Chapter-wide learning goals

1. Compare and contrast how temperature, moisture, and litter quality affect decomposition rates.
2. Design experiments that can determine the relative importance of different factors that drive decomposition rates.
3. Summarize how large-scale data sets like those from the LTER network can be used to explain systematic variation in decomposition rates.

Section 1: Decomposition: A Key to Life

1. Explain why decomposition is important for ecosystem function.

Section 2: Decomposition Rates

1. Determine what is limiting the decomposition rate of a particular litter sample.
2. Measure leaf-litter decomposition rates using the litterbag method.
3. Calculate the decomposition constant, k, from the initial and final mass of a sample incubated for time, t.
4. State the exponential decay model of decomposition, its terms, and its assumptions.
5. Contrast decomposition of plant litter in aquatic and terrestrial environments.
6. Explain how climate affects decomposition rates.
7. Explain to a lay audience how the standardized ecological measurements made across the LTER network have improved our understanding of the factors controlling decomposition rates.
8. Show how regression analysis can be used to compare the effect of different environmental variables on the decomposition rates of various species.
9. Explain why composite climate indices like actual evapotranspiration, potential evapotranspiration, and various climate decomposition indices often explain more of the variation in decomposition rates than temperature or precipitation alone.

Section 3: The Chemistry of Decomposition

1. Summarize how climate, litter quality, and decomposer organisms—the three axes of the "Decomposer Triangle"—interact to determine decomposition rates.
2. Explain why decomposition proceeds more quickly in aerobic environments.
3. Describe the key steps in anaerobic decomposition, including hydrolysis, fermentation, and methanogenesis.
4. Explain how and why litter quality can contribute to different decomposition rates for different litter species.
5. Explain how secondary compounds, including lignin, cellulose, and tannins, affect decomposition rates.
6. Explain why the nutrient content of detritus, as indicated by its C:N ratio, for example, affects its decomposition rate.
7. Provide an example of how changes in litter composition can affect decomposition rates and nutrient cycling.
8. Explain why organic matter with a low C:N ratio decomposes more rapidly.
9. Describe how forensic scientists use information about decomposition processes to estimate time of death.
10. Estimate time of death using data on chemical changes in bodies after death.
11. Summarize the principal reasons why decomposers break down detritus.
12. Explain the stoichiometric equation that relates photosynthesis and respiration, including when energy is stored and when it is released.
13. Describe the likely fate of NPP in terrestrial and aquatic ecosystems.

Section 4: Decomposer Organisms

1. Explain what drives successional sequences of decomposers as a given piece of detritus is decomposed.
2. Explain why the decomposition of plant matter is often biphasic, with a period of rapid mass loss preceding a period of slow decay.
3. Explain why the food quality of some piece of organic matter is not the same for all decomposer species.
4. Describe the successional pattern that is typically observed as decomposers break down the detritus on the forest floor at Coweeta.
5. Provide examples of the types of decomposers belonging to each of three size classes—microorganisms, mesoorganisms, and macroorganisms.
6. Provide examples of the types of decomposers typically found in each of three physical strata of the soil—epidaphic, eudaphic, and hemiedaphic.
7. Contrast the decomposers found in freshwater streams with those found on the forest floor.
8. Provide examples of the types of decomposers feeding on each of three food sources—fresh, coarse litter, fine fragmented litter, and humus.
9. Explain the importance of the interactions between arthropods and microbes (i.e., fungi and bacteria).
10. Explain how the predictable successional sequence that occurs as decomposers colonize a corpse can be used to estimate when a person died.

Section 5: Fossil Fuels, Peat, and Climate Change

1. Summarize the various factors that interact to determine how warming temperatures change carbon emissions from decaying materials, especially in peat bogs.
2. Describe how peat is formed.
3. Explain how peat decomposition is affected by temperature.
4. Explain how peat accumulation is affected by changes in NPP.