**Evolution Practice Test**

1. Your friend remarks, "The giraffe stretched its neck while reaching for higher leaves; as a result, its offspring inherited longer necks” *Which statement is the best response to correct your friend’s misconception?*
2. Overproduction of offspring leads to a struggle for survival.
3. Only favorable adaptations have survival value.
4. Characteristics acquired during an organism's life are generally not passed on through genes to its offspring.
5. Disuse of an organ may lead to its eventual disappearance.
6. Which of the following principles is NOT part of Darwin’s original theory of evolution by natural selection?
7. Evolution is a gradual process that occurs over long periods of time.
8. Variation occurs among individuals in a population.
9. Mutations are the ultimate source of genetic variation.
10. More individuals are born than will survive.
11. Individuals that possess the most favorable variations have the best chance of reproducing.
12. The *more* closely related two different organisms are, the
    1. more similar their habitats are
    2. less similar their DNA sequences are
    3. more recently they shared a common ancestor
    4. less likely they are to have the same genes in common
13. For a population in Hardy-Weinberg equilibrium, the frequency of the recessive allele
    1. increases with each generation until it reaches 50%
    2. decreases with each generation until it reaches 25%
    3. remains the same in every generation
    4. decreases due to negative selection pressure on homozygous recessive individuals
    5. increases due to the occurrence of new mutations
14. For a given population that contains genetic variation and is under the influence of natural selection, what is the *correct sequence* of the following events?

|  |  |
| --- | --- |
| 1 | Well-adapted individuals leave more offspring |
| 2. | A change occurs in the environment. |
| 3. | Genetic frequencies within the population change |
| 4. | Poorly adapted individuals do not survive |

* 1. 2 -> 4 -> 1 -> 3
  2. 2 -> 4 -> 3 -> 1
  3. 4 -> 1 -> 2 -> 3
  4. 4 -> 2 -> 3 -> 1

1. An organism’s *relative fitness* is measured by its
   1. Mutation rate
   2. Health and stability in the face of environmental change.
   3. Contribution to the gene pool of the next generation
   4. Genetic variability
2. Structures as different as human arms, bat wings, and dolphin flippers contain many of the same bones, these bones having developed from very similar embryonic tissues. How do biologists interpret these similarities?
3. By identifying the bones as being homologous structures
4. By the principle of convergent evolution
5. By proposing that humans, bats, and dolphins share a common ancestor
6. A and C only
7. A, B, and C
8. Which of the following is probably the best explanation for the fact that Antarctic penguins cannot fly, although there is evidence that millions of years ago their ancestors could do so?
   1. Penguins live on land and feed in the water; therefore they have no need to fly.
   2. The Antarctic home of penguins is flat and barren; therefore there is no place to fly.
   3. Ancestral penguins without large wings were better able to swim and feed in the water; therefore they passed their genes for shorter wings structure onto their offspring.
   4. Ancestral penguins did not use their wings for long periods of time; therefore today’s penguins have only tiny, nonfunctional wings.
   5. The cold and wind of Antarctica make flight impossible; therefore penguins that live there have lost the ability to fly.
9. A biologist studies a population of squirrels for 15 years. During this time, the population always remains between 30 – 45 squirrels. His data shows that more than ½ of the squirrels born do not survive to reproduce, due to competition for food and predation. Then, in a single generation, 90% of the squirrels born live to reproduce, and the population increases to 80. Which inference(s) about this population might be *true*?
10. The amount of available food may have increased.
11. The number of predators may have decreased.
12. The squirrels of subsequent generations should show greater levels of genetic variation than previous generations, because squirrels that would not have survived in the past will now survive.
13. A and B only
14. A, B, and C
15. Microevolution, or evolution at its smallest scale, occurs when
    1. an individual's traits change in response to environmental factors.
    2. a community of organisms changes due to the extinction of several dominant species.
    3. a new species arises from an existing species.
    4. a population's allele frequencies change over a span of generations.
16. Allopatric speciation occurs when:
    1. one population of the same species is separated geographically and can no longer interbreed.
    2. one population of different species are separated geographically and can no longer interbreed
    3. two populations of different species within the same geographic area share a gene pool
    4. two populations of the same species within the same geographic area share a gene pool
17. What is the only factor that can change allele frequencies in populations to produce *adaptive* evolutionary change?
    1. mutation
    2. gene flow
    3. non-random mating
    4. genetic drift
    5. selection
18. Males of different species of the fruit fly Drosophila that live in the same parts of the Hawaiian Islands have different elaborate courtship rituals. These rituals involve fighting other males and making stylized movements that attract females. What type of reproductive isolation does this represent?

|  |  |
| --- | --- |
| 1. geographic 2. mechanical 3. behavioral 4. gametic | http://www.freshfromflorida.com/pi/pest-alerts/images/drosophila_Fig_1_large.jpg |

1. Which of the following would *most quickly* be eliminated by natural selection?
   1. a harmful allele in an asexual, haploid population
   2. a harmful recessive allele in a sexual, diploid population
   3. a harmful recessive allele in a sexual, polyploid (more than 2) population
   4. any harmful allele, regardless of the system of inheritance in a population
2. How does natural selection affect the frequency of mutations?
3. Under conditions of high selection pressure, beneficial mutations occur more frequently
4. Natural selection does not affect the frequency of mutations
5. All mutations increase when selection pressure is high
6. When there is no selection pressure, mutations do not occur
7. Mutations occur less frequently when selection pressure is high
8. The bones of a human arm are homologous to structures in all of the following EXCEPT a
9. whale flipper
10. bat wing
11. butterfly wing
12. bird wing
13. frog forelimb
14. Which of the following is an example of convergent evolution?
15. similar amino acid sequences of hemoglobin in humans and chimpanzees
16. similar bones in the forelimbs of horses and bats
17. similar body shape of dolphins and fish
18. different beak shapes of Galapagos finches
19. similar plant species on islands and the nearest continent
20. According to natural selection theory,
21. Adaptations beneficial in one habitat should generally be beneficial in all other habitats
22. Different species occupying the same habitat will adapt to that habitat by undergoing the same genetic changes
23. Adaptations beneficial at one time should generally be beneficial during all other times
24. Well-adapted individuals leave more offspring, and thus contribute more to the next generation's gene pool, than do poorly adapted individuals.

19. Fossils of some intermediate forms have not been found because

1. new types of organisms can appear suddenly without progressive changes determined by natural selection
2. fossils are very rare; fossils of only a small fraction of all species have been found
3. all fossils are the same age
4. species produced by punctuated equilibrium do not leave fossils
5. the ages of many fossils are not calculated correctly

20. For some traits (such as birth weight in mammals), natural selection favors individuals that are average and the extremes are selected against. This is known as

1. diversifying selection
2. directional selection
3. adaptive radiation
4. disruptive selection
5. stabilizing selection

21. A species can be defined as

1. a population of organisms similar in size, shape, and color
2. a group of organisms that live in the same habitat
3. a population of organisms that are able to interbreed and produce fertile offspring
4. a population of organisms that have the same number of chromosomes
5. a population of organisms with a common ancestor

22. The condition in which there are barriers to successful interbreeding between individuals of different species in the same community is referred to as

1. latent variations
2. sterility
3. structural differences
4. geographic isolation
5. reproductive isolation

23. If an increase in dicynodont species diversity (i.e., number of species) occurred soon after the Permian extinction roughly 250 million years ago, and if it occurred for the same general reason usually given for the increase in mammalian diversity following the Cretaceous extinction, then it should be attributed to

|  |  |
| --- | --- |
| * 1. An innovation among the dicynodonts that allowed them to fill brand new niches.   2. The availability of previously occupied niches   3. The extinction of the dinosaurs (except the birds)   4. The evolution of humans | http://eonsepochsetc.com/Mesozoic/Triassic/Tri_Animals/Images/Dicynodont%20-%20Beaked.jpg |

24. A common ancestor for both species D and G could be at position number

|  |  |
| --- | --- |
| * 1. 1   2. 2   3. 3   4. 4   5. 5   6. 6 | http://people.biology.ufl.edu/osenberg/courses/bsc2011/1997spring/cwotree6.gif |

**Short Answer (TOTAL = 14 pts)**

**WRITE ALL ANSWERS ON THE ANSWER SHEET**

* 1. *List* **3**sources of genetic variation which can occur in meiosis and sexual reproduction. (3 pts)
  2. *List* the **5** assumptions of the Hardy-Weinberg Principle for a non-evolving population. (5 pts)

**Free Response**

**WRITE ALL ANSWERS ON THE ANSWER SHEET**

**1.** Below is a list of several scenarios that have occurred in our natural world. (5 pts)

Read the situation and *identify* the type of micro-evolutionary selection that may be operating. Choices are below:

stabilizing selection

directional selection

disruptive selection

bottleneck effect

founder effect

genetic drift

intersexual selection

intrasexual selection

heterozygousadvantage

adaptive radiation

1. An elk herd is observed over many generations. Most of the full-grown bull elk have antlers of nearly the same size, although a few have antlers that are significantly larger or smaller than this average size. The average antler size remains constant over the generations.
2. After a copper smelter begins operation, local downwind populations of plants begin to adapt to the resulting air pollution. Scientists document, for example, that the acid tolerance of several plant species has increased significantly in the polluted area.
3. Meerkats breed in groups in the arid savannahs of Southern Africa. Females who invest more heavily in finding breeding locations, and in rearing their young, have greater status in their group.
4. The northern elephant seal population was reduced by over hunting to 20 individuals in the 1890s. Although the population had rebounded to over 30 000 individuals by 1974, 24 gene loci were found to be homozygous by genetic testing.
5. Tay-Sachs is inherited as an autosomal recessive allele. Homozygous individuals die within the first few years of life. However, there is some evidence that heterozygous individuals are more resistant to tuberculosis.

**YOU MUST SHOW YOUR WORK ON THE ANSWER SHEET!**

**2.**

|  |  |
| --- | --- |
| Cystic fibrosis (CF) is a life threatening genetic disease affecting most critically the lungs, and also the pancreas, liver, and intestine. It is characterized by abnormal transport of chloride and sodium ions across the epithelium, leading to thick, viscous secretions in the airways.  CF strikes one out of every 3,300 Caucasian children. It results from the homozygous recessive condition. Utilizing the H-W principle: | http://learn.genetics.utah.edu/content/disorders/whataregd/cf/images/cfchannel.jpg |

1. Calculate the genotypic frequency for the homozygous recessive condition. (1 pt)
2. Calculate the genotypic frequency for the homozygous dominant healthy condition.   
   (1 pt)
3. What is the % frequency of heterozygous carriers? (1 pt)
4. OHS has roughly 750 students. How many OHS students may be carriers; i.e. students considered to be the heterozygous phenotype? (1 pt)
5. In comparison to Caucasians, the frequency of CF heterozygous carriers is lower for minority groups, including Hispanics (1 in 46), African Americans (1 in 60) and Asians (1 in 150). Scientists have speculated that this lower frequency of Cystic Fibrosis carriers among peoples that lived in historically warmer climates compared to Caucasians has to do with the salty sweat associated with Cystic Fibrosis. Experiments have shown that CF carriers have saltier sweat than people with two normal alleles. Hypothesize from an evolutionary standpoint as to why salty sweat may explain these differences in CF heterozygous frequencies. (3 pts)

**YOU MUST SHOW YOUR WORK ON THE ANSWER SHEET!**

**3. CASE STUDY (6 pts)**

**WRITE ALL ANSWERS ON THE ANSWER SHEET**

In 2004, Hurricane Frances ravaged the Bahama islands. This had a drastic effect on the brown anole lizards. Anole lizards on *only* one island, Iron Cay, were spared. Scientists performed an experiment. They took brown anole male and female couples from Iron Cay and released a *single* couple *at random* to each of the 7 tiny treeless islands nearby where no lizards remained after the hurricane.

These are the characteristics that were known about this species of lizards:

|  |  |
| --- | --- |
| Iron Cay Lizards | 7 Small Islands  (***Prior*** to the hurricane) |
| *Long-hind* legs that allow them  to run swiftly along broad tree  branches to avoid predators | Inhabitated by *short hind* legged anole lizards  that were better suited for darting in and out  of the short, tangled, scrubby bushes that thrived there |

Researchers returned *each year* to observe the transplanted anole couples. The researchers measured:

a) the length of the hind legs

b) the number of anoles with each succeeding generation.

**RESULT***:*

*After 6 generations* the researchers observed that a significant population of lizards maintained long hind legs though the environment had short shrubby bushes. They also observed a shortening in a subpopulation of hind legs with *each* generation.

**Do the results observed on the island support the ideas of the founder effect or natural selection or *both*?** *Support your answer as best as you can utilizing your knowledge of these evolutionary concepts as well as the data provided! (6 pts)*



**WRITE ALL ANSWERS ON THE ANSWER SHEET**

**BONUS QUESTION:**

In the article, “Call Duration as an Indicator of Genetic Quality in Male Gray Tree Frogs”, explain why the tadpoles that were derived from artificial selection between female frogs and male long-callers versus male short-callers were reared at two different food levels. (3 pts)



**WRITE ALL ANSWERS ON THE ANSWER SHEET**

**Multiple Choice (1pts each; TOTAL = 37 pts)**

|  |  |
| --- | --- |
| 1. c  2. c  3. c  4. c  5. a  6. c  7. d  8. c  9. e  10. d  11. a  12. e  13. c | 14. a  15. b  16. c  17. c  18. d  19. b  20. e  21. c  22. e  23. b  24. e |

**Short Answer**

**1. 1. Independent orientation of chromosomes during meiosis (assortment)**

**2. Crossing over of chromosomes during meiosis (recombination)**

**3. Random fertilization**

**2. 1. Large breeding population (*no genetic drift*)**

**2. Random mating**

**3. No mutations**

**4. No migration (*no gene flow*)**

**5. No natural selection**

**Short Answer (TOTAL = 14 pts)**

**3. a. Species that breed at different times of the day, different seasons, or different years cannot mix their gametes; example: Western (fall mating) versus Eastern Spotted Skunk (spring mating)**

**b. Sperm of one species may not be able to fertilize eggs of another species; example: red versus purple sea urchins produce gametes that are incompatible and will not fuse**

**Free Response & Critical Thinking Questions (Total = 12 pts)**

**1. a. stabilizing selection**

**b. directional selection**

**c. intrasexual selection**

**d. bottleneck effect**

**e. heterozygous advantage**

**2. a. Final Calculation: 3.03 x 10E-4**

**b. Final Calculation: 0.965**

**c. Final Calculation: 0.0342 => 3.42%**

**d. Final Calculation: 26**

**e. Salty sweat is associated with CF carriers. The frequency of CF carriers is lower in peoples of inherently warmer climates. So in these minority groups, CF carriers appear to be at a heterozygous DISadvantage. Consequently, natural selection would disfavor this genotype as this associated phenotype would more quickly lead to dehydration. (The faster you sweat, the saltier you sweat because there’s less time for the sodium to be reabsorbed by the body.)**

**3. CASE STUDY (6 pts)**

**Find the answer at the following link:**<http://www.upi.com/Science_News/2012/02/17/Founder-effect-observed-for-first-time/UPI-98791329518686/>  
  
Published: Feb. 17, 2012 at 5:44 PM  
WASHINGTON, Feb. 17 (UPI) -- Biologists have observed a theory of species evolution known as the founder effect in action for the first time, U.S. university researchers reported.

The founder effect, first outlined by German evolutionary biologist Ernst Mayr in 1942, says that when a small group of individuals from a genetically diverse population of some species migrates away and "founds" a new colony, the founders' genes play a dominant evolutionary role in the new population for generation after generation.

Biologists, including scientists who did postdoctoral work the University of California, said they wanted to see if the founder effect was real -- it had never been observed in action because evolution takes place so slowly.

They visited heavily forested Iron Cay, a Bahamas island spared the ravages of 2004's Hurricane Frances, and took brown anole lizard couples from the island at random to seven tiny treeless islands nearby where no lizards remained after the Category 4 hurricane.

On each island they released a single lizard pair, they said.

The Iron Cay lizards long ago evolved long hind legs to run swiftly along broad tree branches to avoid predators, the researchers reported.

But on the seven islands slammed by Frances, the anole lizards that drowned had short hind legs, better suited for darting in and out of the short, tangled, scrubby bushes that thrived there, the San Francisco Chronicle reported, citing the researchers.

If the founder effect held up, succeeding generations of the transplanted lizards would maintain their long hind legs, even though the original lizard residents had short legs, the researchers postulated.

The researchers returned to the islands every year to observe and measure the legs on each new generation of lizards, which now populate the islands.

After five or six generations, the founder effect appeared to hold up, with the new generations still sporting the long hind legs of their ancestors, the scientists reported.

But they saw another evolutionary force emerge, they said.

The lizards' long legs began shortening as each generation adapted to the scrub-bush environment, they said.

The scientists realized they were also witnessing [Charles Darwin](http://www.upi.com/topic/Charles_Darwin/" \o "Charles Darwin)'s natural selection, a key mechanism of evolution, they said.

"In this case, we've seen both the founder effect and natural selection operating right before our eyes -- for the first time," Jason Kolbe, a postdoctoral fellow at U.C. Berkeley and U.C. Davis and now at the University of Rhode Island, wrote in the American Association for the Advancement of Science journal Science Express.

Read more: [http://www.upi.com/Science\_News/2012/02/17/Founder-effect-observed-for-first-time/UPI-98791329518686/#ixzz29DxTXPl3](http://www.upi.com/Science_News/2012/02/17/Founder-effect-observed-for-first-time/UPI-98791329518686/" \l "ixzz29DxTXPl3)

**BONUS QUESTION (3 pts):**  
Go to the following link for the original article published in science in June 1998:  
<http://207.239.98.140/UpperSchool/Science/WilsonH/AP%20Biology/Evolution/AP%20Frog%20calls%20-%20evolution.pdf>  
This study involved a multivariate analysis in which females were artificially mated with both long and short callers and progeny tadpoles being exposed to both high and low food levels. If a significant increase in “long-callers-fathered-tadpole-quality” was observed for both food conditions, this would have further supported the study’s hypothesis that females judge genetic quality of males (and their offspring) based on their call duration.