

Question 4: Conceptual Analysis**4 points**

Twenty million years ago the Caribbean Sea and Pacific Ocean were connected, and water flowed freely between the two bodies of water. Many of the same marine species were found in both areas. Over millions of years, the land referred to as the Isthmus of Panama formed, eventually closing off the connection between the Caribbean Sea and Pacific Ocean and creating two separate bodies of water. The ecology of these two marine habitats was dramatically altered by this land formation. The warmer Caribbean water could no longer flow west, so the Pacific water cooled and became more nutrient-rich, while the Caribbean water became warmer.

A	Describe the genetic evidence that evolution is occurring in a population. Examples of acceptable responses may include the following: - There are changes in <u>allele/gene</u> frequencies. - There are heritable changes in phenotypes.	1 point
B	Explain how the isolation of marine species by the formation of a land barrier can lead to divergent evolution of those species. Examples of acceptable responses may include the following: - Selective pressures could result in different <u>allele/gene</u> frequencies. (The land barrier) results in <u>reproductive isolation/lack of gene flow/allopatric speciation</u>. - Different environmental <u>conditions/pressures</u> select for different <u>alleles/genotypes/phenotypes</u>.	1 point
C	The formation of the Isthmus of Panama connected two continents, North America and South America. Many North American land animal species migrated to South America after the formation of the isthmus and occupied similar niches as South American species. Predict the effect the formation of the isthmus had on resource availability for South American species. (Resource availability) would have decreased.	1 point
D	Justify your prediction in part C. More species would now be competing for the same resources, (resulting in fewer resources for each individual).	1 point

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Question 7

Many species of bacteria grow in the mouths of animals and can form biofilms on teeth (plaque). Within plaque, the outer layers contain high levels of oxygen and the layers closest to the tooth contain low levels of oxygen. The surface of the tooth is covered in a hard layer of enamel, which can be dissolved under acidic conditions. When the enamel breaks down, the bacteria in plaque can extract nutrients from the tooth and cause cavities.

Certain types of bacteria (e.g., *Streptococcus mutans*) thrive in the innermost anaerobic layers of the plaque and are associated with cavities. Other types of bacteria (*Streptococcus sanguinis*) compete with *S. mutans* but are unable to thrive in acidic environments.

- (a) **Identify** the biochemical pathway *S. mutans* uses for metabolizing sugar and **describe** how the pathway contributes to the low pH in the inner layers of plaque. **(2 points; both points must be earned from the same row.)**

Identification	Description
fermentation	(lactic) acid/lactate
anaerobic respiration	acid
glycolysis	(pyruvic) acid/pyruvate

- (b) Normal tooth brushing effectively removes much of the plaque from the flat surfaces of teeth but cannot reach the surfaces between teeth. Many commercial toothpastes contain alkaline components, which raise the pH of the mouth. **Predict** how the population sizes of *S. mutans* AND *S. sanguinis* in the bacterial community in the plaque between the teeth are likely to change when these toothpastes are used. **(1 point)**

Prediction (1 point)

- S. mutans* decreases AND *S. sanguinis* increases