2017

AP CollegeBoard

AP Biology

Sample Student Responses and Scoring Commentary

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AP® BIOLOGY
2017 SCORING GUIDELINES

Question 6

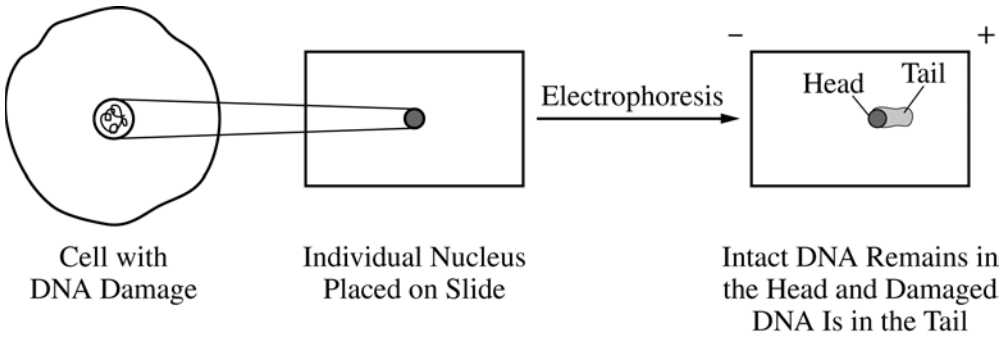

Figure 1. Comet assay to detect double-stranded breaks in DNA

A comet assay is a technique used to determine the amount of double-strand breaks in DNA (DNA damage) in cells. The nucleus of an individual cell is placed on a microscope slide coated with an agarose gel. An electric current is applied to the gel that causes DNA to move (electrophoresis), and the DNA is stained with a fluorescent dye. When viewed using a microscope, undamaged DNA from the nucleus appears as a round shape (the head), and the fragments of damaged DNA extend out from the head (the tail). The length of the tail corresponds to the amount of the damage in the DNA (see Figure 1).

(a) To explain the movement of DNA fragments in the comet assay, **identify** one property of DNA and **provide reasoning** to support how the property contributes to the movement during the comet assay technique. **(2 points; both points must be earned from the same row.)**

Identification (1 point)	**Reasoning (1 point)**
DNA has a (negative) charge.	DNA moves toward the positive/oppositely charged pole.
DNA can be different sizes.	(Different size DNA fragments) move at different rates.

(b) In a different experiment, cells are treated with a chemical mutagen that causes only nucleotide substitutions in DNA. **Predict** the likely results of a comet assay for this treatment. **(1 point)**

Prediction (1 point)

- Head (only) OR (head with) no tail.
- Tail will be shorter than a cell with double-stranded breaks in DNA.

6 A,

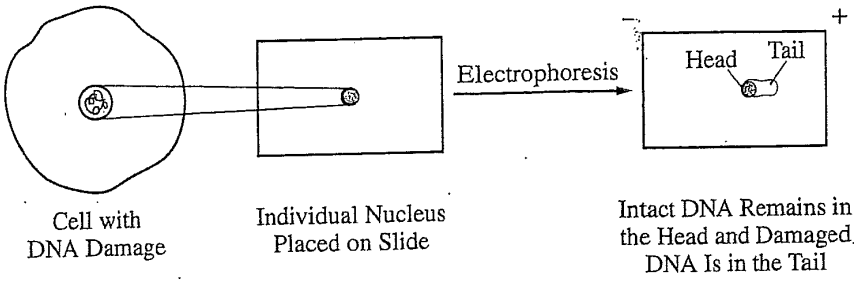

Figure 1. Comet assay to detect double-stranded breaks in DNA

6. A comet assay is a technique used to determine the amount of double-strand breaks in DNA (DNA damage) in cells. The nucleus of an individual cell is placed on a microscope slide coated with an agarose gel. An electric current is applied to the gel that causes DNA to move (electrophoresis), and the DNA is stained with a fluorescent dye. When viewed using a microscope, undamaged DNA from the nucleus appears as a round shape (the head), and the fragments of damaged DNA extend out from the head (the tail). The length of the tail corresponds to the amount of the damage in the DNA (see Figure 1).

   (a) To explain the movement of DNA fragments in the comet assay, **identify** one property of DNA and **provide reasoning** to support how the property contributes to the movement during the comet assay technique.

   (b) In a different experiment, cells are treated with a chemical mutagen that causes only nucleotide substitutions in DNA. **Predict** the likely results of a comet assay for this treatment.

PAGE FOR ANSWERING QUESTION 6

a) DNA is negative, therefore when applying an electric current, DNA will move towards a positive charge. Smaller pieces of DNA move through the agarose gel more easily than larger pieces, which is why the smaller, damaged fragments of DNA are drawn out more towards the positive charge (the tail)

b). All of the DNA will remain in the head (nucleus) because with only nucleotide substitutions, there won't be any damaged fragments to travel outside

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ADDITIONAL PAGE FOR ANSWERING QUESTION 6

as a tail. The nucleotide substitutions will allow the DNA to remain intact, just mutated.

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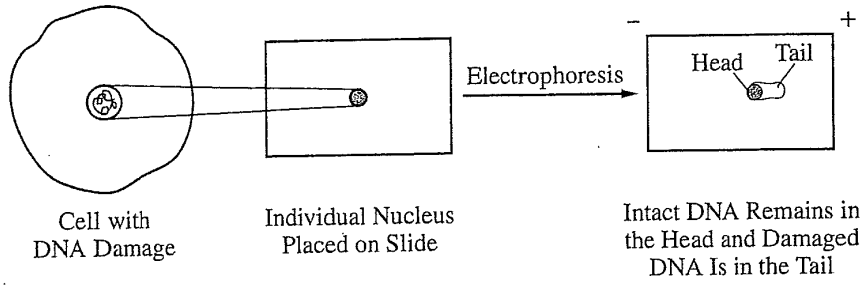

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   (a) To explain the movement of DNA fragments in the comet assay, **identify** one property of DNA and **provide reasoning** to support how the property contributes to the movement during the comet assay technique.

   (b) In a different experiment, cells are treated with a chemical mutagen that causes only nucleotide substitutions in DNA. **Predict** the likely results of a comet assay for this treatment.

PAGE FOR ANSWERING QUESTION 6

6a) DNA fragments are negatively charged and so will move towards the positively charged area of the slide to create a "tail".

b) In this case, the comet assay will be longer, as ~~not all~~ most of the substitutions will be seen in damaged areas, and without the proper enzymes, these nucleotides will not be properly bonded to the DNA strand. It could even cause further fragmentation.

6 C1

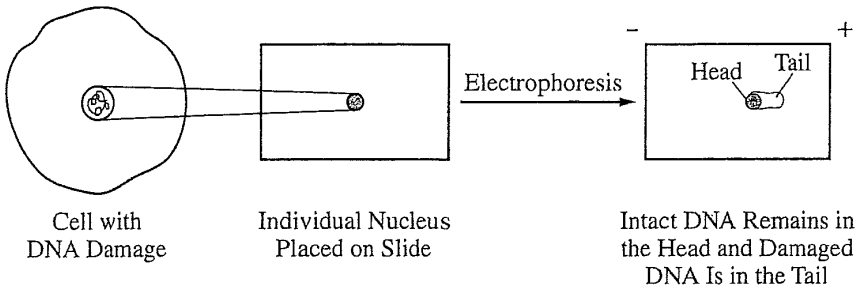

Figure 1. Comet assay to detect double-stranded breaks in DNA

6. A comet assay is a technique used to determine the amount of double-strand breaks in DNA (DNA damage) in cells. The nucleus of an individual cell is placed on a microscope slide coated with an agarose gel. An electric current is applied to the gel that causes DNA to move (electrophoresis), and the DNA is stained with a fluorescent dye. When viewed using a microscope, undamaged DNA from the nucleus appears as a round shape (the head), and the fragments of damaged DNA extend out from the head (the tail). The length of the tail corresponds to the amount of the damage in the DNA (see Figure 1).

   (a) To explain the movement of DNA fragments in the comet assay, **identify** one property of DNA and **provide reasoning** to support how the property contributes to the movement during the comet assay technique.

   (b) In a different experiment, cells are treated with a chemical mutagen that causes only nucleotide substitutions in DNA. **Predict** the likely results of a comet assay for this treatment.

PAGE FOR ANSWERING QUESTION 6

a) One property of DNA that explains the movement of DNA fragments in the comet assay is that it ~~has these gaps~~ which is able to come apart from its double helix structure which allows the damaged part of the DNA to move to the tail during the comet assay technique.

b) The likely results of a comet assay for the treatment causing only nucleotide substitutions is that the DNA will remain all in the head.

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AP® BIOLOGY
2017 SCORING COMMENTARY

Question 6

Overview

This question focused on the analysis of DNA using a comet assay. Students were presented with a diagram demonstrating the results of a comet assay in a cell with DNA damage and a written description of the assay. Students were asked to identify one property of DNA and to provide reasoning to support how this property contributed to the movement of DNA in the comet assay. Students were also asked to predict the results of a comet assay in an experiment in which cells were treated with a mutagen that causes only nucleotide substitutions.

Sample: 6A
Score: 3

The response earned 1 point in part (a) for identifying the property of DNA as being negative. The response earned 1 point in part (a) for providing the reasoning that DNA will move toward a positive charge. The response earned 1 point in part (b) for predicting that all of the DNA will remain in the head. The response could have earned 1 point for predicting that there won't be a tail, but the point had already been earned.

Sample: 6B
Score: 2

The response earned 1 point in part (a) for identifying the property of DNA as being negatively charged. The response earned 1 point in part (a) for providing the reasoning that DNA moves toward the positive end.

Sample: 6C
Score: 1

The response earned 1 point in part (b) for predicting that the results of the comet assay would remain all in the head.