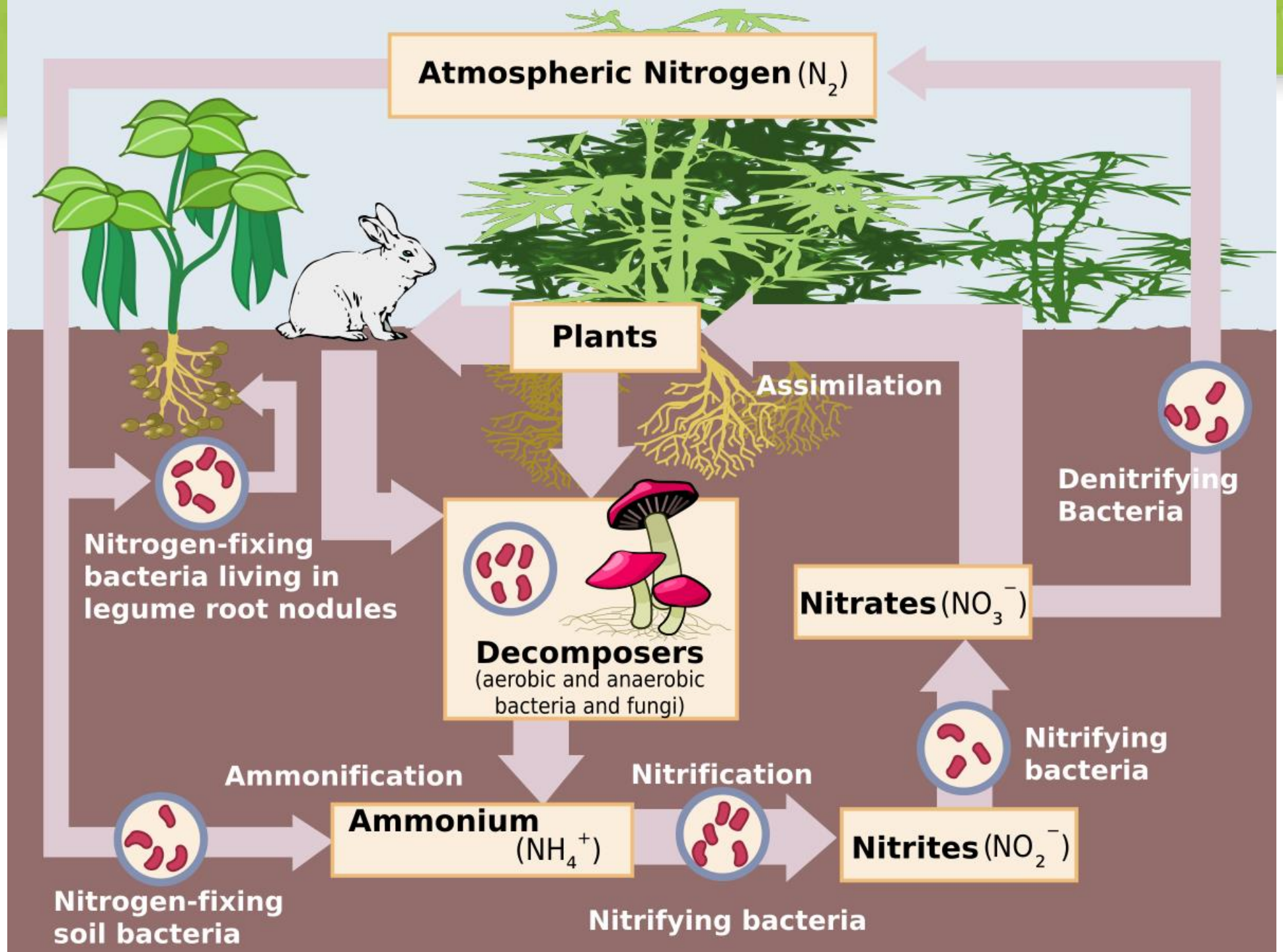
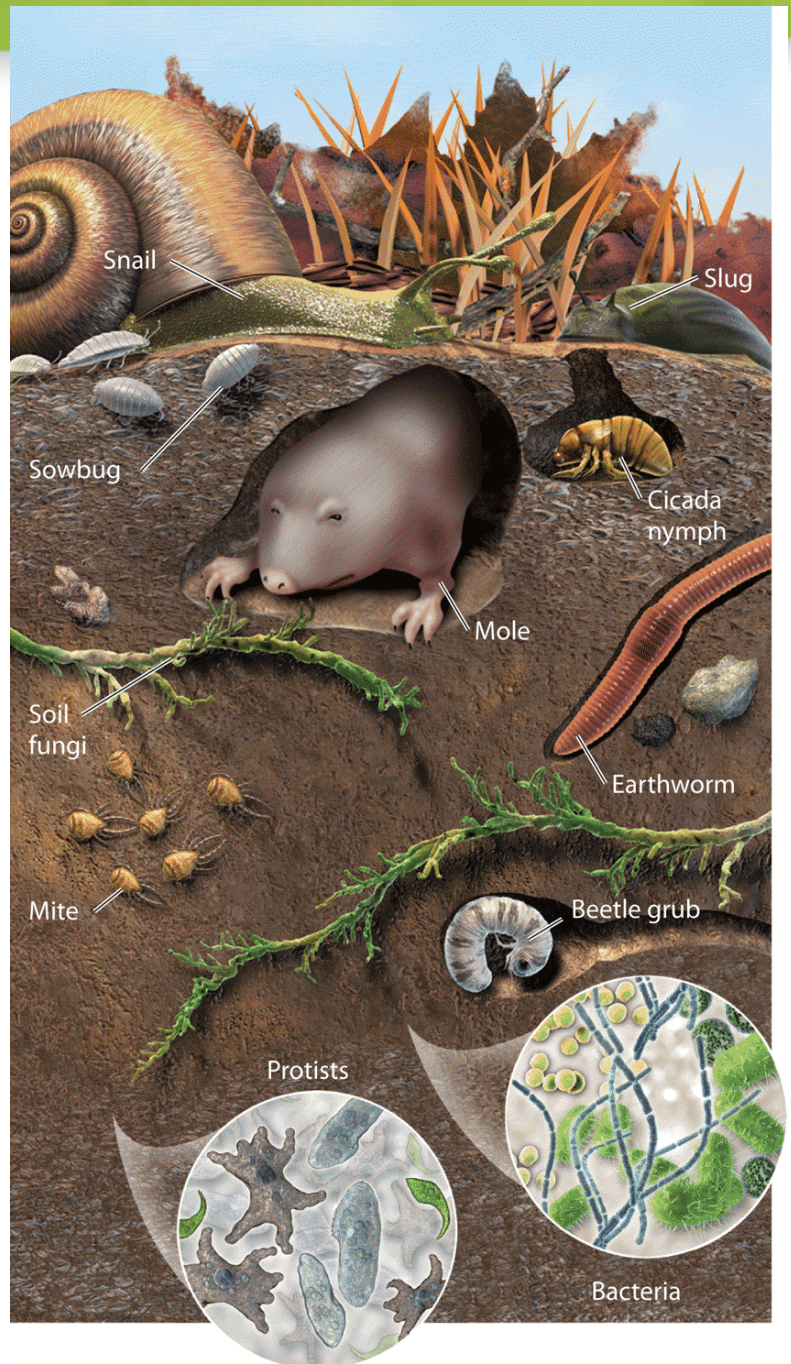
Soils: Don’t Call it Dirt Video Recap

1. Approximately, 10-12% of the Earth’s surface is **arable** land.
2. All the available (undeveloped) **arable land** is currently used for food production and its natural capacity to produce food has been reached. How do we increase our ability to produce food?
3. **Nitrogen** and **phosphorus** are key **limiting nutrients** in soil. Cover crops – such as soybean are used to “fix” nitrogen in the soil.
4. **Current farming methods**: tillage reduction, crop rotation, and pasture rotation


Atmospheric Nitrogen (N_2)
Plants
Assimilation
Denitrifying Bacteria
Nitrogen-fixing bacteria living in legume root nodules
Decomposers
(aerobic and anaerobic bacteria and fungi)
Nitrates (NO_3^-)
Nitrifying bacteria
Ammonification
Nitrification
Ammonium (NH_4^+)
Nitrites (NO_2^-)
Nitrogen-fixing soil bacteria
Nitrifying bacteria

Soil Composition

- Soil is made up of minerals, organic matter, air, and water.
- Soil composition is influenced by **climate**, organisms, landforms, **parent material**, and time.

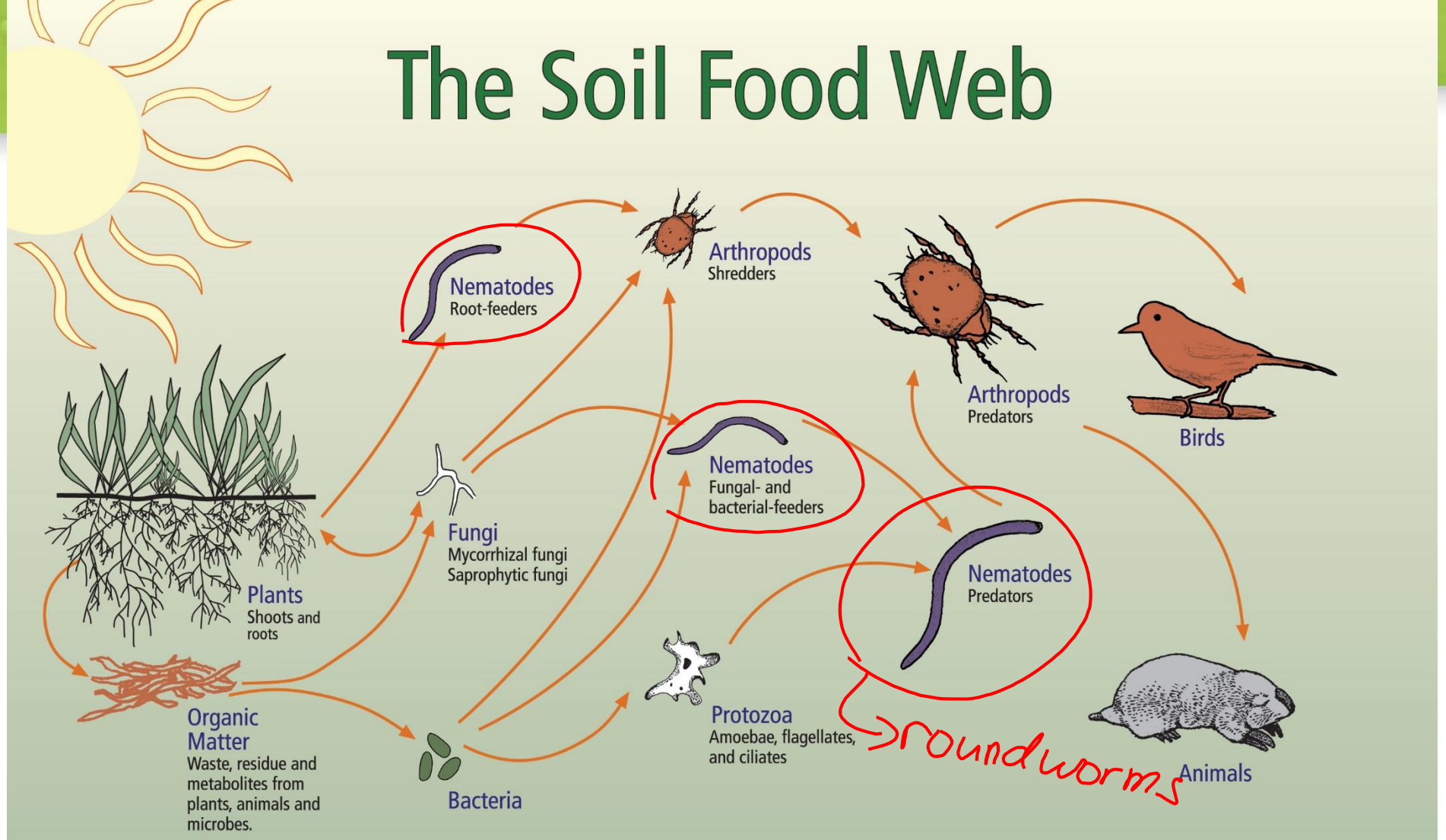


Soil Composition

Factors That Influence Soil Formation	
Factor	**Effects**
Climate	Soil forms faster in warm, wet climates. Heat speeds chemical reactions, weathering, decomposition, and growth of organisms. Moisture is required for many biological processes so it speeds weathering.
Organisms	Earthworms and other burrowing animals mix and aerate soil, add organic matter, and speed decomposition. Plants add organic matter and affect a soil's composition and structure.
Landforms	Hills and valleys affect exposure to sun, wind, and water. Steeper slopes promote runoff and erosion; they also slow leaching, accumulation of organic matter, and formation of soil layers.
Parent material	Chemical and physical attributes of parent material influence properties of the soil formed from it.
Time	Soil formation takes decades, centuries, or millennia.

Adapted from Jenny, H. 1941. *Factors of soil formation: A system of quantitative pedology.* New York: McGraw-Hill, Inc. Reprinted 1994 by Dover Publications, Mineola, New York.

The Soil Food Web

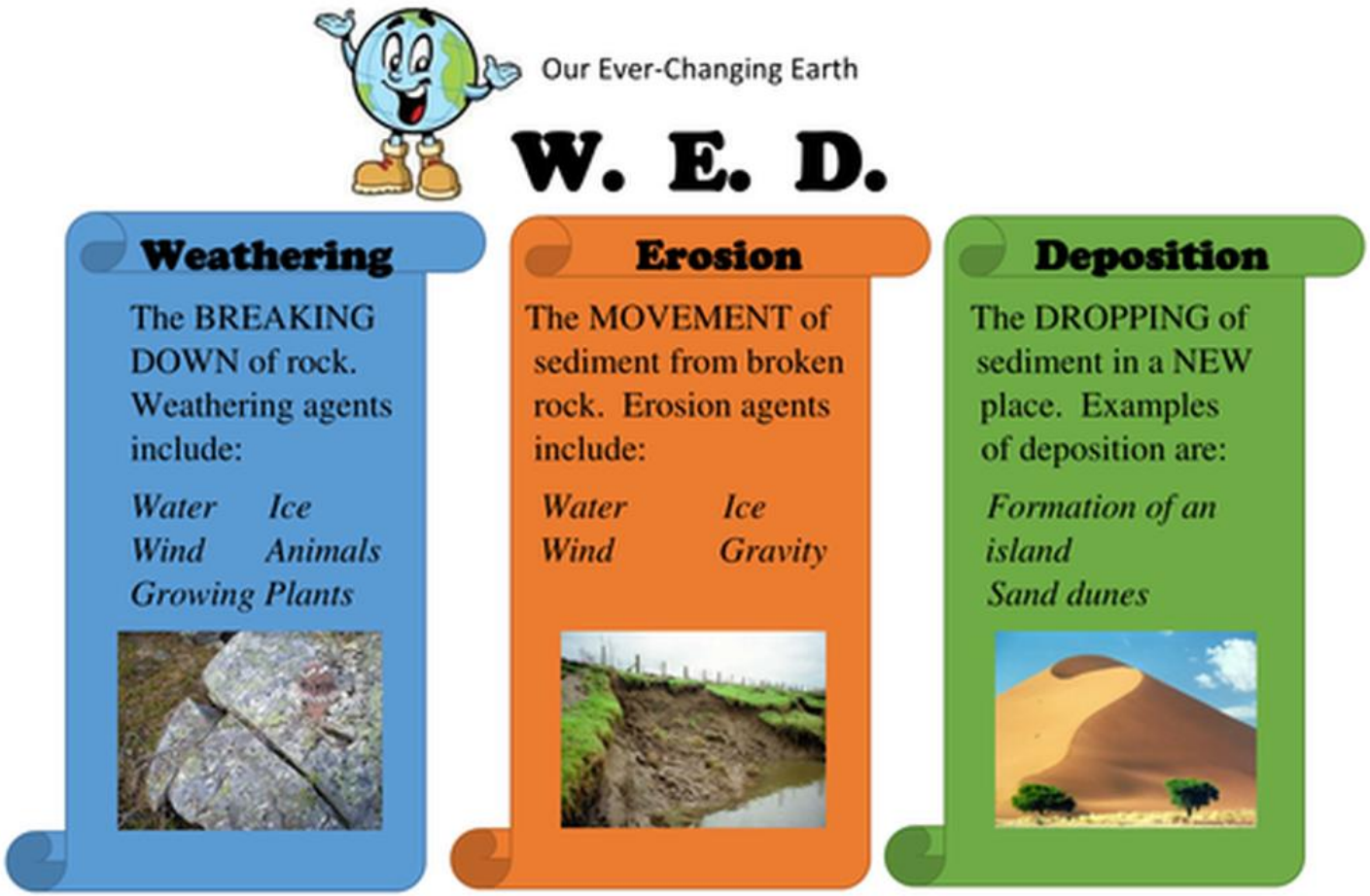


First trophic level:	Second trophic level:	Third trophic level:	Fourth trophic level:	Fifth and higher trophic levels:
Photosynthesizers	Decomposers Mutualists Pathogens, Parasites Root-feeders	Shredders Predators Grazers	Higher level predators	Higher level predators

Typical Numbers of Soil Organisms in Healthy Ecosystems

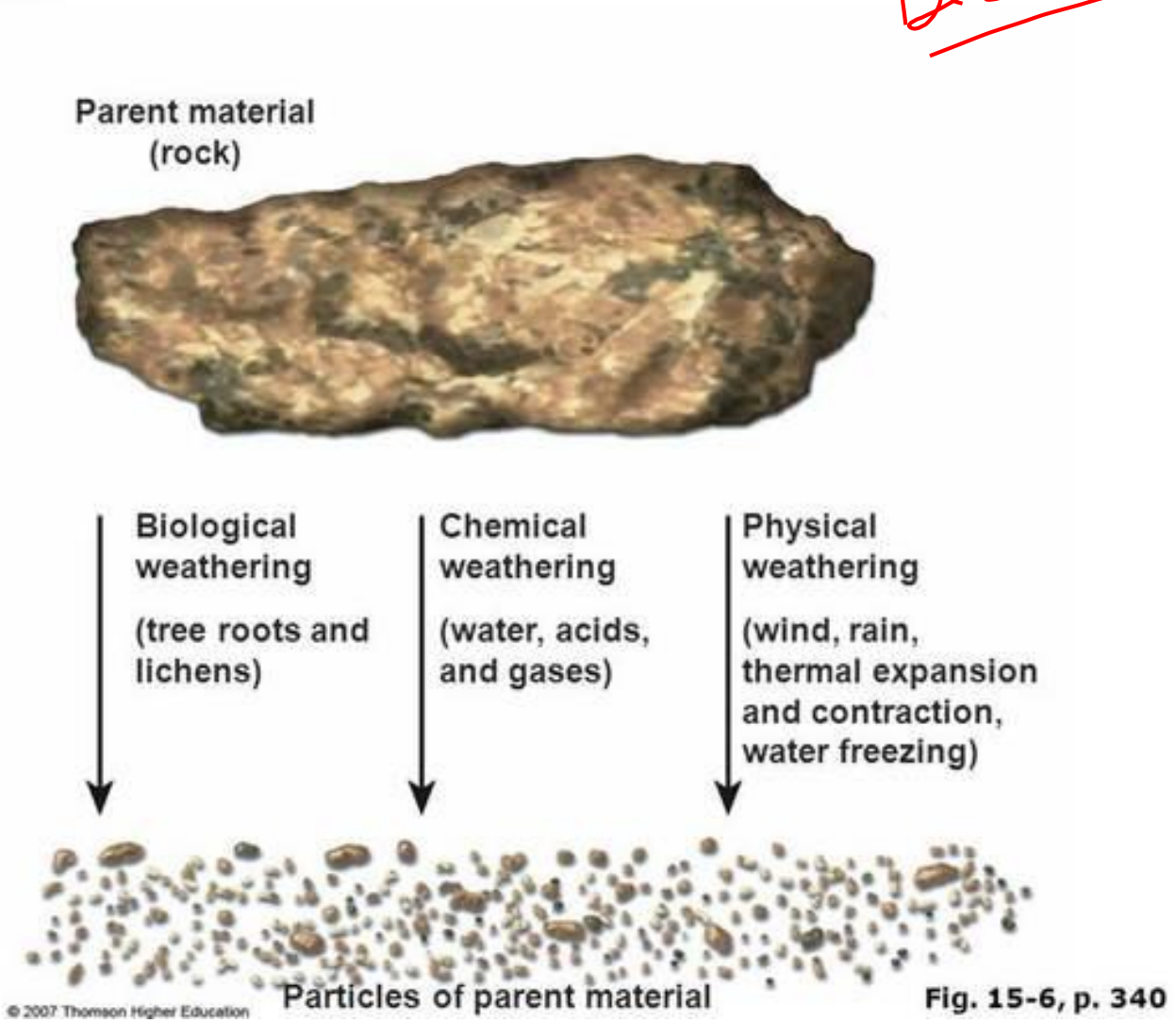
		Agricultural Soils	Prairie Soils	Forest Soils
Bacteria	Per teaspoon of soil (one gram dry)	100 million to 1 billion.	100 million to 1 billion.	100 million to 1 billion.
Fungi		Several yards. (Dominated by vesicular-arbuscular mycorrhizal (VAM) fungi).	Tens to hundreds of yards. (Dominated by vesicular-arbuscular mycorrhizal (VAM) fungi).	Several hundred yards in deciduous forests. One to forty miles in coniferous forests (dominated by ectomycorrhizal fungi).
Protozoa		Several thousand flagellates and amoebae, one hundred to several hundred ciliates.	Several thousand flagellates and amoebae, one hundred to several hundred ciliates.	Several hundred thousand amoebae, fewer flagellates.
Nematodes		Ten to twenty bacterial-feeders. A few fungal-feeders. Few predatory nematodes.	Tens to several hundred.	Several hundred bacterial- and fungal-feeders. Many predatory nematodes.
Arthropods	Per square foot	Up to one hundred.	Five hundred to two thousand.	Ten to twenty-five thousand. Many more species than in agricultural soils.
Earthworms		Five to thirty. More in soils with high organic matter.	Ten to fifty. Arid or semi-arid areas may have none.	Ten to fifty in deciduous woodlands. Very few in coniferous forests.

Soil Formation



- **Weathering:** Physical and chemical breaking of rocks and minerals into smaller pieces
- **Erosion and deposition:** Pick-up, transport, and drop-off of material from one place to another
- **Decomposition:** Breakdown of waste, organisms, and organic material into simple molecules

Soil Formation



Bedrock

- **Parent Rock:** base geological material in a particular location
  - Lava or volcanic ash
  - Rock or sediment deposited by glaciers
  - Sand dunes
  - Sediments dropped by rivers/moving water

Soil Formation

- **Parent Rock:**
- **Bedrock**
  - The continuous mass of solid rock that makes up Earth’s crust

Soil Formation

- **Weathering:**
  - **Physical Weathering:** The natural breakup of rock without a chemical change
    - Temperature Changes, Ice Wedging, Root Wedging

Soil Formation

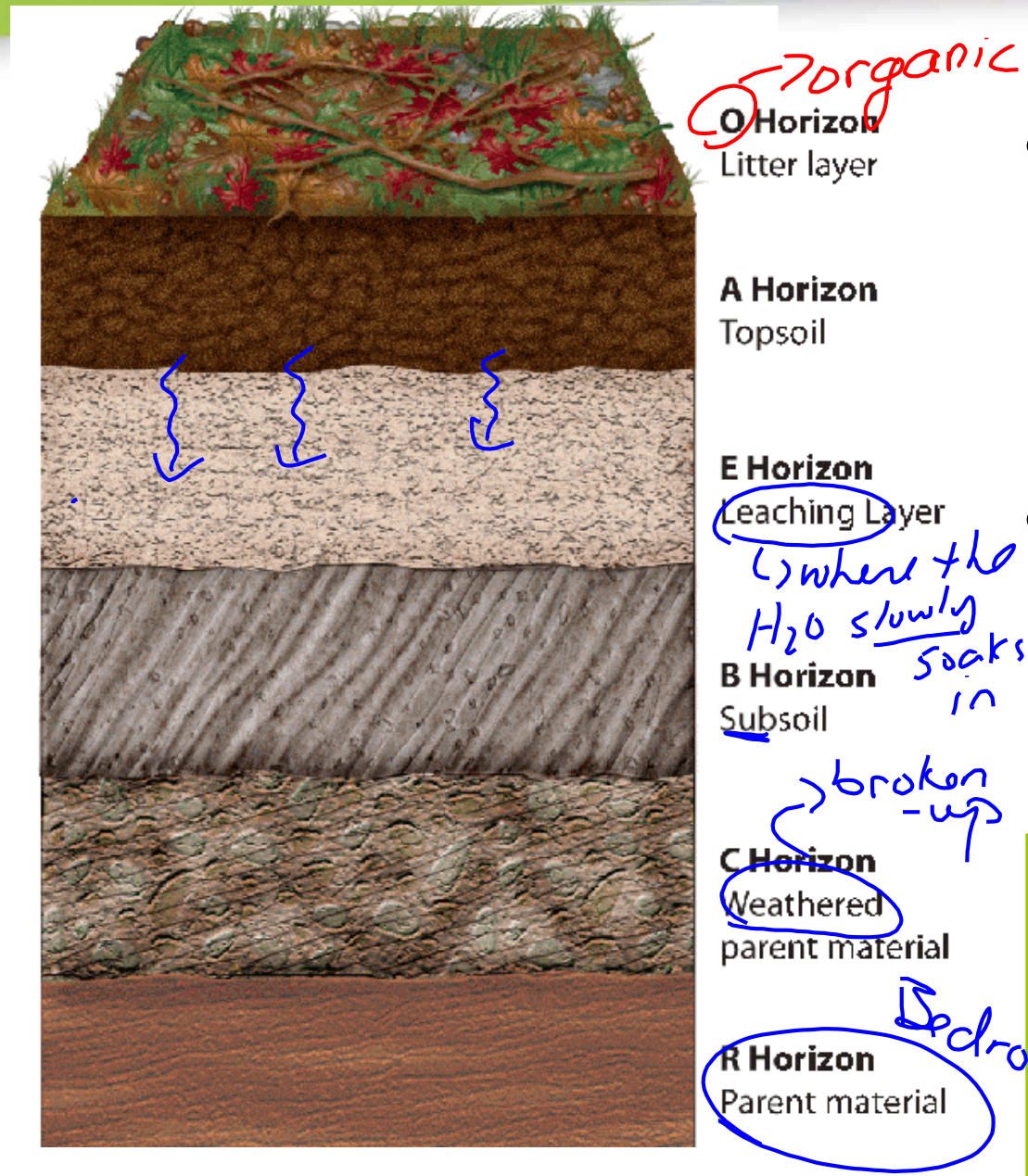
- **Weathering:**
  - **Chemical Weathering:** When water and other substances chemically break down parent material and rocks, transforming them into different materials

Soil Formation

- **Weathering:**
  - **Chemical Weathering:**
    - Water, Carbon Dioxide
      - Increased by warm, wet conditions

rainwater → carbonic acid

Soil Horizons

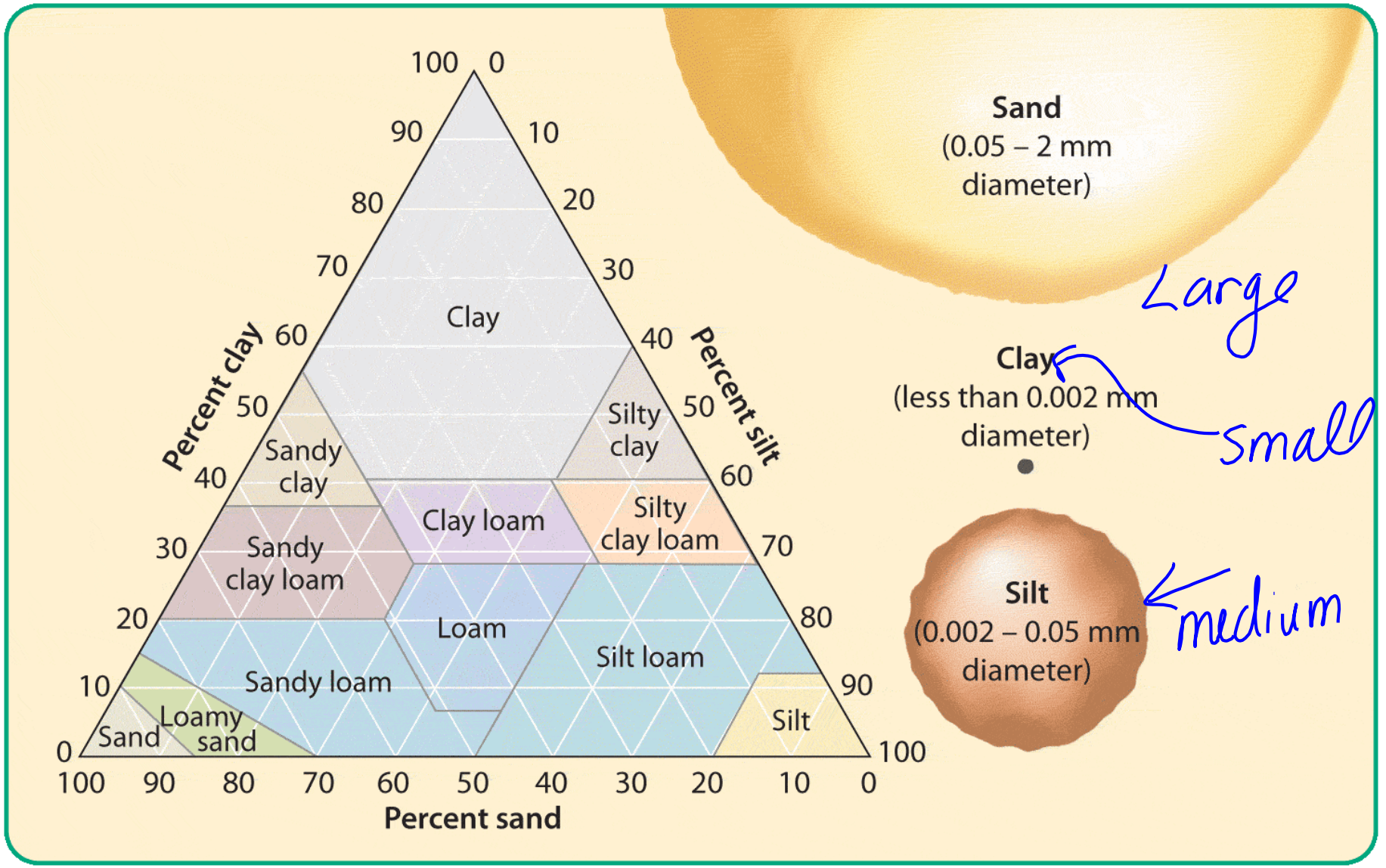


- **Soil horizons** are distinct layers of soil.
- A cross-section of soil horizons is a **soil profile**.

Did You Know? *In general, organic matter is concentrated in the O and A horizons, making them the most critical for agriculture.*

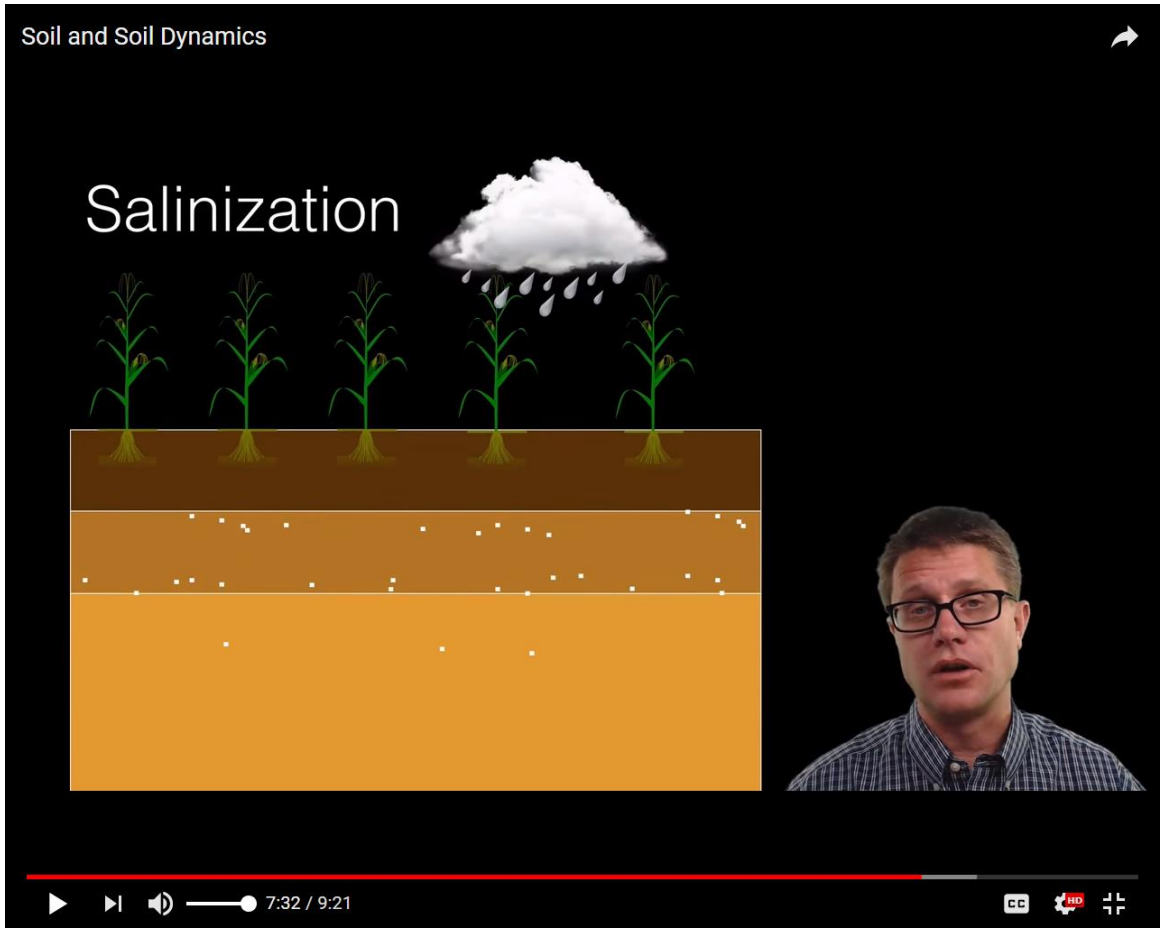
Soil Characteristics

- Soil texture is based on particle size.



Bozeman Science Video: Soil and Soil Dynamics

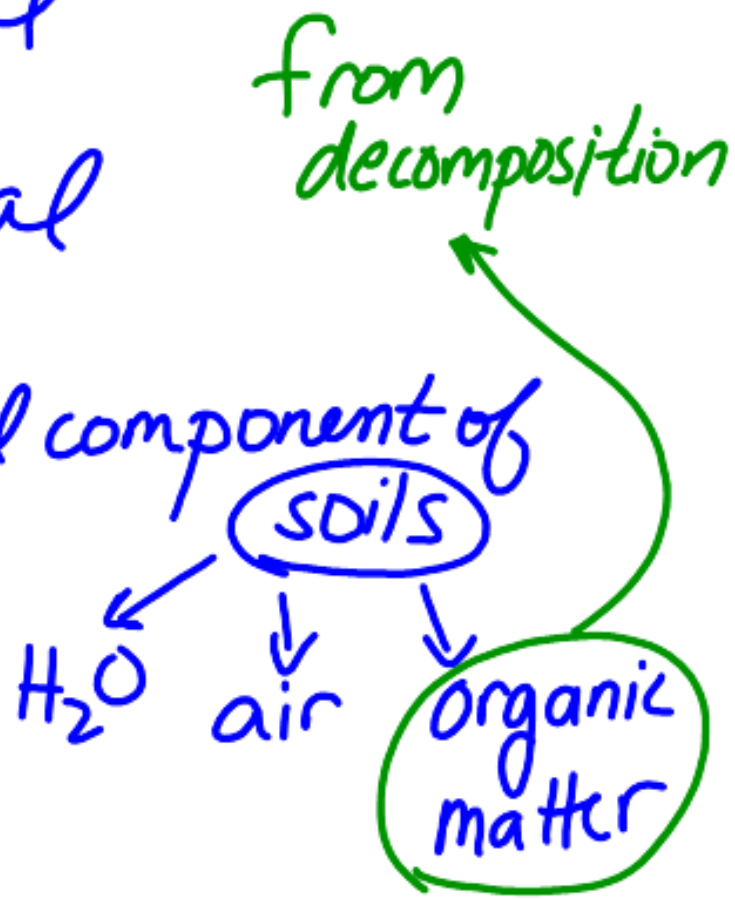
https://www.youtube.com/watch?v=mg7XSjcnZQM

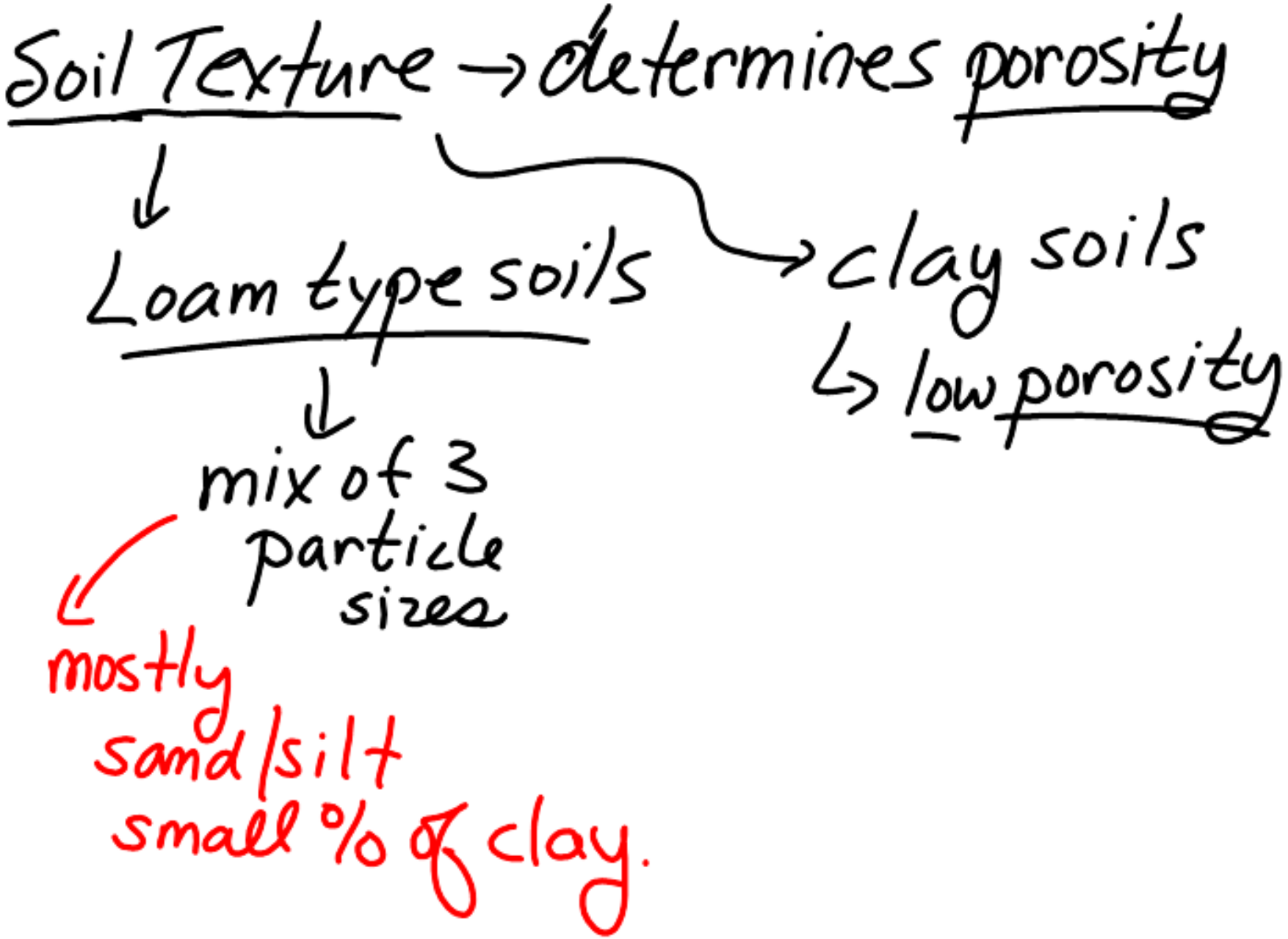


Soils Video (Bozeman)

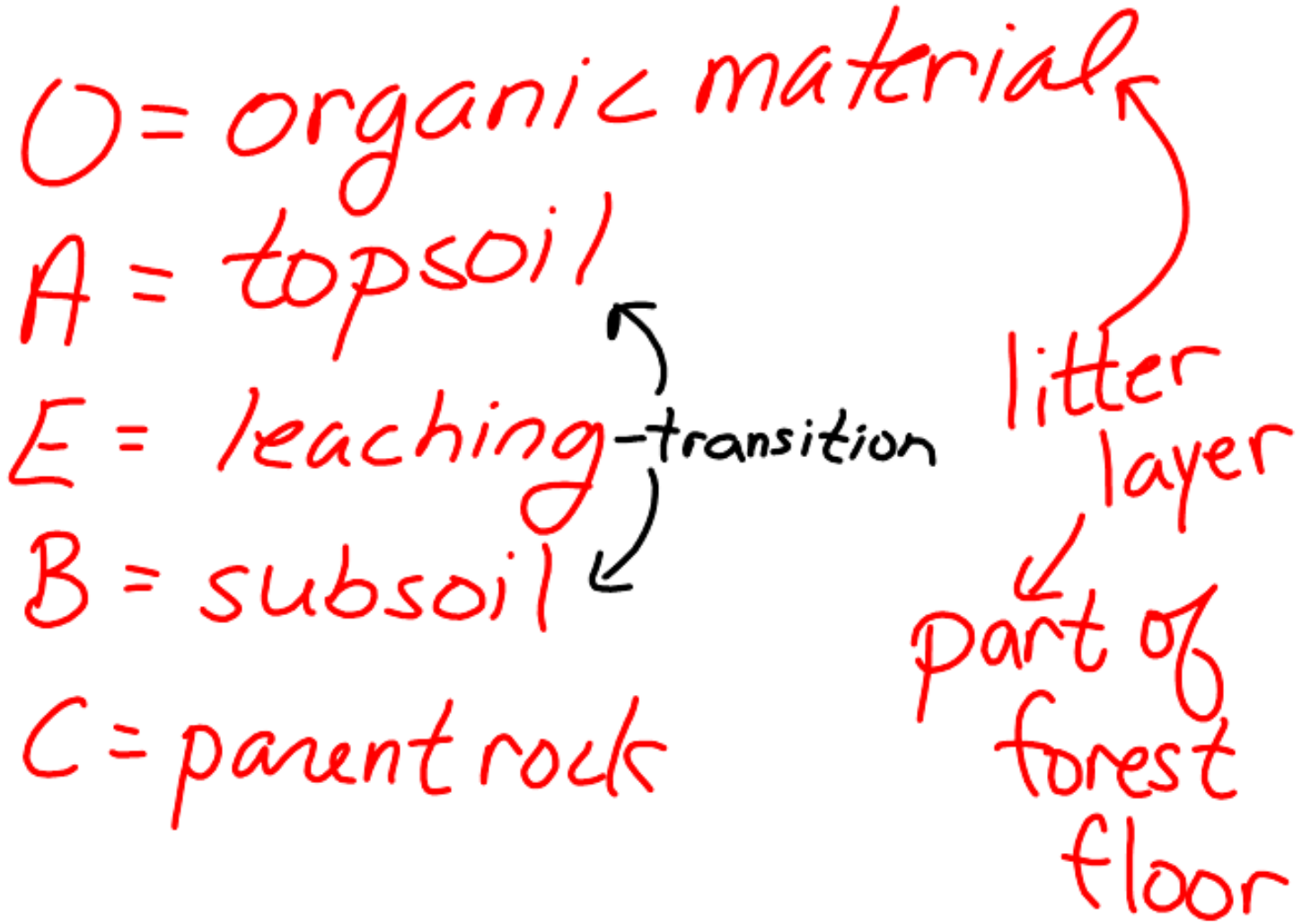
Weathering → Physical
→ Chemical

small particles ⟹ mineral component of soils
(sand, silt, clay)




Soil Texture → determines porosity
Loam type soils
mix of 3 particle sizes
mostly sand/silt
small % of clay.
clay soils
low porosity

Soil Horizons



salinization → build-up of salt in soil from irrigation

soil → non-renewable resource.