PLANT DOCTOR 405 • FIELD ASSESSMENT

Module 7 Review: Soil Biology 101

Course Track: Phase 3 — Applied Living Soil & Low-Friction Growing

Evaluation: 10 Diagnostic Inquiries • Rhizosphere Chemistry & Soil Physics

Instructions: Apply Module 7 soil biology, mineral cycling, and soil physical architecture principles to each scenario. Select the single most scientifically and culinarily accurate deduction.

Biological Soil Inquiries (Questions 01–10)

01. Why does a healthy plant allocate 20% to 40% of its photosynthetic carbon sugars into its rhizosphere as root exudates?

A) To purge toxic carbon byproducts from active transpiration.

B) To nourish specific soil bacteria and fungi that solubilize locked rock minerals.

C) To create a waterproof seal that halts excessive moisture uptake.

D) To prevent beneficial protozoa from colonizing the root cap.

02. How do soil bacteria and mycorrhizal fungal hyphae liberate insoluble calcium, phosphorus, and zinc from parent rock particles?

A) By secreting specialized organic acids and solubilizing enzymes.

B) By generating electrical friction that shatters crystalline silicates.

C) By converting solar photons into mechanical grinding energy.

D) By reducing soil moisture to induce thermal mineral fracturing.

03. What role do protozoan and beneficial nematode grazers play in plant-available nutrient delivery?

A) They feed on plant root hairs to trigger defensive auxin spikes.

B) They excrete surplus ionic nitrogen and chelated minerals directly at root tips.

C) They consume organic mulch to create thick anaerobic hardpan layers.

D) They oxidize volatile plant terpenes into atmospheric nitrogen gas.

04. Why does irrigating with synthetic water-soluble NPK salts result in produce with diluted culinary flavor (2°–4° Bx)?

A) High salt concentrations force excessive osmotic water uptake, bloating cell volume.

B) Synthetic salts convert simple fruit sugars into bitter structural lignins.

C) Blue fertilizer crystals coat cuticles and prevent solar photosynthesis.

D) Salt ions chemically evaporate volatile monoterpenes before synthesis.

05. In the physical architecture of living garden soil, what volumetric ratio represents the ideal 50/50 balance?

A) 50% clay platelets and 50% standing gravitational water.

B) 50% solid matter (minerals/organic) and 50% pore space (air and water films).

C) 50% volcanic rock dust and 50% pure uncomposted wood shavings.

D) 80% solid particles, 10% air voids, and 10% anaerobic pockets.

06. Why is power rototilling destructive to long-term soil health and culinary flavor density?

A) It pulverizes natural soil aggregates and fungal hyphae, creating hardpan crusts.

B) It forces worms to multiply too rapidly, depleting organic matter reserves.

C) It permanently sterilizes all agricultural gypsum and basalt minerals.

D) High-speed blades convert soil carbon into liquid alcohol instantly.

07. In an overwatered, compacted bed that undergoes an anaerobic shift, what diagnostic odor is produced by sulfur-reducing microbes?

A) Rich forest geosmin and sweet petrichor.

B) Hydrogen sulfide smelling of rotten eggs and sour decay.

C) Sweet nutty lactones resembling browned butter.

D) Pungent floral terpenes resembling fresh pine needles.

08. In the Mason Jar Sediment Test, what physical particle fraction settles out of suspension after 2 hours?

A) Heavy coarse Sand (which settles at 1 minute).

B) Medium-sized Silt particles.

C) Microscopic flat Clay platelets (which settle at 24–48

D) Dissolved calcium sulfate ions floating on the water

Module 7 Answer Key & Agronomic Explanations

01 • B **The Rhizosphere Carbon Economy**
Plants invest up to 40% of their photosynthetic carbon sugars as root exudates solely to cultivate, feed, and recruit specialized populations of soil bacteria and fungi within the rhizosphere, which trade locked rock minerals for liquid carbohydrates.

02 • A **Enzymatic Mineral Solubilization**
Trace minerals (calcium, phosphorus, sulfur, zinc) are bound within crystalline mineral lattices unavailable to root hairs. Soil microbes excrete specialized organic acids and enzymes that dissolve these bonds, delivering chelated ionic nutrition on demand.

03 • B **Predator-Prey Nutrient Cycling**
Protozoa and beneficial nematodes graze heavily on bacteria and fungi. Because grazers require far less nitrogen and minerals than their prey contain, their excretions release chelated, plant-ready nutrients directly onto the root hairs precisely when needed.

04 • A **Osmotic Salt Trapping & Cellular Bloating**
Synthetic fertilizers are mineral salts. Dumping them into the root zone creates high osmotic gradients, forcing the plant to drink vast quantities of water to balance internal pressures. Cells swell with water, diluting Brix down to a bland, watery 2°–4° Bx.

05 • B **Soil Pore Space Architecture**
Ideal living soil requires 50% solid matter (45% mineral fractions and 5% organic matter) and 50% void space. The void space is balanced evenly between macro-pores (for atmospheric oxygen diffusion and drainage) and micro-pores (holding capillary water films).

06 • A **Aggregate Pulverization & Compaction**
Mechanical rototilling shatters the delicate fungal hyphae and natural biological glues (glomalin) that bind soil into aggregates. The pulverized particles collapse under rain or irrigation into an impermeable, airless hardpan crust that suffocates roots.

07 • B **Anaerobic Fermentation & Gas Byproducts**
Depriving soil of oxygen eliminates aerobic biology, allowing anaerobic bacteria to dominate. These organisms produce phytotoxic alcohol, volatile organic acids, and hydrogen sulfide (smelling of rotten eggs), which burn root meristems and lock out trace minerals.

08 • B **Sedimentation Dynamics in the Jar Test**
Due to particle mass and surface drag, heavy coarse sand settles out in the first 60 seconds. Medium silt settles at 2 hours. Microscopic, flat clay platelets stay suspended in the surfactant slurry, precipitating between 24 and 48 hours.

09 • A **Stratigraphic Horizon Preservation**
A broadfork fractures compacted hardpans vertically without turning or inverting the soil profile. This preserves natural ecological stratification, keeping aerobic decomposers in top layers and subterranean fungal networks undisturbed.

10 • A **Carbon Armor Protection**
Exposed bare soil subjected to direct solar radiation bakes surface microbes, evaporates capillary moisture, and forms hard mineral crusts. A 2–3 inch carbon mulch armor stabilizes root-zone temperatures, retains moisture, and continuously feeds decomposer fungi.

MODULE 7 MASTERY TAKEAWAY
Real culinary flavor is built underground through biological partnership. When you abandon synthetic chemical salts, protect soil pore architecture, and cultivate active microbial and fungal networks, the soil feeds the plant on its own terms—yielding produce packed with mineral density and genuine terroir.