

## **2015 AP® BIOLOGY FREE-RESPONSE QUESTIONS**

7. Smell perception in mammals involves the interactions of airborne odorant molecules from the environment with receptor proteins on the olfactory neurons in the nasal cavity. The binding of odorant molecules to the receptor proteins triggers action potentials in the olfactory neurons and results in transmission of information to the brain. Mammalian genomes typically have approximately 1,000 functional odorant-receptor genes, each encoding a unique odorant receptor.

- (a) **Describe** how the signal is transmitted across the synapse from an activated olfactory sensory neuron to the interneuron that transmits the information to the brain.
  - (b) **Explain** how the expression of a limited number of odorant receptor genes can lead to the perception of thousands of odors. Use the evidence about the number of odorant receptor genes to **support** your answer.
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8. An individual has lost the ability to activate B cells and mount a humoral immune response.

- (a) **Propose** ONE direct consequence of the loss of B-cell activity on the individual’s humoral immune response to the initial exposure to a bacterial pathogen.
- (b) **Propose** ONE direct consequence of the loss of B-cell activity on the speed of the individual’s humoral immune response to a second exposure to the bacterial pathogen.
- (c) **Describe** ONE characteristic of the individual’s immune response to the bacterial pathogen that is not affected by the loss of B cells.

**STOP**

**END OF EXAM**

**AP® BIOLOGY  
2015 SCORING GUIDELINES**

**Question 7**

Smell perception in mammals involves the interactions of airborne odorant molecules from the environment with receptor proteins on the olfactory neurons in the nasal cavity. The binding of odorant molecules to the receptor proteins triggers action potentials in the olfactory neurons and results in transmission of information to the brain. Mammalian genomes typically have approximately 1,000 functional odorant-receptor genes, each encoding a unique odorant receptor.

- (a) **Describe** how the signal is transmitted across the synapse from an olfactory sensory neuron to the interneuron that transmits the information to the brain.

**Description (1 point)**

- Neurotransmitters are released from the olfactory neuron and bind to receptors in the postsynaptic neuron.

- (b) **Explain** how the expression of a limited number of odorant receptor genes can lead to the perception of thousands of odors. Use the evidence about the number of odorant receptor genes to **support** your explanation.

**Explanation and support (2 points maximum: points may be earned from only one row)**

|             | <b>Explanation (1 point)</b>   | <b>Support (1 point)</b>                                 |
|-------------|--|--|
| Molecular   | <ul style="list-style-type: none"><li>• One odorant molecule can be recognized by more than one odorant receptor</li><li>• One odorant receptor can bind to more than one odorant molecule</li></ul> | Mathematical combinations expand possible odors detected |
| CNS Control | Signals integrated in the brain  | Multiple interactions among neurons in the brain         |
| Genetic     | Alternate processing/splicing (of pre-mRNA/primary transcript)   | Multiple receptors can be produced from a gene           |