

EPSc 413 SP17 Homework #6 ANSWER KEY

1. Nitrogen in soils

N_2 is fixed as organic N (R-NH₂). This is first mineralized to NH₄⁺, which can occur in either the aerobic or anaerobic layer. If this NH₄⁺ migrates to the aerobic layer, such as through diffusion, it can be microbially oxidized to NO₃⁻ through a process of nitrification. A key intermediary in this process is NO₂⁻. If this NO₃⁻ then migrates back to the anaerobic layer it can be converted to N₂ gas through microbial denitrification. NO₂⁻, NO(g), and N₂O(g) are key intermediaries. During these processes, NH₄⁺ and especially NO₃⁻ can be lost from the system through leaching. During the denitrification step, nitrogen can be lost through volatilization of NO(g) and N₂O(g).

2. Soil phosphorus

a. Under acidic conditions phosphorus is fixed through adsorption to iron and aluminum oxide minerals. This phosphorus may eventually convert into distinct iron and aluminum phosphate solids.

b. Under alkaline conditions phosphate is fixed through the precipitation of calcium phosphate minerals. The initial solid formed recrystallizes over time through a series of minerals that are progressively less soluble.

3. Soil micronutrients

Micronutrients are toxic at high concentrations. Adding a large amount at once could move a soil from the deficiency range to the toxicity range. Adding smaller amount each year would be safer.

4. Soil contaminants

Both inorganic and organic contaminants may come from human sources, but there are many natural sources of inorganic contaminants in soil as well. Both contaminant types may adsorb to minerals and organic matter, be lost from soil by leaching or in runoff, or taken up by plants. However, organic contaminants can also be degraded by chemical processes, light, or organisms, breaking them down into non-toxic simple compounds like CO₂ and H₂O. While inorganic contaminants can be transformed into less-toxic forms, they are fundamentally elemental in nature and cannot be broken down. Generally only organic contaminants can be volatilized.

5. Soil erosion

Sheet erosion removes a uniform layer of soil. It involves water flow across the soil surface. Isolated areas protected from rain may not erode. Rill erosion occurs when water flows across the soil surface in small channels. It requires a slope to form. Sheet and rill erosion cause most of the water-derived soil loss. Gully erosion occurs when rills coalesce into larger channels, causing localized areas of deep erosion. Gully erosion typically cuts through the entire A

horizon and exposes the subsoil. The channels produced are deep and cannot be removed by simple plowing. Gullies can propagate and become exceptionally deep. Gully erosion is destructive and catastrophic.