CHEM 100: Atoms to Cells **Spring 2019**

Syllabus

I. General Information

Course Times and Location: Tuesdays and Thursdays from 3:30-4:50, ISC 1111; the "fourth hour" on Fridays from 2:00-2:50 will be used only for small group work, as described below

Prerequisites: none (however, high school biology, physics, and/or chemistry would be helpful)

Instructor: Dr. Beverly Sher
Office Location: ISC-3, Room 2283
Campus phone: 1-2825 (don't leave voice mail-I don't check it very often)
E-mail address: btsher@wm.edu

Office Hours: Tuesdays from 2:00 to 3:00 PM, or by appointment; schedule appointments by email.

II. Course Description

Somewhere between 3.5 and 4 billion years ago, life appeared on Earth. While the details of the long evolutionary process that led to life as we know it are still the subject of lively debate, the scientific consensus is that life's beginnings lie in physics and chemistry, and that life is only possible because of the special properties of the world at the nanoscale. Unfortunately, the physical intuition that we develop as children by interacting with the world at the everyday human scale does not always serve us well as we try to think about molecular and cellular phenomena. In this course, we will use quantitative as well as qualitative information about molecules and cells to develop better intuition for why cells behave as they do.

III. Course Objectives

On the William and Mary website, COLL 100 courses are described as follows:

"COLL 100 is about big questions and big ideas — the significant concepts, beliefs and creative visions, theories and discoveries that have shaped our understanding of the world. Whichever COLL 100 course you choose, you will encounter and learn about the discoveries, texts, and knowledge that are fundamental to further study in one or more academic disciplines. You'll become more adept at culling information and using it effectively. And you'll develop your abilities to present and defend what you have learned, with opportunities to express your ideas in communications media beyond the written word (for example, a visual, quantitative, oral, digital, or other creative presentation)."

The "Big Idea" at the heart of this course is that size matters: in fact, life is possible only because of the way the world works at the nanoscale.

In this course, we will also explore some big scientific questions, including:

-What is life?
-How do the molecular machines that cells use work?
-How do cells manage and transfer information?
-How do cells produce and use energy?
-How might these cellular processes have evolved?

In this course, students will:

-Acquire the tools of basic cell biological numeracy
-Explore some of the big scientific questions of molecular and cellular biology
-Develop better intuition about biological phenomena that take place at the molecular and cellular scales

-Improve their ability to make well-informed scientific estimates, as well as their confidence in their estimation skills
-Improve their oral communication skills, as well as their confidence in those skills
-Improve their visual communication skills, as well as their confidence in those skills

IV. Texts and Other Readings

Reference books:

Cell Biology by the Numbers, by Ron Milo and Rob Phillips, illustrated by Nigel Orme
(This book is available at no cost at http://book.bionumbers.org/ ; serious biology students might want to buy a paper copy, though, as the paper version is much easier to navigate than the online version is)
The Craft of Scientific Presentations: Critical Steps to Succeed and Critical Errors to Avoid, Second Edition, by Michael Alley (available as an e-book in Swem Library; serious science students should read the entire book in their infinite free time!)
Writing Papers in the Biological Sciences, Fifth Edition, by Victoria McMillan (available in Swem Library)

Books we'll read and discuss:

Life's Ratchet: How Molecular Machines Extract Order from Chaos, by Peter M. Hoffman
The Deeper Genome: Why There is More to the Human Genome Than Meets the Eye, by John Parrington
The Vital Question: Energy, Evolution, and the Origins of Complex Life, by Nick Lane
what if?, by Randall Munroe, creator of xkcd (this book will be a resource throughout the course)

There will also be short reading, viewing, and listening assignments from other sources; these will be available via our Blackboard site.

V. Class Climate, Culture, and the Honor System

Most class periods will be spent in a combination of class discussion and small group work. In order for these activities to be productive, all students need to feel comfortable participating. We will create and maintain an atmosphere of mutual respect in which everyone's ideas can be heard.

Collaboration and Feedback

Science is collaborative, and scientists always seek feedback from their colleagues when preparing papers and oral presentations. I encourage students to collaborate in this way as well: thus, collaboration and peer feedback will be integral to many assignments in this course. "Peer feedback" includes helpful comments and constructive criticism; it does NOT, however, include doing someone else's work for them.

Because the College of William and Mary has an honor system, I feel comfortable encouraging collaboration between students under the rules described in the assignment sheets for this course. Please see me if you have any questions about how the Honor System applies to your responsibilities in this course.

Plagiarism

Plagiarism is a serious Honor Code violation. Our writing manual, Victoria E. McMillan's *Writing Papers in the Biological Sciences (Fifth Edition),* defines plagiarism as follows:

"*Plagiarism* is the theft of someone else's words, work, or ideas. It includes such acts as (1) turning in a friend's paper (or a paper purchased online) and saying it is yours; (2) using another person's data or ideas without acknowledgement; (3) copying an author's exact words and putting them in your paper without quotation marks; and (4) using wording that is very similar to that of the original source but passing it off as entirely your own, even while acknowledging the source." (McMillan, p. 23.)

In this course, student work found to contain plagiarized material will be worth zero points, and will guarantee the perpetrator a visit with the Honor Council. If you have questions about plagiarism and how to avoid it, ask me in person, by phone, or by email: I will be happy to answer them.

Appropriate Use of Media Sources

We will discuss the proper ways to give credit to sources of images and other media in class, and our reference books for the course discuss these topics, too. In addition, the College's Writing Center recommends the following websites:

Swem's open media guide: http://guides.swem.wm.edu/openmedia

Notre Dame's guide to remixing and image attribution: https://remix.nd.edu/?q=node/78

VI. Course Responsibilities

Preparation for Class Discussions

Unlike most science courses, this is a seminar course, and most class periods will include group discussion of the reading assignments. For this reason, students must come to class prepared to talk about the day's reading. For each reading assignment, students must bring a typed list of points to raise and questions to ask (discussion points) to class; these lists will be collected at the end of each class session and used as a partial basis for the class participation grade. Guidelines for discussion points are posted in the Information section of the Blackboard site.

Journal Club

For this assignment, students will do an assertion-evidence slide-based group presentation of a scientific article in a journal club format. Students will be grouped by the instructor. Guidelines for this assignment are posted in the Information section of the Blackboard site; a tutorial describing assertion-evidence presentations is available at http://www.assertion-evidence.com/tutorial.html . The journal club articles, which will be chosen by the instructor, will be posted in the Assignments section of the course Blackboard site four weeks before they are to be presented in class. Three weeks before the presentation, the group will meet with Dr. Sher in her office during the Friday "fourth hour" to discuss the article that they will be presenting. Two weeks before the presentation, the group will email a provisional outline and slides to Dr. Sher so that she can provide feedback. One week before the in-class presentation, during the "fourth hour," the group will do a practice talk for their assigned audience.

During the in-class presentation, *the presenters* will provide an overview of the article, supply explanatory background information, answer questions, and direct class discussion of the article. The presentations will be approximately twenty minutes long, with the presentation time split evenly between the members of the group, and they will be followed by five to ten minutes of class discussion facilitated by the presenters.

All other students must read the article in advance and prepare 1) a short written summary of the paper, 2) a one-slide visual summary of the paper (a graphical abstract), and and 3) a set of questions on the paper, all to be turned in on the day of the presentation. These items will be graded. In addition, each student will be required to ask a total of three questions in class during journal club presentations over the course of the semester. Students' written questions, in-class questions, and practice talk feedback will count towards the class participation grade.

Quizzes

There will be short weekly quizzes on the biologically relevant numbers that we will memorize over the course of the semester.

Fermi Problems

"Fermi problems," named after Enrico Fermi, the famous nuclear physicist, are estimation problems that require only educated guesses and a few key numbers to solve. The classic example of a Fermi problem is "How many piano tuners are there in Chicago?" Each week, students will solve Fermi problems in class; their solutions will be explained in a worksheet that includes the answer and a sketch of the method used to arrive at the solution. The numbers that we will memorize over the course of the semester will be very useful for the Fermi problems!

Semester Project

For this project, each student will come up with and then solve, or come as close as available data make it possible to solving, a biologically relevant estimation problem. The project will require library research and the use of the estimation skills that we will be practicing in class this semester. Students will present their problem and solution in a video recording of a whiteboard talk, along with a research worksheet in which the student sketches and explains the solution and acknowledges the sources used to solve the problem. This project will also require a practice presentation to be given for an audience that includes at least one person who is taking the course this semester. Estimation problems for this assignment must be approved in advance by the instructor.

Peer Feedback

Each student must provide feedback for a journal club practice talk during the semester. In addition, each student must provide feedback on another student's practice talk for the semester project.

VII. Course Policies

Grading

Course grades will be determined as follows: class participation (discussion points, in-class worksheets, in-class questions during journal club presentations) 20%; peer feedback 5%; journal club paper questions, summaries, and graphical abstracts 10%; quizzes 10%; journal club presentation 20%; Fermi problems 10%; semester project 25%. There will be no exams.

Deadlines and Late Penalties

1) In-class worksheets (including Fermi problems), discussion points, and journal club summaries, graphical abstracts and question lists must be turned in by the end of class on the day that they are due. Late work in any of these categories will be worth zero points.

2) All other course assignments will also be due in class, unless otherwise specified. Late assignments will lose points according to the following rules:

    *Assignments turned in within the first 24 hours after the end of the class period in which they are due will be worth 25% less than their original value.
    *Assignments turned in within the second 24 hours after the end of the class period in which they are due will be worth 50% less than their original value.
    *Assignments turned in within the third 24 hours after the end of the class period in which they are due will be worth 75% less than their original value.
    *Assignments that are turned in more than 72 hours after the end of the class period in which they are due will be worth zero points.

3) A make-up quiz can be arranged with the instructor if (and only if) the student had an excused absence from class on the day the original quiz was given.

4) There will be no make-up Fermi problems. If a student has an excused absence on a day on which we do a Fermi problem in class, the Fermi problem grade for the course will be adjusted so as not to penalize the student.

"Technical Difficulties" and Deadlines

To avoid late penalties caused by problems with computers, printers, and other devices:

1) Finish your work early. Murphy's Law governs the behavior of electronic devices such as computers and printers, so you should not be planning to print your work half an hour before class begins: that's asking for trouble. Print it well before it is due!

2) Use good computer hygiene. Save frequently, and save to multiple locations: email your work to yourself, copy it onto a flash drive…

2) If a technological disaster strikes and you cannot print your finished work, email it to me *before* class starts so that I will know that it was finished on time: doing so will stop the clock. Work emailed to me after class starts will receive the standard late penalty. Note that I will not print out emailed assignments and grade them: you must still turn in a paper copy in order to receive credit for the assignment even if you have emailed your work to me.

Extensions

Extensions will *only* be given in consultation with the Dean of Students' Office. If you are having health difficulties or other serious problems that are keeping you from finishing your work on time, the Dean's Office can help you negotiate appropriate remedies with your professors. The Dean's Office is the safety net for all students at the College: don't wait until your problems are insurmountable to talk with the nice people who work there.

Attendance

Because having a good class discussion depends on the participation of all students, your presence in class is essential. Thus, *I will be taking attendance*. Three unexcused absences will lower your course grade by one letter grade (A to B, for example); six unexcused absences will lower your grade by two letter grades; and so on. Excused absences should be arranged with me *in advance*.

*If you are a member of an athletic team or other official College group that travels during the semester, tell me about any upcoming absences related to your membership in that group in advance. These absences will be excused.
*Missing class because you are leaving early for a school break, or because you are coming back to campus late after a break, will *not* be excused, so make your travel plans accordingly. If William & Mary is in session, you should be in class.
*Alarm Clock Disease is not an excuse for missing class.
*If you are too sick to come to class, email me or call me *before* class starts that day telling me that you are sick and will be absent. If a pattern of such absences develops, I may require you to confirm the fact that you have indeed been missing class because you were sick with the Dean of Students' Office.
*If an emergency arises and you have no access to email or the phone (for example, you're seriously ill and have been hospitalized), get in touch with me as soon as you can afterwards, and we'll work things out.

Late Arrivals

If you arrive more than five minutes after class starts, it will count as half an unexcused absence. Thus, six late arrivals will lower your course grade by a full GPA point. Participation in an athletic training program will not be accepted as an excuse for arriving late: your coaches and trainers need to respect your academic schedule.

VIII. Course Calendar

Deadlines are underlined. The discussion topics for each class period are given below; the reading assignments will be posted on our Blackboard site one class period before they are to be discussed. This calendar is subject to revision due to unpredictable events such as weather-related closings.

Date	**Topic**
Thursday, January 17	Introduction
Tuesday, January 22	*Life's Ratchet* I
Thursday, January 24	*Life's Ratchet* II

Important Note: Add/Drop ends at 11:59 PM on Monday, January 28

Tuesday, January 29	*Life's Ratchet* III
Thursday, January 31	*Life's Ratchet* IV
Tuesday, February 5	*Life's Ratchet* V
Thursday, February 7	*Life's Ratchet* VI
Friday, February 8	Journal club group #1 meets with Professor Sher, ISC 2283
Tuesday, February 12	(no class) Emailed list of possible research questions for semester project due by class time
Thursday, February 14	*Life's Ratchet* VII
Friday, February 15	Journal club group #2 meets with Professor Sher, ISC 2283
Tuesday, February 19	*Deeper Genome* I
Thursday, February 21	*Deeper Genome* II
Friday, February 22	Journal club group #1 practice talk in ISC 1291, and group #2 is the audience; Journal club group #3 meets with Professor Sher, ISC 2283
Tuesday, February 26	*Deeper Genome* III Deadline for semester project topic approval
Thursday, February 28	*Deeper Genome* IV Journal club presentation #1 Due in class: Semester project topic worksheet

Spring Break: March 2-10

Tuesday, March 12	*Deeper Genome* V
Thursday, March 14	*Deeper Genome* VI
Friday, March 15	Journal club group #2 practice talk in ISC 1291, and group #3 is the audience Journal club group #4 meets with Professor Sher, ISC 2283

(Important Note: The withdrawal deadline for Spring 2019 is at 11:59 PM on Friday, March 15)

Tuesday, March 19	*Deeper Genome* VII
Thursday, March 21	*Deeper Genome* VIII Journal club presentation #2
Friday, March 22	Journal club group #3 practice talk in ISC 1291, and group #4 is the audience Journal club group #5 meets with Professor Sher, ISC 2283
Tuesday, March 26	*Deeper Genome* IX
Thursday, March 28	*Deeper Genome* X Research progress report for semester project due Journal club presentation #3
Friday, March 29	Journal club group #4 practice talk in ISC 1291, and group #5 is the audience Journal club group #6 meets with Professor Sher, ISC 2283
Tuesday, April 2	*The Vital Question* I
Thursday, April 4	*The Vital Question* II Journal club presentation #4
Friday, April 5	Journal club group #5 practice talk in ISC 1291, and group #6 is the audience
Tuesday, April 9	*The Vital Question* III
Thursday, April 11	*The Vital Question* IV Journal club presentation #5
Friday, April 12	Journal club group #6 practice talk in ISC 1291, and group #1 is the audience
Tuesday, April 16	*Vital Question* V
Thursday, April 18	*The Vital Question* VI Journal Club presentation #6
Tuesday, April 23	*The Vital Question* VII Semester project practice talk peer feedback sheet due in class
Thursday, April 25	Semester project discussion Semester project videos and research reports due