DEPARTMENT OF BIOLOGY
College of Arts and Sciences
University of the Philippines Manila

Biology 181 (Experimental Designs and Statistical Analysis)
AY 2023-2024

Course Code:	Biology 181
Course Unit:	3 units
Course Title:	Experimental Designs and Statistical Analysis
Prerequisite:	Biology 180 (Biostatistics)

Course Description:

The course deals with the principles in the construction of experimental research designs and test statistics used in biological research. The course will help the students develop a familiarity with the common research designs used in the respective fields of specialization in the area of Biology. There is also inclusion of an updated perspective on the current trends and requirements in the conduct of a scientific research especially if it involves humans, animals and/or other valuable biological materials. Included also are some ethical guidelines used by scientist in the proper conduct and management of research and its publication.

B.S. Biology Generic Program Learning Objectives:

1. Develop a mindset for lifelong learning in pursuit of excellence with a global perspective

2. Demonstrate adaptability, professionalism, and ethical behavior in the workplace

3. Foster social and environmental responsibility to build a healthy community

B.S. Biology Specific Program Learning Objectives:

4. Demonstrate knowledge and comprehension in the core areas of biology (from molecules to ecosystems)

5. Apply critical, analytical, and integrative thinking to biological problem

6. Employ the scientific method to design and ethically conduct biological research that contributes to addressing national and global issues on environment and health

7. Effectively communicate biological ideas in both written and oral form, and through the use of various media

Mapping of BIO181 Course Outcomes vis-à-vis Program Learning Objectives:

BIO181 Course Outcomes After completing the course, the student shall be able to…	**Generic Objectives**			**Specific Objectives**			
	P01.	**P02.**	**P03.**	**P04.**	**P05.**	**P06.**	**P07.**
1. Explain and compare different study designs and statistical analysis	X			X	X		
2. Demonstrate skills and ethical responsibility in concept formulation, data collection, presentation, and analysis	X	X		X	X	X	X
3. Solve biological research problems through scientifically and ethically sound statistical methods	X	X	X	X	X	X	X

BIO181 Learning Outcomes:

Course Outcomes	Topics/ Learning Objectives	Time (wks)	Intended Learning Outcomes	Teaching Strategies	Assessment Tasks	Materials and Resources
1. Explain the role of the researcher and the scientific process	• Application of Scientific Process • Prerequisites of a researcher Learning Objective: 1.To explain the scientific process and the role of the researcher in the process	3	1. A. Discuss the scientific process B. Differentiate the roles of the researcher	• Lecture-discussion	• Quizzes • Laboratory worksheets •	• Projector and laptop • Computer laboratory (desktop, Linux OS, Open Office, PSPP, PAST)
2. Explain the scientific process and development of a research topic	• Steps and consideration in developing a research topic • Concept mapping • Review on	4	A. Demonstrate skills in the use of methods to develop a research topic	• Lecture-discussion • Return demonstration using statistical software	• Quizzes • Laboratory worksheets • Printed laboratory exercise output	• Projector and laptop • Computer laboratory (desktop, Linux OS, Open Office, PSPP, PAST)

	types of variables Learning Objective: 1.To create concept maps on a developed research topic 2. To describe the process of developing research					• Printer and short bond paper
3. Differentiate and compare the different types of study designs **4. Demonstrate skills and ethical responsibility in the formulation of research, data collection,**	• Types of Study Designs • Estimation of sample size • Sampling methodologies Learning Objective: 1.To describe the basic features of the study designs 2. To compare the	3	A. Differentiate the study designs B. Compare and contrast the study designs C. Demonstrate skills in the use of the different study designs, sample size estimation and sampling methodologies to different research	• Lecture-discussion • Return demonstration using statistical software • Group case study	• Laboratory worksheets • Printed laboratory exercise output • Oral and written case study reports • Examination	• Projector and laptop • Computer laboratory (desktop, Linux OS, Open Office, PSPP, PAST) • Printer and short bond paper

presentation, and analysis	study designs 3. To apply the study designs on different research settings 4. To calculate sample sizes on different research settings 5. To apply sampling methodologies on different research settings		settings			
5. Solve biological research problems through scientifically and ethically sound statistical methods	• Parametric Statistics • Non-Parametric Statistics • Toxicity studies • Meta-Analysis • Potential additional requirements in research	6	A. Demonstrate skills in the use of parametric and non parametric statistical analysis B. Compare and contrast studies that require parametric and non parametric analysis	• Lecture-discussion • Return demonstration using statistical software • Group case study	• Laboratory worksheets • Printed laboratory exercise output • exams • Oral and written case study reports	• Projector and laptop • Computer laboratory (desktop, Linux OS, Open Office, PSPP, PAST) Printer and short bond paper

	● Learning Objective: 1.To devise data collection and analysis management plans in biological research. 2. To interpret statistical and non-statistical significance using statistical tests. 3. To create biological research employing the statistical tools in generalizing outputs.		C. Demonstrate skills in the proper use of methodologies in the conduct and solving biological problems through a case study			

Course Content:

Lecture Topics
I. Application of the scientific method in the experiment process
II. Prerequisites to being a researcher
III. Steps and Considerations in selecting a research topic
IV. Review on Types of Variables • Definition of Variables • Dependent vs. independent • By measurement • Confounding variables • Transformation of variable (by measurement)
V. Concept mapping
VI. Types of Study • Historical • Descriptive • Correlational • Experimental • Quantitative vs. qualitative vs. mixed research

VII. Designs of a True Experimental, non-experimental, quasi experimental research.

VIII. Types of True Experimental Research Designs (simple and complex)

- Pretest-Posttest Design
- Control Group
- Randomization
- Randomized Controlled Trials
- Between Subjects Design
- Within Subject Design

- Factorial Design
- Solomon Four-Group Design
- Repeated Measures Design
- Counterbalanced Measures Design
- Matched Subjects Design
- Bayesian Probability

IX. Estimation of Sample Size

X. Sampling Methodologies

- Simple random
- Systematic
- Proportional
- Multi stage sampling

XI. Studies using Parametric Analysis • Z- test • T-test • Analysis of Variance and Post hoc test
XII. Studies using Non Parametric Analysis • Test for Normality (e.g. Kolmogorov-Smirnov test, Shapiro and Wilk test etc.) • Mann Whitney Test • Chi square test • Spearman's rank's test • Wilcoxons test
XIII. Toxicity / Survival/ Dose dependent Studies (regression and correlation studies)
XIV. Meta Analysis Studies
XV. Potential Additional requirements in Research • Institutional Animal Care and Use Committee (IACUC) requirements • Bioethics and/or human ethics • Biosafety and Biosecurity requirements
XVI. Process Flow chart on the conduct of research in an institution

List of Laboratory Exercises

Meeting	Exercise Activity
1	Introductions of Lab Exercises and Logistics
2	Diagnostic/Validation Test
3	Types of Study (Historical, Descriptive, Correlational, Causation) and Objective Presentation
4	Concept Mapping
5	Identification of Study Designs vs. True, Quasi, Non, and Pre experimental
6	Sampling Size Determination, Sampling and Feasibility Consideration
7	Types of True Experimental Design
8	Statistical Comparison 2 groups (parametric)
9	Statistical comparison>2 groups (parametric) and Post hoc analysis
10	Nonparametric Studies
11	Linear regression and Lethality studies
12	Meta Analysis of studies
13*	Activities on Biosafety and Biosecurity
14	Activities on Studies with IACUC Requirements
15	Activities on Human, Biological and Research Ethics
16	Reporting of Assigned Data Set
*	(data set should be with students already)

Course Requirements:

Lecture Requirements:

Lecture Exam/s	(80%)
Case Paper	(20%)

Lab Requirements:

Journal/ Assigned Reporting	(25%)
Lab exercises (total of 13)	(25%)
Case Study (presentation)	(50%)

The pre final grade of the student will be computed as follows:

PFG = Lecture (50%) + Laboratory (50%)

Should the student obtain a PFG of 2.5 (70% or higher), they are exempted from taking the finals examination. The PFG of those who did not take the finals examination will be their grade for the course. On the other hand, to compute for the course grade of the not exempted students, the formula below will be used:

PFG (80%) + Finals Examination Score (20%) = Grade in the Course

Important: The student must pass both lecture and laboratory component of the course. A grade of 5.0 (53% or lower) in either or both component, the student will not be eligible to take the finals examination and will be given a grade of 5.0 for the course.

Course Policies:

If the student missed an examination for a legitimate reason (e.g. medical illness), he or she will automatically take the finals examination whose scores will be used to replace the missed exam. Should they miss two exams for legitimate reasons only one exam score can be replaced. No make-up exam will be conducted.

Cheating in any form whether pre meditated or not, automatically merits a grade of 5.0 for the course.

University Grading Scale:

Percentile Grade	Equivalent
93 - 100	1.00
90 - 92	1.25
87 - 89	1. 50
84 - 86	1.75
80 - 83	2.00
75 - 79	2.25
70 - 74	2. 50
65 - 69	2.75
60 - 64	3.00
54 - 59	4.00
53 and below	5.00

References:

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Harris Cooper. Research Synthesis and Meta-Analysis: A Step by Step Approach. Sage Publications. 2016. 5th ed.

John W. Creswell. Research Design : Qualitative, Quantitative and Mixed Method Approaches. Sage Publications. 2014. 4th ed.

Kathryn H. Jacobsen. Introduction to Health Research Methods: A Practical Guide. Jones and Bartlett Publishers. 2016

Peter Lake, *et al*. Research Methodology in the Medical and Biological Sciences. Academic Press. 2007

Silverman,J. Suckow, MA, Murthy S. The IACUC Handbook. 3rd edition. CRC Press. 2014

WHO Laboratory Biosafety Manual

WHO Laboratory Biosecurity Manual