

Introduction to Biomedical Research Methods (RSCH 296A)

I. General Information:

- A. Course Number: RSCH 296A
- B. Title: Introduction to Biomedical Research Methods
- C. Units: 3
- D. Prerequisites: At least one GE foundation requirement.
- E. Course Classification: C-3 Lecture Activity (enrollment 25)
- F. Faculty: TBD
- G. Prepared by: Stephen Mezyk (CNSM; lead), Paul Buonora (CNSM), Jesse Dillon (CNSM), Shadnaz Asgari (COE)
- H. Date of Revision: Spring 2015 /Fall 2015 / Spring 2016

II. Catalog Description

Introduction to Biomedical Research Methods (3)

Prerequisite: At least one GE foundation requirement.

Introduction to principles and ethics of experimentation, hypothesis formulation and testing. Students will learn data measurement, analysis and presentation, how to find and read scientific literature, keep a laboratory notebook and basic data graphing and analysis skills.

III. Justification for GE Designation

Requested GE category: B1aNL (Life Sciences without Laboratory)

The course engages students in critical thinking and using the scientific method as a means of gaining knowledge of factors that impact human life, related to biomedical issues (e.g., Biology, Biochemistry, Chemistry, Mathematics, Physics, Biomedical Engineering, Computer Science, etc.). A primary focus of the course is to illustrate how evidence-based knowledge is developed and how to critique existing knowledge and the methods that produced that knowledge. The influence of historical events (e.g., the Nuremberg Trials, the USPHS Syphilis Study at Tuskegee) is included as the driving forces behind the existing Human Subjects Research Protection guidelines that are integrated into each step of the research process, as it is conducted in the present.

The CSULB Research Infused Curriculum:

Among the selling points in pursuing a college education is the idea that graduates will have the skills to discover new solutions to the community's challenges and lay the groundwork for the industries of the future. Much of this promise is directly supported when students are prepared to become research professionals in their respective fields.

CSULB will support the preparation of its graduates to pursue further research training in graduate programs and entry into research careers through its proposed "Research Infused Curriculum." In this integrated and research career focused curriculum, each course's content supports the other courses and provides the skills necessary to identify long-term research projects, design and implement research plans, prepare fundable research proposals, and communicate the findings of research to experts and the general population.

While individual programs may have courses that fit pieces of the curriculum, many programs don't have a large enough pool of research career focused students to offer discipline specific courses of this type. Through the "Research Infused Curriculum" such training will be made

available to the larger population of CSULB students. To address degree unit caps, the proposed courses have been designed to meet general education certification.

The existence of these courses will not preclude programs from running or developing their own more discipline specific courses, and will give course options for those programs wishing to serve their majors desiring to pursue research careers. The curriculum will also help underscore the position of scholarly activity within the training CSULB students receive.

The four courses making up the “Research Infused Curriculum” includes:

Introduction to Research Methods – This sophomore level course begins the training of students to become productive researchers. Although the courses share common elements, two courses have been created to address differences in the Biomedical (ENGR296 & NSCI 296) and Behavioral (CLA 296 & HHS 296) discipline needs in an introductory research methods course.

Introduction to Health Disparities – This interdisciplinary course (HHS 207) is designed to provide a showcase for the ways differing disciplines address health challenges faced by subsets of the community and/or the community at large.

Research Communication – This cross-listed (CLA 361, ENGR 361, HHS 361, NSCI 361) junior level course focuses on the dissemination of research findings and the development of fundable research proposals.

Advanced Research Methods – This senior level course emphasizing the development of a program of research, including proposal development and funding. Although the courses share common elements, two courses have been created to address differences in the Biomedical (ENGR 496 & NSCI 496) and Behavioral (CLA 496 & HHS 496) discipline needs in an advance research methods course.

IV. Expected Student Learning Outcomes (must appear on all course syllabi)

Students who have successfully completed Introduction to Biomedical Research Methods should be able to demonstrate the following:

- A. Describe the nature of research in biomedical science and engineering
- B. Apply basic terminology used in biomedical research
- C. Discuss ethical considerations involved in biomedical research and historical events that prompted their development
- D. Conduct a literature review of previous research
- E. Engage in inquiry and analysis for biomedical research
 1. Topic selection: Identify an innovative and focused biomedical topic that addresses significant yet previously less explored aspects of the topic
 2. Existing Knowledge, Research, and/or Views: Synthesize and critically evaluate in-depth information from existing literature that takes different approaches to studying health topics
 3. Describe the logic and process of hypothesis testing
 4. Identify characteristics (including advantages and disadvantages) of experimental and other research designs
 5. Compute and interpret appropriate descriptive statistics from a dataset
 6. Construct and interpret tabular/graphical presentations of data
- F. Conduct and interpret basic inferential statistics
- G. Compose research reports using the a standard biomedical journal format

- H. Disseminate research findings through concise written communication methods
 - 1. Sources and Evidence: Demonstrate skillful use of extant scientific literature to provide a rationale for the chosen research questions being explored
 - 2. Control of Syntax and Mechanics: Uses refined language that skillfully communicates the meaning and significance of research findings to readers with clarity and fluency, and is virtually error free
- I. Clearly present research findings through oral communication methods
- J. Demonstrate time-, data- and project-management skills with regard to biomedical research
 - 1. Keep an accurate laboratory notebook
 - 2. Develop scientific databases

Assessment of Course Learning Outcomes

Successful completion of Introduction to Research Methods requires that the Course Objectives are met. The table below outlines assessments that will be used to gauge whether learning outcomes are met.

Student Learning Outcomes (SLO)	Activity, Assignment or Assessment (% of course grade)
A	Exams (30%)
B	Exams (30%), Final Research Paper (20%)
C	Human Subjects Training, Exams (30%)
D	Final Research Paper (20%)
E1	Final Research Paper (20%)
E2	Article Critique (15%)
E3	Exams (30%)
E4	Article Critique, Exams (30%)
E5	Final Research Paper (20%), Final Research Presentation (15%)
E6	Final Research Paper (20%), Final Research Presentation (15%)
F	Final Research Paper (20%)
G	Final Research Paper (20%)
H	Final Research Paper (20%)
I	Final Research Presentation (e.g., Power point or Poster; 15%)

V. Topics to be Covered (Outline of Subject Matter)

The following content will be delivered through presentations of discipline-specific (e.g., natural sciences, engineering) as well as collaborative, interdisciplinary team approaches to research. The following is a broad outline of topics to be covered. Specific subject matter and sequence of topics may vary by instructor.

- A) Introduction to the course (SLO A-C)
 - 1) Why care about research
 - 2) History of the Scientific Method
- B) Time management skills and project responsibilities (SLO B, J)
- C) Introduction to hypothesis-driven and curiosity-driven research approaches (SLO B,E)
- D) Scientific literature searching (SLO D-E)
 - 1) introduction to library and on-line systems
- E) Keeping a laboratory notebook and computer records (SLO B, J)
- F) Ethics in scientific research (SLO B-C, E)
 - 1) Scientific fraud, errors and honest mistakes.

- 2) Human/animal introductory subject training.
- 3) Ethics in practice and reporting of research.
- G) Simple data analysis (SLO B, E-F)
 - 1) how to describe and display data,
 - 2) how to perform simple statistics
 - 3) fitting data, eliminating "bad" data,
- H) Scientific Errors (SLO B, E-F)
 - 1) Identification and basic propagation
- I) Types of biomedical research (SLO A-B)
 - 1) Seminars from CSULB research faculty
- J) Simple experimental design principles (SLO B, E)
 - 1) Tips for optimizing laboratory effort

VI. MODES of Instruction

A variety of instructional techniques will be employed. Examples of suitable activities include:

- A. Lectures: present basic, foundation concepts, facts, and procedures
- B. Statistical software demonstrations: facilitate understanding of statistical analyses integral to the process of completing research projects
- C. Individual or group activities: Exercises encourage students to apply knowledge gained through lecture and demonstrations
- D. Research projects: Students will be required to develop a research projects that allow them to engage in the research process as a culminating project, including paper and presentation

This list is not comprehensive and instructors are encouraged to use multiple instructional techniques in the course.

VII. Extent and Nature of the Use of Technology

Biomedical science researchers rely on computer technology, and this emphasis should be reflected in the course. At minimum, students should learn to (a) conduct literature searches using web-based search engines (e.g., PubMed) and (b) use computer software to effectively present research findings in written and graphic formats. Instructors are strongly encouraged to incorporate other uses of technology into the course where appropriate (e.g., posting course materials such as the syllabus, assignments, notes or grades on the Internet, developing computerized laboratory projects, etc.).

VIII. Instructional Requirements for Faculty

A. Textbooks

Instructors will assign written materials (textbook, workbook reading packet, handouts, journal articles, etc.) that reflect all course objectives. These materials also should cover items for A-J, from the Outline of Content.

Recommended and acceptable textbooks include:

Getting It Right: R&D Methods for Science and Engineering

Author(s): Peter Bock and Bettina Scheibe

ISBN: 978-0-12-108852-1

B. Mandatory Assignments

Assessing students' competency in each of the areas listed in the Course Objectives requires a variety of assignments. Therefore, instructors will use each of the following assessment techniques.

1. In-class written examinations, including a comprehensive final exam, should test students' knowledge of some material included in each primary topic (A-J) listed in the Outline of Content.
2. Basic article critique, where students must identify major research components and limitations of a published empirical research article. Format should be short-answer responses to questions from a worksheet.
3. Students must complete at least one substantial written research assignment, which they will develop over several weeks. This assignment will be a group project, and must involve a short literature review and well-developed hypothesis, description of methods, data analysis and interpretation, and discussion of the findings.
4. Student groups must complete a presentation of research findings to their colleagues. A variety of options are appropriate, including formats used at professional conferences (i.e., poster presentations or PowerPoint presentations).

C. Grading Practices

Instructors must follow the general policy on grading outlined by the University.

Therefore, final course grades must be based on at least three separate evaluations of student achievement and no single assessment may count for no more than 30% of the final course grade. Aside from these constraints, the exact number of assignments (and value of each assignment) is left to the discretion of each instructor.

Percentage of total grade per requirement:

1. Midterms	30%
2. Cumulative Final Exam	25%
3. Group Assignments	20%
4. Individual Assignments	20%
5. Participation	5%

Course grades may be based on a descriptive scale such as the following (PS 08-10):

90-100%	= A performance at the highest level showing sustained excellence.
80-89%	= B performance at high level showing consistent and effective achievement.
70-79%	= C performance at an adequate level meeting basic requirements.
60-69%	= D performance is less than adequate meeting minimum course requirements.
Below 60%	= F performance in which minimal course requirements have not been met.

IX. Instructional Policies Requirements

All sections of the course will have a syllabus that includes information required by the syllabus policy adopted by the Academic Senate (PS11-07). Instructors will include information on the interpretation of the withdrawal policy, how students may make up work for excused absences, and how participation will be assessed. Instructors will also include the following statements as part of the syllabus in accordance with the policies of the College of Natural Sciences and Mathematics.

A. Statement of Accessibility - Accommodation

Students needing special consideration for class format and schedule due to religious observance or military obligations must provide the instructor with written notice of those needs by the second week of class.

Students who require additional time or other accommodation for assignments must secure verifications/assistance from the CSULB Disabled Student Services (DSS) office located at Brotman Hall 270. The telephone number is (562) 985-5401.

Accommodation is a process in which the student, DSS, and instructor each play an important role. Students contact DSS so that their eligibility and need for accommodation can be determined. DSS identifies how much time is required for each exam. The student is responsible for discussing his/her need with the instructor and for making appropriate arrangements. Students who are eligible to receive accommodation should present an Accommodation Cover Letter and a DSS Student/Teacher Testing Agreement Form to the instructor as early in the semester as possible, but no later than a week before the first test. (It takes one week to schedule taking an exam at the DSS office.) The instructor welcomes the opportunity to implement the accommodations determined by DSS. Please ask the instructor if you have any questions.

B. Cheating and Plagiarism (CSULB Catalog, AY 2013-2014, pp. 47-49)

1. "Plagiarism is defined as the act of using the ideas or work of another person or persons as if they were ones own, without giving credit to the source. Such an act is not plagiarism if it is ascertained that the ideas were arrived at through independent reasoning or logic or where the thought or idea is common knowledge. Acknowledge of an original author or source must be made through appropriate references, i.e., quotation marks, footnotes, or commentary. Examples of plagiarism include, but are not limited to, the following: the submission of a work, either in part or in whole, completed by another; failure to give credit for ideas, statements, facts or conclusions which rightfully belong to another; in written work, failure to use quotation marks when quoting directly from another, whether it be a paragraph, a sentence, or even a part thereof; or close and lengthy paraphrasing of another's writing or programming. A student who is in doubt about the extent of acceptable paraphrasing should consult the instructor. Students are cautioned that, in conducting their research, they should prepare their notes by (a) either quoting material exactly (using quotation marks) at the time they take notes from a source; or (b) departing completely from the language used in the source, putting the material into their own words. In this way, when the material is used in the paper or project, the student can avoid plagiarism resulting from verbatim use of notes. Both quoted and paraphrased materials must be given proper citations."
2. "Cheating is defined as the act of obtaining or attempting to obtain or aiding another to obtain academic credit for work by the use of any dishonest, deceptive or fraudulent means. Examples of cheating during an examination would include, but not be limited to the following: copying, either in part or in whole, from another test or examination; discussion of answers or ideas relating to the answers on an examination or test unless such discussion is specifically authorized by the instructor; giving or receiving copies of an exam without the permission of the instructor; using or displaying notes; "cheat sheets," or other information or devices inappropriate to the prescribed test conditions, as when the test of competence includes a test of unassisted recall of information, skill, or procedure; allowing someone other than the officially enrolled student to represent the same. Also included are plagiarism as defined and altering or interfering with the grading procedures. It is often appropriate for students to study together or to work in teams on projects. However, such students should be careful to avoid use of unauthorized assistance, and to avoid any implication of cheating, by such means as sitting apart

from one another in examinations, presenting the work in a manner which clearly indicates the effort of each individual, or such other method as is appropriate to the particular course.”

3. One or more of the following academic actions are available to the faculty member who finds a student has been cheating or plagiarizing. These options may be taken by the faculty member to the extent that the faculty member considers the cheating or plagiarism to manifest the student's lack of scholarship or to reflect on the student's lack of academic performance in the course. These actions may be taken without a request for or before the receipt of a Report from the Academic Integrity Committee.
 - a. Review – no action.
 - b. An oral reprimand with emphasis on counseling toward prevention of further occurrences;
 - c. A requirement that the work be repeated;
 - d. Assignment of a score of zero (0) for the specific demonstration of competence, resulting in the proportional reduction of final course grade;
 - e. Assignment of a failing final grade;
 - f. Referral to the Office of Judicial Affairs for possible probation, suspension, or expulsion.”

C. Campus Behavior

1. “California State University, Long Beach, takes pride in its tradition of maintaining a civil and non-violent learning, working, and social environment. Civility and mutual respect toward all members of the University community are intrinsic to the establishment of excellence in teaching and learning. They also contribute to the maintenance of a safe and productive workplace and overall healthy campus climate. The University espouses and practices zero tolerance for violence against any member of the University community (i.e., students, faculty, staff, administrators, and visitors). Violence and threats of violence not only disrupt the campus environment, they also negatively impact the University’s ability to foster open dialogue and a free exchange of ideas among all campus constituencies. To fulfill this policy, the University strives: 1) to prevent violence from occurring; and 2) to enforce local, state, and federal laws, as well as University regulations, regarding such conduct. The University also has established procedures for resolving and/or adjudicating circumstances involving violence, as well as threats of violence. A threat of violence is an expression of intention that implies impending physical injury, abuse, or damage to an individual or his/her belongings. All allegations of such incidents (i.e., acts and threats) will be aggressively investigated. Allegations that are sustained may result in disciplinary action up to and including dismissal from employment, expulsion from the University, and/or civil and criminal prosecution.” (CSULB Catalog, AY 2013-2014, p. 837)
2. Classroom Expectations – All students of the California State University system must adhere to the Student Conduct Code as stated in Section 41301 of the Title 5 of the California Code of Regulations as well as all campus rules, regulations, codes and policies. Students as emerging professionals are expected to maintain courtesy, respect for difference, and respect for the rights of others.
3. Unprofessional and Disruptive Behavior – It is important to foster a climate of civility in the classroom where all are treated with dignity and respect. Therefore, students engaging in disruptive or disrespectful behavior in classes will be counseled about

this behavior. If the disruptive or disrespectful behavior continues, additional disciplinary actions may be taken.

D. Withdrawal Policy

1. Withdrawal Between the 3rd and 12th Weeks of a Semester – Withdrawals during this period semester are permissible only for "**serious and compelling reasons**."
 - a. The definition of "serious and compelling reasons" as applied by faculty and administrators becomes narrower as the semester progresses.
 - b. Please be advised that doing poorly in a class does *not* constitute a serious or compelling reason. The "W" is not intended to be used as a mechanism to escape being awarded the grade that a student has been earning. Thus, the instructor and Department Chair will generally not authorize a withdrawal from this course unless the student seeking to withdraw (a) has been regularly attending classes; (b) has been performing at the level of a "C" or higher in the course; and (c) has a serious and compelling reason for seeking withdrawal.
 - c. To withdrawal during this period you will need both the signature of the course instructor *and* the signature of the Department Chairperson. Please note that the Department Chair may apply more stringent criteria than your instructor for assessing whether your reasons for seeking to withdraw are "serious and compelling."
2. Withdrawal During the Final 3 Weeks of a Semester – Withdrawals after the 12th week of instruction are not granted absent the most serious and compelling of reasons, such as the documented death of an *immediate* (not extended) family member; a documented, serious medical condition that requires withdrawal from all courses; a call from reserve to active military service; etc. The procedures for withdrawal during this period are the same as in above, but also require the approval and signature of the Dean or Associate Dean of the College of Health and Human Services. Moreover, the Office of the Provost will review all such requests before they are formally approved.

X. Consistency Of SCO Standards Across Sections

Course instructors meet twice a semester, once at the beginning and once at the end. They review course assignments, criteria sheets and student outcomes. As a result of the meetings, necessary changes are made in instruction and assignments. All course syllabi are in close alignment with the SCO. All course sections use the same textbook and grading guidelines for assessments.

XI. Program-Level Assessment Plan

- A. Exam grades will be used to assess students' learning of critical, foundational and research information contained in the SLO's.
- B. GE skills will be assessed utilizing rubrics and criteria sheets generated by faculty and based on best-practices for each domain assessed. All instructors will utilize the same rubrics and criteria sheets for all skill-based assessments.
- C. At the close of the each semester, the Faculty Coordinator for the course will convene a meeting of all instructors to conduct an assessment of all rubrics, and any necessary edits will be made at that time.

XII. Justification for Course Offering

NSCI 296 (Introduction to Biomedical Research Methods). This course is designed to introduce topics such as principles of experimentation, hypothesis formulation and testing, measurement,

naturalistic observation, statistical analysis, and reporting common issues across the biomedical sciences and engineering. This biomedical methods course will focus more on various experimental paradigms and techniques used in laboratory-based research. The course will give students the initial skill set they need to start in directed research successfully. The course goal is to give the student a skill set that engenders confidence as they take their first steps into research at CSULB.

There are limited courses that provide students with tools and skills needed to perform undergraduate research. This course focuses on providing students with the skills they need to become research scientists. The course is complementary to existing curriculum, adding to the cadre of professional skills and understanding needed to work in a changing world population. Further supporting the merit and need for this course, NIH funding from the BUILD training grant was received to develop this course.

XIII. Bibliography

Getting It Right: R&D Methods for Science and Engineering
Author(s): Peter Bock and Bettina Scheibe
ISBN: 978-0-12-108852-1

Research Methodology in the Medical and Biological Sciences Kindle Edition
Editor(s): Petter Laake, Haakon Breien Benestad, Bjorn Reino Olsen
ISBN: 9780123738745

Sample Schedule:

Wk#	Topic
1	<ul style="list-style-type: none"> • Introduction /Why care about research/History of the Scientific Method
2	<ul style="list-style-type: none"> • Time management skills and project responsibilities • Introduction to hypothesis-driven and curiosity-driven research approaches.
3	<ul style="list-style-type: none"> • Scientific literature searching, introduction to library and on-line systems
4	<ul style="list-style-type: none"> • Keeping a laboratory notebook and computer files – options and pitfalls
5-6	<ul style="list-style-type: none"> • Ethics in scientific research, fraud, errors and honest mistakes. • Human/animal introductory subject training. • Ethics in practice and reporting of research.
7-9	<ul style="list-style-type: none"> • Simple data analysis: how to use Excel, linearize data and make a complete graph, linear regression, fitting data, eliminating “bad” data, simple statistics (T-test)
10	<ul style="list-style-type: none"> • Scientific Errors – what are they and basic propagation
11-12	<ul style="list-style-type: none"> • Types of biomedical research – Seminars from CSULB research faculty
13-15	<ul style="list-style-type: none"> • Simple design of experiment – how to optimize your laboratory effort
Finals	<ul style="list-style-type: none"> •