CH. 15: Darwin's Theory of Evolution

Directions: READ ch. 15 in your textbook and use the note outline to help you answer the questions below.

1. What is a theory?
2. Describe some of the ideas that influenced Darwin's ideas about the Earth and evolution.
3. Why was Lamarck's ideas about evolution wrong? Describe the recent experiment that supports his ideas.
4. How did Darwin use the finches of the Galapagos islands to demonstrate his ideas about natural selection?
5. Describe the different evidence that Darwin used to support his ideas about evolution.
6. What is "descent with modification"? How do fossils demonstrate this principle?
7. Darwin proposed the idea that natural selection and sexual selection are two important factors that help to drive the evolutionary process. Describe each of these processes and explain how they might change the characteristics of a species over time.
8. What is "artificial selection"? Give an example of a way that humans have used artificial selection.

Evolution Unit – Ch. 16 Questions

Ch. 16, Section 1:

1. Define: Gene pool, Relative frequency

*use these two words (gene pool & relative frequency) to create a definition of evolution in relation to genetics.

2. Describe the two main sources of genetic variation.

3. If you created graphs of the relative frequency of single-gene traits and polygenic traits, how would these two graphs differ?

Ch. 16, Section 2:

1. Describe the effect of natural selection on single-gene traits.

2. Describe the three possible effects of natural selection on polygenic traits (i.e. Directional selection, stabilizing selection, disruptive selection.)

3. Natural selection is NOT the only source of evolutionary change. Describe the force of genetic drift on allele frequency in a population.

4. What kind of populations is more susceptible to the forces of genetic drift?

5. How is the founder effect a cause of genetic drift?

6. Give a real-life example of the founder effect.

7. What condition might result in NO change of allele frequencies?

8. Describe the Hardy-Weinburg principle.

9. What five conditions are required for this principle to work?

10. Explain why EACH of these five factors would result in genetic equilibrium.

Ch. 16, Section 3:

1. Factors such as natural selection & chance events (genetic drift) can change the _____ of _____ in a population.

2. What is the definition of a species?

3. What must happen for a species to evolve into two new species?

4. As new species evolve, population become _____ _____ from each other.

5. What is reproductive isolation?

6. What are several ways in which reproductive isolation can occur?

7. Describe behavioral isolation, geographic isolation, and temporal isolation.

Ch. 17 – The History of Life

1. Describe some of the most important events in the evolution of life on Earth (these should be changes in life on Earth that would either change the environment or create a new type of organism)

2. How do scientists believe that eukaryotes developed?

3. Are mass extinctions a normal occurance? How is the current mass extinction different from the previous extinctions?

4. Compare adaptive radiation to convergent evolution and coevolution.

5. What are analogous structures?

ANSWER KEY - CH. 15: Darwin's Theory of Evolution

Directions: READ ch. 15 in your textbook and use the note outline to help you answer the questions below.

1. What is a theory? Well-supported, testable explanation of phenomena that have occurred in nature.

2. Describe some of the ideas that influenced Darwin's ideas about the Earth and evolution.

   - Hutton and Lyell were two scientists who were looking at the layers of the Earth – they said that based on the amount of layers and the rate at which weathering occurs, that the Earth had to be a lot older than people thought it was at that time. IMPORTANCE – species would have had time to evolve if the Earth was billions of years old instead of only a few thousand years old.
   - Thomas Malthus was an economist who said that the human population would reach the carrying capacity of the Earth very quickly if left to grow unchecked. The controls on the population were war, famine, disease, etc. and they kept the population from outgrowing the resources available on Earth.

3. Why was Lamarck's ideas about evolution wrong? Describe the recent experiment that supports his ideas. Lamarck said that actions taken during a parent's lifetime could change what is passed on to their offspring. For example, if a giraffe stretches his neck to reach higher leaves, then his offspring might have a longer neck. This isn't true – genes determine what the offspring have.
   However, we are beginning to see that the environment/experience of the parent, could possibly determine whether genes are turned on or off in the offspring. For example, rats who had a restricted diet, had offspring that were less prone to obesity due to genes that had been turned off.

4. How did Darwin use the finches of the Galapagos islands to demonstrate his ideas about natural selection?
   He said the finches must have originated from a common ancestor that flew/was blown over to the islands from South America. As time passed, multiple new species of finches developed from the original species by developing adaptations to the different niches available on the island.

5. Describe the different evidence that Darwin used to support his ideas about evolution.
   - Fossils – rock layers and the fossils within them support the idea that the Earth is billions of years old and that species that were once alive were now extinct or different.

- Geographic distribution of living species – as organisms spread into a new environment, some traits will be more successful than others and therefore you will see a change in genetics of that population over time. Eventually, a new species will develop from the ancestral species to fill a new niche in the environment.

- Homologous structures: structures that develop from the same embryonic tissues. For example, even though they look different and may have different functions, the limb bones in 4 –limbed vertebrates are the same. This indicates a COMMON ANCESTOR

- Vestigial structures: traces of structures that were once useful in an organism. For example, leg bones in a whale.

- Similarities in embryological development: The more similar embryos of two different species are as they develop, the more likely it is that they might have shared a common ancestor.

- Genetic comparisons – the closer the DNA code, the more recently those organisms would have shared a common ancestor.

6. What is "descent with modification"? How do fossils demonstrate this principle?
   Species alive today are modified versions of species that existed previously. For example, the fossil of the glyptodont is a very large version of the modern-day armadillo. That species did not go extinct, it just changed over time to become the armadillo.

7. Darwin proposed the idea that natural selection was the driving force behind evolution, but that sexual selection also played an important role in the evolutionary process. Describe these two processes and explain how they might create changes in the genetics of a population over time.
   Natural selection is created when pressures from the environment (living and nonliving factors) determine whether a species lives longer and produces more offspring. Sexual selection is where individuals within the population select to breed with other individuals that have a certain version of a trait – such as a large and beautiful tail in male peacocks. These traits may actually decrease their chances of surviving in the wild, but it does help them pass on their genetics more often. These two processes combine to determine which individuals in the population actually pass on their genetics.

8. What is "artificial selection"? Give an example of a way that humans have used artificial selection.

   Artificial selection is the process in which humans select certain organisms to breed and produce the next generation based on the type of characteristics they possess. For example, humans throughout the years have created many different breeds of dogs, cats, horses, cattle, etc.

through selective breeding. These animals are still part of the same species, just different breeds with very different characteristics.

Evolution Unit – Ch. 16 Questions

Ch. 16, Section 1:

1. Define: Gene pool, Relative frequency

*use these two words (gene pool & relative frequency) to create a definition of evolution in relation to genetics.

Gene pool – all of the genes (and different alleles) that exist in a population. Relative frequency – the number of times that the allele occurs in the gene pool, compared to other alleles.

Evolution is a change in the relative frequency of alleles in the gene pool of a population.

2. Describe the two main sources of genetic variation.

Mutation - any change in the DNA sequence due to a mistake in DNA replication or exposure to radiation or other substance.

Gene shuffling – occurs during independent assortment and crossing over of meiosis to recombine genes.

3. If you created graphs of the relative frequency of single-gene traits and polygenic traits, how would these two graphs differ?

- with a single gene trait, it would only have two different phenotypes (two bars on a bar graph). The dominant one would show up more often than the recessive form.
- A polygenic trait would appear as a bell-curve in a line graph. Phenotypes would appear as different variations on a scale. For example, skin color would vary from very light to very dark. Most people would have medium colored skin. There would be very few people on the extreme end of the chart.

Ch. 16, Section 2:

1. Describe the effect of natural selection on single-gene traits.

Natural seletion on single-gene traits can lead to changes in allele frequencies and thus to evolution. (i.e.- whichever form of the trait that is most successful at reproducing and surviving, will increase in frequency in the gene pool of the population.)

2. Describe the three possible effects of natural selection on polygenic traits (i.e. Directional selection, stabilizing selection, disruptive selection.)

Natural selection on polygenic traits can move the bell curve in one direction or another or change the shape of the bell curve to create two bell curves. (refer to pg. 398 & 399 in your text for illustrations)

3. Natural selection is NOT the only source of evolutionary change. Describe the force of genetic drift on allele frequency in a population.

Genetic drift is a RANDOM change in allele frequency. For example, some individuals might produce more offspring just by chance (not because they were more suited for the environment) – their alleles would increase in the population because of random events.

4. What kind of populations is more susceptible to the forces of genetic drift?

In a small population, one individual may have more offspring just by chance (not because they were more suited for the environment) – their alleles would increase in the population.

5. How is the founder effect a cause of genetic drift?
If a group of organisms from a population gets isolated by some chance event, then they could form a new population. The only alleles in that population would be the ones that the "founders" had – so the genetic variety of the new population would be lower than the original population.

6. Give a real-life example of the founder effect.
If a small group of individuals gets blown to an island where they would form a new population.

7. What condition might result in NO change of allele frequencies?
There is no natural condition in which this would occur.

8. Describe the Hardy-Weinburg principle.
The Hardy-Weinberg principle states that in order for no change in allele frequencies to occur, five conditions would have to be true.

9. What five conditions are required for this principle to work?
a. random mating b. large population c. no emigration or immigration d. no mutations
e. no natural selection

10. Explain why EACH of these five factors would result in genetic equilibrium.
a. random mating – all members of the population must have an equal opportunity to produce offspring.
b. large population – genetic drift would have less effect on a large population
c. no emigration or immigration – new individuals with new alleles could not enter the population, and you wouldn't want anyone to leave so that you didn't lose alleles.
d. no mutations – no new alleles should be created through mutations.
e. no natural selection – environmental pressures should not eliminate any alleles

Ch. 16, Section 3:
1. Factors such as natural selection & chance events (genetic drift) can change the relative frequency of alleles in a population.

2. What is the definition of a species? a group of organisms that can breed together and produce fertile offspring.

3. What must happen for a species to evolve into two new species? the gene pools of two populations must become separated for them to become new species (that can no longer interbreed)

4. As new species evolve, population become reproductively isolated from each other.

5. What is reproductive isolation? When members of two species can not breed together and produce fertile offspring.

6. What are several ways in which reproductive isolation can occur? Behavioral isolation, geographic isolation, and temporal isolation.

7. Describe behavioral isolation, geographic isolation, and temporal isolation. **Behavioral isolation** – the organism doesn't do the right behaviors (mating dances, etc) to win a mate. **Geographic isolation** – the organisms could potentially breed together, but there is a geographic barrier (like a mountain or ocean) that separates the two populations. **Temporal isolation** – the organisms could breed together, but they mate at different times of the year.

Ch. 17 – The History of Life

1. Describe some of the most important events in the evolution of life on Earth (these should be changes in life on Earth that would either change the environment or create a new type of organism)
   - Amino acids form on Earth
   - Formation of microspheres – large organic molecules that are similar to cells, but are not alive.
   - Evolution of DNA and RNA
   - First prokaryotic-like cell arose more than 3.5 billion years ago.
   - 2.2 billion years ago, photosynthetic organisms arose. Oxygen in the atmosphere changed the environment on Earth greatly.
   - 2 billion years ago prokaryotic cells combined with another prokaryote (mitochondria & chloroplasts) to form eukaryotic cells.
   - Eukaryotic cells evolve multicellularity and sexual reproduction.

2. How do scientists believe that eukaryotes developed?

Some prokaryotes engulfed other prokaryotes and instead of digesting them, they lived in symbiosis. We believe these engulfed prokaryotes become mitochondria and chloroplasts.

3. Are mass extinctions a normal occurance? How is the current mass extinction different from the previous extinctions?

Extinction is a normal part of life on Earth, however, it is not normal for large numbers of species to go extinct in a short period of time. All previous mass extinctions have been caused by natural phenomena – this one is being caused by humans.

4. Compare adaptive radiation to convergent evolution and coevolution.

Adaptive radiation – when many species develop from a single common ancestor.
Convergent evolution – when unrelated animals develop similar structures due to similar environmental pressures.
Coevolution – when two species evolve in response to changes in each other over time. Many times, this results in symbiotic relationships between the two species.

5. What are analogous structures?

Structures in unrelated animals that perform similar functions, but did not originate in a common ancestor. These structures are similar because the animals may have evolved under similar environmental pressures.

Assignment: Create a timeline to illustrate what occurred in each of the major periods in Earth's history. (use pictures for each time period)

Include:

I. Precambrian time

II. Paleozoic Era
- Cambrian period
- Ordovician and Silurian Periods
- Devonian Period
- Carboniferous and Permian Periods

III. Mesozoic Era
- Triassic Period
- Jurassic Period
- Cretaceous Period

IV. Cenozoic Era
- Tertiary Period
- Quaternary Period