

Introductory Bioinformatics – PBIO/MBIO 3673- Spring 2016

3 Credit Hours

Lecture MW 3:30-4:45 pm

Open Lab Time for Work on Projects/Worksheets: TBD

SRTC, Room 1030 The Core

Prerequisites: Intro Botany, Microbiology, Biology, or Zoology or Instructor Permission

Recommended: Molecular Biology or Cell Biology or Genetics

Instructor:

Dr. Liz Karr

Department of Microbiology and Plant Biology

Office: SRTC 2021

Phone: 325-5133

Office Hours: M/W 2:30-3:20 pm, or by appointment (Beginning Jan 18th)

Email: lizkarr@ou.edu

Teaching Assistant Info:

Important Notes:

- 1) This syllabus describes how I approach this class - many areas are covered, including course materials, grading, problem resolution, etc. *Consult this resource first, ask questions second.*
- 2) It is your responsibility to read over this syllabus carefully and make sure you are able and willing to abide by the policies of this class. If you feel that you cannot abide by these policies, I strongly advise you to drop the class now. By continuing in this class, you agree to abide by this syllabus.
- 3) This is a fairly new course and I reserve the right to make changes to this syllabus throughout the semester - any changes will apply to everyone. If I must change something major, I will notify you well in advance.

What is Bioinformatics?

Bioinformatics is a rapidly growing field that sits at the crossroads of biology, computer science, and statistics. In its simplest form, *bioinformatics represents the use of computers to analyze and interpret various types of biological data*. People who use bioinformatics tend to come at it from either a computer science angle or a biological perspective (**Important Note:** people who are very talented in both computer science and biology are quite rare and valuable!). Computer scientists are interested in developing computer codes/software and algorithms to investigate complex biological data. Those coming more from the biology side tend to be primarily interested in using available algorithms, hopefully integrated into relatively user-friendly software, to help design better hypotheses, experiments, models, etc. for future laboratory investigations. This class is primarily focused on the latter group - i.e., there are many, many very useful bioinformatics applications available online and lots to be learned by exploring these programs with data in hand. For example, if you joined a molecular biology lab tomorrow and your boss gave you a DNA sequence and said, “what does this thing do?”, you should be able to use available online resources to make a large variety of predictions about that gene.

Everything from where the gene is located in the genome to what kind of protein it might encode, to likely structure, function, and localization can be predicted for most genes/proteins before you even plan your first wet lab experiment. You should also be able to plan a strategy for isolating and cloning this gene.

Course Goal

There is a vast world of freely available data that is available for you to download, investigate, and use however you see fit. It's not just bioinformatics that is available to the curious mind. To quote Shakespeare, "Why, then, the world's mine oyster, Which I with sword will open." This quote supposedly means that youth and wealth opened up the riches of the world to this particular character. In your own play, biological data and information can open the world of ideas and Practical Bioinformatics can help you get started.

At the end of this course you will have confidence in your ability to join a research laboratory and use your newly acquired skills to begin exploring the mountains of publicly available biological data. When that future hypothetical boss "hands" you that gene and wants you to investigate its function, you should be able to readily use available bioinformatics tools to explore the likely functions of this gene and generate a series of reasonable starting hypotheses.

Communication

As you read through this syllabus, you will note that there are multiple instances where public communication will be required in this class. Communicating information – written or orally - is an essential skill for all professionals. Many students are uncomfortable with delivering information in front of a group, which is exactly why we practice it in this class! The setting will be low key and you will have clear instructions regarding what is required, so this class will give you the opportunity to practice this essential skill in a structured and relaxed (as much as possible) environment. Everyone should feel more confident with public communication upon completion of the course.

Class Schedule (subject to change)

The semester will be divided into 5 modules. I've designed the course to be fluid and adaptable. Week by week schedules and reading assignments can be found on D2L (posted ~one week in advance). Poster presentations will be Apr. 25 & 27th and a small group of individuals from the department will be invited to the poster session on the 27th. Show and tell dates for the groups will be assigned when group assignments are made during the third week of class. The **FINAL POSTER SESSION** will be Wednesday May 9th from 4:30-6:30 pm.

Module 1: Central Dogma, the Genetic Code and Gene Structure

Module 2: Databases, Sequence alignments and BLAST analyses

Module 3: Phylogenetics

Module 4: Protein Structure presentation and Homology and Network Modeling

Module 5: *in silico* cloning, etc.

Textbook and Other Materials:

The required textbook for this course is:

Bioinformatics and Functional Genomics, Jonathan Pevsner (3rd Edition)

<https://www.vitalsource.com/textbooks?term=9781118581728>

This class is not about extensive textbook readings and lectures, but instead focuses on actually sitting down at the computer and playing with information. However, I will make use of *Bioinformatics and Functional Genomics* on a regular basis for out of class readings and preparation for quizzes – so you will need it!

The following two books are also useful, but not required – i.e., if you are real excited about this subject, you might also want to check these out:

Practical Bioinformatics, Michael Agostino

Phylogenetic Trees Made Easy, Barry G. Hall (4th Edition)

If you need more of a background on molecular biology and the central dogma, I recommend Molecular Biology Made Simple & Fun, David Clark

Preparation for In Class Discussion – Definitions and background reading will be assigned on a regular basis and will primarily consist of material that will aid in your understanding of language presented in class and the worksheets. Any of this out of class preparation material may appear on quizzes so ignoring it will do additional harm to your grade.

All students must have their own computer or regular access to a computer - in addition to in-class exercises, you will be asked to perform a project that will also require access to a computer. Nothing fancy is required - a standard, relatively modern laptop or desktop system will generally suffice (there are most definitely bioinformatics problems, such as working with sequencing data, that require fast computers and lots of memory, but we will steer clear of those this semester). I am experimenting with different ways to handle files in class, but it is a good idea to bring a memory stick (especially if you will use the available classroom computers). It is also recommended that you bring your own computer to each class meeting.

Course Website/Email: You can find an electronic version of your syllabus, including any current semester modifications, at the course Canvas site. I rely on Canvas for communication with the class, posting readings, grades, etc. All Canvas must have an active email account that is checked daily. I try to answer all email the day I get it, but if you get no answer in 24hrs please resend the email. One cautionary note - I routinely ignore student email if the answer is in this syllabus or can be readily looked up online by the individual (i.e., I am literally anxious to help you, but you must be willing to help yourself first!).

Grading

Grades will come from a single score based on the following categories:

Quizzes	- 100 points (12 X 10-point quizzes, two lowest dropped)
YFG Reports & Poster	- 170 points (100 points for reports/70 points for poster and its presentation)
Show and Tell	- 30 points
Attendance	- 125 points (25 days X 5 points per day)

TOTAL POINTS = 425

Grade assignments:

A – 90% and higher

B – 80 to 89%

C – 70 to 79%

D – 60 to 69%

F – below 60%

Grades will be posted to Canvas. If you want to keep track of your grade as the semester proceeds, please divide the points you have received to date by the total number of cumulative possible points to date and multiply this value by 100.

***Attendance** - This class is sequential in nature with skills building over time. Additionally, you will be working in small groups for most of the semester. Missing class means that you lose the general flow and let your group down - both of which are not great. Therefore, I will take role each day **exactly five minutes after I start the class**. All students in the class by that time will be counted present and you are expected to stay until the end of class unless there is prior arrangement. Everyone gets three missed classes/late arrivals with no cost to your grade. After three, each missed class or late arrival will result in an automatic five-point deduction in your total (i.e., a 1.25% grade drop).

***Quizzes** - Instead of exams, we will have quizzes. Quizzes will begin **Jan 23rd** and continue every Tuesday throughout the semester. Quizzes will be taken either in paper format or in Canvas on the classroom computers or your own laptop computer. *During quizzes, you are not permitted to use notes, the internet or any other source of information*. Quiz material will come from a combination of your readings and in-class work – occasionally a quiz will be take home (i.e., essentially a homework assignment). There will be a total of 14 quizzes and the two lowest grades will be dropped. Quizzes will come from class notes, homework, and readings. **Total points = 120**

*Please note that for both quizzes and attendance, I give a few drops/missed class freebies and *I really, really don't need to hear your excuses*. No, really! If you are sick or have a funeral or your car broke down or you just wanted to go fishing, I don't need to know. My judgment over the validity of your excuses is not a power I wish to have, nor should you grant it. BUT remember, when you take your freebies early in the semester for that fishing trip and then a real emergency arises, you still only get the allotted freebies – i.e., you know the rules and you assume the risks. [**Important Side Note**: At the risk of undoing what I said above, if you are experiencing **extraordinary problems**, such as prolonged illness, please do come speak to me. No, I don't want to hear daily excuses, but if a major roadblock is interfering with your participation, let's discuss this and see what we can come up with together.]

Worksheets – Worksheets will be given on a regular basis and may need to be finished at home or during the weekly computer open lab.

Show and Tell - Just like when you were a kid, who doesn't still enjoy bringing in something cool to show the class? To satisfy this burning desire, each student will give a "Show and Tell" session during the semester (see "**S/T**" dates on the Canvas homepage). On your assigned date, you will describe a new bioinformatic tool or information website that we have not discussed in class. For example, while you are online investigating YFG, you will naturally bump into interesting new tools. These tools will often tell you something about gene function that you did not learn about in class. You will develop a **5-minute presentation** for the whole class see Canvas for your assigned date. I will give some more guidance on useful presentations soon,

but, for now, start looking. **NOTE:** In the YFG Report assignment, everyone will be required to use one of the tools outlined at Show and Tell time *by another student* and clearly identify this in the final report. Thus, be sure to pay attention during S/T. **Total points = 30**

Open Computer Lab-There will be a once weekly open computer lab session held by the graduate teaching assistant. This is a time where you can work on classroom computers for your YFG project, finish worksheets not completed in class obtain additional help with the software.

YFG Projects- (Written reports 100 points/poster and presentation 70 points) – YFG stands for “Your Favorite Gene,” which will be assigned to each student in the first week. You will spend the semester examining this gene in greater detail - sometimes in class, but often at home. **(adapted from Dr. Amy Vollmer’s Adopt a Pathogen, Swathmore College)**

The goal of this project is to develop a portfolio of information regarding YFG. This would be the kind of information you might want to find out regarding a gene and the protein it encodes.

A list of genes will be determined by Dr. Karr and assigned by random drawing by the end of the first week.

You will be expected to collect specific types of information in several writing/data presentation assignments throughout the semester. **You will receive feedback on each assignment and will be expected to incorporate and consider previous feedback on your next assignment.** Each assignment is limited to two pages, minimum of 1.5 line spacing, minimum 11-point font. Page one is the written text information for the assignment. Only figures and their legends can go on page 2. These figures can take up an additional two pages. This teaches you to write succinctly and present data in a useful manner. Proper use of references is required. The Literature Cited section can be on a third page. Each assignment will be turned in via Canvas and will run through Turn It In for plagiarism detection. Please take note of the reports you receive and resubmit as necessary up until the due date. Do note that due to the nature of these short reports you may have phrases that will hit in these reports and I will take that into consideration. The goal is to not have larger chunks of information that are hitting.

Each report should include the following in sentence format:

- Purpose of Experiment - e.g., why did you do a BLAST? What were you hoping to find? This should be reasonably succinct (somewhere between one sentence and one paragraph).
- Web site chosen – Use the name (include the URL in the references)
- Data entered - a description of the data (e.g. amino acid sequence of YFG, nucleic acid sequence of YFG, output from X analysis, etc.)
- Settings - Algorithm parameters chosen, reasons for choices made
- Results – The actual results (these will often be images that can be included on separate pages, give them a figure number and in the text, say refer to figure 4 which shows xxxx)
- Interpretation of results - what did you learn from this analysis? What new questions arose? etc. Be thoughtful! In most cases, this should be accomplished in a single paragraph.
- Brief conclusion

Specific rubrics for each assignment will be posted 10-14 days in advance.

Paper Assignments:

1. (20 pts) Paper #1- BLASTp and Conserved Domains (Due Feb 9th by 11:59 pm)
2. (20 pts) Paper #2- Nucleotide and Amino Acid Alignment of YFG (Due March 2nd by 11:59 pm)
3. (20 pts) Paper #3- Neighbor-Joining Phylogenetic Trees (Due March 30th by 11:59 pm)
4. (20 pts) Paper #4- *Protein structure or Homology Model with labeling of key features* (Due April 13th by 11:59 pm)
5. (20 pts) Paper #5-*Network Analysis* (Due April 27th by 11:59 pm)

YFG Poster and Presentation: The poster will be a presentation representation of your reports. It will consist of an introduction to your favorite gene/protein, a materials & methods section, results (alignments, structures, cloning, phylogenetic trees, etc.) and a conclusions section. I will provide a poster template that everyone will use. It can be downloaded from the module section in Canvas under YFG. Do not change the poster/page size. We will work on posters and poster formatting in class on Apr. 24th and 26th. The poster will be due on Apr. 27th by 11:59 pm submitted as a PDF file and a powerpoint file. The presentation will be during our finals week meeting on Wed. May 9th from 4:30-6:30 pm.

Makeup Work: There is no make-up work for quizzes and there is no loss for missing up to three classes (see Attendance above) - so, once again, I don't need to hear any excuses. Homework can be turned in one class late, but there is an automatic 50% reduction in the final score.

Mistakes on assignments and quizzes: There may be a time when you feel that a mistake was made that affects your grade. I am happy to correct legitimate mistakes and you are welcome to bring any to my attention, but keep the following in mind:

- 1) You must bring your concerns to me no later than one week after the assignment or quiz is returned. After one week, your request will not be considered.
- 2) A request for grade reconsideration must be brought to me **in writing** – please provide all of the following on a single sheet of paper:

Name, Question Number, Thorough Description of the Problem and Justification for Why Your Answer Should be Reconsidered – Attach this to the original test and give me the entire package.

- 3) You must have a concrete, defensible argument. Just because you request that I reconsider an assigned grade doesn't mean that I will actually change your original score.

4) If I re-grade a particular question on the assignment/exam, etc., I reserve the right to re-grade your entire test and this may result in raising **or lowering** your overall grade.

Unusual Illnesses or Emergencies: If you become ill for an extended time (more than a week) or suffer a family emergency, please contact me as soon as possible and plan to come to office hours immediately upon your return to discuss the problem. If you present proper documentation (such as a note from the doctor), I will consider this information when assigning final semester grades. **Do not wait until the end of the semester to bring the situation and documentation to my attention.** Please keep in mind that, regardless of the validity of the excuse, I cannot assign a grade without sufficient completion of the course material.

Reasonable Accommodation Policy

There is not specific language for the Reasonable Accommodation policy to be included in the syllabus. It is good to become familiar with the policy and describe it in your own words. Including the link to Disability Resources Center is encourage, <http://www.ou.edu/drc/home.html>. [See Faculty Handbook 5.4]

Students requiring academic accommodation should contact the Disability Resource Center for assistance at (405) 325-3852 or TDD: (405) 325-4173. For more information please see the Disability Resource Center website <http://www.ou.edu/drc/home.html> Any student in this course who has a disability that may prevent him or her from fully demonstrating his or her abilities should contact me personally as soon as possible so we can discuss accommodations necessary to ensure full participation and facilitate your educational opportunities.

Academic misconduct: The University Misconduct Code will be followed. Refer to the OU Course Catalog, the class Schedule Book or <http://www.ou.edu/provost/> for a written version of the misconduct code and definitions of cheating and plagiarism. It is assumed that each course participant subscribes to the following OU Student Honor Code: "On my honor, as a student at the University of Oklahoma, I affirm that I will neither give nor receive inappropriate aid in the completion of any academic exercise. I understand that it is my responsibility to comply with the Academic Misconduct Code".

Academic Integrity

There is not specific language for the Academic Integrity policy to be included in the syllabus. It is good to become familiar with the policy and describe it in your own words. [See Faculty Handbook 13]

Cheating is strictly prohibited at the University of Oklahoma, because it devalues the degree you are working hard to get. As a member of the OU community it is your responsibility to protect your educational investment by knowing and following the rules. For specific definitions on what constitutes cheating, review the Student's Guide to Academic Integrity at http://integrity.ou.edu/students_guide.html.

To be successful in this class, all work on exams and quizzes must be yours and yours alone. You may not receive outside help. On quizzes you will never be permitted to use your notes, textbooks, calculators, or any other study aids. Should you see someone else engaging in this behavior, I encourage you to report it to myself or directly to the Office of Academic Integrity Programs. That student is devaluing not only their degree, but yours, too. Be aware that it is my professional obligation to report academic misconduct, which I will not hesitate to do. Sanctions

for academic misconduct can include expulsion from the University and an F in this course, so don't cheat. It's simply not worth it.

Plagiarism: This course will require a final report. It will be necessary to use online/library journal resources. These **resources must be properly cited and the information must be written in your own words**. Failure to do so, by taking the work of others as your own, is a **SERIOUS** situation, which can result in severe academic punishment and even expulsion. I will report plagiarism. All reports will be submitted via Canvas and run through "Turn it in" to detect plagiarism. You will have the opportunity to see this report and make alterations if necessary. However, this requires that you allow time for this report and rewriting. Therefore, please do not wait until the last minute to submit your report. References will almost always be flagged and you shouldn't concern yourself with this but only items in the body of the text.

Religious Holidays: From the Faculty Handbook - "It is the policy of the University to excuse absences of students that result from religious observances and to provide without penalty for the rescheduling of examinations and additional required class work that may fall on religious holidays." **Note: You MUST arrange for any special exceptions to the schedule during the first two weeks of class** - last minute requests will not be accepted.

Important Dates: You are responsible for knowing the official university dates for dropping classes – they change each semester and can be found online. After the drop with "W" date, I will only send letters of support to the Dean to receive a "W" grade in the most extreme cases – i.e., the "W" schedule is quite reasonable and you have plenty of time to drop without having to petition the Dean.

Pre-Finals Week: This class is compliant with pre-finals week policies. No quizzes, exams or major assignments are due that week.

Title IX Resources and Reporting Requirement

For any concerns regarding gender-based discrimination, sexual harassment, sexual misconduct, stalking, or intimate partner violence, the University offers a variety of resources, including advocates on call 24/7. To learn more or to report an incident, please contact the Sexual Misconduct Office at 405-325-2215 (8 to 5, M-F) or OU Advocates at 405-615-0013 (24/7). Also, please be advised that a professor/GA/TA is required to report instances of sexual harassment, sexual assault, or discrimination to the Sexual Misconduct Office. For more information, please see <http://www.ou.edu/eoo>.

Adjustments for Pregnancy/Childbirth Related Issues

Should you need modifications or adjustments to your course requirements because of documented pregnancy-related or childbirth-related issues, please contact your professor or the Disability Resource Center at 405/325-3852 as soon as possible. Please see <http://www.ou.edu/eoo/faqs/pregnancy-faqs.html> for answers to commonly asked questions.