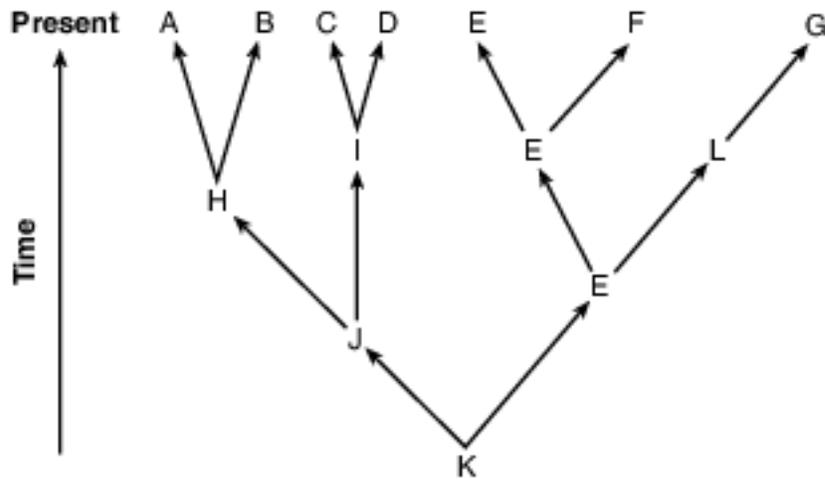


Adaptation By Natural Selection

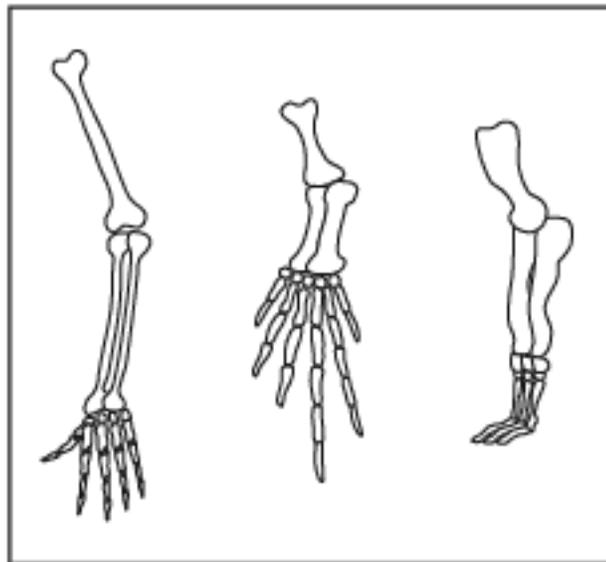
1 The evolutionary pathways of several species are represented in the diagram below.



Which species was best adapted for survival in changing environmental conditions?

- (1) A
- (2) E
- (3) K
- (4) L

2 The diagram below represents the bone arrangements in the front limbs of three different species of mammals.



The similarities and differences in these limbs suggest that all three species developed from the same ancestor, but

- (1) produced different numbers of offspring
- (2) lived in different time periods
- (3) adapted to different habitats
- (4) migrated to similar habitats

- 3 In 1970, a deadly disease spread through corn crops in the United States. Scientists discovered that 80 percent of the corn contained the gene that made the plants more likely to be infected with the disease. This problem might have been avoided if the cornfields across the country had had more
 - (1) large predators to control parasite populations
 - (2) selective mutations
 - (3) genetic diversity
 - (4) breeding of infected plants
- 4 One possible explanation for the fact that some simple, one-celled organisms did not evolve into complex, multicellular organisms is that
 - (1) energy flow in an ecosystem requires simple autotrophic organisms
 - (2) the reproductive rate of single-celled organisms is too fast for change to occur
 - (3) these organisms possessed traits that enabled them to survive in a changing environment
 - (4) stability within an ecosystem requires the presence of a variety of different species
- 5 Potatoes were the main crop in Ireland in the 1800s. Almost the entire population of Ireland was dependent on a single variety of potato, the "lumper." These potatoes were reproduced by a method of asexual reproduction known as vegetative propagation. In the middle of the 1800s, a disease caused by a fungus killed almost the entire lumper crop within two years. As a result, millions of people in Ireland died of starvation. The most likely reason the potato disease was able to destroy the potato crop in such a short time is that the
 - (1) potato population lacked variations
 - (2) lumper variety had a long reproductive cycle
 - (3) lumper had several variations caused by vegetative propagation
 - (4) potato population in Ireland utilized all of the finite resources
- 6 Survival of at least a few members of a population after a major environmental change is most dependent on
 - (1) the population having an individual that is adapted to the original environment
 - (2) the population having an individual that is adapted to great changes in the temperature in its environment
 - (3) variations in many different traits in many individuals in the population
 - (4) no variations in the color of the fur, skin, or feathers of the individuals in the population

Base your answers to questions 7 on the information below and on your knowledge of biology.

The Galapagos pink land iguana, *Conolophus marthae* (*C. marthae*), is native to only one of the Galapagos Islands. Its entire range is currently limited to Wolf Volcano on Isabella Island. The iguana was first discovered on this island in 1986. Genetic studies of the animal began sometime later, and it was identified as a species separate from other iguana populations on the Galapagos in 2009. Its population might have been as high as 100 in 1986, but now there might be as few as 10 of the animals left alive.

Other evidence indicates that this species could have diverged from another line of iguanas about 5.7 million years ago. After that, the other line of iguanas diverged into two other species, *C. pallidus* and *C. subcristatus*.

- 7 In the future, the current population of about ten pink land iguanas will probably
- (1) migrate to new islands in the Galapagos in order to survive
 - (2) soon become extinct, because they have little genetic diversity
 - (3) undergo evolution by natural selection and survive
 - (4) soon become extinct, because they have too much genetic diversity

8 Each row in the chart below represents a different population of the same species of insect. Which row shows the population with the greatest chance of survival in a changing environment?

(1)				
(2)				
(3)				
(4)				

- | | |
|-------|-------|
| (1) 1 | (3) 3 |
| (2) 2 | (4) 4 |

Base your answer to question 9-13 on the information below and on your knowledge of biology.

New varieties of organisms have resulted from human activities. These organisms have often led to problems in modern society. Two of these new varieties are listed below.

Antibiotic-resistant bacteria Pesticide-resistant insects

9-13 Select one of these varieties and discuss a problem associated with the development of this new variety of organism. In your answer, be sure to:

- identify the variety you selected
- identify one biological process by which a population of this variety may develop resistance [1]
- describe how this process is involved in the production of a population of resistant organisms [1]
- identify one problem caused by this resistance [1]
- state one solution to this problem [1]
- identify one possible negative effect of this solution [1]

Variety: _____

- 14 For many years, health officials had encouraged using antibacterial hand soap. Today, many scientists recommend using hand soap with no added antibacterial substances. State one reason why using antibacterial hand soap may no longer be recommended. [1]

Base your answers to questions 15 on the information below and on your knowledge of biology.

EVOLUTION OF THE ELEPHANT

Today's elephants are the result of a long process of evolution. Over millions of years, small changes were passed from one generation to the next. The first fossil elephant species were small, but over time, they increased both in size and weight. The three species alive today are the sole survivors of a once much more widespread group.

Source: www.factmonster.com/dk/science/encyclopedia/evolution.html

- 15 Explain why some elephant species did not survive. [1]
- 16 Several students were diagnosed with strep throat. They were all given the same antibiotic and took it for the time specified. Three weeks later, after finishing all their antibiotic, all the students except one no longer had strep throat. State one likely reason why the one student was still infected with strep bacteria. [1]

Base your answers to questions 17 on the information below and on your knowledge of biology.

Project Frozen Dumbo – Saving the Elephant Population Means Using Special Breeding

Over the last 10 years, 70 percent of Africa's wild elephant population has been killed off. The main cause is ivory poaching, in which elephants are slaughtered for their valuable tusks. At the same time, efforts to breed captive zoo elephants have not been very successful.

Now there is some good news. At zoos in Austria and England, two baby elephants were born, using sperm from South African wild elephants. For the first time, elephant sperm gathered in the wild was frozen and given to zoos. Two female zoo elephants were artificially impregnated with the sperm and went on to deliver calves. ...

Source: Saving the Elephant Population Means Using Special Breeding, Pittsburgh Post-Gazette, 8/21/14

- 17 State one reason why the use of sperm from wild elephants, rather than the use of sperm from elephants in zoos in England or Austria, would be more important to the long-term survival of elephants. [1]

Base your answers to questions 18 on the information below and on your knowledge of biology.

Female Shark Reproduced Without Male DNA, Scientists Say

A hammerhead shark that gave birth in a Nebraska aquarium reproduced without mating, a genetic analysis shows.

This form of asexual reproduction, called parthenogenesis, has been found in other vertebrate species, including some snakes and lizards. But this is the first time it has been documented in a shark....

Instead, the female shark's own genetic material combined during this process of cell division that produces an egg. A cell called the secondary oocyte, which contains half the female chromosomes and normally becomes the egg, fused with another cell called the secondary polar body, which contains the identical [amount of] genetic material....

Robert E. Hueter, director of the Center for Shark Research at the Mote Marine Laboratory in Sarasota, Fla., said the finding helped fill a gap in understanding parthenogenesis, which has been found to occur in most vertebrate lines except mammals, and until now, cartilaginous fishes like sharks....

"It's a last-resort tactic that animals use when they absolutely can't find another mate," Dr. Hueter said.

Source: Henry Fountain, The New York Times, May 23, 2007

18 Explain why parthenogenesis could prove to be harmful to the survival of this species if it were the only method of shark reproduction. [1]

Base your answer to question 19-21 on the information and photographs below and on your knowledge of biology.

In addition to their use for hearing, ears contain many blood vessels that allow heat to escape into the air. Animals that live in warm climates tend to have ears with large areas exposed to the environment. Animals in cold climates have a more compact ear that keeps exposure to the environment to a minimum. The photographs below show a jackrabbit from desert regions of the southwestern United States and a fennec fox from northern Africa with large ears, and a snowshoe hare and an arctic fox with small ears.



Jackrabbit



Fennec Fox



Snowshoe Hare



Arctic Fox

19-21 Discuss how differences in ear size in these organisms might have occurred. In your answer, be sure to:

- explain how the size of these animals' ears can help the animals survive in their environment [1]
- identify one process that most likely resulted in the animals in warm climates having large ears, while animals in cold climates have small ears [1]
- state how the overproduction of offspring in each species for many generations contributed to the presence of different ear sizes [1]

Answer Keys

1 2

2 3

3 3

4 3

5 1

6 3

7 2

8 1

- 9-13 The student's response to the bulleted items in the question need not appear in the following order.
- 9. Allow 1 credit for identifying one biological process by which a population of this variety may develop resistance. Acceptable responses include, but are not limited to:
 - — natural selection
 - — evolution
 - — reproduction
 - — mutation
 - 10. Allow 1 credit for describing how this process is involved in the production of a population of resistant organisms. Acceptable responses include, but are not limited to:
 - Natural Selection:
 - — The population had some members that were naturally resistant to antibiotics. They survived and reproduced, passing on the resistance.
 - Evolution:
 - — Some organisms were resistant to the pesticide. They survived and passed on the trait.
 - Reproduction:
 - — Resistant members survived and passed on the trait.
 - Mutation:
 - — It produces variations that give some organisms a survival advantage.
 - Note: Allow credit for a response consistent with the process identified in question 9. .
 - 12. Allow 1 credit for identifying one problem caused by this resistance. Acceptable responses include, but are not limited to:
 - — Resistant bacteria will survive and continue to make people sick.
 - — Insects will continue to destroy crops.
 - — Antibiotics do not work anymore.
 - — There will be less food available.
 - 13. Allow 1 credit for stating one solution to this problem. Acceptable responses include, but are not limited to:
 - — Do not use antibiotics/antibacterial products unless needed.
 - — Use different antibiotics or pesticides.
 - — Use a natural predator for pests.
 - — Insert genes into plants that will make them resistant to bacteria or pests.
 - — Research and find new antibiotics/ways of controlling insect pests.
 - Note: Allow credit for a response consistent with the problem identified in question 12. .
 - 15. Allow 1 credit for identifying one possible negative effect of this solution. Acceptable responses include, but are not limited to:
 - — People might be sick longer.
 - — More people could get sick.
 - — Organisms may become resistant to other treatments.
 - — Natural predators may get out of control.
 - — Inserted genes may have an undesired effect.
 - — Research takes a lot of time and money.
 - Note: Allow credit for a response consistent with the student's solution to question 13. .
- 14 Allow 1 credit. Acceptable responses include, but are not limited to:
- — Overuse of antibacterial agents may result in an increase in the number of resistant bacteria.
 - — Some bacteria are beneficial and may also be killed.
 - — Antibacterial agents kill nonresistant bacteria, allowing the resistant ones to survive and reproduce.

- 15 Allow 1 credit. Acceptable responses include, but are not limited to:
- — They lacked adaptations to the changing environmental conditions.
 - — They were unable to compete for food or other resources.
 - — They did not have the variations required for survival in their environment.
- 16 Allow 1 credit. Acceptable responses include, but are not limited to:
- — The bacteria in the student's throat were resistant/immune to the antibiotic.
 - — The bacteria had a mutation that made them resistant to the medication.
 - — The student had a more severe infection, and it took longer for the antibiotic to work.
 - — The student had a weaker immune system.
- 17 Allow 1 credit. Acceptable responses include, but are not limited to:
- — It increases genetic diversity/biodiversity.
 - — It increases species variation.
 - — makes the elephant population more diverse
 - — Captive elephants produce lower-quality sperm.
- 18 Allow 1 credit. Acceptable responses include, but are not limited to:
- — Offspring would be less able to adapt to environmental changes, so the possibility of survival is decreased.
 - — There will be less variation, limiting the species' ability to adapt.
 - — The offspring would be all the same sex.
- 19-21 The student's response to the bulleted items in the question need not appear in the following order.
- 19. Allow 1 credit for explaining how the size of these animals' ears can help the animals survive in their environment. Acceptable responses include, but are not limited to:
 - — Large ears can help an animal remove excess heat in a warm environment, which helps the animal maintain a stable internal temperature.
 - — The small ears in the arctic fox help minimize heat loss in its cold environment.
 - — The large ears in the jackrabbit let excess heat escape, helping it stay cool.
 - — Large ears would allow animals to hear predators.
 - 20. Allow 1 credit for identifying one process that most likely resulted in the animals in warm climates having large ears, while animals in cold climates have small ears. Acceptable responses include, but are not limited to:
 - — natural selection
 - — evolution
 - — mutation
 - — recombination
 - 21. Allow 1 credit for stating how the overproduction of offspring in each species for many generations contributed to the presence of different ear sizes. Acceptable responses include, but are not limited to:
 - — When there is overproduction, not all can live, so natural selection results in the survival of the fittest in each generation.
 - — With more offspring, only some survive and pass on their traits, resulting in changes in the species over time.
 - — Overpopulation leads to an increase in the number of variations in a population.
 - — With more individuals, more variations might occur.