

4. Lamarck is probably best remembered by what he got wrong, but he was an astute observer.
 - a. What did Lamarck study?
 - b. By making careful observations, what had he found?
 - c. How did he explain these findings – what were the two principles?
 - d. Analyzing his two principles, what did he get “right” and what did he get “wrong”?

In “The Origin of Species,” Darwin proposed that species change through natural selection

5. Describe Charles Darwin’s childhood. How, even at a young age, was he showing signs of being an astute scientist?
6. How did Darwin find himself on the HMS Beagle?
7. What was the primary mission of the voyage of the Beagle?
 - a. What was Darwin doing?
8. Darwin made many observations which lead to many speculations and “emerging theories.” For each of the following, 1. what did Darwin observe? 2. What did the observations lead him to think/theorize/conclude?
 - a. the plants and animals in temperate regions of South America
 - b. the fossils he found

- c. the geology of South America (be sure to mention Lyell)

 - d. the Galapagos Islands – what fascinated him the most? What puzzled him?
 - i. How did Darwin explain the uniqueness of the flora and fauna on the Galapagos?
9. Darwin connected adaptations to the origin of new species. How did he think they were related? Give an example.
10. Darwin had worked out the major components of his theory of evolution by natural selection by the early 1840's. Why didn't he publish them?
11. Who was Alfred Russell Wallace? What did he do? How was he related to the publishing of "The Origin of Species"?
12. Darwin referred to evolution as "descent with modification."
 - a. What does this mean?
 - b. How is this related to the "unity in life?"
13. We LOVE similes!!! Explain why, in Darwin's view of life "the history of life is like a tree."
 - a. Use elephants as an example of the "unity of life" Darwin was theorizing.

 - b. Describe what the "branches of the tree" are. What can they indicate?

c. How are Darwin's "tree" and Linnaeus' "tree similar and different?"

14. Darwin noticed a number of adaptations in the animals he saw in South America and he wondered how these came about. He proposed a mechanism for this. Explain his observations and what inference(s) they led him to. We will use strawberries to help us understand the logic!!!

- a. Observation #1: Population growth is exponential if EVERYONE survived to reproduce!
 - i. Strawberries produce a tremendous number of seeds and we would be overrun by strawberries if they ALL survived!
- b. Observation #2: Populations tend to remain stable and don't explode exponentially!
 - i. We aren't overrun by strawberries, some get eaten, others seeds don't germinate, etc...
- c. Observation #3: There is a finite amount of resources (land, food, water, mates, etc...)
 - i. Strawberries and their seeds (embryos) only have so much land, water and nutrient!
- d. Inference: More individuals are produced than can survive and because there are limited resources, organisms must compete with each other to gain the resources needed to survive. So...only a few individuals will survive!
 - i. Some strawberries are going to get eaten, some seeds aren't going to germinate because there isn't enough water, land, etc...So... we aren't overrun by strawberries!

NOW...you try it...

a. Observation #4:

b. Observation #5:

15. What was the connection that Darwin made between natural selection, "struggle for existence," overproduction and adaptation?

a. Who was influential in helping him make this connection? What did he theorize?

16. What is "artificial selection"? How does this support Darwin's theory of natural selection?

17. Let's summarize...

a. Natural selection is _____ because organisms have different heritable _____. So...those _____ that are advantageous survive AND _____. Overtime, natural selection can cause a population to _____, sometimes so much that new _____ are formed.

18. Three KEY POINTS about evolution by natural selection are as follows. For each, explain they mean.
- a. Individuals cannot evolve, populations can (KNOW THIS...BREATHE THIS...!!!!)

 - b. Natural selection can amplify or diminish ONLY traits that are heritable.
 - i. Give an example of a trait that is heritable and one that is not.

 - c. Environmental factors vary!

Darwin's theory explains a wide range of observations

19. What is the power of evolution as a "unifying theory"? BE SPECIFIC!!!

20. Natural selection in action!!!! For each of the following examples explain how it shows that natural selection is at work (be sure to describe...

1. Overproduction
2. Inheritable variety of traits
3. Limited resources
4. Competition
5. Differential reproduction
6. Multiple generations)

a. Guppy size and age-at-maturity

b. Drug-resistance in the bacteria *Staphylococcus aureus* (or HIV and other viruses)

20. What is a homology? How does it support the theory of evolution?

There are homologies in anatomy.

a. What is a homologous structure? How does a whale's flipper and your arm illustrate this concept?

b. What are vestigial organs? Give at least 3 examples of vestigial organs.

c. What are molecular homologies?

21. How does the fossil record support evolution?

a. Give an example of a "transitional" fossil and explain how this supports evolution.

22. Darwin observed differences in how species were distributed on the Galapagos Islands. What is this called? How does this contribute to evolution by natural selection?

a. Use Australia as an example and explain how this may have led to the different species seen there.

i. Describe what convergent and divergent evolution are in terms of some of the organisms seen here vs. other parts of the planet.

23. Why does Darwin's theory persist?

- a. What is a “scientific theory”? How is this different from the everyday usage of the word theory?

- b. How is Darwin’s work scientifically theoretical?