

Syllabus Spring, 2017

BCHM 29000 Experimental Design Seminar

T/TH 2:30-3:20 pm, BCHM 105

INSTRUCTOR: Brian Dilkes

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Office hours: Wed 9:00-10:30 or by appointment

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COURSE OBJECTIVES

How does generating new knowledge differ from learning something new to you? The objective of this course is to prepare students to distinguish the generation of new knowledge and the rigorous intellectual challenges of scientific research from learning pre-existing information. The course will introduce the scientific method and provide a conceptual overview of different frameworks and major experimental approaches used in biochemistry. By working in teams, student will work through applying these principles to experimental problems. Specific issues examined include construction of experiments to test hypotheses rather than proving them, the thorny difference between correlation and causation, observation and serendipity, the perils of dogma, the importance of replication of experimental results, false positives and false negatives, necessity and sufficiency, the importance of positive and negative controls, the fundamentals and importance of statistics, and in vitro versus in vivo approaches and the strengths and weaknesses of both.

DEPARTMENTAL LEARNING OUTCOMES ADDRESSED BY THIS COURSE

Students will have an understanding of the scientific method. They will be able to develop hypotheses, design experiments, and critically analyze results to create new knowledge.

grade. In the likely event that more than 200 homework points are possible, students will be graded by the assignments they performed best on, until 200 possible points are reached.

Participation grade: Many class periods will include a written task that must be completed during class to earn participation points. A maximum of 40 points can be earned this way, but more than 40 points of work is offered (and possible). Don't stress if you feel you don't have something to say today. Think about what we are discussing and chip in. And remember, we are all ignorant and can only succeed by working to enlighten each other. If you don't understand, it is likely that many others do not either. Indeed, as you will see, this is the point.

Experimental Designs: These projects are, spread throughout the semester and longer in timescale than the short homework. Some will require you to analyse the experimental design of experiments presented in the literature. Others will ask you to design an experiment, complete with controls to address an open question. These are a combination of creativity, communication, and critical thinking. Each of these will contribute to the grading.

Exams: Missing an exam will result in a grade of 0 being recorded unless documented justification for the absence is presented. The Instructor must be contacted in advance via email. Any request to be excused from a class or exam must include official documentation (doctor's note, request from academic advisor, etc) explaining why the exam was or will be missed. Makeup exams will be scheduled in consultation with the instructor.

I am fallible, I am a scientist, but you cannot haggle with me and win. Please do not try as it will only end in mutual dissatisfaction. If you have any disagreements with the way your exam or assignment has been graded, please submit your exam with a written explanation for why the score should be changed. Requests for re-grades must be submitted no later than one week after the graded test or assignment has been returned. If you make any attempts to verbally argue for points with me I will refer you to this syllabus.

Note: *Science is a fundamentally collaborative enterprise that is accomplished by a loosely coordinated global effort involving the entire Homo sapiens population past and present. Coordination is achieved, overwhelmingly, through clear written communication. Future success in this endeavor depends on each of you making your contribution. For this course, students are strongly encouraged to discuss homework, readings, and experimental design problems together. **Written answers, on the***

other hand, must be completed individually and not copied from each other. Your ability to communicate complex ideas in writing will determine your future success in whatever you choose to do.

EXTRA CREDIT

As opportunities present themselves to do “field exercises” and use-case applications, extra credit will be available.

OBTAINING HELP

Dr. Dilkes is available during office hours, or by appointment. Coordination for appointments should be arranged via **e-mail with “BCHM 290” in the subject line**. You can also submit questions by **e-mail with “BCHM 290” in the subject line**. I will do my level best to answer the question by return e-mail as soon as I get it or alternatively in the next class period.

ACADEMIC MISCONDUCT

Academic misconduct of any kind will not be tolerated in any course offered by the Department of Biochemistry. Information on Purdue’s policies with regard to academic misconduct can be found at:
<http://www.purdue.edu/odos/osrr/academicintegritybrochure.php>

You should familiarize yourself with these policies, particularly if you are new to US academic institutions. All apparent violations of these policies will be referred to the Office of the Dean of Students (ODOS).

If the ODOS establishes that you have committed academic misconduct, the **minimal** response will be for your instructor to assign you a zero for the work in question; however, the **standard** response will be for you to receive a failing course grade and have a permanent record of the violation kept on file at the ODOS. These sanctions will be applied at the sole discretion of your instructor. Particularly egregious examples of academic misconduct or repeat offenses will result in you being expelled from the university by the ODOS.

“Purdue prohibits “dishonesty in connection with any University activity. Cheating, plagiarism, or knowingly furnishing false information to the University are examples of dishonesty.” [Part 5, Section III-B-2-a, [University Regulations](#)] Furthermore, the University Senate has stipulated that “the commitment of acts of cheating, lying, and deceit in any of their diverse forms (such as the use of substitutes for taking examinations, the use of illegal cribs, plagiarism, and copying during examinations) is

dishonest and must not be tolerated. Moreover, knowingly to aid and abet, directly or indirectly, other parties in committing dishonest acts is in itself dishonest." [University Senate Document 72-18, December 15, 1972]

More specifically, the following are a few examples of academic dishonesty which have been discovered at Purdue University.

- substituting on an exam for another student
- paying someone else to write a paper and submitting it as one's own work
- giving or receiving answers by use of signals during an exam
- copying with or without the other person's knowledge during an exam
- doing class assignments for someone else
- plagiarizing published material, class assignments, or lab reports
- turning in a paper that has been purchased from a commercial research firm or obtained from the internet
- obtaining an unauthorized copy of a test in advance of its scheduled administration
- using unauthorized notes during an exam
- collaborating with other students on assignments when it is not allowed
- obtaining a test from the exam site, completing and submitting it later
- altering answers on a scored test and submitting it for a regrade
- stealing class assignments from other students and submitting them as one's own
- fabricating data
- destroying or stealing the work of other students

Plagiarism is a special kind of academic dishonesty in which one person steals another person's ideas or words and falsely presents them as the

plagiarist's own product. This is most likely to occur in the following ways:

- using the exact language of someone else without the use of quotation marks and without giving proper credit to the author
- presenting the sequence of ideas or arranging the material of someone else even though such is expressed in one's own words, without giving appropriate acknowledgment
- submitting a document written by someone else but representing it as one's own
- **CLASS ATTENDANCE** University policy states that you are expected to attend every scheduled class. This course will include problem solving during class so failure to attend could place students at a disadvantage. Slides from the instructor will be available on Blackboard after class along with recordings of the instructor's voice, but these may not capture all the relevant information. If you have a valid reason for missing class such as a University-sponsored activity, religious observances, illness, or family emergency, I will do my best to assist you but it may not be possible to replicate all information missed in class. Students who skip class without a valid excuse should not expect the instructor to provide special help. The official university policy can be found here:
<http://www.purdue.edu/odos/services/classabsence.php>
- **GRIEF ABSENCE POLICY FOR STUDENTS** Purdue University recognizes that a time of bereavement is very difficult for a student. The University therefore provides the following rights to students facing the loss of a family member through the Grief Absence Policy for Students (GAPS). *GAPS Policy: Students will be excused for funeral leave and given the opportunity to earn equivalent credit and to demonstrate evidence of meeting the learning outcomes for misses assignments or assessments in the event of the death of a member of the student's family.*
- **NON-DISCRIMINATION POLICY STATEMENT** Purdue University's non-discrimination policy will be upheld in this classroom. Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of

academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. Purdue University views, evaluates, and treats all persons in any University related activity or circumstance in which they may be involved, solely as individuals on the basis of their own personal abilities, qualifications, and other relevant characteristics. For more information, see http://www.purdue.edu/purdue/ea_eou_statement.html

EMERGENCIES

EMERGENCY NOTIFICATION PROCEDURES are based on a simple concept – if you hear a fire alarm inside, proceed outside. If you hear a siren outside, proceed inside.



Indoor Fire Alarms mean to stop class or research and immediately **evacuate** the building. Proceed to your Emergency Assembly Area away from building doors.

Remain outside until police, fire, or other emergency response personnel provide additional guidance or tell you it is safe to leave.

All Hazards Outdoor Emergency Warning Sirens mean to immediately seek shelter (**Shelter in Place**) in a safe location within the closest building.

“Shelter in place” means seeking immediate shelter inside a building or University residence. This course of action may need to be taken during a tornado, a civil disturbance including a shooting or release of hazardous materials in the outside air. Once safely inside, find out more

details about the emergency*. **Remain in place** until police, fire, or other emergency response personnel provide additional guidance or tell you it is safe to leave.

**In both cases, you should seek additional clarifying information by all means possible...Purdue Emergency Status page, text message, email alert, TV, radio, etc...review the Purdue Emergency Warning Notification System multi-communication layers at http://www.purdue.edu/ehps/emergency_preparedness/warning-system.html*

EMERGENCY RESPONSE PROCEDURES:

- Review the **Emergency Procedures Guidelines**
https://www.purdue.edu/emergency_preparedness/flipchart/index.html
- Review the **Building Emergency Plan** (available on the Emergency Preparedness website or from the building deputy) for:
 - evacuation routes, exit points, and emergency assembly area
 - when and how to evacuate the building.
 - shelter in place procedures and locations
 - **EMERGENCY PREPAREDNESS AWARENESS VIDEOS**
 - "Shots Fired on Campus: When Lightning Strikes," is a 20-minute active shooter awareness video that illustrates what to look for and how to prepare and react to this type of incident. See: <http://www.purdue.edu/securePurdue/news/2010/emergency-preparedness-shots-fired-on-campus-video.cfm> (Link is also located on the EP website)

MORE INFORMATION

Reference the Emergency Preparedness web site for additional information:

https://www.purdue.edu/ehps/emergency_preparedness/

BCHM 290 CLASS SCHEDULE

Jan	10	Introduction and what is science
Jan	12	Total ignorance is necessary for science
Jan	17	Hypotheses testing, observation, and optimization are not the same.
Jan	19	Common features of experiments and interpretation
Jan	24	
Jan	26	The importance of the negative control
Feb	31	The value of the positive control
Feb	2	Bioinformatics: what data is available? How much do we know?
Feb	7	Bioinformatics beyond sequences: large data sets turn every computer into a telescope
Feb	9	Statistical analysis, distributions, p values, and pitfalls
Feb	14	Replication, reproducibility, and power: limits to interpretation and underappreciated design
Feb	16	Fundamental technical approaches in the analysis of macromolecules PCR, PAGE, immunoblots, etc.
Feb	21	Fundamental approaches (continued) recombinant DNA, enzyme activity, digital vs continuous data
Feb	23	Hypothesis driven research case studies
Feb	28	Hypothesis driven research case studies
March	2	Assay design, assay specificity
March	7	Hypothesis driven research case studies
March	9	Hypothesis driven research case studies
NO CLASS: SPRING BREAK	14	
NO CLASS: SPRING BREAK	16	
March	21	MIDTERM EXAM
March	23	Discussion of exam and break-out group exercise
March	28	Observation and serendipity: CRISPR
March	30	CRISPR (continued)
April	4	CRISPR (continued)
April	6	Macromolecule interactions and competition

		tests (in vitro)
April	11	In vivo labeling and extrapolation after extraction
April	13	Creative artifact: Limits of genetics and recombinant DNA for protein interaction study
April	18	Ethical Conduct in Research: data handling and release, authorship, and plagiarism
April	20	Ethical Conduct in Research: misconduct
April	25	Beyond the pathology paradigm: altering gene expression to test protein function
April	27 last class	If this is true what must also be true?

FINALS WEEK FINAL EXAM