Mr. Topp-Hood Predicted FRQ Scoring Guidelines

AP® Biology
2016 Free-Response Questions

* Add up how many points you got on all questions
* Divide by 41 (20 pts for 1+2, 12 pts for 3-5, 9 pts for 6-8)
* If you're in the 40-60% range you've got a pretty solid chance of having passed!

CollegeBoard

↑ solutes in cytosol

2016 AP® BIOLOGY FREE-RESPONSE QUESTIONS

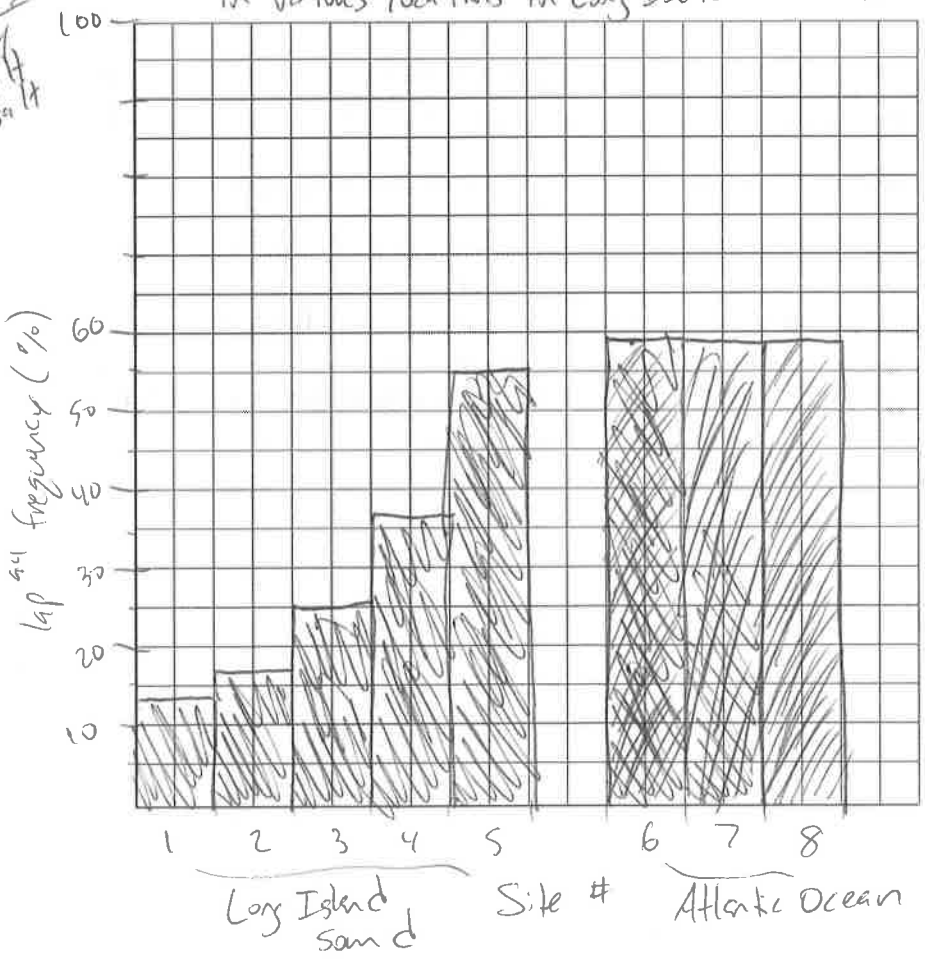
1. Leucine aminopeptidases (LAPs) are found in all living organisms and have been associated with the response of the marine mussel, *Mytilus edulis*, to changes in salinity. LAPs are enzymes that remove N-terminal amino acids from proteins and release the free amino acids into the cytosol. To investigate the evolution of LAPs in wild populations of *M. edulis*, researchers sampled adult mussels from several different locations along a part of the northeast coast of the United States, as shown in Figure 1. The researchers then determined the percent of individuals possessing a particular *lap* allele, lap^{94}, in mussels from each sample site (table 1).

   (a) On the axes provided, **construct** an appropriately labeled bar graph to illustrate the observed frequencies of the lap^{94} allele in the study populations.

   (b) Based on the data, **describe** the most likely effect of salinity on the frequency of the lap^{94} allele in the marine mussel populations in Long Island Sound. **Predict** the likely lap^{94} allele frequency at a sampling site between site 1 and site 2 in Long Island Sound.

   (c) **Describe** the most likely effect of LAP^{94} activity on the osmolarity of the cytosol. **Describe** the function of LAP^{94} in maintaining water balance in the mussels living in the Atlantic Ocean.

   (d) Marine mussel larvae are evenly dispersed throughout the study area by water movement. As larvae mature, they attach to the rocks in the water. **Explain** the differences in lap^{94} allele frequency among adult mussel populations at the sample sites despite the dispersal of larvae throughout the entire study area. **Predict** the likely effect on distribution of mussels in Long Island Sound if the lap^{94} allele was found in all of the mussels in the population. **Justify** your prediction.



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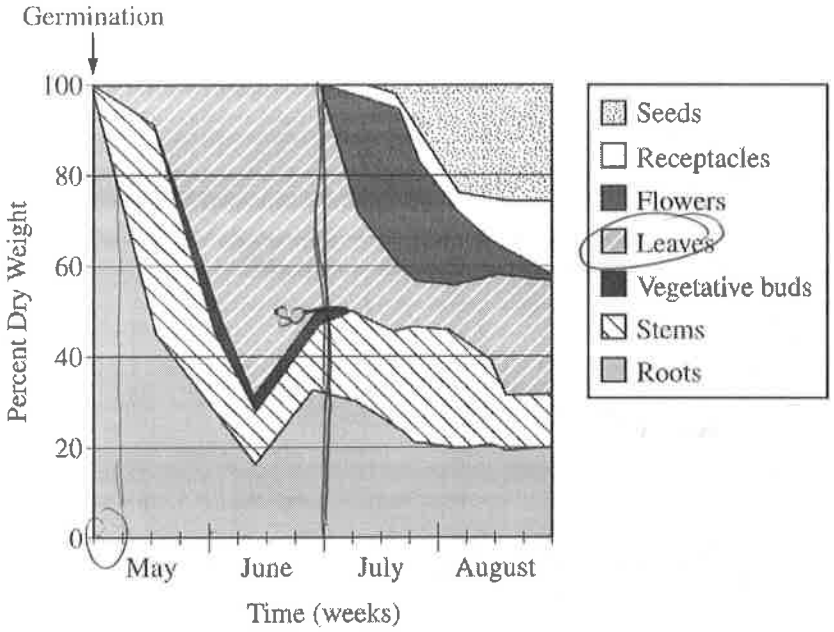


Figure 1. Percent dry weight of different plant structures during the growing season for an annual plant

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).

2 (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. stored starch in seeds; roots

1 (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. 50%

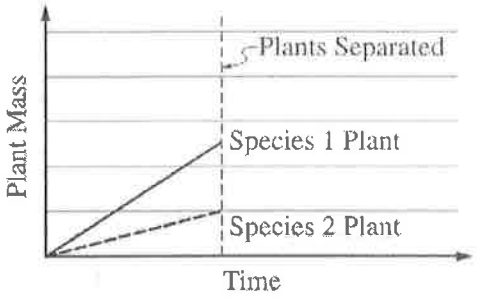
(c) Compared with perennials (plants that live more than two years), annual plants often allocate a much greater percentage of their total energy to growth of their reproductive parts in any given year. **Propose** ONE evolutionary advantage of the energy allocation strategy in annual plants compared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

1 yr only

need to prioritize reproduction because only survive 1 yr and need to successfully reproduce in 1 yr as well in order to pass on genes (evolutionarily fit)

survive → reproduce

towards r selected (↑ rep ↑ fast)



5. The graph above shows the mass of plants from two different species over time. The plants grew while attached to each other. The plants were separated at the time indicated by the vertical line in the graph.

   Using template 1, **graph** the predicted shape of the plant-mass lines after separation of the two plants if the plants were in an obligate mutualistic relationship. On template 2, **graph** the predicted shape of the plant-mass lines if the species 2 plant was a parasite of the species 1 plant. **Justify** each of your predictions.

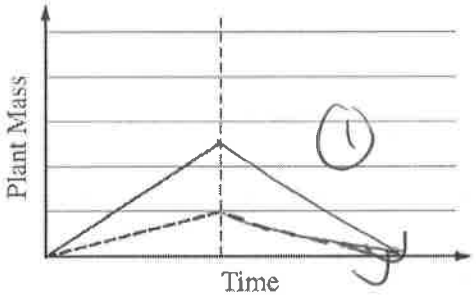
/4

have to be together to survive ↗ work together ++

feed off host w/o benefit +/−

TEMPLATE 1: OBLIGATE MUTUALISM

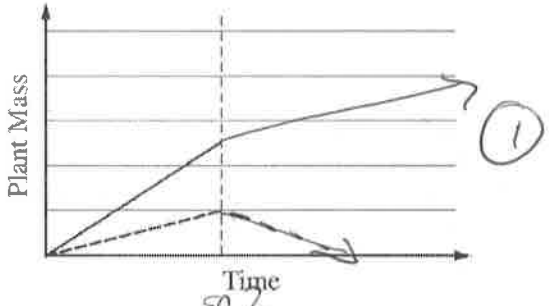
need both



Both have to be together to survive (obligate mutualism), so if they're separated, both will slowly die.

1

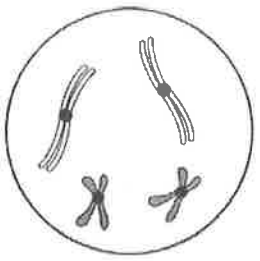
TEMPLATE 2: PARASITISM



Sp 2

Once the parasite (organism that feeds off a host by stealing and not providing any benefit in return) is removed, the species I will not be losing energy/nutrients to Sp 2 parasite and is free to grow more. Without host, sp. 2 parasite will die slowly.

1



Chromosome 1

Chromosome 2

G = green
g = purple
D = dwarf
d = tall

haploid = 2

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.

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

(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.