

UNIT 7: NATURAL SELECTION



COGNITOEDU.LINK/AP-BIO-U7

Scan for Unit 7 notes

20 AP-style MCQs across topics 7.1 to 7.12. Practice, review, revisit.

WHAT'S INSIDE

- ✓ 20 MCQs, four options each, in the style of the real AP exam
- ✓ Every question tagged to a Unit 7 topic so you know what to revise
- ✓ Full answer key with a short explanation for every question
- ✓ Mix of standalone and stimulus-style stems, matching real AP question formats

HOW TO USE IT

- 1. Untimed pass.** Work through slowly, aiming for around 90 seconds per question. Read every option before you commit.
- 2. Timed pass.** Redo the pack in 30 minutes. That matches AP exam pace (1.5 minutes per MCQ) and builds stamina.
- 3. Review.** Check the answer key and mark every miss. Revise those topics on Cognito, then retry after a week.

TOPICS COVERED

- **7.1** Introduction to Natural Selection
- **7.2** Natural Selection
- **7.3** Artificial Selection
- **7.4** Population Genetics
- **7.5** Hardy-Weinberg Equilibrium
- **7.6** Evidence of Evolution
- **7.7** Common Ancestry
- **7.8** Continuing Evolution
- **7.9** Phylogeny
- **7.10** Speciation
- **7.11** Variations in Populations
- **7.12** Origin of Life on Earth

STRUGGLING WITH A TOPIC?



Any topic tricky? Scan the QR to jump straight to the Unit 7 notes on Cognito. For the full AP Biology course (all 8 units, lessons, quizzes, flashcards and past-paper FRQs), head to **cognitoedu.link/ap-bio-notes**. Rework the questions you got wrong a week later to lock the concepts in.

AP EXAM CONTEXT

13-20%

UNIT WEIGHT (MCQ SECTION)

60

MCQS ON THE REAL EXAM

1.5m

AVERAGE TIME PER MCQ

AP BIOLOGY

Unit 7: Natural Selection

SECTION I · MULTIPLE CHOICE

Time—30 minutes

20 Questions

Directions: Each of the questions or incomplete statements below is followed by four suggested answers or completions. Select the one that is best in each case and mark it clearly on your answer sheet or circle your choice below.

- Which of the following is a required condition for natural selection to act on a trait in a population?
 - The trait is heritable, varies among individuals, and variants differ in survival or reproduction.
 - Traits acquired during an individual's lifetime, rather than inherited, are passed on to the next generation.
 - The environment directly changes an organism's DNA to produce useful variants.
 - All individuals in the population reproduce at exactly the same rate regardless of their traits.
- A student is deciding whether a population is likely to remain in Hardy-Weinberg equilibrium at a given locus. Which claim about the theorem is correct?
 - Equilibrium holds only when the two alleles at the locus occur at equal frequency ($p = q = 0.5$).
 - Equilibrium requires natural selection to keep genotype frequencies stable across generations.
 - Equilibrium holds when mating is random and no mutation, migration, drift, or selection is acting on the locus.
 - Equilibrium is more likely in a small population, because sampling error smooths out allele frequencies over time.
- Based on Table 1, which claim about selection on rock pocket mice in this environment is best supported?
 - Pale and dark mice have identical fitness against nocturnal predators in this dark lava environment.
 - Dark coloration is being selected against on the dark lava.
 - Dark coloration is being favored by selection on this dark lava flow.
 - Selection cannot occur in a rock pocket mouse population.
- The cheetah population went through a severe bottleneck ~10,000 years ago and today has extremely low genetic diversity across the major histocompatibility complex (MHC) loci compared with most other large cats. Which prediction about this population is best supported by the low MHC diversity?
 - Cheetahs will be more resistant to a novel infectious disease than a related large-cat species with normal MHC diversity.
 - Cheetahs will show larger, faster responses to selection for coat color than most other species of cat.
 - Cheetahs are more vulnerable to a novel pathogen because the population is unlikely to carry a wide range of resistance alleles.
 - MHC diversity has no effect on how a population responds to disease outbreaks.
- A farmer breeds only the highest-milk-producing cows in each generation and culls the rest. Over decades, average milk yield rises steadily. Which process best explains this steady rise in yield?
 - A random change in allele frequency across generations.
 - Natural selection driven by predation on low-yield individuals.
 - Artificial selection acting on a heritable trait.
 - Sexual selection based on a mate-choice preference for a display trait.

Question 3 refers to the following information.

Rock pocket mice living on a dark volcanic lava flow have a coat-color polymorphism: some individuals are pale (matching sand) and some are dark (matching lava). Researchers released equal numbers of each color onto the dark lava and measured the fraction recaptured after two nights (a proxy for survival against nocturnal predators).

Table 1. Recapture of pale vs. dark rock pocket mice on dark lava

Coat color	Number released	Number recaptured	Recapture rate (%)
Pale	200	26	13
Dark	200	58	29

AP BIOLOGY · Unit 7: Natural Selection · Section I (continued)

6. A very small population of finches is founded on a remote island by 12 individuals from a much larger mainland population. Over the next few generations, allele frequencies in the island population shift substantially away from mainland values, even though no selection pressure clearly differs between the two sites. Which process most likely produced this shift?
- (A) Genetic drift, driven by random sampling in the small founding group.
 - (B) Directional selection driven by the island climate favoring one allele.
 - (C) Gene flow from the mainland population back into the island population.
 - (D) A high mutation rate introducing many new alleles into the island population.

Questions 7, 8 refer to the following information.

A population of 500 beetles was sampled for a single gene locus with two alleles, A and a, where A is dominant. Genotype counts were recorded.

Table 2. Genotype counts in a beetle population (n = 500)

Genotype	Count
AA	245
Aa	210
aa	45

7. Using Table 2, what is the frequency of allele a (q) in this beetle population?
- (A) 0.09
 - (B) 0.30
 - (C) 0.50
 - (D) 0.70

8. Using the allele frequencies from Table 2, calculate the Hardy-Weinberg expected genotype counts for 500 individuals and compare with the observed counts. Which claim is best supported?
- (A) The population is out of Hardy-Weinberg equilibrium at this locus.
 - (B) The observed frequencies are consistent with Hardy-Weinberg equilibrium at this locus.
 - (C) Only heterozygotes are being selected against in the population.
 - (D) Because the fit is exact, the population must satisfy every Hardy-Weinberg condition (no mutation, no migration, no drift, no selection, and random mating).

Questions 9, 10 refer to the following information.

A bacterial culture was grown with a low concentration of an antibiotic for 40 generations. The percentage of cells resistant to the antibiotic was measured at each time point.

Table 3. Percentage of antibiotic-resistant bacteria over time

Generation	Resistant cells (%)
0	0.1
10	1.2
20	18
30	72
40	96

9. Which conclusion about the bacterial population is best supported by Table 3?
- (A) Exposure to the low-dose antibiotic induced resistance mutations directly in surviving cells during the experiment.
 - (B) The antibiotic acted as a selective pressure favoring survival of already-resistant cells.
 - (C) The antibiotic killed both resistant and non-resistant cells equally, so the change is random.
 - (D) All 96% of cells at generation 40 acquired resistance from a neighboring bacterium during the experiment.

AP BIOLOGY · Unit 7: Natural Selection · Section I (continued)

10. A student claims that the resistant bacteria in Table 3 evolved resistance because they 'needed to survive.' Which piece of reasoning best refutes this claim?
- Mutations happen at random and are not directed by need; selection later favors any that help.
 - Bacteria cannot mutate at all when in stressful conditions.
 - The antibiotic makes every bacterium resistant during its lifetime.
 - Bacteria always inherit resistance from their parents, so no evolution is needed at all to explain the pattern.
11. The RNA World hypothesis proposes that self-replicating RNA molecules preceded modern DNA-and-protein life on early Earth. Which observation from modern cells provides the strongest support for this hypothesis?
- DNA is more chemically stable than RNA, so it must have existed before RNA in every early cell.
 - Ribosomes catalyze peptide bond formation using an RNA active site (the ribosome is a ribozyme).
 - Proteins are the only biological molecules that can act as catalysts in modern cells.
 - Modern viruses with RNA genomes replicate faster than DNA-based cells under most laboratory conditions.
12. Which pattern in Table 4 is best explained by natural selection?
- Guppy tail brightness rises as predator density rises.
 - Guppy tail brightness falls as predator density rises.
 - Guppy tail brightness is unrelated to predator density.
 - All guppy populations have the same tail brightness.
13. Which prediction about a heavy-predation stream is best supported by Table 4?
- Removing predators from the stream will shift the mean tail brightness upward within a single guppy generation.
 - Adding more predators will raise the mean tail brightness of the stream.
 - Tail brightness will remain the same regardless of predator density.
 - Over many generations after predators are removed, mean tail brightness will rise.
14. Which of the following is the best example of a homologous structure that is evidence of shared ancestry?
- The wings of a bird and the wings of a butterfly, which both function as flight surfaces.
 - The streamlined shape of dolphins and sharks.
 - The camera eye of an octopus and the camera eye of a human.
 - The forelimbs of a whale, a bat, and a human, all built on the same bone plan.

Questions 12, 13 refer to the following information.

Guppy populations from streams with different predator densities were surveyed. Average tail-color brightness (0 = dull, 10 = brilliant) and predator density were recorded for each stream. Tail color is heritable in guppies, and females typically prefer to mate with males that have brighter tails.

Table 4. Guppy tail brightness in different streams

Stream type	Average tail brightness (0–10)	Average predator density (per m ²)
Heavy predation	3.1	0.9
Moderate predation	5.5	0.4
Low predation	8.2	0.1

AP BIOLOGY · Unit 7: Natural Selection · Section I (continued)

Questions 15, 16 refer to the following information.

Cytochrome c is a protein used in cellular respiration. The percentage of amino acid differences between human cytochrome c and cytochrome c from five other species was measured.

Table 5. Amino acid differences from human cytochrome c (%)

Species	Differences from human (%)
Chimpanzee	0
Rhesus monkey	1
Dog	10
Fruit fly	27
Baker's yeast	40

15. Based on Table 5, which non-human species listed shares the most recent common ancestor with humans?
- (A) Chimpanzee
(B) Rhesus monkey
(C) Dog
(D) Baker's yeast
16. Which claim is best supported by the trend in Table 5?
- (A) Cytochrome c is more important in mammals than it is in fungi, since fungi have accumulated more differences from humans.
(B) Amino acid differences in cytochrome c accumulate over time since divergence from common ancestry.
(C) Every organism uses a completely different cytochrome c protein.
(D) Yeast is more closely related to humans than fruit flies are.

Questions 17, 18 refer to the following information.

A cladogram was built from morphological and molecular data for five vertebrates: lamprey, shark, salamander, lizard, and mouse. The presence (Y) or absence (N) of four derived characters was recorded.

Table 6. Derived character states across five vertebrates

Character	Lamprey	Shark	Salamander	Lizard	Mouse
Jaws	N	Y	Y	Y	Y
Four limbs (tetrapod)	N	N	Y	Y	Y
Amniotic egg	N	N	N	Y	Y
Fur and mammary glands	N	N	N	N	Y

17. Based on Table 6, which species should be placed as the outgroup on a cladogram of these five vertebrates?
- (A) Lamprey
(B) Shark
(C) Salamander
(D) Mouse
18. Which two species in Table 6 are most closely related, based on shared derived characters?
- (A) Lamprey and shark
(B) Shark and salamander
(C) Salamander and lizard
(D) Lizard and mouse

AP BIOLOGY · Unit 7: Natural Selection · Section I (continued)

Questions 19, 20 refer to the following information.

Two isolated island populations of the same finch species were monitored over 20 years. Average beak depth (a heritable trait) was measured each year in both populations, which experienced different feeding environments.

Table 7. Average finch beak depth (mm) over 20 years

Year	Island X (soft seeds)	Island Y (hard seeds)
0	9.5	9.5
5	9.3	10.2
10	9.0	10.8
15	8.7	11.3
20	8.5	11.6

19. Which claim about the finch populations is best supported by Table 7?
- (A) The two populations are experiencing the same environment and evolving in the same direction over the entire two-decade period of the study.
 - (B) Beak depth is not a heritable trait in these populations.
 - (C) Different feeding environments have driven divergent directional selection on beak depth.
 - (D) Both islands have experienced no change in mean beak depth over 20 years.
20. If the two finch populations remain geographically isolated for many thousands of years, which outcome is most likely, based on Table 7?
- (A) The populations will remain a single interbreeding species indefinitely, because they belong to the same species now.
 - (B) The populations will merge into a single species with intermediate beak depth.
 - (C) One population will go extinct because deeper beaks are always fitter.
 - (D) Divergence in traits and mating cues may make them two reproductively isolated species.

Q1. Answer: A

Topic 7.1 · Intro to Natural Selection

Natural selection requires heritable variation in a trait plus differential survival or reproduction among the variants. Without variation, selection has nothing to act on; without heritability, favored traits are not passed on; without differential success, allele frequencies do not shift. B is Lamarckism, which is not how inheritance works. C misstates mutation biology (mutations arise from replication errors and damage, not directed by environmental need). D would eliminate differential reproduction, one of the three requirements.

Q2. Answer: C

Topic 7.5 · Hardy-Weinberg Equilibrium

Hardy-Weinberg equilibrium follows from five conditions: random mating with respect to genotype, no mutation, no migration, no genetic drift (which is why very large populations are assumed), and no natural selection. If all five hold, genotype frequencies stay at p^2 , $2pq$, q^2 at any allele frequencies satisfying $p + q = 1$. A is wrong because the equilibrium holds at any p and q , not only $p = q = 0.5$. B reverses the role of selection, which pushes a locus AWAY from equilibrium. D is wrong because drift in small populations shifts allele frequencies over time, moving the locus away from equilibrium.

Q3. Answer: C

Topic 7.2 · Natural Selection

Dark mice had a recapture rate more than twice that of pale mice (29% vs 13%) on the dark lava. On this substrate, dark coats blend in and are less visible to nocturnal predators, so they survive at higher rates. A is contradicted by the recapture rates. B reverses the direction of selection. D contradicts observed differential survival.

Q4. Answer: C

Topic 7.11 · Variations in Populations

MHC genes recognize foreign antigens, so allelic diversity at MHC loci means the population is likely to contain individuals whose immune systems can recognize a wider range of pathogens. A population with very low MHC diversity is far more likely to have most individuals susceptible to the same novel pathogen, so an outbreak can spread through much of the population. A reverses the relationship between diversity and disease response. B invents a link to coat color that low MHC diversity does not create. D contradicts the general population-genetic finding that low MHC diversity tends to increase disease vulnerability.

Q5. Answer: C

Topic 7.3 · Artificial Selection

Artificial selection is when humans choose which individuals reproduce, based on desired traits. Selective breeding on milk yield fits exactly. A describes a random, non-directional process, not the steady rise in yield. B involves natural predators. D describes selection by mate choice for display traits.

Q6. Answer: A

Topic 7.4 · Population Genetics

Genetic drift is the random change in allele frequencies from generation to generation because each generation is a small statistical sample of the previous one. Its effect is largest in small populations, so a 12-individual founder event will drift substantially even without selection. This is the classic founder-effect scenario. B invokes selection, which the stem says is not clearly acting. C would push island frequencies back toward mainland values, not away. D is unlikely: mutations arise slowly and would not shift allele frequencies over a few generations.

Q7. Answer: B

Topic 7.5 · Hardy-Weinberg Equilibrium

Count the a alleles: each aa contributes 2 ($45 \times 2 = 90$), each Aa contributes 1 ($210 \times 1 = 210$). Total $a = 300$ out of $2N = 1,000$ total alleles, giving $q = 0.30$. A is the fraction of aa homozygotes ($45/500 = 0.09$). C is the value expected under allelic equality. D is p , the frequency of A .

Q8. Answer: B

Topic 7.5 · Hardy-Weinberg Equilibrium

Expected under HW with $p = 0.70$, $q = 0.30$ gives $p^2 \times 500 = 245$ AA , $2pq \times 500 = 210$ Aa , and $q^2 \times 500 = 45$ aa . The observed counts match exactly, so at this locus the genotype frequencies are consistent with a non-evolving population. A contradicts the exact match. C invents selection without evidence. D overinterprets the fit: a good fit at one locus does not prove each HW condition (no mutation, no migration, no drift, no selection, random mating) is met.

Q9. Answer: B

Topic 7.8 · Continuing Evolution

The percentage of resistant cells rose from 0.1% to 96% over 40 generations, exactly the pattern expected when a heritable, favorable trait (resistance) is repeatedly selected for while non-resistant cells fail to reproduce as well. The mutations were rare but pre-existing; the antibiotic did not induce them, it selected among them. A is the common Lamarckian misconception. C is contradicted by the enrichment of resistant cells. D invents horizontal transfer at a rate the data do not require.

Q10. Answer: A

Topic 7.8 · Continuing Evolution

Mutations arise from replication errors and chemical damage without regard to their usefulness. When a resistance mutation happens to be present, cells carrying it survive and pass it on, so the resistant fraction rises. That is selection acting on random variation, not need-driven change. B misstates mutation biology. C misdescribes acquired traits. D is contradicted by the data: the inherited resistance rising in frequency across generations is exactly the definition of evolution by natural selection.

Q11. Answer: B

Topic 7.12 · Origin of Life on Earth

In modern ribosomes, the peptidyl transferase center that forms peptide bonds is built from ribosomal RNA, not protein. A ribozyme catalyzing the most central reaction of biology suggests RNA once had a much wider catalytic role, consistent with an RNA-first world where RNA served as both information and catalyst before proteins took over most enzymatic roles. A confuses stability with primacy; RNA's ability to be both template and catalyst is what matters. C contradicts the existence of ribozymes. D confuses modern replication speed with origins: RNA virus replication speed says nothing about which molecule came first on early Earth.

Q12. Answer: B

Topic 7.2 · Natural Selection

As predator density rises from 0.1 to 0.9 per m², average tail brightness falls from 8.2 to 3.1. Bright tails attract mates in low-predation streams, but they also attract predators, so heavy predation selects for duller tails. A reverses the direction. C and D are contradicted by the trend in the data.

Q13. Answer: D

Topic 7.2 · Natural Selection

The preamble already tells us tail color is heritable and that females prefer brighter tails. If predators are removed, the mate-choice pressure for brighter tails is no longer offset by predation on the brightest males, so brighter tails increase in frequency across generations. A is too fast: allele frequency change occurs across generations, not within a single one. B reverses the effect. C is contradicted by the between-stream pattern.

Q14. Answer: D

Topic 7.6 · Evidence of Evolution

Homologous structures share the same underlying anatomy inherited from a common ancestor, even when function differs. Whale flippers, bat wings, and human arms all use the same one-bone-two-bones-carpals-digits pattern of tetrapod forelimbs. A and B are analogous (independent solutions to flight or aquatic locomotion). C is another famous case of convergent evolution: octopus and human camera eyes evolved separately from very different ancestors, so they are analogous, not homologous.

Q15. Answer: A

Topic 7.6 · Evidence of Evolution

Chimpanzees show 0% amino acid difference from humans in cytochrome c, the smallest divergence in the table. Fewer amino acid differences generally means less time since a common ancestor, which supports chimpanzees as the closest relative here. Rhesus monkey (1%) is next closest, followed by dog, fruit fly, and yeast in order of increasing divergence.

Q16. Answer: B

Topic 7.7 · Common Ancestry

Cytochrome c differences increase with the estimated time since common ancestry: near zero for chimpanzee, 1% for the rhesus monkey, 10% for the dog, 27% for the fruit fly, and 40% for baker's yeast. This is the molecular clock idea: neutral or nearly neutral changes accumulate over time. A is not supported by the data. C contradicts high conservation. D reverses the divergence order (yeast is more divergent than the fruit fly, not less).

Q17. Answer: A

Topic 7.9 · Phylogeny

The lamprey lacks all four derived characters and is the most distantly related to the other four, making it the natural outgroup. The other species (shark, salamander, lizard, and mouse) all share at least one derived character (jaws) that the lamprey lacks. Shark, salamander, lizard, and mouse each carry progressively more derived characters, placing them deeper in the ingroup.

Q18. Answer: D

Topic 7.9 · Phylogeny

Lizard and mouse share the amniotic egg, a derived character found in no other taxon in the table. Jaws and four limbs are shared more widely (salamander and lizard also share both of those), so those characters don't uniquely link lizard and mouse. Combining all four traits, lizard and mouse share three (jaws, four limbs, amniotic egg), the most of any pair, so they are placed as sister groups in the cladogram.

Q19. Answer: C

Topic 7.2 · Natural Selection

Starting at the same mean (9.5 mm), the Island X population's beak depth fell to 8.5 mm (soft seeds favor shallower beaks) while Island Y's rose to 11.6 mm (hard seeds favor deeper beaks). Selection pushed the two populations in opposite directions, an example of directional selection acting on different environments. A misdescribes different environments. B is contradicted by the response to selection. D contradicts the data directly.

Q20. Answer: D

Topic 7.10 · Speciation

Continued divergent selection in different environments, combined with geographic isolation, can produce reproductive isolation over time and lead to two separate species. This is the standard allopatric speciation model. A ignores continuing divergence. B would require gene flow, which is prevented by isolation. C is not supported by the data (deeper beaks are only fitter on Island Y).