

**BIO 58005: Systems and Integrative Biology**  
Fall 2021

Tuesday: 1:40 am – 3:30 pm (Hybrid)  
Wednesday: 11:40 am – 1:30 pm (Hybrid)

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Office hours (online): **Mondays at 8:40 – 9:30 am, Wednesdays at 10:30 – 11:30 am or by appointment** (E-mail me to schedule an appointment).

### **COURSE OVERVIEW**

“Superimposed on the hierarchical framework of defined components of a cell there is another layer. This second layer is highly flexible and can take on an almost infinite variety of forms, like soft and responsive flesh on a bony skeleton. The deep question is whether this higher layer in the construction of cells is itself organized. Are there hierarchies, or at least rules, in the protein-modifying, RNA splicing, gene-regulating processes of a cell? If so, then we have a chance of understanding them. If not, we will never know exactly what a cell will do next. If the detailed chemistry of the cell is simply the outcome of a historical ragbag of ad hoc interactions, then it will be no more predictable than the weather.

I do not have an answer to this question. But two features of cells might be relevant. One is a sense of time, or causation - knowledge of the way that things in the real world follow in a certain sequence. The other is integrity, which enables a cell to distinguish between what belongs to itself and what belongs to the outside world.”

- Dennis Bray, *Wetware: A Computer in Every Living Cell*

Integrative biology is an effective approach to resolving the complex issues we are facing in the 21st century because the solutions to the big problems that remain no longer fit into the confines of a single scientific discipline. Integrative science bridges across disciplines, biological organization, and diverse taxa over time (comparative investigations) to investigate crucial biomedical and evolutionary questions, requiring an integrative approach. Systems biology (derived from systems engineering) is one integrative biology approach used to understand the sum of the parts via their interaction by considering all of the factors which may be involved. This approach focuses on interactions as opposed to the biological entity itself and is in stark contrast to decades of reductionist biology. Consequently, this new approach has recently resulted in many different breakthrough discoveries.

This course can serve to link concepts learned in other upper level BIO courses at the sub cellular and cellular level (i.e. Biochemistry and Cell Biology) with ones focusing on

the organismal level (i.e. Immunology and Genetics), and beyond (i.e. Ecology), with statistics, an engineering framework, and computational tools (i.e. Bioinformatics), required to carry out integrative research. Although there will be some overlap with these courses mentioned above this new course will focus on modeling, experimental, and computational tools required to integrate data from different fields, thus propelling the investigation in a novel direction, with a distinction from the traditional biological fields.

### **COURSE GOALS**

Students will learn how to define and connect concepts across different levels of biological organization. Students will be able to describe and analyze systems biology datasets. In general, they should be able employ complex statistical and computational tools to analyze integrative biological datasets.

By the end of the course students should be able to:

1. demonstrate an understanding of the biological, computational, engineering, mathematical, and physical sciences relevant to integrative biology
2. critically analyze literature and contemporary topics in integrative and systems biology, and present such analyses in written and oral formats
3. adopt a model-building approach to analyze large-scale experimental data
4. explain the importance and impact of topics in integrative biology to individuals from other disciplines in the natural sciences and engineering as well as the general public
5. demonstrate cutting-edge experimental techniques that are currently being used in integrative and systems biology.

### **SUGGESTED TEXTBOOK READING MATERIAL**

Computational Systems Biology by Andres Kriete and Roland Eils

- There is a PDF copy of this on SUcourse+

### **GRADE DETERMINATION**

Points	Item	Due Date
25	Leading a paper discussion	Will be assigned in class
50	Paper discussion assignments	Evaluated throughout
50	Independent grant proposal rough draft	November 2 <sup>nd</sup>

25	Independent grant proposal final draft	December 7 <sup>th</sup>
25	Participation in grant panel reviews	Throughout December
100	Written exam I (during class time and in person)	November 10 <sup>th</sup>
100	Independent group project reports	Jan 10 <sup>th</sup>
375	Total	

**Final letter grades will be determined based on the following numerical basis...**

Letter Grade	Criteria for Earning Grade
A	93.0 – 100 %
A -	90.0 – 92.99 %
B +	87.0 – 89.99%
B	83.0 – 86.99 %
B -	80.0 – 82.99 %
C +	77.0 – 79.99%
C	73.0 – 76.99 %
C -	70.0 – 72.99 %
D +	67.0 – 69.99 %
D	63.0 – 66.99 %
D -	60.0 – 62.99 %
F	Less than 60.0 %

**ACADEMIC MISCONDUCT/PLAGIARISM**

**Academic Integrity Policy -- YOU MUST READ AND FOLLOW**

**Each student will be evaluated only for her/his own work.** Students are encouraged to work and study together; however, what you put down on your problem sets, lab reports, and exam papers should be your own work in your own words. Be aware that you will not be helping your friends by allowing them to copy. Do not allow your friends to make use of your problem sets or, lab reports and exams, allowing them to copy will not help them in the long run. Such behavior, as all forms of cheating, is unfair and disrespectful to yourself, to all the students in the class, to your instructors and teaching assistants, and to the University. A student involved in cheating has misused the trust extended to him or her. If discovered, **such behavior will have DISCIPLINARY consequences for all parties involved.**

**Violations of academic integrity will result in zero grades for that worksheet or exam, both for those who cheat and those who allow and help them cheat.** In all such situations we will ask you to have a face-to-face meeting with the instructor. We have mutual trust and respect for each other as individuals while sharing a collaborative learning experience. This is very valuable for all of us, and having to lose this trust and respect would be very regrettable.

**Late work policy:** Due dates for all written assignments, including discussion forms and big project write-ups, are strict. Extensions will be granted only for cases of true hardship and only when arranged prior to the due date. **Late work will be penalized by a 10% grade reduction per day and will not be accepted if it is more than 2 days late.** Only notes from the Health Center and/or signed note from a medical doctor or President of the University may count as an excuse for late work.

## **EXAMS**

Each exam will build on the material from the entire course, and so anything you have learned up to that point is fair game. Each exam will evaluate your understanding of all lecture material covered to that point in time. They will be closed note and textbook exams. All students must take the last exam at the final exam time designated by the university.

## **E-MAIL**

Check for messages about the course frequently. This is also the best way to make an appointment with me, the instructor. I will send e-mails to your Sabanci e-mail address, be sure to check it.

## **DISCUSSION PAPERS**

Articles from the primary literature will be assigned and we will discuss these during the lecture portion of the course. These discussions will provide in-depth current information in the field of systems and integrative biology, and will give you valuable practice in critiquing the primary scientific literature. As you read each article, fill out the accompanying discussion form that will be graded. This is similar to a form I use when reading scientific papers. Each paper discussion you will need to turn in a filled out copy the night before we have the discussion.

Strive to fully understand all the results, figures, and conclusions - though for some, perhaps most, this might be a challenge. If you have questions (and you should!) about goals, materials and methods, etc., write these issues down and *circle* each question. Use the Internet in two ways. Use Web of Science's (accessible via the library's database pages) to see how many people have cited the article you have read (write down the number), and to see what sorts of articles are being written (write down the citation of one article that sounds interesting; you don't need to actually read the article). And use the Internet to research what the organism(s) look like, the meaning of terms, etc. There will be parts of these papers that you cannot decipher no matter how hard you try; that's okay, but it is important to know which parts are confusing so we can discuss them in class.

**Disability Accommodations:** If you need disability-related accommodations (extra time, etc.) for this course, please contact Ş.Ceren Başak Araz at the Disable Students Support Unit Center of Individual and Academic Development (CIAD)

address: Orhanlı, Tuzla, 34956, Istanbul, Turkey

e-mail: [specialneeds@sabanciuniv.edu](mailto:specialneeds@sabanciuniv.edu)

telephone: + 90 216 483 9448

website: <http://ciad.sabanciuniv.edu/en/disabled-students-services>

Accommodations with an approved letter will be arranged on a case by case basis.

**COVID19:** We are facing uncertain times, but all lectures will be recorded. These videos will be uploaded to SUcourse+ along with the powerpoint presentations to try and make this course as accommodating as possible for your education. Office hours chats will be held with google meet so that I am available if you need any help. All scheduling is subject to change due to uncertainties caused by the COVID19 pandemic.

**Social Distancing and Masks:** Both the instructor and the students must wear masks properly throughout the lecture, lab, studio hours. There will be no exception to this regulation indoors and in the classrooms. Moreover, seating arrangements have been made to provide social distancing.

**Other important points:**

- If you are involved in off-campus activities (e.g. dance, theater, sports, music) that asks you to leave town, please provide me with a list of your scheduled games or events at the START of the semester, as well as the phone number of the coach/supervisor, and I will make a reasonable effort to accommodate your needs.

- Back-up your work!! Save often and save multiple versions! Good scientists have many copies of their data and writing, one of which is a "hard copy"; a version you can hold in your hand (e.g. paper). Another good habit is to e-mail yourself a copy of your work. Papers, etc handed in late due to computer failure are assessed the same penalty as those turned in late for other reasons. I also recommend downloading google drive. This is a free service that automatically backs up your smaller documents to the cloud as you save them.

Finally, please don't hesitate to contact me for clarification on any course policy-related questions.

**\*Note: This syllabus is subject to change throughout the course of the semester. Any changes will be announced during lecture.**