2025

# AP® Biology

## Sample Student Responses and Scoring Commentary

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**Free-Response Question 6**

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## Question 6: Analyze Data — 4 points

The *ald* gene of fruit flies encodes the ALD protein, which is associated with both the centromeres of chromosomes and protein filaments produced during meiosis. In the absence of functional ALD proteins, gamete-producing cells enter anaphase I before homologous chromosomes are correctly aligned. As a result, the gametes produced do not contain the correct numbers of chromosomes.

Scientists generated four mutations in the *ald* gene: *ald1*, *ald3*, *ald23*, and *del*, which was a deletion of the gene. To study the role of the ALD protein in meiosis, scientists used gamete-forming metaphase cells from groups of flies with different *ald* genotypes. Some of the flies were homozygous for the wild-type allele of *ald: WT*/*WT*. Other flies were heterozygous for different *ald* alleles: *WT*/*del*; *ald1*/*del*; *ald3*/*ald23*; *ald23*/*del*. The scientists measured the percent of metaphase cells that contained ALD-associated filaments (Figure 1A) and the amount of ALD protein produced by each of the cell types (Figure 1B).

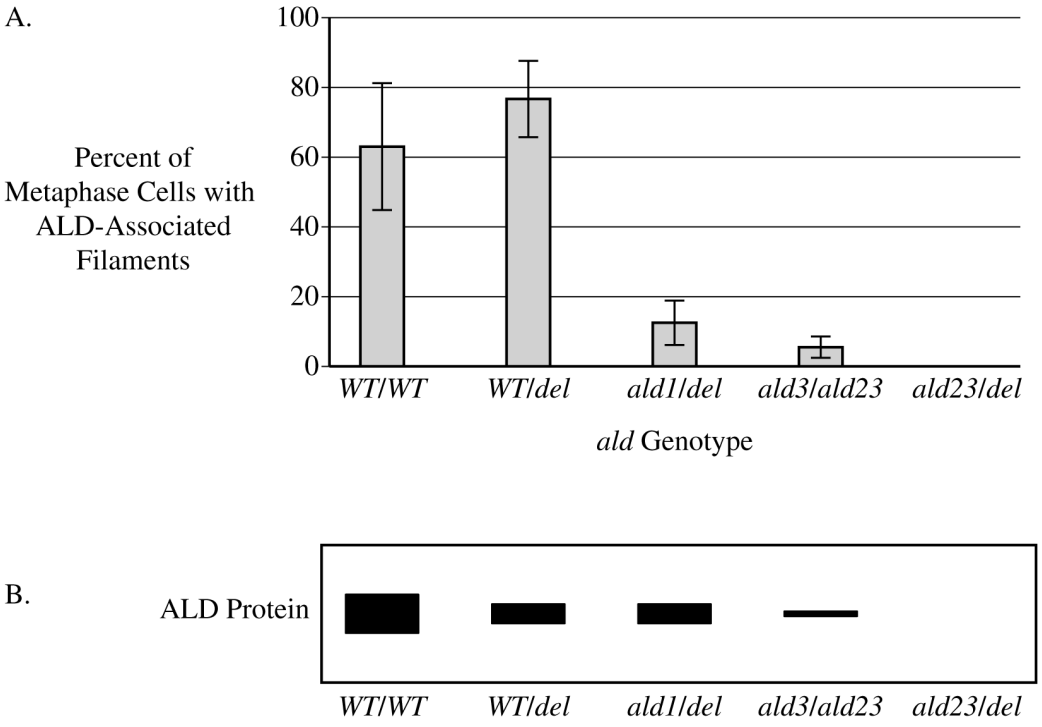


**Figure 1. (A) The average percent of gamete-forming metaphase cells that contained filaments associated with ALD and (B) the amount of ALD protein produced by each cell type. A thicker band indicates a greater amount of ALD protein.**

| | | |
|---|---|---|
| **A** | Based on Figure 1A, **identify** the fly genotype in which the average percent of metaphase cells with ALD-associated filaments is close to 12%.<br>• *ald1/del* | **1 point** |
| **B** | Based on Figure 1B, **describe** the difference in ALD protein production between gamete-forming metaphase cells of flies with the genotype *ald3*/*ald23* and flies with the genotype *ald23*/*del*.<br>Examples of acceptable responses may include the following:<br>• More ALD protein is produced by *ald3*/*ald23* cells (than by *ald23*/*del* cells).<br>• Less ALD protein is produced by *ald23*/*del* cells (than by *ald3*/*ald23* cells).<br>• No ALD protein is produced by *ald23*/*del* cells (whereas it is produced by *ald3*/*ald23* cells). | **1 point** |
| **C** | Scientists hypothesize that gamete-forming metaphase cells can produce a normal amount of ALD-associated filaments even when they produce about half as much ALD protein as the wild-type cells produce. Use the data in Figures 1A and 1B to **support** the scientists' hypothesis.<br>Examples of acceptable responses may include the following:<br>• (With half as much protein) the *WT/del* cells show no difference in percent of (gamete forming metaphase cells with) ALD-associated filaments.<br>• The data for the *WT/del* relative to/in comparison with the *WT/WT* cells support the scientists' hypothesis. | **1 point** |
| **D** | For gamete-forming metaphase cells of the *WT*/*del* and *ald1*/*del* flies, **explain** why the phenotypes observed in Figure 1A differ even though the amount of ALD protein produced (Figure 1B) does not.<br>Examples of acceptable responses may include the following:<br>• (The phenotypes) differ because only the *WT*/*del* flies produce enough functional (ALD) protein to generate a wild-type phenotype.<br>• When one allele encodes functional ALD protein (in *WT/del* flies), the flies can generate a wild-type phenotype/produce ALD-associated filaments in a similar amount as *WT/WT* flies.<br>• Both genotypes produced ALD protein, but the *ald1* mutation resulted in a protein with reduced function (compared with *WT*, resulting in a different phenotype). | **1 point** |

## Question 6

Write your response to **QUESTION 6** on this page. Do not skip lines.

A. The genotype is ald1/del.

B. Flies with the genotype ald3/ald23 produce a reduced amount of ALD compared to the wild type, while flies with the ald23/del genotype produce no ALD.

C. Statistically, the percentage of metaphase cells with ALD associated filaments for WT/WT and WT/del genotypes is the same, even though, as seen in Fig. 1B, WT/del produces around half the ALD as WT/WT does.

D. The ald1 gene may produce a defective or otherwise malfunctioning version of the ALD protein, while the WT/del genotype produces at least one working copy.



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## Question 6

Write your response to **QUESTION 6** on this page. Do not skip lines.

A. The genotype ald1/del is closest to 12%.

B. The ald3/ald23 is higher than ald23/del when comparing the ALD protein production.

C. If we look at genotype WT/del, ALD protein produced is half as much as WT/WT (control group), but the percent of metaphase cells doesn't show a statistical difference to WT/WT, which supports the scientists hypothesis.

D. There could be a mutation inhibiting the proteins to activate which results in an observed, phenotypic difference although the amount of ALD proteins produced is relatively the same.



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## Question 6

Write your response to **QUESTION 6** on this page. Do not skip lines.

(A) ald1/del

(B) ald3/ald23 had a greater amount of AID protein.

(C) In ald1/del of figure 1A, the % of metaphase cells is about 12% but its AID protein is similar to that of WT/del allele in Figure 1A and 1B.

(D) It differes because they are heterozygous.



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## Question 6

**Note:** Student samples are quoted verbatim and may contain spelling and grammatical errors.

### Overview

**NEW for 2025:** The question overviews can be found in the *Chief Reader Report on Student Responses* on AP Central.

### Sample: 6A
### Score: 4

The response earned 1 point in part A for identifying *ald1/del* as the genotype with the average percent of metaphase cells close to 12%. The response earned 1 point in part B for describing that *ald3/ald23* produced less ALD than the wild type, but *ald23/del* produced no ALD. The response earned 1 point in part C for supporting the hypothesis by stating that "[s]tatistically, the percentage of metaphase cells with ALD associated filaments for WT/WT and WT/del genotypes is the same, even though ... WT/del produces around half the ALD as WT/WT does." The response earned 1 point in part D by explaining that the "ald1 gene may produce a defective or otherwise malfunctioning version of the ALD protein, while the WT/del genotype produces at least one working copy."

### Sample: 6B
### Score: 3

The response earned 1 point in part A for identifying *ald1/del* as the genotype with the average percent of metaphase cells close to 12%. The response earned 1 point in part B for describing *ald3/ald23* as higher in ALD protein production. The response earned 1 point in part C for supporting the hypothesis by stating that "genotype WT/del, ALD protein produced is half as much as WT/WT (control group), but the percent of the metaphase cells doesn't show a statistical difference to WT/WT." The response did not earn a point in part D because it does not explain why a mutation in proteins can cause a change in the phenotype and does not describe which genotype this might apply to.

### Sample: 6C
### Score: 2

The response earned 1 point in part A for identifying *ald1/del* as the genotype with the average percent of metaphase cells close to 12%. The response earned 1 point in part B for describing *ald3/ald23* as having more ALD protein. The response did not earn a point in part C because it misidentifies *ald1/del* as the genotype to compare with the *WT/del* genotype. The response did not earn a point in part D because it does not explain why the *WT/del* and *ald1/del* flies have different phenotypes but had similar ALD protein amounts.