

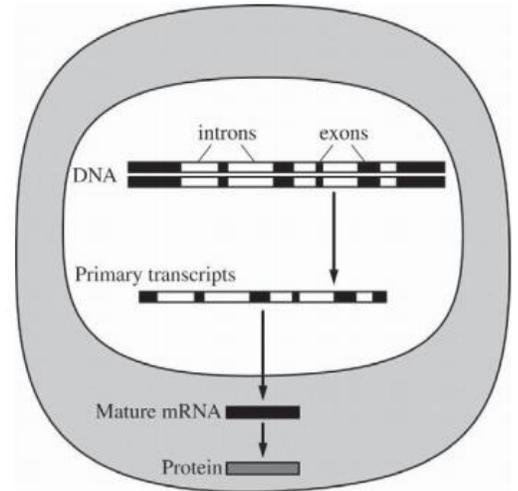
Directions:

1. Choose ONE long essay question to answer. You may not choose parts from several different questions. You will only be scored on ONE of the long essay questions.
2. Choose TWO short essay questions to answer. You may not choose parts from several different questions. You will only be scored on TWO of the short essay questions.
3. If you have time, you may answer a FOURTH question for extra credit. The extra credit question may be either a long or short essay question.

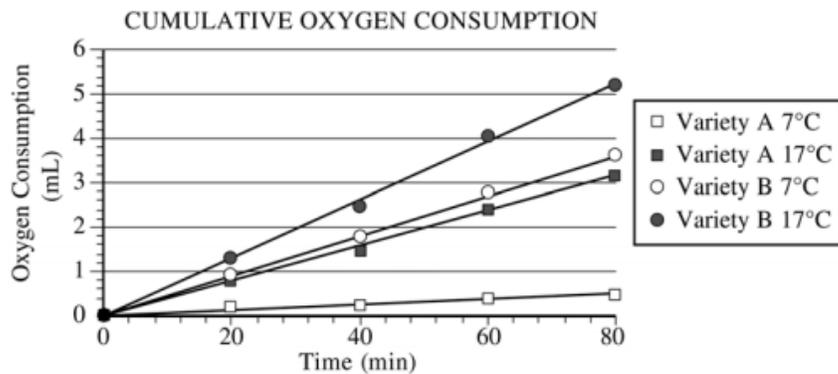
Remember, answers must be in essay form; outline form is NOT acceptable. Labeled diagrams may supplement discussion, but a diagram alone will not suffice. It is important that you read each question completely before writing and answer each part completely!

**Long Essay Questions**

1. The figure represents the process of expression in gene X in a eukaryotic cell.
  - a. The primary transcript in the figure is 15 kilobases (kb) long, but the mature mRNA is 7 kb long. Describe the modification that most likely resulted in the 8 kb difference in length of the mature mRNA molecule. Identify in your response the location in the cell where the change occurs.
  - b. Once in the cytoplasm, how is the mRNA translated to a protein?
  - c. If the cell is a secretory cell, how is the protein eventually targeted, packaged, and secreted to the exterior of the cell?



2. An agricultural biologist was evaluating two newly developed varieties of wheat as potential crops. In an experiment seedlings were germinated on moist paper towels at 20°C or 48 hours. Oxygen consumptions of the two-day-old seedlings was measured at different temperatures. The data are shown in the graph.
  - a. Calculate the rates of oxygen consumption in mL/min for each variety of wheat at 7°C and at 17°C. Show your work, including your setup and calculation.
  - b. Explain the relationship between metabolism and oxygen consumption. Discuss the effect of temperature on metabolism for each variety of seedlings.
  - c. In a second experiment, variety A seedlings at both temperatures were treated with a chemical that prevents NADH from being oxidized to NAD<sup>+</sup>. Predict the most likely effect of the chemical on metabolism and oxygen consumption of the treated seedlings. Explain your predication.



3. 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 amino acids from proteins and release them into the cytosol. To investigate the evolution of LAPs in wild populations of *M. edulis*, researchers sampled adult mussels from several different locations along the northeast coast of the US, (Figure 1). The researchers then determined the percent of individuals possessing a particular *lap* allele, *lap94*, in mussels from each sample site (Table 1).
- Construct a bar graph of the observed frequencies of the *lap94* allele in the populations.
  - Describe the most likely effect of salinity on the frequency of the *lap94* allele in the marine mussel populations in Long Island Sound. Predict the likely *lap94* allele frequency at a sampling site between site 1 and site 2 in Long Island Sound.
  - Describe the most likely effect of *lap94* activity on the osmolarity of the cytosol. Describe the function of *lap94* in maintaining water balance in the mussels living in the Atlantic Ocean.
  - 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 *lap94* 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 *lap94* allele was found in all of the mussels in the population. Justify your prediction.

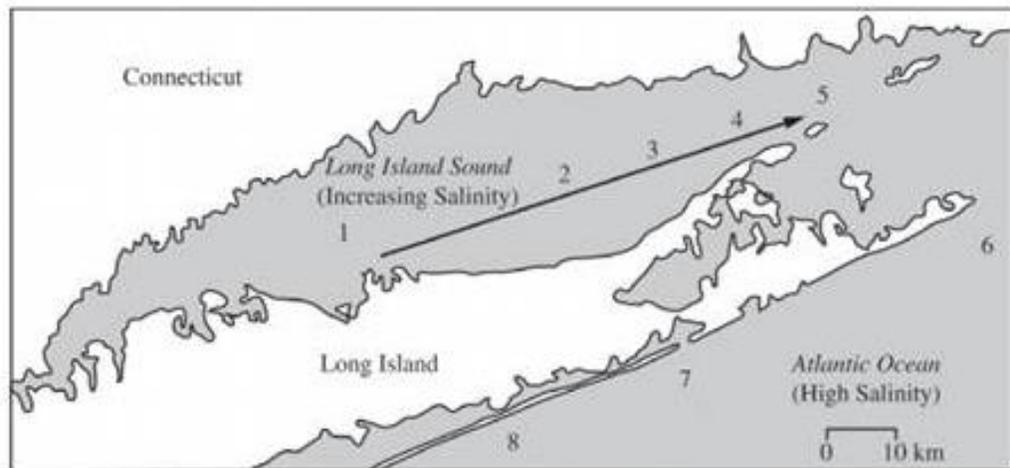


Figure 1. Sampling sites of marine mussels at various locations (1–8) in Long Island Sound and the Atlantic Ocean

TABLE 1. PERCENT OF INDIVIDUALS POSSESSING *lap94* ALLELE

	Long Island Sound					Atlantic Ocean		
Site	1	2	3	4	5	6	7	8
<i>lap94</i> frequency (%)	13	16	25	37	55	59	59	59
Salinity	Low	→			High	High		

### Short Essay Questions

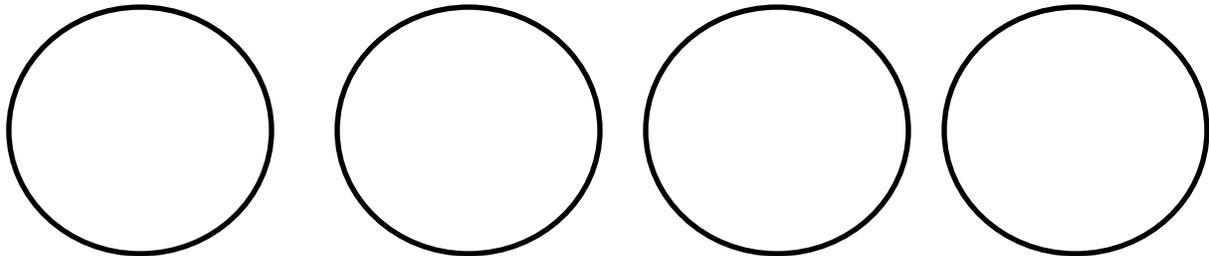
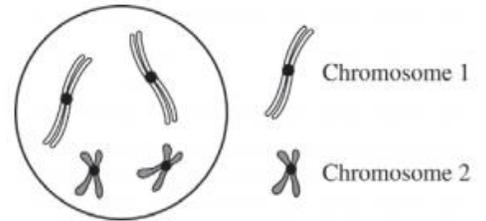
4. As part of a new suburban development, a sports complex consisting of athletic fields and buildings is constructed in a formerly wooded area.
- Predict one ecological consequence on the local plant community that is likely to result during the site preparation and construction of the sports complex. Justify your prediction.
  - To maintain the playing fields, large quantities of water and chemicals are applied regularly to the grass-covered areas. Predict one effect on the local animal community that might result from regular use and maintenance of the playing fields. Justify your prediction.

5. The following data were collected by observing subcellular structures of two different types of eukaryotic cells. Based on an analysis of the data, identify a likely primary function of each cell type and explain how the data support the identification.

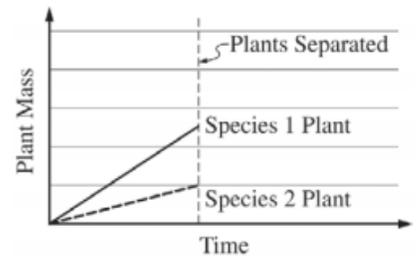
Relative Amounts of Organelles in Two Cell Types					
Cell Type	Smooth ER	Rough ER	Mitochondria	Cilia	Golgi Bodies
A	Small Amount	Small Amount	Large Amount	Present	Small Amount
B	Large Amount	Large Amount	Moderate Number	Absent	Large Amount

6. 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 F1 progeny.

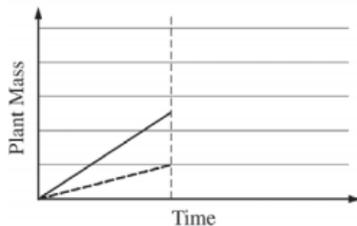
- Construct a diagram below to depict the four possible normal products of meiosis that would be produced by the F1 progeny. Show the chromosomes and the allele(s) they carry. Assume the genes are located on different chromosomes and the gene for flower color is on chromosome 1.
- Predict the possible phenotypes and their ratios in the offspring of a testcross between an F1 individual and a ggdd individual.
- 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 F1 individual and a ggdd individual.



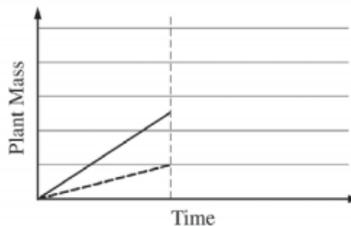
7. The graph shows the mass of plants from two different species over time. The plants grew while attached to each other. The plants were separated at the time indicated by the vertical line in the graph. Using template 1, graph the predicted shape of the plant-mass lines after separation of the two 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.



TEMPLATE 1: OBLIGATE MUTUALISM



TEMPLATE 2: PARASITISM



AP BIOLOGY: Fall Semester Essay Final

8. In an investigation of fruit-fly behavior, a covered choice chamber is used to test whether the spatial distribution of flies is affected by the presence of a substance placed at one end of the chamber. To test the flies' preference for glucose, 60 flies are introduced into the middle of the choice chamber at the insertion point indicated by the arrow in the figure above. A cotton ball soaked with a 10% glucose solution is placed at one end of the chamber, and a dry cotton ball with no solution is placed at the other end. The positions of flies are observed and recorded every minute for 10 minutes.
- Predict the distribution of flies in the chamber after 10 minutes and justify your prediction.
  - Propose ONE specific improvement to each of the following parts of the experimental design and explain how the modification will affect the experiment.
    - Experimental control
    - Environmental factors

