

## Biol 432 and 433L Genetics Experiments Syllabus

### Course Overview

Number	Biol 423 and Biol 423L
Title	Genetics Experiments and Genetics Experiments Lab
Credit hours	3 hours and 1 hour
Course Description	Using genetics and genome biology, students will study DNA repair and chromosome stability using yeast as a model system. Biol 423 and Biol432L combine to make a Course-based Undergraduate Research Experience (CURE). Biol 423L meets the criteria for an Empirical Investigation Lab.
Prerequisites	Biol 202 Genetics and Molecular Biology
Target Audience	Advanced undergraduate students
Instructor	Sarah Grant Office location: Genome Sciences Building 4258 Phone: 919-962-4470 Email: sgrant@email.unc.edu
Teaching Assistants	TBA Name [Office location] Phone: 919-[###-####] Email: [xxx]@email.unc.edu
Course Website	<a href="https://sakai.unc.edu/welcome/">https://sakai.unc.edu/welcome/</a> .
Class Days, Times, Location	Sections 001 and 401: Mondays 1:00 pm to 5:00 pm or Sections 002 and 402: Tuesdays 1:00 pm to 5 pm. Location for all sections: Wilson Hall room 132
Office Hours	Office hours are from 3:30 pm to 4:30 pm on Fridays in GSB 4258. Students may request an appointment by email.
Course Texts	All reading material will be available on the course Sakai web site. Some readings will be taken from the Recommended textbook: Hartwell et al., 2011, Genetics from Genes to Genomes, Edition 4. A copy of the recommended textbook will be available at the Reserve Desk at the Undergraduate Library.
Course Format	Biol 423 and Biol 423L must be taken at the same time. The combination of lecture and lab in one time-block allows students to take an active role in ongoing research led by UNC scientists, but in a classroom format. The course is offered to two sections of 10 students each. Each section will meet once a week from 1 to 5 pm. Students will prepare for each session with a homework assignment that includes questions to answer and suggested readings. The time will be broken up at the instructor's discretion but generally, the first hour will be for group discussion and the remaining time will be used for practical laboratory work and workshops for technical training.

## Course Goals and Student Learning Outcomes

***This Research and Discovery course and an Empirical Investigation lab will enable students to: immerse themselves in a research project and experience the reflection and revision involved in producing and disseminating original scholarship or creative works.***

The combination of Biol 423 and Boil 423L forms a course-based undergraduate research experience or CURE course. Students will engage in cutting-edge genetic research related to an ongoing federally-funded research project lead by a UNC faculty member. In 2020, the collaborating research group is led by Dr Kerry Bloom. Dr Bloom's group studies the structure and function of chromosomes, with emphasis on the physical interactions of DNA and protein complexes that make the centromere. Students will learn the current state of the research as a class by reading and discussing publications on the subject from the Bloom lab and other experts. Researchers from the Bloom lab will meet with the class several times during the semester to help students understand the research problem. Students will work in groups of two or three to develop a research plan in consultation with the Bloom research group and the instructors. Students will learn relevant experimental techniques and design experiments using those techniques. The experiments will involve taking empirical measurements using appropriate apparatus, gathering, storing, organizing and analyzing data. Each group will organize their findings into a poster for presentation at the end of semester QEP research symposium. Students will collaborate with other groups in the class to critique and develop each other's poster presentations. Each student will also prepare two interim reports and a final project report. Students will learn how to communicate research results using these written reports. Each report will build on the previous report, allowing students to respond to criticism and develop their presentation skills throughout the semester.

### Questions for Students

1. How do I establish my point of view, take intellectual risks, and begin producing original scholarship?
2. How do I narrow my topic, critique current scholarship, and gather evidence in systematic and responsible ways?
3. How do I evaluate my research findings and communicate my conclusions?

### Student learning outcomes (SLO)

1. Frame a topic, develop an original research question or creative goal, and establish a point of view, creative approach, or hypothesis.
2. Obtain a procedural understanding of how conclusions can be reached in a field and gather appropriate evidence.
3. Evaluate the quality of the arguments and/or evidence in support of the emerging product.
4. Communicate findings in clear and compelling ways.
5. Critique and identify the limits of the conclusions of the project and generate ideas for future work.

## Course Assignments and Assessments

Assignments	Percentages
5 Homework assignments	25%
Project development assignment	10%
3 Interim progress report assignments	30%
Poster presentation assignment	10%
Class participation and peer feedback	5%
Final Report	20%

### Assignment Descriptions

#### **Homework assignments (each worth 5% of final grade) SLO 1, 2, 3**

Assignments will be designed to help students understand the research problem being investigated. Assignments will include reading primary research papers and preparing descriptions, answering questions posed by the instructor and solving representative problems. Homework Assignments will be posted as a word file in the resources folder on the class Sakai web site for each week. Answers will be posted to the Assignment section of the Sakai web page by 5 pm on the specified day. Instructors will assign a grade and return the assignment without further comment. Answers to the assignments will be discussed in class.

#### **Research Plan Development assignment (10% of final grade) SLO 1, 3**

Each Student will submit a report that will outline their research plan for their group of two or three students for the semester. The members of each group will collaborate to develop the plan and they will work together to carry out the plan. The plan will be based on previous research in the topic area. Students will begin their assignment by summarizing the current state of knowledge derived from peer reviewed publications and from oral presentations to the class by members of the collaborating UNC research laboratory. The summary will include information on methods used and evaluation of the limits of the previous investigations. The rest of the report will include an outline of the strategy to extend the research to answer the new questions developed by the class in discussion with the instructor and researchers from the collaborating UNC research laboratory.

#### **Interim progress report assignments (each worth 10% of final grade) SLO 2, 3, 4**

Each student will submit a report on completed work at three interim points in the semester. Students are expected to share data with their lab partners but they must prepare their own reports including their own figures and tables. Students are encouraged to discuss the interpretation of their results with any member of the class and students may be requested to share data and interpretations with other class members by the instructor. See the course Sakai site for instructions on how to prepare interim lab reports.

#### **Poster presentation assignment (10% of final grade) SLO 3, 4, 5**

At the end of the semester there will be a university-wide undergraduate research symposium where students and instructors from multiple disciplines will present posters describing their semester research projects. Biol 423L Students will work in groups to produce posters describing their own

research during the semester for this symposium. Students will design the posters and orally present the posters to other members of the class for critique before final posters are printed for presentation at the symposium.

### **Class participation and peer feedback (5% of final grade) SLO 1, 2, 4, 5**

Students are expected to participate in class discussions and in group research activities. Students will have the opportunity to express themselves to their peers as they develop research projects and interpret the results of their experiments. They will have class time to compare poster presentations and suggest improvements to the posters of other groups. Evaluation of class participation will be made by the instructor.

### **Final Report (20% of final grade) SLO 1, 2, 3, 4, 5**

At the end of the semester, students will prepare a report on the results of the full semester. The report will have the same format as the interim reports. The rules on collaboration are the same as for interim reports. The final report will be submitted on the last day of classes, April 26. This report will be prepared outside of the final exam period but it will serve as the final exam.

## Course Policies and Resources

<b>Accessibility Resources</b>	UNC-Chapel Hill facilitates the implementation of reasonable accommodations for students with learning disabilities, physical disabilities, mental health struggles, chronic medical conditions, temporary disability, or pregnancy complications, all of which can impair student success. See the ARS website for contact and registration information: <a href="https://ars.unc.edu/about-ars/contact-us">https://ars.unc.edu/about-ars/contact-us</a>
<b>Attendance Policy</b>	<p>No right or privilege exists that permits a student to be absent from any class meetings, except for these University Approved Absences:</p> <ol style="list-style-type: none"> <li>1. Authorized University activities</li> <li>2. Disability/religious observance/pregnancy, as required by law and approved by <a href="#">Accessibility Resources and Service</a> and/or the <a href="#">Equal Opportunity and Compliance Office</a> (EOC)</li> </ol> <p>Significant health condition and/or personal/family emergency as approved by the <a href="#">Office of the Dean of Students</a>, <a href="#">Gender Violence Service Coordinators</a>, and/or the <a href="#">Equal Opportunity and Compliance Office</a> (EOC).</p> <p>Instruction periods cannot be made up at another time but students may arrange with the instructor to work independently in the lab classroom to finish experiments as necessary. If students cannot attend an instruction period because of another commitment such as an interview for professional advancement, an arrangement can be made in advance with the instructor by email, preferably in advance of the date.</p>
<b>University Testing Center</b>	The College of Arts and Sciences provides a secure, proctored environment in which exams can be taken. The center works with

	instructors to proctor exams for their undergraduate students who are not registered with ARS and who do not need testing accommodations as provided by ARS. In other words, the Center provides a proctored testing environment for students who are unable to take an exam at the normally scheduled time (with pre-arrangement by your instructor). For more information, visit <a href="http://testingcenter.web.unc.edu/">http://testingcenter.web.unc.edu/</a> .
<b>Counseling and Psychological Services</b>	CAPS is strongly committed to addressing the mental health needs of a diverse student body through timely access to consultation and connection to clinically appropriate services, whether for short or long-term needs. Go to their website: <a href="https://caps.unc.edu/">https://caps.unc.edu/</a> or visit their facilities on the third floor of the Campus Health Services building for a walk-in evaluation to learn more.
<b>Honor Code Statement</b>	Students are bound by the Honor Code in taking exams and in written work. The Honor Code of the University is in effect at all times, and the submission of work signifies understanding and acceptance of those requirements. Plagiarism will not be tolerated. Please consult with me if you have any questions about the Honor Code.
<b>Technology Use</b>	Computers are necessary for this class. However, instructors reserve the ability to disallow the use of computers when doing so will enhance discussion. Students are expected to use their computers only for work related to the class, which means no e-mail, no Facebook, no Twitter, no ESPN, and so on.

## Course at a Glance

The professor reserves the right to make changes to the syllabus, including project due dates and test dates. These changes will be announced as early as possible.

Before first meeting:

Reading: The Protocols below found in Protocols folder of Sakai site:

- How to keep your notes
- Accurately pipette small volumes of liquid
- How to use a micropipette
- Serial Dilutions of Cultures
- Streak Yeast on Petrie Plates for Single Colonies

Week 1 Jan 13/14

Introduction to course

Topic: Introduction to research problem and introduction to wet lab techniques.

Reading: As outlined in Homework Assignment week 1 on Sakai: Textbook sections and web material to review mitosis and breakage-fusion-bridge cycle. Also, Duina et al 2014, Yeast as a model organism, Genetics, 197:33-48.

Due: Homework 1 will be due at 5 pm two days after class.

Week 2: MLK Holiday week: no class for either section, Monday and Tuesday classes cancelled  
Reading: Hill and Bloom 1987, Genetic Manipulation of Centromere Function. Mol. Cell Biol. 7: 2397-2405; Brock and Bloom 1994, A chromosome breakage assay to monitor mitotic forces in budding yeast. J. Cell Sci. 107:891-902; DNA prep protocol in protocol folder on Sakai site.  
Homework will be assigned reading.

Week 3: Jan 27/28

Topic: The inducible dicentric chromosome.

Lab work: Preparing DNA from yeast.

Reading: As outlined in Homework Assignment week 3: Galactose regulation of gene expression in yeast.

Protocols: Evaluate DNA quality and quantity with Qubit, Gel electrophoresis.

Due: Homework week 3 (#2) will be due at 5 pm two days after class.

Week 4: Feb 3/4

Topic: Establishment of a galactose-regulated centromere in yeast.

Lab work: Evaluation of genomic DNA quality, Gel electrophoresis, plate yeast for centromere activation.

Reading: As outlined in Homework Assignment week 4, reading on centromere structure, Kinley and Cheeseman 2015, The molecular basis for centromere identity and function Nat. Rev. Mol. Cell Biol. 17: 16-29. And Science 2019, and Bloom lab. protocols:

Due: Homework week 4 (#3) will be due at 5 pm two days after class.

Week 5: Feb 10/11

Topic: Centromere structure and function, and mechanisms of double strand DNA break repair. Viability of dicentric strains on glucose media.

Lab work: Isolate survivors of chromosome breakage, count survival frequencies, set up heritability tests.

Reading: As outlined in Homework Assignment week 5, Structure of the centromere DNA.

Due: Homework week 5 (#4) on galactose regulation will be due at 5 pm 2 days after class.

Week 6: Feb 16/17

Topic: Use R to illustrate results of survivorship, Prof. Kerry Bloom discusses goals for research.

Lab work: Evaluate heritability of survivorship trait. Set up for DNA preps of chosen isolates.

Reading: PCR reaction protocol.

Due: Interim report 1 on how galactose regulates centromere function in our strains due at the end of the week.

Week 7: Feb 24/25

Topic: PCR reactions. PCR workshop.

Lab work: Prepare DNA from chosen survivors and control strains. Set up control PCR reactions.

Due: Interim Report 2 on survivorship curves comparing *rad52* genotypes and centromere distances at the end of the week.

Week 8: Mar 2/3

Topic: Discuss plans for studying survivors in class. Workshop on DNA sequence analysis.

Lab work: Evaluate PCR reactions using gel electrophoresis, Evaluate quality of DNA

Due: Project Development Assignment due at end of the week.

Week 9: Spring Break no classes

Week 10: Mar 16/17

Topic: DNA preps, set up PCR reactions, design of additional primers.

Reading: As outlined in Homework Assignment week 10, Lopez et al 2105 Cytokinesis breaks dicentric chromosomes preferentially at pericentromeric regions and telomere fusions. Genes and Development 29:322-336.

Due: Homework week 10 due two days after class.

Week 11: Mar 23/24

Topic: Analyze Lopez et al 2015 in class. Gel electrophoresis of first PCR reactions. Discuss likely outcomes from PCR and what it means. Send interesting PCR products for sequence analysis, set up more PCR reactions. How to present results of PCR analysis. Alignment tools.

Week 12: Mar 30/31

Topic: Results of PCR reactions, Sequence analysis, Alignment of sequence data with a reference and annotation. Consult with Bloom lab members

Due: Interim Report 3 on results of first PCR experiments due at end of the week.

Week 13: April 6/7

Topic: More sequence analysis, more PCRs. Plan poster presentation with group members.

Due: Poster drafts due at 5 pm Thurs April 9.

Week 14: April 13/14

Discussion of Poster presentations, interpretation of final results.

Due: Posters to printer.

Week 15: April 20/21

Topic: lab clean-up. Poster session April 22

Due: final reports due at 5 pm last day of classes.