AP Bio FRQ Fridays

2016 #1
Graphing, Genetics, & Tonicity

NOTES

FRQ Friday #4

2016 #1

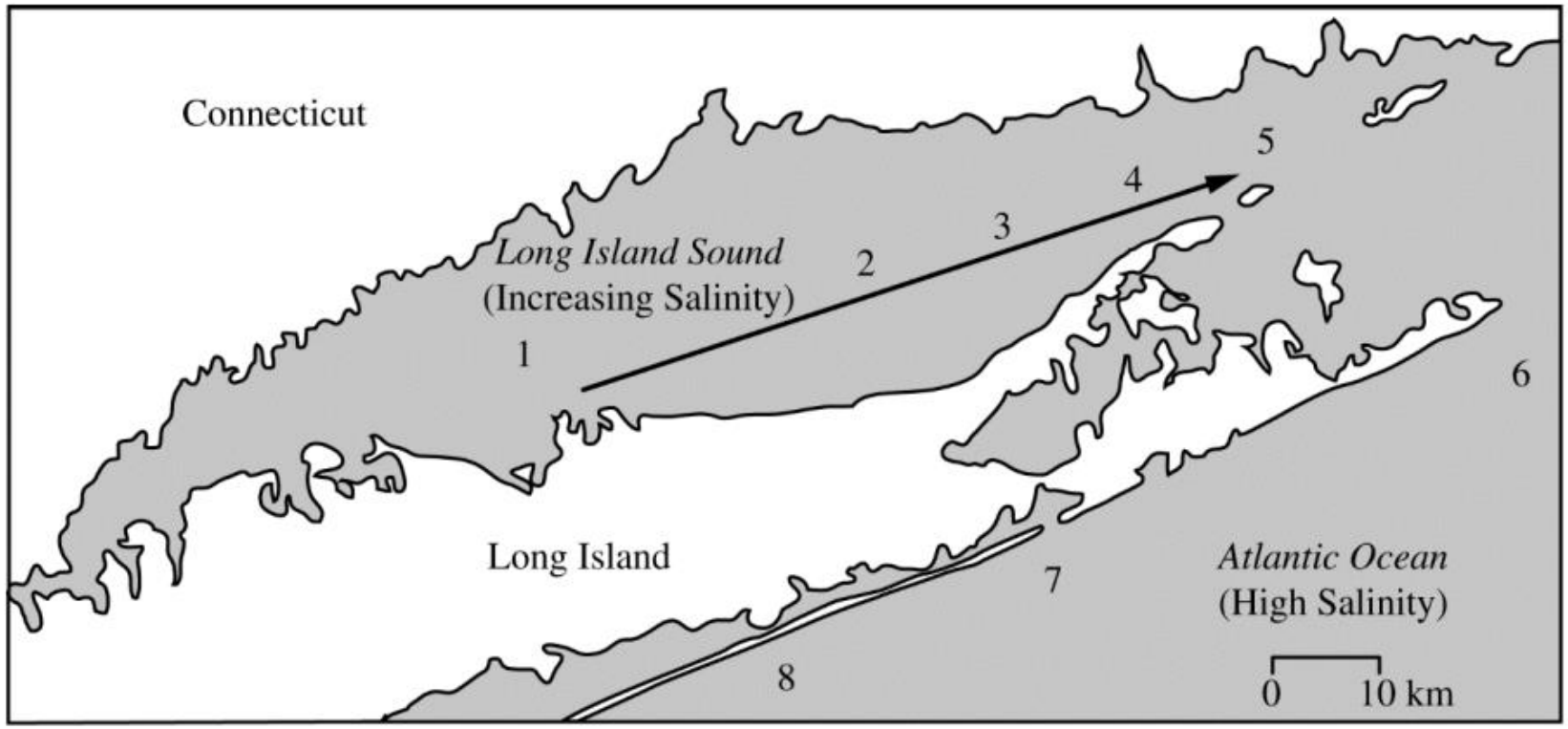

TABLE 1. PERCENT OF INDIVIDUALS POSSESSING *lap*^{94} ALLELE

	Long Island Sound					Atlantic Ocean		
Site	1	2	3	4	5	6	7	8
lap^{94} frequency (%)	13	16	25	37	55	59	59	59
Salinity	Low →				High	High		

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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).

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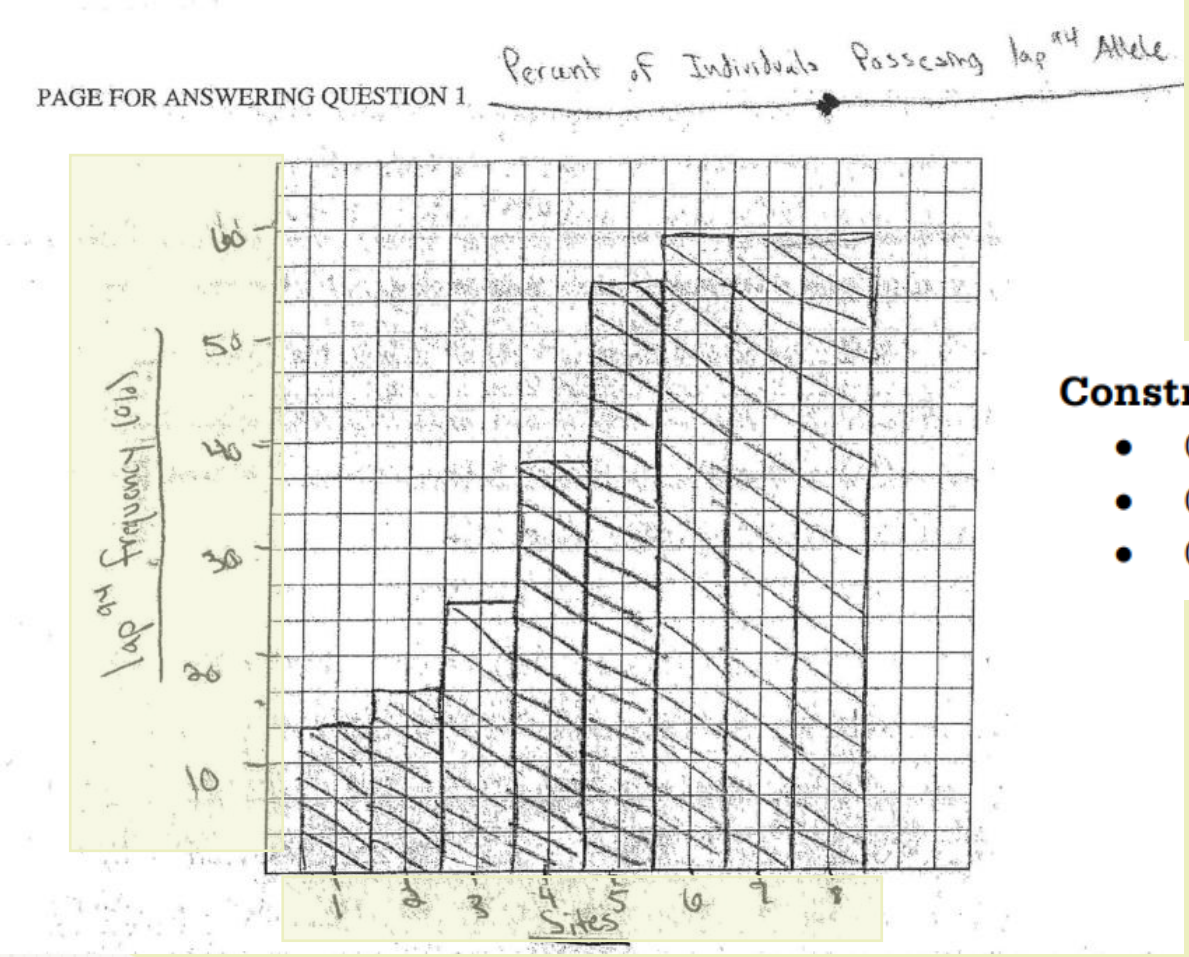
(a) On the axes provided, **construct** an appropriately labeled bar graph to illustrate the observed frequencies of the *lap*^{94} allele in the study populations.



Construct graph (3 points)

- Correctly plotted bar graph that accurately represents the trend
- Correct axis labeling
- Correct scale and units

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(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.

Description (1 point)	**Prediction (1 point)**
• As salinity increases *lap*^{94} frequency increases • As salinity decreases *lap*^{94} frequency decreases	Between 13 and 16 percent (or a selected value between 13 and 16 percent)

(b) The most likely effect on the frequency of the lap^{94} allele is that an increase in salinity is associated with an increase in the frequency of the lap^{94} allele. There is a direct relationship. The lap^{94} allele frequency between site 1 and site 2 is 15%.

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(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.

Describe effect of LAP^{94} activity (1 point)	**Describe function of LAP^{94} in maintaining water balance (1 point)**
• LAP^{94} increases osmolarity/solute concentration of the cytosol • LAP^{94} decreases water potential of the cytosol	Prevents water loss to the environment

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Describe effect of LAP^{94} activity (1 point)	Describe function of LAP^{94} in maintaining water balance (1 point)
• LAP^{94} increases osmolarity/solute concentration of the cytosol • LAP^{94} decreases water potential of the cytosol	Prevents water loss to the environment

(c) LAP^{94} activity releases amino acids in the cytosol which lowers the Water Potential (Ψ) inside of the cell. This leads to a flow of water into the cell. The reason why LAP^{94} activity increases as salinity increases is because the hypertonic environment surrounding the cell would cause the water inside the cell to leave, eventually the cell would plasmolysize and die. LAP^{94} attempts to counterbalance the effect of an increase in salinity. Attempting to create an isotonic solution.

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(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.

Explanation (1 point)	Prediction (1 point)	Justification (1 point)
• Mussels with *lap*^{94} allele are more likely to survive in high salinity/less likely to survive in low salinity. • Mussels without *lap*^{94} allele are less likely to survive in high salinity/more likely to survive in low salinity.	• Mussel population will increase in high salinity. • Mussel population will decline in low salinity.	• Mussels in high salinity with *lap*^{94} allele will osmoregulate. • Mussels in low salinity with *lap*^{94} allele will not osmoregulate.

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(a) The differences in lap^{94} allele frequency are due to the differences of salinity at the sites where adult mussels attach themselves to rocks. A higher population of individuals with the lap^{94} allele will survive ~~in~~ in areas of high salinity. That is why the frequency of the allele is different across the data presented. There would be a greater number of mussels in areas of high salinity if all the mussels had the lap^{94} allele. This is because if mussels with the allele were in areas of low salinity, then water would flow into the cell causing it to burst.