

Assessments

Biology: Hemophilia and PKU Constructed-Response Prompt

Hemophilia is a human X-linked recessive disorder that affects blood clotting. Phenylketonuria (PKU) is a human autosomal recessive disorder that affects the body's ability to use the amino acid phenylalanine. Females are less likely to inherit hemophilia than are males, but males and females are equally likely to inherit PKU.

Using your understanding of genetics, analyze this description. As part of your answer, be sure to:

- Describe the difference between sex chromosomes and autosomal chromosomes.
- Explain why females are less likely to inherit hemophilia than males.
- Explain why males and females are equally likely to inherit PKU.

QualityCore Science Constructed-Response Holistic Scoring Guide

For each of the three constructed-response items, a score (ranging from 0 to 4) is given using this scoring guide. No score is given to an essay that is blank, off-topic, illegible, or written in another language.

Score of 4: A response at this level provides evidence of *thorough* knowledge and understanding of the subject matter.

- The content of the response is correct and thorough, with no significant errors.
- The response contains elaboration and/or detail that demonstrates insight into scientific concepts and principles, and contains no misconceptions.
- The explanation in the response is clear and is enhanced by correct use of appropriate scientific terminology to communicate understanding.

Score of 3: A response at this level provides evidence of *competent* knowledge and understanding of the subject matter.

- The content of the response is generally correct and complete.
- The response contains some elaboration and/or detail that demonstrates sufficient understanding of scientific concepts and principles, and it may contain a few minor misconceptions.
- The explanation in the response is mostly clear and is supported by some correct use of appropriate scientific terminology to communicate understanding.

Score of 2: A response at this level provides evidence of *basic* knowledge and understanding of the subject matter.

- The content of the response is partially correct, and it may be incomplete.
- The response contains a little elaboration and/or detail to demonstrate some understanding of scientific concepts and principles, but it may contain some significant misconceptions.
- The explanation in the response is sometimes clear and sometimes demonstrates correct use of appropriate scientific terminology to communicate understanding.

Score of 1: A response at this level provides evidence of *minimal* knowledge and understanding of the subject matter.

- The content of the response is mostly incorrect, and it is incomplete.
- The response contains little or no elaboration and/or detail to demonstrate understanding of scientific concepts and principles, and it contains evidence of significant misconceptions.
- The explanation in the response is mostly unclear and demonstrates little or no correct use of appropriate scientific terminology to communicate understanding.

Score of 0: A response at this level is not scorable. The response is off-topic, blank, hostile, or otherwise not scorable.

Biology: Hemophilia and PKU Scoring Criteria

A 4-point response will include, but is not limited to, the following points:

- **Description of difference between sex chromosomes and autosomal chromosomes:** Sex chromosomes are the pair of chromosomes that determine the gender of an individual. Autosomal chromosomes are the remaining 22 pairs of chromosomes that are not directly involved in determining the gender of an individual.
- **Explanation of why females are less likely to inherit hemophilia than males:** In order for hemophilia to be expressed, a female, who carries two X chromosomes (one from each parent), must inherit a hemophilia allele from both parents. Females who receive only one hemophilia allele from either parent are carriers of the trait, but do not have hemophilia. Since males only have one X chromosome (inherited from the mother), males who receive a normal allele from the mother will not have hemophilia, but males who receive the hemophilia allele will have hemophilia.

Note: Examinees may use an example as an alternative explanation. If a female carrying the hemophilia trait mates with a male who has hemophilia, there is a 50% chance for their male offspring to have hemophilia, but a 0% chance for their female offspring to have hemophilia. Thus females are less likely to inherit hemophilia.

- **Explanation of why males and females are equally likely to inherit PKU:** The PKU allele is located on an autosomal chromosome. Males and females each have 2 versions of each of their autosomal chromosomes. As such, each gender is equally likely to receive a normal allele or the PKU allele. Therefore, each gender is also equally likely to receive two copies of the PKU allele, which will result in the person having PKU.