Syllabus

BCHM 29000 Experimental Design Seminar

CRN 54185

Spring, 2021

T/TH 2:30-3:20 pm, Synchronous Online

2 Course Credit Hours

"What I want to do is to change your attitude. I want you to sense chaos where at first you noticed an orderly arrangement of well behaved things and processes." Paul Feyerbend, "Against Method"

INSTRUCTOR:

Brian Dilkes

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Office hours: Tuesdays 10:00-11:30 online or by appointment

TEACHING ASSISTANT:

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Shukla38@purdue.edu

Office hours: TBD or by appointment.

COURSE OBJECTIVES

How does generating new knowledge differ from learning something new to you? The objective of this course is to prepare you to engage in the generation of new knowledge and the rigorous intellectual challenges of carrying out or applying the results of scientific research as a process distinct 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 prove 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. At times we will touch on ethics in experimentation and communication, finances, and our responsibilities to each other. We will do this while looking at scientific studies and open questions.

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.

Learning Resources Technology and Texts

No textbook is required for this course. Readings will be assigned throughout the semester and will be made available to download, or as a link, via the Brightspace page for the course. All readings are free to Purdue students. Given the wealth of active scientific programs in the world, and our goal to set ourselves within the process of discovery, there is no reason to leave the primary literature. Welcome to life as a scientist.

All written work should be typed. Some exercises can be done within Brightspace. In other cases you may prefer to use a Word Processor (i.e. MS Word), remember that MS Office is free for all students.

Access the course via Purdue's Brightspace learning management system. The syllabus for the course, lecture notes, lecture recordings, readings, assignments, and grading keys will be available via the Purdue University Brightspace site. Begin with the "Start Here" tab, which describes how the course Brightspace is organized. It is strongly suggested that you explore and become familiar not only with the site navigation but with content and resources available for this course. In addition to course-specific resources, the Student Services widget on the campus homepage for resources such as Technology Help, Academic Help, Campus Resources, and Protect Purdue.

The key to success in this class is to read the assigned work before class and complete any short writing exercise. In past years, performance in the class was strongly correlated with regularly completing these exercises. Even if you feel like

your thinking is incomplete or you are not sure that you are correc*: commit your ideas to the page and submit it*. Not only will you have those ideas on a page in front of you to guide your questions and our discussions, you will have made another attempt at rendering a scientific idea in writing. As you will see, this class is filled with questions and often there is not a single correct answer but multiple paths forward.

CLASS TIME AND PLACE

Tuesday - Thursday 2:30-3:20, Online.

Links to all synchronous video events as well as recordings of lectures and additional videos introducing topics are hosted on the Brightspace page.

ASSESSMENT

The grading for this course will be as follows:

Midterm Exam	100
Short homeworks	400
Class participation	200
Rewrites and projects	200
Final Exam	100
Total	**1000 points**

The cutoff values for letter grades are as follows:

900 points (90%) A; 800 points (80%) B; 700 points (70%) C; 600 points (60%) D; 500 points and below F.

Short homework: Short homework assignments will be due at the beginning of some class periods. They will have a writing prompt or small task to 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 400 homework points are possible, students will be graded by the assignments they performed best on, until 400 possible points are reached. The more you complete, the easier it is for your best material to make up your grade, this is part of the reason I mentioned these in my advice on how to do well in this class.

Participation grade: Some class periods will have discussion, and productive contribution to that contributes to this grade. Asking questions of each other and constructively seeking clarity about each other's thoughts is deeply appreciated

and part of this grade. In addition, a written task is part of the activities during some class periods. In these cases, uploading your work after class is used to get credit for participation points. In this way if you are unable to attend (see Attendance Policy during Covid-19, below) you will not lose the opportunity to participate and receive credit. A maximum of 200 points can be earned this way. Just like the homework points, if more than 200 points of work is offered you will get the best grade calculated using the best 200-points worth of work. 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. It is also worth remembering that 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

Rewrites and projects: 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. There will be opportunities to rewrite short writing prompts and in class exercises into longer exercises and opportunities to rewrite exam questions. These will require a combination of creativity, communication, and critical thinking. Each of these will contribute to the grading.

Exams: All exams will be take home and open book.

The Midterm will be sent to you on	March 17	and is due on	March 23
The Final will be sent to you on	May 1	and is due on	May 8

I can't imagine actually doing science without access to the library and internet and have no intention of making you work without them either. You are required to perform all of the work yourself and you are not permitted to discuss the exam with each other until after the due date. The exams are expected to take an hour, but are not timed. I am not concerned with how long you choose to work on them. Missing an exam will result in a grade of 0 being recorded unless justification for the missing work is presented. You should contact me via email to justify missing an exam.

I am fallible, I am a scientist, and I am absolutely willing to regrade work. But grades are not arrived at through argument. Arguing with me about your grade will only end in mutual dissatisfaction. If you have any disagreements with the way your exam or assignment has been graded, please submit 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. I will avoid verbal disagreements over points by referring 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. This class aims to give you some experience doing that.*

Etiquette for the Digital Era

Your instructor and fellow students wish to foster a safe online learning environment. You are encouraged to comment and question ideas, but attacking an individual is unacceptable behavior. Questioning the concepts we are working to understand is the goal of the class and doing so in an environment of respect is required. Our differences, some of which are outlined in the University's nondiscrimination statement, will add richness to this learning experience.

As you will learn on in the first day of class, many people think they are funnier than they are. Please consider that sarcasm and humor are even easier to misinterpret in online interactions and unintended disruptions are not a welcome addition to the learning environment. Working towards community will build a richer experience and make the class a welcome time for curiosity and engagement.

Please monitor how much space/time you are taking up in any discussion. Give other students the opportunity to join in the discussion. This is an issue in in-person classes (as you all know) and is even more important in synchronous online courses.

Do not use offensive language. Present ideas appropriately.

Avoid using vernacular and/or slang language. This could lead to misinterpretation.

Keep an “open-mind” and be willing to express even your minority opinion. Likewise, seek and value other opinions in discussion.

Think and edit before you push the ‘Send’ button.

Seek and take in feedback from others; learning from other people is an important life skill.

ACCESSIBILITY

Purdue University strives to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: 765-494-1247.

OBTAINING HELP

Dr. Dilkes is available during office hours, or by appointment. Mithila Shukla is available during office hours as well. 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**. Adding this to the subject lets me flag your email into a box for this class which gets priority when I read email every evening.

ATTENDANCE POLICY DURING COVID-19

Students are expected to attend all classes in-person unless they are ill or otherwise unable to attend class. If they feel ill, have any symptoms associated with COVID-19, or suspect they have been exposed to the virus, students should stay home and contact the Protect Purdue Health Center (496-INFO). There is little I would like more than to decrease the number of SARS-CoV2 infections. Nothing about this class should slow or deter you from seeking testing, care, and quarantine should you feel ill or test positive. The participation portion of the grade for this class is designed to encourage your good behavior in this regard and I am deeply grateful to all of you who have and still are doing everything you can to use the available non-pharmaceutical interventions to prevent the spread and continued infection of each other.

In the current context of COVID-19, in-person attendance cannot be a factor in the final grades. However, timely completion of alternative assessments can certainly be part of the final grade. Students need to inform the instructor of any conflict that can be anticipated and will affect the timely submission of an assignment or the ability to take an exam.

Classroom engagement is extremely important and associated with your overall success in the course. The importance and value of course engagement and ways in which you can engage with the course content even if you are in quarantine or isolation, will be discussed at the beginning of the semester.

Only the instructor can excuse a student from a course requirement or responsibility. When conflicts can be anticipated, such as for many University-

sponsored activities and religious observations, the student should inform the instructor of the situation as far in advance as possible. For unanticipated or emergency conflicts, when advance notification to an instructor is not possible, the student should contact the instructor/instructional team as soon as possible by email, through Brightspace, or by phone. In cases of bereavement, quarantine, or isolation, the student or the student's representative should contact the Office of the Dean of Students via email or phone at 765-494-1747. Our course Brightspace includes a link to the Dean of Students under 'Campus Resources.'

ACADEMIC GUIDANCE IN THE EVENT THAT YOU ARE QUARANTINED

If you must quarantine or isolate at any point in time during the semester, please reach out to me via email to ensure that you have access to everything you need to continue to learn. You will be able to work with the Protect Purdue Health Center (PPHC) to get documentation and support, including access to an Academic Case Manager who can provide you with general guidelines/resources around communicating with your instructors, be available for academic support, and offer suggestions for how to be successful when learning remotely. Your Academic Case Manager can be reached at acmq@purdue.edu. Importantly, if you find yourself too sick to progress in the course, notify your academic case manager and notify me via email or Brightspace. We will make arrangements based on your particular situation.

Classroom Guidance Regarding Protect Purdue

The Protect Purdue Plan, which includes the Protect Purdue Pledge, is campus policy and as such all members of the Purdue community must comply with the required health and safety guidelines. Required behaviors in this class include: staying home and contacting the Protect Purdue Health Center (496-INFO) if you feel ill or know you have been exposed to the virus, properly wearing a mask in classrooms and campus building, at all times (e.g., mask covers nose and mouth, no eating/drinking in the classroom), disinfecting desk/workspace before and after use, maintaining appropriate social distancing with peers and instructors (including when entering/exiting classrooms), refraining from moving furniture, avoiding shared use of personal items, maintaining robust hygiene (e.g., handwashing, disposal of tissues) prior to, during and after class, and following all safety directions from the instructor.

Students who are not engaging in these behaviors (e.g., wearing a mask) will be offered the opportunity to comply. If non-compliance continues, possible results include instructors asking the student to leave class and instructors dismissing the whole class. Students who do not comply with the required health behaviors are violating the University Code of Conduct and will be reported to the Dean of Students Office with sanctions ranging from educational requirements to dismissal from the university.

Any student who has substantial reason to believe that another person in a campus room (e.g., classroom) is threatening the safety of others by not complying (e.g., not properly wearing a mask) may leave the room without consequence. The student is encouraged to report the behavior to and discuss the next steps with their instructor. Students also have the option of reporting the behavior to the Office of the Student Rights and Responsibilities. See also Purdue University Bill of Student Rights.

ACADEMIC INTEGRITY

Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breaches of this value by either emailing integrity@purdue.edu or by calling 765-494-8778. While information may be submitted anonymously, the more information is submitted the greater the opportunity for the university to investigate the concern. More details are available on our course Brightspace table of contents, under University Policies. For more, as well as some tips on how to avoid accusations of academic misconduct see:

https://www.purdue.edu/odos/osrr/academic-integrity/index.html

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 the link above as well as in the guide at:

https://www.purdue.edu/odos/osrr/academic-integrity/undergraduate.html

You should familiarize yourself with these policies. All apparent violations of these policies will be referred to the Office of the Dean of Students (ODOS) the Office of Student Rights and Responsibilities (OSRR).

Incidents of academic misconduct in this course will be addressed by the course instructor and referred to the Office of Student Rights and Responsibilities (OSRR) for review at the university level. Any violation of course policies as it relates to academic integrity will result minimally in a failing or zero grade for that particular assignment, and at the instructor's discretion may result in a failing grade for the course. In addition, all incidents of academic misconduct will be forwarded to OSRR, where university penalties, including removal from the university, may be considered.

"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]

Please familiarize yourself with the examples of academic dishonesty at https://www.purdue.edu/odos/osrr/academic-integrity/index.html

In particular, substitution of your work for another's and the section on plagiarism are especially relevant in this class and the era of electronic submission of written work. All of the examples on that page are unacceptable behavior.

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 missed assignments or assessments in the event of the death of a member of the student's family.* Please find details of this policy here: https://www.purdue.edu/advocacy/students/absences.html

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NON-DISCRIMINATION POLICY STATEMENT Purdue University's non-discrimination policy will be upheld in this class. 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. A hyperlink to Purdue's Nondiscrimination Policy Statement is included under University Policies on Brightspace.

http://www.purdue.edu/purdue/ea_eou_statement.html

MENTAL HEALTH/WELLNESS

If you find yourself beginning to feel some stress, anxiety and/or feeling slightly overwhelmed, try WellTrack. Sign in and find information and tools at your fingertips, available to you at any time.

If you need support and information about options and resources, please contact or see the Office of the Dean of Students. Call 765-494-1747. Hours of operation are M-F, 8 am- 5 pm.

If you find yourself struggling to find a healthy balance between academics, social life, stress, etc. sign up for free one-on-one virtual or in-person sessions with a Purdue Wellness Coach at RecWell. Student coaches can help you navigate through barriers and challenges toward your goals throughout the semester. Sign up is completely free and can be done on BoilerConnect. If you have any questions, please contact Purdue Wellness at evans240@purdue.edu.

If you're struggling and need mental health services: Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at 765-494-6995 during and after hours, on weekends and holidays, or by going to the CAPS office on the second floor of the Purdue University Student Health Center (PUSH) during business hours.

BASIC NEEDS SECURITY

Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact the Dean of Students for support. There is no appointment needed and Student Support Services is available to serve students 8 a.m.-5 p.m. Monday through Friday. Considering the significant disruptions caused by the current global crisis as related to COVID-19, students may submit requests for emergency assistance from the Critical Needs Fund.

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 the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor’s control. Relevant changes to this course will be posted onto the course website or can be obtained by contacting the instructors or TAs via email or phone. You are expected to read your @purdue.edu email on a frequent basis.

Disclaimer

This syllabus is subject to change. I will inform you with as much advance notice as possible via Brightspace and email if there are any changes.

BCHM 290 CLASS SCHEDULE

Jan	19	Introduction and what is science?
Jan	21	Embrace Ignorance!
Jan	26	Hypotheses testing, observation, and optimization are not the same.
Jan	28	Data handling and release, authorship, and plagiarism. Do we get what we pay for?
Feb	2	What are we looking at when we “see” experiments are creative artifact
Feb	4	
Feb	9	Common features of experiments and interpretation
Feb	11	Negative controls are important
Feb	16	Is it plugged in? Did you turn it on? Positive Controls
Feb	18	Fundamental approaches: digital vs continuous data in biochemistry
Feb	23	Bioinformatics: formally displaying and operating on information.
Feb	25	Bioinformatics or do you want to be a parasite?
March	2	Statistical analyses, distributions, p values, and pitfalls
March	4	Replication, reproducibility, and power: limits to interpretation
March	9	Hypothesis driven Structure-Function Research case studies
March	11	Hypothesis driven Structure-Function Research case studies
March	16	Hypothesis driven Structure-Function Research case studies
March	**18**	**Reading day**
March	23	Hypothesis driven Structure-Function Research case studies (Midterm exam due)
March	25	Hypothesis driven Structure-Function Research case studies
March	30	Discussion of exam and break-out group exercise
April	1	Observation and serendipity: CRISPR
April	6	CRISPR (continued)
April	8	CRISPR applied!
April	**13**	**Reading Day**
April	15	Science in a blender: In vivo labeling and extrapolation after extraction

April	20	
April	22	Macromolecule interactions and competition tests (in vitro)
April	27	Ethical Conduct in Research: misconduct
April	29 last class	Biochemistry is more than pathology: test protein function by more than breaking it
Remainder of time on earth		**If this is true what must also be true?**

FINALS WEEK **FINAL EXAM**