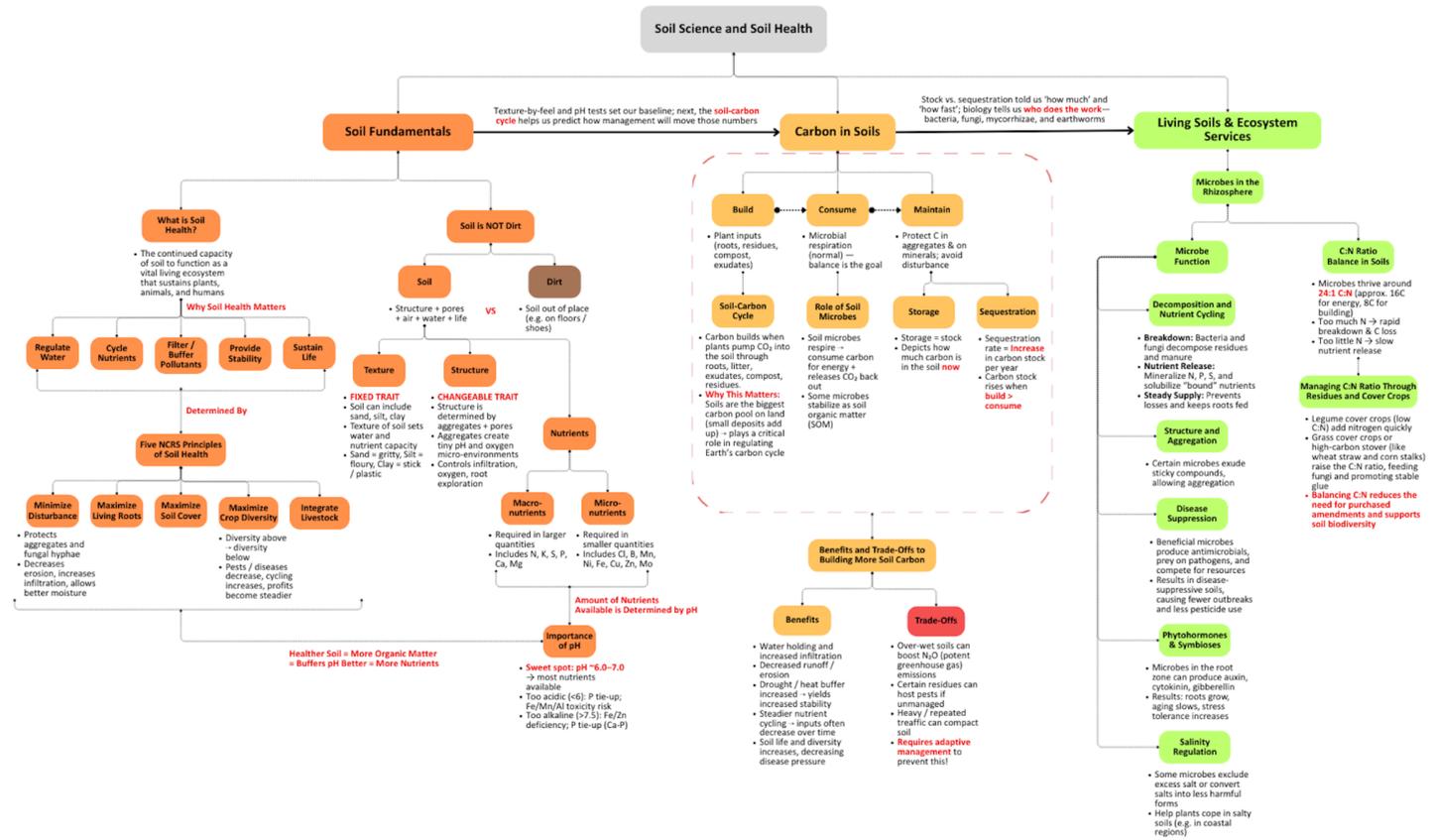




# Module 3: Soil Science and Soil Health

## What You'll Learn

### Comprehensive Mindmap



This module explores how healthy soils function as living ecosystems that regulate water, cycle nutrients, store carbon, and support life. You'll investigate soil basics like texture, structure, and pH, then examine how carbon flows through soils using the Build–Maintain–Consume triad. Through real-world examples, you'll see how practices such as cover crops, compost, and reduced tillage help build carbon inputs, maintain them in stable forms, and manage natural consumption by microbes. Finally, you'll dive into the "living soil" itself—bacteria, fungi, mycorrhizae, and earthworms that drive nutrient cycling, aggregation, and disease suppression—connecting soil biology to ecosystem services like clean water, resilient yields, and climate action.

### Lesson A: Soil Fundamentals

- **Define** soil health using the NRCS definition and list the five soil functions.
- **Classify** a soil by texture using the NRCS Texture-by-Feel method and infer likely drainage/root aeration.
- **Measure** soil pH with an NRCS quick test and interpret one nutrient-availability implication; propose one pH-nudging practice.
- **Map** each measured property (texture/structure, pH, optional infiltration/bulk density) to at least one SDG (2, 6, 13, 15) and justify the link in one sentence.

### Lesson B: Carbon in Soils

- **Diagram** the soil-carbon cycle and distinguish storage (stock) vs. sequestration (rate) in correct units.
- **Categorize** practices with the Build–Maintain–Consume triad and justify placement with one mechanism.
- **Analyze** class SOM field-test and respiration data to infer the likely direction of carbon-stock change and predict water-holding effects.

- **Recommend** a two-practice bundle that increases sequestration and tag the relevant SDGs (2, 6, 12, 13, 15), stating the expected change in one indicator (e.g., infiltration ↑).

### Lesson C: Living Soils & Ecosystem Services

- **Describe** roles of bacteria, fungi (incl. mycorrhizae), and earthworms in nutrient cycling, aggregate formation, and disease suppression.
- **Evaluate** aggregate stability/slake and infiltration results to infer impacts on ecosystem services (erosion control, water quality).
- **Design** a “microbe-booster” practice for the school garden and defend it with class data; predict one SDG outcome (e.g., runoff clarity → SDG 6).
- **Compose** a 1-page, SDG-tagged recommendation memo that applies the Build–Maintain–Consume logic to campus management.

### Important Vocabulary/Terms

Term	Definition	Example
soil health	The ability of soil to function as a living ecosystem that sustains plants and the environment	Healthy soil supports crop growth, reduces erosion, and stores carbon
soil structure	How soil particles are arranged into aggregates affecting air and water movement	Well-aggregated soil allows roots to grow and water to infiltrate easily
infiltration	Water entering and moving through soil	Rainwater soaks into healthy soil instead of running off
erosion	Removal of soil particles by wind or water	Heavy rainfall on bare soil washes nutrients away
runoff	Water that flows over soil surface instead of soaking in	Paved surfaces increase runoff and reduce groundwater recharge
biodiversity	Variety of organisms in soil and aboveground ecosystems	Plants, microbes, and insects all support soil fertility
microbes	Microorganisms that decompose organic matter and cycle nutrients	Bacteria and fungi release nitrogen, phosphorus, and sulfur
roots	Plant structures that absorb water and nutrients	Roots grow into soil pores and interact with microbes
nutrients	Chemical elements plants need to grow, like N, P, K	Fertilizers or compost provide nutrients to crops
dirt	Soil that has lost structure or is out of place	Soil removed from a garden and piled on a construction site is dirt
soil carbon	Carbon stored in soil as organic matter	Plant residues and microbial biomass contribute to soil carbon
carbon sequestration	Long-term storage of carbon in soils to prevent release as CO <sub>2</sub>	Cover crops and no-till farming increase carbon storage
soil organic matter (SOM)	Decomposed plant and animal material that improves fertility	Compost added to soil increases SOM and water retention
aggregates	Clusters of soil particles that create pore spaces	Aggregates allow roots, air, and water to move through soil
mycorrhizae	Fungal extensions of roots that exchange nutrients for carbon	Mycorrhizal fungi help plants absorb phosphorus

auxin	Plant hormone that promotes root growth	Auxin encourages roots to branch and penetrate soil aggregates
cytokinin	Plant hormone that slows aging and stimulates cell division	Cytokinin from microbes helps roots grow and improves stress tolerance
gibberellin	Plant hormone that regulates growth and stress responses	Gibberellin from microbes helps roots respond to drought
carbon-to-nitrogen ratio (C:N)	Proportion of carbon to nitrogen affecting decomposition	A 25:1 C:N ratio supports optimal microbial activity

