Welcome to Genome Diversity and Dynamics!
How are scientists, doctors, and consumers using big data to understand human health and the environment? Why are "omics" technologies key for understanding biology in the 21st century, and how do they work? What skills and strategies will be needed to make sense of the millions of genomes being sequenced? During this course we’ll cover answers to these questions and more.

**What this course will enable you to do:**

**LEARNING OUTCOMES AKA LO's**

By the end of the course you’ll be able to:

1. Explain how phenotype = genotype + environment + expression
2. Compare and contrast extant genomes and connect to phenotypic differences
3. Summarize ways genomes change at the molecular level and propose how evolution takes advantage of those changes
4. Recognize different levels of genome diversity: from within individuals to within communities
5. Relate scale of genomes and genomic data to familiar scales
6. Summarize omics technologies: how they work and what questions can they answer
7. Interpret omics data to draw conclusions
8. Evaluate mainstream media reports of omics data
9. Recognize unknowns in genomics
10. Value the power of genomics research to answer broadly relevant questions

**INSTRUCTOR**

**Dr. Katherine Petrie**
kpetrie@ucsd.edu
OFFICE: AP&M 2824
OFFICE HOURS: F 130-330 or by appt.

**IA**

**Dani Zarate**
dazarate@ucds.edu
OFFICE: TBD
OFFICE HOURS: TBD

DID YOU KNOW UCSD HAS CORE SKILLS FOR ALL STUDENTS TO MASTER? HERE ARE SOME OF THEM.

- **Critical Thinking**
  - Understand heredity
  - Construct reasonable hypotheses to explain biological phenomena

- **Information Literacy**
  - Understand the correlation of structure, function and processes
  - Recognize the interactions between biology and society

- **Written & Oral Communication**
  - Understand evolution and diversity
  - Use contemporary biological research techniques and quantitative approaches to analyze results

- **Quantitative Reasoning**
  - Go goals for bio majors
  - Understand heredity
  - Go goals for all students
ASSESSMENTS AND BASIS FOR FINAL GRADE:

<table>
<thead>
<tr>
<th>ASSIGNMENT</th>
<th>% OF GRADE</th>
<th>LO’S ADDRESSED</th>
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<tbody>
<tr>
<td>In-class Clicker Questions</td>
<td>15%</td>
<td>LO'S 1-7, 9-10</td>
</tr>
<tr>
<td>Weekly Discussion Section quizzes</td>
<td>10%</td>
<td>LO'S 1-7</td>
</tr>
<tr>
<td>Discussion Section Worksheets</td>
<td>15%</td>
<td>LO'S 6-7</td>
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<tr>
<td>Homework 1 - Real World Connections</td>
<td>5%</td>
<td>LO 10</td>
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<tr>
<td>Homework 2 - Real World Connections</td>
<td>5%</td>
<td>LO 10</td>
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<tr>
<td>Homework 3 - Mainstream Media</td>
<td>5%</td>
<td>LO’S 8-9</td>
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<td>20%</td>
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<tr>
<td>Final Exam</td>
<td>25%</td>
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NO BELL CURVE: YOU WON’T BE COMPETING AGAINST EACH OTHER!

GRADING SCALE

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<tr>
<th>Grade</th>
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<tbody>
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<td>97-100</td>
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<tr>
<td>A</td>
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LO’S Addressed:

- LO’s 1-7, 9-10
- LO’s 1-7
- LO’S 6-7
- LO 10
- LO 10
- LO’S 8-9
- ALL
- ALL
- ALL
- ALL

MATERIALS NEEDED TO SUCCEED:

A CLICKER: THERE IS NO TEXTBOOK FOR THIS COURSE, BUT YOU ARE REQUIRED TO HAVE AND BRING TO CLASS AN i>CLICKER THAT IS REGISTERED VIA TRITON ED.

TRITON ED: ASSIGNMENTS, GRADES, AND OTHER COURSE INFORMATION WILL BE POSTED ON TRITON ED, SO MAKE SURE YOU CAN ACCESS IT.

SOMETHING TO TAKE NOTES WITH DURING LECTURE: LECTURES WILL BE PODCAST, BUT RESEARCH SHOWS THAT PEN & PAPER NOTE-TAKING WHERE YOU ORGANIZE, SUMMARIZE AND REPHRASE KEY IDEAS IS ONE OF THE BEST STRATEGIES TO HELP YOU LEARN NEW INFORMATION. EVEN IF YOU CHOOSE NOT TO TAKE NOTES IN CLASS; THINK ABOUT DOING IT FROM THE PODCASTS WHILE STUDYING.

(OPTIONAL) A SMARTPHONE OR LAPTOP FOR DISCUSSION SECTION: SOMETIMES WE’LL BE USING ONLINE RESOURCES TO COMPLETE THE DISCUSSION SECTION WORKSHEETS. A WEB-ENABLED TABLET WILL BE AVAILABLE FOR EVERY GROUP OF 4 STUDENTS, BUT IF YOU HAVE A SMARTPHONE OR LAPTOP YOU ARE WELCOME TO BRING IT TO HELP YOUR GROUP OUT.

WE ALL MAKE MISTAKES. IF YOU THINK YOUR QUIZ, HOMEWORK, WORKSHEET, OR EXAM WAS GRADED IN ERROR, PLEASE SUBMIT A REQUEST BY EMAIL TO DR. PETRIE WITHIN 5 DAYS OF RECEIVING YOUR GRADE. YOU MUST INCLUDE A WRITTEN DESCRIPTION OF THE ERROR, INCLUDING WHICH QUESTION YOU ARE CONCERNED ABOUT AND WHY YOU THINK THE GRADE IS MISTAKEN. NO IN-PERSON REQUESTS WILL BE CONSIDERED. THE REGRADE OPTION IS TO SAFEGUARD YOU FROM GENUINE MISTAKES IN GrADING; THERE IS NO GUARANTEE YOUR SCORE WILL GO UP.

HOW WILL YOU DEMONSTRATE THAT YOU ACCOMPLISHED THE 10 LO'S?

FOR HOMEWORK ASSIGNMENT + RUBRICS, STAY TUNED TO TRITON ED!

Regrade Requests:
IN-CLASS WORK: HOW TO SUCCEED

DAILY CLICKER QUESTIONS (15% OF GRADE)
In every lecture, clicker questions will challenge you to apply what you've just learned. Some questions will be open-ended discussion questions or surveys, and some will have a correct answer. The type of question will be clearly marked as 'participation' or 'performance.' Every day you will have the opportunity to earn:

- 2 participation points (Submit answer to 80% of all questions for 2 pts, else get 0)
- 2 performance points (Get 1 pt for every correctly answered performance question)

There will usually be more than 2 performance questions per class, so even if you get some wrong you may still be able to get full points. Check Triton Ed frequently to make sure your clickers scores are being recorded.

If you miss lecture, or if your clicker is having technical difficulties, you may not make up the questions. However, we'll drop your lowest 6 clicker days.

If you miss discussion section, you may not make up the quiz or worksheet, but we'll drop your 2 lowest quizzes and your 2 lowest worksheets.

If you miss the midterm, your final will be worth a bigger % of your grade to make up the difference. If you miss the final, you may be eligible for an incomplete.

Use these drops wisely: it's better to save them for the unexpected, like when you are sick or your clicker batteries die.

WEEKLY DISCUSSION SECTION QUIZZES (TUESDAYS) (10% OF GRADE)
At the beginning of every discussion section, there will be a brief quiz where you recall, explain, or apply concepts from the prior week.

These quizzes are a chance for you to practice genomic thinking. You will be allowed to bring a half-sheet of standard printer paper (8.5 x 5.5 inches) containing any notes you like on one side. Summarizing and paraphrasing your notes from class, or drawing diagrams of techniques we covered, is a good place to start.

If health or family emergencies result in having to miss more than the allowed drops, see Dr. Petrie to discuss the possibility of an "incomplete." Per UCSD policy, you must be in good standing before class is missed to be eligible.

WEEKLY DISCUSSION SECTION WORKSHEETS (15% OF GRADE)
During discussion sections, you'll be working as a group to solve puzzles and problems relating to genomics data. Pre-assignments (readings, etc.) will help prepare you.

There will be a worksheet that every person will need to complete using their own words. These will be graded individually, but you will need to work as a group to get all of the answers.

You should be able to finish the worksheet by the end of discussion section, but will have 24 hours to put finishing touches on it.
LETS BEGIN! HERE'S A COURSE PREVIEW: MODERN SEQUENCING TECHNOLOGY HAS REVOLUTIONIZED OUR ABILITY TO DETECT HOW GENOMES VARY IN SPACE (BETWEEN INDIVIDUALS, POPULATIONS, AND COMMUNITIES) AND OVER TIME. THIS COURSE WILL REVIEW METHODS AND CONCEPTS IN ECOLOGICAL AND EVOLUTIONARY GENOMICS THAT HELP US UNDERSTAND THESE DIFFERENCES, INCLUDING THEIR RELEVANCE TO HEALTH (HUMAN MICROBIOME, CANCER EVOLUTION), EVOLUTIONARY HISTORY (ANCESTOR RECONSTRUCTION, HUMAN EVOLUTION), AND THE ENVIRONMENT (EFFECT OF CLIMATE CHANGE).

HERE WE GO!!!
WEEK 1. THE 1ST LEVEL OF DIVERSITY: HOW WE ID AND DESCRIBE GENOMES?
M - 4/2 INTRODUCTION TO GENOMES AND COURSE
T - 4/3 NO DISCUSSION SECTION
W - 4/4 OLD-SCHOOL GENOME SEQUENCING
F - 4/6 NEXT-GENERATION GENOME SEQUENCING 1

WEEK 2. HOW DO WE FIGURE OUT WHAT THE PARTS OF GENOME DO?
M - 4/9 NEXT GENERATION GENOME SEQUENCING 2
T - 4/10 QUIZ ON WEEK 1, DE NOVO ASSEMBLY ACTIVITY
W - 4/11 PARTS OF GENOME & GENERAL ORGANIZATION
F - 4/13 GENOME ANNOTATION

WEEK 3. GENOME DIVERSITY BETWEEN INDIVIDUAL SPECIES
M - 4/16 GENERAL DIFFERENCES BETWEEN GENOMES 1
T - 4/17 QUIZ ON WEEK 2, ANNOTATION ACTIVITY
W - 4/18 GENERAL DIFFERENCES BETWEEN GENOMES 2
F - 4/20 MEASURING DIFFERENCES AND BUILDING TREES

WEEK 4. GENOME DIVERSITY WITHIN A POPULATION
M - 4/23 RESequencing, EFFECT OF DIFFERENCES
T - 4/24 QUIZ ON WEEK 3, TREE ACTIVITY
W - 4/25 EFFECT OF DIFFERENCES CONTINUED
F - 4/27 POPULATION DIVERSITY & CONSERVATION BIOLOGY

WEEK 5. GENOME DIVERSITY WITHIN COMMUNITIES
M - 4/30 METAGENOMICS: 16S AND WHOLE-GENOME
T - 5/1 QUIZ ON WEEK 4, GWAS ACTIVITY
W - 5/2 METAGENOMES IN THE ENVIRONMENT + HEALTH
F - 5/4 HOMEWORK 1 DUE! REVIEW FOR MIDTERM
## Course Schedule (Tentative):

### Week 6. Midterm + Genome Dynamics over Short Time Scales

- **M - 5/7** In-Class Midterm!
- **T - 5/8** Metagenomics Activity (No Quiz)
- **W - 5/9** Plastic Responses + RNA-seq
- **F - 5/11** Proteomics

### Midterm!

### Week 7. Genome Dynamics over Short Time Scales

- **M - 5/14** Epigenomics, Chip-seq + Methyl-seq
- **T - 5/15** Quiz on Week 6, RNA-seq Activity
- **W - 5/16** Development + Regulatory Networks
- **F - 5/18** Homework 2 Due! Stem Cells, Differentiation

### HW 2 Due!

### Week 8. Genome Dynamics over Long Time Scales

- **M - 5/21** Mechanisms of Genome Evolution 1
- **T - 5/22** Quiz on Week 7, Stem Cell Activity
- **W - 5/23** Mechanisms of Genome Evolution 2
- **F - 5/25** Examples of Genome Evolution 1

### Long-term Dynamics: Changes in the Genotype Itself

### Week 9. Genome Dynamics over Long Time Scales

- **M - 5/28** Memorial Day! No Class!
- **T - 5/29** Quiz on Week 8, Genome Evolution Activity
- **W - 5/30** Examples of Genome Evolution 2
- **F - 6/1** Ancient Genomics: Fossils + Reconstructions

### HW 3 Due!

### Week 10. Genome Dynamics over Long Time Scales

- **M - 6/4** Genome Evolution in Realtime: Cancer + Viruses
- **T - 6/5** Quiz on Week 9, Genome Evolution Activity
- **W - 6/6** 3rd Generation Sequencing + The Future
- **F - 6/8** Homework 3 Due! Review for Final

### Final Exam: Friday, June 15th, 11:30 AM - 2:30 PM

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**Course Focus:**
- **Genome Diversity in Time**
- **Short-term Dynamics:** Changes in the "expressed" genome
- **Long-term Dynamics:** Changes in the genotype itself

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### Important Dates:
- **MIDTERM:** 5/7
- **QUIZ:** Various
- **DEADLINES:** Homeworks 2 and 3
- **FINAL EXAM:** 6/15, 11:30 AM - 2:30 PM

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**UCSD Genome Diversity and Dynamics**

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University of California, San Diego
Consent to Act as a Research Subject

Investigating the Impact of Pedagogical Choices on University Student Learning and Engagement

Who is conducting the study, why you have been asked to participate, how you were selected, and what is the approximate number of participants in the study?
Gabriele Wienhausen, Director of the Teaching and Learning Commons, together with her education research colleagues is conducting a research study to find out more about how pedagogical choices affect student learning and experience in the classroom. You have been asked to participate in this study because you are a student in a class that is being studied or used as a control. There will be approximately 500,000 participants in this study.

Why is this study being done?
The purpose of this study is to create knowledge that has the potential to improve the learning and educational experience of students at UC San Diego and beyond.

What will happen to you in this study and which procedures are standard of care and which are experimental?
If you agree to be in this study, the following will happen:
- Your data from this class including grades, homework and exam submissions, and survey responses will be included in the analysis to determine the effectiveness of the pedagogical techniques used in this course compared to other similar courses.

How much time will each study procedure take, what is your total time commitment, and how long will the study last?
Your participation involves only agreeing to let us use your data in our analysis. It will require no time on your part above the time you put into this course without agreeing to the study.

What risks are associated with this study?
Participation in this study may involve some added risks or discomforts. These include the following:
1. A potential for the loss of confidentiality. We will not share your personally identifying data with people outside our research team. Data will only be kept in anonymized form for research purposes. Course data will not be used for this research study until after final grades have been posted and will be rendered confidential by removing any identifiers before analysis. Your instructor will not know whether or not you are participating in this study until after final grades have been posted. Data from students who opt out of the study will be removed prior to data analysis. Research records will be kept.
confidential to the extent allowed by law. Research records may be reviewed by the UCSD Institutional Review Board.
Since this is an investigational study, there may be some unknown risks that are currently unforeseeable. You will be informed of any significant new findings.

**What are the alternatives to participating in this study?**
The alternatives to participation in this study are not to participate. If you choose to opt-out of participating in this research study, we will exclude your data from analysis. Whether you participate will have no impact on your experience or grade in the associated class as the professor will not know who is or is not participating in the study until after final grades are assigned.

**What benefits can be reasonably expected?**
There is no direct benefit to you for participating in the study. The investigator, however, may learn more about how to improve student learning, and society may benefit from this knowledge.

**Can you choose to not participate or withdraw from the study without penalty or loss of benefits?**
Participation in research is entirely voluntary. You may refuse to participate or withdraw or refuse to answer specific questions in an interview or on a questionnaire at any time without penalty or loss of benefits to which you are entitled. If you decide that you no longer wish to continue in this study before the end of the quarter, simply respond to the online opt-out form here: [https://goo.gl/forms/JSBRjEmkES6W6xYc2](https://goo.gl/forms/JSBRjEmkES6W6xYc2). If you decide to opt out after the quarter has ended, you must contact Ying Xiong (vix184@ucsd.edu) and give the quarter and the course from which you would like your data withdrawn.

You will be told if any important new information is found during the course of this study that may affect your wanting to continue.

**Can you be withdrawn from the study without your consent?**
The PI may remove you from the study without your consent if the PI feels it is in your best interest or the best interest of the study. You may also be withdrawn from the study if you do not follow the instructions given you by the study personnel.

**Will you be compensated for participating in this study?**
You will not be compensated for participating in this study.

**Are there any costs associated with participating in this study?**
There will be no cost to you for participating in this study.
Who can you call if you have questions?
Gabriele Wienhausen and/or her colleague has explained this study to you and answered your questions. If you have other questions or research-related problems, you may reach Gabriele Wienhausen at gwienhausen@ucsd.edu or (858) 534-3958.

You may call the Human Research Protections Program Office at 858-246-HRPP (858-246-4777) to inquire about your rights as a research subject or to report research-related problems.

Your Consent
If you consent to participate in this study, no action is needed. If you DO NOT consent to participate in this study, or you choose to opt-out at any time during the quarter, please submit this form online at https://goo.gl/forms/JSBRjEmkES6W6xYc2. Your instructor will not have access to the list of students who opted out until after grades are posted. Note that you must separately opt-out of the study for each course involved in this study.

[ ] I am not 18 years or older or I do not consent to anonymized research use of my data from the course specified below.

Course name: ____________  Course section number: _____________  Term: ____________

Name: _______________________________________

PID: ________________________________________