

8.2 Is There Life on Mars? Or Venus?

5. Why do scientists think life on Mars is more likely than life on Venus?
6. Why are scientists interested in searching for water on Mars?
7. Is there evidence that Mars once had water? Is there evidence that Mars currently has water?
8. What information regarding Venus caused scientists to take the possibility of life on Venus more seriously?

8.3 Charles Darwin and *The Origin of Species*

9. What was Lamarck's theory about how evolutionary change occurred?
10. What impressed Darwin about the finches on the Galápagos Islands?
11. How did the work of Thomas Malthus influence Darwin?



12. How did Charles Lyell's work influence Darwin?

8.4 Natural Selection

13. What is an inherited trait?

14. What is genetic variation?

15. Describe how natural selection occurs.

8.5 Examples of Natural Selection

16. What hypothesis did Bernard Kettlewell test using mark and recapture experiments on peppered moths?

17. What conclusion did Kettlewell reach after seeing the results of his mark and recapture experiments on peppered moths?



18. What practices have resulted in increased antibiotic resistance?

8.6 Adaptation

19. From the point of view of natural selection, why is it important for an organism to survive?

20. Define sexual selection and provide some examples of adaptations that evolved as a result of sexual selection.

21. Why is parental care adaptive in certain species?

22. Why is the surface-area-to-volume ratio important in thermoregulation?

23. You are studying a species of tropical goat and comparing it with a related Arctic species. Based on your knowledge of thermoregulation in mammals and its effect on the size and shape of organisms, predict some of the differences you might see between the tropical and Arctic species.

(CLICK TO CHECK YOUR ANSWERS)



Challenging Review Questions

8.1 The Origin of Life

24. Why do scientists consider Miller and Urey's experiment important? Why do some scientists question the assumptions Miller and Urey made when they designed their experiment?

25. What role might environments similar to hydrothermal vents have played in the origin of life?

26. How are liposomes similar to cells? How are they different from real cells?

27. Explain why the earliest life on Earth may have resembled liposomes containing RNA.

8.2 Is There Life on Mars? Or Venus?

28. Of the planets in the Solar System other than Earth, why did scientists initially focus on Mars and Venus as the most likely to harbor life?

29. What features of Venus would make it difficult for life as we know it to live there?



30. What features of Mars would make it difficult for Earth's living things to survive there?

31. How much evidence is there that Mars currently supports life or that it once supported life? What kind of evidence is NASA searching for to determine whether there is life on Mars?

8.3 Charles Darwin and *The Origin of Species*

32. What role did fossils play in the development of Lamarck's ideas—and later Darwin's ideas—about evolution?

33. How did Darwin's experience on the *Beagle* influence his thinking and later work?

34. Horned lizards defend themselves with spiky horns on their heads and bodies. Some individuals will even jerk their heads to stab at predators with their horns. How might Darwin explain the evolution of these horns?

8.4 Natural Selection

35. What are some human traits that do not show genetic variation? What are some that do show genetic variation?



36. How would you determine whether a trait you are interested in studying is an inherited trait?

37. How is the story of the myxoma virus and Australian rabbits similar to the story of antibiotic resistance in bacteria?

38. Nancy Burley of the University of California, Irvine, ran the following experiment: She placed red color bands on the feet of some male birds and green color bands on the feet of other male birds. Females preferred to mate with males that had red color bands. Is this an example of natural selection? Why or why not?

39. What does it mean to say that one rabbit has greater fitness than another?

40. In recent decades, average human height has increased in many parts of the world. Do you think this is an example of evolution?

41. On islands, many large animals—such as elephants— evolve to become miniaturized. On the other hand, many small animals—including some rodents—evolve to be exceptionally large. Why might natural selection produce these results?



42. A single sunflower can have hundreds or even thousands of seeds. Will each of these seeds grow into a sunflower plant? Why or why not? What would happen if every one of these seeds grew into a sunflower plant?

8.5 Examples of Natural Selection

43. A biologist releases 200 marked light moths and 200 marked dark moths in a habitat. A few days later, she recaptures 13 light moths and 36 dark moths. What does this suggest about natural selection in the population? What might you guess about the trees in this habitat?

44. In 2017, the U.S. Food and Drug Administration banned the use of antibiotics to help livestock gain weight. How might this help prevent the evolution of antibiotic resistance?

8.6 Adaptation

45. Male birds of many species have brighter feathers than females. For example, male cardinals are bright red, whereas females are brownish. Bright colors on males are often adaptations for winning mates. Is being less colorful adaptive for female birds? Defend your answer.

46. John Endler studied guppies that lived in ponds in Trinidad. He noticed that the males in different populations of guppies had different coloration patterns. Males that lived in pools with no predators tended to have bright colors and large spots. Males that lived in pools with predators tended to have drab colors. Endler knew that female guppies preferred to mate with brightly colored males. Explain the role of natural selection and sexual selection in these guppy populations.



47. Not all brightly colored animals are trying to attract mates. Some animals use bright colors as a warning. For example, consider bees and wasps (yellow and black), coral snakes (red, yellow, and black), and poison dart frogs (many different bright colors). Explain how bright colors are adaptations in these animals.

48. Explain why mammals that live near the poles are likely to be larger than related mammals that live near the equator.

49. Two species of foxes are shown here. One is a kit fox in Arizona. The other is an Arctic fox. Which is which? How can you tell? Describe at least two traits that make each animal well adapted to its environment.



(CLICK TO CHECK YOUR ANSWERS)



Apply & Discuss Questions

50. If there is life on Mars (and this life had evolved on Mars), what adaptations might the organisms have? How might Martian life differ from life on Earth?

51. If life evolved on Venus, what adaptations might the organisms have?

52. During a drought, the supply of seeds available to a finch population decreases. The smaller, softer seeds, which are easier to crack, are quickly eaten up. Finches with larger, stronger beaks are better able to crack the larger seeds that remain. What evolutionary changes do you expect to see in this finch population?



53. Caterpillars of the Monarch butterfly eat plants that are toxic to other animals. As a result, their tissues become toxic. Birds that try to eat Monarchs vomit and then avoid the striking orange-and-black pattern in the future. The viceroy is another species of butterfly. Viceroy resembles monarchs, but they are not toxic. Is the appearance of the viceroy adaptive? How could you test this hypothesis?



Can you tell which is the Monarch and which is the Viceroy? Viceroy has a black stripe in the hind wing that goes across the other stripes. Monarchs do not.

54. You are eating a salad when you almost bite down on a green caterpillar hidden among the lettuce leaves. The friend who is eating with you says, "That would have been gross, but I don't think it's one of those super-poisonous caterpillars." Do you agree?

55. Bird eggs vary tremendously in color. Do you think the color of a bird's eggs is adaptive? What factors may have shaped the evolution of egg color in different species?

56. Broad-spectrum antibiotics are effective against a wide variety of bacteria. Narrow-spectrum antibiotics are effective against only certain types of bacteria. Public health officials have suggested that one way to combat antibiotic resistance is to use narrow-spectrum antibiotics whenever possible. Do you agree? Explain how the use of narrow-spectrum antibiotics instead of broad-spectrum antibiotics could slow the evolution of resistance in bacteria.

(CLICK TO CHECK YOUR ANSWERS)



End of Chapter Solutions

Simple Review Solutions

1. In 1953, Stanley Miller and Harold Urey built a model of the early Earth in a chemistry lab. A flask containing a mixture of simple compounds—including water vapor, ammonia, methane, and hydrogen gas—simulated Earth's early atmosphere. Liquid water was added to represent Earth's oceans. Electric sparks sent through the mixture simulated lightning. When this model of early Earth was assembled, an amazing thing happened. Many complex organic molecules were formed, including amino acids, the building blocks of proteins. Not only had these molecules formed quickly, there were lots of them.
3. Liposomes have double membranes similar to cell membranes. Although they are not alive, liposomes sometimes behave like living cells—they grow, shrink, and divide. Liposomes also run chemical reactions inside their membranes and control what molecules enter and exit them, two key features of living cells.
5. Early explorations showed that Venus would be hostile to life as we know it. Venus has almost no water, a crushingly dense carbon dioxide atmosphere, clouds of sulfuric acid, and a surface temperature of 462 C (864 degrees F)!
7. Many of Mars's geological features were clearly carved out by water, and the evidence suggests that Mars once had oceans. NASA has looked for places on the planet where pockets of water might still exist. And they have found evidence for it! Specifically, they have seen seasonal streaks of damp soil in certain craters. This has encouraged scientists to look for larger water reservoirs that might still exist under the Martian surface.
9. According to Lamarck, organisms acquired new characteristics during their lifetimes and then passed these characteristics to their offspring. For example, ancestral giraffes stretched their necks to grab the high leaves on a tree, and their necks became longer. They then passed these longer necks to their offspring. The offspring reached for even higher leaves, stretching their necks even further, and so on.
11. Malthus observed that human populations grow much faster than available food supplies and concluded, with despair, that famine was an inevitable feature of human existence. Darwin applied Malthus's idea to the natural world and argued that, because there are not enough resources for all organisms to survive and reproduce as much as they can, living organisms are involved in an intense "struggle for existence." As a result, organisms with advantageous traits leave more offspring than organisms with other traits, causing populations to change over time.
13. Some traits are determined at least partly by genes and so are *inherited traits*—that is, they are passed from parents to offspring.
15. Some inherited traits are advantageous. Organisms with inherited, advantageous traits are able to leave more offspring than organisms with other traits. This is known as natural selection.
17. Kettlewell found that birds ate what they could see: Birds ate more light moths in polluted habitats and more dark moths in unpolluted habitats.
19. Survival is usually an important first step in successful reproduction.



21. Parental care evolved in certain species because natural selection favored organisms that were able to help their offspring survive and thrive. Parental care is found in many animals, including humans.

23. The tropical species is likely to be smaller, with longer limbs and larger ears. The Arctic goat is likely to be larger, with shorter limbs and smaller ears.

Challenging Review Solutions

25. Some scientists think that, before there was life, large numbers of organic molecules may have formed in deep-sea environments similar to today's hydrothermal vent habitats. So, the origin of life may have occurred in a hydrothermal vent-like habitat.

27. Liposomes could have provided a distinct, controlled environment for the earliest cells. Cells would also have needed genetic material, and scientists think it is likely the first genes were made of RNA rather than DNA. This is because RNA can spontaneously assemble from individual nucleotides and even reproduce without cells or enzymes.

29. Venus has almost no water, a crushingly dense carbon dioxide atmosphere, clouds of sulfuric acid, and a surface temperature of 462 C (864 degrees F).

31. There isn't much evidence—yet—that life evolved on Mars or currently exists there, aside from any microorganisms that were accidentally transported from Earth to Mars that are still surviving there. NASA is focused on searching for water on Mars, since water is required for life as we know it. NASA also aims to search for fossils and actual living things in locations where there is, or once was, water on Mars.

33. Darwin's voyage on the *Beagle* started him thinking about the questions that he would work on for the rest of his life. These were largely questions about how life on Earth had gotten to be the way it was. Darwin's experiences studying life in South America and the Galápagos also began to suggest answers to him about how living things evolve, or change over time.

35. Answers will vary. Traits that do not show genetic variation include having a four-chambered heart, five fingers on each hand, two arms, two legs, one nose, etc. Traits that do show genetic variation include height, weight, arm length, foot length, eye color, hair color, etc.

37. In both cases, the administration of a lethal agent (antibiotics or myxoma virus) led to natural selection for resistant individuals in the population. These resistant individuals survived and reproduced. As a result, over time, populations evolved resistance to the lethal agent.

39. The fitness of an organism describes the number of offspring it leaves over its lifetime compared to other individuals in the population. An organism that leaves more offspring than other individuals in the population is said to have greater fitness. So, if one rabbit has greater fitness than another, then it has left more offspring than the other rabbit.

41. One leading hypothesis is that large animals become miniaturized because of limited food availability on relatively small islands, and that small animals evolve to larger size because of the absence of predators.



43. Since she recaptured more dark moths, dark moths survived better in this population than light moths. This means that in this population, there is natural selection for dark peppered moths. This suggests that, if camouflage explains the difference in survival, the trees are probably dark rather than light or lichen-covered.

45. Bright colors on certain male birds help them attract female mates. However, bright colors also make these males more visible to predators. It is adaptive for females to be less colorful because they don't need the bright colors to attract mates, and their duller feathers make it harder for predators to see them.

47. Bright colors serve to warn other species that these organisms are dangerous. Other species either learn through experience or evolve an instinctual response to the bright appearance of these poisonous or toxic species. The bright colors make the toxic or dangerous animal easy to see and identify so that other species can avoid disturbing them or trying to eat them.

49. The kit fox is the one with pale brownish fur, large ears, and long limbs. The fur color helps it stay camouflaged in its environment. The large ears and long limbs help it increase surface area available for heat dissipation. The Arctic fox has white fur, which helps it stay camouflaged, and small ears and short limbs that help it decrease the surface area from which heat is lost.

Apply & Discuss Solutions

51. Many answers are possible! Surface life would need some way to withstand the very high temperatures and huge atmospheric pressure on Venus's surface, as well as the acidic clouds and rain. Life in the Venusian atmosphere, perhaps more likely, would need a way to stay within the area of favorable conditions within the atmosphere. There is also little to no water on Venus, so the chemistry of Venusian life would have to be pretty different from that of life on Earth.

53. The appearance of the viceroy is adaptive—birds may mistake it for a foul-tasting monarch and not try to eat it. One way to test this hypothesis would be to offer viceroys and other edible butterflies to birds that were known to be familiar with monarchs. Do the birds eat the viceroys less often than they eat the butterflies that do not look like toxic monarchs?

55. This is a very open question! Scientists have proposed many different ideas, and different factors may have shaped egg color evolution in different bird species. Egg color may be related to camouflage or heat absorption (darker eggs will absorb more heat). Or, they may allow some birds to recognize their own eggs in cases where there are nest parasites (birds that lay their eggs in the nests of other birds, such as the cuckoo). Other answers are possible!

