

Reading Homework

Advanced Reading Comprehension — Level C1 (Academic English)

Directions: Read the following academic passage and answer the 10 multiple-choice questions that follow. Choose the best answer (A, B, C, or D) for each question based on what is stated or implied in the text.

Passage: Epigenetics and Phenotypic Plasticity in Evolutionary Biology

For over a century, classical evolutionary theory operated under the rigid paradigm that genetic inheritance is governed strictly by the sequence of nucleotides encoded within an organism's DNA. According to the Modern Synthesis formulated in the mid-twentieth century, phenotypic variations—the observable traits of an organism—arise primarily through random genetic mutations and recombination, which are subsequently filtered by natural selection. However, groundbreaking discoveries in molecular biology over the past two decades have radically expanded this perspective, introducing the field of epigenetics. Epigenetics examines heritable changes in gene expression or cellular phenotype caused by mechanisms other than alterations in the underlying

DNA sequence. These non-genetic modifications challenge long-held assumptions regarding inheritance and force evolutionary biologists to re-evaluate the speed and flexibility of adaptation.

At the molecular level, epigenetic modifications predominantly occur through DNA methylation and histone modification. DNA methylation involves the addition of a methyl group to specific cytosine bases within the DNA strand, an intervention that typically acts to suppress gene transcription. Histone modifications, on the other hand, alter the structural dynamic of chromatin—the protein-DNA complex that packages genetic material within the nucleus. By tightening or relaxing chromatin compaction, cells dynamically regulate which genes are accessible to transcriptional machinery. [A] Remarkably, these biochemical tags are not entirely erased during gametogenesis; under certain circumstances, they can be transmitted across generations. [B] This phenomenon, known as transgenerational epigenetic inheritance, implies that environmental exposures

experienced by a parent—such as severe nutritional stress, toxins, or systemic trauma—can exert a direct, functional impact on the physiological traits of their offspring without changing a single letter of the genetic code. [C]

This capacity for environmental factors to directly induce Heritable non-genetic variation underpins phenotypic plasticity: the capacity of a single genotype to produce multiple distinct phenotypes in response to varying ecological conditions. [D] While classical Neo-Darwinism posits that adaptation is a arduous, multi-generational process dependent on serendipitous genetic mutations, epigenetic mechanisms enable organisms to execute rapid, acclimative responses within a single lifespan or across immediate descendant generations. For example, when exposed to predator cues, certain species of *Daphnia* (water fleas) develop defensive neck spines and helmets—a morphologic alteration mediated by epigenetic triggers

that is subsequently passed on to their progeny. Such immediate responsiveness offers a crucial survival advantage in volatile environments where waiting for random beneficial mutations would prove fatal.

Despite these compelling insights, the integration of epigenetics into evolutionary framework remains a subject of vibrant academic debate. Skeptics point out that many epigenetic marks are inherently transient, undergoing comprehensive 'reprogramming' or erasure during early embryonic development. Consequently, critics argue that non-genetic traits lack the persistent fidelity required to drive macroevolutionary speciation over geological timescales. Nevertheless, proponents contend that even transient epigenetic flexibility can act as an evolutionary 'pacemaker.' By allowing populations to survive sudden environmental shifts in the short term, epigenetic plasticity provides a crucial physiological buffer, granting species the requisite time for stable genetic mutations to accumulate later—a process termed genetic assimilation. Far from replacing Darwinian selection, epigenetics enriches it, revealing a

nuanced interplay between genome, epigenome, and environment.

Questions 1–10

1. The word *paradigm* in paragraph 1 is closest in meaning to

- (A) hypothesis
- (B) model
- (C) controversy
- (D) anomaly

2. According to paragraph 1, what was a core belief of the Modern Synthesis?

- (A) Environmental factors directly modify nucleotide sequences.
- (B) Gene expression is primarily controlled by non-genetic triggers.
- (C) Phenotypic traits change mainly due to random mutations and natural selection.
- (D) Epigenetic marks are passed down uninterrupted across generations.

3. The word *suppress* in paragraph 2 is closest in meaning to

- (A) stimulate
- (B) inhibit
- (C) translate
- (D) replicate

4. Which of the following best describes the process of histone modification mentioned in paragraph 2?

- (A) Adding cytosine bases directly to DNA molecules
- (B) Removing toxic substances from the cellular nucleus
- (C) Altering chromatin structure to control gene accessibility
- (D) Permanently erasing all biological markers during reproduction



5. Why does the author mention *Daphnia* (water fleas) in paragraph 3?

- (A) To demonstrate how severe nutritional stress harms aquatic organisms
- (B) To illustrate how epigenetic triggers enable rapid, adaptive morphological changes
- (C) To argue that genetic mutations occur faster in small invertebrates
- (D) To prove that defensive traits prevent species from undergoing natural selection

6. The word *arduous* in paragraph 3 is closest in meaning to

- (A) laborious
- (B) unpredictable
- (C) systematic
- (D) rapid

7. In paragraph 4, why do critics doubt the role of epigenetics in driving macroevolutionary speciation?

- (A) They believe epigenetic changes occur too slowly to affect species.
- (B) They argue that epigenetic marks are often erased during early embryonic development.
- (C) They assert that organisms with high plasticity are unable to reproduce.
- (D) They claim that chromatin cannot be altered by environmental conditions.

8. According to paragraph 4, what is the function of epigenetics as an evolutionary 'pacemaker'?

- (A) It eliminates the need for any permanent genetic changes.
- (B) It speeds up the rate of beneficial DNA sequence mutations.
- (C) It provides short-term survival flexibility, allowing time for genetic assimilation.
- (D) It prevents organisms from adapting to sudden environmental shifts.

9. Which of the following statements can be inferred from the passage about classical Neo-Darwinism?

- (A) It fully anticipated the mechanisms of DNA methylation.
- (B) It struggled to account for rapid adaptation without DNA sequence alteration.
- (C) It denied that natural selection plays any role in evolutionary change.
- (D) It prioritized environmental factors over genetic inheritance.

10. Look at the four brackets [A], [B], [C], and [D] in paragraphs 2 and 3 that indicate where the following sentence could be added:

"As a result, a parent's environmental experience leaves a biological mark that is inherited by the next generation without changing DNA."

Where would the sentence best fit?

- (A) [A]
- (B) [B]
- (C) [C]
- (D) [D]