~~Unit 11 Exam~~ SPECIATION & CLASSIFICATION

1. The biological species concept is inadequate for grouping
    a. plants.
    b. parasites.
    c. asexual organisms.
    d. animals that migrate.
    e. sympatric populations.

2. Which example below will most likely guarantee that two closely related species will remain distinct biological species?
    a. colonization of new habitats
    b. convergent evolution
    c. hybridization
    d. geographic isolation from one another
    e. reproductive isolation from one another

3. A defining characteristic of allopatric speciation is
    a. the appearance of new species in the midst of old ones.
    b. asexually reproducing populations.
    c. geographic isolation.
    d. artificial selection.
    e. large populations.

4. According to the concept of punctuated equilibrium, the "sudden" appearance of a new species in the fossil record means that
    a. the species is now extinct.
    b. speciation occurred instantaneously.
    c. speciation occurred in one generation.
    d. speciation occurred rapidly in geologic time.
    e. the species will consequently have a relatively short existence, compared with other species.

5. Speciation
    a. occurs at such a slow pace that no one has ever observed the emergence of new species.
    b. occurs only by the accumulation of genetic change over vast expanses of time.
    c. must begin with the geographic isolation of a small, frontier population.
    d. proceeds at a uniform tempo across all taxa.
    e. occurs via anagenesis and cladogenesis, but only the latter increases biodiversity.

6. Which combination of the following species characteristics would cause the greatest likelihood of fossilization in sedimentary rock?

I. The species was abundant.
II. The species was widespread.
III. The species had hard body parts.
IV. The species was adapted to desert life.
V. The species had a long duration in geologic time

a III only
b. III and IV
c. I, II, and III
d. I, II, and V
e. I, II, III, and V

7. The ostrich and the emu look very similar and live in similar habitats, however they are not very closely related. This is an example of
a. divergent evolution.
b. convergent evolution.
c. exaptation.
d. adaptive radiation.
e. sympatric speciation.

8. The correct sequence from the most to the least comprehensive of the taxonomic levels listed here is
a. family, phylum, class, kingdom, order, species, and genus.
b. kingdom, phylum, class, order, family, genus, and species.
c. kingdom, phylum, order, class, family, genus, and species.
d. phylum, kingdom, order, class, species, family, and genus.
e. phylum, family, class, order, kingdom, genus, and species

9. *Panthera* is a taxon at which level?
a. order
b. family
c. phylum
d. genus
e. class

10. In evolutionary terms, the more closely related two different organisms are, the
a. more similar their habitats are.
b. less similar their DNA sequences are.
c. more recently they shared a common ancestor.
d. less likely they are to be related to fossil forms.
e. more similar they are in size.

11. Which statement about natural selection is *most* correct?
    a. Adaptations beneficial in one habitat should generally be beneficial in all other habitats as well.
    b. Different species that together occupy the same habitat will adapt to that habitat by undergoing the same genetic changes.
    c. Adaptations beneficial at one time should generally be beneficial during all other times as well.
    d. Well-adapted individuals leave more offspring, and thus contribute more to the gene pool, than poorly adapted individuals.
    e. Natural selection is the sole means by which populations can evolve.

12. Given a population that contains genetic variation, what is the correct sequence of the following events, under the influence of natural selection?

    1. Differential reproduction occurs.
    2. A new selective pressure arises.
    3. Allele frequencies within the population change.
    4. Poorly adapted individuals have decreased survivorship.

    a. 2, 4, 1, 3
    b. 4, 2, 1, 3
    c. 4, 1, 2, 3
    d. 4, 2, 3, 1
    e. 2, 4, 3, 1

13. Which statement best describes how the evolution of pesticide resistance occurs in a population of insects?
    a. Individual members of the population slowly adapt to the presence of the chemical by striving to meet the new challenge.
    b. All insects exposed to the insecticide begin to use a formerly silent gene to make a new enzyme that breaks down the insecticide molecules.
    c. Insects observe the behavior of other insects that survive pesticide application, and adjust their own behaviors to copy those of the survivors.
    d. A number of genetically resistant pesticide survivors reproduce. The next generation of insects contains more genes from the survivors than it does from susceptible individuals.
    e. B and D only

14. What would be the best technique for determining the evolutionary relationships among several closely related species, each of which still contains living members?
    a. examining the fossil record
    b. comparison of homologous structures
    c. comparative embryology
    d. comparative anatomy
    e. DNA or RNA analysis

15. All of the following are criteria for maintaining Hardy-Weinberg equilibrium involving two alleles *except*
    a. the frequency of all genotypes must be equal.
    b.t here should be no natural selection.
    c. matings must be random.
    d. populations must be large.
    e. gene flow from other populations must be zero.

16. Which is true regarding genetic variation in prokaryotes, where cell reproduction occurs via binary fission?
    a. Prokaryotes lack any ability to increase their genetic variation.
    b. Prokaryotes are limited to the rare-chance mutation to increase their genetic variation.
    c. Only when binary fission occurs by meiosis do prokaryotes have the ability to undergo genetic recombination.
    d. Prokaryotic genomes can experience increased genetic variation via both mutation and genetic recombination.
    e. Prokaryotic genomes gain genetic variation solely through the action of bacteriophages.

17. When we say that an individual organism has a greater fitness than another individual, we specifically mean that the organism
    a. lives longer than others of its species.
    b. competes for resources more successfully than others of its species.
    c. mates more frequently than others of its species.
    d. utilizes resources more efficiently than other species occupying similar niches.
    e. leaves more viable offspring than others of its species.

18. Which of the following statements best summarizes evolution as it is viewed today?
    a. It is goal-directed.
    b. It represents the result of selection for acquired characteristics.
    c. It is synonymous with the process of gene flow.
    d. It is the descent of humans from the present-day great apes.
    e. It is the differential survival and reproduction of the most fit phenotypes.

19. All of the following occur during mitosis *except* the
    a. condensing of chromosomes.
    b. uncoupling of chromatids at the centromere.
    c. formation of a spindle.
    d. synthesis of DNA.
    e. disappearance of the nucleolus.

20. How do the two members of a pair of homologous chromosomes differ from each other?
    a. their length
    b. the identity and relative position of the genes present on each of the chromosomes
    c. their staining patterns
    d. the position of the centromere within each of the chromosomes
    e. the precise sequence of the DNA within each of the chromosomes

21. Which of the following is *true of the process of meiosis?*
    a. Two diploid cells result.
    b. Four diploid cells result.
    c. Four haploid cells result.
    d. Four autosomes result.
    e. Four chiasmata result.

22. Independent assortment of chromosomes is a result of
    a. the random and independent way in which each pair of homologous chromosomes lines up at the metaphase plate during meiosis I.
    b. the random nature of the fertilization of ova by sperm.
    c. the random distribution of the sister chromatids to the two daughter cells during anaphase II.
    d. the relatively small degree of homology shared by the X and Y chromosomes.
    e. all of the above

23. Which of the following statements is *false* when comparing prokaryotes with eukaryotes?
    a. The prokaryotic chromosome is circular, whereas eukaryotic chromosomes are linear.
    b. Prokaryotic chromosomes have a single origin of replication, whereas eukaryotic chromosomes have many.
    c. The rate of elongation during DNA replication is higher in prokaryotes than in eukaryotes.
    d. Prokaryotes produce Okazaki fragments during DNA replication, but eukaryotes do not.
    e. Eukaryotes have telomeres, and prokaryotes do not.

24. What determines the nucleotide sequence of the newly synthesized strand during DNA replication?
    a. the particular DNA polymerase catalyzing the reaction
    b. the relative amounts of the four nucleoside triphosphates in the cell
    c. the nucleotide sequence of the template strand
    d. the primase used in the reaction
    e. both A and D

25. Muscle cells and nerve cells in one species of animal owe their differences in structure to
    a. having different genes.
    b. having different chromosomes.
    c. using different genetic codes.
    d. differential gene expression.
    e. having unique ribosomes.

26. Approximately what proportion of the DNA in the human genome codes for proteins or functional RNA?
    a. 83%
    b. 46%
    c. 32%
    d. 13%
    e. 2%

27. Plasmids are important in biotechnology because they are
    a. a vehicle for the insertion of foreign genes into bacteria.
    b. recognition sites on recombinant DNA strands.
    c. surfaces for protein synthesis in eukaryotic recombinants.
    d. surfaces for respiratory processes in bacteria.
    e. proviruses incorporated into the host DNA.

28. What is the enzymatic function of restriction enzymes?
    a. to add new nucleotides to the growing strand of DNA
    b. to join nucleotides during replication
    c. to join nucleotides during transcription
    d. to cleave nucleic acids at specific sites
    e. to repair breaks in sugar-phosphate backbones

29. The polymerase chain reaction is important because it allows us to
    a. insert eukaryotic genes into prokaryotic plasmids.
    b. incorporate genes into viruses.
    c. make DNA from RNA transcripts.
    d. make many copies of a targeted segment of DNA.
    e. insert regulatory sequences into eukaryotic genes.

30. Restriction fragments of DNA are typically separated from one another by which process?
    a. filtering
    b. centrifugation
    c. gel electrophoresis
    d. PCR
    e. electron microscopy

31. Which of the following *must* occur during a period of geographic isolation in order for two sibling species to remain genetically distinct following their geographic reunion in the same home range?
    a. prezygotic barriers
    b. postzygotic barriers
    c. ecological isolation
    d. reproductive isolation
    e. temporal isolation

32. Races of humans are unlikely to evolve extensive differences in the future for which of the following reasons?

    I. The environment is unlikely to change. ✓
    II. Human evolution is complete.
    III. The human races are incompletely isolated. ✓

    a. I only
    b. III only
    c. I and II only
    d. II and III only
    e. I, II, and III

33. All of the following have contributed to the diversity of organisms on the Hawaiian archipelago *except* that
    a. the islands are distant from the mainland.
    b. multiple invasions have occurred.
    c. adaptive radiation has occurred.
    d. the islands are very young in geologic time.
    e. environmental conditions differ from one island to the next.

34. According to the concept of punctuated equilibrium,
    a. natural selection is unimportant as a mechanism of evolution.
    b. given enough time, most existing species will branch gradually into new species.
    c. a new species accumulates most of its unique features as it comes into existence.
    d. evolution of new species features long periods during which changes are occurring, interspersed with short periods of equilibrium or stasis.
    e. transitional fossils, intermediate between newer species and their parent species, should be abundant.

35. In certain motile prokaryotes, dozens of different proteins comprise the motor that powers the prokaryotic flagellum. The motor has a complicated structure, and its various proteins interact to carry out its function. Based on Darwin's explanation for the existence of human eyes, how would he probably have explained the existence of such motors?
    a. Because he could not have explained their existence, he would have used supernatural agents as a temporary explanation until the gap in scientific knowledge had been filled.
    b. Because he could not have explained their existence, he would have concluded that the human brain has not (and probably cannot) evolve the capability to solve such complex problems.
    c. He would have proposed that these motors were the products of aliens, and had been delivered to Earth by extraterrestrial visitors.
    d. Faced with such complexity, he would have given up science.
    e. He would have proposed that less complicated, but still functional, versions (though maybe with a different function) had existed in ancestral prokaryotes.

36. Some molecular data place the giant panda in the bear family (Ursidae) but place the lesser panda in the raccoon family (Procyonidae). The morphological similarities of these two species must therefore be due to
    a. inheritance of acquired characteristics.
    b. sexual selection.
    c. inheritance of shared derived characters.
    d. convergent evolution.
    e. possession of shared primitive characters.

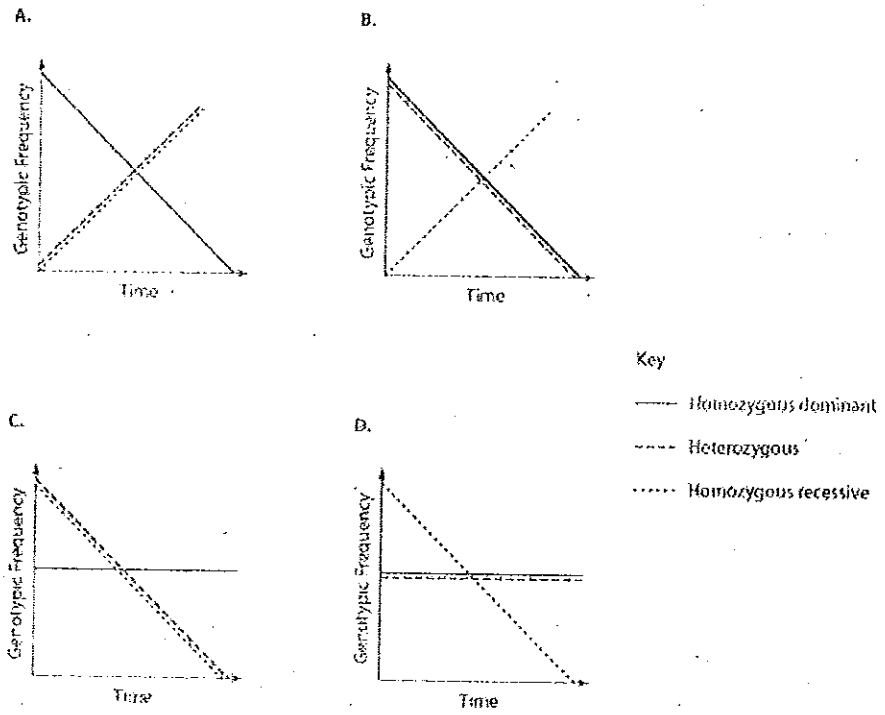
37. If organisms A, B, and C belong to the same class but to different orders and if organisms D, E, and F belong to the same order but to different families, which of the following pairs of organisms would be expected to show the greatest degree of structural homology?
    a. A and B
    b. A and C
    c. B and D
    d. C and F
    e. D and F

38. When using a cladistic approach to systematics, which of the following is considered most important for classification?
    a. shared primitive characters
    b. analogous primitive characters
    c. shared derived characters
    d. the degree of evolutionary divergence
    e. overall phenotypic similarity

39. Phylogenetic hypotheses (such as those represented by phylogenetic trees) are strongest when
    a. they are based on amino acid sequences from homologous proteins, as long as the genes that code for such proteins contain no introns.
    b. each clade is defined by a single derived character.
    c. they are supported by more than one kind of evidence (such as when fossil evidence corroborates molecular evidence).
    d. they are accepted by the foremost authorities in the field.
    e. they are based on a single commonly regarded homologous DNA sequence.

40. Which statement represents the best explanation for the observation that the nuclear DNA of wolves and domestic dogs has a very high degree of homology?
    a. Dogs and wolves have very similar morphologies.
    b. Dogs and wolves belong to the same order.
    c. Dogs and wolves are both members of the family Canidae.
    d. Dogs and wolves shared a common ancestor very recently.
    e. Convergent evolution has occurred.

41. In an environment in which members of a population compete with each other for resources, a change occurs that selects against members that exhibit a particular dominant trait (the trait exhibits complete dominance). Which graph best depicts the trends in genotypic frequencies that would be expected to occur over time?




a. graph A
b. graph B
c. graph C
d. graph D

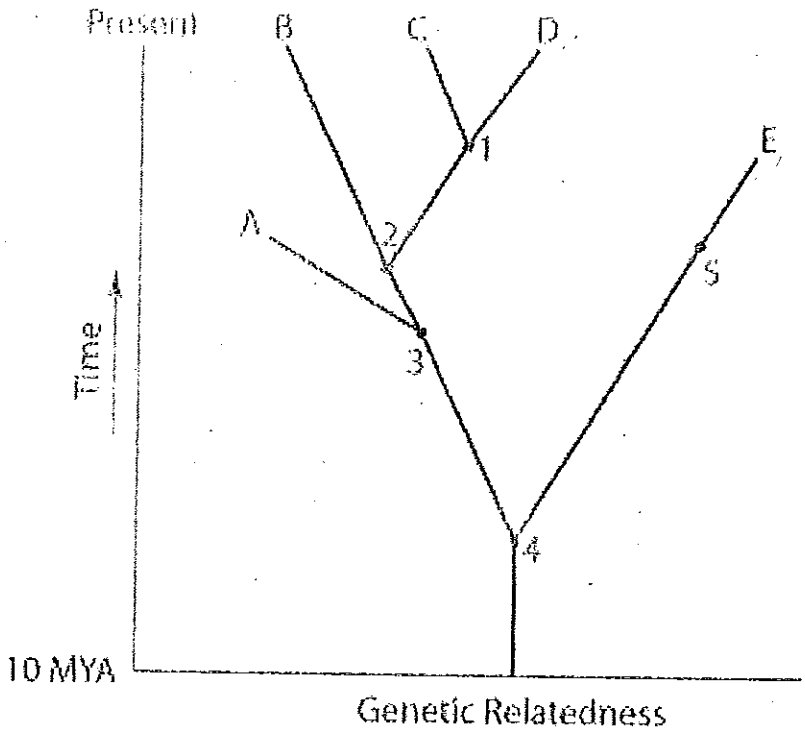
42. Two closely related populations of mice have been separated for a long period by a river. Climatic change causes the river to dry up, thereby bringing the mice populations back into contact in a zone of overlap. Which of the following is *not* a possible outcome when they meet?
    a. They interbreed freely and produce fertile hybrid offspring.
    b. They no longer attempt to interbreed.
    c. They interbreed in the region of overlap, producing an inferior hybrid. Subsequent interbreeding between inferior hybrids produces progressively superior hybrids over several generations.
    d. They remain separate in the extremes of their ranges but develop a hybrid zone in the area of overlap.
    e. They interbreed in the region of overlap, but produce sterile offspring.

43. Beetle pollinators of a particular plant are attracted to its flowers by their bright orange color. The beetles not only pollinate the flowers, but they mate while inside of the flowers. A mutant version of the plant with red flowers becomes more common with the passage of time. A particular variant of the beetle prefers the red flowers to the orange flowers. Over time, these two beetle variants diverge from each other to such an extent that interbreeding is no longer possible. What kind of speciation has occurred in this example, and what has driven it?
    a. allopatric speciation, ecological isolation
    b. sympatric speciation, habitat differentiation
    c. allopatric speciation, behavioral isolation
    d. sympatric speciation, sexual selection
    e. sympatric speciation, allopolyploidy

44. An explanation for the evolution of insect wings suggests that wings began as lateral extensions of the body that were used as heat dissipaters for thermoregulation. When they had become sufficiently large, these extensions became useful for gliding through the air, and selection later refined them as flight-producing wings. If this hypothesis is correct, insect wings could best be described as
    a. adaptations.
    b. mutations.
    c. exaptations.
    d. isolating mechanisms.
    e. examples of natural selection's predictive ability.

45. The existence of evolutionary trends, such as increasing body sizes among horse species, is evidence that
    a. a larger volume-to-surface area ratio is beneficial to all mammals.
    b. an unseen guiding force is at work.
    c. evolution always tends toward increased complexity or increased size.
    d. in particular environments, similar adaptations can be beneficial in more than one species.
    e. evolution generally progresses toward some predetermined goal.

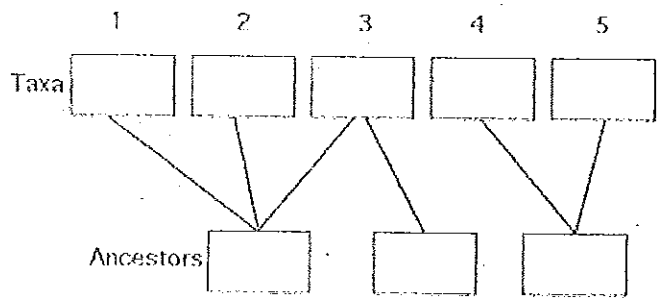
*Use the figure below to answer the following questions.*




46. A common ancestor for both species C and E could be at position number
    a. 1.
    b. 2.
    c. 3.
    d. 4.
    e. 5.

47. Which extinct species should be the best candidate to serve as the outgroup for the clade whose common ancestor occurs at position 2?
    a. A
    b. B
    c. C
    d. D
    e. E

*The following questions refer to the hypothetical patterns of taxonomic hierarchy shown in the figure below.*




48. If this figure is an accurate depiction of relatedness, then which taxon is unacceptable, based on cladistics?
    a. 1
    b. 2
    c. 3
    d. 4
    e. 5

*Use the information below to answer the following questions.*

| Species | Percentage |
|---|---|
| Chimpanzee | 99.7 |
| Orangutan | 98.6 |
| Baboon | 97.2 |
| Rhesus Monkey | 96.9 |
| Rabbit | 93.7 |

A researcher compared the nucleotide sequences of a homologous gene from five different species of mammals with the homologous human gene. The sequence homology between each species' version of the gene and the human gene is presented as a percentage of similarity.

49. What conclusion can be drawn validly from these data?
    a. Humans and other primates evolved from rabbits within the past 10 million years.
    b. Most of the genes of other organisms are paralogous to human genes, or with chimpanzee genes.
    c. Among the organisms listed, humans shared a common ancestor most recently with chimpanzees.
    d. Humans evolved from chimpanzees somewhere in Africa within the last 6 million years.
    e. Both B and C are correct.

50. Typically, mutations that modify the active site of an enzyme are more likely to be harmful than mutations that affect other parts of the enzyme. A hypothetical enzyme consists of four domains (A-D), and the amino acid sequences of these four domains have been determined in five related species. Given the proportion of amino acid homologies among the five species at each of the four domains, which domain probably contains the active site?

| Domain | Percentage of Homologous Amino Acids |
|---|---|
| A | 38% |
| B | 8% |
| C | 78% |
| D | 45% |

a. A
b. B
c. C
d. D
e. E

# Speciation & Classification. (Key)

1. C
2. E
3. C
4. D
5. E
6. E
7. B
8. B
9. D
10. C
11. D
12. A
13. D
14. E
15. A
16. D
17. E
18. E
19. D
20. E
21. C
22. A
23. D
24. C
25. D
26. E
27. A
28. D
29. D
30. C
31. D
32. B
33. D
34. C
35. E
36. D
37. E
38. C
39. C
40. D
41. B
42. C
43. B
44. C
45. D
46. D
47. A
48. C
49. C
50. C