

AP Biology Ecology Unit Study Questions

These questions are designed to help you learn and study the ecology unit over the summer and also prepare you for the ecology unit test we will have at the first of the year.

Essential Questions

- How do changes in free energy available to organisms result in changes to population size and disruptions to an ecosystem?
- How are biological systems from cells to organisms to populations, communities, and ecosystems affected by complex biotic and abiotic interactions involving exchange of matter and free energy?
- In what ways do interactions between and within populations influence patterns of species distribution and amount of local and global ecosystem changes over time?
- How does the diversity of species within an ecosystem influence the stability of the ecosystem?

Old AP Free response question

As part of a new suburban development, a sports complex consisting of athletic fields and buildings is constructed in a formerly wooded area.

(a) Predict ONE ecological consequence on the local plant community that is likely to result during the site preparation and construction of the sports complex. Justify your prediction.

(b) To maintain the playing fields, large quantities of water and chemicals are applied regularly to the grass-covered areas. Predict ONE effect on the local animal community that might result from regular use and maintenance of the playing fields. Justify your prediction.

Specific Chapter Questions

Chapter 52

- What is ecology? What are the different levels of hierarchy that ecologists work at, what is included in each level, and what is an example of a question that would be asked at each level?
- How does the concept of time apply to ecological and evolutionary changes? Do ecological time and evolutionary time ever overlap? Give some examples of this overlap.
- Why is Rachel Carson important? Distinguish between ecology and environmentalism.
- What are the factors that can limit the geographical distribution of a species? Describe Fletcher's investigation into the question of sea urchins limiting seaweed distribution. Describe the experiment, the control, the results, and his conclusions. What further investigations would you suggest as a follow up to this? (Look at questions 12 in the self-quiz of chapter 52 to help you with this.)
- What abiotic factors may limit a species distribution? Describe/give an example of how each could limit a species.
- What is climate? What are the major abiotic components of climate? Distinguish between macroclimate and microclimate and give an example of each.
- Describe how oceans and large lakes moderate the climate of nearby land and use that to explain the temperature differences between Lafayette and Berkeley in the summer and winter.
- Why do deserts often occur on the leeward sides of mountain ranges?
- Give examples of human actions that could expand a species distribution by changing its (a) dispersal or (b) biotic interactions.
- How do the oceans impact the biosphere? Describe and give examples.
- Where on the planet are most coral reefs found? Why?
- What is a thermocline? Where do you find it? How is it produced and is it a permanent feature of a lake or ocean? Explain.
- In which ocean zone is most life found? Why? What are the dominant producers in the ocean and why are these the dominant producers in the oceans?
- List and describe the 8 aquatic biomes highlighted in chapter 52. What estuary do we live close to? What is the ocean zone going from the Golden Gate bridge to just past the Farallon Islands? (Look at google earth to help you with this.) What impacts are we having on each of these?

- What factors determine where a terrestrial biome exists? How do disturbances affect biomes? Give a specific example of this.
- List and describe the 8 terrestrial biomes described in chapter 52. In which biome do we live? What impacts are we having on each of these biomes?

Chapter 53

- What is studied in the field of population ecology?
- What is a population? List and describe the fundamental characteristics of a population.
- What are three ways that ecologists estimate population sizes? (Why do they need to estimate sizes?)
- Describe the mark-recapture method in detail. If you use this method to estimate a population size and you initially capture 40 individuals and mark them. Then, during the second capture, 4 of your marked individuals are recaptured out of a total of 20 individuals. What is the population size estimate? What are the assumptions and limitations to this method? Describe a situation where the assumptions of individuals having the same probability of being recaptured as unmarked individuals might not be valid and explain how the estimate of the population size might not be valid.
- How do individuals get added to a population? Removed?
- What contributes to variations in population density?
- What are the three patterns of dispersion? Which is most common? Give two specific examples of how each pattern could be established using a specific population.
- One species of forest bird is highly territorial, while a second lives in flocks. Predict each species' likely pattern of dispersion, and explain.
- What is a life table? What does the life table for Belding's Ground Squirrels at Tioga Pass in the Sierra Nevada tell you about the population? List at least three things.
- Describe the three main types of survivorship curves and give an example of an organism with each.
- Each female of a particular fish species produces millions of eggs per year. Draw and label the most likely survivorship curve for this species, and explain your choice.
- What are reproductive tables? What do they show for sexually reproducing populations?
- What is a life history of organism? What three basic variables does a life history include?
- Compare and contrast semelparity and iteroparity. Give an example of an organism that does each. What kinds of environments favor each and why? Give an example of an organism that is between semelparity and iteroparity and explain why this is an intermediate example.
- Consider two rivers: One is spring fed and has a constant water volume and temperature year-round; the other drains a desert landscape and floods and dries out at unpredictable intervals. Which river would you predict is more likely to support many species of iteroparous animals? Why?
- What limits the reproductive capability of all organisms (three things)? Describe the trade-offs for producing a lot of offspring with little care versus producing few offspring with a lot care.
- In the fish called the peacock wrasse, females disperse some of their eggs widely and lay others in a nest. Only those in the nest receive parental care. Explain the trade-offs in reproduction that this behavior illustrates.
- What is exponential growth and under what conditions does it occur (what does it assume)? What is the formula that describes exponential growth? What does each of the variables in the formula stand for/come from? What is this formula leaving out?
- What is zero population growth? When do you get zero population growth in a population?
- Explain why a constant rate of increase (r_{max}) for a population produces a growth graph that is J shaped rather than a straight line.
- Where is exponential growth by a plant population more likely – on a newly formed volcanic island or in a mature undisturbed rain forest? Why?
- In 2006, the United States had a population of about 300 million people. If there were 14 births and 8 deaths per 1,000 people, what was the country's net population growth that year (ignoring immigration and emigration, which are substantial)? Do you think the United States is currently experiencing exponential population growth? Explain.

- What is logistic population growth? What does it incorporate? What is the equation for the change in population size with the logistic growth model and what does each variable represent? Under the logistic growth model, when is the per capita rate of increase large? Small?
- What are the assumptions built into the logistic growth model? Give two specific examples (one for each assumption) for when these don't apply to a population. Why is the logistic model useful/important?
- Compare and contrast K and r selection. Include examples of species that represent each.
- Explain why a population that fits the logistic growth model increases more rapidly at intermediate size than at relatively small or large sizes.
- When a farmer abandons a field, it is quickly colonized by fast growing weeds. Are these species more likely to be K-selected or r-selected species? Explain.
- List and describe density-dependent factors that regulate population size (and how they regulate size) and give a specific example of each.
- You are testing the hypothesis that the population density of a particular plant species influences the rate at which a pathogenic fungus infects the plant. Because the fungus causes visible scars on the leaves, you can easily determine whether a plant is infected. Design an experiment to test your hypothesis. Include your experimental treatments and control, the data you will collect, and the results expected if your hypothesis is correct.
- What is population dynamics? Use the Soay sheep and the snowshoe hares and lynx to explain the fluctuations seen in populations and explain some of the factors that may contribute to these fluctuations.
- Describe the growth of the human population from 1650 up through the projections for 2050. Are we in exponential growth right now? What changes have occurred since the 1960's?
- Compare and contrast population growth in industrialized and less industrialized countries.
- What are age structure pyramids (diagrams)? What do they show you? Compare and contrast the age structure pyramids in your text for Afghanistan, the United States, and Italy.
- What is infant mortality? Life expectancy? Compare and contrast these in Afghanistan and Japan. What factors do you think are contributing to these?
- Do we have a global carrying capacity for people? How do scientists attempt to estimate the carrying capacity for people? How are ecological footprints calculated? Describe factors that may eventually limit our growth. What does the number of people the planet can sustain depend on (ultimately)?

Chapter 54

- What is a community? What is an interspecific interaction?
- What is competition? What is competitive exclusion (include the idea of niches, fundamental and realized in your answer)? How does competition and natural selection lead to resource partitioning (what is resource partitioning)? Character displacement?
- Describe physiological and behavioral, adaptations of predators.
- Describe behavioral, morphological, and physiological adaptations prey have to avoid predation. Compare and contrast cryptic coloration and aposematic coloration and give three examples of prey species with each of these.
- Compare and contrast Batesian and Mullerian mimicry and give two specific examples of each. How is Mullerian mimicry an example of convergent evolution?
- Describe the adaptation that plants have to avoid herbivory. List five "chemical weapons" found in some plants. (These chemicals that appear to serve as defense and have no other metabolic function in the plant are called secondary compounds, by the way.)
- Compare and contrast the three types of symbioses (what is a symbiosis)? Give an example of each.
- Compare and contrast an endoparasite and an ectoparasite and give an example of each. Explain how parasites can affect the survival and reproductive success of their hosts.
- Compare and contrast obligate mutualism and facultative mutualism and give an example of each.
- Why are most examples of commensalism probably not commensalism? Explain and give two specific and contrasting examples to support your answer.
- Suppose you lived in an agricultural area. What examples of the four types of community interactions (competition, predation, herbivory, and symbiosis) might you see in the growing or use of food?

- What are the two components of species diversity? How does the Shannon diversity index used to quantitatively compare different communities in terms of species diversity? (Know the equation and make sure you can use it!!)
- Why are molecular tools now being used to help assess species diversity? What were the results of Fiere and Jackson's study on the diversity of soil bacteria in habitats across North and South America?
- What are food chains? Food webs? How do the two relate? Why are food chains limited in size?
- What is a dominant species? How do dominant species affect communities? Give a specific example to illustrate your answer.
- What is a keystone species? How do keystone species affect communities? Give a specific example to illustrate your answer. How do keystone species compare to dominant species?
- What is a foundation species? How do foundation species affect communities? Describe and give a specific example of how a foundation species can serve as a facilitator. (What is a facilitator?)
- Compare and contrast the bottom-up and top-down models of community organization. Give an example of each. How are top-down models used in biomanipulation?
- What two components contribute to species diversity? Explain how two communities that contain the same number of species can differ in species diversity.
- Describe two hypotheses that explain why food chains are usually short, and state a prediction for each hypothesis.
- Consider a grassland with five trophic levels: plants, grasshoppers, snakes, raccoons, and bobcats. If you released additional bobcats into the grassland, how would the plant biomass change if the bottom-up model applied? The top-down model?
- How has the "balance of nature" view evolved to include disturbances? (What are disturbances?) What is the intermediate disturbance hypothesis? Give at least one specific example that supports this hypothesis.
- What is a nonequilibrium community? What is the norm for these communities?
- What is ecological succession? Compare and contrast primary and secondary succession and give a specific example of each. How can early and late arrival species be linked?
- Describe the primary succession that occurs on glacial moraines. How does the transition vegetation contribute to succession?
- What is causing one of the strongest disturbances of the environment today? List and describe three examples of this.
- Why do high and low levels of disturbance usually reduce species diversity? Why does an intermediate level of disturbance promote species diversity?
- During succession, how might the early species facilitate the arrival of later species?
- Most prairies experience regular fires, typically every few years. How would the species diversity of a prairie likely be affected if no burning occurred for 100 years? Explain your answer.
- What are the two main biogeographic features that affect biodiversity? Briefly explain how each affects the biodiversity.
- Why are tropical communities "older" than polar communities?
- Describe the two hypotheses that explain why species diversity is greater in tropical regions than in temperate and polar regions.
- What is evapotranspiration? How does it correlate with biodiversity?
- What is a species-area curve? What is the general trend seen in species-area curves?
- Describe how an island's size and distance from the mainland affect the island's species richness. (Are all "islands" in the water? Explain.)
- What is the island equilibrium model? What are the factors that go into this model? How does size fit into this model? Is this model good for ongoing, long-term predictions? Explain.
- Based on MacArthur and Wilson's model of island biogeography, how would you expect the richness of birds on islands to compare to the richness of snakes or mammals? Explain.
- What are pathogens? Zoonotic Pathogens? How can they alter community structures? Give two specific examples.
- Some parasites require contact with at least two host species to complete their lifecycle. Why might this characteristic be important for the spread of certain zoonotic diseases?

- Explain why adaptations of particular organisms to interspecific competition may not necessarily represent instances of character displacement. What would a researcher have to do to demonstrate about two competing species to make a convincing case for character displacement?
- An ecologist studying plants in the desert performed the following experiment. She staked out two identical plots, each of which included a few sagebrush plants and numerous small annual wildflowers. She found the same five species of wildflowers in roughly equal numbers on both plots. She then enclosed one of the plots with a fence to keep out kangaroo rats, the most common grain-eaters of the area. After two years, four of the wildflower species were no longer present in the fenced plot, but one species had increased drastically. The control plot had not changed in species diversity. Using the principles of community ecology, propose a hypothesis to explain her results. What additional evidence would support your hypothesis?
- By 1935, hunting and trapping had eliminated wolves from the United States except for Alaska. Because wolves have been protected as an endangered species, they have moved south from Canada and have become reestablished in the Rocky Mountains and northern Great Lakes region. Conservationists who would like to speed up wolf recovery have reintroduced wolves into Yellowstone National Park. Local ranchers are opposed to bringing back the wolves because they fear predation on their cattle and sheep. What are some reasons for reestablishing wolves in Yellowstone National Park? What effects might the reintroduction of wolves have on the ecological communities in the region? What might be done to mitigate the conflicts between ranchers and wolves?

Chapter 55

- What are the two dynamics involved at the ecosystem level (what is an ecosystem)?
- Compare and contrast how energy and nutrients move through an ecosystem. Why does each move in this way? Include the 1st and 2nd laws of thermodynamics as well as the conservation of mass in your explanation.
- Why is the transfer of energy in an ecosystem referred to as energy flow, not energy cycling?
- How does the 2nd law of thermodynamics explain why an ecosystem's energy supply must be continually replaced?
- Which trophic level ultimately supports all others in an ecosystem? Why? What is the ultimate source of energy for most ecosystems?
- What are detritivores? Why are they important?
- You are studying nitrogen cycling on the Serengeti Plain in Africa. During your experiment, a herd of migrating wildebeests grazes through your study plot. What would you need to know to measure their effect on nitrogen balance in the plot?
- What is primary production? Gross and net primary productivity? Why is net primary productivity a key measurement in ecosystems? How does the standing crop compare to the net primary productivity?
- Why is only a small portion of the solar energy that strikes the Earth's atmosphere stored by primary producers?
- Which terrestrial biome has the highest primary productivity? Why? What about aquatic biomes?
- What limits primary production in aquatic ecosystems? Which factor has a greater limitation? Why? Give two specific examples to illustrate nutrient limitation.
- What is upwelling? Considering that the continental shelf ends just past the Farallon islands (which are about 22 miles west of the Golden Gate bridge), explain why we have such a huge diversity of organisms in the waters right off of our coast.
- What is eutrophication? What causes eutrophication and how can it be prevented? What did research into eutrophication lead to?
- What are the main factors that control primary productivity in terrestrial ecosystems? How do these relate to actual evapotranspiration?
- What limits primary production on local scales? Explain the practical application of these studies.
- How can ecologists experimentally determine the factor that limits primary productivity in an ecosystem?
- As part of a science project, a student is trying to estimate the total primary production of plants in a prairie ecosystem for a year. Once each quarter, the student cuts plots of grass with a lawnmower and

then collects and weight the cuttings to estimate plant production. What components of plant primary production is the student missing with this approach?

- What is secondary production? Net secondary production? Production efficiency? Compare and contrast the production efficiency of endotherms like birds and mammals and ectotherms like fish. Why is there such a difference?

- If an insect eats plant seeds containing 100 J of energy and uses 30 J of that energy for respiration and excretes 50 J in its feces, what is the insect's net secondary production? What is its production efficiency?

- What is trophic efficiency? What does it represent and what is it roughly equal to? Use this to explain how our carrying capacity (for people) would be affected if the world population was vegan (ate a strictly plant based diet).

- What is a pyramid of net production? A pyramid of biomass? What do they each show? Why is the pyramid of biomass for most aquatic systems "upside down?"

- Explain the green world hypothesis.

- Tobacco leaves contain nicotine, a poisonous compound that is energetically expensive for the plant to make. What advantage might the plant gain by using some of its resources to produce nicotine?

- As part of a new reality show on television, a group of overweight people are trying to safely lose in one month as much weight as possible. In addition to eating less, what could they do to decrease their production efficiency for the food they eat?

- Briefly describe the general model for nutrient cycling and the four reservoirs. Then, describe the carbon, water, nitrogen, and phosphorus cycles in detail (including the biological importance of the nutrient, the key process and the reservoirs for that specific cycle).

- What factors control decomposition? Compare and contrast decomposition in tropical rain forests, temperate forests, and aquatic ecosystems.

- Using two neighboring ponds in a forest as your study site, design a controlled experiment to measure the effect of falling leaves on net primary production in a pond.

- Briefly describe the experimental set up in the Hubbard Brook Experimental Forest. What did preliminary studies confirm? What were the results after clear-cutting a watershed? What new results have been documented about the effects of acid rain?

- Why does deforestation of a watershed increase the concentration of nitrates in streams draining the watershed?

- Why is nutrient availability in a tropical rain forest particularly vulnerable to logging?

- How does agriculture affect the nitrogen cycle? What other human activities are disrupting the nitrogen cycle?

- What is the critical load? What are examples of things that can occur in an ecosystem when the critical load is exceeded? Describe how dead zones in oceans form. How are ocean dead zones similar to eutrophication of large lakes?

- What acid precipitation (how is it defined)? What causes acid precipitation? What affects does acid precipitation have on terrestrial ecosystems? Aquatic ecosystems? Although we have and continue to reduce some the emissions that lead to acid precipitation, why is this still a problem?

- Why are top-level carnivores the organisms that are most severely affected by toxic compounds in the environment?

- What are PCB's? What does current research indicate about PCB's?

- Describe what happened with DDT and why Rachel Carson is considered to be one of the founders of the modern environmental movement.

- In the face of biological magnification of toxins, is it healthier to feed at a lower level or higher trophic level? Explain.

- Why is the concentration of CO₂ in the atmosphere increasing? Why is it likely that the increase in plant production is not going to be as great as scientists had predicted? Describe the FACTS-I experiment to support your answer.

- What is the greenhouse effect? What do global models predict about the CO₂ concentration in the atmosphere by the end of the 21st century? Describe what we are already seeing as a result of this increase and what is predicted to occur in the future. (How do we measure CO₂ concentrations and temperatures of the past?)

- How is the climate change occurring now different than past climate changes? Why will organisms have a harder time adapting to the changes occurring now?
- There are vast stores of organic matter in the soils of northern coniferous forests and tundra around the world. Based on what you learned about decomposition, suggest an explanation for why scientists who study global warming are closely monitoring these stores.
- What will be the approximate CO₂ concentration in 2100? What ecological factors and human decisions will influence the actual rise in CO₂ concentrations? How might additional scientific data help societies predict this value?
- What is ozone and why is it important? What has happened to the ozone layer in the stratosphere and why has this occurred? How is this a good example of humans working to solve an environmental problem?

Chapter 56

- To date, how many species have been identified and named? How are human activities altering the biosphere?
- What is conservation biology? Restoration ecology? Why is each important?
- What is responsible for today's biodiversity crisis?
- Compare and contrast genetic, species, and ecosystem diversity. Why is each important? Give a specific example of the effects of losing these.
- Why should we care about losses to biodiversity? List and describe at least five reasons.
- What are ecosystem services? Give an example of ecosystem services have saved us money. What are ecosystem services linked to?
- List and describe the three threats to biodiversity. For each threat, give at least two specific examples of how biodiversity has negatively been impacted.
- One factor favoring rapid population growth by an introduced species is the absence of predators, parasites, and pathogens that controlled its population in the region where it evolved. Over the long term, how should evolution by natural selection influence the rate at which the native predators, parasites, and pathogens in a region of introduction attack an introduced species?
- Explain why it is too narrow to define the biodiversity crisis and simply a loss of species.
- Imagine two populations of fish species, one in the Mediterranean Sea and one in the Caribbean Sea. Now imagine two scenarios: (1) The populations breed separately, and (2) adults of both populations migrate to the North Atlantic to interbreed. Which scenario would result in a greater loss of genetic diversity if the Mediterranean population were harvested to extinction? Explain your answer.
- What is the small population approach to conservation? What do conservation biologists study through this approach? Use a specific example to help you answer this question.
- What is the extinction vortex? How does that relate to the minimum viable population and effective population size?
- Why does the reduced genetic diversity of small populations make them more vulnerable to extinction?
- Consider a hypothetical population of 100 greater prairie chickens, a species in which the females choose a mate from a group of displaying males. What is the effective population size if 35 females and 10 males of this species breed?
- What is the declining population approach to conservation? What do conservation biologists study through this approach? Use a specific example to help you answer this question.
- Can a population be small and not declining? What about declining but not small? Explain.
- List and describe two examples of conflicting demand.
- In 2005, at least ten grizzly bears in the greater Yellowstone ecosystem were killed through contact with people. Three things caused most of these deaths: collisions with automobiles, hunters (not of grizzly bears) shooting when charged by a female with cubs nearby, and conservation managers killing bears that attacked livestock repeatedly. If you were a conservation manager, what steps might you take to minimize such encounters in Yellowstone?
- What is an ecosystem edge? What defines the edges? How do edges and the proliferation of edge species correlate with fragmentation of ecosystem? Give a specific example in your answer.
- What are the pros and cons of movement corridors (what are movement corridors)?

- What is a biodiversity hot spot? Is identifying biodiversity hot spots easy? Explain.
- What is a nature reserve? Are most of our national parks large enough to protect biodiversity? Explain.
- What are zoned reserves? What is the approach to conservation with zoned reserves? Describe the zones reserves in Costa Rica and some of the problems they face.
- How do zoned reserves provide economic incentives for long-term conservation of protected areas? Use the Florida Keys Marine Reserve as an example in your answer.
- Suppose a developer proposes to clear-cut a forest that serves as a corridor between two parks. To compensate, the developer also proposes to add the same area of forest to one of the parks. As a professional ecologist, how might you argue for retaining the corridor?
- Identify the main goal of restoration ecology. Why is restoration ecology needed?
- Compare and contrast bioremediation and biological augmentation. Give specific examples of each in your answer.
- In what way is the Kissimmee River project a more complete ecological restoration than the Maungatautari project?
- What is meant by the term sustainable development? Use the case study in Costa Rica in your answer.
- Suppose a new fishery is discovered, and you are put in charge of developing it sustainably. What ecological data might you want on the fish population? What criteria would you apply for the fishery's development?