

Credit Hours: 3

Time: Mondays and Wednesdays, 9:00 a.m. - 10:20 a.m.

Location: Legacy Hall, room 222

This syllabus is intended as a guide for this course. Dates, assignments, and evaluation are subject to revision by the instructor and will be announced in advance when possible.

Course Faculty

Instructor of Record:

Name: David Ussery <https://experts.okstate.edu/david.ussery>

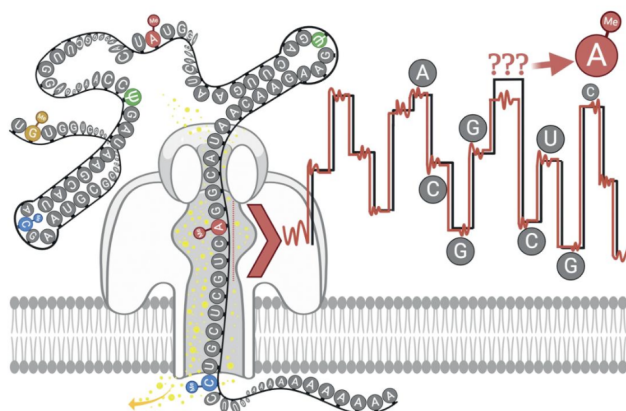
Email: david.ussery@okstate.edu

Office: Legacy Hall south, room 218A

Office Hours: by request

PREREQUISITES:

- None.
- A basic understanding of molecular biology and genetics is helpful but not required.
- Basic knowledge of the programming language R is recommended, but not required.



Course Description

Course Catalog Description:

Special research problems in the various fields of veterinary biomedical sciences. Previously offered as VIDP 5110 and VBSC 5110. Offered for variable credit, 1-6 credit hours, maximum of 20 credit hours.

ABOUT THIS COURSE

This course provides an introduction to genome sequencing, with emphasis on sequencing microbial genomes (viruses and bacteria) to completion (one complete sequence per replicon). This is an experimental methods course, in general with lab work on Mondays, and lectures / discussions on Wednesdays. The students are expected to bring their own sample of purified viral or bacterial genomic DNA to be sequenced (samples can be provided upon request). The students will sequence their genomes using Oxford Nanopore flow cells, during the first few weeks of the course. They will also sequence the same sample using Sanger Dideoxy sequencing (first generation), Illumina (second generation) and PacBio (third generation). Third generation sequencing methods (PacBio and Oxford Nanopore) will also be used to quantify epigenetic modifications to the DNA bases. *The final project will include a short written manuscript, to be submitted to [Microbiology Resource Announcements](#), for publication.*

Through hands-on application, students will gain practical experience in genomic sequencing and data analysis and interpretation, preparing them for careers in research, medicine, and biotechnology.

REQUIRED MATERIALS

There is **no** required textbook for this course. I will provide a PDF version of my textbook: **Computing for Comparative Microbial Genomics: Bioinformatics for Microbiologists**, by David Wayne Ussery, Trudy M. Wassenaar, Stefano Borini, (ISBN 978-1-84800-254-8; Springer, 2009), as well as PDFs of recent articles published in the scientific literature; all materials you need will be provided through Canvas, and links to open-access articles will be provided in updated versions of the course syllabus.

COMMUNICATION AND OFFICE HOURS

It is expected that you may need to contact me, or that you might want additional support when learning new material. Email is the best way to reach me, and I do my best to respond within 24 hours during weekdays. Please know that because I spend weekends with my family, I am away from email during those times. Responses to weekend emails may not arrive before Monday morning.

I hold office hours on **Wednesdays** from **1:00-3:00**. These are student-centered times when I am available to answer questions outside class times. During office hours, you are welcome to simply stop by my office (room 218A, Legacy Hall south). I am also happy to arrange meetings beyond those times, either in person or on Zoom. Just send an email to schedule a time. Please do not hesitate to contact me; I am here to help you succeed!

Course Learning Outcomes

1. Sequencing Foundations. By **4 September (week 3)**, students will be able to explain the concept of genome sequencing, and the basic technology used in first, second, and third generation sequencing.

2. Produce complete genome sequence. By **25 September (week 6)**, students will be able to explain how they can construct a fully assembled genome from their sample.

3. Annotate genome sequence. By **30 October (week 10)**, students will understand the use Prodigal, RNAmmer, and tRNAscan to annotate bacterial genome sequences.

4. Genome Sequence Publication. By **4 December (week 15)**, students will know how to generate a manuscript formatted for Microbial Resource Announcements, suitable for submission for publication.

Attendance & Absenses

Absences:

Life happens — people get sick, things come up. Absences for illness or personal reasons are fine, but please let me know ahead of time (or as soon as you can) so I'm aware and can help you stay caught up. Consistent communication is key.

Attendance:

Attending and participating in class results in deeper learning and better prepares you for success on assignments and assessments. Because I want you to be successful, I think it is important that I see you in class.

Professionalism

Please refer to the CBSC Student Handbook for further information on expectations and professionalism.

Conduct of the course

Sequencing Project Assignments: Each student is expected to turn in a text file, containing genome sequences from various machines, and these can be shared with the class.

- **Due 4 September.** Use Oxford Nanopore flow cells to sequence a first draft of your genome, and then assemble to one draft contiguous piece. Turn in a text file with sequence of the 10 longest reads, the length of each read, and the number of bp covered.
- **Due 18 September.** Use Sanger dideoxy sequencing to obtain DNA sequences for part of your genome. Turn in a text file with the 10 longest fragments, and a short description of the length of each one, and the number of bp covered.
- **Due 16 October.** Use Illumina sequencing to obtain DNA sequences for your genome. Turn in a text file with the 10 longest fragments, and a short description of the length of each one, and the number of bp covered.
- **Due 6 November.** Assemble the Illumina reads into contigs. Turn in a text file with the 10 longest fragments, and a short description of the length of each one, and the number of bp covered.
- **Due 20 November.** Use PacBIO to sequence your genome. Turn in a text file with the 10 longest fragments, and a short description of the length of each one, and the number of bp covered.
- **Due 4 December.** Final paper due, formatted for submission to [Microbial Resource Announcements](https://journals.asm.org/journal/mra) <https://journals.asm.org/journal/mra>.

Grading Scale, Policy and Expectations, and Rubrics:

The tables below show the points possible for assignments/assessments along with the grading scale for this course. Your grades will be recorded in the Canvas gradebook so that you can easily track your progress. Weekly quizzes will be posted on Canvas, and are due BEFORE the start of class on Monday (that is, no later than 9:30 a.m. on Monday). I recommend taking the quiz more than once - multiple attempts are allowed, and after the first try, the answers are given, so it should be pretty easy to get a perfect score on the exam. The idea is to prime you for what the lecture will be about. Quizzes are every week, and I will take the grades from the 10 highest scores. (Note there are more than 10 weeks in the semester!). Because course grades are based on demonstrated mastery of learning outcomes, there are no opportunities for extra credit. Rather than focusing on “extra” work, I prefer that you devote your efforts toward the actual assignments. Grades in this course will not be rounded up. This means an 89.9% earns a B, not an A. To earn an A, you must receive between 90-100% of the total possible points.

Assignment or Assessment Task	Points Possible	% of total grade
Sequencing progress reports	500	30%
Weekly Quizzes (best 10 @ 100 points each)	1000	30%
Final project oral presentation	100	40%
Total Possible	-	100%

Percentage of Possible Points	Grade
90-100%	A
80-89%	B
70-79%	C
60-69%	D
0-59%	F

LATE AND MISSED WORK

Due dates are designed to keep you on track throughout the semester, and this course will be more manageable if you maintain the established schedule. Deep learning develops over time, and this schedule is designed so that feedback from one task will be received in time for you to apply it on later assignments. However, I know that life happens, so you will be able to extend the deadline of one assignment by up to two days. You do not need to share the reason why with me; just email to let me know that you are going to use this extension. If a larger issue arises, such as jury duty or a major medical emergency, please email me and we will create a plan together.

INCLUSIVITY AND ACCESSIBILITY

My goal is that you will have a positive learning experience and leave this course thinking about concepts in ways you may not have previously. There could be times when a discussion feels a bit uncomfortable, but considering others' points of view is an important aspect of college life. OSU has a diverse student population, and I believe each person should feel like a valued member of our learning community; however, it is up to all of us to create an environment that fosters respect for everyone. Although I consider this a personal responsibility as your instructor, I hope that you will join me in the effort.

I am committed to educational access and have attempted to structure the course in ways that will enable your success. Yet, if something seems amiss, please let me know right away. I am happy to visit with you during office hours regarding strategies that will help you be successful. Beyond my help, there are other mechanisms of support available to you. If you believe that you qualify for academic accommodations, please contact [Student Accessibility Services](#). Their office is located at 1514 W. Hall of Fame Ave. #103 (in the Seretean Wellness Center behind the Colvin Recreation Center) and their phone number is (405) 744-7116. You may also qualify for [Student Support Services](#), so it is worth checking. [The LASSO Center](#) can provide tutoring and academic support, and the [OSU Writing Center](#) can help with all aspects of writing. There are many more services available to you, including those pertaining to accessing basic needs, health and wellness resources, and mental health support. If you find yourself in need, please look at the OSU webpage, [Connecting Cowboys to Resources](#).

ACADEMIC INTEGRITY POLICY

The official academic integrity policy is shown below, but this is what I really want you to know. In my experience, most academic integrity issues are the result of:

1. Students not realizing that something actually *is* an academic integrity violation.
2. Students thinking that they cannot successfully complete an assignment without support.
3. Students falling behind and feeling pressure to complete an assignment quickly.

Please do not let situations such as these result in an even larger issue. If you are unsure, ask. If you need additional support, reach out. If an assignment is taking longer than expected, use your two-day extension or come talk with me. I would much prefer that we work something out together than to see you suffer a consequence that could have been prevented.

At OSU, we value academic integrity. Violating academic integrity comes in many forms including cheating, copying others' work, or even reusing portions your own work. Maintaining integrity is an ethical ideal important during your time as a student, but it is also valued when you begin your career. If you're not sure whether something is a violation, please ask. You can also learn more by reading [OSU's Violations of Academic Integrity](#). Essentially, even when it feels challenging, you should always submit your own original work.

Language from Academic Affairs:

OSU is committed to maintaining the highest standards of integrity and ethical conduct. All OSU courses will maintain this level of ethical behavior and integrity. Participating in behavior that violates academic integrity (e.g., unauthorized collaboration, plagiarism, multiple submissions, cheating on examinations, fabricating information, helping another person cheat, unauthorized advance access to examinations, altering or destroying the work of others, and altering academic records) will result in an official academic sanction. Assignments, quizzes, and exams (individual questions or in their entirety) should not be uploaded to websites offering note-sharing, tutoring, or other academic help (free or paid subscription). Violations may subject you to disciplinary action, including the following: receiving a failing grade on an assignment, failing a course, receiving a notation of a violation of academic integrity on your transcript, having the academic integrity violation become part of your educational record, and being suspended from the university. Students have the right to appeal the charge. Contact the Office of Academic Affairs at 101 Whitehurst, 405-744-5627, or academics@okstate.edu for more information. A copy of the university's policy is available at <http://academicintegrity.okstate.edu>.

AI USAGE

Daily use of AI tools, such as ChatGPT or Google Gemini, is expected, as these can help with homework assignments and potential coding problems. Appropriate uses of these tools should *enhance* your learning, not replace the effort required to learn something new. Ideas for using AI appropriately include helping you trouble-shoot problems getting R-BioTools properly installed, as well as for getting basic information about the various genomic subjects discussed in the course. AI can be helpful for brainstorm ideas for a writing assignment, generating practice questions to help you prepare for exams, or checking your written work for grammatical errors. It would not be appropriate to use AI to completely produce, reproduce, or manufacture written work and/or other assignments without devoting any personal effort to the learning process, as this would result in an academic integrity violation. We will discuss more about appropriate AI usage regarding specific assignments in class.

Whenever AI is utilized in any project, research, or clinical decision-making, it should be explicitly acknowledged. The usage, reliability, and limitations of the technology should be thoroughly communicated and understood.

College Policies, Procedures, and Services

COPYRIGHT & FAIR USE POLICY OF COURSE MATERIALS

Course materials may not be published, leased, sold to others, or used for any purpose other than appropriate OSU-related individual or group study without the written permission of the faculty member in charge of the course and other copyright holders. This paragraph grants you a limited license giving you access to materials for this course, including PowerPoint slides, audio/video recordings, written, or other materials, for appropriate OSU-related educational use only. Lectures should not be recorded without permission from the faculty member and must not be further disseminated or shared.

EQUAL OPPORTUNITY

328 Student Union/405-744-5470/<https://1is2many.okstate.edu/>

OSU is committed to maintaining a learning environment that is free from discriminatory conduct based on race, color, religion, sex, sexual orientation, gender identity, national origin, disability, age or protected veteran status. OSU does not discriminate on the basis of sex in its educational programs and activities. Examples of sexual misconduct and/or sex discrimination include: sexual violence, sexual harassment, sexual assault, domestic and intimate partner violence, stalking, or gender-based discrimination. OSU encourages any student who thinks that he or she may have been a victim of sexual misconduct or sexual discrimination to immediately

report the incident to the Title IX Coordinator (405-744-9153) or Deputy Title IX Coordinator (405-744-5470). Students may also report incidents of sexual misconduct or sex discrimination to a faculty or staff member, who is then required by federal law (Title IX) to notify the Title IX or Deputy Title IX Coordinator. If a reporting student would like to keep the details confidential, the student may speak with staff in the Student Counseling Center (405-744-5472) or one of the University's Sexual Assault Victim Advocates (Mon-Fri 8 AM-5 PM, 405- 564-2129 or 24 Hour Help Line 405-624-3020).

STUDENT DISABILITY SERVICES

Seretean Wellness Center, Oklahoma ABLE Tech & Student Accessibility Services
1514 W. Hall of Fame/405-744-7116/ <https://accessibility.okstate.edu/>

According to the Americans with Disabilities Act, each student with a disability is responsible for notifying the University of his/her disability and requesting accommodations. If you think you have a qualified disability and need special accommodations, you should notify the instructor and request verification of eligibility for accommodations from Student Disability Services. Please advise the instructor of your disability as soon as possible, and contact Student Disability Services, to ensure timely implementation of appropriate accommodations. Faculty have an obligation to respond when they receive official notice of a disability but are under no obligation to provide retroactive accommodations. To receive services, you must submit appropriate documentation and complete an intake process to verify the existence of a qualified disability and identify reasonable accommodations.

STUDENT CONDUCT EDUCATION AND ADMINISTRATION

328 Student Union/405-744-5470/ <https://ssc.okstate.edu/>

By enrolling at Oklahoma State University, you accept responsibility for complying with all University policies and contracts, and for local, state and federal laws on- or off-campus that relate to the University's mission. The Student Code of Conduct educates students about their civic and social responsibilities including policies and procedures involving student misconduct. In general, the University expects students to aspire to follow and promote the Cowboy Community Standards or integrity, community, social justice, respect, and responsibility. Complete syllabus attachment and additional information/resources are available at: <https://academicaffairs.okstate.edu/student-support/>

Additional policies and information, including academic integrity, can be found in the Oklahoma State University Syllabus Attachment for Spring 2026 on Canvas.

Useful resource links for microbial genome sequencing and analysis

Sanger sequencing / chromatogram analysis

Galaxy Training: Clean and manage Sanger AB1 files:

https://training.galaxyproject.org/training-material/topics/sequence-analysis/tutorials/Manage_AB1_Sanger/tutorial.html

Illumina sequencing

1. Illumina NGS workflow steps:

<https://www.illumina.com/science/technology/next-generation-sequencing/beginners/ngs-workflow.html>

2. Illumina DRAGEN DNA pipeline:

<https://help.dragen.illumina.com/dragen-v4.4/product-guide/dragen-v4.4/dragen-dna-pipeline>

3. nf-core/bacass bacterial assembly pipeline:

<https://nf-co.re/bacass>

4. nf-core/bactmap bacterial reference-mapping pipeline:

<https://nf-co.re/bactmap/1.0.0/>

Nanopore sequencing

1. Dorado basecalling documentation:

https://software-docs.nanoporetech.com/dorado/latest/basecaller/basecall_overview/

2. Oxford Nanopore data analysis / EPI2ME:

<https://nanoporetech.com/document/data-analysis#data-analysis-in-epi2me>

PacBio sequencing

1. PacBio whole-genome sequencing:

<https://www.pacb.com/products-and-services/applications/whole-genome-sequencing/>

Workflow managers and reproducibility

1. Ghana WGS Workflow Managers module:

https://avantonder.github.io/Ghana_course/materials/08-workflow_managers/8.1-workflow_managers.html

2. Snakemake official documentation:

<https://snakemake.readthedocs.io/en/stable/>

3. Nextflow official website:

<https://www.nextflow.io/>

Bioconductor / R genomic data analysis

1. Introduction to Bioconductor for Sequence Analysis:

<https://bioconductor.org/help/course-materials/2014/useR2014/>

2. Main Bioconductor website:

<https://www.bioconductor.org/>

3. Bioconductor Workflows:

<https://www.bioconductor.org/help/workflows/>

CBSC 5110: Special Topics in Microbial Genome Sequencing

Mondays & Wednesdays: room 101, McElroy Hall, 9:00 – 10:20 p.m., spring 2026

Weekly themes for main lectures (Monday class; one page version)

Week	Topic
1 17 August	Introduction to Genome Sequencing - first runs on Oxford Nanopore
2 24 August	Three Generations of DNA Sequencing (Dave Ussery, PhySci)
3 31 August	Sanger Sequencing - part 1: Sample preparation (Janet Rogers, Biochemistry)
4 7 Sept.	Sanger Sequencing - part 2: Data analysis (Janet Rogers, Biochemistry)
5 14 Sept.	Illumina Sequencing - part 1: Lecture from Qiagen (Classroom)
6 21 Sept.	Illumina Sequencing - part 2: DNA Library Prep. (Sam Jeyasingh, NGS Core)
7 28 Sept.	Illumina Sequencing - part 3: Data analysis (Sam Jeyasingh, NGS Core)
8 5 Oct.	Oxford Nanopore sequencing - part 1: Sample prep (Sam Jeyasingh, NGS Core)
9 12 Oct.	Oxford Nanopore sequencing - part 2: Experimental setup (direct RNA sequencing)
10 19 Oct.	Oxford Nanopore sequencing - part 3: Data analysis (Classroom)
11 26 Oct.	PacBio Sequencing - part 1: Library Prep. (Sam Jeyasingh, NGS Core)
12 2 Nov.	PacBio Sequencing - part 2: Sequencing (Sam Jeyasingh, NGS Core)
13 9 Nov.	PacBio Sequencing - part 3: Data analysis (Classroom)
14 16 Nov.	Student discussions about genomes (Classroom)
15 23 Nov.	Student presentations (Classroom)
16 30 Nov.	Student presentations (Classroom)