Learning Outcomes

Chapter-wide learning goals

1. Explain why decomposition is an essential process in nutrient cycles and ecosystem energetics.
2. Compare and contrast how a site's physical environmental conditions, litter quality, and decomposer organisms, the three axes of the affect decomposition rates.
3. Determine what is limiting the decomposition rate of a particular litter sample.
4. Contrast the role of decomposition and primary production in the carbon cycle and show how changes in these rates can affect (and be affected by) Earth's climate.

Section 1: Decomposition Rates

1. Explain why decomposition is important for ecosystem function.
2. Measure leaf-litter decomposition rates using the litterbag method.
3. Calculate the decomposition rate, k, from the initial and final mass of a sample incubated for time, t.
4. Explain why ecologists use an exponential decay function to model decomposition, and explain how the decomposition rate, k, can be used to compare decomposition in different ecosystems.
5. Describe how forensic scientists use changes in the concentration of ammonia in a corpse's vitreous humor to estimate time of death.

Section 2: The Physical Environment

1. Describe how climate (specifically average annual temperature and precipitation) affects decomposition rates.
2. Explain how standardized ecological measurements made by groups like the LTER network and the LIDET team have improved our understanding of the factors driving variation in decomposition rates across ecosystems.
3. Show how regression analysis can be used to compare the effect of different environmental variables on the decomposition rates of various species.
4. Explain why composite climate indices like actual evapotranspiration and the climate decomposition index (CDI) often explain more of the variation in decomposition rates than temperature or precipitation alone.
5. Contrast decomposition in aerobic and anaerobic environments.
6. Contrast decomposition of plant litter in aquatic and terrestrial environments.

Section 3: Litter Quality

1. Evaluate how and why litter quality can contribute to different decomposition rates for different litter species.
2. Describe recalcitrant chemicals (e.g., lignin, phenolics, tannins) and explain how and why their presence in leaf litter affects decomposition rate.
3. Summarize why the nutrient content of detritus affects its decomposition rate.

4. Provide an example of how changes in litter composition can affect decomposition rates and nutrient cycling.

Section 4: Decomposer Organisms

1. Summarize the two key reasons that decomposers break down detritus: to gain energy and acquire nutrients.
2. Explain decomposer food preferences in terms of litter quality and palatability.
3. Describe what drives the progression of decomposers as a sample of detritus decomposes.
4. Explain why the decomposition of plant matter is often biphasic, with a period of rapid mass loss preceding a period of slow decay.
5. Design a cafeteria experiment that can be used to determine decomposer diet preference.
6. Outline how different decomposer classification schemes (i.e., by size, location, or diet) can highlight different aspects of decomposer functional roles in an ecosystem.
7. Determine the stage of decay of a cadaver using the predictable sequence that occurs as decomposers colonize a corpse.
8. Contrast the relative importance of the detrital and grazer food chains.
9. Provide examples of how decomposer organisms help maintain an ecosystem's ability to provide ecosystem services.

Section 5: Fossil Fuels, Peat, and Climate Change

1. Describe how climate change may cause some peat bogs to switch from being long-term carbon sinks to carbon sources.
2. Use a simulation to analyze how changes in precipitation and temperature may affect the accumulation of peat by altering rates of decomposition and net primary production.
3. Describe how peat is formed.