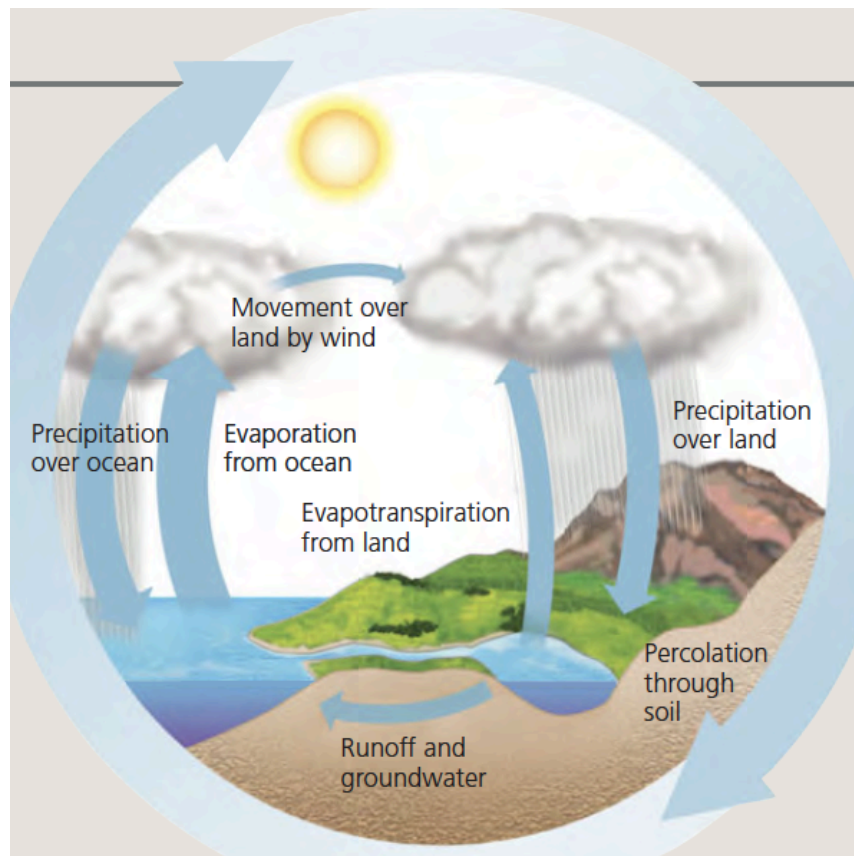
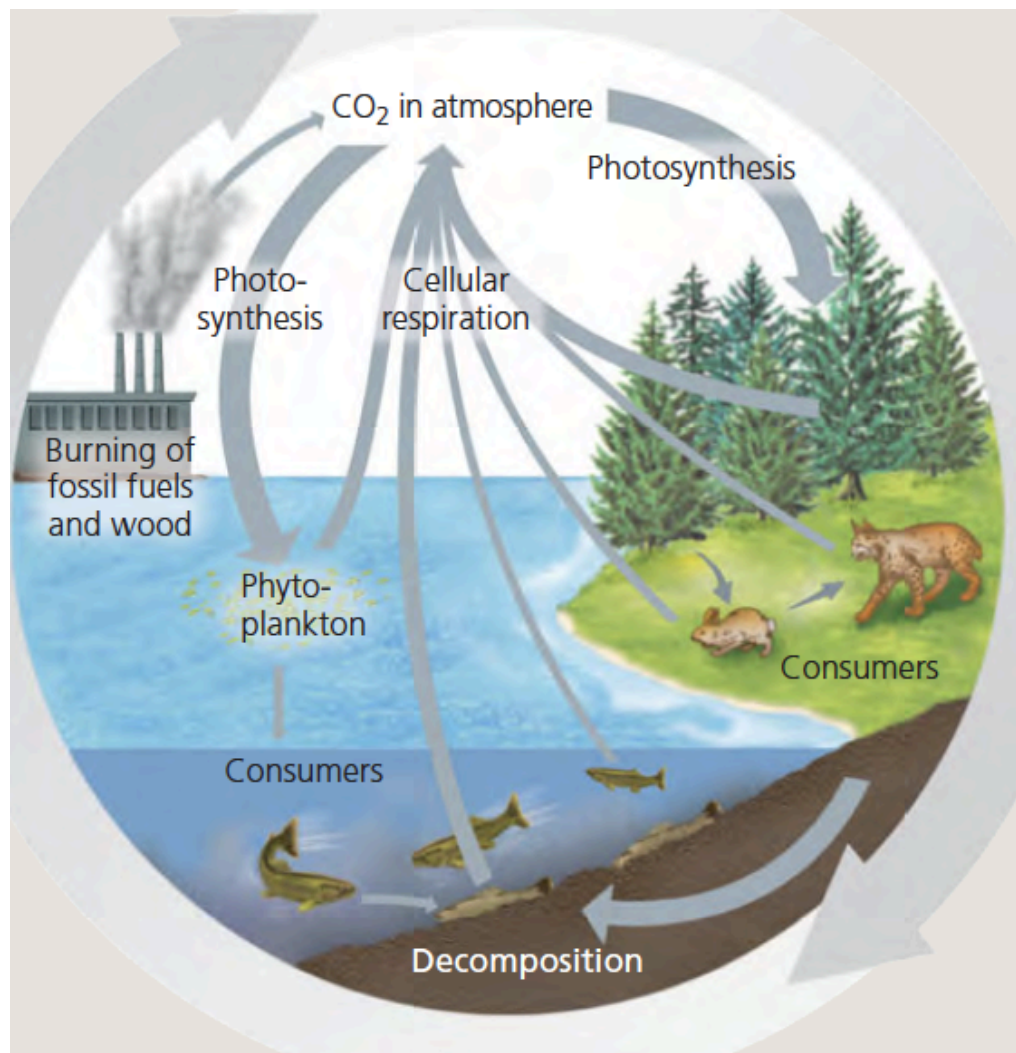
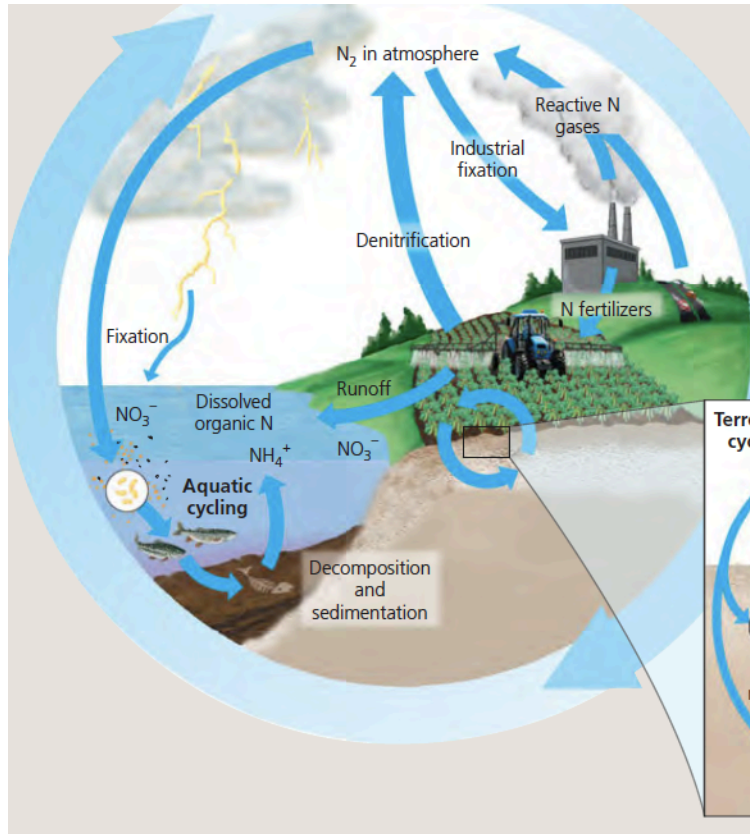


## Cheat Sheet

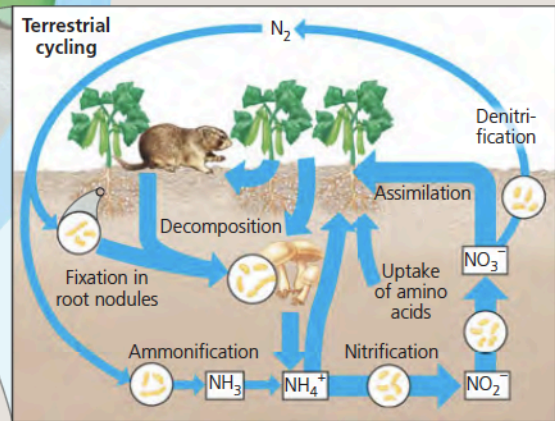


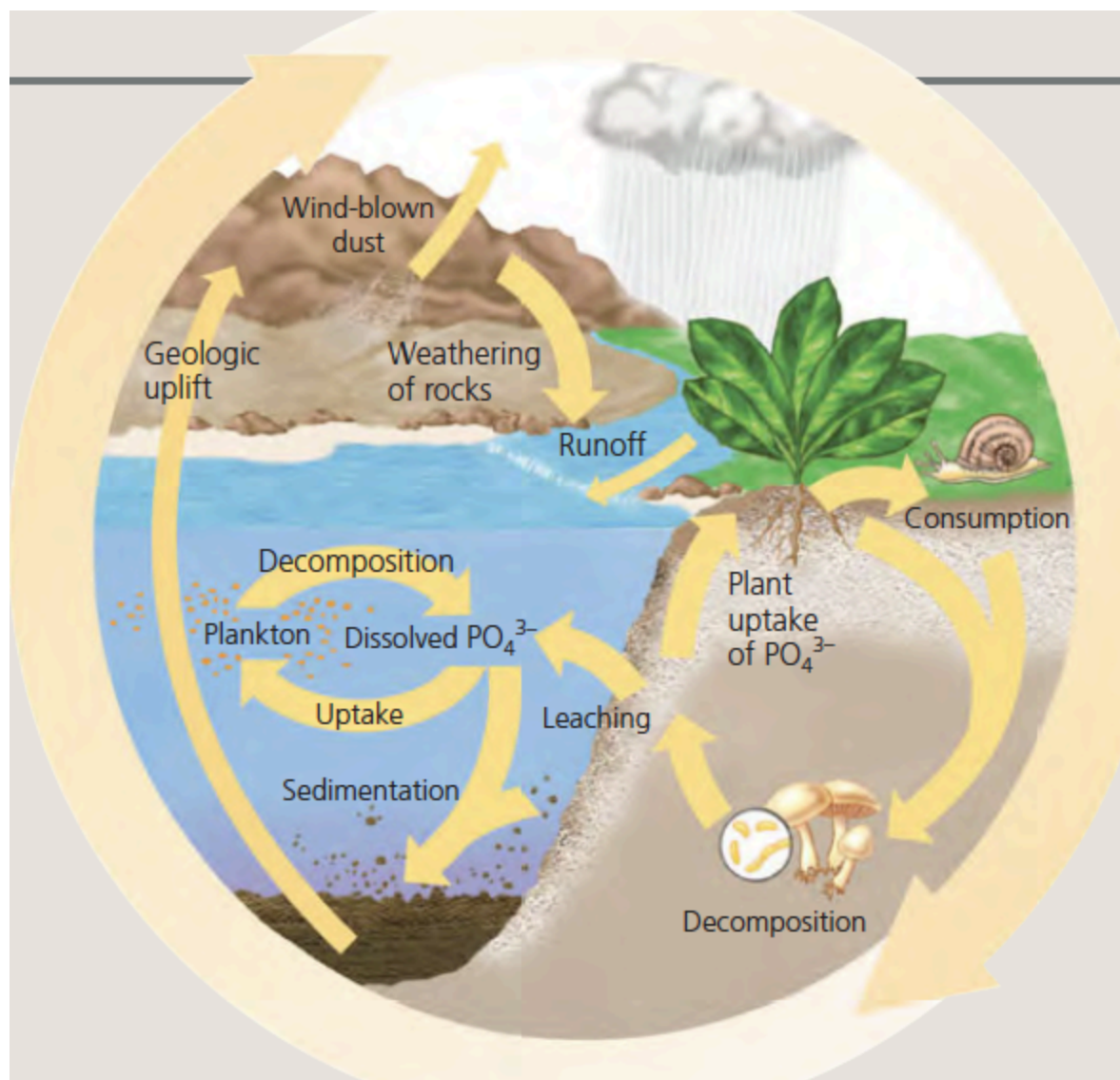




**Reservoirs** The main reservoir of nitrogen is in the atmosphere, which is 80% free nitrogen gas ( $N_2$ ). The other reservoirs are inorganic and organic nitrogen compounds in lakes, rivers, and oceans; surface water; and the biomass of living organisms.

**Key processes** The major pathway for nitrogen in an ecosystem is via *nitrogen fixation*, the conversion of atmospheric  $N_2$  into a form that can be used to synthesize organic compounds. Certain bacteria, as well as lightning, and human activities (e.g., N fertilizers) contribute to nitrogen inputs on land. Two major contributors to nitrogen inputs on land are produced fertilizers and legume crops that fix nitrogen.





## Chapter 55 Questions

1. What is an ecosystem?
2. What are primary producers?
3. What are primary, secondary, and tertiary consumers?
4. What are detritivores?
5. What is detritus?
6. What is primary production?
7. Describe the energy of that the sun radiates on the earth.
8. What is gross primary production (GPP)?
9. What is net primary production (NPP)?
10. What is net ecosystem production (NEP)?
11. Describe the penetration of light in an aquatic ecosystem?
12. How does latitude affect NPP?
13. What is a limiting nutrient?
14. What are areas of upwelling?
15. What is eutrophication?
16. How do precipitation, temperature, and solar radiation affect NPP?
17. What are the most common limiting nutrients in terrestrial ecosystems?
18. What are phosphatases?
19. What are chelating agents?
20. What is a carbon sink?
21. What is a carbon source?
22. What fraction of plant material do herbivores eat?
23. What is net secondary production?
24. What is assimilation of primary production?
25. What is production efficiency?
26. Why do birds and mammals have low efficiencies (compare to other animals)?
27. What is trophic efficiency?
28. What is an energy pyramid?
29. What is a biomass pyramid?
30. Why is it more energy efficient to eat soybean for protein than meat?
31. How does decomposition differ in tropical and temperate forests?
32. What conditions slow decomposition?
33. How long does decomposition take in anaerobic muds of aquatic ecosystems?
34. What are biogeochemical cycles?
35. What elements cycle locally, what elements cycle globally in terrestrial ecosystems?
36. In what forms is water available to life?
37. Where is the biosphere's water located?
38. Describe the flows of the water cycle and their relative contributions.
39. What is the largest reservoir of carbon?

40. Describe the flows of the carbon cycle and their relative contributions.
41. What forms of nitrogen are available for life?
42. What is the main reservoir of nitrogen?
43. What are nitrogen fixation, nitrification, and denitrification?
44. Describe the flows of the nitrogen cycle and their relative contributions.
45. What is the most important form of phosphorus?
46. What are the largest phosphorus reservoirs?
47. Why is phosphorus cycling localized?
48. Describe the flows of the phosphorus cycle and their relative contributions.
49. What is bioremediation?
50. What is *Shewanella oneidensis*?
51. What is biological augmentation?
52. What are lupines?

## Chapter 55 Answers

1. Sum of all organisms in a given area and the abiotic factors with which they interact
2. Autotrophs that support all other trophic levels
3. Herbivores, carnivores that eat herbivores, and carnivores that eat carnivores
4. Decomposers, used synonymously to refer to consumers that get energy from detritus
5. Nonliving organic material
6. Amount of light energy/chemical energy converted to chemical energy (in organic compounds) by autotrophs in given time period
7.  $10^{22}$  J, 50% absorbed, scattered, or reflected by clouds/dust in atmosphere, 1% of visible light that strikes photosynthetic organisms is converted to chemical energy
8. Total primary production in an ecosystem
9. GPP minus energy used by primary producers for their cellular respiration ( $R_A$ ), NPP usually =  $1/2$ GPP. Expressed as energy per unit area per unit time ( $J/(m^2 \cdot yr)$ ) or as biomass added per unit area per unit time ( $g/(m^2 \cdot yr)$ ).
10. Measure of total biomass accumulation, defined as gross primary production minus total respiration of all organisms in the system ( $R_T$ )
11. Half of radiation absorbed in first 15 m, in clear water only 5-10% reaches 75 m
12. No gradient is present
13. Element that must be added for production to increase, most often nitrogen and phosphorus in marine ecosystem, phosphorus in lakes
14. Deep, nutrient rich waters circulate to ocean surface, high primary production, largest occur in Antarctic Ocean (Southern Ocean), equator, coastal waters off Peru, parts of Western Africa
15. When primary producers get a lot of nutrients, produce a lot and die and detritivores decompose them, deplete water of oxygen
16. NPP increases with all three
17. Nitrogen and phosphorus, nitrogen limits plant growth the most. Phosphorus limitations common in older soils where phosphate leached by water.
18. Enzymes that increase availability of phosphorus by cleaving phosphate group from larger molecules
19. Molecules that make micronutrients more soluble in the soil
20. Ecosystem with  $NEP > 0$ , stores carbon.
21.  $NEP < 0$
22.  $\frac{1}{2}$  of total plant production globally
23. Energy stored in biomass represented by growth/reproduction
24. Total amount of energy organism has consumed and used
25. Percentage of energy stored in assimilated food that is used for growth/reproduction, not respiration (net secondary production \* 100%)/ assimilation of primary production.
26. 1-3%, must maintain body temperature, fish are ectothermic so have 10% efficiency, insects/microorganisms 40% or more

27. Percentage of production passed from one trophic level to next, must be less than production efficiencies. Avg. 10%.
28. Net productions of different trophic levels are arranged in tiers, width of tier proportional to net production in joules
29. Each tier represents total dry mass of organisms in one trophic levels, narrow sharply from producers to carnivores. Some aquatic ecosystems are inverted since producers (phytoplankton) grow, reproduce, and are consumed so quickly by zooplankton
30. 1 lb of soybean only produces  $\frac{1}{10}$  a pound of beef
31. Tropical rain forest decomposes in few months to few years, 75% nutrients in trunks of trees, 10% in soil. temperate from 4-6 yrs, 50% of organic material in soil
32. Cold and wet means slow decomposition
33. 50 yrs or longer
34. Involve both biotic and abiotic components
35. Phosphorus, potassium, calcium; Carbon, oxygen, sulfur, nitrogen
36. Primarily liquid, some organisms can harvest water vapor
37. 97% in oceans, 2% in glaciers/polar ice caps, 1% in lakes, rivers, and ground water, negligible amount in atmosphere
38. See picture
39. Sedimentary rocks like limestone
40. see picture
41. For plants, ammonium  $\text{NH}_4^+$  and nitrate  $\text{NO}_3^-$  and organic forms. Bacteria, same + nitrite ( $\text{NO}_2^-$ ). Animals only organic forms.
42. Atmosphere, 80% free nitrogen gas ( $\text{N}_2$ )
43. Conversion of  $\text{N}_2$  to forms that can be used to synthesize organic nitrogen compounds  
Conversion of ammonium to nitrate  
Conversion of nitrate to nitrogen gas  
Carried out by bacteria
44. see picture
45. Phosphate  $\text{PO}_4^{3-}$ , absorbed by plants and used to synthesize organic compounds
46. Sedimentary rocks of marine origin (also a lot in soil, oceans, and organisms)
47. soil particles bind phosphate
48. Using organisms to detoxify polluted ecosystems
49. Bacterium that can metabolize a dozen or more elements, converts soluble forms of uranium/chromium/nitrogen to insoluble forms
50. Using organisms to add essential materials to degraded ecosystem
51. Alpine, nitrogen fixing plants.