Biology: Natural Selection & Evolution

Unit Review Name: _____ Date: _____

Answer Key

1. Darwin's work offers insight into the living world showing how modern organisms **EVOLVE** over long periods of time through **DESCENT** from common ancestors.
2. Lyell and Hutton thought that **GEOLOGIC** processes operated very slowly, on the human scale.
3. According to Lyell, the processes that changed Earth in the past are **THE SAME** as the processes that operate in the present.
4. The ideas of **MALTHUS** led Darwin to conclude that many more organisms will be **BORN** than will survive to adulthood.
5. Inherited traits that make an organism better suited to survival are called **ADAPTATIONS** .
6. Differences among adaptations affect an organism's **FITNESS**, its ability to survive and reproduce.
7. An individual organism does not **EVOLVE**, it only **LIVES** or **DIES** .
8. Structures that are shared within a clade by related species and have been inherited from a common ancestor are known as **HOMOLOGOUS** structures.
9. In humans, the appendix and tail bone are examples **VESTIGIAL** structures, having been greatly reduced in size as they have no function.
10. The **FOSSIL** record provides physical evidence of descent with modifications over long periods of time.

Choices may be used once, more than once or not at all

Descent	Geologic	Analogous
The same	Strength	Adaptations
Different	Dies	Fitness
Malthus	Reproduces	Size
Wallace	Fossil	Evolve
Mendel	Vestigial	
Lives	Homologous	

11. Fully compare and contrast Lamarck & Darwin.

Who were they? **They were both naturalists who believed in evolution, that life on Earth has changed over time.**

What were they trying to describe? **Both of them were trying to explain the mechanism by which evolution occurs.**

What did their work have in common? **Both of them did believe that life had changed and that generation after generation populations**

How did they differ? **Lamarck thought that an individual could, during its lifetime, acquire traits it needed to be best fit for its environment and then pass those traits along to their offspring. Darwin thought no, there's a natural variety and those best suited would survive and pass along those successful traits.**

12. What are the four principles of Natural Selection?

a. **Over production of offspring**

b. **Variation in offspring**

c. **Competition and struggle to survive**

d. **Survival of the fittest – those best adapted live, reproduce and pass on successful traits.**

13. Be able to apply each of the four principles of Natural Selection to Happy Bunny Meadow to both the bunny population **and** to the invading fox population.
    a. **Lots of bunnies made through sexual reproduction, and with a short gestation time and short time to maturity, bunnies will quickly overpopulate the meadow. Foxes reproduce more slowly, but will also be able to reproduce successfully with an abundance of bunnies to dine upon.**
    b. **In both bunnies and foxes there will be a variety of offspring produced. They will differ in size, in speed, in ear size, eyesight, etc.**
    c. **Not all of the bunnies, nor all of the foxes will be equally adept at getting food, water, mates, etc, given the variety in the offspring. The smaller foxes may not be able to catch up to bunnies. The bunnies with poorer senses will not be able to notice the foxes sneaking up on them. Those that can, they survive to see another tomorrow. Survive to see enough to tomorrows? You earn the right to…**
    d. **…breed. Reproduce. Find a mate and pass on your successful traits to your offspring, creating a population that is better adapted to the environment in which that population resides. The bunnies will be more camouflaged. They will be more skittish and aware of their surroundings. The foxes will be more cunning and faster.**

14. Be able to explain the changes to both populations (fox & bunny) ***through the principles of natural selection*** and how each population might change over time. (**see above, and below**)

15. Does evolution happen to an individual? A population? A species? Explain with details & examples.
    a. Evolution does not happen to an individual. It either lives or dies. A population can evolve, over time, as each successive generation is made up of offspring from successful parents in the previous generation. Any given bunny gets enough grass to eat, enough water to drink and shelter, surviving the terrors brought on by the foxes, or it does not. It starves, goes thirsty, or gets eaten. If it lives and finds a mate (who was also successful) they combine and pass along their "fit" genes to their offspring. Generation in and generation out, this continues. As time passes, the **population** evolves to become more fit – in this case, better able to cope with the 'pressure' brought about by the foxes.

16. Members of a population share a common group of genes called a **gene pool** .
17. In genetic terms, evolution is any change in the **allele** frequency in a population
18. A gene pool typically contains different **alleles** for each heritable trait.

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19. Natural selection works on an organism's **phenotype** rather than its **genotype** .
20. A **polygenic** trait is one controlled by more than one gene, and generally results in more **phenotypes** for that trait.
21. A random change in an organism's DNA is called a **mutation** .
22. A symmetrical bell-shaped graph is typical of **polygenic** traits.
23. **Stabilizing** selection takes place when individuals with extreme phenotypes disappear and the average phenotype has higher fitness.
24. A change in allele frequency that may occur when a few individuals from a population migrate and colonize a new habitat is known as **founder effect** and is an example of **genetic drift**

Choices may be used once, more than once or not at all

Genotype(s)	single gene	bottleneck effect
Phenotype(s)	mutation (s)	founder effect
Allele(s)	directional	Genetic Drift
Gene pool	stabilizing	Genetic Equilibrium
polygenic	Disruptive	Sexual Selection

25. What clues do we have in the natural world to show that life has evolved? Explain each of the following pieces of evidence in regards to evidence for evolution and what each demonstrates or each type of evolution it supports.

    a. Biochemical – **organisms which are more closely related, frequently looking alike, or similar in some (or many) respects have more genes in common than distantly related organisms. Similar genes lead to similar body plans and similar proteins and other biomolecules being developed in those organisms. The more distantly related, the fewer the genes/macromolecules in common.**

    b. Embryology - – **organisms which are more closely related, frequently looking alike, or similar in some (or many) respects go through recognizably similar embryological developmental stages. This make sense from a genetic standpoint, in that organisms which are closely related have similar genes. And these genes in turn will code for similar body parts and development, seen in developing embryos.**

    c. Fossil – **fossils show that life on Earth has changed over the 3.5 B years it has been on this planet. Many fossils have been found which clearly show the transition from earlier forms to those forms of life we see living around us today.**

        i. faunal succession - **fossils in layers closer to the surface in undisturbed layers tend to look more like organisms alive today. The deeper down into the layers one digs, the fossils one encounters are less and less like organisms alive today, but represent a progression or transition connecting current species to their extinct ancestral forms.**

        ii. law of superposition **– In layers of sedimentary or other rocks, the rocks closer to the surface are younger than those rocks in deeper layers, provided that those layers are undisturbed.**

26. The Hardy-Weinberg Equation states that allele frequency should remain constant within a population unless one or more factors cause those frequencies to change. Imagine a *large* population of squirrels living in a forest on a mountain slope. Explain how allele frequency might change within that population considering each of the following situations.

Behavioral Isolation:

The frequency of alleles may change in the squirrels as they adapt to different, yet adjacent habitats. For instance, if there is a diversity in alleles for fur color, those squirrels that move upslope into a lighter, open scree slope may develop differently than those squirrels that move cross slope into a darker forested area. Those squirrels that move into the open may have an increased frequency in light fur alleles as those might be the more successful squirrels in that environment. Those squirrels that move into the forest may have an increased frequency of darker fur alleles. Along with fur color, behaviors may come along with those changes, such as the time of day they are active or the types of food or shelter they prefer. These changes in behavior may result in populations not actually recognizing the other as candidates for breeding partner.

Geographic Isolation:

A large landslide comes downslope on the mountain. Large landslide. Really large. Blasts a swath of habitat into oblivion, rendering that piece of the mountain uninhabitable to the squirrels. Population is split into two gene pools now, that cannot interbreed. If they cannot interbreed, different pressures may yield different patterns of selection, and since they're not interbreeding, those differences may become more pronounced. And if they <u>are</u> able to interbreed, occasionally, their offspring may be less fit to survive in either environment. This further reinforces population differences and sends them on their way to speciation.

28. Vestigial structures - **B**	**A**. The model of evolution in which gradual change over a long period of time leads to species formation
29. Homologous structures - **D**	**B**. Structures that have little or no use are evidence of an organism's evolutionary past
30. Vertabrate embryos - **E**	**C**. The model of evolution in which periods of rapid change in a species are separated by long periods of little change
31. Gradualism - **A**	**D**. Structures that share a common ancestry but may have different functions at present
32. Puncutated Equilibrium - **C**	**E**. Pharyngeal pouches and tails are evidence of evolution
33. Fossil - **G**	**F**. process by which two species evolve in response to changes in each other over time.
34. Adaptive Radiation - **I**	**G**. remains of, or remains of evidence of an organism preserved in rock
35. Coevolution - **F**	**H**. theory that Earth's outermost layer is composed of distinct pieces which are in motion and have moved/shifted over geologic time.
36. Plate Tectonics - **H**	**I**. process in which a single species or a small group of species evolves into diverse species living in different ways

Complete each statement by underlining the correct term or phrase in the brackets

37. Traits of individuals best suited for survival will become **more** common in each new generation.
38. **Genes** is (are) responsible for inherited traits.
39. **Natural selection** cause(s) the frequency of certain alleles in a population to vary over time.
40. **Isolation** is the condition in which two populations of the same species cannot breed with one another.
41. Generally, when the individuals of two relate populations can no longer breed with one another, the two populations are considered to be different **species**.
42. Species that diverged recently have **fewer** genetic differences than those species that are not closely related.
43. In frogs, different mating seasons are a(n) **barrier** to reproduction.
44. Individuals of a species often **compete** with one another to survive.
45. Individuals within a population that are better able to cope with the challenges of their environment tend to leave **more** offspring than those less suited to survival in that particular environment.

46. Using Happy Bunny Meadow as a model, describe each of the three types of selection we discussed and how each might shape a population over time. Being able to draw appropriate graphs is a must.

    a. stabilizing (see your notes for this)

    b. directional

    c. disruptive

47. Nothing changes in nature without a pressure. How do changes in nature shape evolution? Explain with supporting details. What are some pressures that *shape an ecosystem* and *how do organisms respond*, over time? Use the principles of natural selection when providing your answer.
    Environments change due to abiotic features such as landslides, hurricanes, drought, earthquakes and volcanoes, etc. There are also biotic factors such as disease, loss of a food source, a new competitor, a new predator, etc. Al of these changes will tend to change what it means to be fit within that population. Due to the over-abundance of offspring for any given species and the variation found within those offspring, as the environment shifts so too will a shift occur in what it means to be "fit" in that changing environment. In successive generation, as the environmental factors shift, and allele frequencies shift in response, each generation becomes better and better adapted to the (new) environment.

48. Compare and contrast gradualism to punctuated equilibrium. What evidence exists for each?

    N/A

49. What does the Hardy-Weinberg equation **<u>say</u>**? (I don't care if you know the actual equation).

That the frequency of the alleles for traits in a population will remain in genetic equilibrium. No visible change in a population, from generation to generation.

50. HWE never exists in nature?!?!!!!

So, why would we study it? Give three examples.

a. **Gives us a base line of the diversity of alleles present in the population biologists may be studying.**

b. **Allows those biologists to monitor the population(s) and see how/where/when they are changing in response to the environment where they live**

c. **Provides the ability to craft meaningful policy to affect change to benefit populations of organisms under study.**

Why doesn't it actually exist? Give five reasons. Give examples of and explain each.

a. **Sexual selection – organisms do not reproduce randomly. They very purposefully choose this or that mate over other individuals in their species. This favors one set of alleles or another.**
b. **Gene flow – individuals may move into or out of a population, taking/bringing alleles with them, thereby disrupting the previous balance of allele frequency.**

c. **Genetic Drift – random changes have a much more pronounced effect on smaller populations than larger, more genetically robust populations.**

d. **Mutations – new alleles are constantly being generated by random mutation events. Most mutations are bad and eliminated from the population, but some do persist. And with the introduction of new, novel alleles into the gene pool, the overall frequency changes too.**

e. **Natural Selection – environments shift and change. There is no static environment, over any longer term period of time. And what it means to be fit within that environment shifts too. And so, nature is continually selecting what it means to be most fit. And this selection favors one set of alleles over another set.**