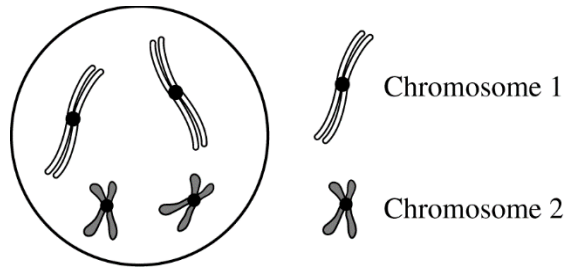


AP[®] BIOLOGY
2016 SCORING GUIDELINES

Question 7

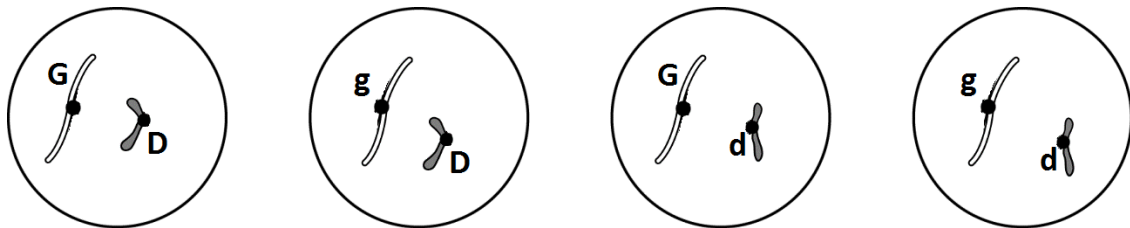


In a certain species of plant, the diploid number of chromosomes is 4 ($2n = 4$). Flower color is controlled by a single gene in which the green allele (G) is dominant to the purple allele (g). Plant height is controlled by a different gene in which the dwarf allele (D) is dominant to the tall allele (d). Individuals of the parental (P) generation with the genotypes $GGDD$ and $ggdd$ were crossed to produce F_1 progeny.

- (a) **Construct** a diagram below to depict the four possible normal products of meiosis that would be produced by the F_1 progeny. Show the chromosomes and the allele(s) they carry. Assume the genes are located on different chromosomes and the gene for flower color is on chromosome 1. **(1 point)**

Construct diagram (1 point)

- Diagram must include all of the following:
 - Each cell has one unduplicated chromosome 1 (with G or g).
 - Each cell has one unduplicated chromosome 2 (with D or d).
 - Genotype combinations should be: GD , Gd , gD , gd .



- (b) **Predict** the possible phenotypes and their ratios in the offspring of a testcross between an F_1 individual and a $ggdd$ individual. **(1 point)**

Prediction (1 point)

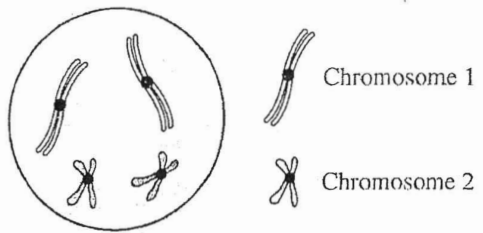
- 1 green dwarf: 1 green tall: 1 purple dwarf: 1 purple tall

- (c) If the two genes were genetically linked, **describe** how the proportions of phenotypes of the resulting offspring would most likely differ from those of the testcross between an F_1 individual and a $ggdd$ individual. **(1 point)**

Identify difference (1 point)

- The majority/greater than 50 percent would have the parental plant phenotypes
- Greater than 25 percent would be green dwarf plants and greater than 25 percent would be purple tall plants
- Less than 25 percent would be green tall plants and less than 25 percent would be purple dwarf plants

7A1



7. In a certain species of plant, the diploid number of chromosomes is 4 ($2n = 4$). Flower color is controlled by a single gene in which the green allele (G) is dominant to the purple allele (g). Plant height is controlled by a different gene in which the dwarf allele (D) is dominant to the tall allele (d). Individuals of the parental (P) generation with the genotypes $GGDD$ and $ggdd$ were crossed to produce F_1 progeny.

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PAGE FOR ANSWERING QUESTION 7

$G G$ $D D$ $G g$ $D d$
 $g g$ $d d$ $g g$ $d d$

$F_1 \times ggdd$

g	Gg	Dd	green, dwarf: $\frac{2}{4}(\frac{2}{4}) = \frac{4}{16}$
g	Gg	dd	green tall: $\frac{2}{4}(\frac{2}{4}) = \frac{4}{16}$
g	gg	Dd	purple dwarf: $\frac{2}{4}(\frac{2}{4}) = \frac{4}{16}$
g	gg	dd	purple tall: $\frac{2}{4}(\frac{2}{4}) = \frac{4}{16}$

green dwarf = green tall = purple dwarf = purple tall ratio is **1:1:1:1**

if the genes were linked then there would be a lot more

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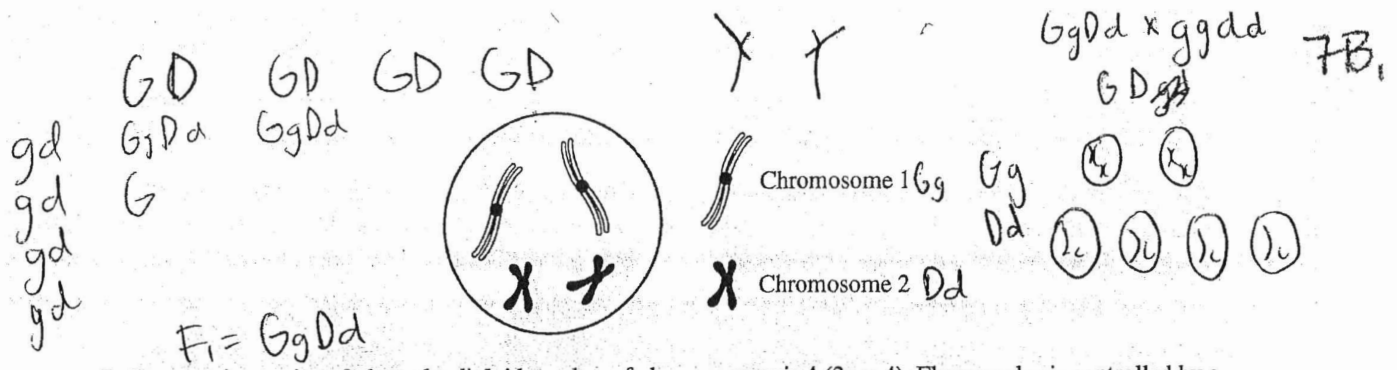
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7A2

ADDITIONAL PAGE FOR ANSWERING QUESTION 7

green dwarf and purple tall plants in the resulting offspring of $F_1 \times YyDd$ and the phenotype ratio would not be 1:1:1:1, it would have 2 phenotypes at a larger proportion to the other 2.

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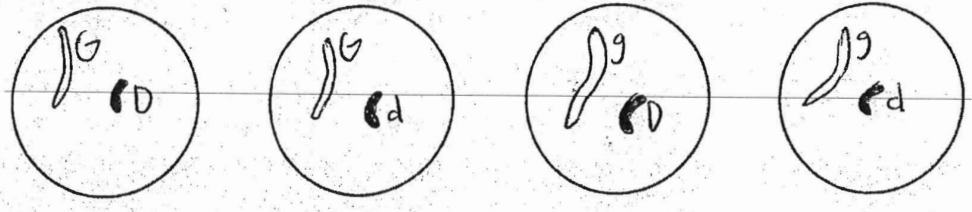


7. In a certain species of plant, the diploid number of chromosomes is 4 ($2n = 4$). Flower color is controlled by a single gene in which the green allele (G) is dominant to the purple allele (g). Plant height is controlled by a different gene in which the dwarf allele (D) is dominant to the tall allele (d). Individuals of the parental (P) generation with the genotypes $GGDD$ and $ggdd$ were crossed to produce F_1 progeny.

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- (c) If the two genes were genetically linked, describe how the proportions of phenotypes of the resulting offspring would most likely differ from those of the testcross between an F_1 individual and a $ggdd$ individual.

Handwritten: $GgDd \times ggdd$

PAGE FOR ANSWERING QUESTION 7



b. Possible phenotypes include green dwarf (25%), purple dwarf (25%), green tall (25%), purple tall (25%).

c. There would most likely be ^{many} more instances of green dwarf plants ~~if~~ if the genes were genetically linked. There would also be decreases in ~~purple~~ green tall and purple tall and a

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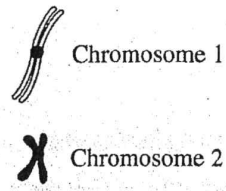
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7B₂

ADDITIONAL PAGE FOR ANSWERING QUESTION 7

slight increase in purple dwarfs.

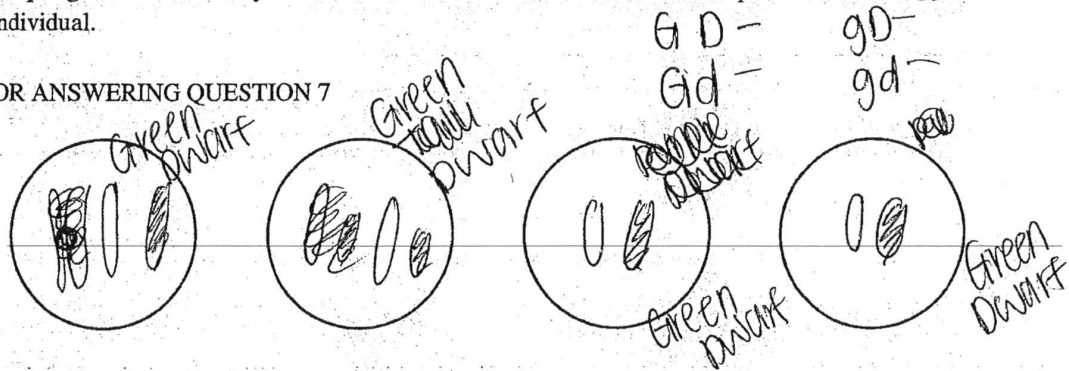
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7. In a certain species of plant, the diploid number of chromosomes is 4 ($2n = 4$). Flower color is controlled by a single gene in which the green allele (G) is dominant to the purple allele (g). Plant height is controlled by a different gene in which the dwarf allele (D) is dominant to the tall allele (d). Individuals of the parental (P) generation with the genotypes $GGDD$ and $ggdd$ were crossed to produce F_1 progeny.

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It is possible that the first generation would be a green dwarf plant. The possible phenotypes between a cross between a green dwarf plant and a purple homozygous tall plant is a 25% chance of getting a dwarf green plant, 25% chance of getting green tall plant, 25% chance of getting a purple dwarf plant and a 25% of

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ADDITIONAL PAGE FOR ANSWERING QUESTION 7

getting a purple tall plant. If two genes were genetically linked then the ~~the~~ proportion may differ by having ~~genes~~ a mixer of other alleles in the same gene.

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AP[®] BIOLOGY

2016 SCORING COMMENTARY

Question 7

Question 7 was written to the following Learning Objectives in the AP Biology[®] Curriculum Framework: 3.12, 3.14, and 3.17.

Overview

This question focused on the process of meiosis and independent assortment. Students were given a diagram of a cell with two pairs of homologous chromosomes. Students were asked to construct a diagram to indicate the four normal products of meiosis from a doubly heterozygous F_1 individual. Students were then asked to predict the phenotype ratios from a testcross with the F_1 individual and to describe how the proportions of phenotypes would likely differ if the two genes in question were genetically linked.

Sample: 7A

Score: 3

The response earned 1 point in part (a) for constructing a diagram that included two labelled unduplicated chromosomes in each cell. The response earned 1 point in part (b) for predicting a phenotypic ratio of 1 green dwarf: 1 green tall: 1 purple dwarf: 1 purple tall. The response earned 1 point in part (c) for describing that the majority of the offspring would be green dwarf plants and purple tall plants.

Sample: 7B

Score: 2

The response earned 1 point in part (a) for constructing a diagram that included two labelled unduplicated chromosomes in each cell. The response earned 1 point in part (b) for predicting that the proportion of each phenotype will be 25 percent green dwarf, 25 percent purple dwarf, 25 percent green tall, and 25 percent purple tall.

Sample: 7C

Score: 1

The response earned 1 point in part (b) for predicting that the proportion of each phenotype will be 25 percent green dwarf, 25 percent green tall, 25 percent purple dwarf, and 25 percent purple tall.