

Summary of Expectations

Briefly explain each of the following points.

- Through natural selection, organisms become adapted to their immediate environment over a period of time. (12.1)
- While adaptations are products of evolution by natural selection, variations within a species are the raw material upon which natural selection acts. (12.1)
- Exaptation occurs when an adaptation that evolved for one function is co-opted for another use. (12.1)
- Adaptations can be broadly classified as structural (or anatomical), physiological, or behavioural. (12.1)
- A species consists of a reproductively compatible population. (12.2)
- Two patterns of speciation are transformation and divergence (cladogenesis). (12.2)
- Pre-zygotic (or pre-fertilization) barriers either impede mating between species or prevent fertilization of the ova; post-zygotic barriers prevent hybrid zygotes from developing into normal, fertile individuals. (12.2)
- Alternative concepts recognize some degree of genetic exchange between species. (12.2)
- Sympatric speciation occurs when populations become reproductively isolated without geographical isolation. Allopatric speciation occurs when populations are geographically isolated. (12.3)
- Polyploidy, a mutant condition resulting in extra sets of chromosomes, can lead to speciation. (12.3)
- The process of adaptive radiation occurs when there is diversification of a common ancestor into a variety of species. (12.3)
- In convergent evolution, similar traits arise because each species has independently adapted to similar environmental conditions. In divergent evolution, a species that was once similar to an ancestral species diverges or becomes increasingly distinct. (12.3)
- In coevolution, organisms that are closely linked to other species have evolved by responding to the changes in one another. (12.3)
- Two hypotheses that describe the pace of evolution are gradualism and punctuated equilibrium. (12.3)

Language of Biology

Write a sentence including each of the following words or terms. Use any six terms in a concept map to show your understanding of how they are related.

- adaptation
- exaptation
- structural adaptation
- mimicry
- cryptic coloration
- physiological adaptation
- behavioural adaptation
- biological species
- transformation
- divergence
- speciation
- geographical barrier
- biological barrier
- pre-zygotic barrier
- post-zygotic barrier
- morphological species concept
- sympatric speciation
- polyploidy
- allopatric speciation
- adaptive radiation
- mass extinction
- divergent evolution
- convergent evolution
- coevolution
- gradualism
- punctuated equilibrium

UNDERSTANDING CONCEPTS

1. Explain the differences between adaptations and variations.
2. Describe exaptation and provide an example.
3. Distinguish between structural, behavioural, and physiological adaptations. Give an example of each.
4. Explain why natural selection does not achieve perfection in organisms.
5. In order for species to remain distinct, they must remain reproductively isolated. Describe a pre-zygotic barrier and a post-zygotic barrier to reproduction.
6. Define and provide an example of:
 - (a) habitat isolation
 - (b) mechanical isolation
 - (c) gametic isolation
7. What are the limitations to defining species using only the concept of biological species?
8. Describe two other ways to define species. Why are these definitions used?
9. Hedgehogs and echidnas both have spiny skins, yet they live in very different environments. Is this an example of convergent or divergent evolution? Explain your answer.
10. Distinguish between sympatric and allopatric speciation.

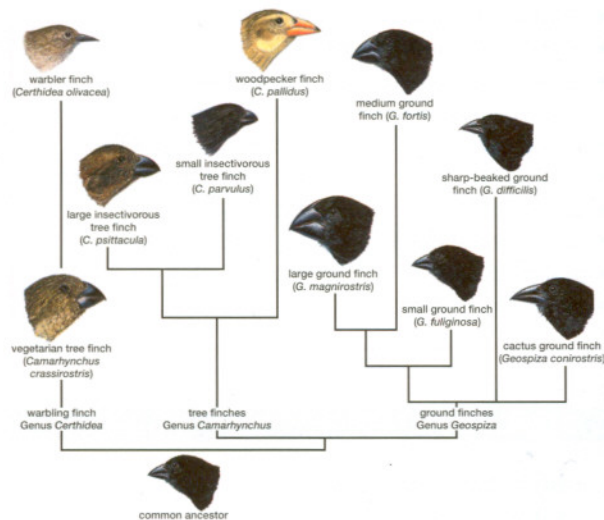
11. Explain why it is more likely for small populations that have become isolated from a parent population to become a new species than it is for a large population to become a new species.
12. Describe the relationship between adaptive radiation, mass extinction events, and punctuated equilibrium.
13. The coevolution of predator and prey or parasite and host are sometimes portrayed as being an “arms race.” Explain why this description is used.
14. Why is it always imperative to consider time scales when discussing evolution, gradualism, and punctuated equilibrium?
15. Suppose bird books published years ago list two birds as different species. However, biologists applying the biological species

concept later realized that the two birds are actually the same species. What did the biologists learn that caused them to revise the categorization of these birds?

16. Hummingbird moths are night-flying insects that look similar to hummingbirds. Explain how these two organisms demonstrate the concept of convergent evolution.
17. What are some of the factors that prevent hybrids of two species from developing viable offspring?
18. In both plants and animals, successful matings may occur between different species. In those matings, what are some reasons that gametes are prevented from fusing?
19. Contrast the basic ideas of gradualism and punctuated equilibrium with regard to speciation.

INQUIRY

20. Interpret the evolutionary history of 10 species of finch in the Galápagos Islands using this phylogenetic tree.



21. Scientists compare differences in protein amino-acid sequences to determine the relationships among organisms. Compare the short sequences of amino acids of these proteins to determine evolutionary relationships.

- (a) Calculate how many amino acids in the baboon, chimp, and lemur differ from those in the human sequence. Calculate the percentage differences as well.
- (b) Which primate appears to be most closely related to humans? Which appears to be the least closely related?

- (c) Construct a phylogenetic tree that shows the relationships among the primates in this table.

Baboon	Chimp	Lemur	Human
ASN	SER	ALA	SER
THR	THR	THR	THR
THR	ALA	SER	ALA
GLY	GLY	GLY	GLY
ASP	ASP	GLU	ASP
GLU	GLU	LYS	GLU
VAL	VAL	VAL	VAL
ASP	GLU	GLU	GLU
ASP	ASP	ASP	ASP
SER	THR	SER	THR
PRO	PRO	PRO	PRO
GLY	GLY	GLY	GLY
GLY	GLY	SER	GLY
ASN	ALA	HIS	ALA
ASN	ASN	ASN	ASN

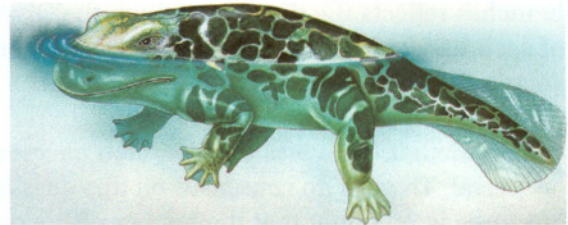
22. What tools and techniques can biologists use to determine whether two populations that look quite similar are one species or two?

COMMUNICATING

23. Draw an illustrated time line or flowchart that shows how a complex adaptation such as an eye might have evolved.
24. Use a concept organizer to illustrate the relationships between variations, adaptations, and natural selection.
25. Use a diagram to show the two general pathways that can lead to the formation of new species. Indicate which pathway promotes biological diversity.
26. Use a labelled diagram to show how polyploidy can lead to speciation.
27. You have been asked by a group of health-care professionals to write a short newspaper article explaining to the general public the dangers of

misusing antibiotics. Prepare this article and include references to evolution.

28. This animal was called *Ichthyostega*, a tetrapod that was one of the first amphibians with limbs efficient enough to crawl on land. Many of its characteristics were still quite fish-like. Explain how scientists might use the term “exaptation” when discussing this animal’s ability to walk on land.



MAKING CONNECTIONS

29. Investigate how plant breeders use the chromosomal condition of polyploidy in their work.
30. There are many antibiotic soaps and sprays currently available over-the-counter. Why might an evolutionary biologist suggest that you avoid buying (or restrict your use of) these products?
31. Today, individuals and populations of the giant panda are being isolated in many small reserves in China. What are the genetic implications of having so many small reserves rather than one large reserve? If the giant panda were to become extinct in the wild, what might some of the economic, political, and social implications be for China?

32. In Canada, individuals and populations of grizzly bear are being isolated as human populations expand their use of the land previously used by the bears. If the grizzly bear were to become extinct in the wild, what might some of the economic, political, and social implications be for Canada? How might the wildlife corridors (designed to help animals cross busy highways in Canada’s mountain parks safely) help the situation?
33. In the past, scientists considered gorillas to be the closest primate relative to humans. How have new technologies contributed to our changing phylogenetic tree?
34. As humans have populated remote islands throughout the world, some people have been isolated from other populations for long periods of time. Despite the geographical barrier, speciation has not occurred. Explain.