



**UNIVERSITY OF
CALGARY**

DEPARTMENT OF BIOLOGICAL SCIENCES
COURSE OUTLINE

1. Course: BIOLOGY 315 - Quantitative Biology I

Lecture Section(s) L01 MWF 14:00-14:50 ENE 243 WINTER 2018
Instructor(s): Dr. Jeremy Fox BI 260 403-220-5275 jefox@ucalgary.ca
 D2L Course: BIOL 315 L01 - (WINTER 2018) – QUANTITATIVE BIOLOGY I (W2018BIOL315L01)
 Biological Sciences Department BI 186 403-220-3140 biosci@ucalgary.ca

2. Prerequisites: **Biology 233 or 241**

See section 3.5.C in the Faculty of Science section of the online Calendar
www.ucalgary.ca/pubs/calendar/current/sc-3-5.html

3. Grading: The University policy on grading and related matters is described sections F.1 and F.2 of the online University Calendar. In determining the overall grade in the course the following weights will be used:

Individual Work

Midterm Exam	20%	Tentative: Mar. 6, 18:30-20:30, location TBD
Lab Assignments	20%	
Final Exam (Cumulative)	30%	Scheduled by the Registrar
Quizzes	11%	
Learning Surveys & Peer Evaluations	3%	

Team Work¹

Quizzes	11%
Application Activities	5%

Each piece of work submitted by the student in the categories outline above will be assigned a percentage score. A student's grade is determined by marks for both individual and team work components (team quizzes and assignments). The student's average percentage score for the various components listed above will be combined with the indicated weights to produce an overall percentage for the course, which will be used to determine the course letter grade using the conversion scale provided below.

¹At the end of the term, each student will evaluate the contributions of the other members of his/her team (using the ITP Metrics Peer Evaluation Tool). All team members will get a "peer score" based on the final peer evaluation. The peer score for a student is the average rating of the student, divided by the average overall rating for all members of the team. This provides a way to evaluate the relative contributions of each team member to the team's work. Each student's total teamwork mark will be multiplied by his/her peer score to determine his/her final mark for the teamwork component of the course (16% of final grade).

Letter Grade	A+	A	A-	B+	B	B-	C+	C	C-	D+	D
Min. Percent Required	95	88	84	80	76	72	68	64	60	55	50

4. Missed Components of Term Work: The regulations of the Faculty of Science pertaining to this matter are found in the Faculty of Science area of the Calendar in Section 3.6. It is the student's responsibility to familiarize himself/herself with these regulations. See also Section E.6 of the University Calendar

5. Scheduled out-of-class activities: Midterm exam. Tentative time: Mar. 6, 18:30-20:30, location TBD

REGULARLY SCHEDULED CLASSES HAVE PRECEDENCE OVER ANY OUT-OF-CLASS-TIME-ACTIVITY. If you have a clash with this out-of-class-time-activity, please inform your instructor as soon as possible so that alternative arrangements may be made for you.

6. Course Materials: [Required]

1. *Quantitative Biology I: Lecture Readings and Lab Skills 2014/2016*. LR Linton & L. Harder. Department of Biological Sciences. Available at the Bookstore.
 2. *The Analysis of Biological Data, 2nd ed. (2014)*. Michael Whitlock and Dolph Schluter. Available at the Bookstore.
- See attached Reserve Reading list.

Online Course Components: Some teamwork resources are provided by **ITP Metrics**, a UofC based system of secure web-based tools for forming teams and conducting Peer Evaluations and assigning student to teams. This tool is free to all students. Students will also use **Top Hat** (TH; <https://tophat.com/>) in class to enhance learning in the classroom. Students who do not have a cell phone or a portable computing device should contact the instructor in the first week of class. Use of Top Hat is not tied to any grading components of this course and is only used to facilitate classroom engagement and understanding of the material.

7. **Examination Policy:** Students will be able to use a non-programmable calculator for the midterm and final exams. Students should also read the Calendar, Section G, on Examinations.
8. **Writing across the curriculum statement:** e.g. "In this course, the quality of the student's writing in laboratory reports will be a factor in the evaluation of those reports. See also Section E.2 of the University Calendar.
9. **Human studies statement:** Studies in the Biological Sciences involve the use of living and dead organisms. Students taking laboratory- and field-based courses in these disciplines can expect involvement with and experimentation on such materials. Students perform dissections on dead or preserved organisms in some courses. In particular courses, students experiment on living organisms, their tissues, cells, or molecules. Sometimes field work requires students to collect a variety of living materials by many methods, including humane trapping. All work on humans and other animals conforms to the Helsinki Declaration and to the regulations of the Canadian Council on Animal Care. The Department strives for the highest ethical standards consistent with stewardship of the environment for organisms whose use is not governed by statutory authority. Individuals contemplating taking courses or majoring in one of the fields of study offered by the Department of Biological Sciences should ensure that they have fully considered these issues before enrolling. Students are advised to discuss any concern they might have with the Undergraduate Program Director of the Department. See also Section E.5 of the University Calendar.

10. OTHER IMPORTANT INFORMATION FOR STUDENTS:

- (a) **Academic Misconduct:** (cheating, plagiarism, or any other form) is a very serious offence that will be dealt with rigorously in all cases. A single offence may lead to disciplinary probation or suspension or expulsion. The Faculty of Science follows a zero tolerance policy regarding dishonesty. Please read the sections of the University Calendar under Section K. Student Misconduct to inform yourself of definitions, processes and penalties
- (b) **Assembly Points:** In case of emergency during class time, be sure to FAMILIARIZE YOURSELF with the information on assembly points.
- (c) **Student Accommodations:** Students needing an Accommodation because of a Disability or medical condition should contact Student Accessibility Services in accordance with the Procedure for Accommodations for Students *with Disabilities available at http://www.ucalgary.ca/policies/files/policies/procedure-for-accommodations-for-students-with-disabilities_0.pdf*.

Students needing an Accommodation in relation to their coursework or to fulfil requirements for a graduate degree, based on a Protected Ground other than Disability, should communicate this need, preferably in writing, to the Associate Head of Biological Sciences, Dr. H. Addy by email addy@ucalgary.ca or phone 403 220-3140.
- (d) **Safewalk:** Campus Security will escort individuals day or night (<http://www.ucalgary.ca/security/safewalk/>). Call 220-5333 for assistance. Use any campus phone, emergency phone or the yellow phones located at most parking lot pay booths.
- (e) **Freedom of Information and Privacy:** This course is conducted in accordance with the Freedom of Information and Protection of Privacy Act (FOI/PP). As one consequence, students should identify themselves on all written work by placing their name on the front page and their ID number on each subsequent page. For more information see also
- (f) <http://www.ucalgary.ca/secretariat/privacy>.
- (g) **Student Union Information:** VP Academic Phone: 403 220-3911 Email: suvpaca@ucalgary.ca
SU Faculty Rep. Phone: 403 220-3913 Email: science1@su.ucalgary.ca, science2@su.ucalgary.ca and science3@su.ucalgary.ca;
Student Ombuds Office: 403 220-6420 Email: ombuds@ucalgary.ca; <http://ucalgary.ca/provost/students/ombuds>
- (h) **Internet and Electronic Device Information:** You can assume that in all classes that you attend, your cell phone should be turned off unless instructed otherwise. Also, communication with other individuals, via laptop computers, Blackberries or other devices connectable to the Internet is not allowed in class time unless specifically permitted by the instructor. If you violate this policy you may be asked to leave the classroom. Repeated abuse may result in a charge of misconduct.
- (i) At the University of Calgary, feedback provided by students through the Universal Student Ratings of Instruction (USRI) survey provides valuable information to help with evaluating instruction, enhancing learning and teaching, and selecting courses (www.ucalgary.ca/usri). Your responses make a difference - please participate in USRI Surveys.

Department Approval _____ ORIGINAL SIGNED _____ Date _____

Associate Dean's Approval for
out of regular class-time activity: _____ ORIGINAL SIGNED _____ Date: _____

COURSE OUTLINE

BIOLOGY 315 QUANTATIVE BIOLOGY I

COURSE PERSONNEL:

LECTURER(S): Dr. Jeremy Fox BI 260 jefox@ucalgary.ca

LAB COORDINATOR: Dr. Jeremy Fox BI 260 jefox@ucalgary.ca

TEACHING ASSISTANTS: Contact information for TAs will be updated on D2L in the first week of lectures

OFFICE HOURS:

Dr. Fox Thursdays 3-4 and Fridays 9-10. I'm happy to meet with you (seriously, that's what I'm here for!) and am available at other times by appointment. Just email me.

EMAIL COMMUNICATION: I will make every effort to answer your emails within 24 hours (except on weekends)

OVERVIEW OF THE COURSE:

In this course you will learn:

- 1) many of the most important statistical tests used by biologists,
- 2) how to design an experiment,
- 3) how to apply the process of statistical inference to make statistical conclusions regarding experimental/observational data,
- 4) how to identify and justify the appropriate statistical test to apply given a biological research question or scenario,
- 5) how to perform and interpret statistical analyses on real data sets using the statistical computer program, R

By necessity, this course involves a fair bit of math and computer programming. However, this is not a math or programming class—these are both tools to help us quantify the statistical significance of patterns and trends. I hope to convince you that statistics is not only really useful, but really cool as well. And if you find the prospect of learning about statistics daunting, relax. I wouldn't try to teach you anything you couldn't handle. That doesn't mean the course will be easy (if it was easy, you'd be bored), but it does mean that you'll have a lot of opportunity to ask questions and get practice. I'm going to do everything I can to help you understand this material, so that at the end, like many years' worth of students before you, you're glad you took the class and go away having learned a lot.

RESPONSIBILITIES and EXPECTATIONS:

My philosophy of teaching is that it is my responsibility to 'set the stage' for learning to occur. It is my job to ensure that the classroom environment, support materials, assessment tools used all support the conditions that allow students to learn. Feedback from students is very important in this so that I will know whether such conditions exist, how well the course is going and where problems are arising. In addition to an end-of-semester course evaluation, I will also encourage that you feel free to tell us about these things at any point in the semester. It is also my goal that, as much as possible, students will spend class time actively working with course material and applying what has been learned from the readings and lectures. This means coming to class prepared and willing to participate.

My expectations of you:

- treat others in class with respect. This means:
 - no talking when I am teaching
 - turn off cell phones in class (unless we are doing Top Hat)
 - restrict your use of laptops and other electronic devices to only those activities directly related to class. If you violate this policy or disturb other students you may be asked to leave the classroom
 - be on time & come prepared; participate actively in class and lab activities

What you can expect from me:

- treat all students with respect
- start and end classes on time
- available outside of class time to discuss course content or any other course concerns
- prepare reading guides and organize review sessions for exams
- post materials for lecture and labs on D2L in a timely manner
- reply to emails within 24 h (except weekends)

TEAM BASED LEARNING:

In this class, we will be using a Team Based Learning (TBL) approach. In this process, you will spend many classes working in teams applying what you've learned from the textbook and from lectures. Teams in TBL are different than the kind of group work you may have done in other classes: the instructor forms the teams (as described below) which work together throughout the term to complete course assignments and quizzes; team members also evaluate each other's contributions to the group throughout the term. Before your team tackles an assignment, TBL uses short quizzes to make sure you've got the basics from the required readings. They're not ordinary quizzes, though: you take the quiz both individually and as a team, and you get immediate feedback, so the quizzes function as learning tools. I will do some lecturing but a lot of our class time will be spent on applying what we've learned. Here are the basics:

1. We will be forming teams in the first week of class. Research shows that *diverse* teams function the best and produce the best outcomes. So it's my job to make the teams as diverse as possible. To help with this I will be using ITP Metrics to divide you into teams of about 6 students based on previous courses you've taken, your major/year, work experience, and other factors that will help us form successful teams. These may feel like big teams at first, but research shows that teams of 5-7 individuals work best. As the term progresses, I am sure you will appreciate having the diversity of ideas and perspectives that come with a team of this size. Additionally, I will be putting measures in place (Team Contract, Peer Evaluation) to ensure there is individual accountability to the team.

2. For each module in the course, you will be assigned a reading that you are expected to complete before the start of the module; I prepare Module Objectives for all assigned readings to help you focus on the most important points in the assigned readings. At the beginning of the Module, you will individually take a short (~10-15 questions) multiple choice test called an "Individual Readiness Assessment Test" (iRAT) to see how well you've understood the concepts in the assigned reading. In calculating your final grade, *I will not count your lowest individual quiz score for the term.*

Quizzes missed without a valid excuse (medical or family emergency) will be awarded a mark of zero. Missed quizzes may not be written at a later time.

3. Immediately after taking the iRAT, you will take the *same* test with your team. This is called a "Team Readiness Assessment Test" (tRAT). For the group test, you'll use a special "scratch-off" answer sheet that immediately tells you whether you have the correct answer for full marks. If your team doesn't choose the correct answer on the first try, you make a second choice for partial credit. If it takes you three tries to get the correct answer, you again earn partial credit for the item. As for the iRATs, quizzes missed without a valid excuse will be awarded a mark of zero; missed quizzes may not be written at a later time.

4. When you've finished the tRAT, your team provides written feedback to me as to which concepts are still unclear or for which you would like more information.

5. I'll use the individual and team scores, as well as, the written feedback to determine what material needs to be discussed and clarified. The next class (or two) will be spent exploring the most difficult aspects of that module. I'll also incorporate any supplemental information that you'll need to complete the in-class team application activities that involve application of what you learned in the readings.

6. The final aspect of a module will be the *Team Application Activities*. These application activities are the most critical part of the course because they will involve real problems and applications of the material that I expect you to be able to do by the end of the module/course. During these activities, you will work with your teammates to bring all you've learned in the module together to solve a problem. My goal for you in this course is that you should be able **to do something** with the material you learn. These activities should help you achieve this and also allow you to see how I will examine your ability to apply the material on a midterm and/or final exam. All the teams will be working on the same problem and I will likely be asking teams to defend their answers in a class discussion. Some of the application activities, or parts of application activities will be graded (5% of final grade); however, the purpose of grading the activities is to provide you with feedback and show you how I would mark on a Midterm or Final exam, not to be a high-stakes assessment of your understanding (like an exam). So don't sweat the grading aspect of these activities too much!

7. The team nature of this class requires you to be in class and to do your part as a member of your Team. Quizzes missed without a valid excuse (medical or family emergency) will be awarded a mark of zero. Missed quizzes may not be written at a later time. The nature of team assignments is such that you can't do them individually, so you can't make them up. In addition, attendance at all labs is required for this course.

8. If you should miss a class quiz, team activity, lab assignment or the midterm exam for medical reasons, the only documentation that will be accepted in BIOL 315 is a completed Physician/Counselor Statement form, which can be downloaded from: http://www.ucalgary.ca/UofC/departments/UHS/PDFs/deferred_exam_form.pdf You must provide the completed form, signed by your physician, to me **within 48 hours** from the date that you missed the lab, class or midterm.

9. If you are having issues in your team, please don't hesitate to come and talk to me. Little problems can turn into big problems if not addressed. We are happy to facilitate a discussion with your team to help resolve issues.

Congratulations for reading this far in the course outline! Well done. Your conscientiousness will serve you well in this course. To show that you've read this far, please google an image of a kitten and email it to me (jefox@ucalgary.ca) with the subject line "Kitten!" Don't tell your classmates, obviously. And keep reading! ☺

Other grade components in the Course include:

1. **Lab Assignments:** Lab assignments will focus primarily on your ability to use R to statistically analyze biological problems. These assignments are to be completed **INDIVIDUALLY**. Academic misconduct on these assignments is taken very seriously. The most common form of misconduct in this course is plagiarism. Some points to keep in mind:

- I know the vast majority of students are honest. That's why I take plagiarism and other academic misconduct so seriously. I do not want the rare dishonest students to gain an unfair advantage over the many honest students, or to devalue the university degree that the many honest students are earning through their own efforts. Academic misconduct is not a victimless crime.
- It's totally fine to talk with your classmates, TAs, and instructor about lab assignments. But when it comes time for you to sit down and do the assignment, you need to do it individually.
- Copying someone else's assignment without attribution is plagiarism, *even if you rephrase it*
- Copying *part* of someone else's assignment, rather than an entire assignment, is still plagiarism
- Under University rules, voluntarily allowing your work to be plagiarised is academic misconduct. To be safe, I recommend that you do not share your lab assignments with anyone, even your close friends. There is *no* good reason for you to give anyone else a paper or electronic copy of your assignment, not even if the other person "just wants to see what answer you got" and promises not to plagiarise it.
- We have ways of detecting plagiarism, even between students in different lab sections, or involving students who took the course in previous terms, and even if a student rephrases the copied material (or uses a "spinning" website to rephrase the copied material).
- A lot of plagiarism is conducted by students who leave an assignment until the last minute, and then panic when they realize they haven't left sufficient time to complete it. You will always have plenty of time to do the lab assignments; use it! And if you do leave an assignment too late, take my advice: just turn it in late and take the late penalty. Or worst case scenario, just don't turn it in at all and take the zero. A single lab assignment is only worth a very small percentage of your final mark, so trying to plagiarize it just isn't worth the risk. The payoff is small even if you get away with it—and you're not going to get away with it. You'll get caught, and you'll end up not just with a zero on the assignment, but with whatever additional academic misconduct penalties the Dean decides to impose.

I will provide a detailed guide as to how I would like you to structure your answers for the lab assignments. These assignments will be submitted via a Dropbox on D2L. If you choose to submit your lab assignment *1 day late* (without appropriate documentation), you will be eligible for *50% of the total marks on the assignment*. Assignments more than 1 day late will be eligible for *0 points*.

2. **Midterm & Final exams:** The midterm exam and final exams will be a combination of multiple choice and short-answer format and will consist mainly of the same types of questions as the team application activities and quizzes completed during the term. Exam questions will be based on lectures, assigned readings, and lab material. The final exam will be cumulative. Both the midterm and final exam will include material covered in readings, lectures, application activities and labs.

BIOL 315 W 2018 – Tentative Course Schedule¹

Module	Reading	Date		Class activity	Labs	Lab assignment
Orientation to the course	Handouts	Jan.	8	How the course will work; why do statistics	No lab	No assignment
			10	Getting into teams, contracts, practice RAT		
1. Descriptive statistics and estimating with uncertainty	Ch 1, 3, 4		12	Module 1: iRAT and tRAT Quiz	Lab 1: Skills 1-4. Introduction to R	No assignment
			15	Module 1: Descriptive Statistics and Sampling		
			17	Module 1: Estimating with uncertainty		
			19	Module 1: Estimating with uncertainty & Team Activity #1		
			22	Module 1: Team Activity #1		
			24	Module 2: iRAT and tRAT Quiz		
2. Hypothesis testing and statistical inference	Ch 6 and interleaf 3		26	Module 2: Hypothesis testing, inferential statistics, errors of inference	Lab 2: Skills 5-9. Graphing in R	Assignment 1: summary statistics, graphing. 2%. Due Feb. 2.
			29	Module 2: Team Activity #2		
			31	Module 3: iRAT and tRAT Quiz		
3. Proportions and frequencies	pp. 179-185, 191-193, 217-223	Feb.	2	Module 3: Binomial and Poisson distributions	Lab 3: Skills 10-12. Sampling distributions, sampling error.	No assignment
			5	Module 3: Goodness of fit (G-test)		
			7	Module 3: Contingency analysis (G-test)		
			9	Module 3: Team Activity #3		
			12	Module 4: iRAT and tRAT Quiz		
4. Testing hypotheses about one or two means	Ch 10, 11, pp. 328-335		14	Module 4: Normal distribution, central limit theorem	Lab 5: Skill 16. Type I and II errors, single-sample t-test	No assignment
			16	Module 4: t-distribution, t-tests		
			19	Reading Week; no class		
Reading week, no class			21	Reading Week; no class	No lab	No assignment
			23	Reading Week; no class		
			26	Module 4: Team Activity #4		
4 (continued). Testing hypotheses about one or two means			28	Module 5: Experimental design (no iRAT, tRAT)	Lab 6: Skills 17-18. Paired and two-sample t-tests	Assignment 3: t-tests. 3%. Due Mar. 9.
5. Experimental design	Ch 14, and interleaves 2, 4, 5, 6	Mar.	2	Module 5: Experimental design		

¹ The schedule may slightly deviate from this due to the needs of the class. All reading chapter and page numbers refer to the required textbook by Whitlock and Schluter. All lab Skills are found in the required Lab Manual, available at the bookstore.

			5	Module 5: Case study	No lab	No assignment
Review session			7	Review and midterm practice		
6. Comparing two or more means	Ch 15		9	Module 6: iRAT and tRAT Quiz		
			12	Module 6: GLM, SS, ANOVA	Lab 7: Skills 19-21. ANOVA, Tukey's HSD, checking assumptions	Assignment 4: ANOVA, Tukey's HSD. 3%. Due Mar. 23.
			14	Module 6: GLM, SS, ANOVA		
			16	Module 6: Assumptions, Tukey's HSD test		
			19	Module 6: Team Activity #5	Lab 8: Skills 22-23.	Assignment 5: transformation, permutation. 3%. Due Apr. 2.
7. Dealing with violations of assumptions: transformations, permutation tests, bootstrapping	pp. 369-383, 394-398, 639-646		21	Module 7: iRAT and tRAT Quiz	Transformation, permutation	
			23	Module 7: transformations		
			26	Module 7: permutation tests, bootstrapping	Lab 9: Skills 24-25. Correlation and regression	Final lab assignment. 7%. Due Apr. 13.
			28	Module 7: Team Activity #6		
8. Regression and correlation	Ch 16, 17		30	Good Friday; no class		
		Apr.	2	Module 8: iRAT and tRAT Quiz	Lab 10: All skills. Review lab.	Work on final lab assignment.
			4	Module 8: correlation		
			6	Module 8: regression		
			9	Module 8: Team Activity #7	No lab	No assignment
Review			11	Review and practice final		
			13	Review and practice final		

¹ The schedule may slightly deviate from this due to the needs of the class. All reading chapter and page numbers refer to the required textbook by Whitlock and Schluter. All lab Skills are found in the required Lab Manual, available at the bookstore.