



OMSB9: Methodology of Science – Biology

Course Description

Methodology of Science – Biology is a year-long Core course that introduces students to the methods and reasoning used throughout science. Students will learn how evidence can be obtained for scientific claims from raw data based on statistical methods through biological examples. Students will be exposed to various statistical concepts and techniques to interpret data and make inferences from the interpretations. These techniques will be applied to the study of life. Students will explore how organisms interact with each other and their environment, and the properties and processes of cells and molecules.

Course Objectives

Through the successful completion of this course students will:

- Understand the fundamental ideas of modern biology.
- Understand statistical concepts and apply basic methods to reason statistically.
- Develop skills to design a well-defined scientific research, critically analyze data, and draw conclusions scientifically.
- Be able to communicate effectively scientific ideas through written reports and verbal discussion.

Required Textbooks

Practical Statistics for Field Biology, J. Fowlor, L. Cohen, and P. Jarvis
Second Edition, 1998, Wiley
ISBN-10: 0471982962
ISBN-13: 978-0471982968

Essential Biology, Simon, Reece, and Campbell
Third Edition, 2007, Pearson
ISBN-10: 0805368426
ISBN-13: 9780805368420

Key Assignments

Each semester, grades will be based on the following:

- **In class participation:** Students are expected to participate in in-class discussions and be part of an active learning environment. This portion of the grade will be determined based on attendance and regular participation in the discussion including asking and answering questions.
- **Weekly Exercises:** Every week, a set of exercises will be posted on the course webpage. Students are expected to do those exercises online through the website. Exercises will be on the material of each week and designed to test understanding of the material of the corresponding week.
- **Writing Assignments:** Periodically, students will be given more in-depth free-response questions to answer at home. These questions will be designed to test depth of understanding of biological/statistical concepts and ability to integrate knowledge into a broader understanding of the concepts.

- **Midterm and Final Exams:** There will be comprehensive, written, proctored midterm and final exams that will include multiple-choice and free response questions regarding material covered in lecture, discussions, and writing assignments as described above.
- **Final Project (Spring Term only):** Toward the end of the year, students will be expected to conduct a biological/statistical study of their own. Students will design an experiment, collect biological data and interpret the data based on the statistical methods learned.

Sample Writing Assignment

Instructions

Compose a 750-1250 word essay (approximately 3-5 pages). Be sure to include a list of references that you use, outside of your textbooks and lectures. Your essay will be scored out of 100 points.

Prompt: Glycogen Levels in Animal Tissues

The following is a description of an experiment conducted to study the glycogen levels of 5 tissues, arbitrarily labeled as tissue A, B, C, D and E. To begin your response to this prompt, explain what glycogen is, focusing on its structure (composition) and function.

METHODS

10 rhesus monkeys were imported from India and quarantined for 90 days before they were used for experiments. The monkeys were 2 to 4 years old and were fed a commercial stock diet while they were at NIH. The modification of the Faylor-Hoshi method was used to assay the glycogen content of the five tissues, A, B, C, D and E.

RESULTS

The glycogen concentration in milligrams glycogen/gram wet weight for the 5 tissues of 10 monkeys are presented in the following table:

	Glycogen Concentration (mg/g)									
Tissue	Monkey 1	Monkey 2	Monkey 3	Monkey 4	Monkey 5	Monkey 6	Monkey 7	Monkey 8	Monkey 9	Monkey 10
A	0.77	0.53	0.48	0.60	0.59	0.71	0.39	0.75	0.50	0.52
B	0.012	0.020	0.009	0.000	0.015	0.018	0.030	0.017	0.002	0.001
C	5.1	4.2	6.8	6.2	3.8	5.2	5.3	4.8	3.8	7.2
D	160	110	100	170	120	110	140	180	90	130
E	0.001	0.000	0.008	0.000	0.020	0.001	0.001	0.007	0.000	0.005

DATA ANALYSIS

Estimate the mean of the glycogen concentrations for each tissue with confidence interval. Details of your calculation are not necessary, but you need to explain the general idea of the method of your calculation.

CONCLUSION

Draw conclusions from your data, including identifying the origin of the two tissues in which glycogen is enriched. Why might glycogen be enriched in these tissues?