Chapter-wide learning goals

1. Choose an appropriate model to describe the growth of a given population.
2. Defend the choice of a population model as appropriate for a particular situation.
3. Draw an appropriate graph of population size over time given the type of growth it is experiencing.
4. Use an appropriate model to predict the change in size of a population over time.
5. Give an example of how population models can be used to describe the growth of a population over time.
6. Describe the difference among natural populations that are growing geometrically, exponentially and logistically.
7. Contrast the geometric, exponential, and logistic growth models, their terms, and their assumptions.
8. Create graphs that depict how per capita growth rate, population growth rate, realized growth rate, and maximum potential growth rate vary with population size, depending on whether the population is growing geometrically, exponentially or logistically.

Section 1: Geometric Growth

1. Calculate the expected population size at time t of a population that is experiencing geometric growth given its current population size and its finite rate of increase, λ.
2. Draw a graph of population size versus time for a population undergoing geometric growth.
3. Provide examples of populations that grow geometrically.
4. State the geometric growth equation, its terms, and its assumptions.

Section 2: Exponential Growth

1. Calculate (A) the expected population size at time t, (B) the population growth rate at time t, and (C) the doubling time of a population that is experiencing exponential growth, given its current population size and its per capita growth rate, r.
2. Draw a graph of population size versus time for a population undergoing exponential growth.
3. Provide examples of populations that grow exponentially.
4. State the exponential growth equation, its terms, and its assumptions.
5. Calculate the per capita growth rate, r, from the finite rate of increase, λ, and vice versa.
6. Calculate λ or r, as appropriate, from data on a growing population.
7. Distinguish between the instantaneous rate of change (dN/dt), the intrinsic growth rate, r, and the maximum intrinsic growth rate, r_{max}.
8. Describe how a population is changing if dN/dt is greater than 0, equal to 0, or less than 0.
9. Graphically depict (as the slope of a line tangent to a plot of population size versus time) a population's "instantaneous rate of change".

Section 3: Logistic Growth

1. Describe the general pattern for how intrinsic growth rate changes with body weight and an accepted hypothesis for that pattern.
2. Calculate the expected population growth rate (dN/dt) at time t of a population that is experiencing logistic growth given its current population size, carrying capacity, and its intrinsic growth rate, r.
3. Draw a graph of population size versus time for a population undergoing logistic growth, indicating both the population's carrying capacity, K, and where along the curve the population growth rate is greatest.
4. Explain why neither geometric nor exponential population growth can continue indefinitely.
5. Provide examples of populations that grow logistically.
6. State the logistic growth equation, its terms, and its assumptions.
7. Distinguish between density-dependent and density-independent limits on population growth rates.
8. Describe qualitatively how to estimate parameters for a population growth equation from data on how a population changes size over time.

Section 4: Dispersal and Metapopulations

1. Explain how barriers to movement, distance between patches, and patch size are likely to affect the source-sink dynamics and population persistence of a specific population.
2. List four demographic rates that can cause a population to grow or shrink.
3. Explain Levin's equation describing metapopulation dynamics including both its terms and assumptions.
4. Calculate the expected patch turnover rate (dP/dt) at time t of a metapopulation given the current proportion of occupied patches, P, the patch colonization rate, c, and the patch extinction rate, e.
5. Break down how the spatial configuration and size of patches affects metapopulation dynamics, including colonization, extinction, and turnover rates.
6. Use a graph to show how equilibrium patch occupancy changes as immigration and extinction rates change according to Levin's equation of metapopulation dynamics.
7. Provide examples of organisms exhibiting metapopulation dynamics.

Section 5: Variability in Populations

1. Distinguish between density-dependent and density-independent limits on population growth rates.
2. Explain how simple population models can be improved to capture some of the variability inherent in natural populations.
3. Provide examples of how environmental stochasticity can affect population dynamics.
4. Provide examples of how Allee effects can affect population dynamics.
5. Illustrate how delayed density dependence can affect population growth.
6. Draw how a given logistic growth curve will change as r and K change.