Welcome to Human Evolutionary Genetics (Biol 5221, spring 2024)

The central goal of this course is to help you learn how to think productively about genetic variation which is very interesting, medically important, and also the substrate or "fuel" of genetic evolution. All of the important issues are quantitative and dynamic, and they turn on ***probabilities***. So we'll start with a quick review of the basic principles of probability theory. Don't worry if you haven't formally met them yet. They're simple, and quite intuitive once you get them. Our text will be a short guide called *Just Enough Probability* (JEPr), which was written by Alan. Like almost all of the course materials, it's available on the ***web site:*** **https://content.csbs.utah.edu/~rogers/tch/ant5221/index.php**

Please go there and poke around. You'll find JEPr under "Readings/Main texts". There are printed paper copies available in the School of Biological Sciences main office (Biol building, room 201), for those of you who would prefer to read it on paper but don't have an easy way to print your own copy. We'll do this for many of the other required readings. Some copyrighted readings will require a ***password***, which is given on the ***Canvas main page***.

The textbook is John Gillespie's *Population Genetics: A Concise Guide (2nd edn)*. There are a few paper copies in the Campus Store, and you can also buy the eBook version there, or get it online (printed or digital). You won't really need it for a couple of weeks, so there's time for a paper copy to arrive. It's a great book and well worth keeping if genetics may reappear in your academic or professional future.

This course also features a computer lab where you'll learn to write and run simple programs using the *Python* language. This is a fun and extremely valuable skill, which many former students have used in subsequent courses, jobs and research projects. We'll develop some simulations to better understand the basic evolutionary processes, and we'll analyze masses of real human genetic variation to see how patterns in the data can reveal how those processes have played out in recent human history. There's a lab manual, and also a Python tutorial called *Just Enough Python* (JEPy) on the course web site.

This year the Wednesday lab meetings will again be online in a "synchronous remote" or IVC (Interactive Virtual Conferencing) format, because there's no way that students and tutors can maintain safe social distances while working on the same keyboard and screen, while the SARS-Cov2 virus is still circulating. During the pandemic we learned to our pleasant surprise that the labs work as well (and in some ways better) over Zoom as in person, thanks to screen-sharing among all the people in a breakout room. Zoom links for the lab meetings will be listed in clickable form on Canvas.

However, this year we're going back to in-person lectures which seem to be much better than Zoom lectures because they allow for eye contact and other important aspects of human communication that cannot be replicated through screens. We'll typically begin each lecture with a discussion of any questions or other issues you would like to raise from the previous lecture. So please try to come prepared to participate in open-ended conversations. They're essential to real education!

The lecture slides should always be available in ***pdf*** format before a lecture is given, on the ***course web site*** (URL above). Last year's slides are still there, if you care to preview what's coming, for lectures that haven't changed much since last year. You'll use Canvas mainly to access the Zoom links, upload completed assignments, and take the quizzes.

Remember to log in to Canvas on Wednesday the 10th, before 1:00, to join the first lab meeting!

What does it take to succeed in this course, and to enjoy it? As we said above, it's about ***learning how to think productively about genetic variation***, which means about where that variation comes from (its

sources, such as mutation and migration), where it goes (that is, how variation is shaped by genetic drift, natural selection and recombination), and what it does along the way (how it influences phenotypes of various kinds). Thus the course aims to help you ***acquire some new abilities and skills***, not beliefs about the answers to specific questions. These skills are best learned through practice, not by reading or listening to us talk about them. Of course written and verbal exposure to the content is important – all of the learning modes play their parts. But you will solidify your understanding and turn it into a ***toolkit you can use*** to think for yourself about new situations, by doing problems and lab exercises that work your "mental muscles", and by talking with each other and with us about what you think you're doing.

Please read the attached essay on how best to succeed in college, by Jonathan Malesic. Prof. Malesic doesn't know us, but he perfectly describes how we're trying to help you educate yourselves!

The pandemic has interfered with this learning paradigm by making conversations more difficult to start and sustain, of course. But they're not impossible, and they're essential to your progress. So we're doing all we can to create opportunities for open-ended interaction, beginning with the question-driven review period at the beginning of each lecture. In addition, the lab meetings are basically one-on-one or few-on-one tutoring sessions, organized around the chapters of JEPr, JEPy and the lab manual which are written as free-standing tutorials. Some students find it possible to do the labs mostly or entirely on their own, just by following the explanations and instructions in the tutorials, and that's fine. But most run into occasional confusions, or put "bugs" in their code that need some help to sort out. Pre-pandemic, we did very little lecturing in the lab meetings, and a lot of wandering around, responding to raised hands. This model transfers surprisingly well to Zoom, where the virtual breakout rooms make it easy for us (the instructors) to meet with you (the students) in small groups.

This year the course will be led by *three* instructors! Prof. Alan Rogers [rogers@anthro.utah.edu] started Anth 5221 many years ago. Prof. Jon Seger [seger@biology.utah.edu] then joined and helped Alan add the computer lab component to what became Anth/Biol 5221. And this year we'll be joined by a former U undergraduate, Dr. Angela Hancock [hancock@mpipz.mpg.de], who now heads her own research group at the Max Planck Institute for Plant Breeding Research in Cologne, Germany [http://www.mpipz.mpg.de/hancock]. We'll all be present and ready to dive in at almost every lecture and lab meeting, and you should feel free to contact us by email with any relevant questions or concerns.

Our species is young and it contains relatively little genetic variation (much less than occurs in our closest living relatives the chimpanzees and bonobos, for example). Most of our variation is distributed widely through modern human populations, but some is distributed geographically, contributing to the visible differences among racial groups and ethnic populations. This geographic variation has repeatedly been imagined by some people to support prejudicial and even frankly racist interpretations of the social, political and economic conditions now prevailing in countries and regions around the world. Such views do not withstand careful scientific analysis of the facts, which provide no support for claims about the genetic "superiority" or "inferiority" of any natural population groupings, with respect to any non-trivial human traits or abilities. We're all just slightly different – hooray! By the end of the course you should be able to explain (in general terms) how and why it is that we're all just slightly different, genetically. But this course cannot seriously treat the social history of public thinking about human genetic variation, both because there isn't enough time in the semester (given the scientific topics we must cover), and because the instructors lack professional expertise in this complex subject. But please feel free to talk with us about these matters if they interest you, especially if you think we've presented any of our material in ways that invite misinterpretation.

The New York Times https://www.nytimes.com/2023/01/03/opinion/college-learning-students-success.html

GUEST ESSAY

The Key to Success in College Is So Simple, It's Almost Never Mentioned

Jan. 3, 2023

By Jonathan Malesic
Mr. Malesic is the author of "The End of Burnout." He teaches writing at the University of Texas at Dallas.

For Emily Zurek Small, college did what it's supposed to do. Growing up in a small town in northeastern Pennsylvania, she had career and intellectual ambitions for which college is the clearest pathway. "I just kind of always wanted to learn," she told me recently. "I wanted to be able to have intelligent conversations with people and know about the world."

She enrolled at a small nearby Catholic college, majored in neuroscience and in 2016 became the first person in her family to earn a bachelor's degree — and later, a master's. She now works as a school psychologist in Virginia.

I saw Ms. Zurek Small's education up close, in two theology classes I taught during my 11 years as a professor at the college she attended. She was a good student, but what struck me more than her ability was the fact that she cared. Being in class, asking questions and exploring ideas meant something to her.

One reason she cared was that she was paying her own way and was thus amply aware of her education's cost. "If I was not engaging, I was just throwing money out the window," she said. That engagement helped her realize that her "thoughts and opinions matter."

As universities in much of the country suffer declining enrollment, they need to make the broader case for going to college even as they debate how best to help students learn after Covid disruptions. How should universities carry out remote learning? How should they teach writing in the age of artificial intelligence? How difficult should it be to pass organic chemistry?

But there's an equally important question that only students can answer: What will they do to get the most out of college? It's their education, after all.

One of the most important factors in Ms. Zurek Small's success seems almost too obvious to mention but, in fact, deserves far more attention and discussion: a simple willingness to learn. In more than 20 years of college teaching, I have seen that students who are open to new knowledge will learn. Students who aren't won't. But this attitude is not fixed. The paradoxical union of intellectual humility and ambition is something that every student can (with help from teachers, counselors and parents) and should cultivate. It's what makes learning possible.

The willingness to learn is related to the growth mind-set — the belief that your abilities are not fixed but can improve. But there is a key difference: This willingness is a belief not primarily about the self but about the world. It's a belief that every class offers something worthwhile, even if you don't know in advance what that something is.

Unfortunately, big economic and cultural obstacles stand in opposition to that belief.

The first obstacle is careerism. To an overwhelming degree, students today see college as job training, the avenue to a stable career. They are not wrong, given the 70 percent wage premium for 22- to 27-year-old workers with a bachelor's degree over those with only a high school diploma. But this orientation can close students off from learning things that don't obviously help their job prospects. Despite the fact that I taught at a religious college, students in my theology class grumbled about having to satisfy a requirement. Why, they asked, would they need to know theology as an accountant, athletic trainer or advertising manager?

The human mind, though, is capable of much more than a job will demand of it. Those "useless" classes like philosophy, literature, astronomy and music have much to teach.

I haven't had to solve a calculus problem in 25 years. But learning to do so expanded my brain in ways that can't simply be reduced to a checklist of job skills. Living in the world in this expanded way is a permanent gift.

The other big obstacle to the willingness to learn is the urge to present yourself as always already informed. The philosopher Jonathan Lear calls this attitude knowingness. He regards it as a sickness that stands in the way of gaining genuine knowledge. It is "as

though there is too much anxiety involved in simply asking a question and waiting for the world to answer," he writes.

Knowingness is everywhere in our culture. From a former president claiming "everybody knows" some conspiracist nonsense to podcasters smugly debunking cultural myths to your feeling you have to have read, heard and streamed everything, the posture of already knowing supersedes the need to approach new situations with curiosity.

Every semester during my years teaching theology, students would tell me on the first day of class that they knew they would get an A, because they'd already had 12 years of Catholic school. But often enough, they'd get a C. Their assumptions about the subject matter kept them from learning the more critical approach to the subject I was trying to teach.

Knowingness is a danger especially for talented students who have been rewarded for always having the right answer. At the University of Pennsylvania, undergraduates complain that student clubs expect prospective members to have extensive knowledge of the club's area of interest. As a first-year student, Adrian Rafizadeh, told the campus newspaper, "If I can't get into the clubs that will help educate me and foster that interest, then how do I even get started?"

Once, in a cafe near an elite liberal-arts college, I overheard a student lament to another, "I can't take a Russian history class. I don't know any Russian history!" Of course not. That's why you take the class.

Universities are factories of human knowledge. They're also monuments to individual ignorance. We know an incredible amount, but I know only a tiny bit. College puts students in classrooms with researchers who are acutely aware of all they don't know. Professors have a reputation for arrogance, but a humble awareness of the limits of knowledge is their first step toward discovering a little more.

To overcome careerism and knowingness and instill in students a desire to learn, schools and parents need to convince students (and perhaps themselves) that college has more to offer than job training. You're a worker for only part of your life; you're a human being, a creature with a powerful brain, throughout it.

In addition, adults need to show K-12 students that it's OK not to know something yet. School isn't a quiz show; the first person to say the right answer doesn't deserve the greatest reward. Rather, school should cultivate students' curiosity and let them feel the thrill of finding something out.

I would bet most teachers already share this outlook, but it's hard to encourage open-ended curiosity when schools are judged by standardized test scores, and it's hard to defeat narrow-minded careerism when the entire economy seemingly mandates it.

The career orientation and the culture of knowingness take for granted the outcomes of college — jobs, knowledge — and gloss over the means. But the means are everything: the books, teachers and fellow students who will change your life.

Emily Zurek Small compared graduating to "unlocking a door." She is no longer a student, but, she said, "I am still exploring what's on the other side of that door."

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