

87.202 - PRINCIPLES OF EARTH & ENVIRONMENTAL SYSTEMS II
 STUDY QUESTIONS AND PROBLEMS XV

1. What is ecology?

2. What is an ecosystem? Is the extent of an ecosystem the same for all organisms in the ecosystem?

3. Figure 1 shows a simplified food web for a temperate forest ecosystem. The heavy lines mean that the particular food source is twice as important compared to the light lines. Any particular organism can be on several trophic levels at the same time. To determine the exact trophic level for the organism weight the various energy sources. For example, if an organisms gets 50% of its energy from the 2nd trophic level and 50% of its energy from the 3rd trophic level it is on trophic level 3.5. For the following questions assume an ecological efficiency of 10%.

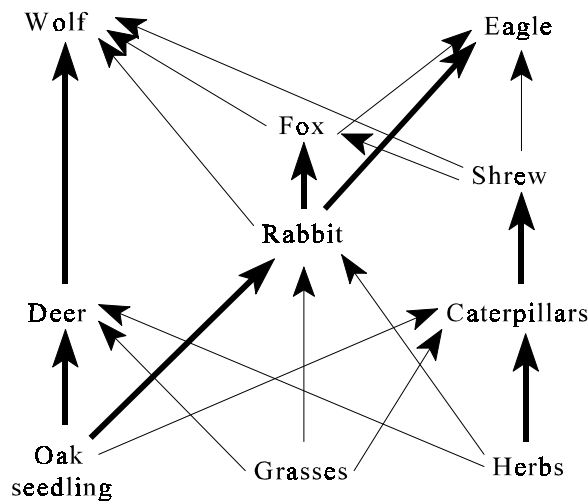


Figure 1. Simplified food web for a temperate forest community.

- a. Name the primary producers.

- b. Name the primary consumers

- c. Name the secondary consumers

- d. The rabbit is on what trophic level?

- e. The Eagle is on what trophic level?

- f. For every 1000 calories of energy in the grasses, how much of this energy ultimately ends up in the fox?

- g. For every 1000 calories of energy in the herbs, how much of this energy ultimately ends up in the eagle?

4. A simple global cycle for phosphorus is illustrated in Figure 2. The mass of phosphorus in the different reservoirs is in metric tons P (10^{12} g) and the fluxes are in metric tons P per year (10^{12} g yr⁻¹). The “LAND” reservoir refers to the top 60 cm of soil.

a. Calculate the residence time for phosphorus in the “LAND BIOTA” and “LAND” reservoirs. Remember that you can use either inputs or outputs to the reservoir to calculate the residence time. When you do the calculation for the “LAND” reservoir do not use the “MINEABLE P” flux.

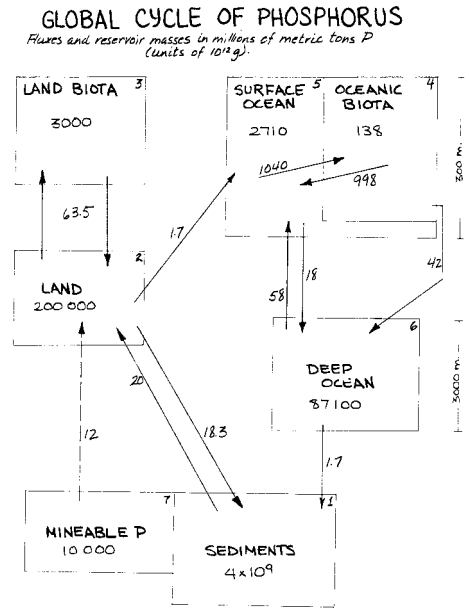
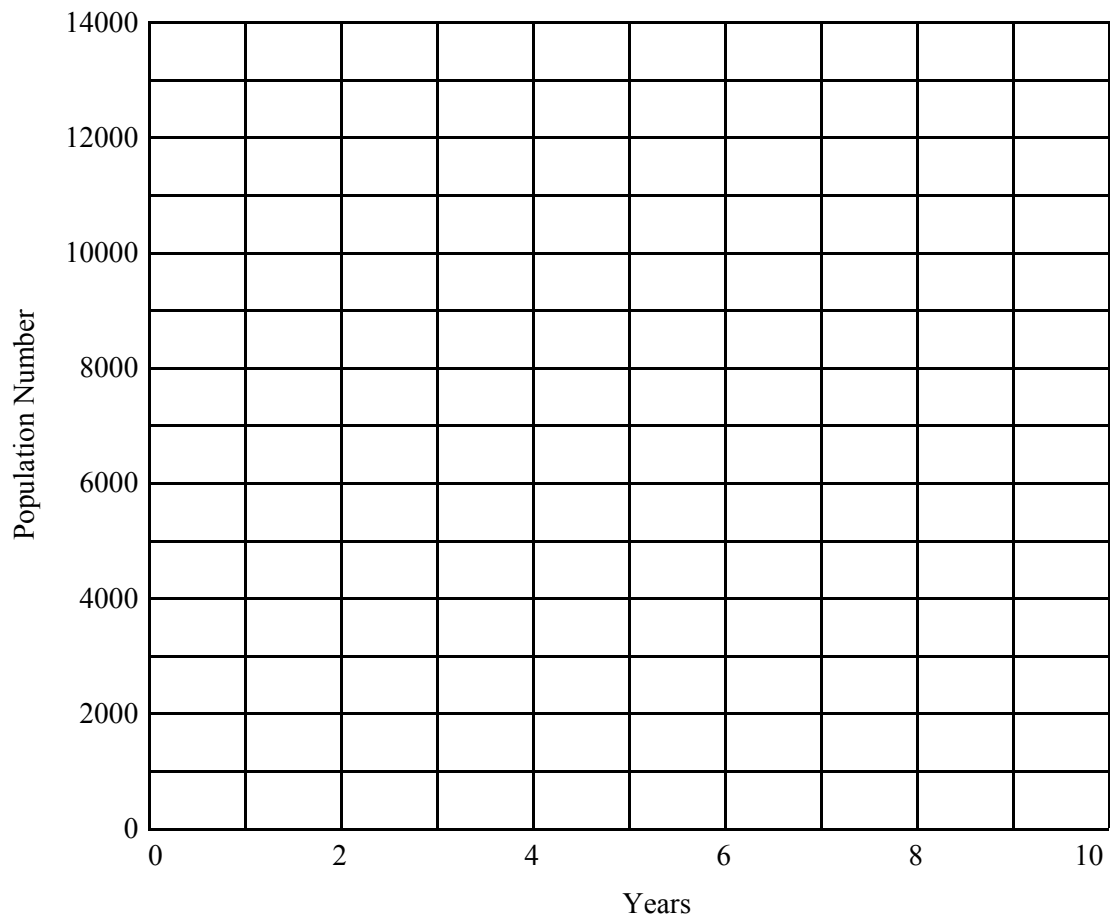


Figure 2. Simplified global phosphorus cycle. From Garrels, Mackenzie & Hunt, 1975. *Chemical Cycles and the Global Environment*. Los Altos: William Kaufmann, Inc., p. 159.

b. Recalculate the residence time for phosphorus in the “LAND” reservoir taking into account the “MINEABLE P” flux (dashed arrow). How does this residence time compare to the natural cycle? Do you think the input of phosphorus by mining will significantly impact the total P of the “LAND” reservoir? Explain.

5. The change in population numbers for two species, as a function of time, are listed below. Plot these data on the graph below and connect the points with two smooth lines.

Population A		Population B	
Time (yrs)	Numbers	Time (yrs)	Numbers
1	10	1	100
2	50	2	200
3	100	3	400
4	600	4	800
5	3000	5	1600
6	6000	6	3200
7	9000	7	6400
8	10000	8	12800
9	10000	9	1280
10	10000	10	128



8. Natural selection means that only those organisms that are in the best physical condition will survive. Is this true? If not, explain.

9. What is the critical level?

10. List and briefly explain three factors that can lead to the extinction of species.

11. What characteristics favor the survival of a species?

12. Define demography.

13. In terms of human population growth, define and explain the importance of the “Cultural”, “Agricultural”, and “Industrial-medical” revolutions.

14. The average population of Lowell is 100,000. In a given year there are 1500 births, 1800 deaths, 500 people move into the city and 300 people leave the city.

a. Calculate the crude birth rate.

b. Calculate the crude death rate.

c. Calculate the net rate of growth.

15. What is the demographic transition?

16. The diagrams below show the age distributions for three populations. Which population is growing, which is stable, which is in decline. Explain.

