INSTRUCTOR:
Brian Dilkes
office: WSLR B035B email: bdilkes@purdue.edu
Office hours: Tuesdays 10:00-11:30 or by appointment

TEACHING ASSISTANT:
Alyssa Nestor
nestora@purdue.edu
Office hours: Monday 3-4pm, outside the Lavazza at the Marriot Hall lobby or by appointment for the 11 people disappointed in the office hours time.

COURSE OBJECTIVES
How does generating new knowledge differ from learning something new to you? The objective of this course is to prepare you 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 individually and as groups, students will apply these principles to experimental problems. Specific issues examined include construction of experiments to test hypotheses, rather than proving them, the thorny differences between correlation and causation, the value of observation and serendipity, the perils of dogma, the importance of replication of experimental results, false positives and false negatives, the concepts of necessity and sufficiency in interpretation of experiments, 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.

Students will have an appreciation of ethical issues facing professionals in the life sciences.

Students will communicate scientific knowledge, experiments and conclusions effectively. Students will communicate both orally and in writing.

Students will have an appreciation of the role that digital repositories, data science, and computation play in generating new knowledge.

TEXTBOOK

No textbook is required. Readings will be assigned throughout the semester.

CLASS TIME AND PLACE

Tuesday - Thursday 1:30-2:20, BCHM 105

BLACKBOARD

The syllabus for the course, lecture notes, and grading keys will be available via the Purdue University Blackboard site at: https://mycourses.purdue.edu

ASSESSMENT

The grading for this course will be as follows:

- Midterm Exam: 100
- Short homeworks: 250 maximum
- Class participation: 100 maximum
- Experimental design projects: 100
- Final Exam: 50

Total: 600 points

The cutoff values for letter grades are as follows:

540 points (90%) A; 480 points (80%) B; 420 points (70%) C; 360 points
D; 359 points and below F.

**Short homework:** Short homework assignments of 5-20 points will be due at the beginning of some class periods. They will prepare you for the discussion and problems presented in class. Not only are these graded work for the class, completion of these prior to the class period will greatly facilitate your ability to participate productively in the discussion. Thus, completion of these assignments will help you with your participation grade. In the likely event that more than 250 homework points are possible, students will be graded by the assignments they performed best on, until 250 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 100 points can be earned this way, but more than 100 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. Often, the loudest voice incompletely understands the full scope of the discussion. This is also the point.

“A scientist's aim in a discussion with […] colleagues is not to persuade, but to clarify.” - Leo Szilard

**Experimental Designs:** These projects are spread throughout the semester and longer in timescale than the short homework. Some will require you to analyze 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 grades are not arrived at through haggling. 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. I will regrade the entire exam or assignment and return it to you. 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](http://www.purdue.edu/ehps/emergency_preparedness/warning-system.html)

**EMERGENCY RESPONSE PROCEDURES:**


- 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/
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<tr>
<th>Date</th>
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<tbody>
<tr>
<td>Jan 14</td>
<td>Introduction and what is science?</td>
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<tr>
<td>Jan 16</td>
<td>Embracing Ignorance</td>
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<td>Jan 28</td>
<td>Hypotheses testing, observation, and optimization are not the same.</td>
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<td>Jan 30</td>
<td>Common features of experiments and interpretation</td>
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<td>Negative Controls are important</td>
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<td>Feb 11</td>
<td>Can you boil water? Positive Controls</td>
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<td>Feb 13</td>
<td>Bioinformatics: formally displaying and operating on information.</td>
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<td>Feb 18</td>
<td>Bioinformatics or do you want to be a parasite?</td>
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<td>Feb 20</td>
<td>Statistical analyses, distributions, p values, and pitfalls</td>
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<td>Feb 25</td>
<td>Replication, reproducibility, and power: limits to interpretation and underappreciated designs</td>
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<td>Feb 27</td>
<td>What are we looking at when we “see” macromolecules in PCR, PAGE, immunoblots, etc.</td>
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<td>Fundamental approaches: digital vs continuous data in biochemistry</td>
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<td>Hypothesis driven Structure-Function Research case studies</td>
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<td>Feb 26</td>
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<td>Feb 28</td>
<td>Assay design, assay specificity</td>
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<td>March 3</td>
<td>Hypothesis driven Structure-Function Research case studies</td>
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<td>March 10</td>
<td>Hypothesis driven Structure-Function Research case studies</td>
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<td>March 12</td>
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<tr>
<td>March 16</td>
<td>NO CLASS: SPRING BREAK</td>
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<td>March 21</td>
<td>NO CLASS: SPRING BREAK</td>
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<td>March 24</td>
<td>MIDTERM EXAM</td>
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<td>March 26</td>
<td>Discussion of exam and break-out group exercise</td>
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<td>March 31</td>
<td>Observation and serendipity: CRISPR</td>
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<td>April 2</td>
<td>CRISPR (continued)</td>
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<td>April 7</td>
<td>CRISPR applied!</td>
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<td>April 9</td>
<td>Macromolecule interactions and competition tests (in vitro)</td>
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<td>April 14</td>
<td>Science in a blender: In vivo labeling and extrapolation after extraction</td>
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<td>April 16</td>
<td>What are we looking at when we “see”: Experiments are creative artifact</td>
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<td>April 21</td>
<td>Ethical Conduct in Research: data handling and release, authorship, and plagiarism</td>
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<td>April 23</td>
<td>Ethical Conduct in Research: misconduct</td>
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<td>April 28</td>
<td>Biochemistry is more than pathology: test protein function by more than breaking it</td>
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<tr>
<td>April 30 last class</td>
<td>If this is true what must also be true?</td>
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FINALS WEEK **FINAL EXAM**