AP® Biology
2003 Sample Student Responses

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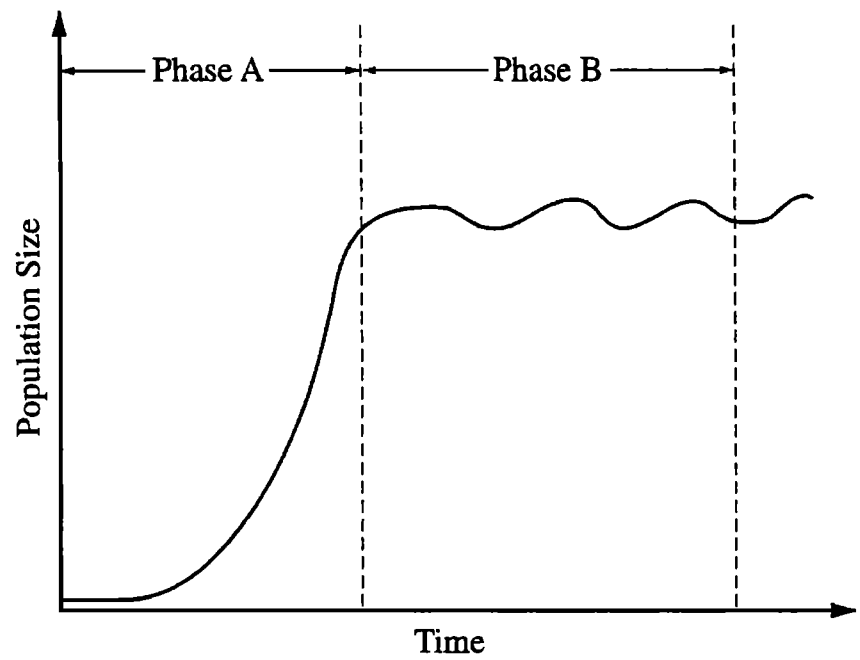
3. Many populations exhibit the following growth curve:



(a) Describe what is occurring in the population during phase A.

(b) Discuss **THREE** factors that might cause the fluctuations shown in phase B.

(c) Organisms demonstrate exponential (*r*) or logistic (*K*) reproductive strategies. Explain these two strategies and discuss how they affect population size over time.

(a) During phase A, the population is experiencing exponential growth, a growth phase characterized by lack of environmental resistance. However, exponential growth rapidly outstrips food supply and other limiting factors, which comprise the carrying capacity of an environment. Carrying capacity is the maximum number of individuals of a certain population that an environment can sustain. For most of phase A, the population experiences its biotic potential, or maximum growth rate, until it apparently decelerates once it nears the carrying capacity of the particular environment. (Before the exponential growth and subsequent deceleration, the population was in a lag phase, a period of slow growth produced by the small amount of reproducing organisms present.)

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(b) In phase B, the population seems to remain relatively stable, though it fluctuates periodically above and below its apparent carrying capacity. Such fluctuations may be the result of numerous factors, including these 3 particular ones: a biotic factor such as competition for a food source; an abiotic factor such as the presence of some nutrient; or predation. As a population increases rapidly, more stress is placed on the food supply by increasing number of organisms. As a result, food resources decrease and there is increased competition among members for food. This increased competition causes less successful members to die off (or their differential reproductive success to be limited) resulting in the decreases in population observed in the fluctuations. As competitors decrease, food resources increase, and the increased food supply in turn leads to an increase in the number of members supported by those resources. In a similar way, the fluctuations might be produced by a limited supply of an abiotic factor like phosphorus, which is required by some organisms for nutrition. As the population increases, phosphorus supplies are outstripped, leading to a decrease in population size. As the population size decreases, less stress is placed on phosphorus resources and the population is able to grow again. Finally, the fluctuations may be caused by predators: As the population increases, it experiences more predation, and thus falls. This fall leads to a decrease in the predator population, which in turn occasions another rise in the prey population. (All the above phenomena cycle.)

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(C) Th r-selected reproductive strategy entails that practiced by opportunistic species. Large amounts of offspring are produced, little time is invested by parents in their development, and overall lifespan is abbreviated. Thus these organisms are successful at colonizing new ecosystems, but are generally out-competed by K-selected ~~individuals~~ organisms which are described below.

The K-selective reproductive strategy entails that which is practiced by organisms that produce limited ~~amounts~~ numbers, of offspring, invest much time in the development of these offspring, and have a long lifespan. Although there are fewer organisms in these populations, they are usually able to outcompete r-selected populations on account of their enhanced development and longevity, and thus would be more prevalent in a population over time. K-selected populations, on the other hand, would increase the size of a population drastically but only initially.

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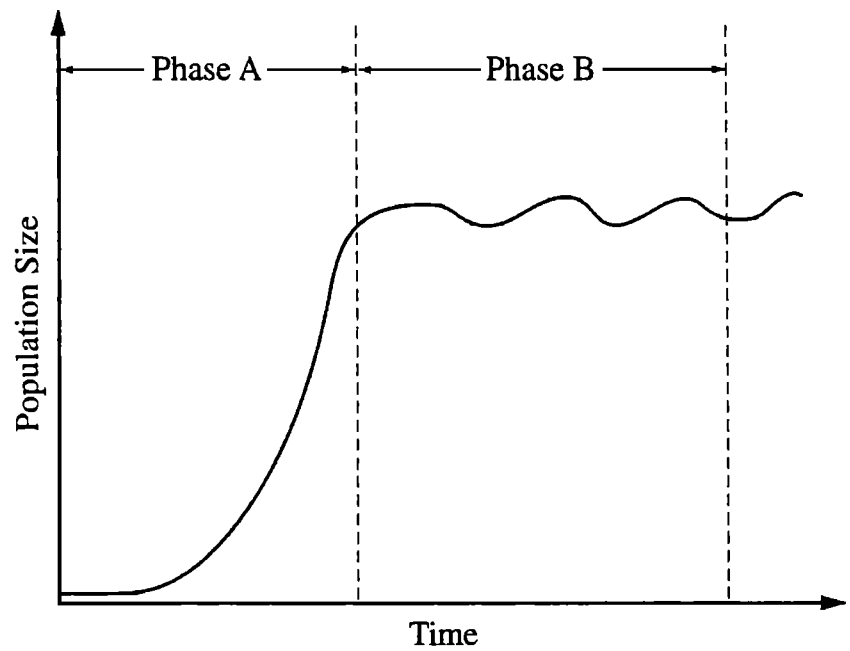

(a) Describe what is occurring in the population during phase A.

(b) Discuss **THREE** factors that might cause the fluctuations shown in phase B.

(c) Organisms demonstrate exponential (*r*) or logistic (*K*) reproductive strategies. Explain these two strategies and discuss how they affect population size over time.

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3. (a) During phase A, the population is experiencing what is known as exponential growth. The population starts out very small, with only a few members, but rapidly reproduces. The population is still too small to be affected by density dependant factors, therefore it grows at an exponential rate. However, as the population size begins to grow too large for the carrying capacity of the environment, the growth rate begins to level off, as one can see towards the very end of phase A.

(b) In phase B, the population is experiencing stable growth. The population size remains constant, with slight fluctuations every few units of time. These fluctuations could be caused by many different factors. For example, the population could increase slightly due to a very fertile spring/summer, which would increase the carrying capacity of the environment slightly. With an increased number of animals in

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the population could also cause an increased number of predators. If the number of predators increased, it would cause the population size to decrease. Once the population was decreased, the predators would not have enough prey to support them, which would cause the number of predators to decline. As a result, the population size would then increase again. Another cause of variation within a population could be natural disasters. Droughts, fires, and severe weather often cause population sizes to decrease. Population sizes are affected by both biotic and abiotic factors.

© Organisms that express exponential reproductive strategies produce a large amount of offspring, but provide very little parental care for them. The parents hope for favorable weather conditions and low predator levels. Most often, only a small amount of the offspring ever reach maturity. In logistic reproductive strategies, the parents produce a small number of offspring, but provide nearly constant parental care. The parents protect their offspring from predators and other environmental factors, rather than relying simply on chance. In perfect conditions, exponential reproductive strategies will produce an enormous amount of offspring, raising the population size at an exponential rate; however, if conditions aren't perfect, the population size isn't really affected. Organisms that express logistic reproductive strategies produce an even amount offspring that reach maturity most of the time. This causes the population size to remain stable w/ slight fluctuations as seen in phase B of the graph.

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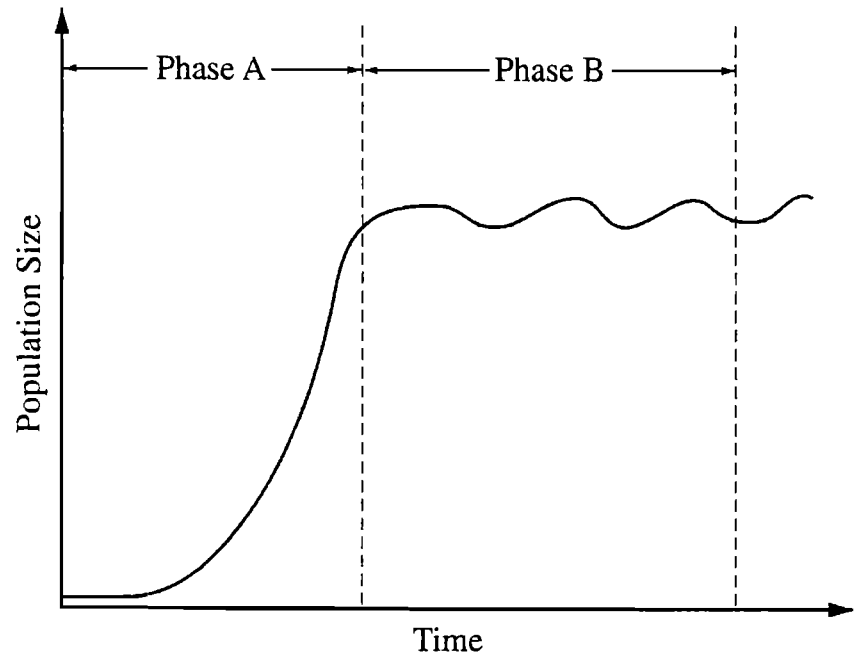
3. Many populations exhibit the following growth curve



(a) Describe what is occurring in the population during phase A.

(b) Discuss **THREE** factors that might cause the fluctuations shown in phase B.

(c) Organisms demonstrate exponential (*r*) or logistic (*K*) reproductive strategies. Explain these two strategies and discuss how they affect population size over time.

a) During phase A, exponential growth is occurring. The population size was small to start with, probably due to a natural disaster or limited resources. However, then conditions became favorable again and the population size increased exponentially to plenty of space and energy. There is nothing to check the population growth rate and it just keeps increasing and increasing until the carrying capacity is reached.

b) Phase B is when the population has reached the carrying capacity. The population fluctuates due to competition for resources. There will be organisms dying off because they cannot obtain enough resources. The population size will then drop. When those organisms die, there will be more available resources and the population will rise again. When it rises, there won't be enough resources for every member of the population

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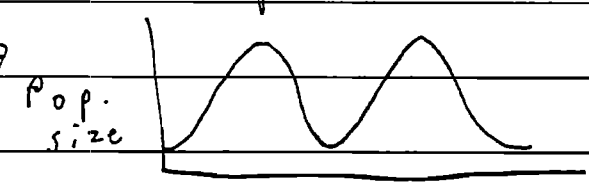
and members will die again, continuing the cycle.
Another factor that causes the fluctuations is disease. When the population reaches a very large size, diseases will run rampant and kill many members of the population. However, once the weak individuals die of disease, the disease itself will die out, allowing the population to rebound once again.
Finally, available space is another limiting factor. Just as resources and nutrients are limited, so is space. The environment can't accomodate all the members of population. Once the population becomes too large, individuals will die due to the lack of space. Once they die, there will be more space and the population can increase again, until the lack of space starts the cycle all over again.
c) Exponential reproductive strategy is when the parents produce a huge amount of offspring all at once, but doesn't take very good care of the offspring so that many will die. The population size is characterized be huge increases of individuals, and then dips in the population →



Logistic reproductive strategy is when the parents don't produce very many offspring, but take very good care of the offspring so that they have a very high survival rate. Mammals generally tend to exhibit this type of growth. The population

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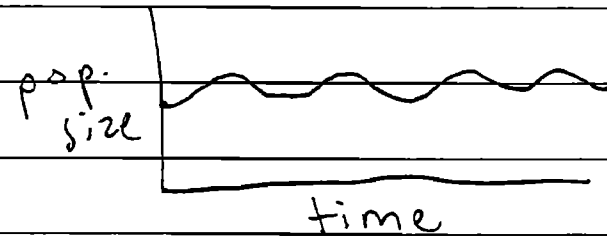
size will remain very steady and have minor fluctuations due to birth and death.



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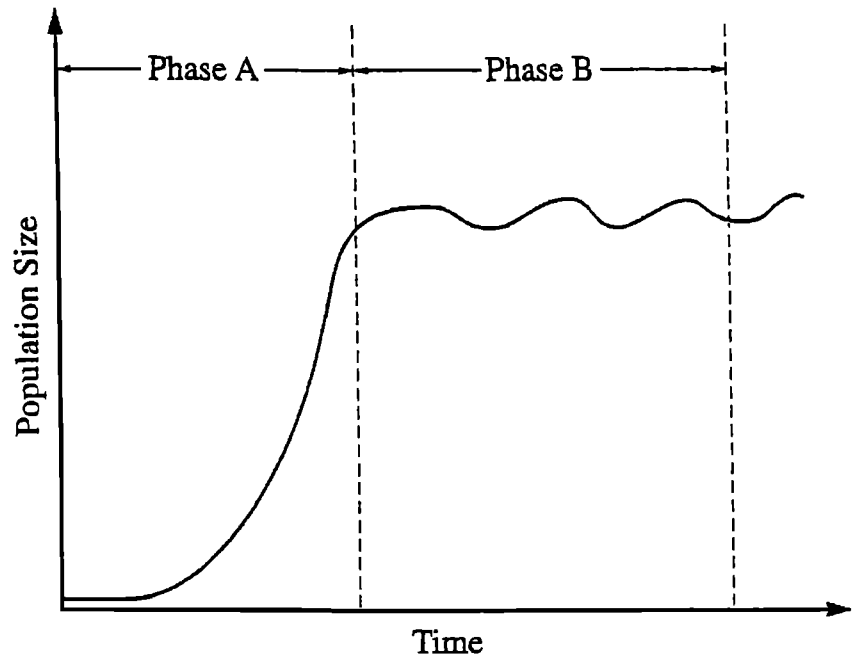

(a) Describe what is occurring in the population during phase A.

(b) Discuss **THREE** factors that might cause the fluctuations shown in phase B.

(c) Organisms demonstrate exponential (*r*) or logistic (*K*) reproductive strategies. Explain these two strategies and discuss how they affect population size over time.

A.) During phase a the population is growing rapidly. This type of growth is known as exponential growth. The population goes from a relatively stable growth rate to a very rapid growth period over a short period of time

B.) Three factors that might be the cause of the fluctuations of the population might be: disease, a scarce food supply resulting in the death of many in the population, and the introduction of new species or predators into their community. Disease might be the culprit of the fluctuations in the population because the disease might be killing the older organisms as well as the new offspring of the population resulting in a drop in population size because not enough newborns, or young are making it into adulthood to

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replace the dead, older organisms. The disease might strike on certain years resulting in fluctuations in the population because the organisms are allowed to recover before the disease strikes again. Scarce food supplies might also be the culprit of the population fluctuations. Food supplies may diminish on certain times of the year due to drought, or extreme heat or cold which might destroy the food supply of the population. As a result, when food is scarce, more organisms will perish because there will not be enough food for everybody and, when food supplies return to normal the population will also, it will increase to its previous numbers before the food shortage. The food shortage might be happening at specific times of the year resulting in population fluctuations. New species might also be the cause for population fluctuations because they might be killing many of species population

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