UCSD

BIEB 146: GENOME DIVERSITY AND DYNAMICS

SPRING '19

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.

CENTER HALL 115, MWF 1-1:50 PM

INSTRUCTOR **DR. KATHERINE PETRIE**
kpetrie@ucsd.edu
OFFICE: AP&M 2824
OFFICE HOURS: M 230-4 or by appt.

IAS **CONG DINH**
cbdinh@ucsd.edu

VAL JACKSON-HUNDLEY
vzjackso@ucsd.edu

NADIA TOLEDO
ndtoledo@ucsd.edu

ALEX FLORES
alf022@ucsd.edu

WHAT THIS COURSE WILL ENABLE YOU TO DO:

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

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

GOALS FOR BIO MAJORS

GOALS FOR ALL STUDENTS

UNDERSTAND HEREDITY

UNDERSTAND THE CORRELATION OF STRUCTURE, FUNCTION AND PROCESSES

WRITTEN + ORAL COMMUNICATION

UNDERSTAND EVOLUTION AND DIVERSITY

QUANTITATIVE REASONING

USE CONTEMPORARY BIOLOGICAL RESEARCH TECHNIQUES AND QUANTITATIVE APPROACHES TO ANALYZE RESULTS

CONSTRUCT REASONABLE HYPOTHESES TO EXPLAIN BIOLOGICAL PHENOMENA

CRITICAL THINKING

INFORMATION LITERACY

RECOGNIZE THE INTERACTIONS BETWEEN BIOLOGY AND SOCIETY

UCSD

GENOME DIVERSITY AND DYNAMICS

SPRING '19

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

ASSESSMENTS AND BASIS FOR FINAL GRADE:

ASSIGNMENT	% OF GRADE	LO'S ADDRESSED
PACKBACK	10%	LO'S 7-10
IN-CLASS CLICKER QUESTIONS	6 %	LO'S 1-7, 9-10
WEEKLY DISCUSSION SECTION QUIZZES	10 %	LO'S 1-7
DISCUSSION SECTION WORKSHEETS	14 %	LO'S 6-8
HOMEWORK - OUTSIDE CONNECTIONS	15 %	LO 10
MIDTERM EXAM	20 %	ALL
FINAL EXAM	25 %	ALL

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

NO BELL CURVE: YOU WON'T BE COMPETING AGAINST EACH OTHER!.

GRADING SCALE

97-100	A+	(4.0)
93-97.	A	(4.0)
90-93	A-	(3.7)
87-90	B+	(3.3)
83-87	B	(3.0)
80-83	B-	(2.7)
77-80	C+	(2.3)
73-77	C	(2.0)
70-73	C-	(1.7)
60-70	D	(1.0)
<60	F	(0)

MATERIALS NEEDED TO SUCCEED:

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

PACKBACK ACCESS CODE: WE'LL BE USING THIS AI-MODERATED FORUM TO DIVE DEEPER INTO THE TOPICS WE COVER IN CLASS. YOU'LL NEED TO PURCHASE AN ACCESS CODE, ($28), AVAILABLE FROM THE BOOKSTORE WEBSITE (LOOK UP BIEB 146 UNDER 'TEXTBOOKS').

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.

(OPTIONAL) A SMARTPHONE OR LAPTOP FOR DISCUSSION SECTION: SOMETIMES WE'LL BE USING ONLINE RESOURCES IN SECTION. WEB-ENABLED TABLETS WILL BE AVAILABLE FOR EVERY GROUP OF 5-6 STUDENTS, BUT YOU ARE WELCOME TO BRING AND USE YOUR OWN DEVICE.

REGRADE REQUESTS:

WE ALL MAKE MISTAKES. IF YOU THINK YOUR QUIZ, HOMEWORK, WORKSHEET, OR EXAM WAS GRADED IN ERROR, SUBMIT A REQUEST **BY EMAIL** TO DR. PETRIE WITHIN 7 DAYS OF RECEIVING YOUR GRADE. 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 YOU SCORE WILL GO UP.

UCSD

GENOME DIVERSITY AND DYNAMICS

SPRING '19

IN-CLASS WORK: HOW TO SUCCEED

THERE WON'T BE ANY MAKE-UP WORK IF YOU MISS CLASS. BUT DON'T WORRY....

DAILY CLICKER QUESTIONS (6% 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 75% OF **ALL** QUESTIONS FOR 2 PTS, ELSE GET 0)
2 PERFORMANCE POINTS (GET 1 PT FOR EVERY CORRECTLY ANSWERED PERFORMANCE QUESTION)

THERE ARE USUALLY MORE THAN 2 PERFORMANCE QUESTIONS PER CLASS, SO EVEN IF YOU GET SOME WRONG YOU MAY STILL GET FULL POINTS, AND YOU CAN MAKE UP **ONE** POINT BY SUBMITTING A 'MUDDIEST POINT' ON TRITON ED (LIMIT = 1). CHECK OFTEN TO MAKE SURE YOUR CLICKERS 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 **LOWEST WORKSHEET**.

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 (10% OF GRADE)

AT THE END OF MOST SECTIONS, THERE WILL BE A BRIEF QUIZ WHERE YOU RECALL, EXPLAIN, OR APPLY CONCEPTS FROM THE PRIOR WEEK (SEE SCHEDULE FOR EXACT DATES COVERED).

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.

WEEKLY DISCUSSION SECTION WORKSHEETS (14% OF GRADE)

DURING DISCUSSION SECTIONS, YOU'LL BE WORKING AS A GROUP TO SOLVE PUZZLES AND PROBLEMS RELATING TO GENOMICS DATA.

THERE WILL BE A WORKSHEET THAT EVERY PERSON MUST COMPLETE USING THEIR OWN WORDS. THESE WILL BE GRADED INDIVIDUALLY, BUT YOU WILL OFTEN 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.

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.

UCSD

GENOME DIVERSITY AND DYNAMICS

SPRING '19

ONLINE DISCUSSION FORUM

PACKBACK (10% OF GRADE)
THIS AI-MODERATED DISCUSSION FORUM IS A KEY LEARNING TOOL FOR THE CLASS. IT IS DRIVEN BY YOUR CURIOSITY AND WILL HELP YOU MAKE CONNECTIONS BETWEEN WHAT WE LEARN IN CLASS AND THE REAL WORLD. EVERY **WEEK**, YOU ARE REQUIRED TO:

POST 1 QUESTION
AND
RESPOND TO 2 QUESTIONS

TO EARN CREDIT, YOUR POSTS MUST MEET CERTAIN GUIDELINES. PACKBACK WILL COACH YOU ON HOW TO DO THIS, AND WILL ASSIGN A CURIOSITY SCORE BASED ON DEPTH, CREDIBILITY, AND PRESENTATION. CONSISTENTLY HIGH CURIOSITY SCORES ARE AN OPPORTUNITY TO EARN EXTRA CREDIT - DETAILS COMING SOON.

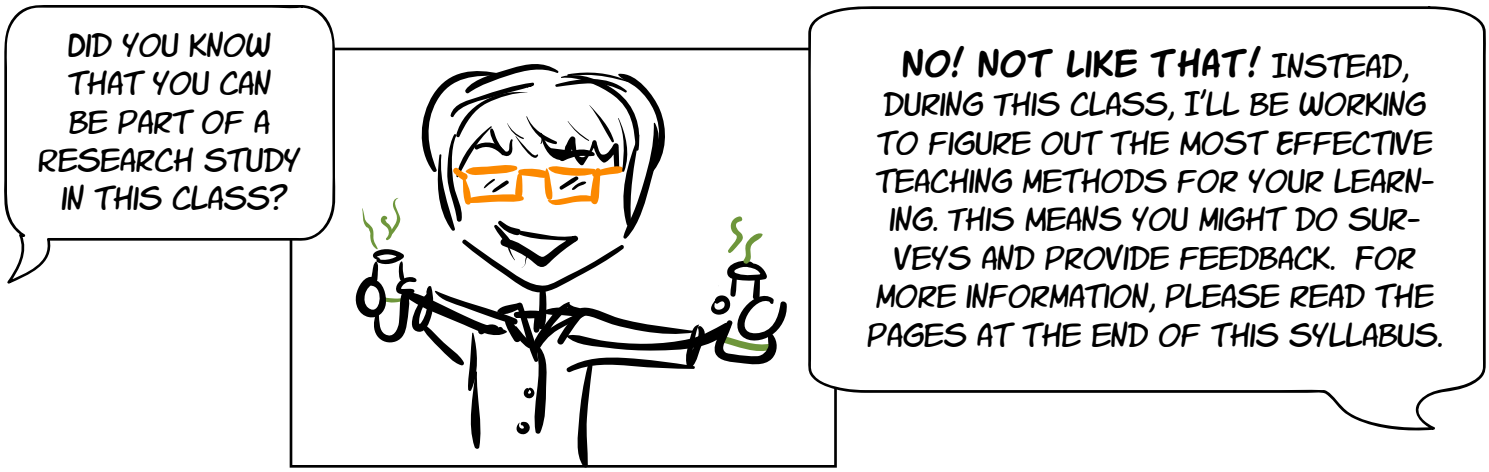
INCLUSIVITY:

EVERYONE WILL COME TO THIS COURSE WITH DIFFERENT BACKGROUNDS, KNOWLEDGE, AND PERSPECTIVES. WE WANT TO CREATE A CLASSROOM CULTURE THAT RESPECTS AND REVELS IN THIS HUMAN DIVERSITY. IF YOU HAVE ANY CONCERNS RELATED TO INCLUSIVITY OR FEEL YOUR IDENTITIES (RACE, GENDER, SEXUALITY, RELIGION, ABILITY, ETC) ARE NOT BEING HONORED, PLEASE LET US KNOW! **ACCOMMODATIONS CAN BE MADE FOR STUDENTS WITH A LETTER FROM THE OSD.** FOR MORE INFORMATION ON CAMPUS + COMMUNITY RESOURCES, CHECK TRITON ED.

ACADEMIC INTEGRITY:

AN INCLUSIVE ENVIRONMENT IS ONE WHERE EVERYONE HAS AN EQUAL OPPORTUNITY TO SUCCEED. ACADEMIC DISHONESTY (INCLUDING, BUT NOT LIMITED TO: CHEATING, PLAGIARIZING, ANSWERING WITH SOMEONE ELSE'S CLICKER) FRACTURES THE PLAYING FIELD, BY GIVING SOME STUDENTS AN UNFAIR ADVANTAGE. ASSIGNMENTS WILL BE MONITORED VIA TURN-IT-IN, AND STUDENTS FOUND TO HAVE COMMITTED ACADEMIC DISHONESTY WILL BE REFERRED TO THE UCSD ACADEMIC INTEGRITY OFFICE AND MAY RECEIVE A FAILING GRADE FOR THE COURSE.

WE'RE WORKING TO IMPROVE YOUR EDUCATIONAL EXPERIENCE:



UCSD

GENOME DIVERSITY AND DYNAMICS

SPRING '19

COURSE SCHEDULE (TENTATIVE):

INTRODUCTION

WEEK 1. THE 1ST LEVEL OF DIVERSITY: HOW DO WE ID AND DESCRIBE GENOMES?

(DI) **NO SECTION MEETINGS THIS WEEK!**
M - 4/1 INTRODUCTION TO GENOMES AND COURSE
W - 4/3 OLD-SCHOOL GENOME SEQUENCING
F - 4/5 NEXT-GEN GENOME SEQUENCING 1 (ILLUMINA)

WEEK 2. HOW DO WE FIGURE OUT WHAT THE PARTS OF GENOME DO?

(DI) **QUIZ (4/1-4/5), ASSEMBLY ACTIVITY**
M - 4/8 NEXT-GEN GENOME SEQUENCING 2 (ASSEMBLY)
W - 4/10 NEXT-GEN GENOME SEQUENCING 3 (SCAFFOLDING)
F - 4/12 GENOME ANNOTATION

GENOME DIVERSITY IN SPACE

WEEK 3. EXTANT GENOME DIVERSITY (SPECIES, POPULATIONS)

(DI) **QUIZ (4/8-4/12), ANNOTATION ACTIVITY**
M - 4/15 COMPARATIVE GENOMICS 1
W - 4/17 COMPARATIVE GENOMICS 2
F - 4/19 MEASURING DIFFERENCES AND BUILDING TREES

GENOME DIVERSITY AMONG THINGS THAT ARE ALIVE IN THE BIOSPHERE TODAY.

WEEK 4. EXTANT GENOME DIVERSITY (POPULATIONS, COMMUNITIES)

(DI) **QUIZ (4/15-4/19), TREE ACTIVITY**
M - 4/22 DIVERSITY WITHIN A POPULATION, RESEQUENCING
W - 4/24 EFFECT OF DIFFERENCES WITHIN A POPULATION
F - 4/26 POPULATION DIVERSITY AND CONSERVATION BIO

WEEK 5. EXTANT GENOME DIVERSITY (COMMUNITIES)

(DI) **(NO QUIZ), OPTIONAL 'OFFICE-HOURS' SECTION**
M - 4/29 METAGENOMICS: 16S AND WHOLE-GENOME
W - **5/1 HOMEWORK 1 DUE!** REVIEW FOR MIDTERM
F - **5/3 IN-CLASS MIDTERM!**

HW 1 DUE!

MIDTERM!

UCSD

GENOME DIVERSITY AND DYNAMICS

SPRING '19

COURSE SCHEDULE (TENTATIVE):

GENOME DIVERSITY IN TIME

SHORT-TERM DYNAMICS: CHANGES IN THE "EXPRESSED" GENOME

WEEK 6. GENOME DYNAMICS OVER SHORT TIME SCALES

(DI) (NO QUIZ) GWAS ACTIVITY
M - 5/6 METAGENOMES IN THE ENVIRONMENT + HEALTH
W - 5/8 PLASTIC RESPONSES AND RNA-SEQ 1
F - 5/10 PLASTIC RESPONSES AND RNA-SEQ 2

WEEK 7. GENOME DYNAMICS OVER SHORT TIME SCALES

(DI) QUIZ (5/6-5/10), METAGENOMICS ACTIVITY
M - 5/13 EPIGENOMICS, CHIP-SEQ, + METHYL-SEQ
W - 5/15 DEVELOPMENT + REGULATORY CASCADES
F - 5/17 STEM CELLS, DIFFERENTIATION

WEEK 8. GENOME DYNAMICS OVER SHORT TIME SCALES

(DI) QUIZ (5/13 - 5/17), RNA-SEQ ACTIVITY
M - 5/20 HOMEWORK 2 DUE! PROTEOMICS
W - 5/22 MECHANISMS OF GENOME EVOLUTION
F - 5/24 EXAMPLES OF GENOME EVOLUTION

HW 2 DUE!

LONG-TERM DYNAMICS: CHANGES IN THE GENOTYPE ITSELF

WEEK 9. GENOME DYNAMICS OVER LONG TIME SCALES

(DI) NO SECTION MEETINGS THIS WEEK!
M - 5/27 NO CLASS TODAY - MEMORIAL DAY HOLIDAY!
W - 5/29 KEY TRANSITIONS IN GENOME EVOLUTION
F - 5/31 HOW TO STUDY ANCESTRAL GENOMES

WEEK 10. GENOME DYNAMICS OVER LONG TIME SCALES

(DI) QUIZ (5/20-5/31), GENOME EVOLUTION ACTIVITY
M - 6/3 THE EVOLUTION OF CANCER 1
W - 6/5 THE EVOLUTION OF CANCER 2
F - 6/7 HOMEWORK 3 DUE! REVIEW FOR FINAL

HW 3 DUE!

FINAL!

FINAL EXAM: THURSDAY, JUNE 13TH, 11:30AM - 2:30 PM

Human Research Protections Program
UC San Diego
Approved
Current Approval: 07/05/2018
Do not use after 07/04/2019
Pages 3

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. If you decide to opt out after the quarter has ended, you must contact Ying Xiong (yix184@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.

Human Research Protections Program
UC San Diego
Approved
Current Approval: 07/05/2018
Do not use after 07/04/2019

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://docs.google.com/forms/d/e/1FAIpQLScs0Cznypp4SxQJOsFMgP9nFDjJ0zzYPlSBWsiP3_wiWkdjaA/viewform. 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: _____

Human Research Protections Program
UC San Diego
Approved
Current Approval: 07/05/2018
Do not use after 07/04/2019