Name: _____   Date: _____

AP Biology Exam Review 7: Animal Behavior and Ecology

Helpful Videos and Animations:
1. Bozeman Biology: Ecosystems
2. Bozeman Biology: Ecosystem Change
3. Bozeman Biology: Ecological Succession
4. Bozeman Biology: Populations
5. Bozeman Biology: R and K Selection
6. Bozeman Biology: Cooperative Interactions
7. Bozeman Biology: Communities
8. Bozeman Biology: Niche

Relevant Objectives:

150. Describe the difference between innate and learned behaviors, and explain the evolutionary advantages of both
151. Describe the difference between kinesis and taxis, and explain the evolutionary advantages of both
152. Describe animal responses to various stimuli (food, habitat, mates)
153. Explain animal behaviors (cooperation, territoriality, conditioning, altruistic) in terms of evolutionary advantage to the animal or group of animals
154. Describe plant behaviors in terms of response to stimulus (light, gravity) and explain the evolutionary advantage of these behaviors
155. Know the levels of organization within the biosphere from largest to smallest
156. Define population
157. Define biotic, abiotic, exponential and logistic growth, carrying capacity, and limiting factors
158. Define range, spacing, and size of a population, and explain the factors that affect each of these components
159. Describe the three major types of survivorship curves, and explain what their shape means
160. Be able to interpret age structure diagrams
161. Discuss the trade-offs of reproduction, and explain how these lead to different life strategies (r vs. k selected species)
162. Describe conditions that lead to both exponential and logistic growth
163. Explain the difference between density dependent and density independent limiting factors
164. Define invasive species and describe their impact on an area
165. Explain how the predator-prey relationship leads to cycles in population size
166. Explain how human growth has changed over time, and discuss problems that could arise from this
167. Describe different methods of estimating population size (quadrat vs. mark-recapture)
168. Explain how mark-recapture allows for estimating population size, and describe factors that can affect results of this method
169. Define community, niche (fundamental & realized), competitive exclusion, resource partitioning, symbiosis, mimicry, species diversity and keystone species
170. Describe interspecific competition and explain the effects it has on populations
171. Explain the competitive exclusion principle, describe the effects it has on niches, and explain how populations use resources partitioning to live in the same habitat
172. Describe the three types of symbiosis and how they effect each organism in the interaction
173. Explain the evolutionary significance of mimicry, and describe the difference between batesian and mullerian mimicry
174. Describe how coevolution occurs
175. Explain how high biodiversity leads an ecosystem to be healthier
176. Explain the effects of a keystone species on an ecosystem
177. Describe the changes that occur in an ecoytem during ecological succession
178. Define ecosystem
179. Explain what a trophic level is and be able to name the trophic levels in an ecosystem
180. Describe how energy changes as it flows through trophic levels, and explain why this change occurs
181. Describe the cycling of nutrients in ecosystems
182. Compare chemosynthesis to photosynthesis
183. Define primary productivity, and describe aspects affecting it
184. Be able to calculate primary productivity (given conversion factors)
185. Describe the ecological problems caused by humans including global warming, ozone depletion, deforestation, acid precipitation, loss of biodiversity, and overharvesting
186. Explain solutions to human caused ecological problems
187. Describe the characteristics of each of the major biomes and explain adaptations that organisms have to living in these biomes
188. Describe the major threats to each of the biomes

Topic Outline:

1. Behavior
   - Plant
     - Phototropism – bend toward light (due to auxin)
     - Photoperiodism – plants only bloom at certain times, based on length of night
     - Gravitropism – roots grow towards gravity, shoots grow away from
     - Chemical defenses – herbivory induces plants to start producing toxic/unpalatable chemicals
   - Animal
     - Innate – behavior animal is born with, instinctive; controlled by genes; help animal to survive and/or reproduce
       - All animals of species exhibit behavior regardless of environment
       - Kinesis vs. Taxis
         - Kinesis – change in rate of movement in response to a stimulus (ex: water); helps animal to find necessary resources & avoid danger
         - Taxis – directed movement toward or away from a stimulus (ex: predator pheromone); helps animal to find necessary resources & avoid danger
       - Fixed action pattern – sequence of behaviors, unchangeable from start to finish (ex: egg rolling)
       - Migration, Imprinting
     - Learned behavior – behavior that is changeable and modified by experience; flexible with a changing environment
       - Operant vs. classical conditioning
         - Operant – associate behavior with reward or punishment (rats push lever, given treats)
         - Classical – connect behavior to stimulus (Pavlov's dogs)
       - Problem solving
     - Social behavior – interactions between individuals that develop as an evolutionary advantage
       - Altruistic – keep family alive (pass on some of your genes)
       - Cooperation – pack hunting
       - Dominance hierarchy – pecking order
       - Agnostic behavior – territoriality, fighting
       - Communication – see populations below

2. Populations
   - Population Growth
     - Density dependent limiting factors (competition for resources, parasites & diseases, waste products, stress, predation)
       - Change based on population size
       - Leads to intraspecific competition for resources
     - Density independent limiting factors (climate = temperature & rainfall, natural disaster)
     - Exponential growth (J-shaped, unlimited) vs. logistic growth curve (S-shaped, limited)
       - Logistic more realistic, takes into account carrying capacity and density-dependent limiting factors
     - Carrying capacity = maximum population supported by habitat
   - Using age structure to study human populations – life tables, etc.
   - Spacing patterns
     - Random – randomly spaced; caused by there being no interactions between individuals
     - Clumped – typically clumped around a resource, or for protection
     - Uniform – caused by negative interactions between species; territoriality
   - Survivorship curves
     - Type I – many live in infancy, high death rate later in life
     - Type II – constant mortality rate throughout life
     - Type III – many deaths at young age, few survivors live often
   - R vs. k selection
     - R – rapidly growing, small offspring, many offspring, little parental care; very good at being invasive – opportunistic
     - K – slow growing, large offspring, few offspring, high parental care; very good in a stable environment
   - Population ability to respond to changes in the environment is affected by genetic diversity. Species and populations with little genetic diversity are at risk for extinction.

- Communication within populations
  - Cooperative behavior (ex: predator warnings)
  - Behaviors to enhance reproductive success (ex: territory marking)
  - Different types of behaviors and reasons for behaviors: Animals use visual, audible, tactile, electrical and chemical signals to indicate dominance, find food, establish territory and ensure reproductive success. (ex: bee dances)

3. Communities
   - Niche (fundamental vs. realized)
     - Fundamental – niche that is possible for species to occupy
     - Realized – niche that species actually occupies due to competition
       - Interspecific competition
   - Be able to analyze food chains and food webs/identify trophic levels
     - Producer – does chemosynthesis or photosynthesis
     - Consumer – consumes food (primary, secondary, tertiary)
     - Decomposer – breaks down dead organisms and recycles nutrients
   - Location of decomposers on a food chain – feed on every level
   - Primary productivity (gross vs. net)
     - Measure of amount of carbon fixed; net takes into account loss of carbon due to respiration
   - Trophic Efficiency: energy pyramids, pyramids of biomass
     - Rule of 10 – only 10% efficiency, 90% lost between each level due to metabolic processes and heat
   - The importance of species diversity in a community (determined by species richness and relative abundance)
     - Keeps ecosystem stable
   - Types of symbiosis: mutualism, commensalism, parasitism,
   - Protection mechanisms – mimicry, Batesian vs. Mullerian; aposematic coloration; herding
   - The effect of removing a dominant or keystone species – large impact on an ecosystem, keystone species keep other populations in check (ex: otter)
   - Invasive species – no predators in new area, grow very quickly, outcompete native species for resources
     - Severely reduce biodiversity (ex: zebra mussel, purple loostrife)

4. Ecosystems
   - Levels of ecology: population, community, ecosystem, biome, biosphere
   - Abiotic vs. biotic factors (non-living vs. living)
   - Effect of human activities on ecosystems (ex: invasive species)
   - Effect of geological/meteorological events on ecosystems (ex: meteor causing extinction of dinosaurs)
   - Free Energy
     - Laws of thermodynamics
       - First law – energy is neither created nor destroyed, just changes form
         - What goes in must come out somewhere
       - Second law – some energy is "lost" as heat during every conversion; considered "lost" because heat is a "useless" energy
         - Leads to rule of 10
   - Nutrient Cycling
     - Carbon cycle – photosynthesis and respiration; sinks are fossil fuels and plants; released by burning fossil fuels
     - Nitrogen cycle – N fixation, nitrification, denitrification; sink is atmosphere
     - Phosphorus cycle – no gaseous phase; sinks in rocks
     - Water cycle – transpiration, evaporation, condensation, precipitation, runoff
     - CHNOPS = limiting nutrients
     - Excess N or P can lead to eutrophication of waters
       - Algal bloom, decaying algae decomposed by bacteria, bacteria use oxygen to respire → hypoxia
   - Ecological succession
     - Primary succession – starts from no soil
     - Secondary succession – starts with soil, after a disturbance
     - First plant species either create (primary) or change (secondary) the soil so that the environment becomes more suitable for other producers; increased producers leads to increased biodiversity

- Human Impact
  - Climate change – increased CO_2 in atmosphere due to burning fossil fuels; increases greenhouse effect; rising temperatures; rising sea level, melting ice, etc
  - Ozone depletion – CFC use depletes ozone layer; ozone essential to block out harmful UV rays; Montreal Protocol banned CFC use
  - Deforestation – cutting of forests causes increased CO_2 due to loss of sink; habitat loss, biodiversity loss
  - Overharvesting/overfishing – overuse of an area leads to reduced biodiversity
  - Pollution – biomagnification, more concentrated pollutants higher up the food chain; eutrophication from fertilizers

5. Biomes – characterized by precipitation and temperature (overall climate)
   - Tropical Rain forest
     - Near equatorial regions; abundant precipitation; high temperatures; high humidity
     - Large storage sink for carbon; most biodiverse biome on earth
     - All nutrients in trees/leaf litter; lost when deforestation occurs
   - Desert
     - 30° N or S of equator; very little precipitation; most extreme fluctuations of any biome – can get very cool at night, very hot during day
     - Plants adapted to be drought resistant – deep roots; thick, waxy cuticle; small needles to minimize loss
     - Animals adaptations to stay cool – active at night; large SA:V ratio accomplished through large ears etc.
   - Grasslands
     - Huge areas in temperate and tropical regions
     - Low rainfall or uneven seasonal rainfall; conditions inhospitable for forests
     - Grasses are producers; consumers include bison, prairie dogs
   - Temperate Deciduous
     - North America, South of Taiga
     - Trees drop leaves in winter (deciduous)
     - Vertical stratification – small, medium, and large trees; allows for diversification of animals
     - Rich soils
   - Coniferous Forest (Taiga)
     - Located in northern Canada and much of world's northern regions; very cold winters; heavy snowfall
     - Dominated by conifers (do not drop leaves in winter – needle-like); trees shaped with branches slanted downwards to prevent heavy accumulations of snow
   - Tundra
     - Northern parts of world
     - Characterized by permafrost – permanently frozen subsoil; large carbon sink
     - "Frozen desert" – very little rainfall, very little vegetation
     - Vegetation is very small, guards against the winds
   - Aquatic – cover 75% of earth
     - Freshwater vs. saltwater
     - Estuaries – mouths of rivers where freshwater and saltwater mix; mangroves and salt marshes are very diverse, serve as nurseries for fish
   - Wetlands – extremely biodiverse, prevent against floods, naturally filter water

Practice Multiple Choice Questions:

1. Long-term studies of Belding's ground squirrels show that immigrants move nearly 2 km from where they are born and become 1% –8% of the males and 0.7% –6% of the females in other populations. On an evolutionary scale, why is this significant?
a. These immigrants make up for the deaths of individuals, keeping the other populations' size stable.
b. Young reproductive males tend to stay in their home population and are not driven out by other territorial males.
c. These immigrants provide a source of genetic diversity for the other populations.
d. Those individuals that emigrate to these new populations are looking for less crowded conditions with more resources.
e. Gradually, the populations of ground squirrels will move from a clumped to a uniform population pattern of dispersion.

2. Approximately how many kg of carnivore (secondary consumer) biomass can be supported by a field plot containing 25,000 kg of plant material?
a. 250,000
b. 2,500
c. 250
d. 25
e. 2.5

3. Which of the following graphs illustrates the REALISTIC growth curve of a small population of rodents that has grown to reach a static carrying capacity?
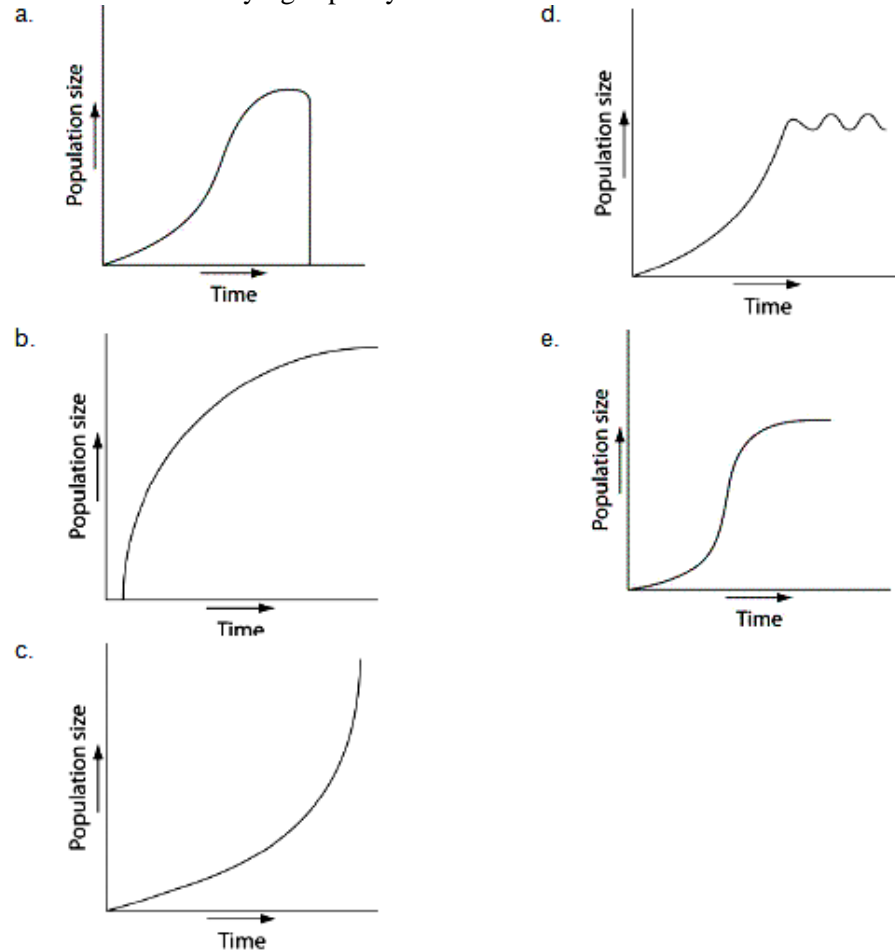
4. Why is net primary production (NPP) a more useful measurement to an ecosystem ecologist than gross primary production (GPP)?
a. NPP can be expressed in energy/unit of area/unit of time.
b. NPP can be expressed in terms of carbon fixed by photosynthesis for an entire ecosystem.
c. NPP represents the stored chemical energy that is available to consumers in the ecosystem.
d. NPP is the same as the standing crop.
e. NPP shows the rate at which the standing crop is utilized by consumers.

5. Elephants are not the most dominant species in African grasslands, yet they influence community structure. The grasslands contain scattered woody plants, but they are kept in check by the uprooting activities of the elephants. Take away the elephants, and the grasslands convert to forests or to shrublands. The newly growing forests support fewer species than the previous grasslands. Which of the following describes why elephants are the keystone species in this scenario?
a. Essentially all of the other species depend on the presence of the elephants to maintain the community.
b. Grazing animals depend upon the elephants to convert forests to grassland.
c. Elephants prevent drought in African grasslands.
d. Elephants are the biggest herbivore in this community.
e. Elephants help other populations survive by keeping out many of the large African predators.

6. Researchers in the Netherlands studied the effects of parental care given in European kestrels over five years. The researchers transferred chicks among nests to produce reduced broods (three or four chicks), normal broods (five or six chicks), and enlarged broods (seven or eight chicks). They then measured the percentage of male and female parent birds that survived the following winter. (Both males and females provide care for chicks.)

Which of the following is a conclusion that can be drawn from this graph?

a. Female survivability is more negatively affected by larger brood size than is male survivability.
b. Male survivability decreased by 50% between reduced and enlarged brood treatments.
c. Both males and females had increases in daily hunting with the enlarged brood size.
d. There appears to be a negative correlation between brood enlargements and parental survival.
e. Chicks in reduced brood treatment received more food, weight gain, and reduced mortality.
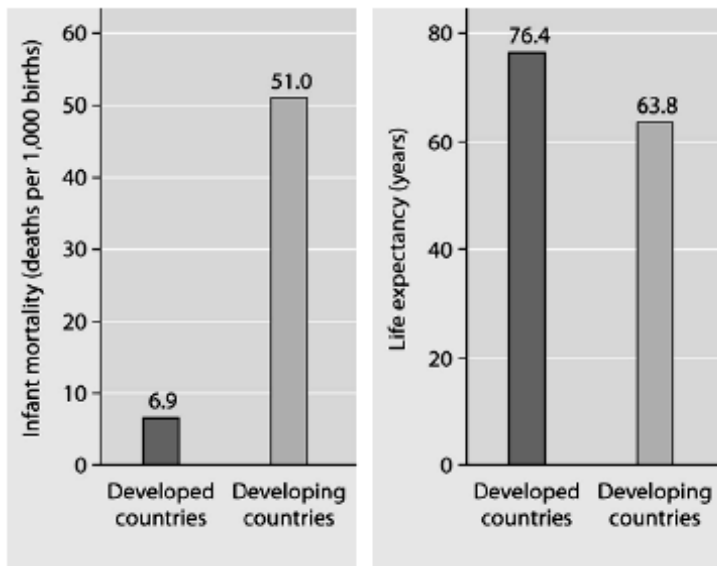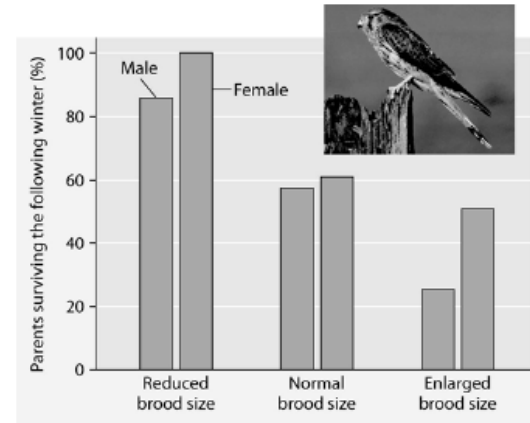
6. What is a logical conclusion that can be drawn from the graphs above?
a. Developed countries have lower infant mortality rates and lower life expectancy than developing countries.
b. Developed countries have higher infant mortality rates and lower life expectancy than developing countries.
c. Developed countries have lower infant mortality rates and higher life expectancy than developing countries.
d. Developed countries have higher infant mortality rates and higher life expectancy than developing countries.
e. Developed countries have a life expectancy that is about 42 years more than life expectancy in developing countries.

8. Food chains are sometimes short because
a. only a single species of herbivore feeds on each plant species.
b. local extinction of a species causes extinction of the other species in its food chain.
c. most of the energy in a trophic level is lost as it passes to the next higher level.
d. predator species tend to be less diverse and less abundant than prey species.
e. most producers are inedible.

9. Consider the food chain grass → grasshopper → mouse → snake → hawk. How much of the chemical energy fixed by photosynthesis of the grass (100%) is available to the hawk?
a. 0.01%
b. 0.1%
c. 1%
d. 10%
e. 60%

10. If the figure to the right represents a terrestrial food web, the combined biomass of C + D would probably be
a. greater than the biomass of A.
b. less than the biomass of H.
c. greater than the biomass of B.
d. less than the biomass of A + B.
e. less than the biomass of E.
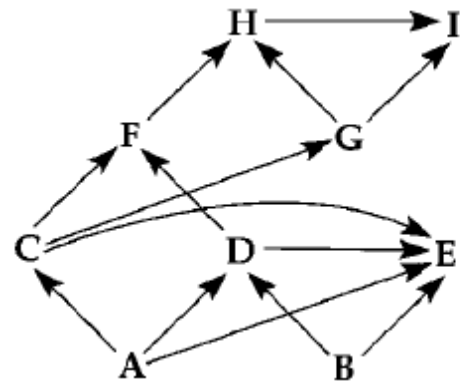
11. All of the following are density-dependent factors that limit animal populations EXCEPT
a. weather   d. food competition
b. predation   e. mortality
c. birthrate

12. During the carbon cycle, which of the following carbon compounds would be utilized as an energy source by heterotrophs?
a. calcium carbonate
b. carbonic acid
c. organic molecules
d. carbon dioxide
e. carbon monoxide

13. All of the following statements concerning characteristics of predator-prey relationships are correct EXCEPT:
a. A rise in the population of prey is often followed by a rise in the population of predators.
b. A rise in the population of predators is followed by a decrease in the population of prey.
c. Camouflage is an adaptation that protects prey.
d. The production of large numbers of offspring within very short periods of time ensures the survival of some prey populations.
e. The population of predators most often eliminates the population of prey.

14. In the nitrogen cycle, the transformation of gaseous nitrogen into nitrogen-containing compounds is performed primarily by
a. fungi   b. bacteria
b. green plants   e. herbivores
c. carnivores

15. The organic and inorganic materials in all the organisms in the diagram will eventually return to the environment by the action of
a. decomposers   d. producers
b. primary consumers e. secondary consumers
c. top carnivores

**Questions 16-18** Refer to the graph to the right.

16. Represents the carrying capacity of the ecosystem

17. Represents exponential growth of a population

18. Represents the effect of density-dependent resources

19. The high level of pesticides in birds of prey is an example of
a. the principle of competitive exclusion
b. cycling of nutrients by decomposers
c. exponential growth
d. biological magnification
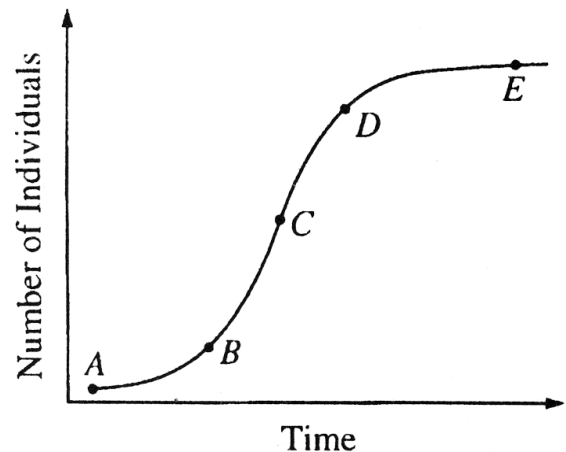
The illustrations to the right show the age and sex of the human populations in Country 1 and Country 2. The ages are grouped by 5-year classes, and the sexes are represented separately. The percentages in the different age classes are shown by the relative widths of successive horizontal bars.
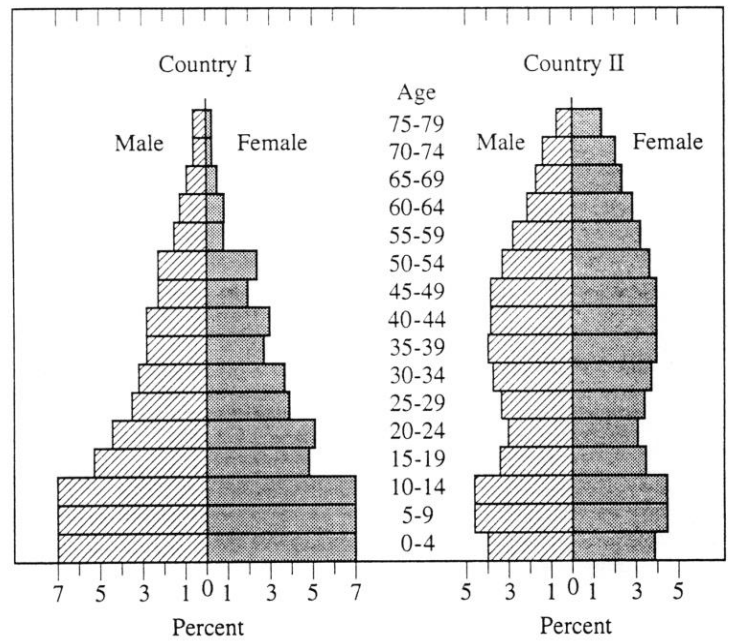
20. In Country 2, approximately what percentage of the individuals are younger than fifteen years of age?
a. 10%
b. 26%
c. 45%
d. 60%
e. It cannot be estimated from this graph

21. Which country is likely experiencing population growth?
a. Country I
b. Country II
c. Neither country I or country II
d. Both country I and country II

22. Which of the following is NOT an abiotic factor
a. air
b. water
c. decomposers
d. temperature

23. Which of the following lists the biomes as they appear as you move from the equator to the North Pole in the northern hemisphere?
a. tropical rainforest → desert → temperate deciduous forest → taiga → tundra
b. desert → tundra → taiga → temperate deciduous forest → tropical rainforest
c. taiga → temperate deciduous forest → tundra → desert → tropical rain forest
d. tundra → taiga → temperate deciduous forest → desert → tropical rainforest

Questions 24-26. Refer to the survivorship curve shown to the right.

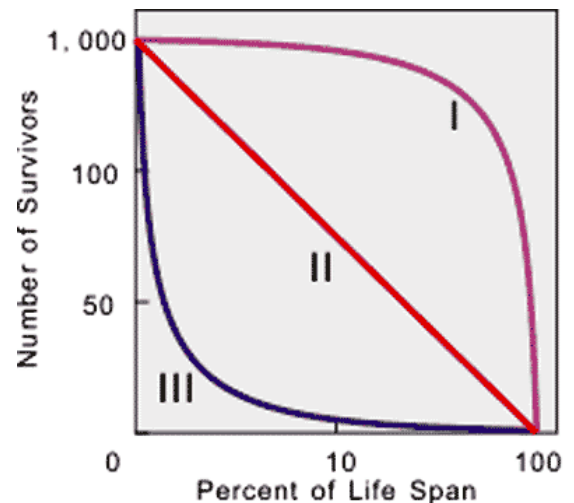24. This curve best describes a K-strategist
a. Type I
b. Type II
c. Type III
d. Type I and II
e. None of the above

25. This curve best describes a starfish
a. Type I
b. Type II
c. Type III
d. Type I and III
e. None of the above

26. Which curve best describes an organism that invests a lot of energy in parenting?
a. Type I
b. Type II
c. Type III
d. Type I and II
e. None of the above

27. What would most likely be the cause of one species growing in area in a uniform spacing pattern?
a. random distribution of offspring
b. interactions among individuals in a population
c. chance
d. varied nutrient supplies in the area

28. You want to train your puppy to wait at the curb until you tell him to cross the road. Your friend advises you to give your dog a treat every time he does as you ask. Your friend is advising that you train the dog using
a. operant conditioning   c. classical conditioning
b. imprinting   d. fixed action pattern

29. Animals that help other animals are expected to be
a. stronger than other animals   c. related to the animals they help
b. male   d. female

30. Eutrophication in lakes results from
a. an increase in temperatures   c. a decrease in temparatures
b. an increase in carbon dioxide in the air   d. an increase in nutrients in the lake

31. A scientist recorded the amount of dissolved oxygen produced by elodea, an underwater plant, as 52 mg O_2/L. How much carbon (in mg/L) was fixed by this plant? Round your answer to the nearest tenth.

32. A hypothetical population has a carrying capacity of 1,500 individuals and rmax is 1.0. What is the population growth rate for a population with a size of 1,600 individuals? Round your answer to the nearest hundredth. What is happening to this population?

33. Using the diagram to the right, determine how much carbon (in g/m2) is released into the atmosphere as a result of the metabolic activity of herbivores. Give your answer to the nearest whole number.
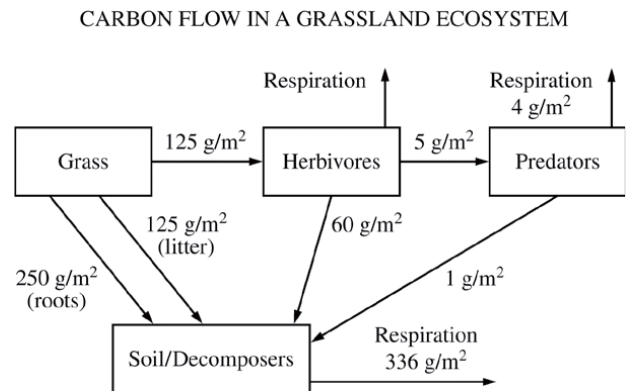
34. A growth curve for a population of rabbits that were accidentally introduced into a region of New Zealand is shown to the right. Calculate the mean growth rate of the population of rabbits from day 30 to day 40. Give your answer to the nearest whole number.

CARBON FLOW IN A GRASSLAND ECOSYSTEM
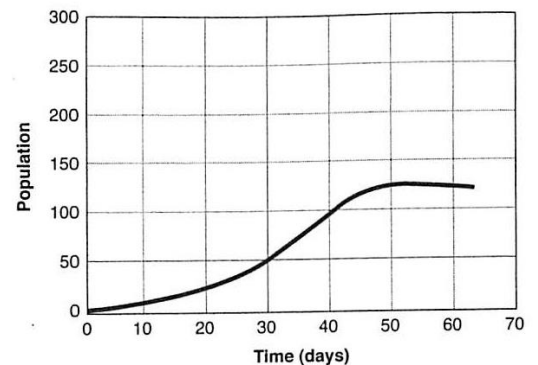
Practice Long Response Questions

1. Ecological succession describes the pattern of changes in communities over time. The graph below shows changes in plant diversity following the abandonment of an agricultural field in a temperate biome.

CHANGE IN SPECIES
DIVERSITY OVER TIME

...... Ground flora
—— Shrubs
--- Understory trees
—— Canopy trees
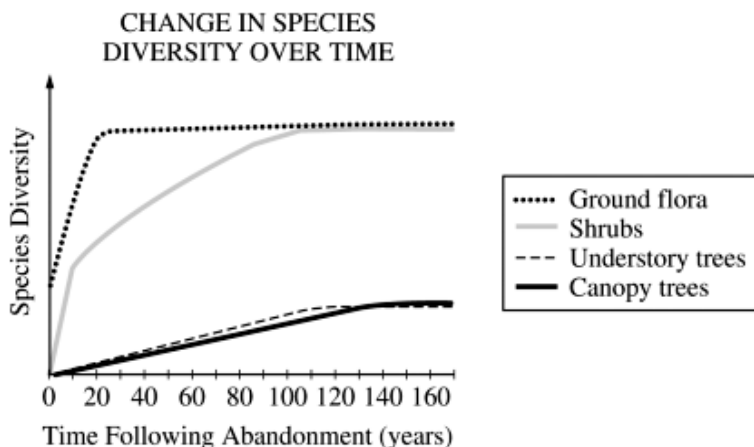
(a) Discuss the differences in plant diversity shown in the graph and explain how the changes affect the animal species composition between years 0 and 120.
(b) Identify TWO biotic and TWO abiotic factors and discuss how each could influence the pattern of ecological succession.

2. In many ways, all organisms in a food web can said to be solar-powered. The producer level of the food web is responsible for the transformation of the solar energy into a form that can be used by other living organisms.
a. Discuss the role of green plants in transforming the Sun's energy into a form that can ultimately be used by heterotrophs.
b. discuss the flow of energy from producers through top carnivores in a food web in terms of the laws of thermodynamics.
c. An energy pyramid for an ecosystem is shown below. Label each trophic level of the pyramid and provide an example of an organism found at each level of this pyramid. Explain why the energy available at the top layer of the pyramid is a small percentage of the energy present at the bottom of the pyramid.
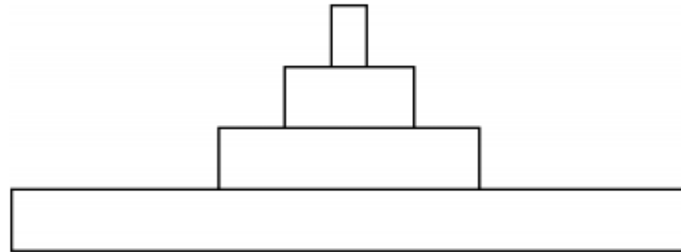
3. The element carbon is contained in all organic compounds.
(a) Discuss the role of photosynthesis and cellular respiration in carbon cycling in the biosphere.
(b) For TWO of the following, predict and explain the effect on the carbon cycle if:
    o   decomposers were absent
    o   deforestation occurred
    o   volcanic dust accumulated in the atmosphere
    o   the average ocean temperature increased
(c) Explain how increased CO_2 in the atmosphere results in greater acidification of oceans and describe the effect on marine organisms. Include in your discussion TWO examples of how human activity can increase atmospheric CO_2.

4. Referring to the diagram below, discuss how TWO of the following processes are accomplished:
    o   process A
    o   process B
    o   process D
    o   process E