Module 3: Soil Science & Soil Health
Student Notes
Red Notes

Lesson A – Soil Fundamentals
Vocabulary in Context – Fill in the Blanks (Answers)

1. The term Soil Health describes the continued capacity of soil to function as a vital living ecosystem.
2. Soil texture refers to the proportions of sand, silt, and clay, while soil structure refers to how particles clump into aggregates.
3. A small (~5%) fraction of organic matter fuels microbes, stores water, and binds particles.
4. Soil pH measures how acidic or alkaline soil is and controls nutrient availability.
5. Nitrogen, phosphorus, and potassium are examples of macronutrients, while iron, manganese, and zinc are micronutrients.
6. The NRCS Principles encourage keeping soil covered, minimizing disturbance, maximizing biodiversity, maintaining living roots, and integrating livestock.
7. Healthy soils provide multiple ecosystem services such as plant production, water filtration, nutrient cycling, biodiversity support, pollutant buffering, and carbon storage.

Self-Test

1. Soil health is the continued capacity of soil to function as a living ecosystem.
2. Healthy soil is made up of about 45% minerals, 25% air, 25% water, and 5% organic matter.
3. Soil texture refers to the proportions of sand, silt, and clay, while soil structure refers to how particles are arranged into aggregates.
4. Soil pH measures acidity or alkalinity and determines the availability of nutrients.
5. Nitrogen, phosphorus, and potassium are examples of macronutrients, while iron, manganese, and zinc are micronutrients.
6. The NRCS Principles encourage keeping soil covered, minimizing disturbance, maximizing biodiversity, maintaining living roots, and integrating livestock.
7. Healthy soils provide multiple ecosystem services such as plant growth, water filtration, nutrient cycling, and carbon storage.

Lesson B – Carbon in Soils
Vocabulary in Context – Fill in the Blanks (Answers)

1. The Build–Maintain–Consume Triad framework encourages us to add diverse inputs, protect them with minimal disturbance and cover, and recognize natural decomposition.
2. Carbon storage is the carbon currently held in soil, while sequestration refers to the net increase of carbon stored beyond a baseline.
3. Leaves, roots, and plant exudates feed microbes and become soil organic matter (SOM), the pool of decomposing organic compounds in soil.
4. Microbes respire CO_2 during respiration, releasing some carbon back to the atmosphere.
5. A cover crop adds fresh plant growth between cash crops to build carbon and protect soil.
6. Returning food scraps to soil through compost adds organic matter and inoculates microbes.
7. Biochar is a carbon-rich amendment that can improve water holding and provide habitat for microbes.
8. Soil particles glued together into aggregates create pore space for air and water.
9. The rhizosphere is the zone around roots where plants release exudates to feed microbes.

Self-Test

1. The Build–Maintain–Consume Triad framework guides soil carbon management by encouraging us to Build, Maintain, and balance Consumption.
2. Carbon storage is the total amount of carbon currently stored in soil, while carbon sequestration is the net increase beyond a baseline.
3. Plants pump carbon into the soil through roots and exudates, which microbes then use as food.
4. Microbial respiration releases carbon dioxide back into the atmosphere during decomposition.
5. Adding compost or cover crops can increase soil organic matter and boost microbial activity.
6. Soil particles held together as aggregates help protect organic matter from rapid decomposition.

7. Biochar is a carbon-rich amendment that can improve soil water holding and provide habitat for microbes.
8. Building soil organic carbon has many co-benefits, such as improving water holding capacity and stabilizing yields.

Lesson C – Living Soils & Ecosystem Services
Vocabulary in Context – Fill in the Blanks (Answers)

1. The rhizosphere is the zone around roots where exudates feed microbes and intense nutrient cycling occurs.
2. A diverse soil food web—including bacteria, fungi, protozoa, and earthworms—decomposes organic matter, recycles nutrients, builds structure, and suppresses pests.
3. Symbiotic fungi that extend root reach and exchange nutrients for carbon are called mycorrhizae.
4. Earthworms shred organic matter, create biopores, and mix soil, improving aeration and nutrient cycling.
5. Maintaining a balanced C:N ratio (around 24:1) ensures efficient decomposition without tying up nitrogen.
6. The One Health concept links soil, plant, animal, and human health.
7. A aggregate stability test reveals how well soil aggregates hold together when wetted, indicating the presence of microbial glues and organic matter.
8. A simple infiltration experiment compares how quickly water enters soils under different cover treatments.

Self-Test

1. The rhizosphere is the zone around roots where plants release exudates that feed microbes and drive nutrient cycling.
2. The interconnected community of bacteria, fungi, protozoa, nematodes, and earthworms is called the soil food web.
3. Symbiotic fungi that extend plant root systems and trade nutrients for carbon are known as mycorrhizae.
4. Earthworms are soil organisms that shred organic matter, create biopores, and mix soil to improve aeration.
5. A balanced C:N ratio of around 24:1 allows microbes to decompose organic matter efficiently.
6. The One Health concept connects soil health to the health of plants, animals, and people.
7. A slake test shows how well soil aggregates hold together when wetted, reflecting biological activity.
8. An infiltration experiment compares how quickly water enters soils with different covers.

These answers provide guidance for teachers. Encourage students to think critically and develop their own explanations based on class discussions and data.