Ecosystems: Components, Energy Flow, and Biogeochemical Cycles: Chapter 4

1. Identify the five major " levels of organization of matter" which the field of ecology focuses on:
2. How many species exist on earth?
3. Of the 1.8 million or so named species, approximately ____% of these are in this taxonomic class.
4. Describe or characterize each of the following: (a) Lithosphere (b) hydrosphere (c) Atmosphere(Troposphere, Stratosphere,…) (d) Ecosphere/Biosphere
5. Distinguish between the following: Population, Community, Ecosystem:
6. What is the "goal of ecology"?
7. Distinguish between open and closed systems:
8. Identify four biogeochemical cycles:
9. Why is it necessary that biogeochemical cycles exist? Explain:
10. Describe what abiotic ecosystem components are; include three examples:
11. Identify two physical factors and two chemical factors that generally markedly influence ecosystem health/function.
12. Briefly describe the events which take place in/on Earth's Sun to release large amounts of energy.
13. About 34% of the solar energy reaching the troposphere is reflected; (a) how is this "reflection" generally accomplished? (b)What natural dynamic changes/events might increase the albedo(reflectivity)? (c)What anthropogenic(human-caused) events or changes might increase albedo? (d) What anthropogenic changes or events might decrease albedo? Define biome: include the two major factors which determine biome type.
14. Define aquatic life zone(ALZ): include the major factors which determine ALZ type:
15. Describe the unique characteristics of an Ecotone, providing two examples:
16. How does the optimum range relate to the range of tolerance?(for a given species and a specific abiotic factor, such as a Golden trout and water temperature.)
17. Describe the Law of Tolerance:
18. What does the Limiting Factor Principle state?
19. Describe how limiting factors differ in terrestrial vs. aquatic ecosystems?
20. Write the chemical equation for photosynthesis:
21. Write the chemical equation for cellular respiration:
22. Compare and contrast terrestrial producers and aquatic producers:
23. What other category of producers exists besides the photosynthetic producers?
24. Identify two locations/environments where you might find such non-photosynthetic producers.
25. Identify and distinguish between seven types of consumers.
26. Contrast detritus feeders and decomposers:
27. Which consumer type feeds at every trophic level; Briefly explain:
28. Define the following types of Biodiversity: (a) Genetic (b) Species & (c) Ecological
29. Identify two instrumental values and two intrinsic values of biodiversity:
30. What is the fundamental difference between food chains and food webs?
31. In food chains and food webs, what specifically is indicated by the arrows?
32. Identify the three basic types of Ecological Pyramids:
33. Which of these three can never appear as an inverted pyramid? (in other words: Which of the three must always appear as a "classic" pyramid with a wide base.)
34. Name the two types of ecological pyramids which may appear inverted; explain:
35. Approximately what percent of the kilocalories found in the "preceeding" or lower trophic level actually become incorporated into the tissues of organisms in the trophic level directly above it?
36. From #35 above, what happens to the remainder of the kilocalories (those which do not make it into the biomass of the consumer organisms feeding on the trophic level below them.)

37. If there are 1,000,000 kilocalories in the producer level of an energy pyramid, how kilocalories will be incorporated into the bodies of the: (a) Primary Consumers? (b) Secondary Consumers? (c) Tertiary Consumers?
38. Define Gross Primary Productivity(GPP):
39. Define Net Primary Productivity(NPP):
40. Explain why GPP is always greater than NPP in a given ecosystem, biome, or aquatic life zone, or when looking at the planet as a whole.
41. Which of the two, GPP or NPP, represents the number of kilocalories that are available for use by consumers?
42. What is the upper limit determining earth's carrying capacity(K) for all consumer species? (note: Solar input is not what we are after here, although, clearly, Ultraviolet light is essential in order to drive earth's systems.)
43. Identify typical units for expressing Net Primary Productivity:
44. Identify the four top biomes/aquatic life zones on the estimated annual average NPP per unit area list.
45. Discuss the significant reasons why these four types of biomes/aquatic life zones (from #44 above) are indeed so productive: provide as much detail as possible.
46. Identify the three general types of nutrient cycles:

* Hydrologic Cycle:

47. Briefly describe the seven main processes involved in the hydrologic cycle:
48. Name the two driving forces behind the water cycle:
49. Relate precipitation and condensation nuclei:
50. Relate the following terms: groundwater, aquifer, and water table:
51. Describe three significant anthropogenic interventions in the hydrologic cycle:
52. Why is the water cycle vital to the biosphere?(Describe three specific functions performed by or made possible by water.)

* Carbon Cycle:

53. Provide three specific ways in which carbon is essential for biota to function:
54. Carbon dioxide comprises approximately what percent of tropospheric gases?
55. How is this relative* amount(%) of CO_2 so significant in contributing to the earth's "natural thermostat"? (*e.g., relative to the amount of water vapor in the troposphere.)
56. Identify the two processes which have the greatest influence on tropospheric concentrations of carbon dioxide on a monthly or yearly basis. Explain:
57. Name the two largest sinks(storage areas) for carbon; briefly explain how these areas have become such substantial carbon sinks.
58. Though you likely commented on this in #56 above, relate "new carbon" stores found in plant and animal tissues to the formation of "old carbon" stores found in fossil fuels.
59. Discuss how oceans play a major role in regulating CO_2 levels in the troposhpere. Include in your discussion the formation of the following ions or compounds CO_3 2-, HCO_3 -, Ca 2+, $CaCO_3$
60. Describe the two major human interventions in the carbon cycle:
61. Discuss three specific ramifications of increased tropospheric temperature as a result of an increase in tropospheric CO_2 concentration.
62. Comment on the type of feedback loop(s) (the relationship) that would likely be involved in a scenario in which tropospheric concentrations of CO_2 increase and the amount of snowpack and glacier size/area.

* Nitrogen Cycle:

63. Why is the nitrogen cycle significant to biota?
64. Identify the two major ways that nitrogen is “fixed”;
65. Describe what takes place in each of the following processes or steps of the N-Cycle: (include a description of the events and chemical transformations occurring in each step:)

a. Nitrogen Fixation:
b. Nitrification:
c. Assimilation:
d. Ammonification:
e. Denitrification:

66. Identify the major sinks for nitrogen:
67. Describe seven anthropogenic interventions in the nitrogen cycle:

* Phosphorus Cycle:

68. How, specifically, is phosphorus important to biota?
69. Explain why phosphorus does not circulate in the troposphere to a great extent:
70. Identify the largest sinks for phosphorus:
71. Phosphorus is typically found in what ionic form?
72. Explain why the addition of phosphate compounds to aquatic areas typically has a dramatic effect on biological productivity.
73. Comment on how human activities have influenced the phosphorus cycle regarding each of the following:

a. Mining phosphate rock:
b. Deforestation(especially tropical):
c. Animal wastes from Livestock Feedlots:
d. Commercial phosphate Fertilizers in Agricultural areas:
e. Discharge of Municipal Sewage/Wastewater Treatment Facilities:

* Sulfur Cycle:

74. How, specifically, is sulfur significant to biota?
75. Identify the two largest storage areas for sulfur:
76. Comment on a major natural source of each of the following sulfur compounds: (a) H_2S (b) SO_2 (c) SO_4^{2-} (d) CH_3SCH_3 (dimethyl sulfide, or DMS)
77. How can fluctuating DMS emissions affect cloud cover in a given region?
78. Illustrate the chemical transformations(reactions) which occur when SO_2 reacts with O_2 and H_2O in the troposphere to eventually become sulfuric acid:
79. Identify the three major human activities influencing the sulfur cycle:
80. What is GIS and how does it assist environmental scientists in expanding the knowledge and understanding of ecosystems?
81. Describe systems analysis:
82. What is meant by “ecosystem or ecological services”? Identify seven examples:
83. Comment on the efforts by men and women to “replace” or mimic ecological services (such as those found in Figure 4-36 on page 99) in terms of the relative ease or difficulty in achieving similar outcomes to those delivered or accomplished by nature.

84. What are the two basic principles of Ecosystem Sustainability? Hints are certainly not needed, but just for the record: Energy Source = _____ ;(b) Is Earth a “Closed” or an “Open” system for matter?

Important Terminology & Concepts: Chapter 4

1. Ecology
2. Organism
3. Cell
4. Prokaryotic vs. Eukaryotic
5. Microorganisms
6. Species
7. Asexual vs. Sexual Reproduction
8. Taxonomists
9. Population, Community, and Ecosystem
10. Genetic Diversity
11. Habitat vs. Niche
12. Biosphere/Ecosphere
13. Atmosphere: Troposphere, Stratosphere, Mesosphere, Thermosphere
14. Hydrosphere, Lithosphere
15. Cycling of Matter: Earth as a Closed system for Matter
16. Photosynthesis and Cellular Respiration: Chemical Equations for:
17. Natural Greenhouse Effect vs. Enhanced Greenhouse Effect
18. Biomes and Aquatic Life Zones
19. Climate
20. Ecotone
21. Abiotic vs. Biotic Factors
22. Range of Tolerance, Law of Tolerance, Tolerance Limits, Optimum Range
23. Limiting Factor(s), Limiting Factor Principle
24. Dissolved Oxygen Level(DO level)
25. Salinity
26. Carbon Dioxide level
27. Nitrogen (as nitrate) level and Phosphorus (as phosphate) level
28. Turbidity
29. Hardness
30. Temperature
31. Metabolism
32. Producers and Consumers
33. Autotrophs vs. Heterotrophs
34. Photosynthesis and Chemosynthesis
35. Primary, Secondary, Tertiary, and Quaternary Consumers
36. Herbivores, Carnivores, Omnivores, Scavengers, Detritivores, Decomposers
37. Detritus and Detritus Feeders
38. Aerobic vs. Anaerobic Respiration
39. Fermentation
40. Biodiversity: Genetic, Species, Ecological
41. Food Chains and Food Webs
42. Biomass
43. Ecological Efficiency
44. Ecological Pyramids: (a) Pyramid of Energy Flow (b) Pyramid of Number (c) Pyramid of Biomass
45. Gross Primary Productivity(GPP)
46. Net Primary Productivity(NPP)
47. Biogeochemical Cycles: (a) Major types of: Atmospheric, Sedimentary, Hydrologic (b) Specific chemical cycles: N, C, H_2O, P, S
48. Hydrologic Cycle Processes/terms: Evaporation, Transpiration, Condensation, Precipitation, Infiltration, Percolation, Surface Runoff, Groundwater, Aquifer, Water Table
49. Absolute and Relative Humidity
50. Condensation Nuclei
51. Dew Point
52. Carbon Cycle: Carbon Dioxide, Glucose, Calcium Carbonate, Carbonate ions, Bicarbonate ions, Calcium ions
53. Global Warming
54. Nitrogen Cycle: N-Fixation(Cyanobacteria and Rhizobium) --> Nitrification à Assimilation --> Ammonification --> Denitrification
55. Acid Deposition: Nitric Acid(HNO_3)
56. Phosphorus Cycle
57. Sulfur Cycle: associated acid deposition (SO_2 + O_2 --> SO_3 + H_2O --> H_2SO_4)
58. Field Research, Remote Sensing, GIS, Systems Analysis