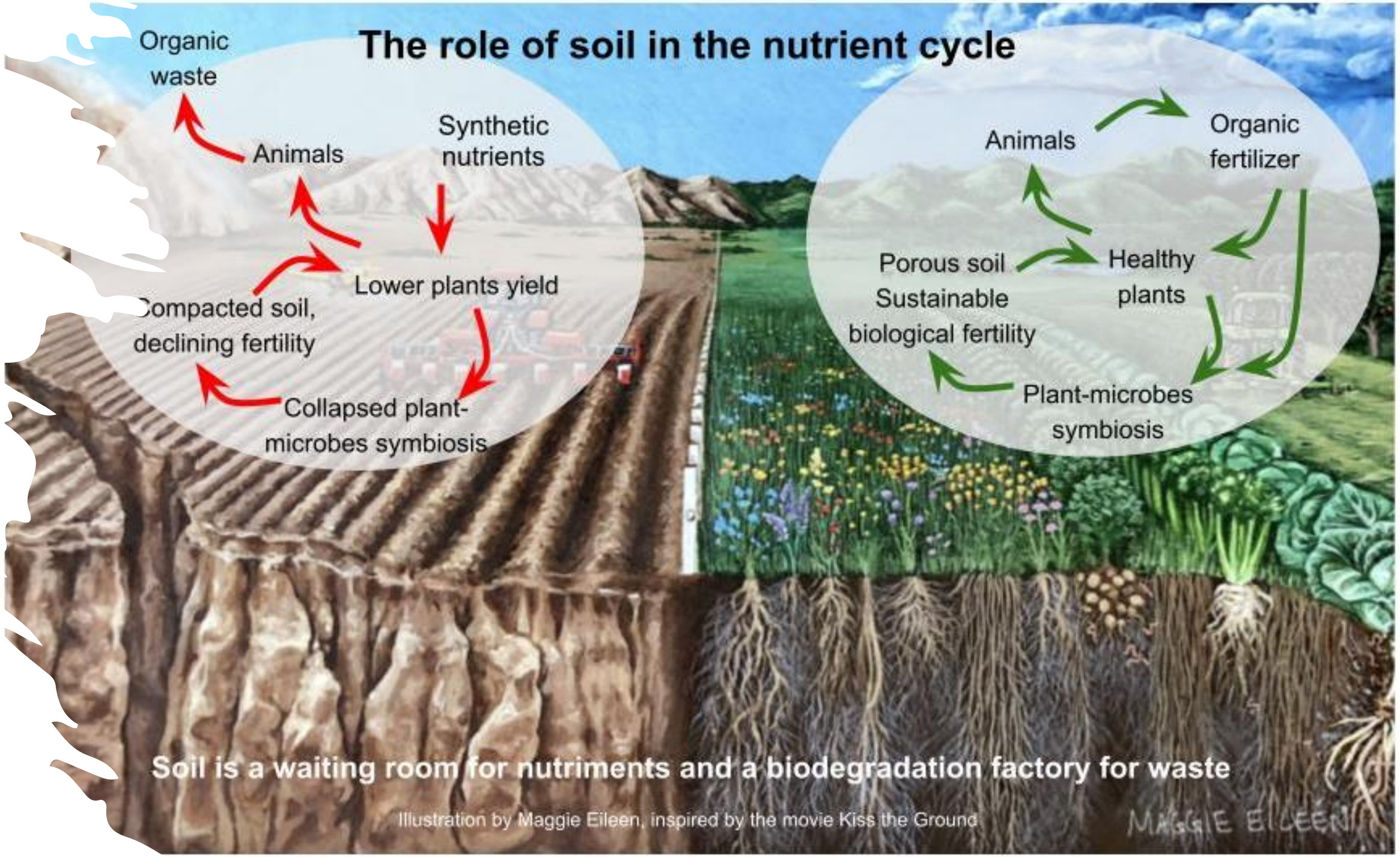
Healthy Soil

Steps to Developing Healthy Soil

What does it mean to have healthy soil?


The role of soil in the nutrient cycle
Organic waste
Animals
Synthetic nutrients
Lower plants yield
Compacted soil, declining fertility
Collapsed plant-microbes symbiosis
Animals
Organic fertilizer
Porous soil
Sustainable biological fertility
Healthy plants
Plant-microbes symbiosis
Soil is a waiting room for nutriments and a biodegradation factory for waste
Illustration by Maggie Eileen, inspired by the movie Kiss the Ground
MAGGIE EILEEN





Compaction Layer






(b)
(c)







Soil Activity

Is your soil healthy?

Why?

Why not?

What do you notice about your soil?

Healthy Soil

Healthy soil is biologically active, meaning microbes breath, grow, and are in symbiosis with organic matter and plant roots. For that they need organic matter, a porous nutritious medium. They emit and fix CO2, with a net amount being fixed (by growing).

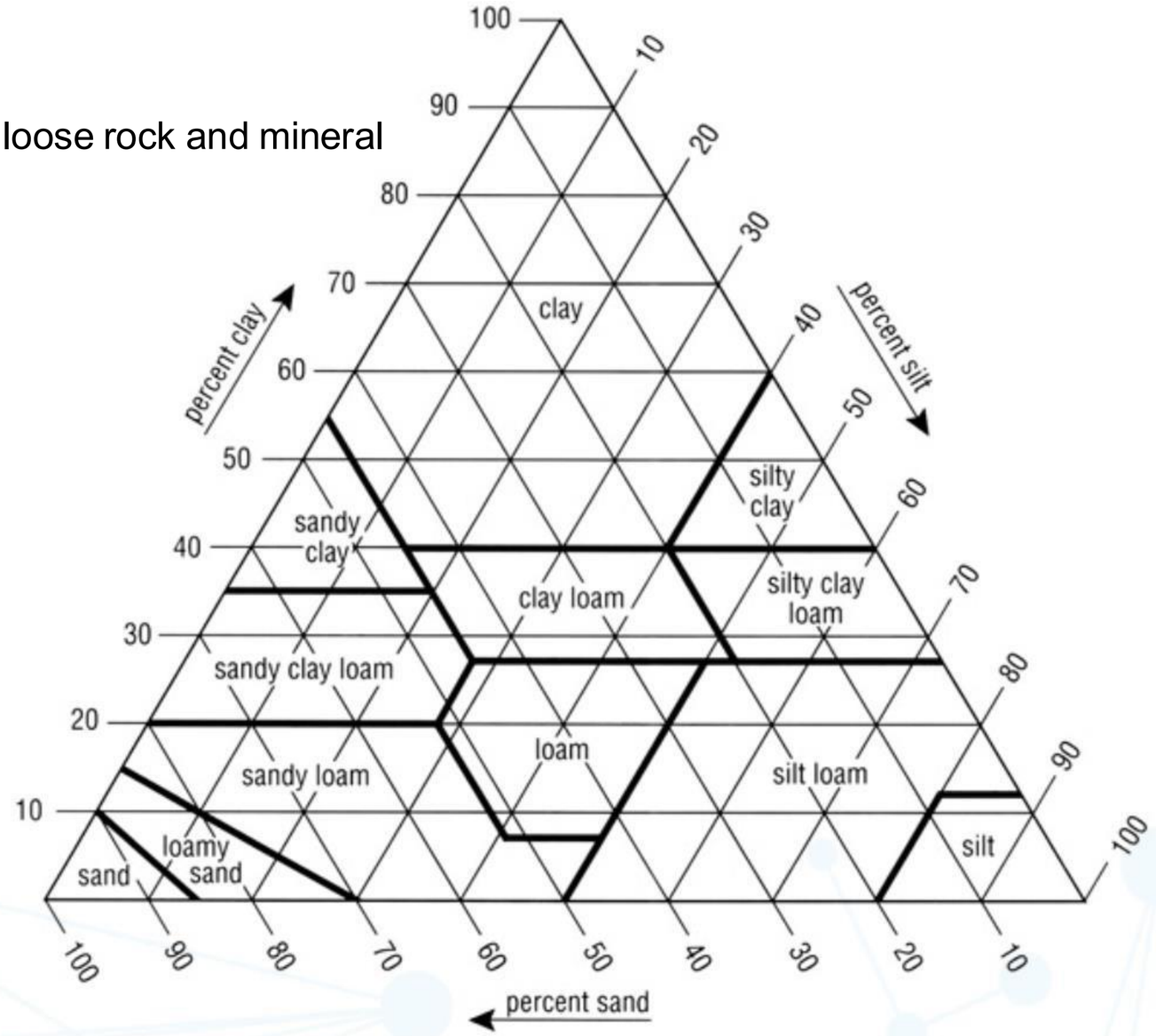
What is Soil?

Soil

The top layer of the Earth's surface generally consists of loose rock and mineral particles mixed with dead organic matter.

Soil is made up of:

- Small rocks (2 mm or more)
- Sand (2 mm – 0.5 mm)
- Silt (0.5 mm – 0.002 mm)
- Clay (less than 0.002 mm)



What is Soil?

Jar Test



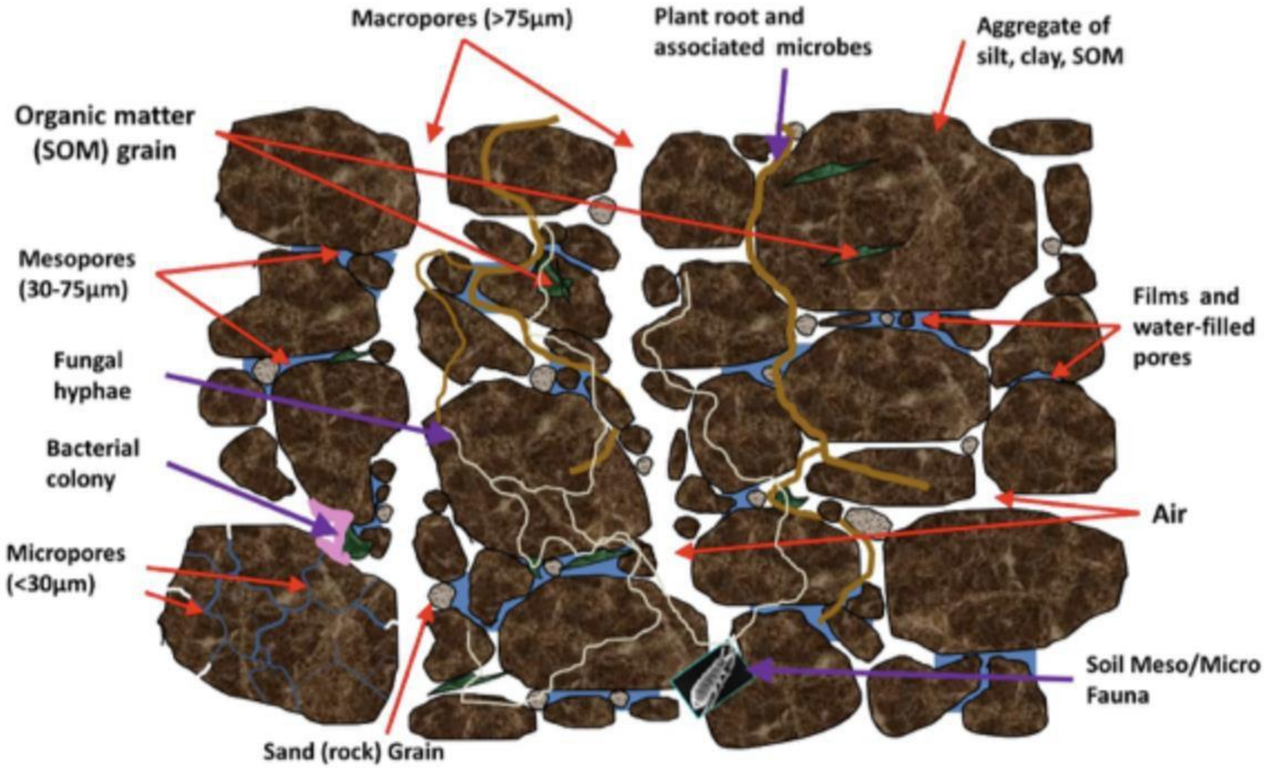
Characteristics of Sand, Silt and Clay

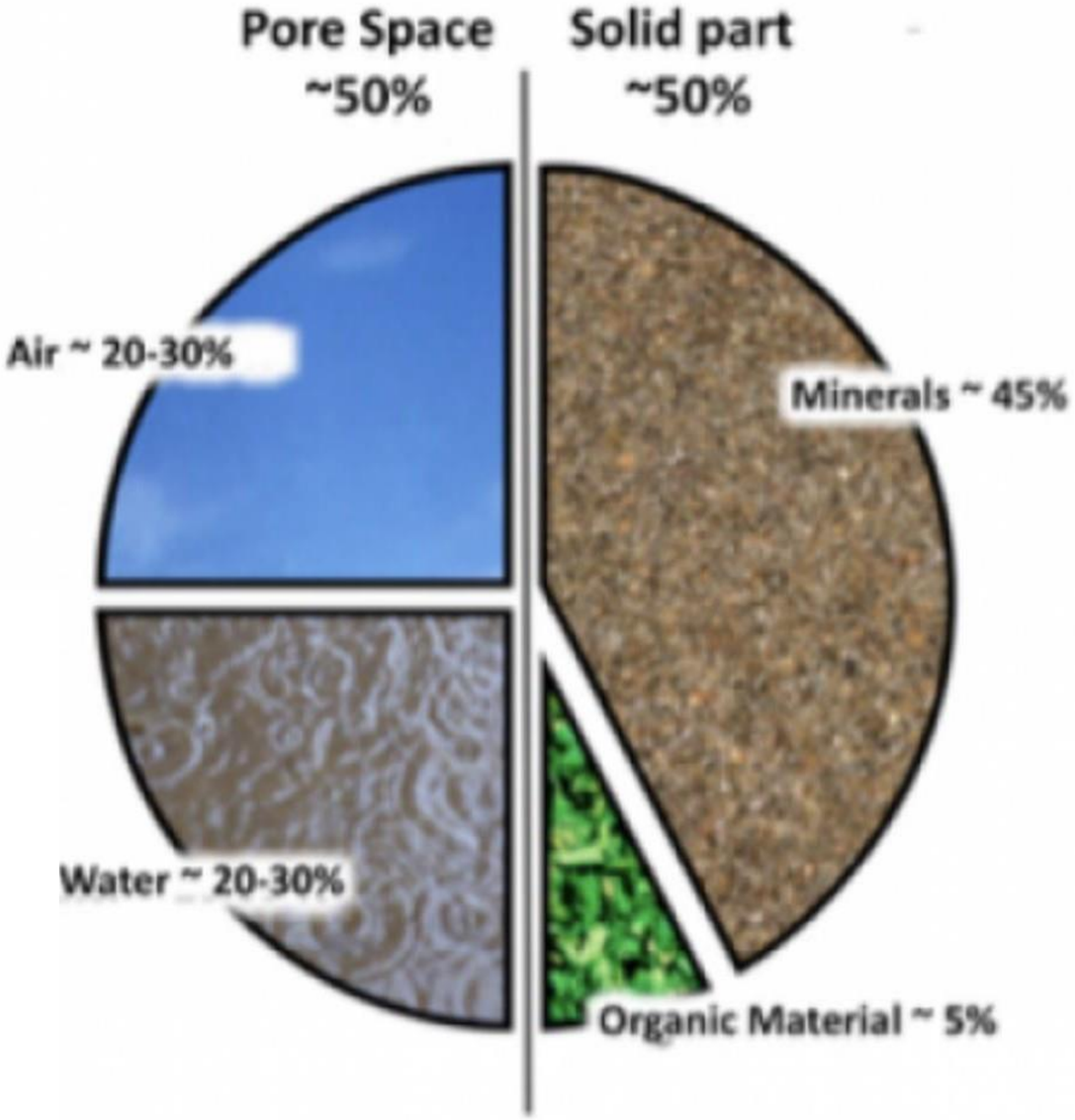
Sand, Silt, Clay

Property	Sand	Silt	Clay
Visible to naled Eye	Yes	No	No
Cohesion	Low	Moderate	High
Ability to Hold Water	Low	Moderate	High
Rate of Water Infiltration	Rapid	Slow	Slow
Degree of Aeration	Good	Moderate	Low
Resistance to Ph Change	Low	Moderate	High
Ability fo Hold Nutrients	Low	Low	High
Compactability	Low	Moderate	High

What is Soil?

Soil Composition







What is Soil?

Aggregation

• Peds are aggregates of soil formed by a pedogenic process.

• Peds are formed as a natural process separated by pores or voids. Particles stick together due to:

- Plant matter
- Organic matter
- Bacteria
- Fungi
- Earthworms
- Insect excrements

What is Soil?

pH

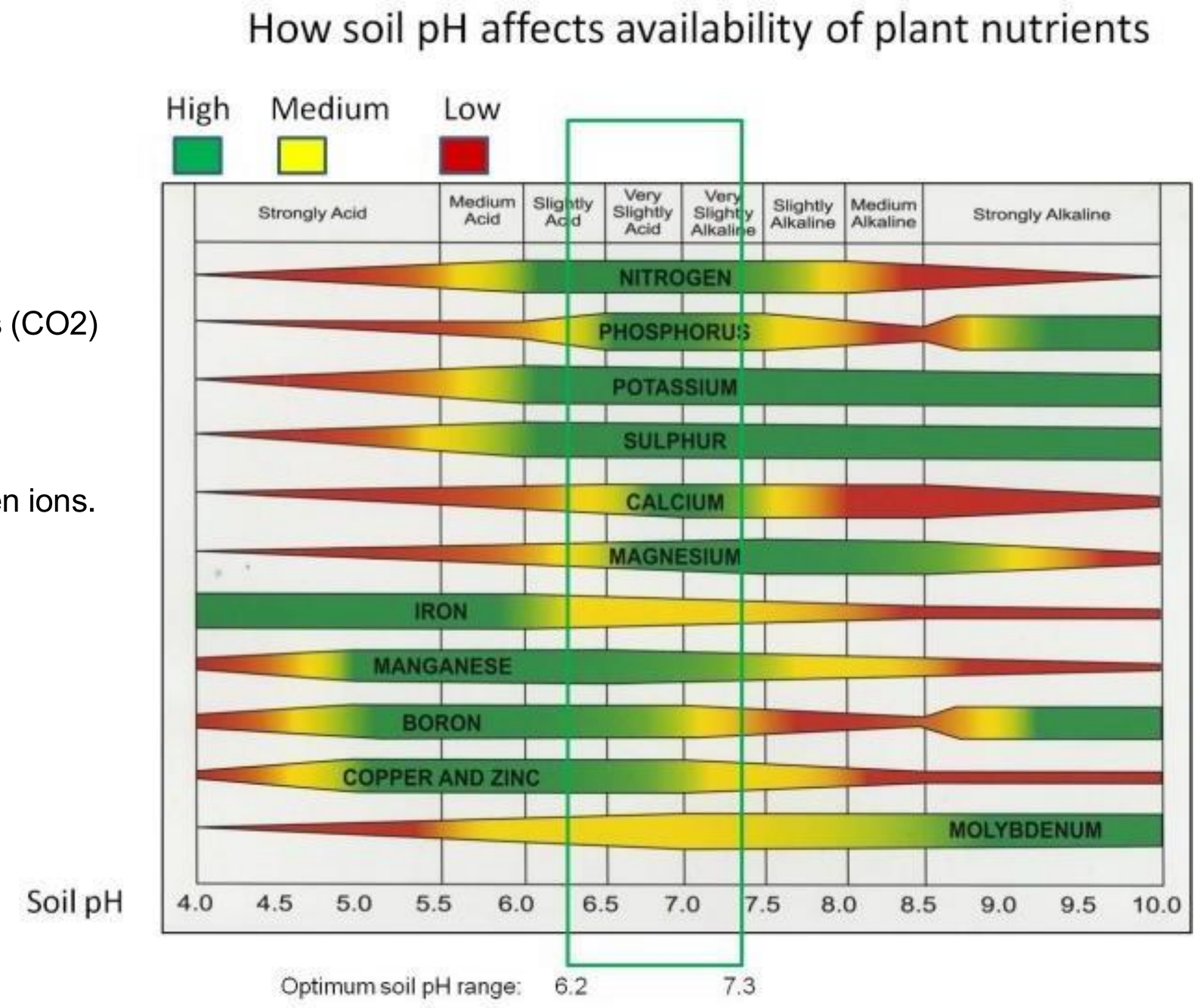
Things that naturally increase pH:

- Respiration by soil roots and organisms (CO2)
- Decay of organic matter
- Plants absorb minerals leaving hydrogen ions.

Things that change pH:

- Sulfur decreases pH
- Lime increases pH

[pH Chart for Plants]



What is Soil?

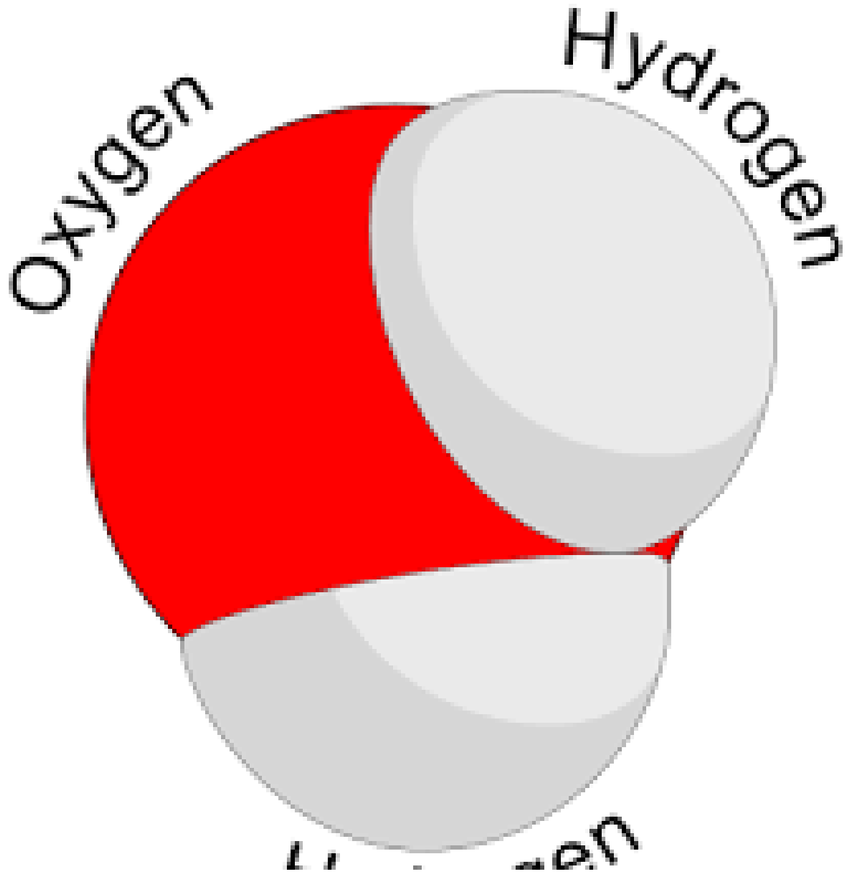
Nutrients

Non-Mineral Nutrients (make up 96% of plants)

- Oxygen
- Hydrogen
- Carbon

Mineral Nutrients (make up 4% of plants)

- Soil minerals
- Organic matter
- Nutrients are absorbed into clay and humus
- Soil solution



What is Soil?

Macro Nutrients

N = Nitrogen

P = Phosphorus

K = Potassium

Ca = Calcium (available in soil)

S = Sulfur (available in soil)

Mg = Magnesium (available in soil)

Micro Nutrients

B = Boron

Mn = Manganese

Fe = Iron

Zn = Zinc

Cu = Copper

Mo = Molybdenum

Cl = Chlorine*

Ni = Nickel*

Co = Cobalt*

Si = Silicon*

* = may not be essential.

Non-Essential (Beneficial) Nutrients

Al – Aluminum

Se = Selenium

Na = Sodium

V = Vanadium

Ga = Gallium

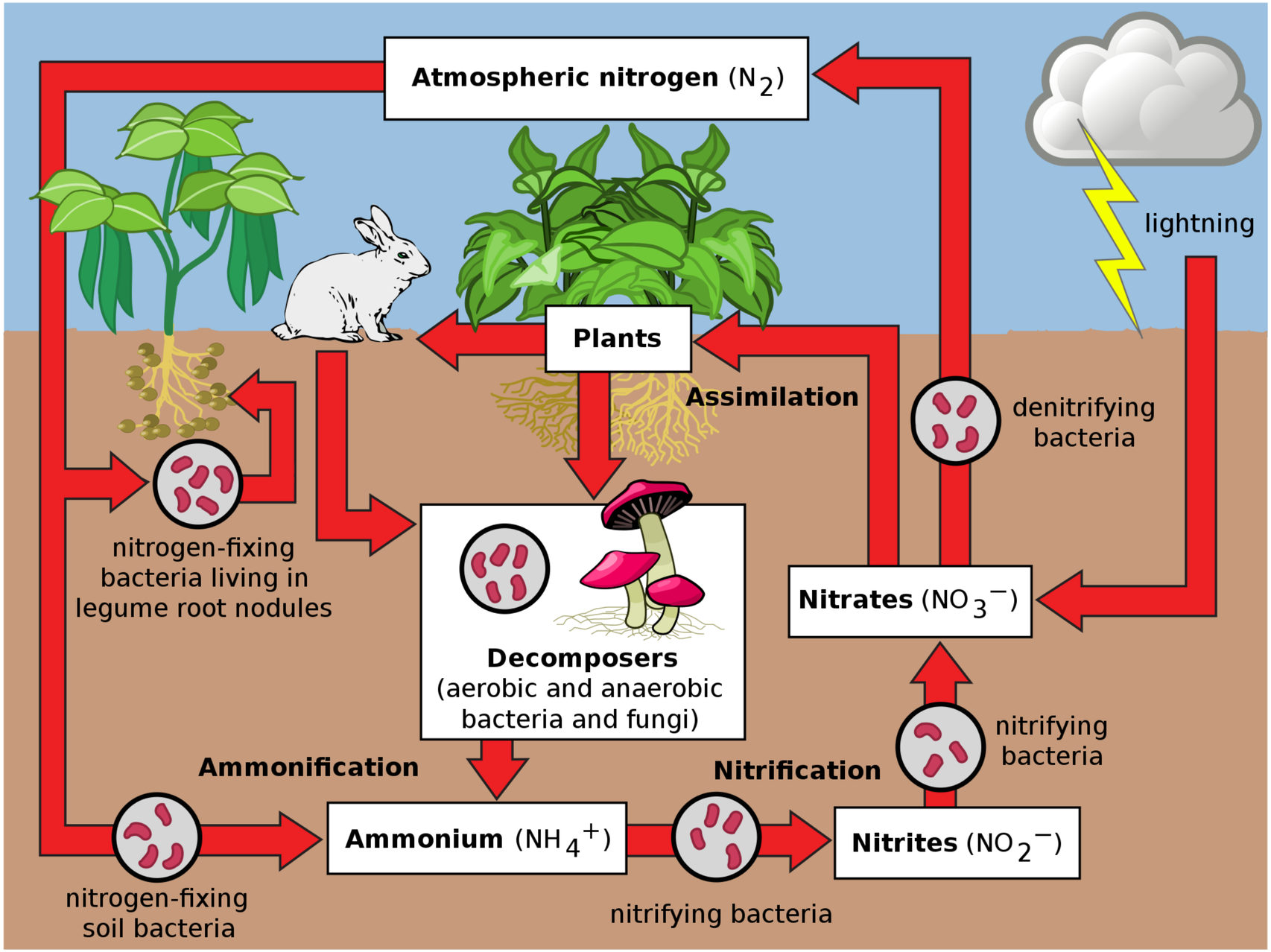
What is Soil?

Nitrogen Cycle

Nitrogen is essential for plant growth.

Too much nitrogen can make plants weak, more prone to disease, remain in a vegetative state and change the flavour of fruits. In mass quantities, it can cause problems in rivers, lakes, streams and oceans.

Nitrogen Fixing Organisms

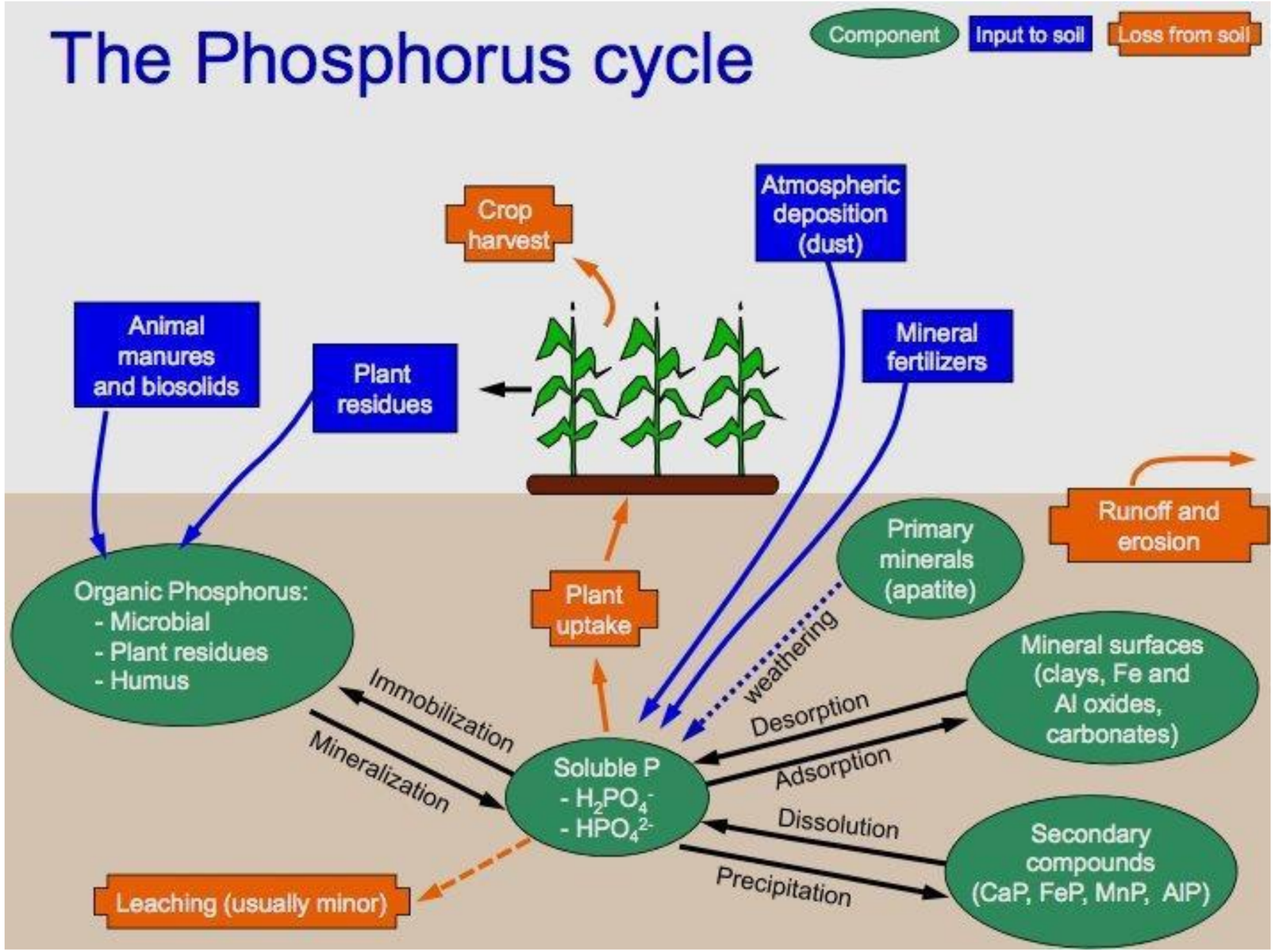


What is Soil?

Phosphorus Cycle

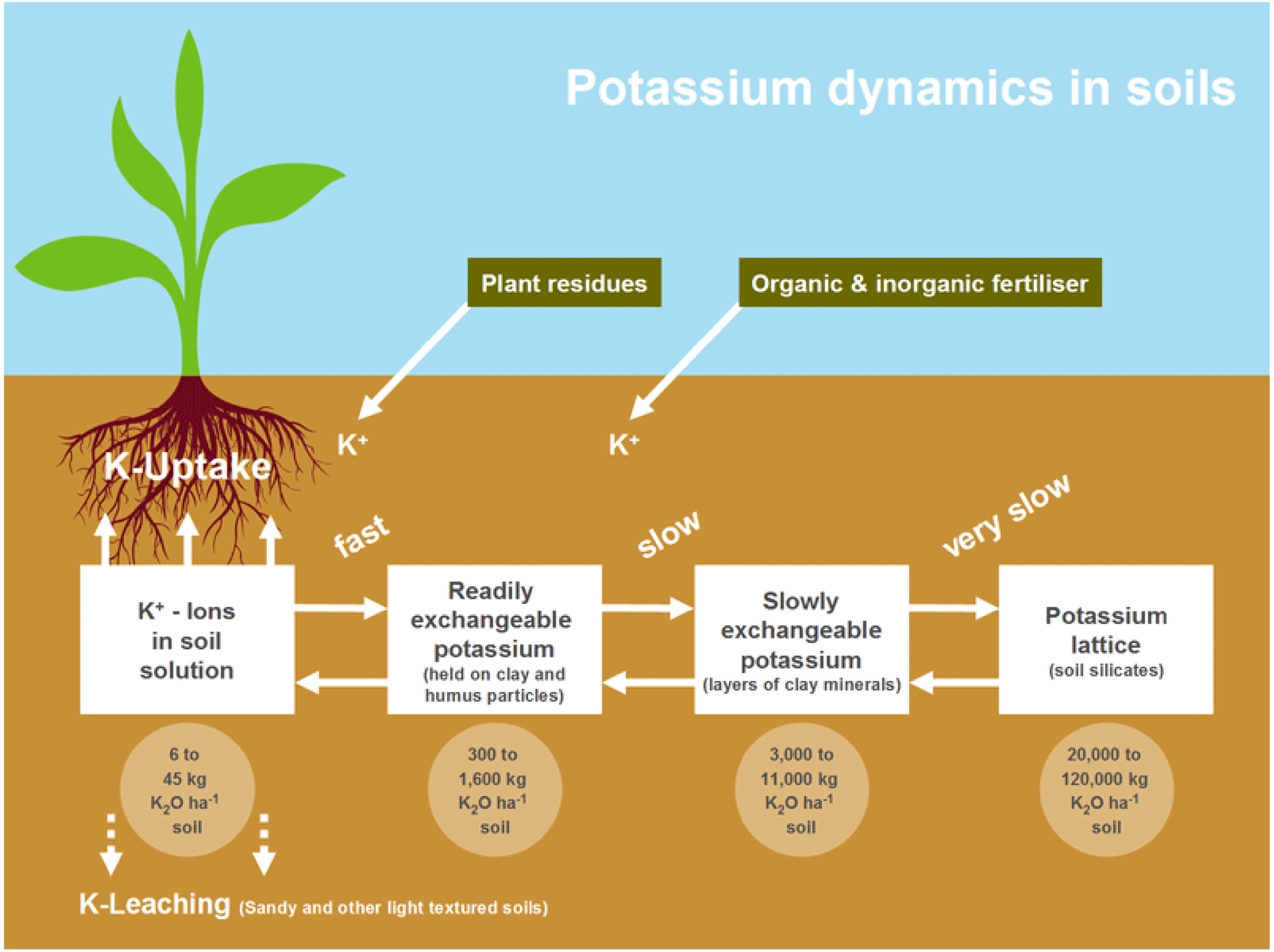
Phosphorus is essential for plant growth.

Too much phosphorus can be harmful to plants, microorganisms, mycorrhizal fungi and waterways.



What is Soil?

- **Potassium**
- Potassium is essential for plant growth.



Soil Tests

REPORT NUMBER: C22151-10053
ACCOUNT NUMBER: 01810

A & L Canada Laboratories Inc.

2136 Jetstream Rd, London, Ontario, N5V 3P5
Telephone: (519) 457-2575 Fax: (519) 457-2664

REPORT OF ANALYSIS

TO: CANADIAN ORGANIC GROWERS
56 SPARKS STREET
SUITE 600
OTTAWA, ON K1P 5B1

RE: CALEB WOOLCOTT

DATE RECEIVED: 2022-05-31
DATE REPORTED: 2022-06-14
PAGE: 1 / 1

LAB NO.	SAMPLE ID	ANALYSIS	RESULT	UNIT	METHOD
61470	MEILLEUR	Total Carbon	3.41	%	Combustion
61470	MEILLEUR	Carbonate-C	0.7	%	Calcimeter
61470	MEILLEUR	Bulk Density	1442	kg/m3	USGA Journal & Turf Management
61470	MEILLEUR	Total Organic Carbon	3.32	%	Calculation
61470	MEILLEUR	C:N Ratio	12.6	---	
61470	MEILLEUR	Sand	61	%	MSA Part 1 (1986) pp 404-408
61470	MEILLEUR	Silt	25	%	MSA Part 1 (1986) pp 404-408
61470	MEILLEUR	Clay	14	%	MSA Part 1 (1986) pp 404-408
61470	MEILLEUR	Soil Textural Class	Sandy Loam		MSA Part 1 (1986) pp 383-385
61471	PAUVRE	Total Carbon	5.45	%	Combustion
61471	PAUVRE	Carbonate-C	1.8	%	Calcimeter
61471	PAUVRE	Bulk Density	1326	kg/m3	USGA Journal & Turf Management
61471	PAUVRE	Total Organic Carbon	5.24	%	Calculation
61471	PAUVRE	C:N Ratio	16.4	---	
61471	PAUVRE	Sand	69	%	MSA Part 1 (1986) pp 404-408
61471	PAUVRE	Silt	20	%	MSA Part 1 (1986) pp 404-408
61471	PAUVRE	Clay	11	%	MSA Part 1 (1986) pp 404-408
61471	PAUVRE	Soil Textural Class	Sandy Loam		MSA Part 1 (1986) pp 383-385

C22151-10053

Results Authorized By:

A&L Canada is a laboratory accredited by Standards Council of Canada / CAEAL and OMAF

Soil Tests

Report Number: C22151-10053
Account Number: 01810

To: CANADIAN ORGANIC GROWERS
56 SPARKS STREET
SUITE 600
OTTAWA, ON K1P 5B1

613-236-0743

A & L Canada Laboratories Inc.

2136 Jetstream Road, London, Ontario, N5V 3P5
Telephone: (519) 457-2575 Fax: (519) 457-2664

C22151-10053

For: CALEB WOOLCOTT

Reported Date:2022-06-03 **Printed Date:**Jun 14, 2022

SOIL TEST REPORT

Sample Number	Lab Number	Organic Matter	Phosphorus - P ppm Bicarb	Phosphorus - P ppm Bray-P1	Potassium K ppm	Magnesium Mg ppm	Calcium Ca ppm	Sodium Na ppm	pH pH	pH Buffer	CEC meq/100g	Percent Base Saturations % K	% Mg	% Ca	% H	% Na
MEILLEUR	61470	5.9		76 G	92 M	310 H	2540 M	20 L	7.1		17.1	1.4	15.1	74.1	8.9	0.5
PAUVRE	61471	6.8		30 L	114 M	222 M	2790 H	14 VL	7.1		17.7	1.6	10.4	78.6	9.0	0.3

Sample Number	Sulfur S ppm	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Soluble Salts ms/cm	Saturation %P	Aluminum Al ppm	Saturation %Al	Nitrate Nitrogen NO3-N ppm	K/Mg Ratio	ENR	Field ID
MEILLEUR	9 VL	9.5 H	34 H	85 VH	2.1 H	0.7 M		20 H	487	0.0 G		0.09	72	
PAUVRE	11 VL	11.4 VH	27 M	83 VH	2.2 H	0.8 M		2 L	504	0.0 G		0.15	81	

OE VL = VERY LOW, L = LOW, M = MEDIUM, H = HIGH, VH = VERY HIGH, G = GOOD, MA = MARGINAL, MT = MODERATE PHYTO-TOXIC, T = PHYTO-TOXIC, ST = SEVERE PHYTO-TOXIC

SOIL FERTILITY GUIDELINES (lbs/ac)

Sample Number	Crop	Yield Goal	Lime Tons/Acre	N	P2O5	K2O	Mg	Ca	S	Zn	Mn	Fe	Cu	B

What is Soil?

Microbes

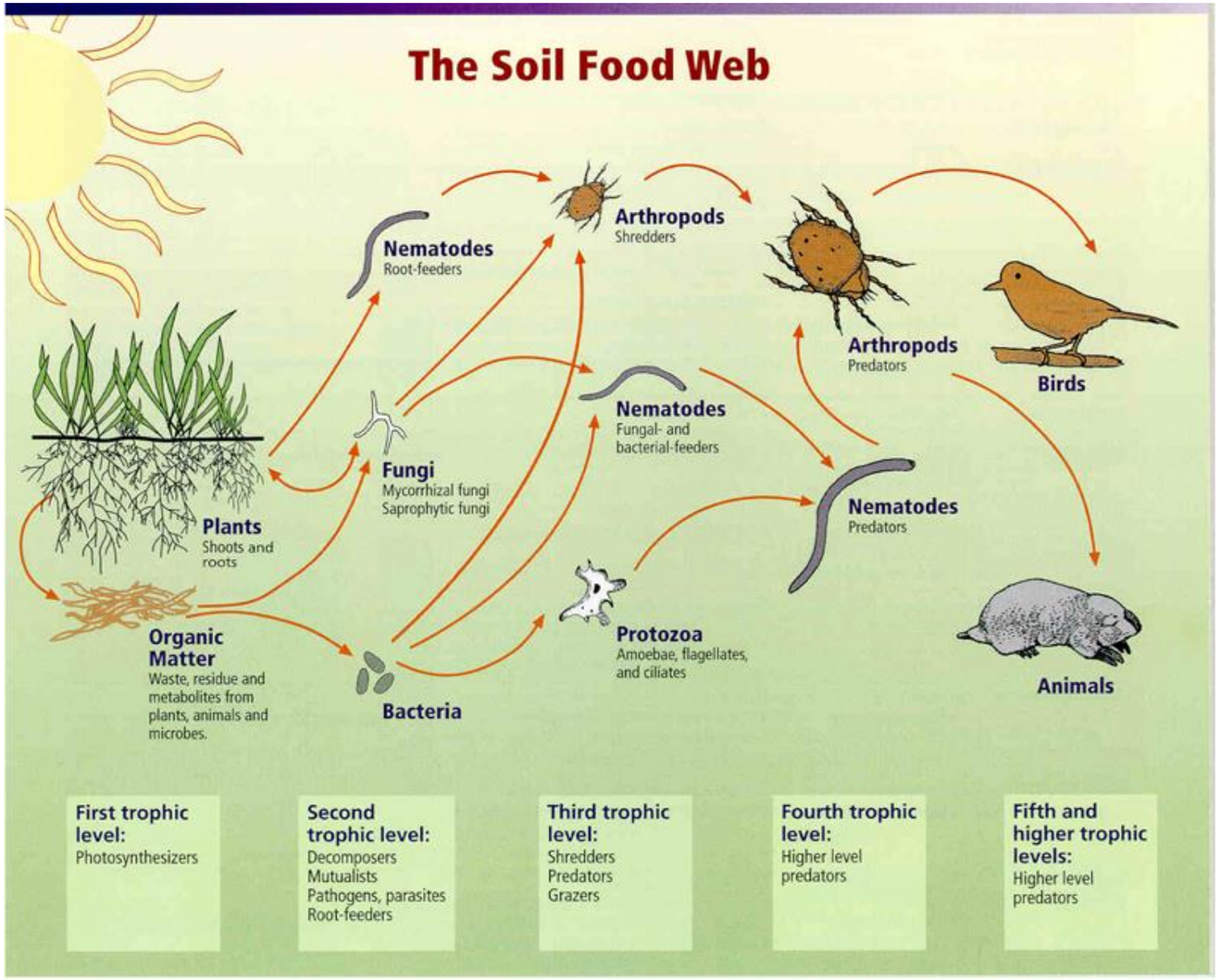
Microorganisms can Promote Plant Growth

- Nitrogen-fixing
- Production of plant hormones
- Synthesis of vitamins
- Mineral Solubilization
- Degradation of Toxins
- Decompose organic matter

Microorganisms can Be Harmful to Plants

- Pathogens
- Disease
- Fungal Infections
- Mildew

Soil Food Web



Relationships between soil food web, plants, organic matter, and birds and mammals
Image courtesy of USDA Natural Resources Conservation Service
http://soils.usda.gov/sqi/soil_quality/soil_biology/soil_food_web.html.

Making Soil

Vermi Compost
Static Compost
Thermophilic Compost
Compost teas
Compost Extracts

Making Soil?

Composting

Basics of Composting
- 60% carbon based
- 30% Nitrogen
- 10% High nitrogen

- Compost must reach 131 –170 for 10 – 15 days

- Carbon vs Nitrogen in soil 30:1

- Carbon = Leaves, paper, plant stocks, wood chips.
- Nitrogen = Dead plants and weeds, long grass, straw.
- High Nitrogen = Grass clippings, food scraps, green weeds.

Making Soil










Home Composting



Feeding Soil Roots Matter

Home Gardening Made Easy

- Setting Up A Garden/Farm for the First Time
  - **Remove problematic rhizomes (perennial plants)**
  - **Remove weeds before they go to seed**
  - **Add compost** (Acti-Sol, Bio-Sol, Gaia Green Organics, Mycorrhizae, Biochar)
    - **Methods**
      - Lasagna layer
      - Cover crop (cover and/or grazing)
      - Reduce tilling or digging when possible

Questions?

Thank you!