Topic 5: Natural Selection And Evolution

Evolution - change over time; change in the frequency (how often they appear) of selected genes within a population of organisms.

*organisms tend to become more complex as organisms evolve (change) through time

*genes that have high adaptive value (allow an organism to survive) will increase in number as time goes on (from one generation to another)

*Evolution (change) happens faster if the environment is changing

*Evolution (change) occurs as a result of natural selection

Natural Selection - Theory proposed by Charles Darwin in 1859

*if an organism has the genes that let them survive (have Adaptive Value), then they reproduce passing the genes on to the next generation then gene becomes more common in the population.

*in a changing environment, favorable genes accumulate rapidly changing the appearance or behaviors of the population.

*If a species doesn't adapt/evolve in a changing environment, they may go extinct

Four Steps of Natural Selection

1. Overproduction - too many offspring are created (not all can survive because of limited resources in the environment)

2. Competition - because the species share common niches they will compete for food, space, mates...

3. Variation - Sexual reproduction (creates new combination of genes)

Mutations change the DNA/gene slightly

*Individuals in the population are not all the same. They contain different genetic information because of sexual reproduction and mutations.

4. Selection + Reproduction - the genes that are not adapted to the environment are selected against (die)

*Genes that have an adaptive value will survive and be passed on to the offspring.

*If a population lacks genetic variation (asexual reproduction, no mutation, inbreeding), they lose the ability to adapt/evolve to a changing environment.
*If two species share a common **ancestry** (they are related), they will have similar **DNA, patterns, embryonic development, bone structures**

**ELECTROPHORESIS GEL OF DEER SPECIES**

<table>
<thead>
<tr>
<th>Deer Species</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong> (common ancestor)</td>
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</table>

**Evolutionary Tree** (phylogenetic tree) - a diagram that illustrates the **change of species** over time.

*The very bottom is the **common ancestor**

*Lines that end before the **tip** represent species that are now **extinct**

*Lines that reach the **tip** are currently **living species**

*Branches that are drawn **close to one another** are more closely related that branches drawn **further apart**.
1. The females of certain species of turtles will sneak into a nest of alligator eggs to lay their own eggs and then leave, never to return. When the baby turtles hatch, they automatically hide from the mother alligator guarding the nest and go to the nearest body of water when it is safe to do so. Which statement best explains the behavior of these baby turtles?

1) More of the turtles' ancestors who acted in this way survived to reproduce, passing this behavioral trait to their offspring.
2) The baby turtles are genetically identical, so they behave the same way.
3) Turtles are not capable of evolving, so they repeat the same behaviors generation after generation.
4) The baby turtles' ancestors who learned to behave this way taught the behaviors to their offspring.

2. Limited resource contribute to evolutionary change in animals by increasing

1) genetic variation within the population
2) competition between members of the species
3) the carrying capacity for the species
4) the rate of photosynthesis in the population

3. The illustration below shows an insect resting on some green leaves.

The size, shape, and green color of this insect are adaptations that would most likely help the insect to

1) compete successfully with all birds
2) make its own food
3) hide from predators
4) avoid toxic waste materials

4. Which factor is least likely to contribute to an increase in the rate of evolution?

1) presence of genetic variations in a population
2) environmental selection of organisms best adapted to survive
3) chromosomal recombinations
4) a long period of environmental stability

5. The Florida panther, a member of the cat family, has a population of fewer than 100 individuals and has limited genetic variation. Which inference based on this information is valid?

1) These animals will begin to evolve rapidly.
2) Over time, these animals will become less likely to survive in a changing environment.
3) These animals are easily able to adapt to the environment.
4) Over time, these animals will become more likely to be resistant to disease.

6. Beak structures differ between individuals of one species of bird. These differences most likely indicate

1) the presence of a variety of food sources
2) a reduced rate of reproduction
3) a large supply of one kind of food
4) an abundance of predators

7. Base your answer to the following question on the information and graph below and on your knowledge of biology.

A small community that is heavily infested with mosquitoes was sprayed weekly with the insecticide DDT for several months. Daily counts providing information on mosquito population size are represented in the graph below.

What is the most probable reason for the decreased effectiveness of the DDT?

1) DDT caused mutations in
2) DDT was only sprayed once.
3) Mosquitoes resistant to DDT lived and produced offspring.
4) DDT chemically reacted with the DNA of the mosquitoes.
8. The diagram below represents four different species of bacteria.

Which statement is correct concerning the chances of survival for these species if there is a change in the environment?

1) Species A has the best chance of survival because it has the most genetic diversity.
2) Species C has the best chance of survival because it has no gene mutations.
3) Neither species B nor species D will survive because they compete for the same resources.
4) None of the species will survive because bacteria reproduce asexually.

9. Which process can produce new inheritable characteristics within a multicellular species?

1) cloning of the zygote
2) mitosis in muscle cells
3) gene alterations in gametes
4) differentiation in nerve cells

10. Which process is least likely to add to the variety of traits in a population?

1) deletion of bases from DNA
2) genetic engineering
3) accurate replication of DNA
4) exchange of segments between chromosomes

11. In the early stages of development, the embryos of dogs, pigs, and humans resemble one another. This observation suggests that these animals may have

1) a similar number of chromosomes
2) similar habitat requirements
3) the same blood components
4) a common ancestry

12. A species that lacks the variation necessary to adapt to a changing environment is more likely to

1) develop many mutated cells
2) become extinct over time
3) begin to reproduce sexually
4) develop resistance to disease

13. A researcher recently discovered a new species of bacteria in the body of a tubeworm living near a hydrothermal vent. He compared the DNA of this new bacterial species to the DNA of four other species of bacteria. The DNA sequences came from the same part of the bacterial chromosome of all four species.

<table>
<thead>
<tr>
<th>Species</th>
<th>DNA Sequence</th>
</tr>
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<tbody>
<tr>
<td>unknown species</td>
<td>ACT GCA CCC</td>
</tr>
<tr>
<td>species I</td>
<td>ACA GCA CCG</td>
</tr>
<tr>
<td>species II</td>
<td>ACT GCT GGA</td>
</tr>
<tr>
<td>species III</td>
<td>ACA GCA GGG</td>
</tr>
<tr>
<td>species IV</td>
<td>ACT GCA CCG</td>
</tr>
</tbody>
</table>

According to these data, the unknown bacterial species is most closely related to

1) species I
2) species II
3) species III
4) species IV
14. A classification system is shown in the table below.

<table>
<thead>
<tr>
<th>Classification</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kingdom — animal</td>
<td>△, ○, △, ☆, □, △, △, □, ☆</td>
</tr>
<tr>
<td>Phylum — chordata</td>
<td>△, △, ☆, □, ☆</td>
</tr>
<tr>
<td>Genus — Falls</td>
<td>□, □</td>
</tr>
<tr>
<td>Species — domestica</td>
<td>□</td>
</tr>
</tbody>
</table>

This classification scheme indicates that □ is most closely related to

1) ☆

2) △

3) □

4) □

15. The diagram below shows the evolutionary relationships between several groups of organisms.

Genus 1

Genus 2

Genus 3

Genus 4

Family A

Family B

Order B

Order A

Order C

Class A

Organisms with the greatest biochemical similarities would most likely be found in which pair of genera?

1) 1 and 3

2) 2 and 3

3) 3 and 4

4) 1 and 4

16. Which statement concerning the evolution of species A, B, C, D, and E is supported by the diagram below?

Species B and C can be found in today's environments.

Species A and D evolved from E.

Species A and C can still interbreed.

Species A, B, and E all evolved from a common ancestor and all are successful today.

17. Base your answer to the following question on the diagram below.

The similarities of the bones labeled A provide evidence that

1) the organisms may have evolved from a common ancestor

2) all species have one kind of bone structure

3) the cells of the bones contain the same type of mutations

4) all structural characteristics are the same in animals
Better Rice

The production of new types of food crops will help raise the quantity of food grown by farmers. Research papers released by the National Academy of Sciences announced the development of two new superior varieties of rice—one produced by selective breeding and the other by biotechnology.

One variety of rice, called Nerica (New Rice for Africa), is already helping farmers in Africa. Nerica combines the hardiness and weed resistance of rare African rice varieties with the productivity and faster maturity of common Asian varieties.

Another variety, called Stress-Tolerant Rice, was produced by inserting a pair of bacterial genes into rice plants for the production of trehalose (a sugar). Trehalose helps plants maintain, healthy cell membranes, proteins, and enzymes during environmental stress. The resulting plants survive drought, low temperatures, salty soils, and other stresses better than standard rice varieties.

18. Which substance from bacteria was most likely inserted into rice plants in the development of the trehalose-producing rice?
1) sugar
2) enzymes
3) DNA
4) trehalose

19. Why is the production of new varieties of food crops necessary?
1) Essential food crops are rapidly becoming extinct.
2) Technology for producing fresh water for agriculture has improved.
3) Burning fossil fuels has decreased agricultural areas.
4) World population continues to increase.
Color in peppered moths is controlled by genes. A light-colored variety and a dark-colored variety of a peppered moth species exist in nature. The moths often rest on tree trunks, and several different species of birds are predators of this moth.

Before industrialization in England, the light-colored variety was much more abundant than the dark-colored variety and evidence indicates that many tree trunks at that time were covered with light-colored lichens. Later, industrialization developed and brought pollution, which killed the lichens, leaving the tree trunks covered with dark-colored soot. The results of a study made in England are shown below.

Which conclusion can best be drawn from the information given?
1) The trait for dark coloration better suits the peppered moth for survival in non-polluted environments.
2) The trait for light coloration better suits the peppered moth for survival in polluted environments.
3) The variation of color in the peppered moth has no influence on survival of the moth.
4) A given trait may be a favorable adaptation in one environment, but not in another environment.