MUTANTS
& the Making of Us

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Class code: HC 241H Mon & Wed
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From Homer's cyclops to CRISPR technology, circus "freak shows" to evolutionary biology, X-men comics to designer babies, the idea of mutation has a long history in science, literature and culture. As I write this, the news is filled with stories about an emerging variant of COVID-19 that is rapidly spreading in the UK. This new strain, a "mutant", seems to be more transmissible and is beginning to outcompete other strains; we don't yet know whether it causes more severe symptoms.

Mutations change the properties of viruses, tweaking how they interact with our cells and altering the damages they may cause. Mutations also underlie the recent emergence of bacterial superbugs and, when mutations strike our own DNA, they can cause countless diseases including cancer. But mutations are also central to the evolution of life on Earth, creating the amazing diversity we see around us. Our own long history of mutations, back through the eons, is why we are here and why we are the way we are. And now, in the laboratory, scientists are creating mutant animals — the mouse with extra toes or the fly with a leg growing from its head — to understand the deep secrets of how animals develop, how we build ourselves from the starting point of a single cell.

In this course, we will try to understand the idea of "mutation", integrating concepts from genetics and evolutionary biology, developmental biology and medicine, disability studies and literature, philosophy and ethics. We will learn about why mutations occur, what effects they have, and how we can use them to understand—and change—the world around us. Through our study of mutants, we will hold a mirror up to ourselves and ask, from a variety of perspectives, *where did we come from, how are we made, and what does it mean to be human?*

Assessment

30% Participation
30% Journal
40% Final essay

Materials

Scientific articles
Popular science books
Science journalism
Talks & interviews
Short stories

Learning objectives

- Be introduced to reading/evaluating the scientific literature
- Experience communicating cross-disciplinary ideas in writing and discussion
- Gain appreciation of how science is communicated (to other scientists and the broader public)
- Acquire awareness of the methods used in biology to understand how organisms form and the diseases they suffer
- Understand some core concepts of genetics and developmental biology including from philosophy and history
- Integrate ideas from a variety of perspectives

Class covenant

This class is a collaboration between me and you, and your fellow students, with the goal of using the concept of mutation as a lens through which to approach some big questions in biology and other disciplines. In our first class, we will take some time to brainstorm a "class covenant" — a set of rules we want to live by that will help us reach our goals in the class. The rest of this page is intentionally left blank. During the first class, we will complete the syllabus by adding our covenant here.

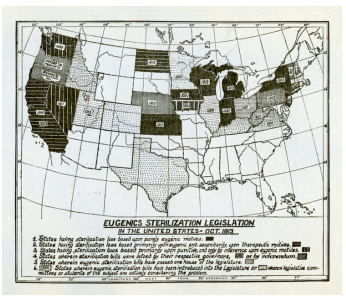
The following covenant was designed by students during our discussions in Class 1 on 29th March 2021.

- We value engagement with each other. We suggest that cameras be kept on (though we understand this isn't always possible) and that we give each other cues when speaking (e.g. nodding, use of emoji's to show agreement).
- We understand that everyone comes to the course with a different background and perspective. We view this as a resource to be tapped. We want to especially note that different students will have different levels of previous engagement with some of the scientific concepts. We will help each other understand things.
- Silence is fine. We all need quiet time to think.
- Half-formed thoughts are okay; nobody needs to have complete answers to anything in order to contribute to discussion.
- Breakout rooms will be kept small and occupants random. We appreciate lively conversations in breakout rooms and the instructor will ensure sufficient time is given for these.
- The course includes some heavy topics and so trigger warnings will be included. We will all appreciate the sensitivity of some of the matters discussed and we will be conscious of the fact that some topics may be especially difficult for some students. We will be respectful during our discussions and discuss these topics with sensitivity.
- The instructor will treat course participants as human beings first and students second. We are still in a pandemic and we must look after ourselves and look out for each other. We will be understanding of the fact that life is especially stressful at the moment.
- We all make mistakes and we agree to give each other a break!
- We value trust. We will not gossip about each other or bring up what people have said outside of class.

Course Requirements

Attendance. Students are expected to attend every class. If you absolutely cannot attend a class, tell me beforehand and we will try to figure out a way for you to make up the missed class. If you absolutely cannot complete the readings or weekly tasks, tell me before the class. You should still attend in these cases.

Journal. At the end of the course, students will submit a journal. The journal will consist of a personal response to the assigned readings, any further readings, and class discussions. You should complete one response per week, for a total of 10. You could include things you found particularly interesting, and why, how the topic of the week relates to other aspects of the course, or to other things you know about, what you learned from the readings and discussions etc. The journal can take many forms, and each entry could be different. Some students produce text or other media, others short videos or an explanatory image; others design an experiment, visualize some data in a compelling way or write a journalism-type article based on a scientific paper. You will submit polished versions of your journal after week 5 and week 10. After week 5's submission, I will give you written and personalized feedback on your journal entries as well as suggestions for further improvement and further avenues to explore areas you demonstrate particular interest in. I expect each of these submissions to be around 5 written pages (double-spaced, 12 pt font). If your journal is not in the form of written text, it should demonstrate equivalent levels of effort. I strongly encourage you to make these entries weekly and not to do them all just before the deadline. This way, the journal will have its own story, documenting your increasing engagement with the material as you navigate the class. I also strongly encourage you to discuss the progress of your journal with me in office hours. Overall, my expectations are that your journal will demonstrate deep engagement with the material of the course.



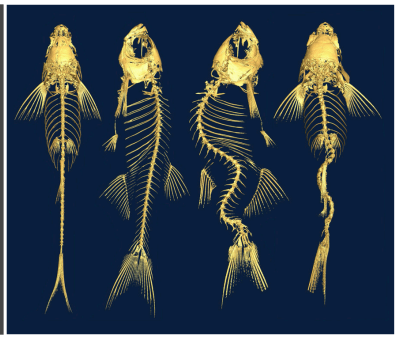
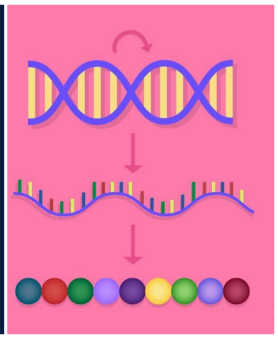
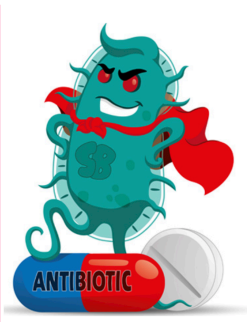
Participation and Materials. Students are expected to participate in class discussions and to complete all assigned readings and tasks. Students should come to class with impressions about the week's materials, as well as questions and ideas for the discussion. It is therefore essential that students complete readings (or watch videos etc.) before the class. The most obvious way to show participation is by being vocal during discussions, but there are other ways. A student could make detailed notes during or after class and attach them as an appendix to their journal. Journal entries could include reflections on some specific points raised during class discussion. A student could regularly come to office hours to discuss class topics further. Ultimately, students should find ways to make their participation visible. I am available to discuss how that can be achieved or to provide feedback as the course continues.

Final Essay. You must submit an approximately 2,000 word essay (12-pt font, double spaced) by the end of the course. This is your chance to demonstrate what you have learned on the course, any additional reading and thinking you have done, and to reflect on the topics covered. You should answer one of the following questions, and you get to choose which one:

1. Animals (such as *Drosophila*, zebrafish and mice) are exceptional models for understanding human disease. Discuss.
2. A duck's wing, an ant's nest and the Oregon Ducks Autzen Stadium. Discuss the similarities and differences of how each of these objects was "designed".
3. How do we make mutant mice? And what do those mutants tell us about human development and disease?
4. Lewis Wolpert once asked, "Will the egg be computable? That is given a total description of the fertilized egg—the total DNA sequence and location of all proteins and RNA—could we predict how the embryo will develop?" What is your answer to this question?
5. Chimpanzees are our closest living non-human relatives. Why don't we use chimpanzees to conduct life-saving medical research?
6. "If we enable the weak and the deformed to live and to propagate their kind, we face the prospect of a genetic twilight. But if we let them die or suffer when we can save or help them, we face the certainty of a moral twilight". Share your informed reaction to this quote, written by Theodosius Dobzhansky in *Heredity and the Nature of Man*.
7. "Phenotype depends on much more than genotype". How strongly do you agree with this statement? Describe your rationale and provide example cases to back up your position.
8. Highlighting specific examples, what are the causes of human disease?
9. Provide a balanced response to the question posed by David Baltimore at the International Summit on Human Gene Editing in 2015: “When, if ever, will we want to use gene editing to change human inheritance?”

Alternatively, you can design your own question to answer. If you take this route, you should discuss with me your question and a brief outline of how you will answer it before you spend a lot of time on the task. Together, we will ensure the question is broad enough and will allow you to demonstrate thinking from across several aspects of the course.

Task of the week. For every other class (starting with class 3) there will be a "task of the week" in which 2 or 3 students chosen randomly will be assigned a small task. This will usually involve doing a little research and thinking, it may be based on that weeks reading or it might be something else. At the beginning of the class, the 2 or 3 students will speak for a few mins each

summarizing the task and what they did. This will hopefully lead to some discussion within the rest of the group. The purpose is to get us all thinking and discussing right from the start of the class. Whilst this is not strictly graded, performing this task well (and being an active participant in discussions that stem from these tasks) could help demonstrate your participation in the course, which is graded. The people that will do the tasks each week will be drawn at random. If you are struggling to come up with ideas or don't know how to approach a task, please get in touch with me.

Additional Notes

COVID-19 and the Virtual Environment. As has been the case for the last year, this is not a normal term, and we should not pretend it is. We are still separated, worried, stressed and over-worked. Our classes will be virtual, which presents many challenges. I will do my best to ensure an open, fair and interactive classroom environment. If my expectations are not compatible with what you are going through, contact me to discuss your situation. We will talk through how we can best use the virtual environment in our first class when we design our class covenant.

Contacting Me. If you want to contact me, you can e-mail me at **dtgrimes@uoregon.edu**. In the subject line of your email, include "CHC 241: (your subject)". If you don't do this, your e-mail will not be shuttled to the correct part of my inbox and it will likely be missed. My apologies in advance if that happens, but if you do correctly include that subject line I will respond to your email in a timely manner (meaning within 2-3 days; I will often respond faster than that, but I can't guarantee it).

This term, because of the virtual nature of the course, I will not have a set time for office hours. However, I am available at several points during the week for meetings/discussions. If you would like to arrange a meeting with me, contact me by email at least 2-3 days in advance and offer me 3-4 blocks of time when you could meet. I will pick one. An example of a good e-mail would be:

> *Dear Prof. Grimes,*
>
> *I would like to meet with you this week for office hours. I am available on Monday 26th (either 1.00-1.30 or 2.30-3.00), Tuesday 27th (10.30-12.00) or Wednesday 28th (2.30-5.00).*
>
> *Best,*

You can include more details in the e-mail if you think it might be useful, such as which topics you want to discuss or if you have a particular question.

Challenging Material. Aspects of this course include controversial and perhaps triggering topics such as eugenics, genocide, abortion, human genetic experimentation, racism, disability and the COVID-19 pandemic. We must approach these topics with sensitivity and appreciate that discussing them may be emotionally taxing for ourselves and others. We will discuss how to deal with such challenging material in the first class as we design our class covenant.

Taking Things Further. I will sometimes provide you with additional notes or suggestions for further reading material after classes. These would be an ideal starting point for more deeply engaging with the material. I am always happy to discuss avenues you can take to delve more deeply into particular topics either by e-mail or in office hours.

Class 1 *03/29*

Mutants

This class serves as an introduction and foundation for our course. We will discuss our objectives, methods, and expectations and together generate a class covenant. We will brainstorm what the word "mutant" means to us and recap the structure of DNA, what genes are and how the information within genes is decoded to make functional products such as proteins.

Materials

Video: "The Central Dogma of Molecular Biology: DNA to proteins (an animated lecture video)"
YouTube 27 min 27 sec. youtube.com/watch?v=QvNdzLALvkI

Class 2 *03/31*

A Family Thing

In this class, we will think about the causes of human diseases. Topics will include patterns of inheritance, gene-environment interactions, and the effects of mutations on protein structure and function. We will also discuss the relationship between different scientific disciplines and the concept of gene-centric reductionism.

Materials

"Mechanisms and causality in molecular diseases", Keenan and Shvartsman. HPLS (2017)
“Hijacking Evolution”, Scudellari. *Nature* (2019)

Class 3 *04/05*

Why are Some People Left-Handed?

Using handedness as our main example, we will think about how scientists try to understand the genetics that underly our traits. This will likely lead us to discuss biological variation and genetic determinism.

Materials

Introducing the Silmans by Denis Noble: pg1-3 of *The Music of Life*

Class 4 *04/07*

Harrison Bergeron and the Nazis

In this class, we will take a look at the history and afterlife of eugenics.

Materials

Lebensunwerters Leben by Siddhartha Mukherjee: pg119-138 of The Gene (2016)
"Harrison Bergeron" by Kurt Vonnegut (1968)

Classes 5 & 6 *04/12 & 04/14*

Plague and Pestilence

From the Plague of Justinian to COVID-19, we will look at how epidemics and pandemics have played an important part in human history. We will discuss how infectious agents cause disease, how they change over time, how we try to fight back against them and how they resist those attempts.

Materials

Spillover by David Quammen, Chapter 1: Pale Horse
Video: “The antibiotic apocalypse explained”
YouTube 5 min 57 sec. https://www.youtube.com/watch?v=xZbcwi7SfZE

Classes 7 & 8 *04/19 & 04/21*

Darwin and Design

We will discuss mechanisms of creation by thinking about how designed objects (like cathedrals, birds wings, human brains and chess-playing computers) come into being.

Materials

"Darwin's greatest discovery: design without designer", Ayala. PNAS (2007)

Classes 9 & 10 *04/26 & 04/28*

The Vitruvian Mouse

We will talk about model organisms, what they do (and don't) model, and how they can be used to understand human development and disease. We will ponder the meaning of "wild type" and discuss whether there is such a thing as a perfect "model" animal which represents something to which all others of the species should be compared.

Materials

"To solve old problems, study new research organisms", Sanchez-Alvardo, Dev Biol
"Collaborating to Find Developmental Genes", iBiology Video. https://www.ibiology.org/development-and-stem-cells/developmental-genes/

Classes 11 & 12 *05/03 & 05/05*

The Mutant Cure

In these classes, we will discuss the promise, perils, challenges, ethics and sociology of altering human genes.

Materials

"Orphaned at conception", Carl Zimmer: pg523-549 of She Has Her Mother's Laugh (2018)

Classes 13 & 14 *05/10 & 05/12*

The Making of the Fittest

The science of Evolutionary Developmental Biology (Evo-Devo) aims to explain how embryonic development changes over time to drive evolutionary changes. Recent discoveries suggest that most evolutionary change is driven not by changes in coding genes themselves but by changes in “regulatory DNA”, that is DNA which controls when and where genes are expressed during development.

Materials

Video: “Making of the fittest: evolution of the stickleback fish” YouTube 15 min 38 sec.
https://www.youtube.com/watch?v=Pv4Ca-f4W9Q

Classes 15 & 16 *05/17 & 05/19*

Not By Genes Alone

This class will serve as an introduction to polyphenism and epigenetics through discussions of how and to what extent the environment impacts an organism's form and evolutionary trajectory.

Materials

None. Instead use the time for workshopping/brainstorming your final essay.

Classes 17 & 18 *05/24 & 05/26*

The One-Eyed King

What is normal? What is abnormal? Where is the boundary between health and disease? Should we cure all diseases?

Materials

“Who Is the World Built For?”, Sara Hendren: pg3-32 of What Can a Body Do?

Class 19 *06/02*

What’s next?

Additional Notes and Resources

Mental Wellbeing

Life at college can be very complicated. Students often feel overwhelmed or stressed, experience anxiety or depression, struggle with relationships, or just need help navigating challenges in their life. If you're facing such challenges, you don't need to handle them on your own--there's help and support on campus.

As your instructor if I believe you may need additional support, I will express my concerns, the reasons for them, and refer you to resources that might be helpful. It is not my intention to know the details of what might be bothering you, but simply to let you know I care and that help is available. Getting help is a courageous thing to do—for yourself and those you care about.

University Health Services help students cope with difficult emotions and life stressors. If you need general resources on coping with stress or want to talk with another student who has been in the same place as you, visit the Duck Nest (located in the EMU on the ground floor) and get help from one of the specially trained Peer Wellness Advocates.

University Counseling Services (UCS) has a team of dedicated staff members to support you with your concerns, many of whom can provide identity-based support. All clinical services are free and confidential. Find out more at counseling.uoregon.edu or by calling 541-346-3227 (anytime UCS is closed, the After-Hours Support and Crisis Line is available by calling this same number).

Basic Needs

Any student who has difficulty affording groceries or accessing sufficient food to eat every day, or who lacks a safe and stable place to live and believes this may affect their performance in the course is urged to contact the Dean of Students Office (346-3216, 164 Oregon Hall) for support.

The UO Basic Needs Resource Guide includes resources for food, housing, healthcare, childcare, transportation, technology, finances, and legal support.

General Guidelines for Remote Class Participation

Students are expected to participate by sharing ideas and contributing to the collective learning environment. This entails preparing, following instructions, and engaging respectfully and thoughtfully with others. More specific participation guidelines and criteria for contributions will be provided for each specific activity.

Use Proper Netiquette: Please use good “net etiquette”: identify yourself with your real name and use a subject line that clearly relates to your contribution. Write or speak in the first person when sharing your opinions and ideas but when addressing other students or discussing their ideas, use their names (e.g. "I think red is the most important term in the poem, but I also think Kate is correct that blue is important, too"). Respect the privacy of your classmates and what they share in class. Understand that we may disagree and that exposure to other people’s opinions is part of the learning experience. Good netiquette also means using humor or sarcasm carefully, remembering that non-verbal cues (such as facial expressions) are not always possible or clear in a remote context. In addition, your language should be free of profanity, appropriate for an academic context, and exhibit interest in and courtesy for others’ contributions. Be aware that typing in all capital letters indicates shouting. Be aware that performing other tasks like talking or texting during class, even if you are muted, is obvious to others and can be disruptive. Certain breaches of netiquette can be considered disruptive behavior.

Our learning environment provides an opportunity to practice being professional and rigorous in our contributions. As much as possible, use correct spelling, grammar, and style for academic and professional work. Use discussions and activities as opportunities to practice the kind and quality of work expected for assignments. Moreover, seize the chance to learn from others and develop your interpersonal skills, such as mindful listening and awareness of one's own tendencies (e.g. Do I contribute too much? Too little?).

All classes at the University of Oregon welcome and respect diverse experiences, perspectives, and approaches. What is not welcome are behaviors or contributions that undermine, demean, or marginalize others based on race, ethnicity, gender, sex, age, sexual orientation, religion, ability, or socioeconomic status. We will value differences and communicate disagreements with respect. We may establish more specific guidelines and protocols to ensure inclusion and equity for all members of our learning community.

Our goal is to learn together by learning from one another. As we move forward learning during this challenging time, it is important that we work together and build on our strengths. Not everyone is savvy in remote learning, including your instructor, and this means we need to be patient with each other, identify ways we can assist others, and be open-minded to receiving help and advice from others. No one should hesitate to contact me to ask for assistance or offer suggestions that might help us learn better.

Specific Guidelines for Best Practices Using Zoom

Please test your video and audio prior to joining a live class session. You can learn more about testing your audio and video by visiting the UO Service Portal.

Try to be on time when the meeting starts. It can be distracting to have participants join late.

All of us occasionally need to hide video, but know that seeing your faces is a joy to me and, I believe, enriches our ways of relating—when you can, I value video on.

That said, please be mindful that others can see you and your surroundings if your video is on. Try to find a quiet setting without lots of noise or busy activities in the background. Please minimize distractions like eating or multitasking.

Use a microphone or speak closely to your computer microphone so that others can hear you. If you have video on, try to look at your camera, not the screen, when you are contributing.

Mute your audio when you are not actively contributing. When contributing, avoid making other noises such as typing or eating or having side conversations with others that might be present with you.

Use chat to pose questions or offer insights "on the side" while others are contributing. The chat can be read by all and should reflect a high standard of respect for our class community.

For help and troubleshooting with Zoom, visit the UO Service Portal.