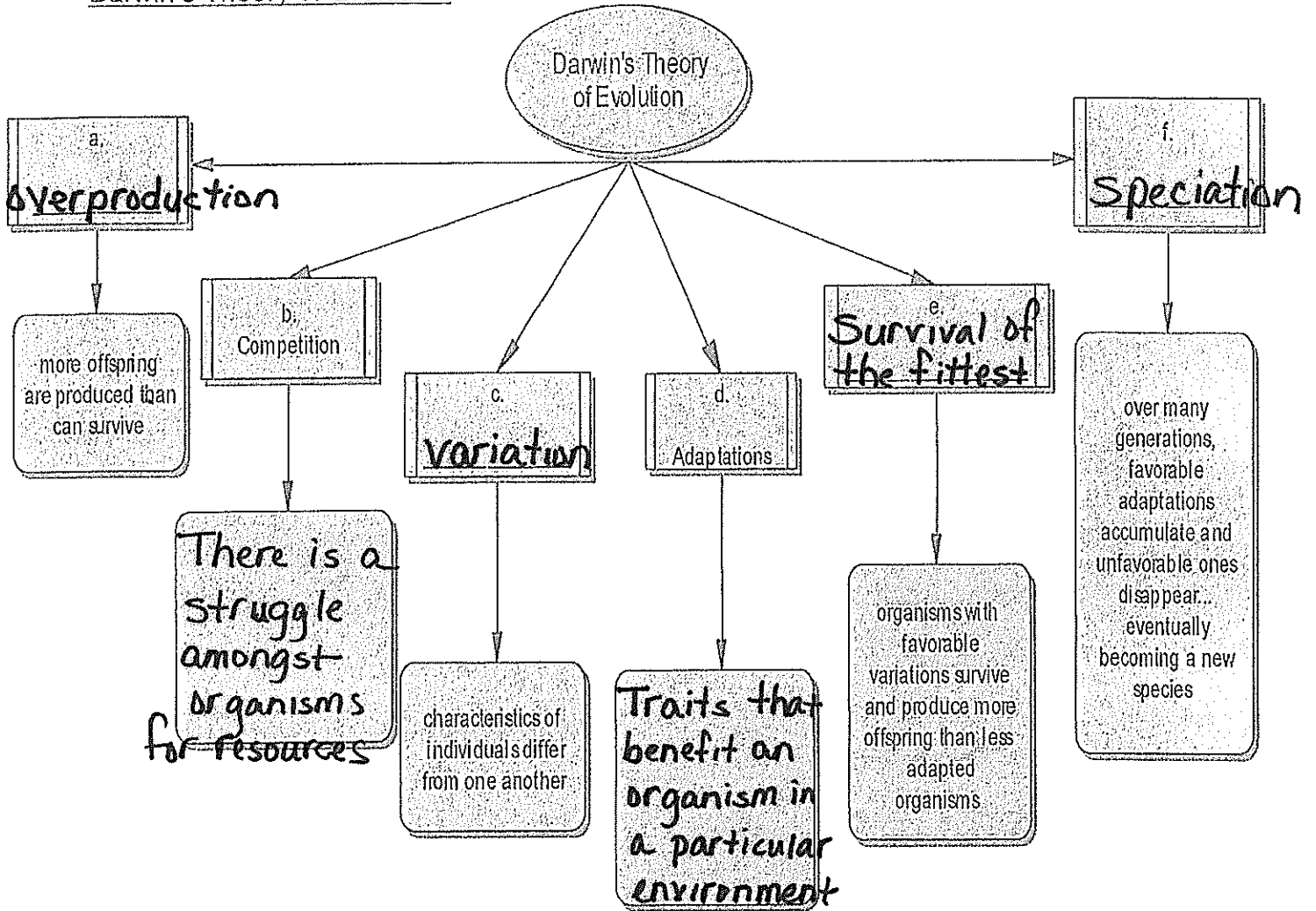
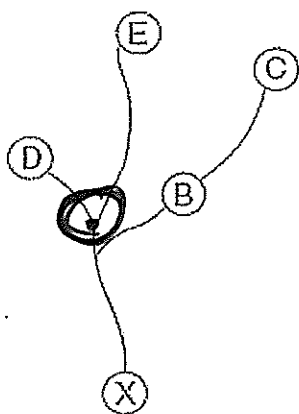


Topic 8: Evolution & Classification

Darwin's Theory of Evolution:



Evolution of organisms is often represented as a bush or tree.



Who is more closely related, D and E or D and B?

D and E

How did you know this?

D and E share a recent common ancestor

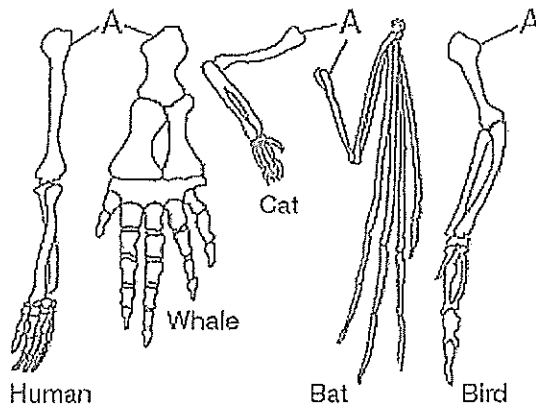
Sources of Variation:

- o **Mutation**: change in the base sequence of a DNA molecule
  - o random
  - o radiation and some chemicals
  - o must be in sex cells (**gametes**) to be passed on to offspring
  - o can be beneficial and lead to evolution
- o **Sexual Reproduction**: sorting and random recombining of genes during meiosis and fertilization results in new and different combinations of genes

Where there is sex... there is **variety** !!!!!

Evidence of Evolution:

- o **Homologous Structures**: common ancestor but different niche (role)



Structures that have similar structure but different functions

- o **Analogous Structures**: different ancestor but similar niche (role)

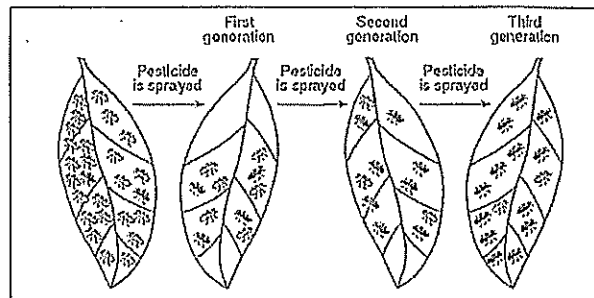
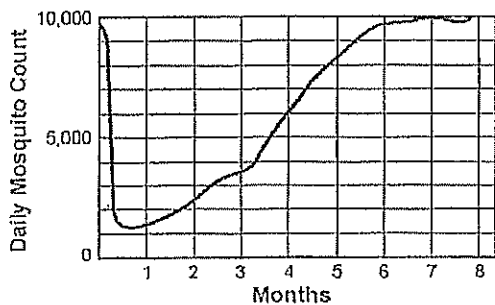
o Example:

**Bird Wing & Butterfly Wing**

Structures that have different structure but similar functions.

Resistance:

- o 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:



Why did some mosquitoes survive the first spraying? **There was variation in the population. Some mosquitoes were resistant.**

What is the source of the resistant gene? **Mutation**

What caused the decreased effectiveness of the DDT?

**Natural Selection favored the resistant mosquitoes. They lived and reproduced more mosquitoes with the resistance gene.**

Describe what happens with the overuse of antibiotics and how this can lead to an increase in antibiotic resistant bacteria.

Antibiotic overuse causes accelerated natural selection to occur in the bacteria population. There is variation in the bacteria population due to random mutations. These bacteria survive the antibiotic and create large populations of themselves.

Extinction:

• What is extinction? The loss of an entire species. (population)

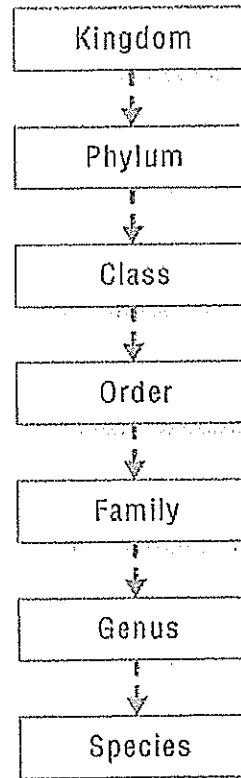
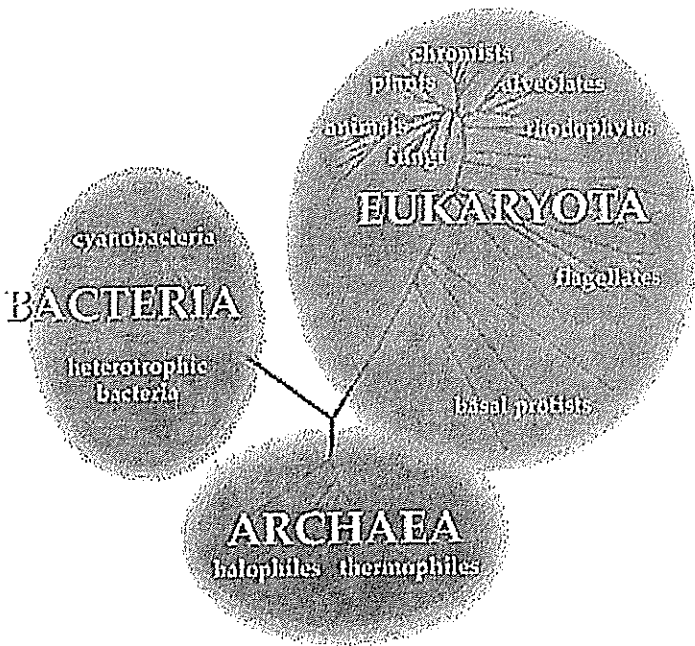
• What are some causes of extinction?

Drastically changed environment / A population has little or no variation

• True or False: The majority of the species that ever lived on Earth is now extinct.

Taxonomy: Classification of Organisms

The Three Domains:



Characteristics become more specific

Number of organisms in each level decreases

How are organisms grouped together for classification?  
Based on evolutionary relationships, Molecular, and structural similarities

Binomial Nomenclature: when we refer to organisms, we call them by their genus and species

Fill in the evolutionary tree below:

Amino Acid Differences

Species	Number of Amino Acid Differences
human	0
frog	67
pig	10
gorilla	1
horse	26

Based on the information in the data table, write the names of the organisms from the table in their correct positions on the evolutionary tree below. [1]

Fill in the dichotomous key below:

**Dichotomous Key**

1. a. Legs present..... Go to 2
- b. Legs not present..... Go to 3

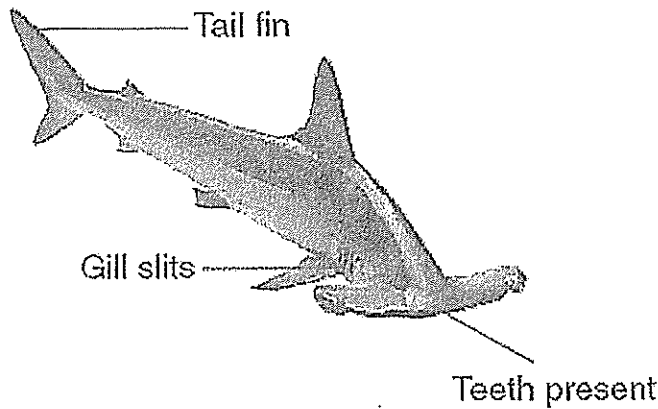
	Characteristic	Organism
2. a.	Four legs present .....	IV (dog)
b.	Eight legs present .....	II (spider)
3. a.	Fins and Tail present.....	III (fish)
b.	No fins, no tail .....	I (worm)

A dichotomous key is shown below.

Dichotomous Key

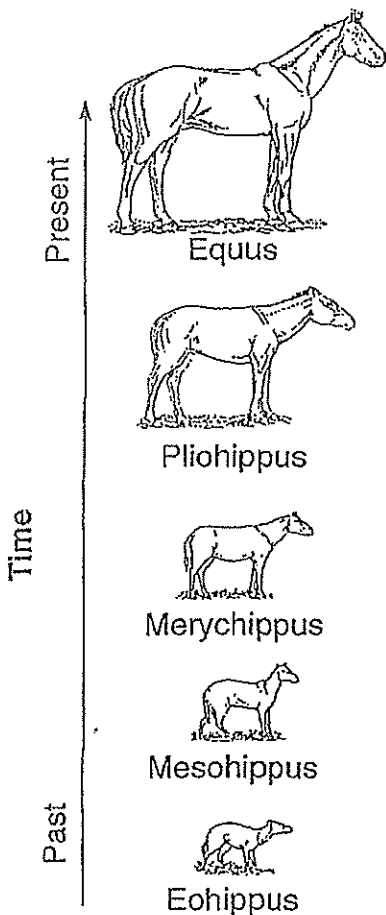
- 1. a. tail fins are horizontal.....go to 2
- b. tail fins are vertical.....go to 3
  
- 2. a. has teeth or tusk.....go to 4
- b. has no teeth.....*Balaena mysticetus*
  
- 3. a. has gill slits behind mouth.....go to 5
- b. has no gill slits.....*Lepidosiren paradoxa*
  
- 4. a. black with white underside.....*Orcinus orca*
- b. tusk, gray with dark spots.....*Monodon monoceros*
  
- 5. a. head is hammer shaped.....*Sphyrna mokarran*
- b. tail fins are half the body length.....*Alopias vulpinus*

Use the dichotomous key to identify the scientific name of the organism represented below. [1]



Sphyrna mokarran

- Which statement best supports the inference that the ancestors of modern day elephants had no trunks or tusks and were the size of pigs?
  - Population size tends to remain stable from generation to generation.
  - Evolutionary change is always rapid and continuous.
  - Existing life forms have evolved from earlier life forms.
  - Geographic isolation rarely favors speciation in small populations.
- Genetic variations are the raw material for evolution. These variations cannot be acted upon by natural selection factors unless they
  - produce only unfavorable characteristics
  - produce only favorable characteristics
  - are found in fossil records of the population
  - are in the phenotype of the organism
- The diagram below shows the gradual change over time in the anatomy of the horse.



Which concept is best illustrated by the physical variations in the horse as its body size and structure change over time?

- acquired characteristics
- artificial selection
- intermediate inheritance
- organic evolution

- The term "evolution" is best described as
  - a process of change in a population through time
  - a process by which organisms become extinct
  - the reproductive isolation of members of certain species
  - the replacement of one community by another
- Many scientists believe that the earliest cells on Earth were relatively simple, lacking nuclear membranes and other organized cellular structures. Over time, more complex cells developed from these simple cells.

These statements describe the concept of

- inheritance of acquired characteristics
  - evolution
  - dominance
  - use and disuse
- Some behaviors such as mating and caring for young are genetically determined in certain species of birds. The presence of these behaviors is most likely due to the fact that
    - birds do not have the ability to learn
    - individual birds need to learn to survive and reproduce
    - these behaviors helped birds to survive in the past
    - within their lifetimes, birds developed these behaviors
  - The theory of biological evolution includes the concept that
    - species of organisms found on Earth today have adaptations not always found in earlier species
    - fossils are the remains of present-day species and were all formed at the same time
    - individuals may acquire physical characteristics after birth and pass these acquired characteristics on to their offspring.
    - the smallest organisms are always eliminated by the larger organisms within the ecosystem
  - Which statement is most closely related to the modern theory of evolution?
    - Characteristics that are acquired during life are passed to offspring by sexual reproduction.
    - Evolution is the result of mutations and recombination, only.
    - Organisms best adapted to a changed environment are more likely to reproduce and pass their genes to offspring.
    - Asexual reproduction increases the survival of species.
  - Which factor has the greatest effect on the rate of evolution of animals?
    - environmental changes
    - use and disuse
    - asexual reproduction
    - vegetative propagation
  - Many modern evolutionists have accepted much of Darwin's theory of evolution, but have added genetic information that gives a scientific explanation of
    - overproduction
    - the struggle for existence
    - the survival of the fittest
    - variations

*modern genetics*

11. In a certain area, DDT-resistant mosquitoes now exist in greater numbers than ten years ago. What is the most probable explanation for this increase in numbers?

- 1) Genetic differences permitted some mosquitoes to survive DDT use.
- 2) Mosquito eggs were most likely to have been fertilized when exposed to DDT.
- 3) DDT acted as a reproductive hormone for previous generations of mosquitoes.
- 4) DDT serves as a new source of nutrition.

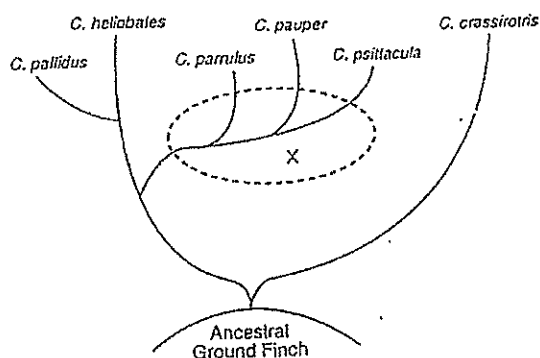
12. Which concept was *not* included by Darwin in his theory of evolution?

- 1) overproduction in a population
  - 2) struggle for existence
  - 3) genetic basis for variations
  - 4) survival of the fittest
- Could not explain variation**

13. After the Industrial Revolution, dark-colored moths outnumbered light-colored moths in certain regions of England. Within the past 40 years, factories in these regions have added scrubbers and air purifiers to their smokestacks, and the relative number of light-colored moths has increased. The probable reason for this increase is that

- 1) the allele for light color became dominant over the allele for dark color
- 2) the environment favored the survival of light-colored moths over dark-colored moths
- 3) dark-colored moths turned light because they needed to survive
- 4) overpopulation occurred and most of the light-colored moths died, leaving only dark-colored moths to reproduce

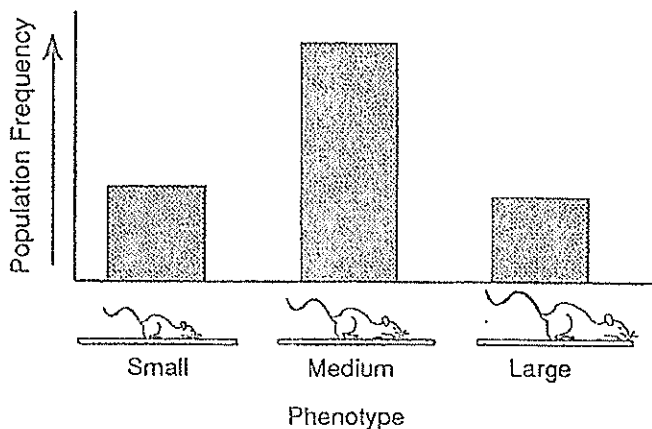
14. The diagram below represents a taxonomic tree showing the possible evolution of six species of finches.



The most likely explanation for the branching pattern seen in the circled region labeled X is that

- 1) environmental changes resulted in extinction
- 2) speciation occurred as a result of inbreeding
- 3) no speciation occurred during this time
- 4) environmental changes influenced speciation

15. The graph below shows the results of an investigation related to evolution.



This graph was most likely developed from data involving a study of the

- 1) transmission of acquired characteristics
- 2) concept of punctuated equilibrium
- 3) concept of gradualism
- 4) variation within a species

16. Which factor has most likely caused the rapid increase in the number of pesticide-resistant insect species over the past 30 years?

- 1) a decrease in food production
  - 2) an increase in competition between plants
  - 3) more widespread use of insecticides
  - 4) greater mating between insect species
- Natural Selection**

17. Of the 500 eggs produced by a certain female frog, only 10% developed into adult frogs. Which part of Darwin's theory does this best illustrate?

- 1) Favorable variations are not inherited.
- 2) There is a struggle for existence among organisms.
- 3) Mutations occur by chance.
- 4) Mating occurs in a random manner in a species.

18. The concept that new varieties of organisms are still evolving is best supported by the

- 1) increasing need for new antibiotics
- 2) increasing number of individuals in the human population
- 3) decreasing number of new fossils discovered in undisturbed rock layers
- 4) decreasing activity of photosynthetic organisms due to warming of the atmosphere

19. Which concept includes the other three?

- 1) competition
- 2) survival of the fittest
- 3) natural selection
- 4) overproduction

20. One concept that supports the theory of evolution states that organisms best adapted for survival are the ones that will reproduce and pass traits on to future generations. Adaptations that can be passed on do *not* include

- 1) the basic structure of the organism
  - 2) the reflex actions of the organism
  - 3) the manner in which the organism carries out respiration
  - 4) techniques for hunting food taught by the parents of the organism
- (Acquired)

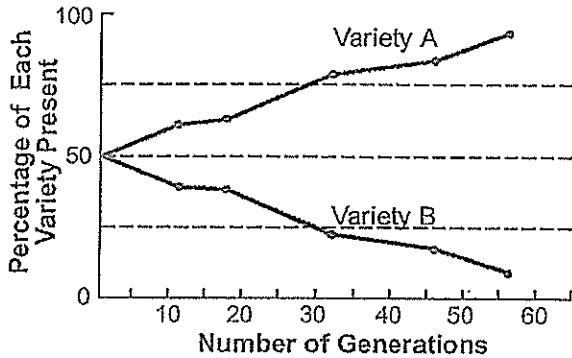
21. Darwin's studies of finches on the Galapagos Islands suggest that the finches' differences in beak structure were most directly due to

- 1) acquired characteristics in the parent finches
  - 2) the size of the island where the finches live
  - 3) mating behaviors of the different finch species
  - 4) adaptations of the finches to different environments
- Adaptive radiation

22. When penicillin was first introduced, it was very effective in destroying most of the bacteria that cause gonorrhoea. Today, certain varieties of this bacterium are resistant to penicillin. Which statement best explains the appearance of these resistant varieties?

- 1) Penicillin stimulated the bacteria to become resistant, and this resistance was passed to the offspring. *No!*
- 2) Penicillin killed the susceptible bacteria, while naturally resistant varieties survived and reproduced.
- 3) Penicillin used today is not as strong as the penicillin used when it was first introduced.
- 4) Penicillin stimulated the production of antigens in the resistant bacteria.

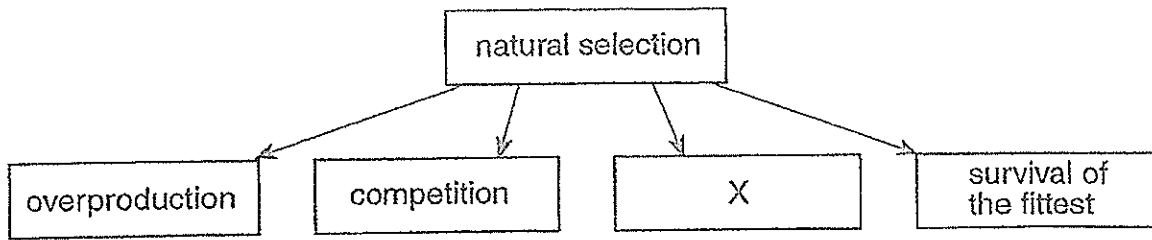
23. What is the most probable reason for the increase in the percentage of variety A in the population of the species shown in the graph below?



- 1) There is no chance for variety A to mate with variety B.
- 2) There is no genetic difference between variety A and variety B.
- 3) Variety A is less fit to survive than variety B is.
- 4) Variety A has some adaptive advantage that variety B does not have.



24. Some of the concepts included in Darwin's theory of natural selection are represented in the diagram below.

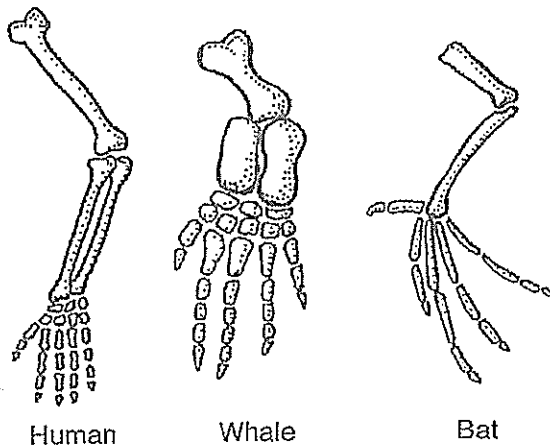


Which concept would be correctly placed in box X?

- 1) use and disuse
- 2) variation
- 3) changes in nucleic acids
- 4) transmission of acquired traits

*Darwin had no knowledge of modern genetics*

25. The diagrams below show the bones in the forelimbs of three different organisms.



*Homologous Structures*

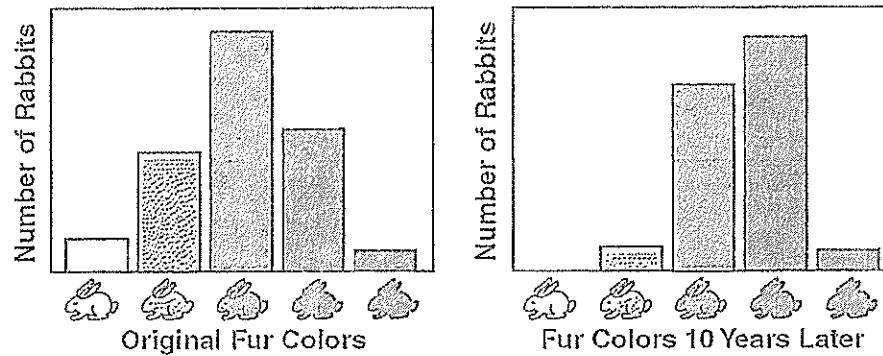
Differences in the bone arrangements support the hypothesis that these organisms

- 1) are members of the same species
- 2) may have descended from the same ancestor
- 3) have adaptations to survive in different environments
- 4) all contain the same genetic information

26. Scientists compared fossil remains of a species that lived 5,000 years ago with members of the same species living today. Scientists concluded that this species had changed very little over the entire time period. Which statement best accounts for this lack of change?

- 1) The environment changed significantly and those offspring without favorable characteristics died.
- 2) The environment changed significantly, but the species had no natural enemies for a long period of time.
- 3) The environment did not change significantly and those offspring expressing new characteristics survived their natural enemies.
- 4) The environment did not change significantly and those offspring expressing new characteristics did not survive.

27. The diagram below illustrates the change that occurred in the physical appearance of a rabbit population over a 10-year period.



Which condition would explain this change over time?

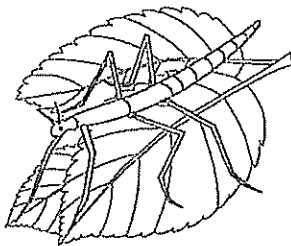
- 1) a decrease in the mutation rate of the rabbits with black fur
- 2) a decrease in the advantage of having white fur
- 3) an increase in the advantage of having white fur
- 4) an increase in the chromosome number of the rabbits with black fur

Darker fur favored  
(selected)

28. 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

29. 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

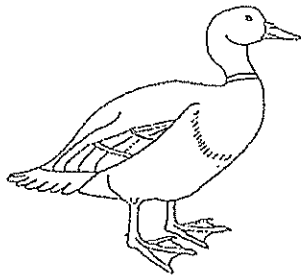
30. Lamarck proposed that new organs evolved according to the

- 1) needs of the organism
- 2) process of natural selection
- 3) role of mutation
- 4) sorting out of genes

31. Based on modern evolutionary theory, the development of a new species would most likely be associated with

- 1) a constant environment
- 2) stable gene pools
- 3) geographic isolation
- 4) a lack of mutations

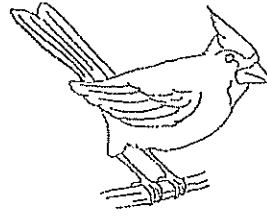
32. The diagram below represents four different species of wild birds. Each species has feet with different structural adaptations.



Mallard duck



Redheaded woodpecker



Northern cardinal

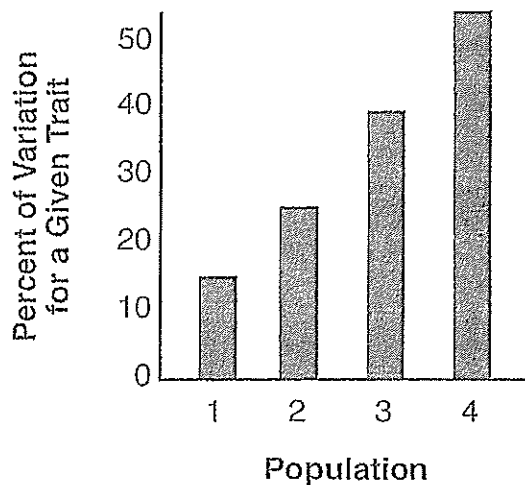


Common snipe

The development of these adaptations can best be explained by the concept of

- 1) inheritance of resistance to diseases that affect all these species
- 2) inheritance of characteristics acquired after the birds hatched from the egg
- 3) natural selection
- 4) selective breeding

33. The graph below shows the percent of variation for a given trait in four different populations of the same species. The populations inhabit similar environments.



In which population will the greatest number of individuals most likely survive if a significant environmental change related to this trait occurs?

- 1) 1
- 2) 2
- 3) 3
- 4) 4

34. Which statement is most consistent with the theory of evolution as stated by Lamarck?

- 1) In a litter of puppies, the weakest one died.
- 2) A cat that lost a toe produced a kitten missing a toe.
- 3) The mutation rate of a bacterium increased under ultraviolet light.
- 4) A change in DNA structure produced longer tails in monkeys.

35. Over a long period of time the organisms on an island changed so that they could no longer interbreed with the organisms on a neighboring island. This inability to interbreed is known as

- 1) hybridization
- 2) reproductive isolation
- 3) artificial selection
- 4) survival of the fittest

36. Darwin observed that different, but closely related, species of finches filled the diverse environmental niches on the different Galapagos Islands. The filling of these environmental niches is known as

- 1) acquired characteristics
- 2) blending inheritance
- 3) common ancestry
- 4) adaptive radiation

37. Which process is primarily responsible for maintaining variation in a population?

- 1) sexual reproduction
- 2) binary fission
- 3) spore formation
- 4) vegetative propagation

38. Fish, reptiles, and mammals each contain gill slits during part of their embryological development. Which statement best explains this observation?

- 1) Their embryos all swam in the sea.
- 2) They each evolved one from the other.
- 3) They all had a common ancestor.
- 4) They do not excrete gases during their development.

39. The sequence of amino acids in horse hemoglobin is very similar to the sequence of amino acids in human hemoglobin. This evidence supporting organic evolution has been drawn from studies in the field of comparative

- 1) biochemistry
- 2) cytology
- 3) anatomy
- 4) embryology

40. From the information given in the chart below, which two organisms are most closely related?

ORGANISM	ENZYME TYPE			
	1	2	3	4
A	X		X	
B				X
C	X	X	X	X
D	X		X	X

X = Enzyme present in organism

- 1) A and B  
 2) B and C  
 3) C and D  
 4) D and B
41. Base your answer to the following question on the chart below and on your knowledge of biology.

Species	Sequence of Amino Acids in the Same Part of the Hemoglobin Molecules
Human	Lys-Glu-His-Iso
Horse	Arg-Lys-His-Lys
Gorilla	Lys-Glu-His-Lys
Chimpanzee	Lys-Glu-His-Iso
Zebra	Arg-Lys-His-Arg

According to this information, the closest evolutionary relationship most likely exists between the

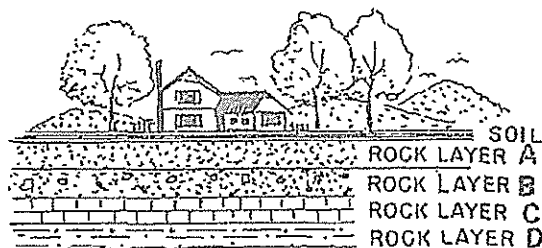
- 1) human and the chimpanzee  
 2) human and the gorilla  
 3) chimpanzee and the gorilla  
 4) horse and the zebra

42. In the past, a specific antibiotic was effective in killing a certain species of bacteria. Now, most members of this bacterial species are resistant to this antibiotic. Explain how this species of bacteria has become resistant. Your answer must include at least the concepts of:

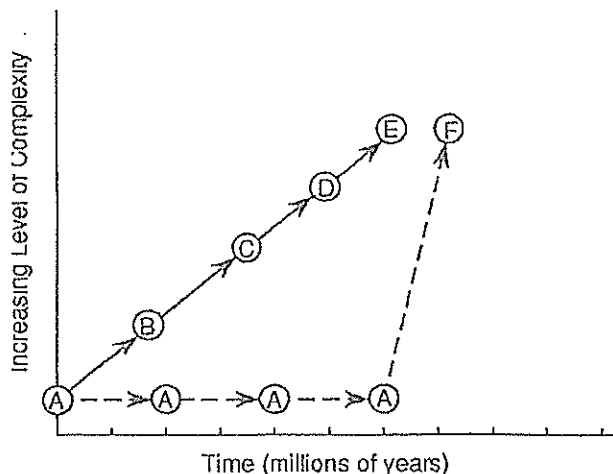
- overproduction
- variation
- natural selection
- adaptation to the environment

- There are always more offspring produced than there are resources for
- There are differences among the members of a population
- Organisms with favorable variations will survive a changing environment.
- Over many generations, these favorable traits are seen throughout the population as adaptations.

43. A geologist finds fossils in each of the undisturbed rock layers represented in the diagram below. The fossils are all structurally similar. Which is the most likely conclusion that the geologist would make?



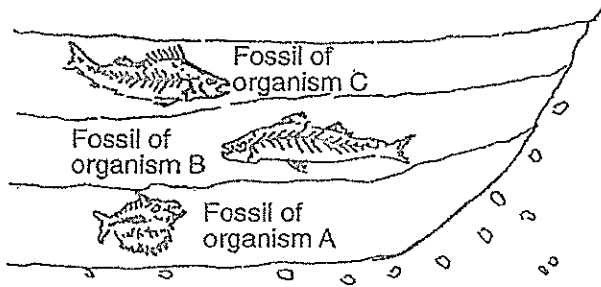
- 1) All the fossils are of the same age.  
 2) The relative ages of the fossils cannot be determined.  
 3) The fossils in rock layer D are older than those in layer A.  
 4) The fossils in rock layer B are older than those in layer C.
44. Letters A through F on the graph below represent different species that are related but show different structural, functional, and behavioral adaptations.



One inference that can be drawn from the graph is that

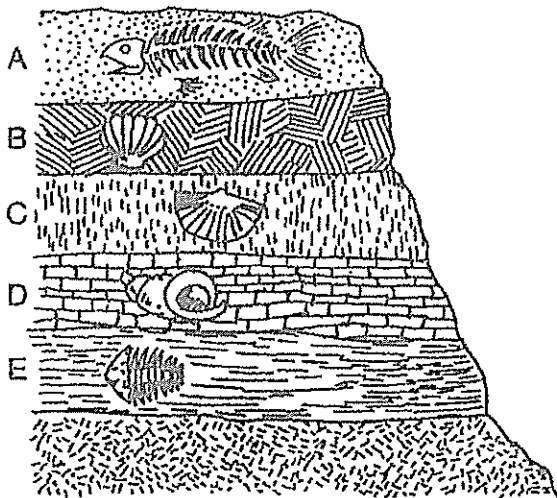
- 1) speciation occurs only gradually, over long periods of time  
 2) species E is the ancestor of species F  
 3) species E resulted from the extinction of species A, B, C, and D  
 4) speciation may be either gradual or abrupt

45. The diagram below represents undisturbed rock strata in a given region. A representative fossil of an organism is illustrated in each layer.



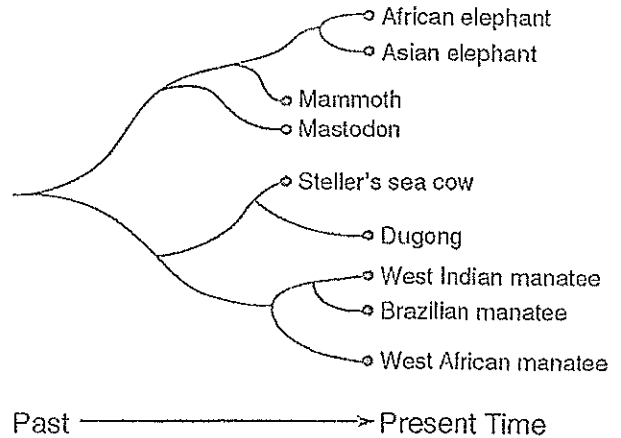
Which statement best describes a relationship between these representative organisms?

- 1) Organism A was probably more structurally advanced than organism B and organism C.
  - 2) Organism C probably gave rise to organism A and organism B.
  - 3) All of these organisms probably evolved at the same time.
  - 4) Organism A was probably more primitive than organism B and organism C.
46. In the diagram below of undisturbed sedimentary rock strata, in which rock layer are the fossils of more complex animals generally found?



- 1) A
- 2) B
- 3) E
- 4) D

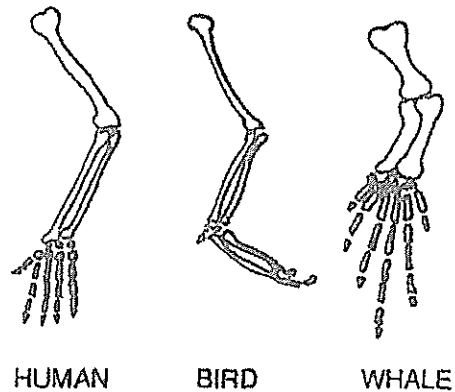
47. The relationship of some mammals is indicated in the diagram below.



Which statement about the African elephant is correct?

- 1) It is more closely related to the mammoth than it is to the West African manatee.
- 2) It is more closely related to the West Indian manatee than it is to the mastodon.
- 3) It is not related to the Brazilian manatee or the mammoth.
- 4) It is the ancestor of Steller's sea cow.

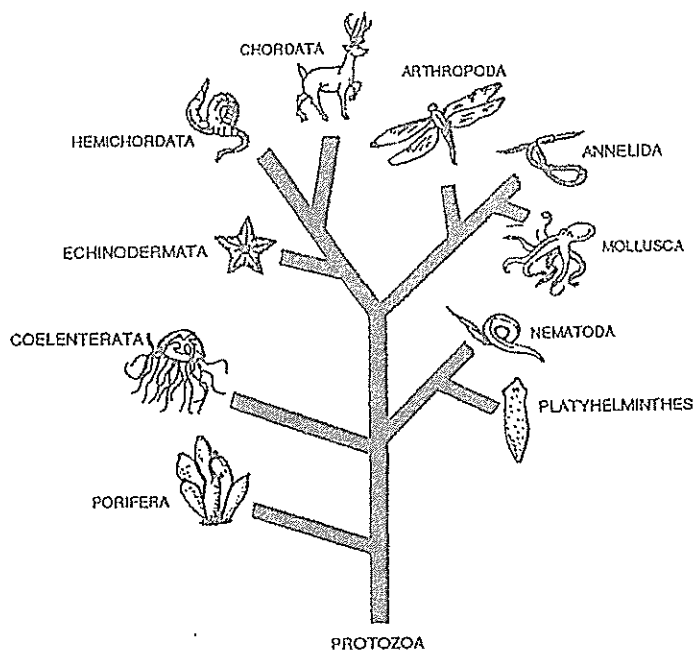
48. The diagrams below represent the forelimbs of three different organisms.



These structures are classified as homologous because they

- 1) demonstrate the law of use and disuse
- 2) are identical in function
- 3) represent acquired characteristics
- 4) are similar in structure and origin

49. Base your answer to the following question on the diagram below and on your knowledge of biology. The diagram illustrates one possible scheme of evolution among various groups of organisms.



Which inference does the diagram best support?

- 1) Members of the animal kingdom are more complex than members of the plant kingdom.
- 2) Members of the animal kingdom and members of the plant kingdom share a common ancestry.
- 3) Chordates are more closely related to arthropods than to echinoderms.
- 4) Members of the phylum Echinodermata and the phylum Annelida share a common ancestry.

50. Base your answer to the question below on the information and statement below.

Information

The Galápagos Islands in the Pacific were probably never connected to South America. However, in the various habitats on the islands, there are about 14 species of finch-like birds that appear to be related to finches on the South American mainland. Though the Galápagos finches vary in structure, there is a close resemblance between these species in plumage, calls, nests, and eggs. These species do not interbreed and do not compete for food.

Statement

Isolation from the South American mainland and different habitats on the Galápagos Islands are important factors in the production of new species.

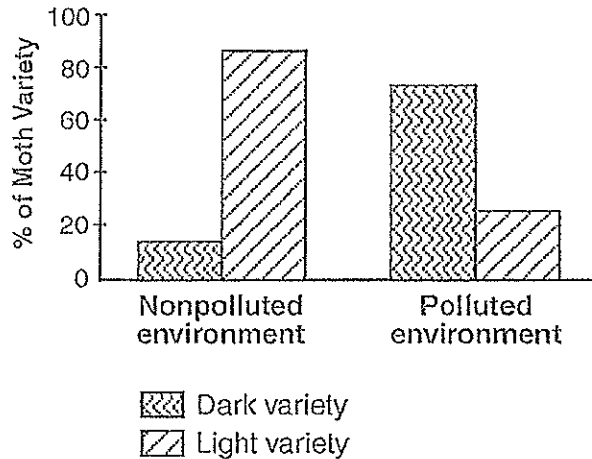
What is the relationship between the statement and the information given?

- 1) The statement is supported by the information given.
- 2) The statement is not supported by the information given.
- 3) The statement is contradicted by the information given.
- 4) No relevant information is given regarding the statement.

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

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?

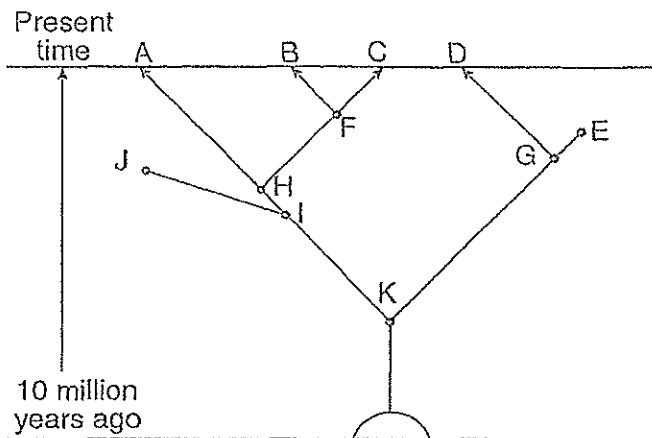
- 1) The trait for dark coloration better suits the peppered moth for survival in non-polluted environments.
- 2) The trait for light coloration better suits the peppered moth for survival in polluted environments.
- 3) The variation of color in the peppered moth has no influence on survival of the moth.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

- \* 52. A group of biology students participated in a prey-predator laboratory investigation. Fifty green bean seeds and 50 white bean seeds, both representing prey, were scattered in a 25-square-meter area of the school lawn. Three students representing predators were then given 30 seconds to search the area and collect the "prey." This procedure was repeated five times. Using one or more complete sentences, state the hypothesis being tested in this activity.

If green and white bean seeds are scattered on a lawn, then students will pick up more white seeds.



53. Base your answer to the following question on the diagram below. The diagram shows an interpretation of relationships based on evolutionary theory. The letters represent different species.



Explain why species B and C are more closely related than species A and C are.

B and C share a more recent common ancestor

54. State what could happen to a species in a changing environment if the members of that species do not express any genetic variations.

The species may become extinct.

55. <1column>

When Charles Darwin was developing his theory of evolution, he considered variations in a population important. However, he could not explain how the variations occurred. Name two processes that can result in variation in a population. Explain how these processes actually cause variation.

Mutations and Sexual Reproduction