

Measures of Production

GPP: Gross Primary Production

(energy converted to chemical energy of organic compounds in a given amount of time)

NPP: Net Primary Production

(includes only GPP not used for respiration in the producers)

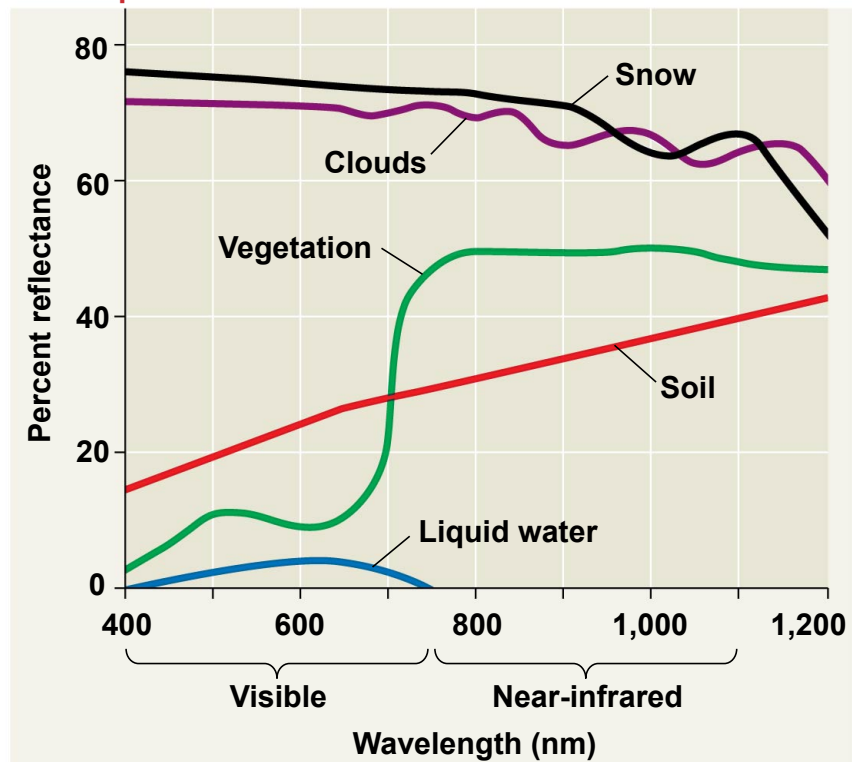
$$NPP = GPP - R_a$$

NEP: Net Ecosystem Production

(total accumulation of biomass)

$$NEP = GPP - R_T$$

Technique



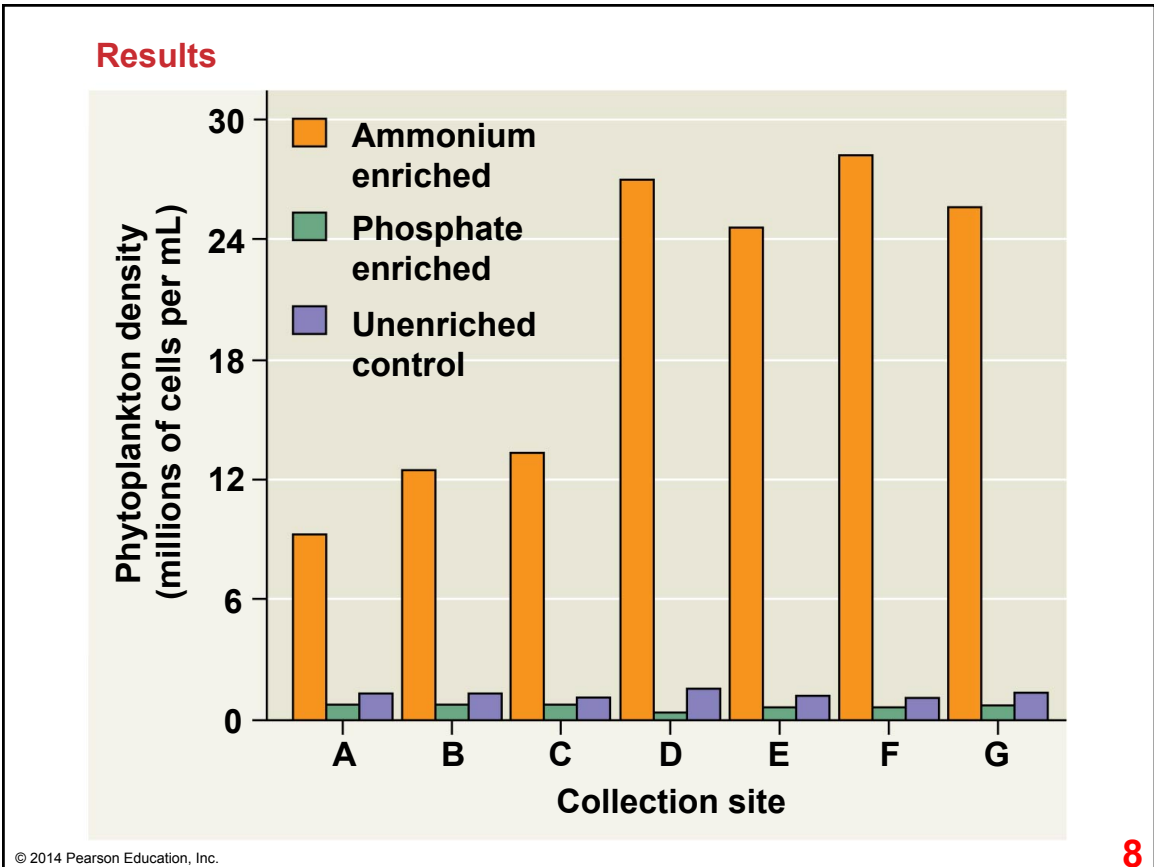
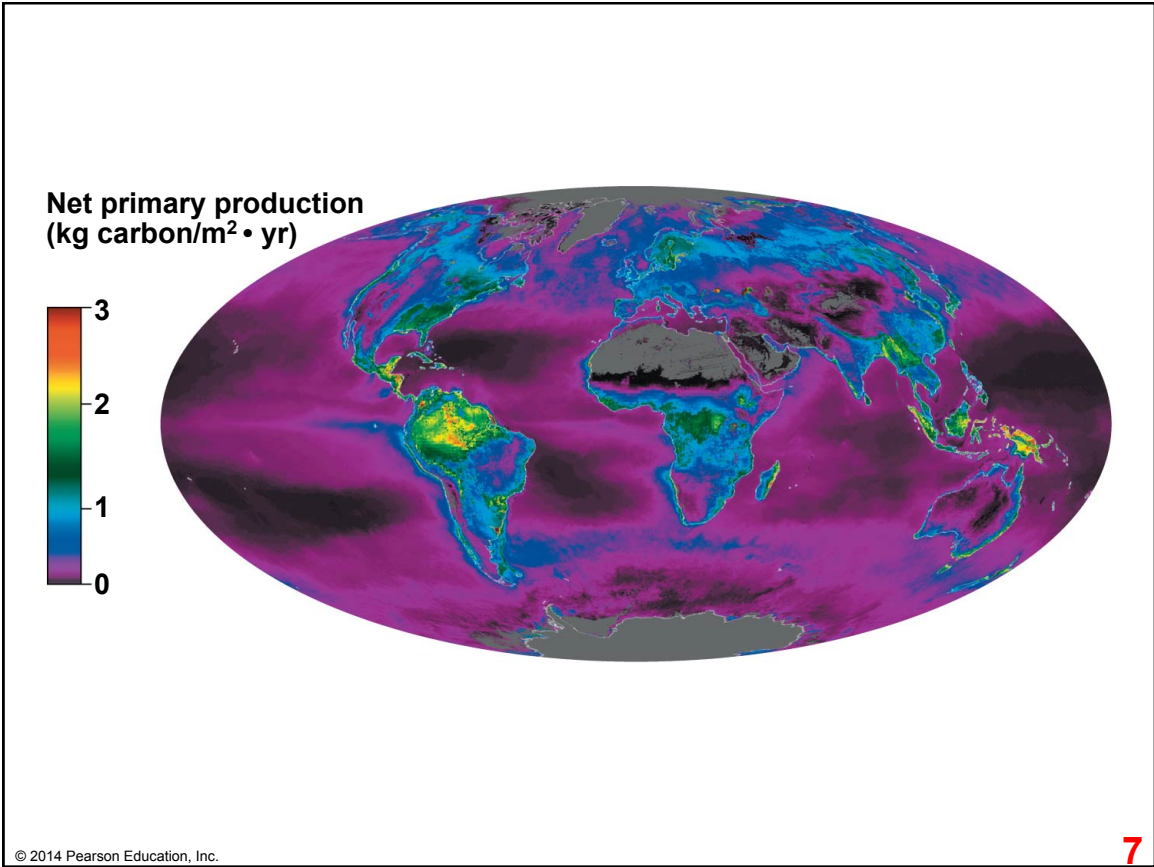
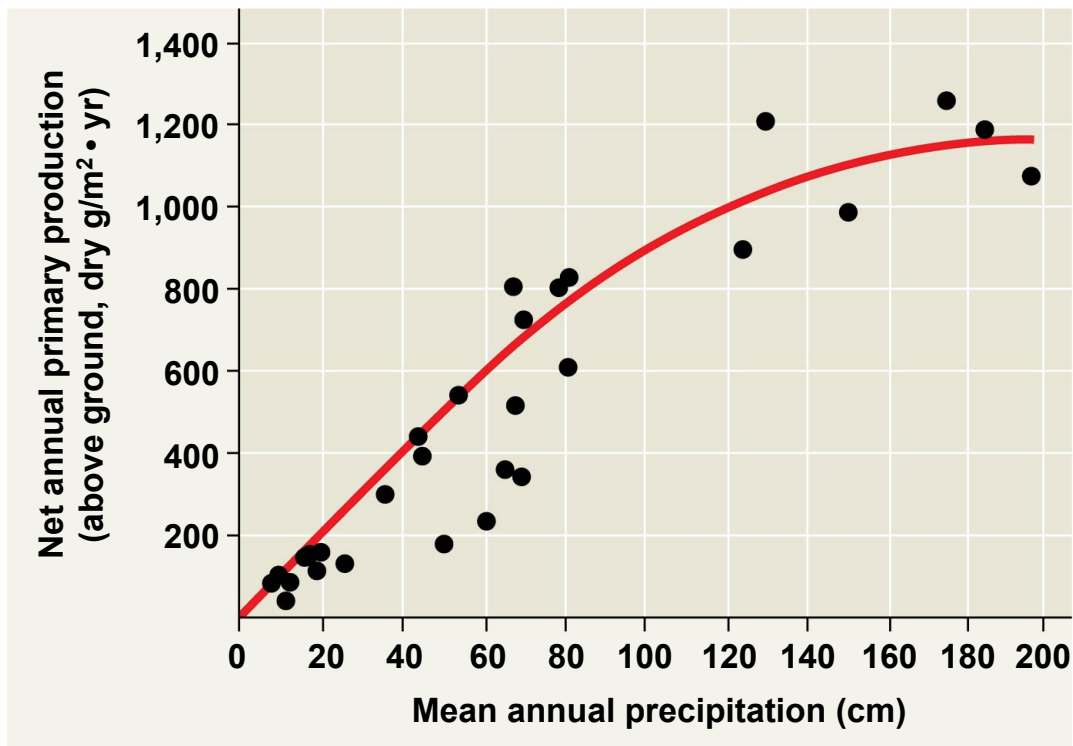


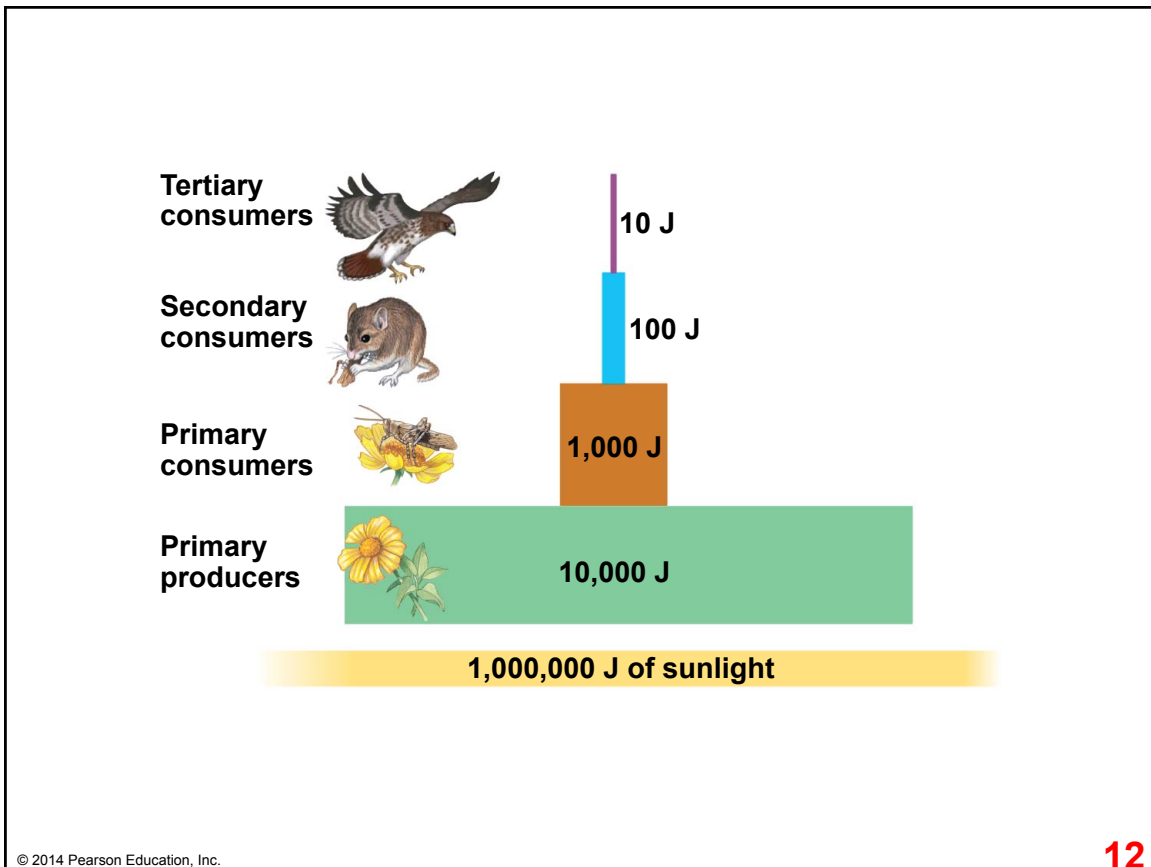
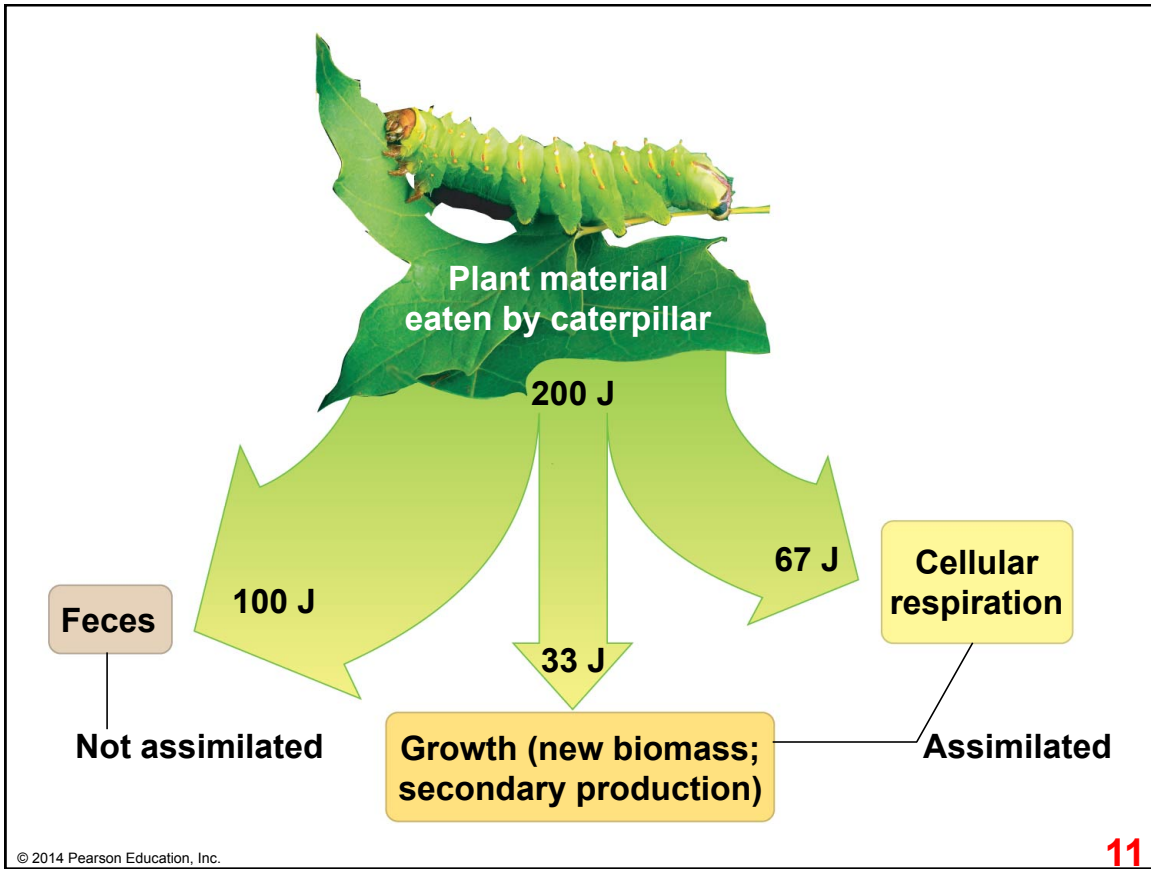
Table 42.1 Nutrient Enrichment Experiment for Sargasso Sea Samples

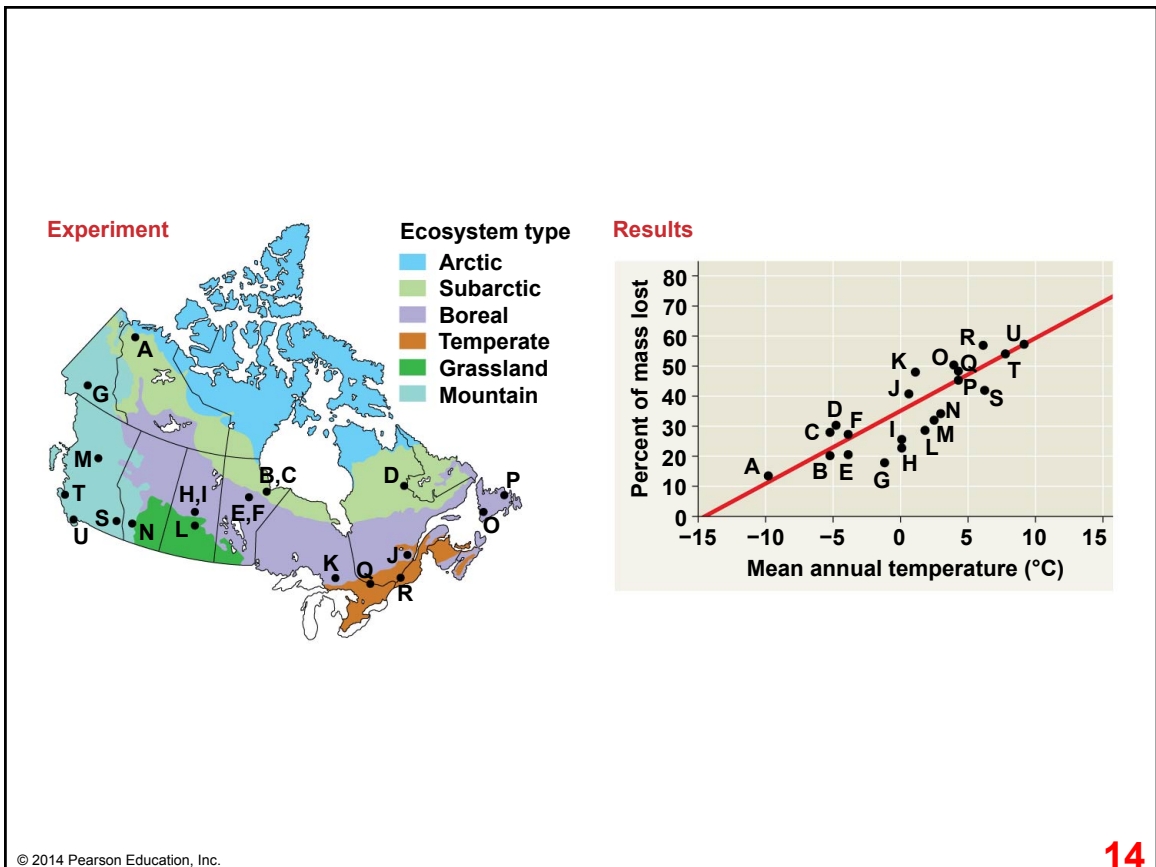
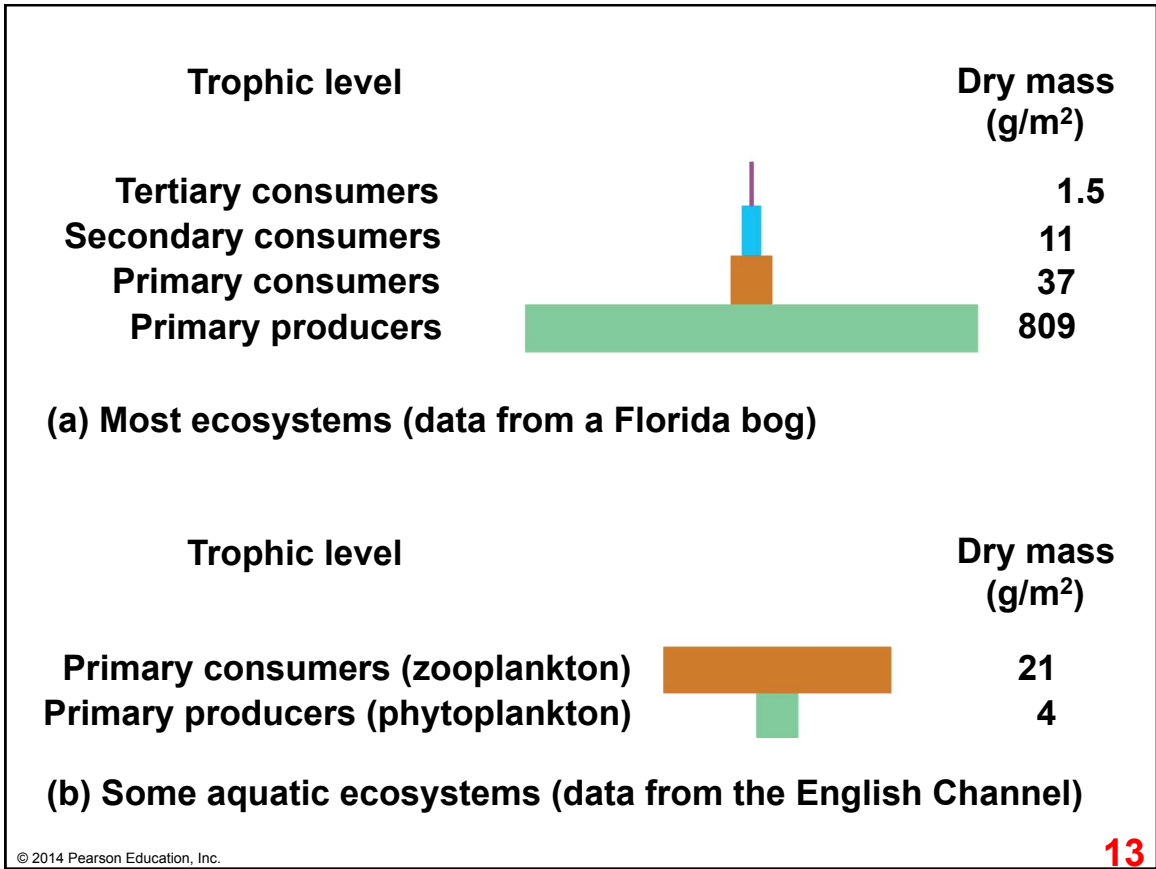
Nutrients Added to Experimental Culture	Relative Uptake of ^{14}C by Cultures*
None (controls)	1.00
Nitrogen (N) + phosphorus (P) only	1.10
N + P + metals (excluding iron)	1.08
N + P + metals (including iron)	12.90
N + P + iron	12.00

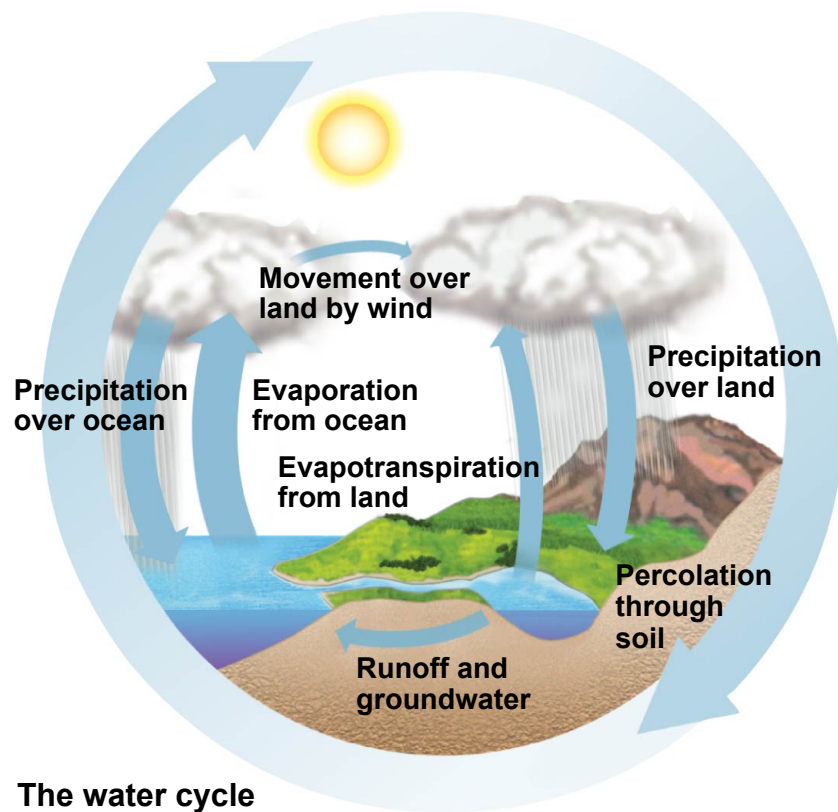
* ^{14}C uptake by cultures measures primary production.

Source D. W. Menzel and J. H. Ryther, Nutrients limiting the production of phytoplankton in the Sargasso Sea, with special reference to iron, *Deep Sea Research* 7:276–281 (1961).

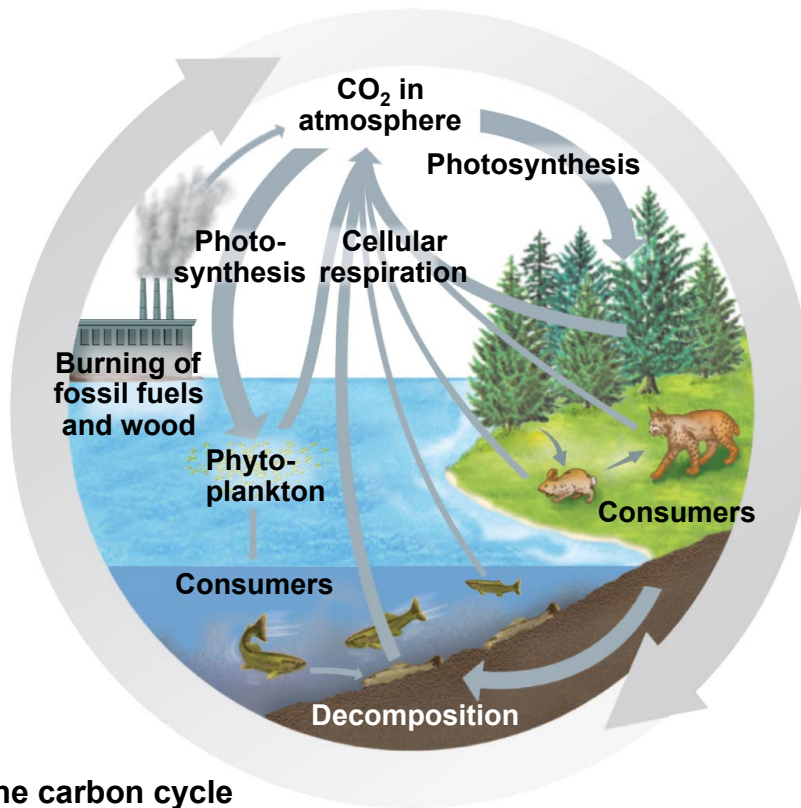




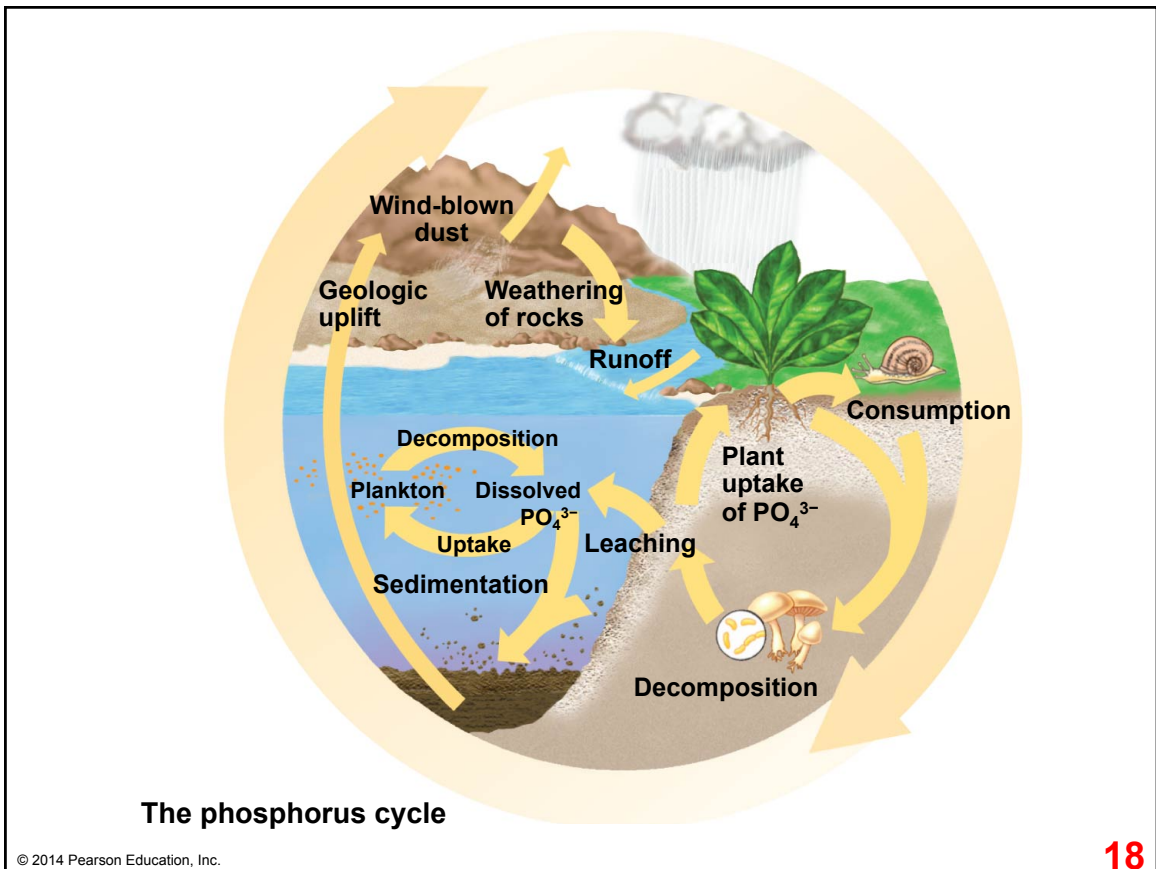
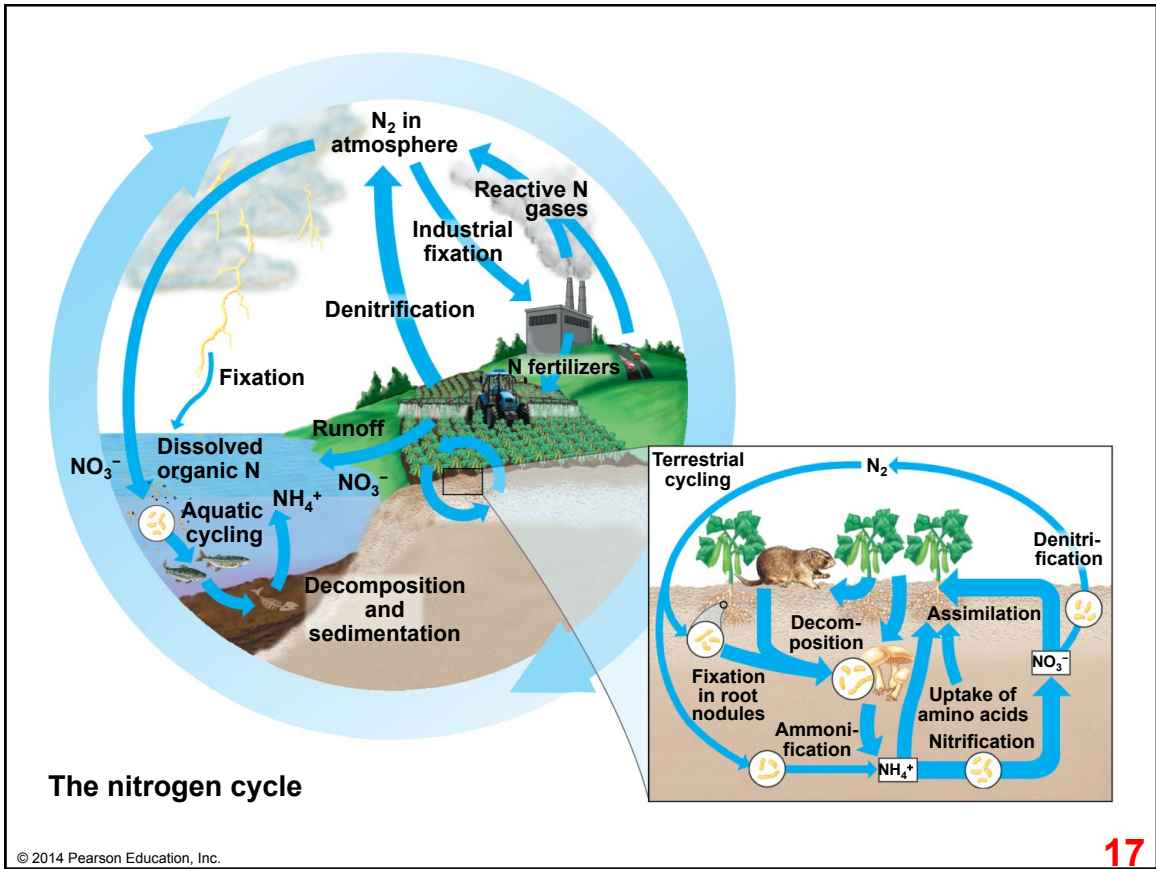




The water cycle



The carbon cycle

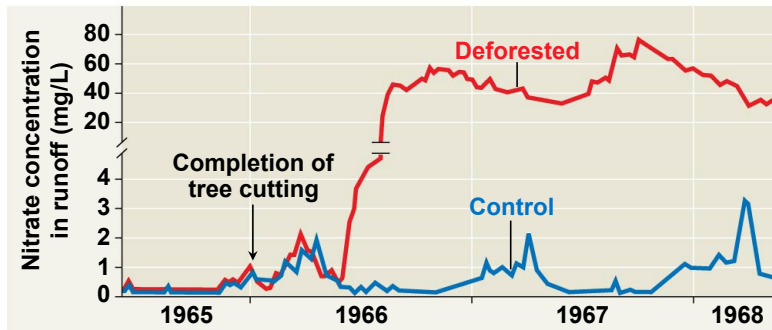




(a) Concrete dam and weir



(b) Clear-cut watershed



(c) Nitrate in runoff from watersheds



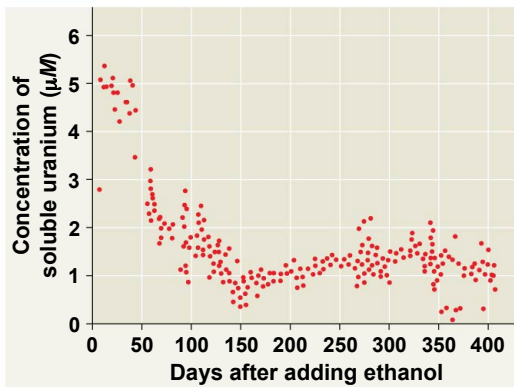
(a) In 1991, before restoration



(b) In 2000, near the completion of restoration



(a) Wastes containing uranium, Oak Ridge National Laboratory



(b) Decrease in concentration of soluble uranium in groundwater