Chapter-wide learning goals:

1. Defend Theodosius Dobzhansky's assertion that "nothing in biology makes sense except in the light of evolution."
2. Summarize the logic of evolution by natural selection for a lay audience; include its three primary requirements and the inevitable consequence when all three hold.
3. Explain how the genetics underlying phenotypic variation are linked to the evolution of populations.
4. Show that evolutionary processes can affect ecological interactions operating on ecological time scales.

Section 1: The Importance of Evolution in Ecology

1. Describe why time scales of evolution mean that ecologists must be aware of evolution's role when asking ecological questions.
2. Describe how ecological processes can be agents of evolution.
3. Provide an example of an evolutionary change that affected an ecological interaction.
4. Provide an example of how evolution has impacted humans on an ecological time scale.
5. Explain why invasive species might be able to invest more in growth and reproduction when they invade a novel environment.
6. Provide at least two examples of an important ecological problem or system where evolution plays a significant role, and fully describe that role.
7. Describe how each of the four mechanisms of evolution can lead to a change in allele frequencies in a population.

Section 2: The Logic of Evolution by Natural Selection

1. Explain how phenotypes in a population change when the three requirements for evolution by natural selection hold.
2. Explain why evolution by natural selection cannot occur if there is no phenotypic variation within the population.
3. Explain why evolution by natural selection cannot occur if the trait in question is not heritable.
4. Explain why evolution by natural selection cannot occur if there is no selective survival and/or reproduction.
5. Describe an example of natural selection occurring on ecological timescale, highlighting the conditions (variability, heritability, selection) that lead to natural selection.
6. Use experimental data to evaluate whether natural selection is likely playing a role in an ecological phenomenon.
7. Design an experiment to test whether or not a particular population is evolving by natural selection.
8. Draw a histogram illustrating how a given trait is expected to vary within a population, if natural selection is to occur.
9. Draw a graph demonstrating the expected relationship (for a given trait) between offspring and their parents, if natural selection is to occur.
10. Provide examples of the types of evidence that would support the assertion that survival and/or reproduction is selective.

Section 3: Genetics and Evolution

1. Restate the logic of evolution in terms of genetic change.
2. Calculate allele frequencies from genotype frequencies.
3. Provide examples of phenotypic variation.
4. Explain why natural selection requires some phenotypic variation to be a result of genotypic differences.
5. Explain why natural selection requires some genotypes to have greater survival and reproduction than others.

6. Based on the number of genes contributing to a trait, predict whether the trait will be discrete or quantitative.
7. Explain the difference between discrete and quantitative traits in terms of the observed phenotypes.
8. Explain why evolution is expected to produce local adaptations.
9. Provide examples of species that are well-adapted to their local environment (e.g., sticklebacks, beach mice).
10. Explain why trade-offs may lead to the frequent local adaptations documented by Hereford (2009).
11. Explain to a lay audience how random genetic drift can produce a change in allele frequencies across generations.
12. Explain how the founder effect produces evolutionary change, making sure to describe the role of sampling error.
13. Explain how migrants can result in random changes in the genetic composition of a population (i.e. can produce genetic drift).
14. Defend the assertion that mutation is the source of heritable variation.
15. Explain how on-going migration between two populations can equalize allele frequencies between them.
16. Describe how the four mechanisms of evolution can act simultaneously, and describe a scenario in which more than one mechanism is acting on a population.

Section 4: Managing the Evolution of Resistance

1. Describe the genetic basis of a trade-off, and use an example to show how this trade-off can lead to evolution under different conditions.
2. Explain why a high-dose/refuge strategy is able to effectively control some pests over the long-term.
3. Describe how antibiotic use can lead to antibiotic resistance in bacterial populations.
4. Formulate a strategy for managing resistance to pesticides and/or antibiotics.