AP Bio FRQ Fridays

2014 #1
Experimental Design & Data Analysis

FRQ Friday #27

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Trichomes are hairlike outgrowths of the epidermis of plants that are thought to provide protection against being eaten by herbivores (herbivory). In a certain plant species, stem trichome density is genetically determined.

To investigate variation in stem trichome density within the plant species, a student counted the number of trichomes on the stems of six plants in each of three different populations. The student used the data to calculate the mean trichome density (numbers of hairs per square centimeter) for each population. The results are provided in the table below.

TRICHOME DENSITY IN THREE PLANT POPULATIONS (number of trichomes/cm^2)

Population	Plant 1	Plant 2	Plant 3	Plant 4	Plant 5	Plant 6	Mean	Standard Error of the Mean (SEM)
I	8	11	9	10	8	6	9	1
II	12	6	15	9	13	8	11	1
III	13	17	9	14	12	16	14	1

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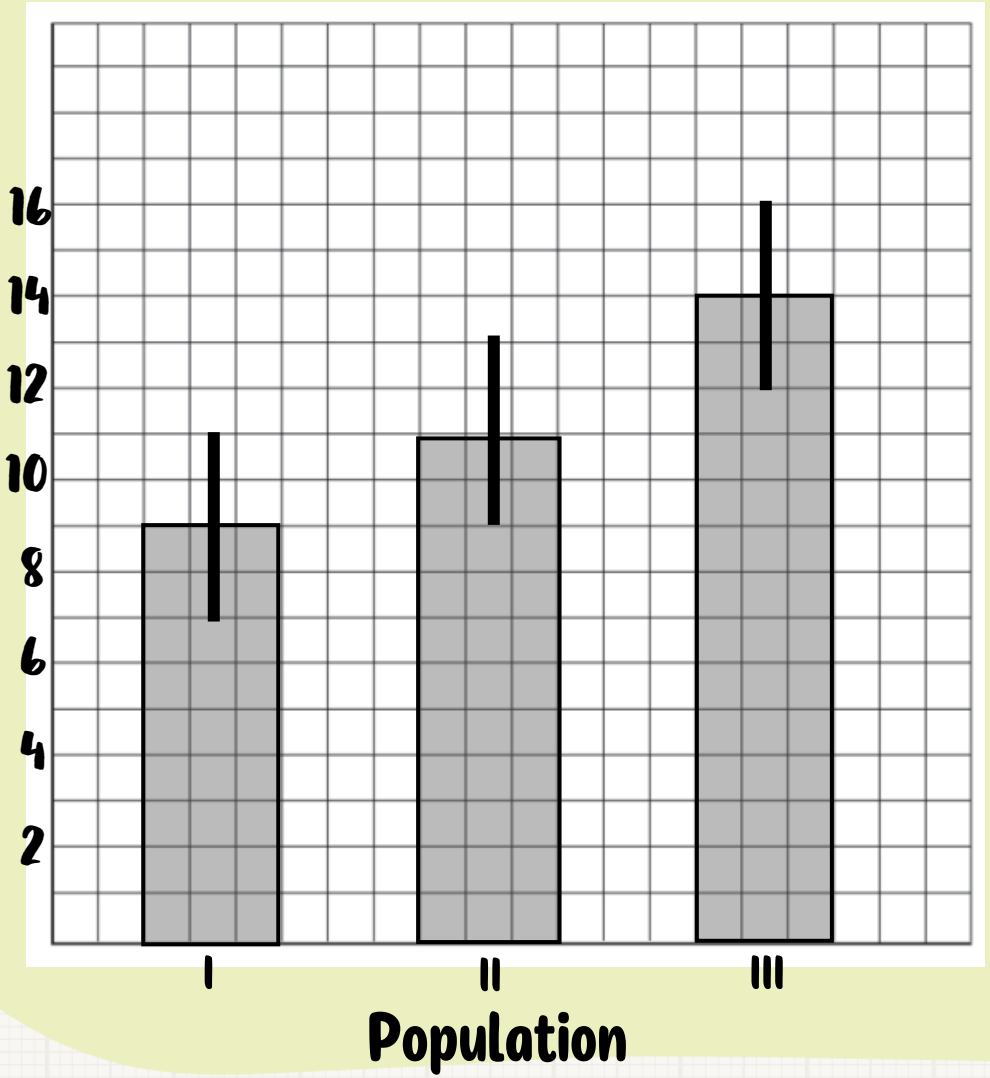
(a) On the axes provided, **create** an appropriately labeled graph to illustrate the sample means of the three populations to within 95% confidence (i.e., sample mean ± 2 SEM).



Population	Mean	Standard Error of the Mean (SEM)
I	9	1
II	11	1
III	14	1

- Correctly labeled, scaled, with proper units
- Bar graph or modified bar graph with appropriately plotted means
- 2x standard error (SEM) above and below means

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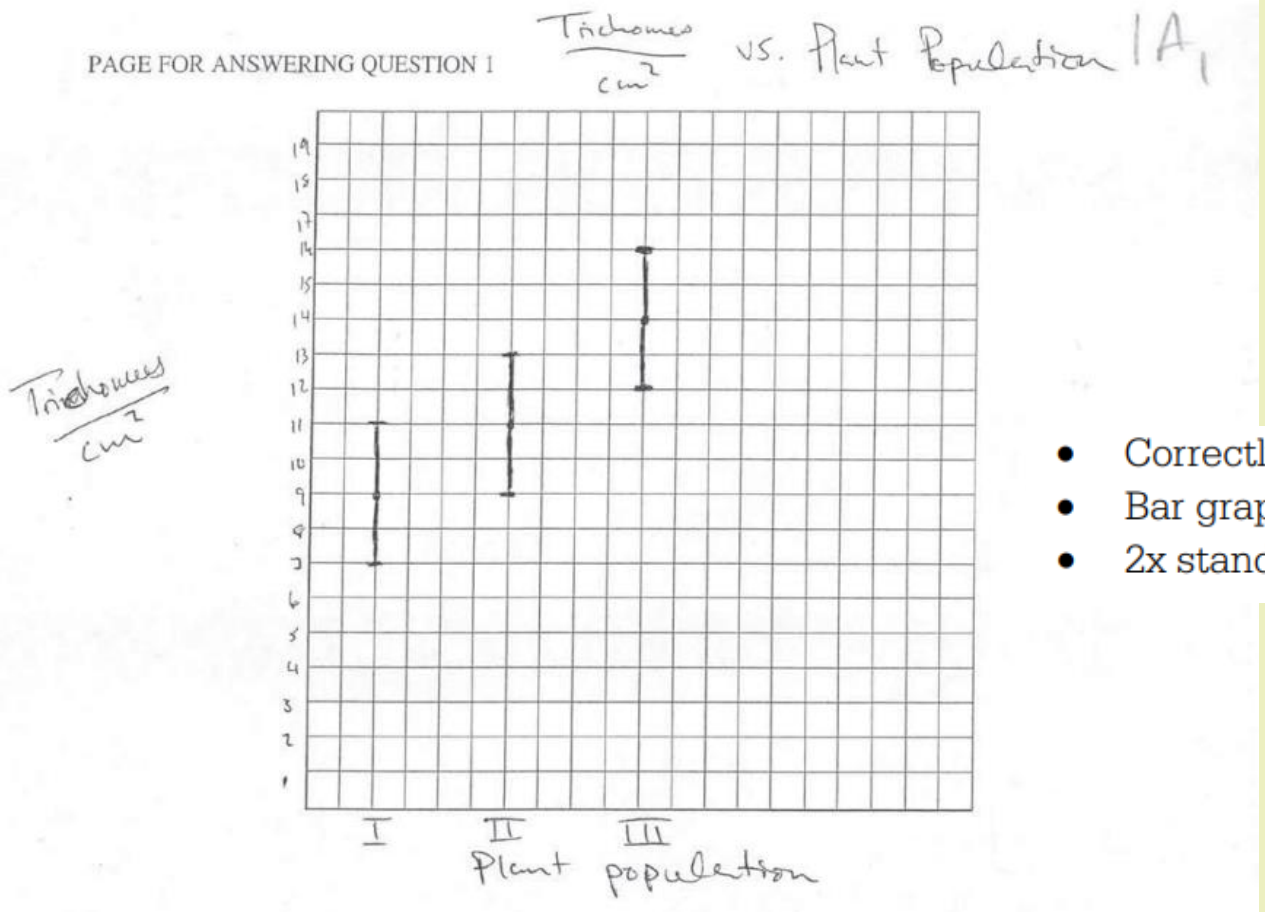
PAGE FOR ANSWERING QUESTION 1



Population	Mean	Standard Error of the Mean (SEM)
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- Correctly labeled, scaled, with proper units
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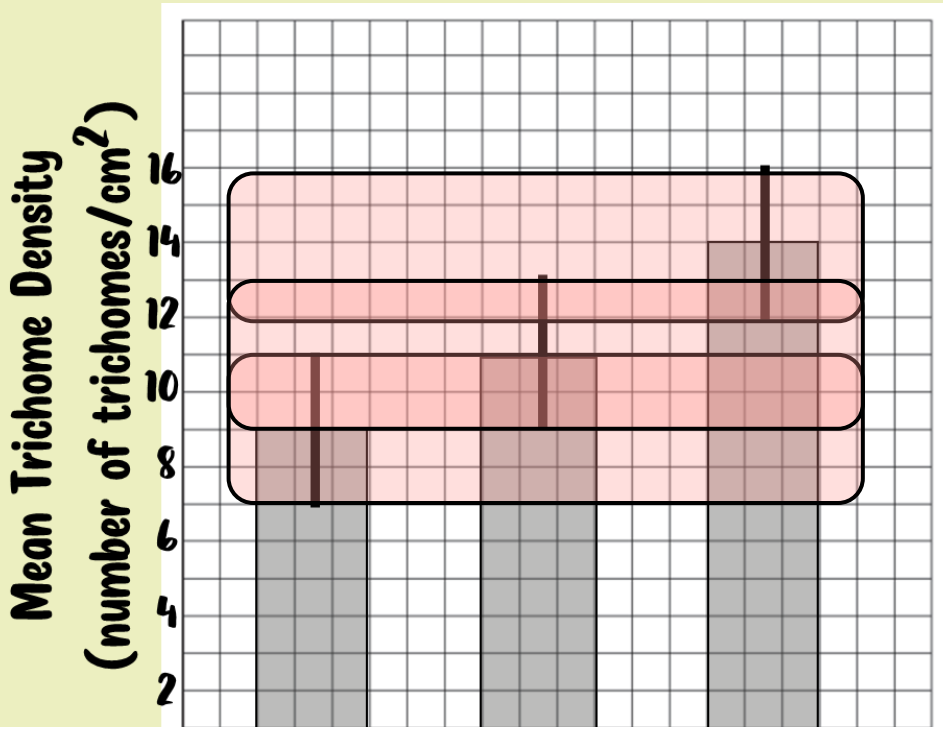
(b) Based on the sample means and standard errors of the means, **identify** the two populations that are most likely to have statistically significant differences in the mean stem trichome densities. **Justify** your response.



Identification (**1 point**)

- Populations I and III

Justification (**1 point**)

- The error bars/95 percent confidence intervals for populations I and III do not overlap
- (Sample mean + 2 SEM of population I) < (Sample mean – 2 SEM of population III)

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(b) Based on the sample means and standard errors of the means, **identify** the two populations that are most likely to have statistically significant differences in the mean stem trichome densities. **Justify** your response.

Identification (**1 point**)

- Populations I and III

Justification (**1 point**)

- The error bars/95 percent confidence intervals for populations I and III do not overlap
- (Sample mean + 2 SEM of population I) < (Sample mean – 2 SEM of population III)

b) Plant population I is most likely to have significantly differences in mean stem trichomes density to population III because the means as well as the standard error of the mean do not overlap numerically. There is a difference of 1 between the highest limit of pop I (at 11) and the lowest of pop III (at 12). This means that data within those data sets can not equal each other ~~data~~ data in the other set and remain acceptable as data in those sets.

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(c) **Describe** the independent and dependent variables and a control treatment for an experiment to test the hypothesis that higher trichome density in plants is selected for in the presence of herbivores. **Identify** an appropriate duration of the experiment to ensure that natural selection is measured, and **predict** the experimental results that would support the hypothesis.

Trichomes are hairlike outgrowths of the epidermis of plants that are thought to provide protection against being eaten by herbivores (herbivory). In a certain plant species, stem trichome density is genetically determined.

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NOTE: Points are earned in a single row only.

Independent Variable **(1 point)**	Dependent Variable **(1 point)**	Control **(1 point)**	Duration **(1 point)**	Prediction **(1 point)**
Presence of herbivores	Trichome density	Absence of herbivores	More than one generation	Increased trichome density relative to control
Trichome density in the presence of herbivores	Reproductive success OR # of plants	Plants with lower trichome density	More than one generation	Size of the population with higher trichome density will be larger than control population

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c) In an ~~experiment~~ experiment to test for whether 'high trichomes density is selected for with the presence of herbivores, the independent variable would be exposure to herbivors, the dependent variable would be the number trichomes / cm^2, and a control would be a population of plants that is not exposed to herbivors. An appropriate duration would be over several generations, let us say ~~10~~ 7 so that the offspring of the generations begin to show the phenotype that is being selected for in a measurable percentage that can be compared to the change of the control.

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This change will occur if natural selection changes the frequency of phenotypes.

I predict that the mean and SEM will be higher (higher Trichomes/cm^2) in the plant population that is exposed to herbivory than in the population without exposure to herbivory.