

AP Biology  
Population Ecology Practice Problems

Answer the following questions. Show your work in the space provided and grid-in your answer in the grids provided on the separate answer sheet.

1. If 300 blue jays are found in a 20 hectare plot, what is the density in blue jays/hectare in that plot? Round to the nearest whole number.

$$\frac{300}{20} = 15 \text{ blue jays/hectare}$$

2. If 3400 maple trees are counted on a 3km x 4km rectangular patch of land, what is the density of maple trees per square kilometer? Round to the nearest tenth.

$$\frac{3400}{12} = 283.3 \text{ maple trees/Km}^2$$

3. Suppose the population density of a sample of deer is 50 per square kilometer. Assuming that the population is uniformly distributed what would the population size be if the deer encompassed an area that was 20km x 200km? Round to the nearest whole number.

$$50 \left( \frac{20 \times 200}{20} \right) = \frac{20,000}{20} \text{ deer/Km}^2$$

4. There are 252 deer in a population. There is no net immigration or emigration. If 47 deer die and 32 deer are born in one month, what is the population size at the end of the month? Round to the nearest whole number.

$$252 - 47 + 32 = 237 \text{ deer}$$

5. In a population of 600 squirrels, the per capita birth rate in a particular period is 0.06 and the per capita death rate is 0.12.

- a. What is the per capita growth rate of the population? Round to the nearest hundredth.

$$r = 0.06 - 0.12 = (-0.06)$$

- b. What is the actual number of squirrels that die during this particular period? Round to the nearest whole number.

$$D = 600 \times 0.12 = 72 \text{ deaths}$$

- c. What is the actual number of squirrels that are born during this period? Round to the nearest whole number.

$$B = 600 \times 0.06 = 36 \text{ births}$$

6. In a population of 750 fish, 25 die on a particular day while 12 were born.

- a. What is the per capita death rate for the day? Round to the nearest thousandth.

$$d = 25/750 = 0.033$$

- b. What is the per capita birth rate for the day? Round to the nearest thousandth.

$$b = 12/750 = 0.016$$

- c. What is the per capita rate of increase for the day? Round to the nearest thousandth.

$$r = b - d = 0.016 - 0.033 = (-0.017)$$

7. In a population of 125 foxes, 10 die on a particular day and 22 were born on that day.

- a. What is the per capita death rate for the day? Round to the nearest hundredth.

$$d = 10/125 = 0.08$$

- b. What is the per capita birth rate for the day? Round to the nearest thousandth.

$$b = 22/125 = 0.176$$

- c. What is the per capita rate of increase for the day? Round to the nearest thousandth.

$$r = b - d = 0.176 - 0.08 = 0.096$$

8. Suppose that of a cohort of 200 rats in a rat colony born in January, 160 are still alive at the start of March and 120 are still alive at the start of May.

a. What is the survivorship up to the start of March? Round to the nearest hundredth.

$$160/200 = 0.80$$

b. What is the mortality rate from the beginning of March to the beginning of May? Round to the nearest hundredth.

$$40/160 = 0.25$$

c. If the survivorship during May is 0.3, how many rats died during the month of May? Round to the nearest whole number.

$$120 \times 0.3 = 36 \text{ survived, } 120 - 36 = \underline{84 \text{ died}}$$

9. Suppose that of a cohort of 150 mice in a mouse colony born in February, 125 are still alive in March and 115 are still alive in April.

a. What is the survivorship up to the start of April? Round to the nearest hundredth.

$$125/150 = 0.83$$

b. What is the mortality rate during the month of March? Round to the nearest hundredth.

$$10/125 = 0.08$$

c. If the survivorship during April is 0.5, how many mice will there be at the start of May? Round to the nearest whole number.

$$115 \times 0.5 = 57.5 = \underline{58}$$

10. There are 2,000 mice living in a field. If 1,000 mice are born each month and 200 mice die each month, what is the per capita growth rate of mice over a month? Round to the nearest tenth.

$$b = \frac{1000}{2000} = 0.5 \quad d = \frac{200}{2000} = 0.1 \quad r = b - d = 0.5 - 0.1 = \underline{0.4}$$

11. The doubling time of a population of plants is 12 years. Assuming that the initial population is 300 and that the rate of increase remains constant, how large will the population be in 36 years?

$$2400 \text{ plants}$$

12. Suppose that 50 fish are born in year 1. There are only 36 left in year 2 and 22 left in year 3. What is the mortality rate between years 2 and 3? Round to the nearest hundredth.

$$d = \frac{14}{36} = 0.39$$

13. You and your friends have monitored two populations of wild lupine for one entire reproductive cycle (June year 1 to June year 2). By carefully mapping, tagging, and taking a census of the plants throughout this period, you obtain the data listed in the chart.

Parameter	Population A	Population B
Initial # of plants	500	300
Number of new seedlings established	100	30
Number of initial plants that die	20	100

a. Calculate the following parameters for each population. Round each to whole number or hundredth where applicable and record your answers here (no grids provided.)

Parameter	Population A	Population B
$B$ (births during time interval)	100	30
$D$ (deaths during time interval)	20	100
$b$ (per capita birth rate)	$100/500 = 0.20$	$30/300 = 0.10$
$d$ (per capita death rate)	$20/500 = 0.04$	$100/300 = 0.33$
$r$ (per capita rate of increase)	$0.2 - 0.04 = 0.16$	$0.1 - 0.33 = (-0.23)$

- b. Given the initial population size of **Population A** and assuming that the population is experiencing growth at the growth rate  $r$  (calculated above), what will the number of plants be in each of the next 5 years? (Use the initial population size as time 0.) Round each to the nearest whole number and record your answers here (no grids provided).

Time (year)	Population Size
0	500
1	580
2	673
3	780
4	905
5	1050

(Adapted from: Mastering Biology, Pearson 2013)

14. A population of 265 swans was introduced to Circle Lake. The population's birth rate is 0.341 swans/year per capita, and the death rate is 0.296 swans/year per capita. What is the rate of population growth per capita, and is it increasing or decreasing? Round to the nearest thousandth.

$$r = b - d = 0.341 - 0.296 = 0.045, \text{ increasing}$$

15. There are 190 grey tree frogs in a swamp. The population is under carrying capacity. If  $r = (-0.093)$  frogs/year, predict the population size next year. Round to the nearest whole number.

$$(-0.093) \times 190 = -17.67 \text{ frogs lost}, 190 - 17.67 = 172.33 = \underline{172}$$

16. A population of 1492 Baltimore orioles was introduced to an area of Nerstrand Woods. Over the next year, the Orioles show a death rate of 0.395 while the population drops to 1134. What's the birth rate for this population? Round to the nearest hundredth.

$$\frac{dN}{dt} = rN \rightarrow \frac{dN}{dt} = (b - d)N, \quad \frac{(1134 - 1492)}{1} = (b - 0.395)(1492), \quad \underline{b = 0.16}$$

17. There are 780 turkeys living in Merriam Township, which is 92 acres in size. The birth rate is 0.472 turkeys/year per capita. The death rate is 0.331 turkeys/year per capita.

- a. What is the population density? Round to the nearest tenth.

$$780/92 = 8.5 \text{ turkeys/acre}$$

- b. What is  $dN/dt$ ? Round to the nearest whole number.

$$dN/dt = (b - d)N = (0.472 - 0.331)(780) = \underline{110} \text{ turkeys/year}$$

- c. Predict  $N$  after one year, assuming  $dN/dt$  stays constant. Round to the nearest whole number.

$$780 + 110 = \underline{890} \text{ turkeys}$$

18. One dandelion plant can produce many seeds leading to a high growth rate for dandelion populations. If a population of dandelions is currently 40 individuals and  $r_{\max} = 0.2$  dandelions/month per capita, predict how many dandelions would be in this population after 4 months. Round to the nearest whole number.

$$\text{Month 1 } (0.2)(40) = 8$$

$$\text{Month 3 } (0.2)(48 + 9.6) = 11.5$$

$$\text{Month 2 } (0.2)(40 + 8) = 9.6$$

$$\text{Month 4 } (0.2)(57.6 + 11.5) = 13.8$$

$$69.1 + 13.8 = 82.9 = \underline{83}$$

19. Imagine the dandelion population of 40 (in #18) cannot continue to grow exponentially due to lack of space. The carrying capacity for their patch of lawn is 70 dandelions. What is their  $dN/dt$  in this logistic growth situation? Round to the nearest tenth.

$$dN/dt = r_{\max} N \left[ \frac{K - N}{K} \right] = (0.2)(40) \left[ \frac{70 - 40}{70} \right] = \underline{3.4} \text{ dandelions}$$

20. A hypothetical population has a carrying capacity of 1,500 individuals and  $r_{\max}$  is 1.0. Fill out the following table. Round all answers to the nearest whole number and record your answers here (no grids provided).

Population Size	Show Work Here	Population Growth
1600	$(1.0)(1600) \left[ \frac{1500 - 1600}{1500} \right]$	-107
1750	$(1.0)(1750) \left[ \frac{1500 - 1750}{1500} \right]$	-292
2000	$(1.0)(2000) \left[ \frac{1500 - 2000}{1500} \right]$	-667