

Fall 2021: **BIO/MBB/MAT 355**

## Introduction to Computational Molecular Biology

### Syllabus

**Time:** Mon / Wed 12:00 - 1:15 pm | **Location:** Tempe - Hayden Library C10

**Instructor:** Dr. Qiyun Zhu, Assistant Professor, School of Life Sciences

**Email:** [Qiyun.Zhu@asu.edu](mailto:Qiyun.Zhu@asu.edu) | **Office:** BDB 324A | **Phone:** (480) 727-9992

**Office hour** (remote only): Wed 1:30 - 3:30 pm or by appointment | **Zoom:** 659 730 4367

**Teaching assistant:** Ziqi Zhu | **Email:** [zzhu49@asu.edu](mailto:zzhu49@asu.edu)

**Office hour** (remote only): Fri 1:30 - 3:30 pm or by appointment | **Zoom:** 390 353 8831

---

**Course Description:** Due to the large volume of data generated by genome sequencing and cellular measurements of gene expression changes, computer science and mathematics have profoundly changed the science of modern biology. Computational methods are now critical to the development of both experimental and analytical tools in biological sciences. This course will provide students from all disciplines with an introduction to basic computational skills that are used to understand and analyze biological data. It combines both theories and applications, with a focus on the later.

**Main Objectives:** The main aims of the class are for each student to:

1. Become familiar with different types of data that result from molecular biology research or applications such as in biomedicine,
2. Become familiar with some of the online tools that are available for analyzing these data,
3. Understand the algorithms behind the tools so that you can judge which tool is appropriate and which choices should be made during usage, and
4. Gain practical experience in obtaining data from online resources and using tools to analyze the data within an appropriate biological context.

**Format:** The course will be taught in the classroom as a combination of lectures and computer labs. It consists of 12 topics of the area of computational molecular biology, each of which will be covered by two consecutive classes each week.

**Prerequisites:** Because this is an upper level course, we prefer that students take MAT 119, 210, 243, 251, 265, or 270, or STP 220, 226, or 231 prior to this course. However, all mathematical, statistical and programming skills needed during the course will be covered in class.

**Course materials:** Slides and programming codes demonstrated during the class will be provided to the students through a shared Google Drive folder after each class. Other materials

will be made available to the students where applicable. Redistribution of course materials by the student without the instructor's approval is prohibited.

**Textbook:** **No text book is required** for this class. Computational molecular biology is a rapidly evolving field. The learning materials are widely available and frequently updated on the Internet, in the forms of forum discussions, program documentations and journal papers, in addition to electronic course materials.

However, the students may find the following *optional* textbooks beneficial if they want to extend their understanding of computational molecular biology, in both breadth and depth, on the topics covered or not covered by the classes.

- **An Introduction to Applied Bioinformatics (IAB)** by J Gregory Caporaso. This is a free, interactive ebook, available at: <http://readiab.org>.
- **Exploring Bioinformatics: A Project-Based Approach** (2nd Edition) (2015) by Caroline St. Clair and Jonathan E. Visick.
- **Bioinformatics Algorithms: An Active Learning Approach** (3rd Edition) (2018) by Phillip Compeau and Pavel Pevzner.

**Computer:** Each student is expected to **bring a laptop to the class**. It is required for practicing courseworks using bioinformatics programs. Any mainstream operating system (Windows, macOS or Linux) will work. A tablet or a smartphone (with Android or iOS) may work in only limited circumstances, and is not recommended. If you do not have a laptop, please discuss with the instructor in advance for accommodations.

**Programming:** The students are expected to **program in Python** as part of the coursework. The necessary Python skills needed will be covered in the class. No prerequisite coding experience is required.

**Web account:** Each student is expected to have an ASU-provided **Google Drive** account (<https://uto.asu.edu/google-drive>) to perform course activities.

---

**Grading Scheme:** Quizzes: 25%, Project: 35%, Exams: 40%.

**Letter Grades:**

<b>A+</b> 100-97%	<b>A</b> 96.9-94%	<b>A-</b> 93.9-90%	<b>B+</b> 89.9-87%	<b>B</b> 86.9-84%
<b>B-</b> 83.9-80%	<b>C+</b> 79.9-76%	<b>C</b> 75.9-70%	<b>D</b> 69.9-60%	<b>E</b> <60%

**Quizzes:** Starting from the third week (**Sep 6**), students will take an in-classroom quiz during each Monday class, at 12:05-12:10 pm (i.e., 5-10 minutes into the class). Students will use their computer to access and answer the questions in the Canvas system. Each quiz consists of five questions, graded on a scale of 0-5 points. An untaken quiz will be graded as 0. Make-up quizzes are not available. A total of 12 quizzes will be given in the semester, of which the two lowest scores will be dropped, and the remaining 10 will be calculated into the final grade.

**Group project:** Students will form groups of 4-5, and complete a group project of researching any bioinformatics-related question selected by the group members and approved by the instructor. You will apply knowledge and skills acquired in the class to conduct the analysis. Each group will perform a presentation to introduce the outcome of the project to the class during the last week of the semester (Nov 29). The presentation will be reviewed and graded by your peers and the instructor. A write-up by each group describing the project is due by Dec 6, and evaluated by the instructor. It should cover basic elements of a research article, including introduction, methods, results, and discussion.

**Exams:** Students will take two exams during the semester (midterm: Oct 13, final: Dec 6). The two exams have the same weight (20% each) in the final grade. The exams will be based on the knowledge covered in the class. Students must take the exams independently, without using reference materials or electronic devices. Make-up exams require permission in advance with a Doctor's excuse in the case of illness.

---

**COVID-19 policy:** Please refer to the ASU Coronavirus website for updated announcements: <https://eoss.asu.edu/health/announcements/coronavirus>.

The ASU Face Cover Policy (<https://www.asu.edu/about/fall-2021#face-coverings>) requires the wearing of face covers in locations where physical distancing may not be possible, which includes classrooms, teaching laboratories, studios and workshop settings.

The university continues to strongly recommend that people get vaccinated and ASU continues to provide COVID-19 vaccines free of charge to students, faculty and staff. Greater rates of vaccination are the best tool available to reduce the rate of transmission in the community, which could change the applicable face covering guidance.

---

### Course Schedule

Mon	Content	Wed	Content
Aug 23	Introduction to molecular biology	Aug 25	(same)
Aug 30	Biological sequence data	Sep 1	(same)
Sep 6	Pairwise sequence alignment	Sep 8	(same)
Sep 13	Homology searching	Sep 15	(same)
Sep 20	Multiple sequence alignment	Sep 22	(same)
Sep 27	Molecular phylogenetics	Sep 29	(same)
Oct 4	Molecular phylogenetics (cont.)	Oct 6	(same)

Oct 11	Fall Break	<b>Oct 13</b>	<b>Midterm exam</b>
Oct 18	Comparative genomics	Oct 20	(same)
Oct 25	Gene prediction	Oct 27	(same)
Nov 1	Gene expression analysis	Nov 3	(same)
Nov 8	Gene expression analysis (cont.)	Nov 10	(same)
Nov 15	Gene regulatory network	Nov 17	(same)
Nov 22	Structural biology	Nov 24	(same)
Nov 29	Group project presentation	Dec 1	(same)
<b>Dec 6</b>	<b>Final exam</b>		

**Academic Dishonesty:** Academic honesty is expected of all students in all examinations, papers, laboratory work, academic transactions and records. The possible sanctions include, but are not limited to, appropriate grade penalties, course failure (indicated on the transcript as a grade of E), course failure due to academic dishonesty (indicated on the transcript as a grade of XE), loss of registration privileges, disqualification and dismissal. For more information, see <http://provost.asu.edu/academicintegrity>.

**Disability Accommodations:** Qualified students with disabilities are encouraged to make their requests at the beginning of the semester to get disability accommodations. Disability information is confidential. Verification of eligibility from the Student Accessibility and Inclusive Learning Services (<https://eoss.asu.edu/accessibility>) is required prior to receiving disability accommodations. Their contact information is: Matthews Center Building, 1st floor. Phone: (480) 965-1234. Fax: (480) 965-0441. Email: [Student.Accessibility@asu.edu](mailto:Student.Accessibility@asu.edu).

**Title IX:** Title IX is a federal law that provides that no person be excluded on the basis of sex from participation in, be denied benefits of, or be subjected to discrimination under any education program or activity. Both Title IX and university policy make clear that sexual violence and harassment based on sex is prohibited. An individual who believes they have been subjected to sexual violence or harassed on the basis of sex can seek support, including counseling and academic support, from the university. If you or someone you know has been harassed on the basis of sex or sexually assaulted, you can find information and resources at <https://sexualviolenceprevention.asu.edu/faqs>.

As a mandated reporter, I am obligated to report any information I become aware of regarding alleged acts of sexual discrimination, including sexual violence and dating violence. ASU Counseling Services at <https://eoss.asu.edu/counseling> is available if you wish to discuss any concerns confidentially and privately.

**Inclusion:** ASU encourages faculty to address and refer to students by their preferred name and gender pronoun. If your preferred name is different than what appears on the class roster, or you would like to be addressed using a specific pronoun, please let me know.

---

**Syllabus Disclaimer:** This syllabus is tentative and should not be considered definitive. The instructor reserves the right to modify it (including the dates) to meet the needs of the class. Every effort will be made to avoid changing the course schedule but the possibility exists that unforeseen events will make syllabus changes necessary. It is the student's responsibility to attend classes regularly and make note of any change.