Chapter-wide learning goals:

1. Choose an appropriate model to describe the growth of a given population.
2. Explain how competition for resources can both reduce a population's growth rates and determine a population's carrying capacity.
3. Predict the outcome of competition between two species using Lotka-Volterra competition equations.
4. Show how environmental complexity can alter the outcome of competition between two populations.

Section 1: Limited Resources and Competition

1. Summarize the conditions under which individuals are expected to compete.
2. Contrast a species' fundamental and realized niche.
3. Define a species' fundamental niche based on the species' physiological tolerances.
4. Design an experiment to determine the fundamental niche of a species along some environmental gradient.
5. Explain the competitive exclusion principle.
6. Explain why the existence of multiple similar species in an ecological community is a puzzle (i.e. paradox of the plankton).
7. Explain how Gause was able to demonstrate the competitive exclusion principle.
8. Infer from a description of competition between two species whether they are exhibiting direct or indirect competition, including, if appropriate, the mode of resource competition (i.e. interference competition, allelopathy, territoriality, or preemption).
9. Describe two examples of a limiting resource including why they are limiting.

Section 2: Intraspecific Competition

1. Explain how competition can reduce population growth rates by reducing average growth rates and/or birth rates and by increasing death rates.
2. Choose an appropriate model to describe the growth of a given population.
3. Predict the change in size of a population over time using an appropriate model.
4. Give an example of how population models can be used to describe the growth of a population over time.
5. Determine from experimental data whether individuals appear to be experiencing intraspecific competition in a certain environment.
6. Describe how a change in carrying capacity will influence intraspecific competition and population growth rates at different population densities.
7. Describe how a population is changing if dN/dt is greater than 0, equal to 0, or less than 0.
8. Graphically depict (as the slope of a line tangent to a plot of population size versus time) a population's "instantaneous rate of change".
9. State the logistic growth equation, its terms, and its assumptions.
10. Draw how a given logistic growth curve will change as r and K change.

Section 3: Interspecific Competition

1. Provide examples of field and/or laboratory research demonstrating interspecific competition.
2. Interpret results of Thomas Park's laboratory research on flour beetles.
3. Choose an appropriate model to describe the growth of a given population.
4. Predict the change in size of a population over time using an appropriate model.
5. Give an example of how population models can be used to describe the growth of a population over time.
6. Predict the outcome of a competitive interaction between two species using the Lotka-Volterra competition equations.

7. Estimate the instantaneous growth rates of two competing populations given their current population sizes, intrinsic growth rates, carrying capacities, and competition coefficients.
8. Describe each of the terms and assumptions in the Lotka-Volterra predator-prey equations.
9. Contrast the meaning of competition coefficients of 0 and 1.
10. Calculate a competition coefficient from experimentally varying population densities in a fixed environment.
11. Determine whether a given scenario meets the assumptions of the Lotka-Volterra competition equations.
12. Illustrate the four potential outcomes of a two-species competitive interaction using a phase plot of the Lotka-Volterra competition equations (including their isoclines).
13. Draw the approximate trajectory of two populations as they move through phase space from the point representing their initial population sizes to the appropriate outcome (competitive exclusion or coexistence) as determined by the location of their respective competition isoclines.
14. Draw competition isoclines for each species, given a phase portrait showing competition between two species.
15. Describe what would happen to the populations of two competing species in the next instant of time, given their initial population sizes and a phase plot showing the competition isoclines for the two species.
16. Explain how Tillman's R* model of competition can lead to the same four outcomes as predicted by Lotka and Volterra's model.
17. Draw a line graph of population size vs. time for two populations, given a description of how they have changed over some period of time.
18. Draw the trajectory in phase space showing how the populations of two species change with respect to one another, given a time series for the two species.

Section 4: Competition in Complex Environments

1. Provide examples of field and/or laboratory research demonstrating interspecific competition.
2. Deduce whether two species are competing, in a given environment using data from common garden experiments.
3. Design a common garden experiment to test the hypothesis that there is competition between two species in some location.
4. Describe the insights gained from Gurevitch's meta-analysis of competition experiments.
5. Defend, with supportive evidence, two distinct hypotheses for how competing species can come to coexist.