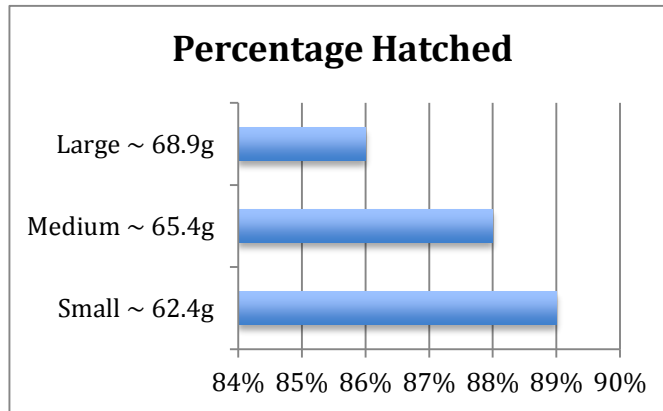


Big Idea 1: Multiple Choice

Big Idea 1A

1. Which of the following is *not* an observation or inference upon which natural selection is based?
 - a. There is heritable variation among individuals.
 - b. Poorly adapted individuals leave less offspring.
 - c. The size of populations fluctuates over time.
 - d. Individuals whose inherited characteristics best fit them to the environment will leave more offspring.
2. Which of the following observations provides the most support for the concept of descent with modification?
 - a. Species diversity declines as distance from the equator increased.
 - b. Fewer species were found living on islands than on the nearby continents.
 - c. Organisms produce more offspring that can survive.
 - d. South American temperate plants are more similar to the tropical plants of South America than to the temperate plants of Europe.
3. Selection acts *directly* on
 - a. Phenotype
 - b. Genotype
 - c. The individual
 - d. The entire gene pool
4. In terms of algebraic symbols used to represent the Hardy-Weinberg theorem (p and q), the most likely effect of negative assortative mating (mating between organisms with opposing phenotypes) on the frequencies of alleles and genotypes for a gene locus would be
 - a. A decrease in p^2 compared to q^2
 - b. Convergence of p^2 and q^2 toward equal values
 - c. A change in p and q , relative frequencies of the two alleles in the gene pool
 - d. A increase in $2pq$ above the value expected by the Hardy-Weinberg theorem
5. Populations are at Hardy-Weinberg equilibrium when the frequency of alleles in the population remains stable over time. Which factor is required for a population to remain in equilibrium?
 - a. Random mating
 - b. Geographic isolation
 - c. Steady mutation rate
 - d. Genetic drift
6. Chickens have been artificially selected to produce large eggs for human consumption. A group of graduate students designed an experiment to test the effect of egg size on the production of viable chicks. A graph of the data is shown below. If human intervention were absent, what type of selection

would you expect to occur in the size of chicken eggs?

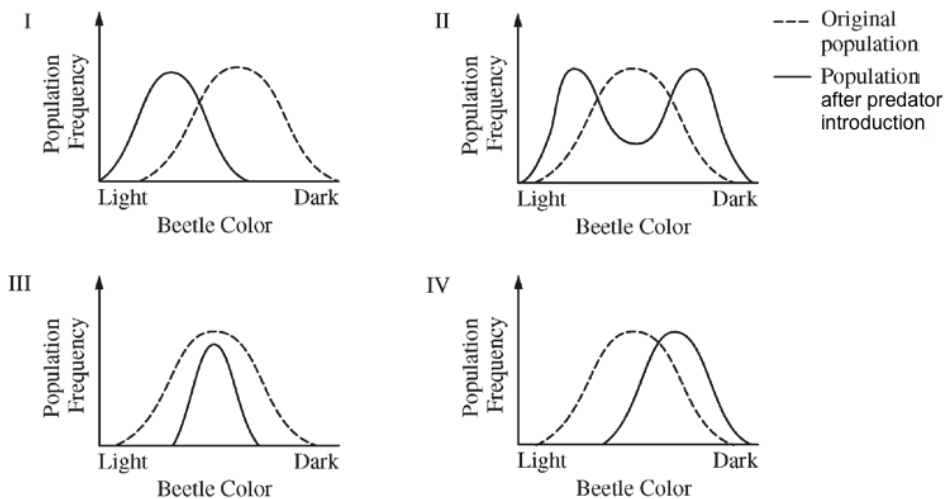


- Disruptive
- Stabilizing
- Directional
- Artificial

A biologist spent many years researching the rate of evolutionary change in the pink salmon (*Onchorhynchus gorbuscha*) population of the Pacific Northwest. It was determined that the average size (both length and mass) of the salmon decreased dramatically between 1945 and 1970. During this time fishermen were paid by the pound and there was an increase in the use of gill netting to harvest fish.

- Which of the following procedures was most likely followed to determine the change in fish size?
 - A few salmon were trapped in 1945 and again in 1970 and their sizes were compared.
 - Twenty wild salmon were caught in 1970 and their sizes compared to a population of salmon raised at a hatchery that pre-dated 1945.
 - The size in a large number of salmon was measured every year from 1945 to 1970.
 - Pink salmon were caught and moved to a hatchery in 1970. The sizes of their offspring were compared.
- Which of the following best describes the mechanism behind the change in size in the pink salmon population?
 - A change in gene frequencies in the salmon population due to selective pressure from fishing.
 - The formation of two new salmon species from a single parent species.
 - A new allele appearing in the salmon population as a result of mutation.
 - The achievement of dynamic equilibrium in the salmon population as a result of homeostasis.
- The biologist discovered that from 1971 to 1980, the average size of the salmon rose. The reversal in size from 1971 to 1980 was most likely related to which of the following events?

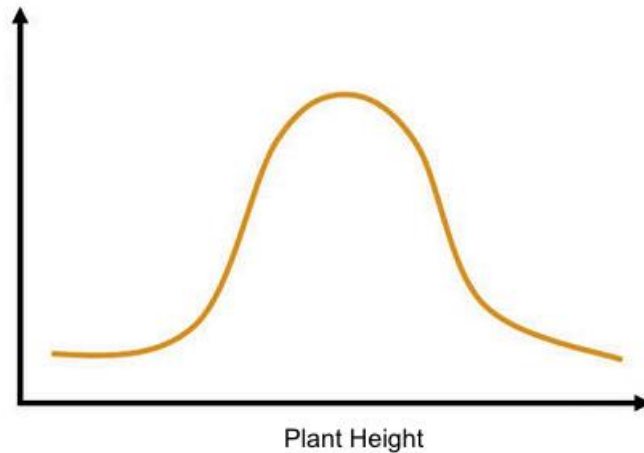
- a. A behavioral variation in larger salmon that allowed them to evade gill nets
 - b. A increase in the salmons' food supply
 - c. A law was introduced limiting the use of gill nets to harvest fish
 - d. A decrease in the salmons' non-human predator population
10. In a hypothetical population of beetles, there is a wide variety of color, matching the range of coloration of the tree trunks on which the beetles hide from predators. The graphs below illustrate four possible changes to the beetle population as a result of predation from an introduced bird species. This bird species fed on medium sized insects in its home range. Which of the following includes the most likely change in the size of beetle population after introduction of the predator and a correct rationale for the change?



- a. The size range shifted toward smaller beetles, as in diagram I. The smaller size allowed beetles to avoid detection by predators.
- b. The size of the population split into two extremes, as in diagram II. Both the smaller and larger beetles were difficult for the predators to catch and/or consume.
- c. The size range became narrower as in diagram III. The predators selected beetles at the extremes.
- d. The size of the population shifted toward larger beetles, as in diagram IV. Predators more easily caught the smaller beetles than the larger sized beetles.

Big Idea 1B

11. The height distribution of a certain plant is graphed below. What type of inheritance is mostly likely involved?



- a. Incomplete dominance
 - b. Multiple alleles
 - c. Polygenic
 - d. Codominance
12. Which of the following is *not* a benefit of sexual reproduction?
- a. All an organism's genes are passed on to their offspring
 - b. Creates genetic variety within a population
 - c. Purges a population of damaging mutations
 - d. Produces viable offspring, some of which have an improved chance of survival
13. Yeast cells can split producing a mother cell and a smaller daughter cell. What type of asexual reproduction is this?
- a. Fission
 - b. Budding
 - c. Fragmentation
 - d. Parthenogenesis
14. A population of fruit flies exhibits two eye color phenotypes, white and red. Scientists studying this population cross white-eyed flies with white-eyed flies. All offspring exhibit the white-eyed phenotype. When red-eyed flies are crossed with red-eyed flies. Most of the offspring exhibit the red-eyed phenotype; some exhibit the white-eyed phenotype. The most likely explanation for these results is
- a. The white and red alleles are codominant
 - b. The white allele is dominant over the red allele
 - c. The red allele is dominant over the white allele
 - d. Dominance can not be determined without additional matings
15. Epigenetics is the study of heritable changes in the phenotype caused by mechanisms other than changes in the DNA sequence. Which of the following is *not* a topic studied by an epigeneticist?
- a. Stress

- b. Pollution
 - c. Mating behavior
 - d. Maternal diet
16. A woman with blood type B gives birth to a child with O type blood. A DNA paternity test is performed on two possible fathers. While awaiting the results from the lab it is determined that Man 1 has blood type B and Man 2 has blood type AB. Which of the following hypotheses is best supported by this data?
- a. Neither man is the father because neither man exhibits the O phenotype
 - b. Man 1 is the father because homozygous B individuals exhibit the O phenotype
 - c. Man 1 is the father because he carries the O allele
 - d. Man 2 is the father because he carries the O allele
17. A newly discovered, recessively inherited disease is expressed only in individuals with type O blood, although the disease and blood group are independently inherited. A normal man with type B blood and a normal woman with type A blood have already had one child with the disease and one who is not affected by the disease. The woman is now pregnant for a third time. What is the probability that the third child will have the disease?
- a. 0.06
 - b. 0.13
 - c. 0.25
 - d. 0.50
18. In fruit flies, the mutant curly wing type is dominant over the wild type straight wing. The mutant yellow coloring of the body and wings is recessive to the wild type. A mutant fly with curly wings and a yellow body was crossed with a wild type fly. The offspring were as follows 116 wild type flies, 120 flies with curly wings and wild type body color, 117 flies with yellow body color and wild type wings, and 116 yellow flies with curly wings. Using this information, determine the genotypes of the parent generation.
- a. CcYY x CcYy
 - b. CcYy x CcYy
 - c. ccYY x CcYy
 - d. Ccyy x ccYy
19. The sex of fish is determined by the same XY system as in humans. An allele at one locus on the Y chromosome of the fish *Lebistes* causes a pigmented spot to appear on the dorsal fin. A male fish that has a spotted dorsal fin is mated with a female fish that has an unspotted fin. Which of the following describes the phenotypes of the F₁ and F₂ generations from this cross?
- a. F₁: all normal; F₂: 75% normal, 25% spotted
 - b. F₁: all normal; F₂: spotted males, normal females
 - c. F₁: spotted males, normal females; F₂: spotted males, normal females
 - d. F₁: spotted females, normal males; F₂: spotted females, normal males
20. In corn, the gene *R* for red seed color is dominant over gene *r* for green seed color. Gene *N* for normal seed is dominant over gene *n* for abnormal seed.

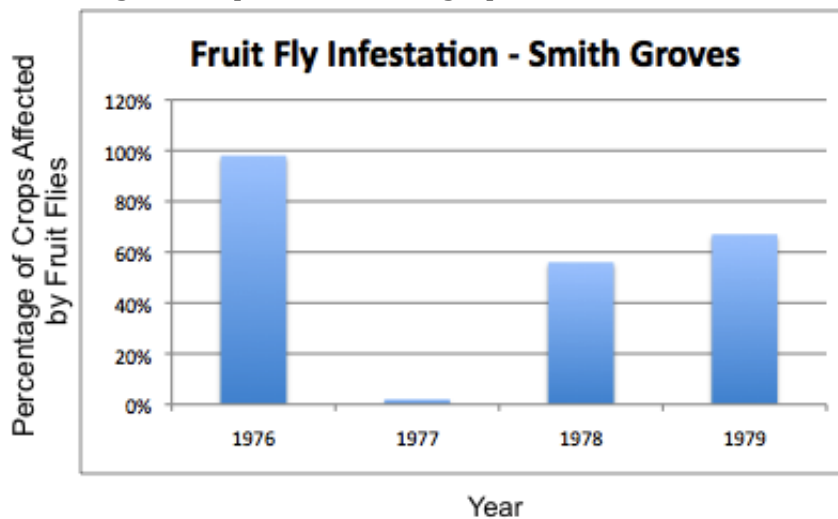
The results of crossing a heterozygous red seed color plant with normal seeds with a green seed color plant with abnormal seeds were: 97 red, normal; 1 red, abnormal; 99 green abnormal; 0 green, normal. These genes

- a. Exhibit Mendelian genetic pattern
- b. Exhibit a pattern of incomplete dominance
- c. Are linked
- d. Assort independently

Big Idea 1C

21. Pangaea was a supercontinent that existed during the late Paleozoic and early Mesozoic eras. Which of the following is *not* scientific evidence that supports Pangaea's existence?
 - a. The modern distribution of species
 - b. The presence of fossils of the same species on different continents
 - c. The matching geographic trends of the eastern coast of South America and the western coast of Africa
 - d. The continuity of the Appalachian Mountains from North America to the British Isles and Scandinavia
22. Which of the following statements about species and speciation is *not* true?
 - a. Hybrids are always selected against in nature
 - b. Polyploidy often occurs in plants
 - c. Species usually have multiple reproductively isolating mechanisms
 - d. A single species can undergo adaptive radiation and produce a cluster of related species
23. Wheat is a hexaploid plant with a total of 42 chromosomes. Rye is diploid with 14 chromosomes. Triticale is a hybrid of wheat and rye with the sought-after characteristics of both parent species. The diploid number of triticale would probably be
 - a. 14
 - b. 21
 - c. 28
 - d. 56
24. The speciation episode described in the above question is most likely a case of
 - a. Allopatric speciation
 - b. Sympatric speciation
 - c. Speciation based on sexual selection
 - d. Geographic isolation
25. Two fish species in the family *Gasterosteidae* (sicklebacks) do not interbreed. One species of this fish lives year-round in small freshwater streams. The other species spends the winter at sea and returns to freshwater to breed in the spring and summer. This is an example of which isolating mechanism?
 - a. Temporal
 - b. Behavioral
 - c. Mechanical
 - d. Gametic

26. Xerophytic plants have adapted to their environments by reducing the surface area of their leaves, producing waxes that reflect sunlight and reduce evaporation, and increasing their capacity for water storage. Which of the following is the most likely selective pressure producing these adaptations?
- Extensive predation
 - Coevolution with the local insect population
 - Low moisture environment
 - High altitude environment
27. In the 18th and 19th centuries Northern elephant seals were hunted to produce oil from their blubber. The Marine Mammal Protection Act protected the species in 1972 and the population has rebounded, growing at an average of 25% per year. Conservationists have found these protected animals to be very susceptible to diseases and pollution and remain concerned for the species survival. One possible explanation for this susceptibility is
- A high rate of mutation among the population
 - A loss of genetic diversity due to the bottleneck effect
 - An increase in the genetic diversity of the population due to the founder effect
 - A sympatric speciation event is in progress
28. In 1977, Mr. Smith used the pesticide malathion to protect his orange groves from fruit fly damage. He sprayed his trees with malathion again in 1978. In 1979, Mr. Smith used twice the dose of malathion to protect his crop. Which of the following best explains the data graphed below?



- The plants developed a resistance to the malathion in 1978, rendering it less effective.
- The fruit flies develop resistance to malathion through a random mutation in 1978
- The fruit flies who were immune to malathion survived the first application in 1977 and produced more offspring than the flies who did not have this genetic variation

- d. The pesticide used by Mr. Smith in 1978 and 1979 was not as potent as that used in 1977
29. A new pesticide is developed by scientists to combat fruit flies. It has been found to be effective in the laboratory. Predict what will happen to the percentage of Mr. Smith's crops affected by infestation after application of the new pesticide.
- None of the crops will be affected by fruit flies
 - None of the crops will be affected by fruit flies if both the new pesticide and the malathion are applied
 - All of the crops will be affected by fruit flies
 - Most of the fruit flies will be killed off by the new pesticide
30. Sickle cell disease is a recessively inherited blood disorder that causes acute pain, severe anemia, and vascular blockages that can lead to organ damage and death. The disease is particularly prevalent in sub-Saharan Africa where 2% of the population has the disease and an estimated 25% of the population is believed to carry the trait. Given the decreased fitness of persons with this disease, why might the allele remain frequent in the population?
- The malaria parasite exerts a positive selective pressure on the trait
 - The population is exhibiting positive assortative mating
 - The allelic frequencies of the population remain constant in the absence of migration
 - Alleles never disappear from a population

Big Idea 1D

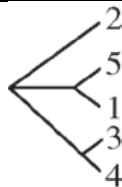
31. Which of the following would be most useful for constructing a phylogenetic tree emphasizing the evolutionary branching among several bird species?
- Several analogous characteristics shared by all the birds
 - A single homologous characteristic shared by all the birds
 - The total degree of morphological similarity among various bird species
 - Several characteristics thought to have evolved after different bird diverged from one another
32. Microsatellites are short repetitive sequences of nuclear DNA. The following is microsatellite analysis of ten DNA loci from red wolves, gray wolves, and coyotes. These findings indicate:

	Microsatellite Location									
Species	1	2	3	4	5	6	7	8	9	10
Gray Wolves	X	X		X		X		X	X	
Red Wolves		X		X	X					X
Coyotes			X		X		X			X

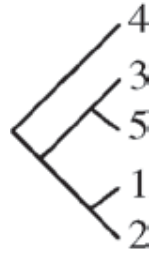
- DNA sequence analysis is unreliable for extant species
- The red wolf is a coyote-gray wolf hybrid rather than a true species
- Incorrect restriction enzymes were used to cleave the DNA
- The red wolf is the common ancestor of both the gray wolf and the coyote

33. When comparing birds to other vertebrates, having four appendages is
- A shared primitive characteristic
 - An example of a vestigial structure
 - An example of an analogy rather than a homology
 - A characteristic useful in distinguishing birds from other vertebrates
34. Which of the following does *not* support the RNA world hypothesis, which states that RNA functioned as the first genetic material in early protobionts?
- Many of the most critical elements of cells are composed mostly or entirely of RNA
 - RNA has been demonstrated to act as a catalyst in modern cells
 - Modern cells use an RNA template when synthesizing proteins
 - In modern cells, RNA provides the template on which DNA nucleotides are assembled
35. By discharging electrical sparks into a laboratory chamber atmosphere that consisted of water vapor, hydrogen gas, methane, and ammonia, Stanley Miller obtained data that showed that a number of organic molecules, including many amino acids could be synthesized. Miller was attempting to model early Earth conditions as understood in the 1950s. What would be an appropriate *null* hypothesis for Miller's work?
- The molecules essential to life today could not have been formed under early Earth conditions.
 - The molecules essential to life today could have been carried to the primordial Earth by a comet or meteorite.
 - The molecules essential to life today could have formed under early Earth conditions
 - The molecules essential to life today were initially self-replicating proteins that were synthesized approximately four billion years ago.
36. Which of the following phylogenetic trees is most consistent with the data provided below?

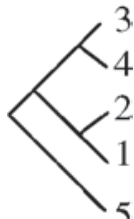
Species	Notochord	Vertebrate	Radial Symmetry	Mammary Glands	Placenta
1	Yes	No	Yes	No	No
2	Yes	No	Yes	No	No
3	Yes	Yes	No	Yes	Yes
4	No	No	No	No	No
5	Yes	Yes	No	Yes	Yes



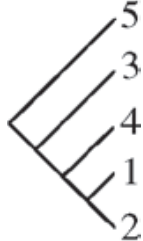
a.



b.



c.



d.

37. The mechanisms of transcription and translation are virtually identical in species from all three domains, Archaea, Bacteria, and Eukarya. Which of the following hypotheses could be best supported by this evidence?

- The mechanisms of transcription and translation presently found in living organisms are the only mechanisms that could effectively convert heredity information into protein structures.
- The mechanisms of transcription and translation are universal processes and therefore suggest a common ancestor for all forms of life.
- The similarity in these processes in all organisms suggests that convergent evolution has occurred.
- This evidence does not support a hypothesis because the products of transcription and translation vary widely.

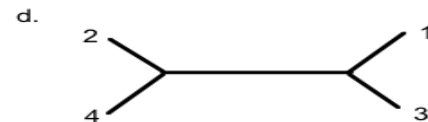
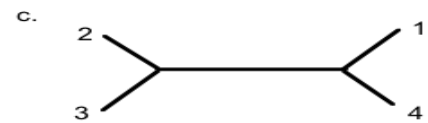
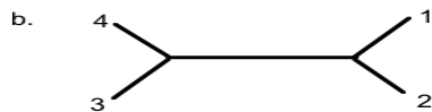
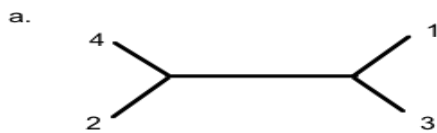
38. A group of students summarized information on the five great extinction events. The students have found fossilized trilobites and brachiopods. They hypothesize that the strata in which they are working dates to the Permian period. Based on the chart, what additional evidence will they need to collect to support their hypothesis?

Mass Extinction	Time of Extinction	Organisms Greatly Reduced or Made Extinct
End of Ordovician period	443 mya	Trilobites, brachiopods, echinoderms, and corals
End of Devonian period	354 mya	Marine families on tropical reefs, corals, brachiopods, and bivalves

End of Permian period	248 mya	Trilobites, mollusks, brachiopods, and many vertebrates
End of Triassic period	206 mya	Mollusks, sponges, marine vertebrates, and large amphibians
End of Cretaceous period	65 mya	Ammonites, dinosaurs, brachiopods, bivalves, and echinoderms

- a. Fossils of mollusks deposited in the same rock layer
 - b. Fossils of mollusks and vertebrates deposited in the same rock layer
 - c. Fossilized corals found in lower rock strata
 - d. No additional evidence is needed
39. Adenine, cytosine, guanine, and thymine react through a process called dehydration synthesis. What polymer do these monomers form and what is the name of their bond?
- a. Polysaccharide; covalent bond
 - b. Polypeptide; peptide bond
 - c. Nucleic Acid; phosphodiester bond
 - d. Phospholipid; hydrogen bond
40. Four species have been found to have the below sequence of DNA at a specific loci. Which of the following is the most likely phylogenetic tree for these species?

Species	DNA Sequence
1	TGCA
2	TACA
3	AGGA
4	AAGA



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