Nutrient Cycling vs. Energy Flow

*Why do materials (nutrients) cycle within ecosystems while energy flows through ecosystems?*

All energy transformations *degrade energy* (i.e., they are irreversible) while material transformations, given available energy, are reversible.

**Cycle rate and residence times**

Cycling rates refer to the rate at which nutrients cycle from one of the pools (say the biotic pool) back to that pool. Residence times refer to the time spent in a particular pool, once you get there. Thus shorter residence times will generally correspond to faster cycling rates as well.

*What pools will have long residence times?*

*How will cycling rates change in different ecosystems or for different elements?*

*How are the C N and P cycles tied together?*

*“Ecological Stoichiometry”*

Stoichiometry: balance of chemical elements in reactions and transformations (elemental accounting)

Organisms have characteristic biological stoichiometries depending on their composition

Classical Example: The Redfield ratio: the atomic ratio of C:N:P in both marine phytoplankton and ocean water is ~ 106:16:1.
Building a biological – ecological stoichiometry

1. Consider the elemental balance (stoichiometry) of different components of the biota
   Macromolecules, organelles, organs

2. In terms of energy flow and nutrient cycling, how does the balance of nutrients change
   across trophic levels
   is this the same in aquatic and terrestrial systems?

   *What are the bases for the observed differences?*

3. How do shifts in elemental composition affect material cycling
   Cebrian 1999 (Am Naturalist) – Patterns in the Fate of Primary Production