2023 AP Daily: Practice Sessions

AP Biology

Session 5 – MCQ (Set-Based Questions)

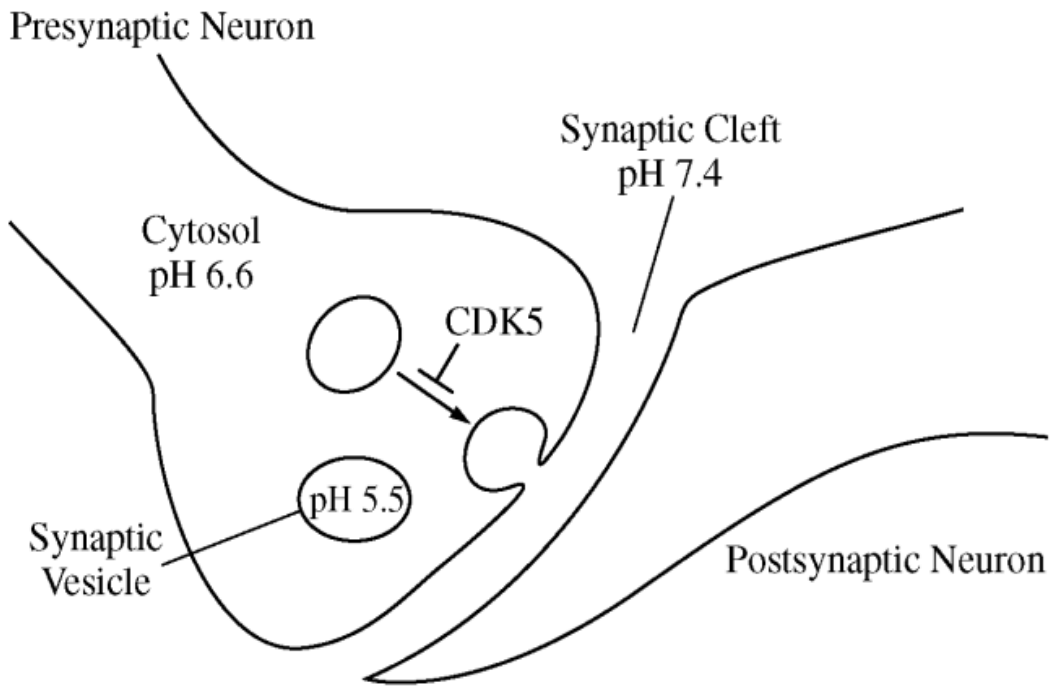

Figure 1. Model of synapse

Researchers investigating the regulation of neurotransmitter release from presynaptic neurons proposed a model (Figure 1) in which CDK5, a protein expressed in axon terminals, inhibits the movement of synaptic vesicles to the presynaptic membrane.

To test their model, the researchers used a modified version of green fluorescent protein (GFP*). In slightly alkaline conditions, GFP* exhibits a bright green fluorescence. In acidic conditions, GFP* exhibits no fluorescence. Using standard techniques, the gene encoding GFP* is easily introduced into living cells. By engineering the expression of GFP* in laboratory-cultured nerve cells, the researchers found that a bright green fluorescence was exhibited only when a presynaptic neuron was given a certain stimulus.

Source: Released AP Exam; Taken from: AP Classroom

1. Which of the following observations best supports the hypothesis that CDK5 negatively regulates neurotransmitter release?
    A. Introduction of CDK5 protein into neurons results in the movement of synaptic vesicles to the plasma membrane in the absence of any stimulus.
    B. Uptake of a gene encoding CDK5 by neurons results in the movement of synaptic vesicles to the plasma membrane in the absence of any stimulus.
    C. Suppression of CDK5 expression in neurons inhibits the movement of synaptic vesicles to the plasma membrane in response to a specific stimulus.
    D. Inhibition of CDK5 activity in neurons increases the movement of synaptic vesicles to the plasma membrane in response to a specific stimulus.

2. Previous experiments indicate that CDK5 is active only when attached to a protein called p35. Which of the following best predicts how p35 might play a role in regulating neuron function?
    A. Elevated intracellular levels of p35 result in increased synaptic activity.
    B. Degradation of p35 results in increased synaptic activity.
    C. Reabsorption of p35 from the synaptic cleft results in increased synaptic activity.
    D. Attachment of p35 to synaptic vesicles results in increased synaptic activity.

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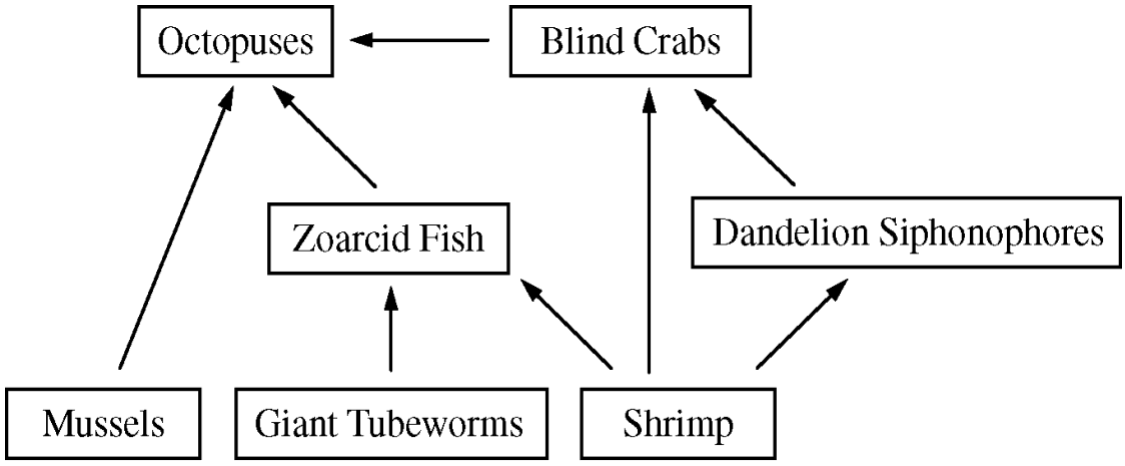

The food web above represents feeding relationships in a biological community near a deep-sea hydrothermal vent. Hydrothermal vents are geysers on the seafloor that gush super-heated, mineral-rich water.

The seawater surrounding hydrothermal vents typically contains carbon dioxide (CO_2), molecular hydrogen (H_2), hydrogen sulfide (H_2S), and methane (CH_4). Sunlight, however, fails to reach the seafloor where deep-sea hydrothermal vents are located.

As part of an investigation, researchers collected living specimens from an area near a deep-sea hydrothermal vent. Mussels in the collection were found to be dependent on molecular hydrogen in seawater. Also, the researchers discovered multiple species of bacteria living in the gills of the mussels. Mussels use gills for filter-feeding and gas exchange with the surrounding seawater. On the basis of their experimental results, the researchers hypothesized that some bacteria living in the gills of the mussels are capable of chemosynthesis.

Source: Released AP Exam; Taken from: AP Classroom

3. Which of the following best explains how biological communities near deep-sea hydrothermal vents can exist in a habitat lacking sunlight?
    A. Environmental conditions on some distant planets resemble those experienced by organisms living near hydrothermal vents.
    B. Heterotrophs metabolize carbon-containing compounds produced by the photosynthetic organisms that live on the seafloor.
    C. Some organisms rely on energy captured from inorganic compounds to drive basic biological processes.
    D. Some organisms that can tolerate high temperatures are single celled, whereas others are multicellular.

4. Researchers are investigating the evolutionary relationships among organisms found near deep-sea hydrothermal vents and similar organisms found closer to the ocean surface. Which of the following scientific questions is most relevant to the investigation?
    A. What large-scale geological events have occurred recently in the Mid-Atlantic Ocean?
    B. Do species found near deep-sea hydrothermal vents all have the same haploid number of chromosomes?
    C. Does water temperature at different ocean depths affect the relative levels of dissolved oxygen?
    D. What are the nucleotide sequences of ribosomal RNA genes that are found in the genomes of the different species?

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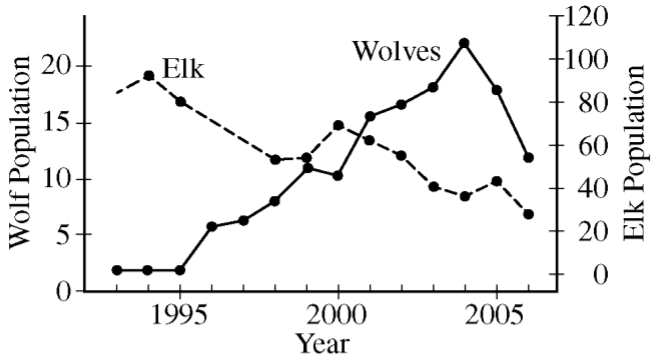

Figure 1. Wolf and Elk Population Sizes in Yellowstone National Park

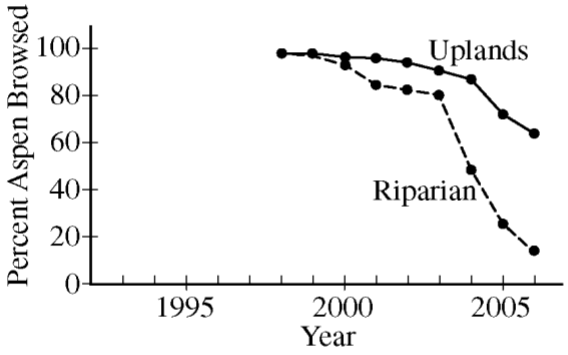

Figure 2. Browsing of Aspen in Yellowstone National Park

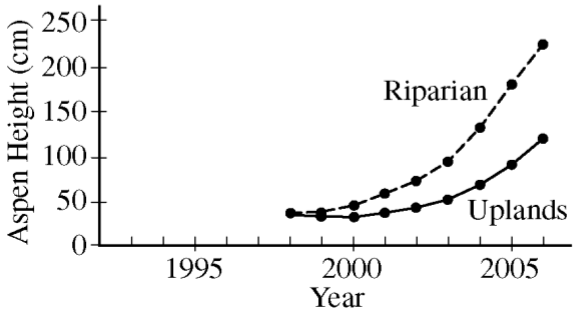

Figure 3. Growth of Aspen in Yellowstone National Park

Wolves, a top predator, were reintroduced to Yellowstone National Park in 1995 after a 50-year absence. In a multiyear study, the numbers of wolves and elk were monitored. The data are shown in Figure 1. In two different environments scientists monitored the percent of aspen trees browsed by herbivores (Figure 2) as well as the growth of the trees (Figure 3). The upland environments consist mostly of flat forested areas. The riparian environments are areas along streams with steep, wooded banks.

Source: Released AP Exam; Taken from: AP Classroom

5. Based on the data, which of the following is the best explanation for the changes in the elk population size between 2000 and 2005?

    A. The height of the aspen trees increased during that time period.
    B. Predation by wolves was higher than before 1995.
    C. The number of aspen trees increased during that time period.
    D. Wolf populations increased more rapidly in the upland areas.

6. Based on the data, which of the following behaviors in elk could account for the differences between the percent of aspens browsed by herbivores and the height of aspen trees in riparian and upland environments?

    A. Elk tend to avoid riparian areas where the steep, wooded riverbanks make it difficult to escape predators.
    B. Elk tend to prefer riparian areas where there is easy access to water.
    C. Elk tend to avoid upland areas where trees are too tall to be easily eaten.
    D. Elk tend to prefer upland areas where there are richer sources of mineral nutrients, such as potassium and iodine

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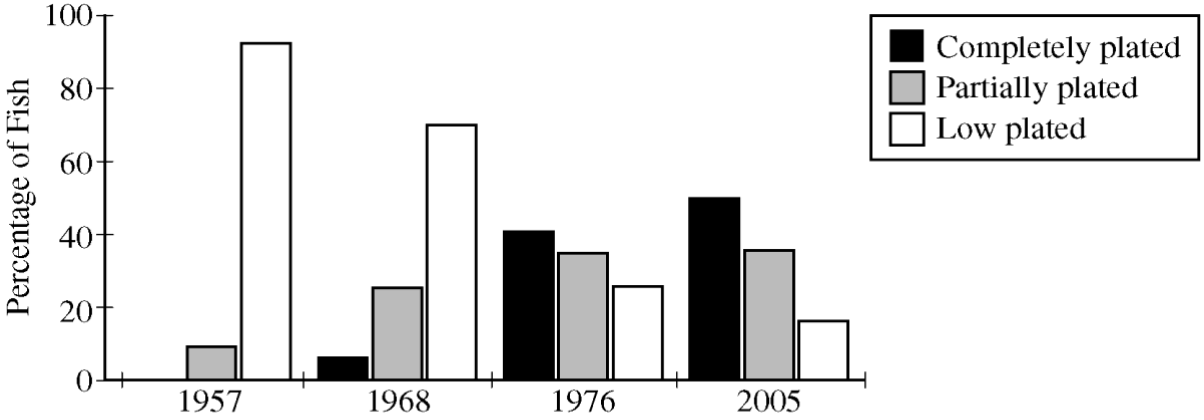

Figure 1. Armor plating phenotypes in Lake Washington stickleback population

The three-spined stickleback is a small fish found in both marine and freshwater environments. Marine stickleback populations consist mainly of individuals with armor-like plates covering most of their body surface (completely plated). Approximately 10,000 years ago, some marine sticklebacks colonized freshwater environments. After many generations in the freshwater environments, the freshwater stickleback populations lacked the armor-plating (low-plated) typical of marine stickleback populations.

Over the period between 1957 and 2005, one freshwater population, in Lake Washington, a lake in a coastal region of the northwestern United States, changed from having a majority of individuals of the low-plated phenotype to having more individuals of the completely plated phenotype than of the low-plated phenotype. Figure 1 shows the distribution of plated phenotypes in Lake Washington sticklebacks at four time points between 1957 and 2005.

Source: Released AP Exam; Taken from: AP Classroom

7. Which of the following best explains the differences in the armor of the Lake Washington stickleback population summarized in Figure 1?

    A. Analysis of somatic cells using chromosomal staining and light microscopy indicates that stickleback fish have a diploid number of 42.
    B. Stickleback males from natural freshwater populations are typically more aggressive when competing for mates than are stickleback males from laboratory-bred populations.
    C. Fish exhibiting the low-plated phenotype were selected against in the Lake Washington stickleback population over the last 50 years.
    D. Migration of individuals from other freshwater environments to Lake Washington led to gene flow between populations that were once geographically isolated.

8. A completely plated stickleback from a marine population was mated to a low-plated stickleback from a freshwater population. The resulting F_1 hybrids all displayed a completely plated phenotype. When the F_1 hybrids were allowed to interbreed, the resulting F_2 generation included completely plated offspring and low-plated offspring in an approximate 3:1 ratio. Which of the following conclusions is best supported by the results of the breeding experiments?

    A. Phenotypic variation in the F_2 generation suggests that armor morphology is controlled by many alleles of a single gene.
    B. The completely plated phenotype is controlled by a dominant allele of a single gene.
    C. Armor loss is an acquired characteristic that is affected by one or more environmental factors.
    D. Patterns of armor plating in stickleback populations are regulated by sex-specific signals.