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GOVERNOR'S SCHOOL
for Government and International Studies

Summer Assignment 2023-2024	
Course: AP Biology	
Assignment title	*Emergent Properties of Life and Biostatistics*
Date due – first day of class, August 22, 2023	Part 1 – Fill-in Notes for three (3) Google slide presentations Part 2 – HHMI Spreadsheet Tutorials #1-3 Part 3 – Practice Free Response Questions (FRQs)
Estimated time for completion	4 – 5 hours
Resources needed to complete assignment	• Textbook - *OpenStax Biology for AP Courses* • Links for Part 1, Part 2, and Part 3 of the summer assignment • Computer/laptop • Calculator
How the assignment will be assessed	The **Fill-in Notes** will be checked for completion. The **HHMI Spreadsheet Tutorials** and **Practice Free Response Questions** will be scored for correctness. The scores for all three assignments will be averaged together and will be counted as a **project grade** for the 1st quarter.
Purpose of assignment	• Review of foundational material, concepts, and skills. • Introduce students to required material/concepts/skills that will be covered in greater detail during the academic year.

Welcome to AP Biology! This course is designed to be the equivalent of a two-semester introductory biology course usually taken in the first year of college. In other words, it is a little like drinking from a fire hose. It will be a rewarding experience, but as with most things that are, it will also be challenging. Throughout the course, you will become familiar with major recurring ideas that persist throughout all topics and material.

The 4 Big Ideas of AP Biology
Big Idea 1: The process of evolution drives the diversity and unity of life. **Big Idea 2:** Biological systems utilize free energy and molecular building blocks to grow, to reproduce and to maintain dynamic homeostasis. **Big Idea 3:** Living systems store, retrieve, transmit and respond to information essential to life processes. **Big Idea 4:** Biological systems interact, and these systems and their interactions possess complex properties.

On the pages that follow, you will find instructions for the three assignments that comprise your summer work for AP Biology. The assignments will review experimental design with more detail than your previous science classes and the assignments will also introduce you to descriptive statistics and have you practice the skills necessary to begin statistically analyzing data.

- Part 1 of your summer assignment involves closely reading through three sets of lecture notes in Google slide presentations and filling the corresponding note sheets. Print your filled in notes and I will check them the first day of class when we begin the school year in August 2023.
- Part 2 of your summer assignment consists of completing the HHMI Spreadsheet Tutorials #1 – 3 using the links provided. You will be submitting the completed Google sheets tutorials to a portal in Schoology.
- Part 3 of your summer assignment requires you to use/apply the information from the notes and spreadsheet tutorials to answer six (6) Free Response style questions. Answer the questions ON YOUR OWN PAPER and be prepared to turn them in on the first day of class.

A hardcopy (printed) of your Part 1-Fill-in notes the three lectures, and for Part 3-Free Response Questions will be due on August 22, 2023. The completed HHMI Spreadsheet Tutorials #1-3 will be due (submitted through Schoology) August 22, 2023. Scores for all three parts of this summer assignment will be averaged together and counted as a project grade for 1st quarter. No late summer assignments will be accepted!

Summer Assignment Part #1 – Fill-in Notes from Presentations
due August 22, 2023

Use the links provided below to access both the gSlides presentations and the Fill-in Notes gDocs.

Read the notes closely and carefully – to watch the imbedded videos you will need to put the gSlides document in presentation mode. Print the associated set of fill-in notes for each presentation and complete the missing information using the notes presentations.

Fill-in notes will NOT be accepted late and MUST be printed/hardcopy to receive credit.

Presentation Hyperlinks	Fill-in Notes Hyperlinks
Experimental design and Scientific Variables	Experimental design and Scientific Variables
Data Analysis and Graphing	Data Analysis and Graphing
Biostatistics: Means, Standard Deviation and Standard Error of the Mean (SEM)	Biostatistics: Means, Standard Deviation and Standard Error of the Mean (SEM)

Summer Assignment Part #2 – HHMI Spreadsheet Tutorials
due August 22, 2023

Use the links provided below to access the three tutorials that will walk you through how to use the functions present in the sheets to analyze data. If you prefer to work in Microsoft Excel, download the Google Sheets to Microsoft Excel and complete the tutorials in that format – either format can be submitted successfully through the Schoology portal for this assignment.

Read the directions for each tutorial closely and carefully using the tabs along the bottom of the window to access each page/sheet of the tutorial – do not skip any pages/sheets, the result will be incorrect answers to the tutorial exercise and loss of points on the assignment. Submit this part of the summer assignment through Schoology by the assigned date and time.

Tutorials will NOT be accepted late and MUST be submitted through Schoology by the assigned date and time to receive credit.

Tutorial Hyperlinks
HHMI Spreadsheet Tutorial #1-Primer-Function-Average-Median
HHMI Spreadsheet Tutorial #2-Variance-Standard-Deviation
HHMI Spreadsheet Tutorial #3-Standard-Error-Confidence-Interval

AP Biology Summer Assignment
Part #3 – Practice Free Response Questions (FRQs)
due August 22, 2023

- Answer each question ON YOUR OWN PAPER.
- Answer each subsection of a question separately and label each subsection of a question.
- Each answer should be in an organized, well-balanced, and comprehensive prose form; outline form is not acceptable.
- **Do not** spend time restating the questions or providing more than the number of examples called for. For instance, if a question calls for two examples, you can earn credit only for the first two examples you provide.
- Diagrams may be used to supplement discussion, but diagrams alone will not suffice, unless required by the question.

Answers to the FRQs will NOT be accepted late and MUST be printed/hardcopy to receive credit.

FRQ #1. Practicing Science

Background

Scientific inquiry is often called upon to address problems that arise in society and industry. In 1916, British horticulturalists were concerned with a disease that killed daffodils. Daffodils grow from bulbs, which are large underground stems that store energy and are seen in many plants, such as daffodils, tulips, and onions. However, the disease caused leaves to wither, bulbs to become discolored, and eventually death to the plant. The demise of the plants represented a substantial loss of commercial production and income to the horticultural industry. While some suspected a fungus caused the plant deaths, no one was able to determine the source of the problem.

The British Royal Horticultural Society took up the cause and assigned the problem to James Kirkham Ramsbottom. As the time he was a top student at the Royal Horticultural Society's garden in Wisely, a community near London.

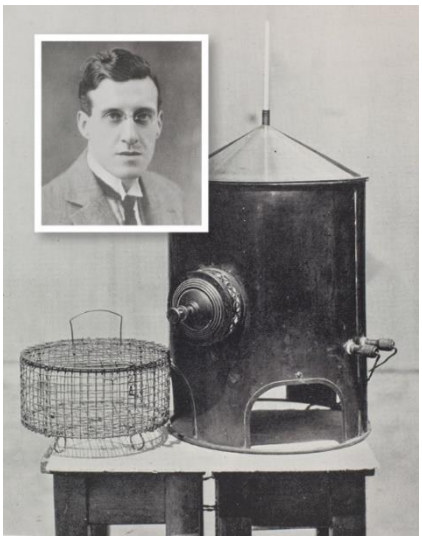
Observation and Hypothesis

Ramsbottom began by making observations. He examined hundreds of diseased bulbs, preparing microscopic slides and studying them closely. While he did see fungi, Ramsbottom observed that all of the diseased bulbs contained a parasitic worm, *Tylenchus devastrtix*. Ramsbottom hypothesized that the worm was the cause of the disease afflicting the plants and predicted that if he could devise a way to kill the worm without killing the bulbs, this disease would be eliminated.

Experimentation

Ramsbottom launched a series of experiments where he examined a number of agents that might selectively kill the worm while keeping the daffodil plant alive. He tried chemical treatments, spraying the plants and dousing them. He experimented with both gas and formaldehyde. He settled on the use of heat. Ramsbottom immersed the bulbs for different amounts of time in hot water. The photograph shows the removable wire basket and copper boiler that permitted Ramsbottom to heat the daffodil bulbs for different periods of time. He determined that soaking the bulbs in 110OF (43OC) water 2-4 hours left the bulbs intact while the parasite was eliminated. Untreated, infected daffodil bulbs failed to grow, died, and did not produce flowers. The heat-treated daffodil bulbs grew normally and produced the sought-after plant and flower. Today, the Ramsbottom heat treatment is still used in virtually the same manner as he developed it.

James Kirkham Ramsbottom used the process of scientific inquiry to figure out what was causing the death of daffodils.

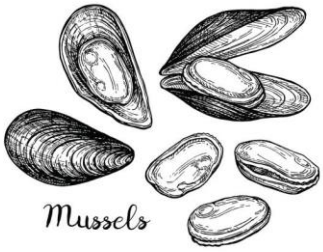


Describe Ramsbottom's experiment using complete sentences. Organize your description of Ramsbottom's experiment by identifying the following:

A. The scientific (testable) question
B. The hypothesis
C. The independent variable
D. The dependent variable
E. The experimental group
F. The control group

FRQ #2. Data Analysis to support a hypothesis

A student investigated the variation in the length of mussel shells at two locations on a rocky shore in New Hampshire. Her data are below. Use an Excel spreadsheet or Google Sheets to analyze the data.



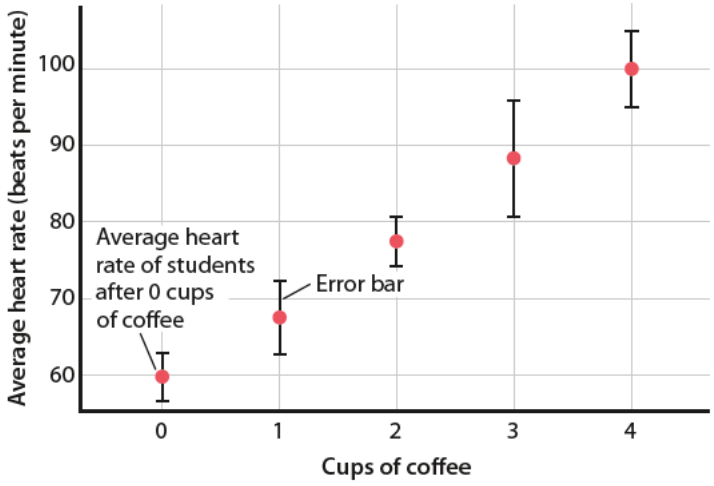
A. **Formulate** a null hypothesis for this investigation.
B. **Formulate** an alternative hypothesis for this investigation.
C. **Calculate** the Standard Deviation for both groups of mussel shells.
D. **Calculate** the Standard Error for both groups of mussel shells.
E. **Calculate** the confidence limits for both groups of mussel shells.
Confidence limits = ±2 SEM
F. **Graph** the data, include the SEM bars.
H. What does the data indicate about the two populations of mussels and their environment? Which of your hypotheses is supported by the data? What EVIDENCE can you use to determine which hypothesis is supported?

Table – Mussel Shell Length

Group A (mm)	Group B (mm)
46	23
50	28
45	41
45	31
63	26
57	33
65	35
73	21
55	38
79	30
62	36
59	38
71	45
68	28
77	42
Mean ($\tilde{x}$) =	Mean ($\tilde{x}$) =

FRQ #3. Graph/data analysis

Examine the graph below and answer the questions that follow.



This graph shows the relationship between caffeine consumption and resting heart rate. It plots the average resting heart rate of groups of people who consumed 0, 1, 2, 3, or 4 cups of coffee, with error bars giving an indication of the uncertainty of the data.

A. What information do you need about the error bars that is not revealed in this graph?
B. In which data points are you most confident? Least confident? **Justify your choices.**

FRQ #4. Experimental Design

Write your answer to each part clearly. Support your answers with relevant information and examples. Where calculations are required, show your work.

An experiment was performed on a wild population of Anna hummingbirds (Calypte anna) to see if they preferred feeding from a specific color of sugar water. Scientists had previously observed the hummingbirds feeding from a glass feeder with a clear sugar water solution. The scientists placed five identical glass feeders side by side and filled each with a different colored sugar water solution: red, yellow, green, blue, and clear.

Every 15 minutes, the scientists changed the positions of the feeders relative to one another to eliminate any position bias. The scientists recorded the color of the first sugar water solution that each hummingbird visited. The experiment was carried out for 2 days. The results of the experiment are shown in the table.

A. **Identify** the independent and dependent variables.
B. **Identify** the control group and the experimental group.
C. **State** an alternative hypothesis and the corresponding null hypothesis.
D. **Explain** what the data tell us about the hummingbirds' feeding preference.

Average Number of Birds Approaching and Drinking from Each of Five Containers Containing Different Colored Solutions

Color	Mean counts
Red	33.9
Yellow	13.1
Green	8.4
Blue	4.3
Clear	5.3

Data from https://sora.unm.edu/sites/default/files/journals/wilson/v092n01/p0053-p0062.pdf

FRQ #5. Descriptive Statistics

Researchers in an aquatic biology lab have collected data on the mass of algae in a recent experiment. The data are shown in the following table:

Experimental tank	Algae mass (g)	Experimental tank	Algae mass (g)
1	0.36	9	0.66
2	0.51	10	0.31
3	0.25	11	0.22
4	0.42	12	0.29
5	0.22	13	0.33
6	0.25	14	0.32
7	0.28	15	0.48
8	0.27		

A. **Calculate** the mean, variance, standard deviation, and standard error of the mean (±2) for this data set.

B. If you were to graph error bars for these data, what range of values would represent a 95% confidence interval of the mean?

FRQ #6. Organizing data for analysis

Juan did a survey of the number of pets owned by 30 of his classmates, with the following results.

Classmate	# of Pets	Classmate	# of Pets	Classmate	# of Pets
1	1	*11*	1	*21*	0
2	4	*12*	2	*22*	3
3	2	*13*	0	*23*	1
4	1	*14*	5	*24*	3
5	5	*15*	1	*25*	1
6	2	*16*	2	*26*	1
7	1	*17*	1	*27*	2
8	1	*18*	1	*28*	2
9	0	*19*	2	*29*	6
10	1	*20*	2	*30*	0

A. **Create** a data table in Excel or Google Sheets that more accurately reflects the data and **graph** the data.

B. **Calculate** the mean, standard deviation, and standard error of the mean (SEM) for the data. Include those values in your data analysis spreadsheet.

C. Add the 95% Confidence Interval (SEM ±2) bars to your graph.