

AP[®] BIOLOGY
2016 SCORING GUIDELINES

Question 3

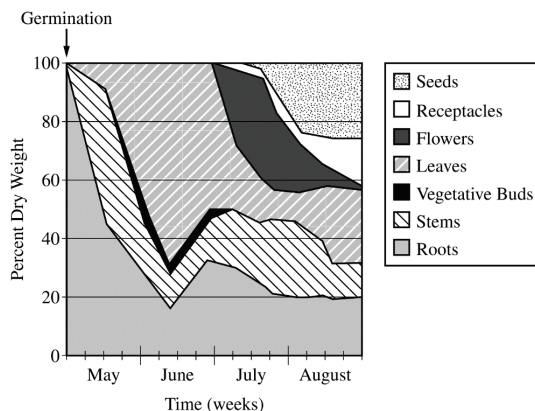


Figure 1. Percent dry weight of different plant structures during the growing season for an annual plant

The graph above illustrates the percent dry weight of different parts of a particular annual plant (plants that live less than one year) from early May to late August. The percent dry weight can be used to estimate the amount of energy a plant uses to produce its leaves, vegetative buds, stems, roots, and reproductive parts (seeds, receptacles, and flowers).

- (a) **Identify** the direct source of the energy used for plant growth during the first week of May, and **identify** the part of the plant that grew the most during the same period. **(2 points)**

Identify direct source of energy (1 point)

- Seed
- Stored organic nutrients/carbohydrates

Identify plant part (1 point)

- Roots

- (b) Based on the data on the graph, **estimate** the percent of the total energy that the plant has allocated to the growth of leaves on the first day of July. **(1 point)**

Identification (1 point)

- Any value between 45-55 percent

- (c) Compared with perennials (plants that live more than two years), annual plants often allocate a much greater percentage of their total energy to growth of their reproductive parts in any given year. **Propose** ONE evolutionary advantage of the energy allocation strategy in annual plants compared with that in perennial plants. **(1 point)**

Proposed advantage (1 point)

- Increased chance of reproduction before the plants die.
- If the plants do not use the strategy, they decrease the likelihood they will ever reproduce.

3A,

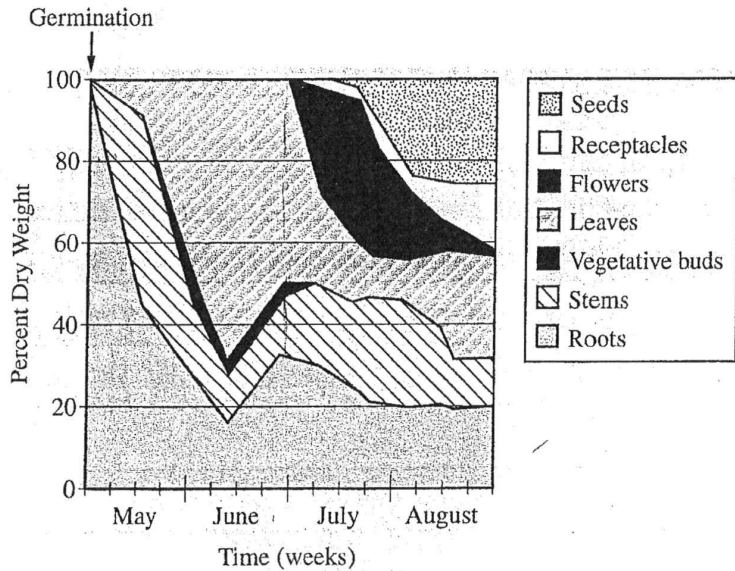


Figure 1. Percent dry weight of different plant structures during the growing season for an annual plant

3. The graph above illustrates the percent dry weight of different parts of a particular annual plant (plants that live less than one year) from early May to late August. The percent dry weight can be used to estimate the amount of energy a plant uses to produce its leaves, vegetative buds, stems, roots, and reproductive parts (seeds, receptacles, and flowers).
- Identify the direct source of the energy used for plant growth during the first week of May, and identify the part of the plant that grew the most during the same period.
 - Based on the data on the graph, estimate the percent of the total energy that the plant has allocated to the growth of leaves on the first day of July.
 - Compared with perennials (plants that live more than two years), annual plants often allocate a much greater percentage of their total energy to growth of their reproductive parts in any given year. Propose ONE evolutionary advantage of the energy allocation strategy in annual plants compared with that in perennial plants.

PAGE FOR ANSWERING QUESTION 3

a) The direct source of energy for the initial growth is food stored in the seed.

The part of the plant that grew the most during that period are the ~~leaves~~ roots

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ADDITIONAL PAGE FOR ANSWERING QUESTION 3

b) Approx. 50% percent of total energy has been ~~used~~ allocated to the growth of leaves

c) Annual plants must make reproductive structures in a year or less otherwise they do not get to reproduce. By dedicating more energy to creating reproductive structures annual plants increase their chances of reproducing before death.

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3B

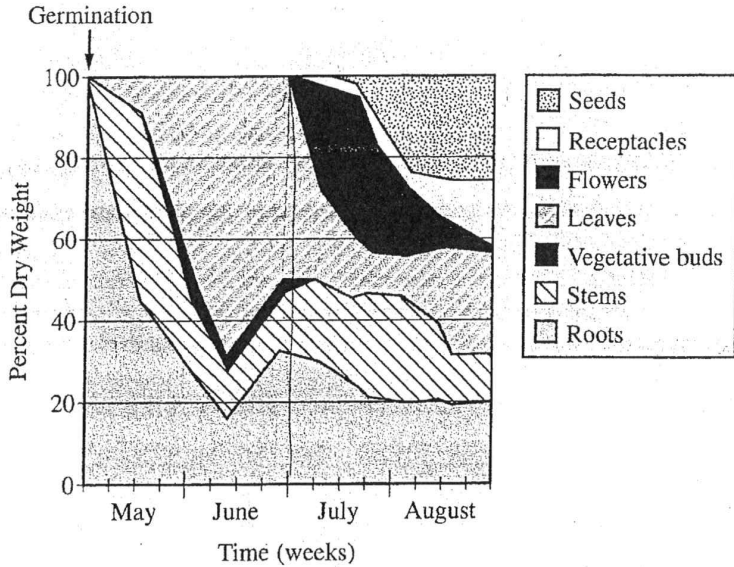


Figure 1. Percent dry weight of different plant structures during the growing season for an annual plant

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- Identify the direct source of the energy used for plant growth during the first week of May, and identify the part of the plant that grew the most during the same period.
 - Based on the data on the graph, estimate the percent of the total energy that the plant has allocated to the growth of leaves on the first day of July.
 - Compared with perennials (plants that live more than two years), annual plants often allocate a much greater percentage of their total energy to growth of their reproductive parts in any given year. Propose ONE evolutionary advantage of the energy allocation strategy in annual plants compared with that in perennial plants.

PAGE FOR ANSWERING QUESTION 3

3a. The plant was most likely using endosperms, which provide a temporary source of energy for seeds which have begun germinating. The roots are the plant structure that grew the most during this period.

3b. 50% energy toward the leaves

3c. An advantage of energy allocation in annual plants includes being able to reproduce a large amount of (genetically variable) ^{germinating} offspring.

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expressing in a short amount of time

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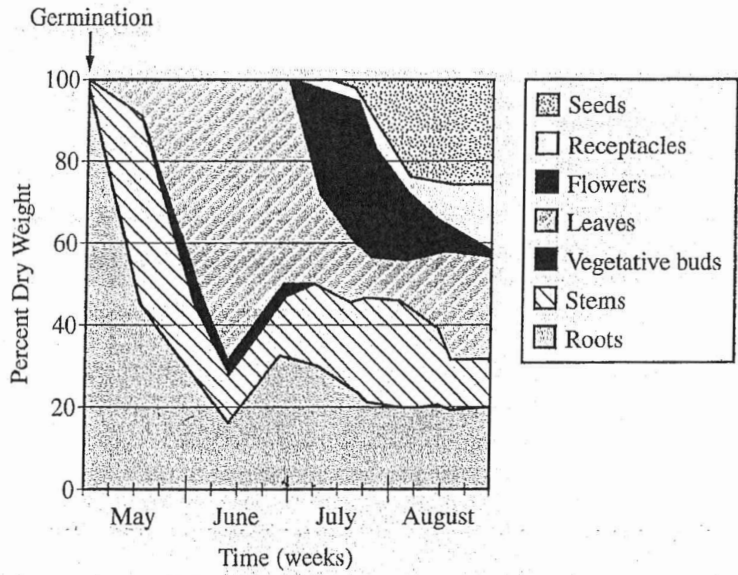


Figure 1. Percent dry weight of different plant structures during the growing season for an annual plant

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 - (a) **Identify** the direct source of the energy used for plant growth during the first week of May, and **identify** the part of the plant that grew the most during the same period.
 - (b) Based on the data on the graph, **estimate** the percent of the total energy that the plant has allocated to the growth of leaves on the first day of July.
 - (c) Compared with perennials (plants that live more than two years), annual plants often allocate a much greater percentage of their total energy to growth of their reproductive parts in any given year. **Propose** ONE evolutionary advantage of the energy allocation strategy in annual plants compared with that in perennial plants.

PAGE FOR ANSWERING QUESTION 3

a) The direct source of energy was sunlight, the root grew the most during that period of time

b) About 50% was allocated to the growth of leaves.

c) If they spend most of their energy on

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ADDITIONAL PAGE FOR ANSWERING QUESTION 3

reproductive parts it is more likely that they will produce more offspring, creating an advantage of passing on their genes. IF they produce more offspring the more ~~likely~~ ~~more~~ offspring will survive and ~~then~~ go on to reproduce as well. ~~Genes~~ Genes will be passed on to each generation.

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AP[®] BIOLOGY

2016 SCORING COMMENTARY

Question 3

Question 3 was written to the following Learning Objectives in the AP[®] Biology Curriculum Framework: 1.10, 2.24, and 2.32.

Overview

This question focused on the energy allocation strategy in plants. Students were given a graph showing the percent dry weight allocated to different plant parts throughout a single growing season. Students were told that the percent dry weight is an indication of the energy used to produce a structure in the plant. Students were asked to identify the direct source of energy used for plant growth during a particular period and to identify the part of the plant that grew most during that same period. Students were then asked to estimate the percent of the total energy that has been allocated to the growth of the leaves on a particular day. Finally, students were asked to propose one evolutionary advantage of an annual plant allocating much more energy to the growth of its reproductive parts compared to perennial plants.

Sample: 3A

Score: 4

The response earned 1 point in part (a) for identifying that food stored in the seed is the direct source of energy. The response earned 1 point in part (a) for identifying that the roots grew the most. The response earned 1 point in part (b) for estimating that approximately 50 percent of the total energy was allocated to the leaves on the first day of July. The response earned 1 point in part (c) for proposing that annual plants must reproduce in a year or less, which increases their chance of reproducing before they die.

Sample: 3B

Score: 3

The response earned 1 point in part (a) for identifying that the endosperm is the direct source of energy. The response earned 1 point in part (a) for identifying that the roots grew the most. The response earned 1 point in part (b) for estimating that 50 percent of the total energy was allocated to the leaves on the first day of July.

Sample: 3C

Score: 2

The response earned 1 point in part (a) for identifying that the roots grew the most. The response earned 1 point in part (b) for estimating that about 50 percent of the total energy was allocated to the leaves on the first day of July.