# Raising a Woke Generation of Geneticists:

## How and why to include eugenics history in genetics classes

TAGC 2020 online

An online workshop held May 26, 2020
500 people registered; 250 attended online

Organized by
Michele Markstein and Greg Davis


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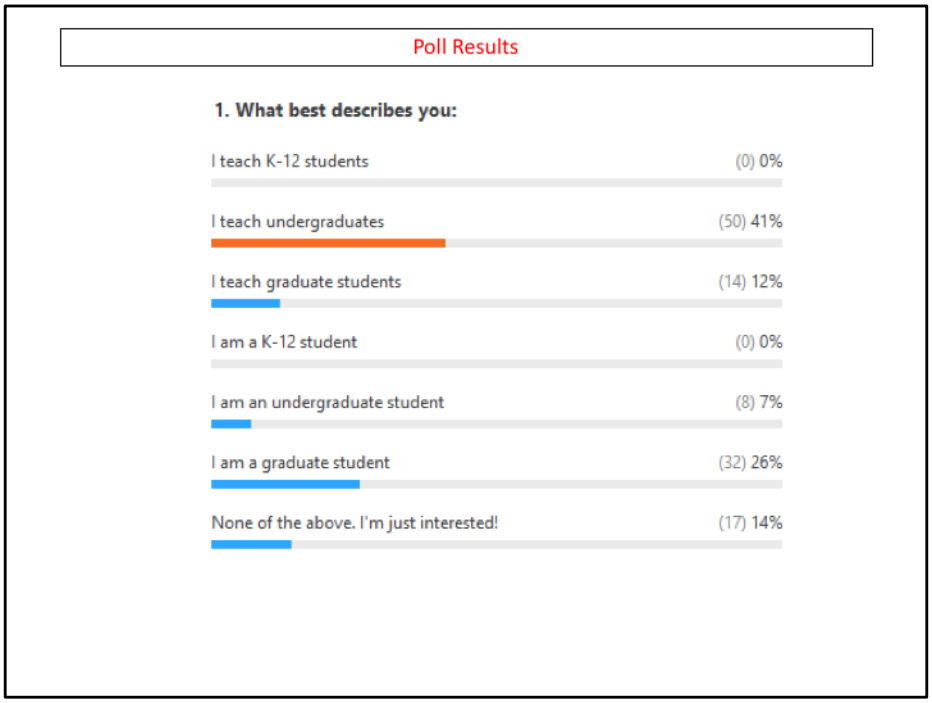
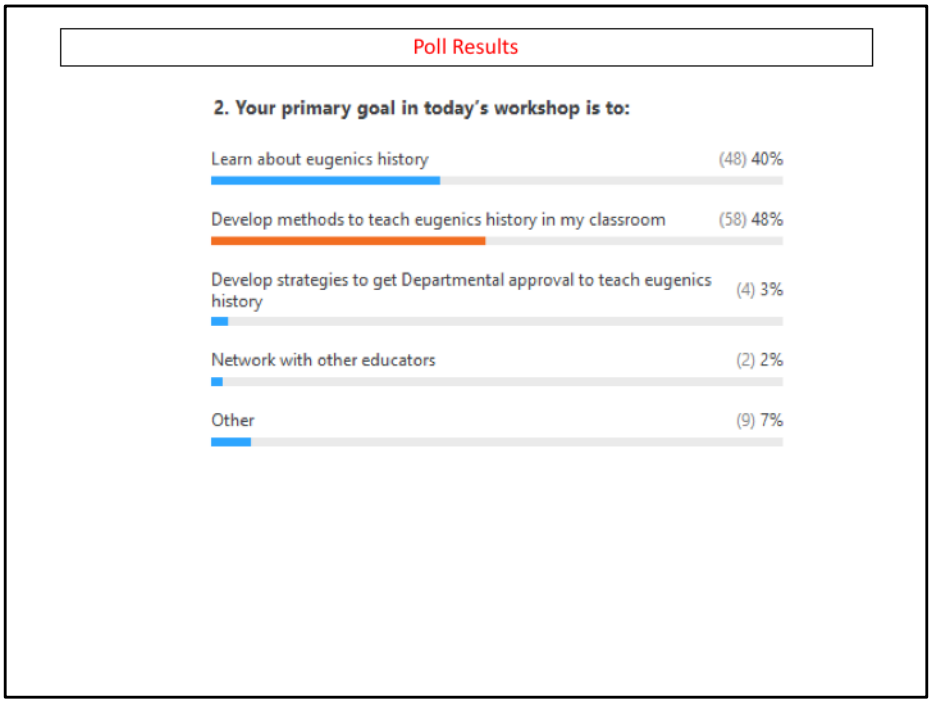
# Welcome!

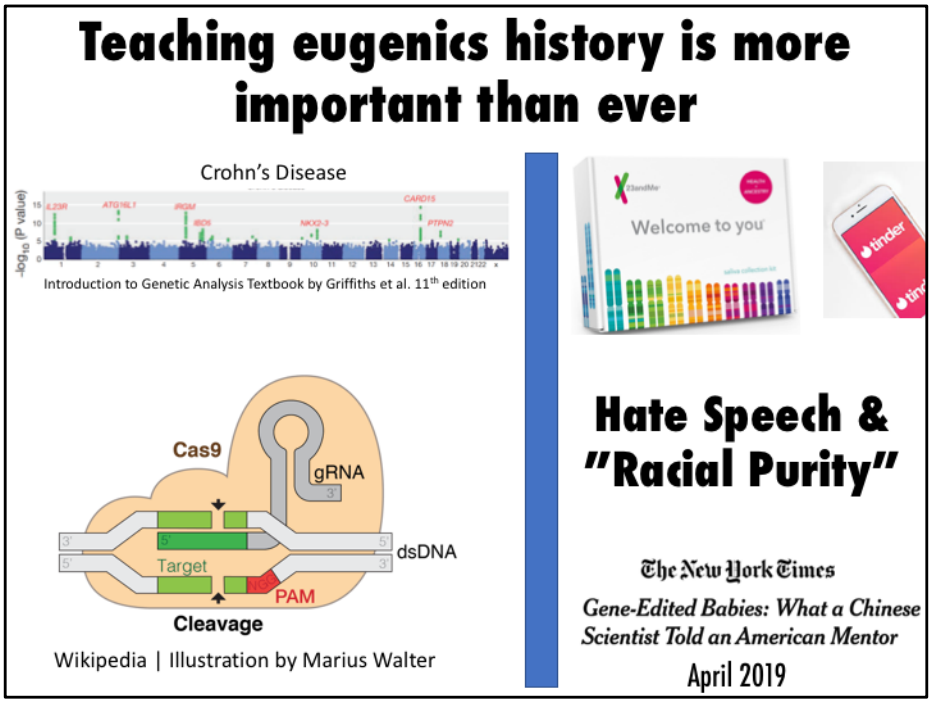
We started the workshop with two polling questions to get a sense of who were were in the ”room” together. Results on next pages.



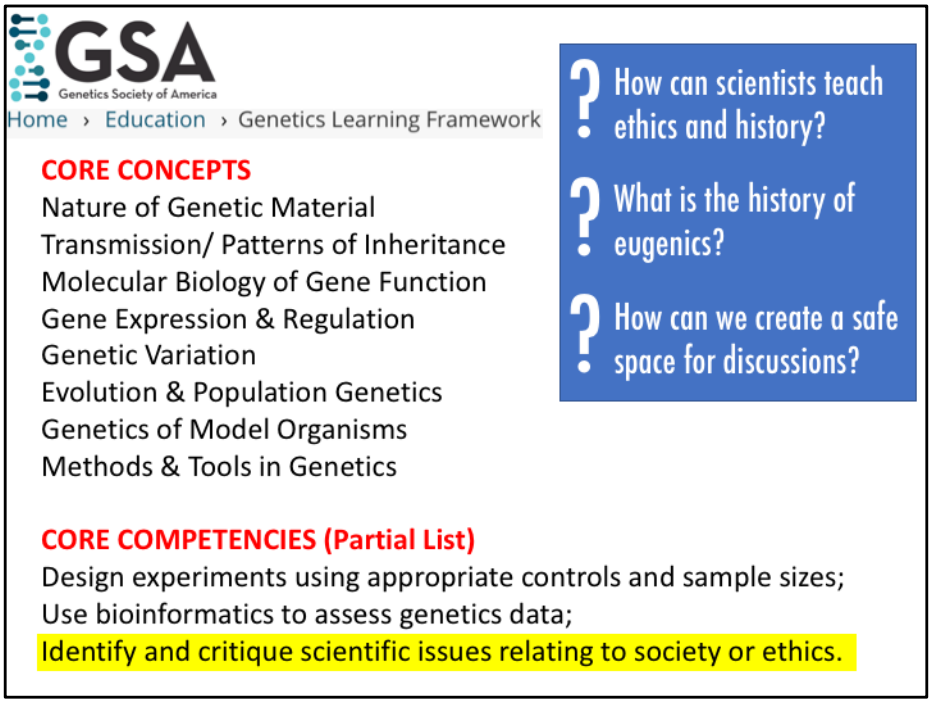

About 125 people were present at the beginning when we took the poll. There were postdoctoral fellows present too and unfortunately our poll did not capture their numbers.




Attendees came mostly to learn more about how to teach eugenics history, including learning about the history itself.

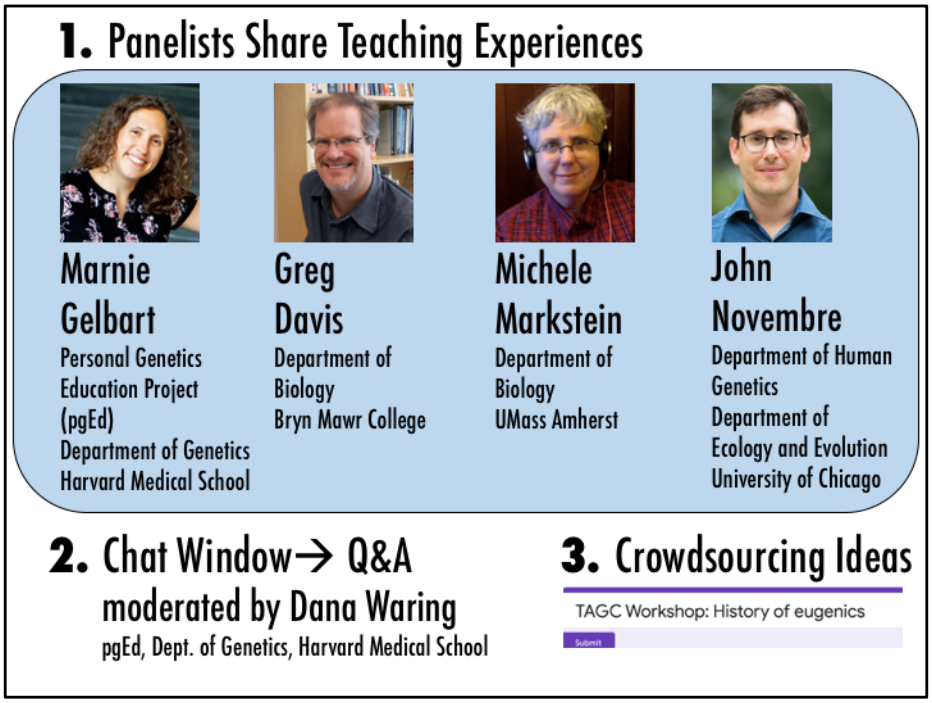



Many of us are interested in teaching eugenics history at this time because new technologies like DNA seqeucning and CRISPR-Cas9 genome editing have reawakened eugenics-related ideas. As geneticists, we're comfortable teaching the material on the left, like SNP genotyping (and GWAS studies) and CRISPR-Cas9 genome editing. But in general we're less comfortable discussing how these technologies have entered the public domain; some examples are on the right.




Although genetics textbooks do not include eugenics history, we're not alone in wanting to help our students bridge the gap between the science of genetics and its impact on society. The GSA Learning Framework for undergraduate genetics education lists being able to "identify and critique scientific issues relating to society or ethics" as a "Core Competency." But the Learning Framework does not provide any guidance on how to get there. There is nothing listed under "Core Concepts" that would give students a framework with which to discuss "issues relating to society or ethics." For those of us who are familiar with the history of eugenics, it is clear that this history is a "Core Concept" that students need to know in order to have informed discussions about the effects of genetics on society and ethics today. For those who are not familiar with this history yet, we included an overview in the workshop. Our workshop focused on the three questions above.

We jumped to the third question, "How to create a safe space for discussions," because this applies not only to our classroom but any group of people discussing highly charged issues. The key to creating a safe space is to set the tone at the beginning by reminding students (and ourselves) that we are in this learning process together and that the isues that come up may feel uncomfortable at times, even physically uncomfortable. Some might argue that it should feel uncomfortable. Tell them it's OK to feel uncomfortable. At the same time, it's important to treat each other with respect and compassion. Beginning a discussion with this reminder helps set a tone for empathy and kindness in the classroom. Some refer to this kind of start as laying out "ground rules" or providing "guardrails."




The workshop was organized into three parts:

I. 4 panelists discussed experiences teaching eugenics history to different audiences: Marnie Gelbart, through pgEd reaches out to teachers, community leaders, and the general public, Greg Davis teaches undergraduates in small classes at a PUI, Michele Markstein teaches undergraduates in large classes at a public university, and John Novembre teaches graduate students, our future leaders and teachers in genetics.

II. We kept a live chat window throughout and answered questions as a panel at the end. The chat and discussion was moderated by Dana Waring.

III. We provided an online survey for all registrants to crowdsource expertise, questions, and visions for future steps. The results were shared with all registrants.

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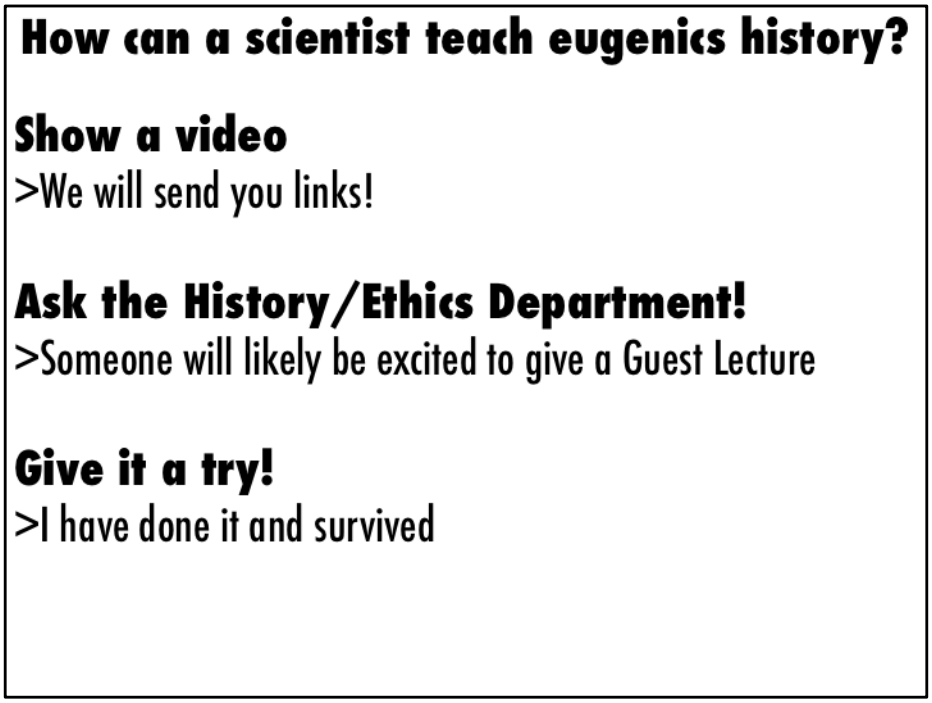
**Michele Markstein**
Biology Department
UMass Amherst

Typical undergraduate class size
**100-200 students**

The following slides were presented after the presentations by Marnie Gelbart and Greg Davis. These slides forcus on my experiences teaching eugenics history to students in large undergraduate classes.




The takehome is that you do not have to be an historian to talk about eugenics history. You can show a video, such as clips from the Ken Burns PBS documentary "The Gene," as Marnie Gelbart shared with us at the beginning. In my case, I started out by inviting an expert from the History Department to guest lecture. My colleague did an outstanding job and I thought I was safe from having to do this myself. But then she moved to another institution, so I gave it a try and learned that I too, though just a scientist, can talk about history. I shared student responses to having a guest lecturer and my approach to presenting material in a "hybrid" lecture that included both history and science.

## The US Eugenics Movement: 2 Approaches

**NEGATIVE EUGENICS**
prevent reproduction of "unfit"

>Segregation

>Sterilization

>Marriage Restriction

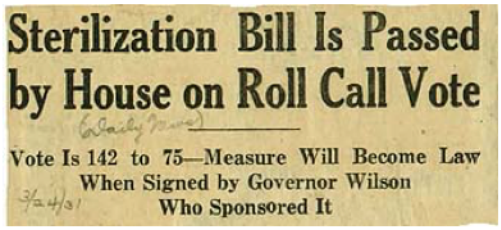
>Euthanasia

**POSITIVE EUGENICS**
promote reproduction of "fit"

>Fitter Family Contests

>Co-ed Dormitories

>Housing (redlining)



Sterilization Bill Is Passed by House on Roll Call Vote

Vote Is 142 to 75—Measure Will Become Law When Signed by Governor Wilson Who Sponsored It

Burlington Daily News, March 24, 1931, p.8


http://www.mercatornet.com/articles/view eugenics_wasnt_always_a_dirty_word

Slide derived from Prof. Laura Lovett's guest lecture; she is now in the Department of History, University of Pittsburgh

When you bring in an expert to guest lecture about eugenics, they will likely cover the two major approaches of the eugenics movement, "Negative" and "Positive" eugenics methods. And, if you're lucky they may show you how eugenics concepts have shaped today's world. For example, the institution of **co-ed housing** on college campuses was intended to promote reproduction of the "fit", and **redlining** was based on "a eugenically informed racial hierarchy to justify redlining and preferential home loans that discriminated against African Americans and immigrants" (quoted text from Laura Lovett, *Eugenic Housing: Redlining, Reproductive Regulation, and Suburban Development in the United States*).

## Typical Student Responses to Historian Guest Lecture

1. "I did not know that history could be interesting!"

2. "I really appreciated this lecture. I feel seen."

3. "That was a long lecture that had nothing to do with science!"

Overall, I have found that students enjoy having a guest lecture on eugenics history. Most importantly, I have found that this lecture resonates with Black and Latinx students in my classes (who collectively make up less than 10% of my classes at UMass Amherst). These students often come up after class to continue the discussion. This was surprising to me at first, but it makes a lot of sense. It is a mistake to pretend that genetics does not have a racist past (and a persistent presence). Having an open discussion about eugenics history is validating to people who have historically been (and continue to be) the targeted by white supremacy ideology.

You may get the complaint that history has nothing to do with science. There are two solutions: (1) Take the time to explain why you are taking a class period to discuss eugenics history. I think students respond well to the idea that studying mistakes and ethical errors of the past helps us to avoid repeating those mistakes. (2) You can provide the information yourself. In the remaining slides I showed a hybrid approach that I have taken.

## A blended Approach

Historical information plus a modern case example

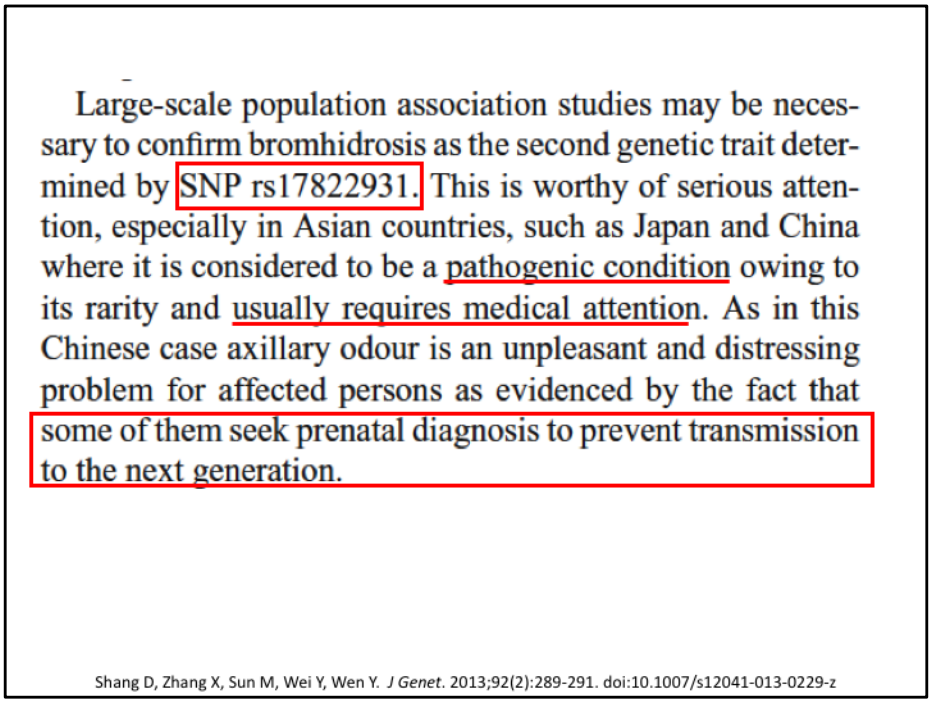
**The case for eliminating a SNP from the human population that causes severe body odor**

If presented at the end of the course,
it can serve as a review of key concepts

If you would like my complete lecture on this topic, please join the mailing list and I will share the slides with the list later this summer.

**The case for eliminating a SNP from the human population that causes severe body odor**

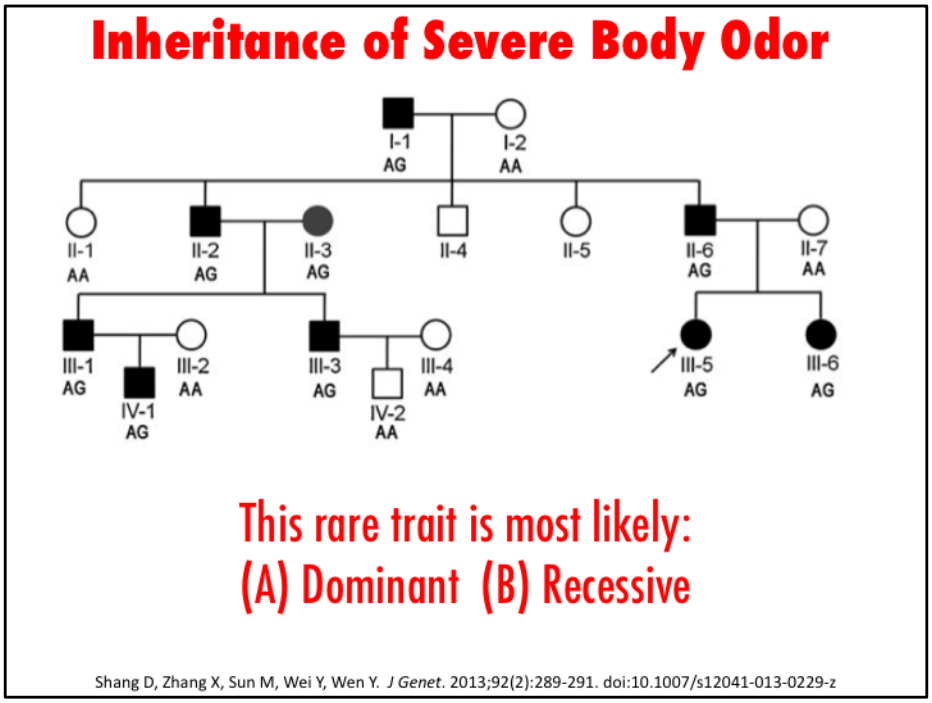
I show the following slide after a brief discussion of the history of eugenics in the United States including how Nazi Germany used the US eugenics programs to justify its extermination of disabled children, Jews, and other people the Nazis deemed "unfit."



Large-scale population association studies may be necessary to confirm bromhidrosis as the second genetic trait determined by SNP rs17822931. This is worthy of serious attention, especially in Asian countries, such as Japan and China where it is considered to be a pathogenic condition owing to its rarity and usually requires medical attention. As in this Chinese case axillary odour is an unpleasant and distressing problem for affected persons as evidenced by the fact that some of them seek prenatal diagnosis to prevent transmission to the next generation.

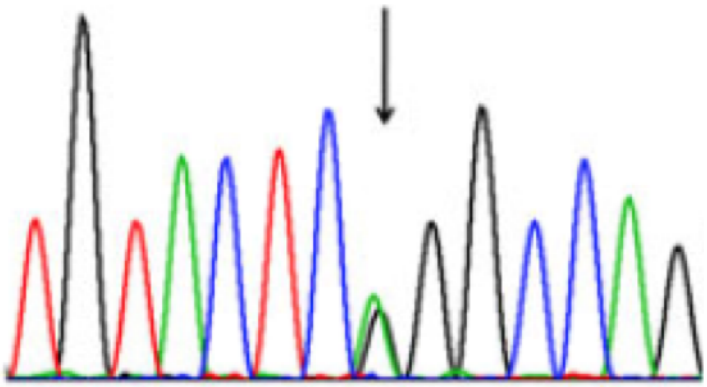
Shang D, Zhang X, Sun M, Wei Y, Wen Y. *J Genet*. 2013;92(2):289-291. doi:10.1007/s12041-013-0229-z

I start this section showing text from scientific papers, describing a SNP associated with a "pathogenic condition" of severe body odor, and explaining that knowledge of the SNP now allows affected individuals to get prenatal screening.




I typically present the eugenics lecture at the end of the course and present these slides as a review of some of the material covered in the class. Here's a chance to remind them about pedigree analysis. Hopefully they can see that this is a dominant trait, or autosomal dominant if you want to get them thinking more deeply…If you want you can bring up the two SNP alleles, A and G and ask them to deduce which is linked with the disease.

Your SNP genotype for the body odor allele can be detected by Capillary Gel **Sanger Sequencing**




Shang D, Zhang X, Sun M, Wei Y, Wen Y. *J Genet*. 2013;92(2):289-291. doi:10.1007/s12041-013-0229-z

Again more review. You can point out that this chromatogram shows an individual heterozygous for the SNP. Quiz them: Will this person have the severe body odor trait? What are the odds that they will pass it down? Etc. Then I explain that while you might think you would know if you have this trait and therefore at least one copy of the G allele, just in case you're worried you can have this SNP genotyped by 23&Me. It's included in their general analysis.

## Your SNP genotype for body odor alleles (T/C) is included in **23&Me reports**

Note: the alleles for this SNP are described according to the coding strand. The pedigree described the alleles as G and A. The community has agreed on a standard and describes the SNPs based on the other strand, thus C and T.

https://www.snpedia.com/index.php/Rs17822931

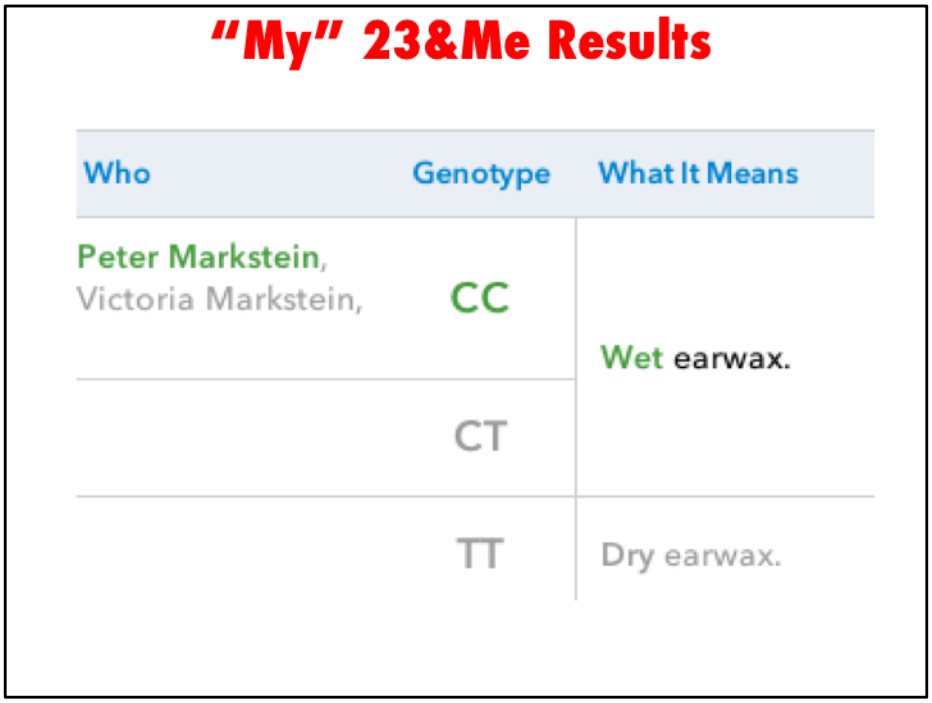
| | | |
|---|---|---|
| TT | = | no disease |
| CC | = | body odor disease |
| CT | = | body odor disease |

The body odor determining SNP is included on the 23&me genotyping chip. When I have time, I review ask students to explain how they would design a probe to detect this SNP. I explain to students that I did not send my DNA to 23&Me, but both my parents did. So, for better or for worse, 23&Me knows a lot about me without my permission (another wrinkle…). And then I tell them I will share my (my parents') results.

## "My" 23&Me Results

| Who | Genotype | What It Means |
|---|---|---|
| Peter Markstein, Victoria Markstein, | CC | |
| | CT | |
| | TT | |

I explain the genotype format and tell them of course they all now know my genotype, and I remind them that C is the allele associated with the dominant "pathogenic" body odor trait. Trust me, students' expressions change quite quickly at this point and I always wonder if some will leave thinking there is something seriously wrong with me. And then I point out that 23&me has a section that explains what the genotype "means," and interestingly… they don't say anything about pathogenic body odor.




As you can see, 23&me instead reports ear wax type! What's going on? This SNP is pleiotropic -- it affects more than one trait. 23&me concentrates on ear wax not to be polite, but because from the perspective of most 23&me employees, it's the most striking phenotype. Body odor does not seem to be on their radar.

# The rs17822931 SNP is Pleiotropic!

## It affects body odor and ear wax type

LETTERS

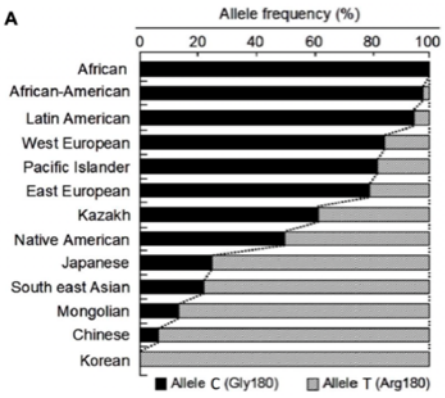
nature genetics

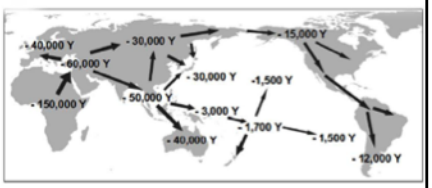
A SNP in the *ABCC11* gene is the determinant of human earwax type

Koh-ichiro Yoshiura[1,2], Akira Kinoshita[1,2], Takafumi Ishida[3], Aya Ninokata[3], Toshihisa Ishikawa[4], Tadashi Kaname[2,5], Makoto Bannai[6], Katsushi Tokunaga[6], Shunro Sonoda[7], Ryoichi Komaki[8], Makoto Ihara[9], Vladimir A Saenko[10], Gabit K Alipov[11], Ichiro Sekine[11], Kazuki Komatsu[12], Haruo Takahashi[12], Mitsuko Nakashima[1,2,13], Nadiya Sosonkina[1,2], Christophe K Mapendano[1,2], Mohsen Ghadami[1,2], Masayo Nomura[1,2,14], De-Sheng Liang[2,15], Nobutomo Miwa[1,2], Dae-Kwang Kim[16], Ariuntuul Garidkhuu[17], Nagato Natsume[17], Tohru Ohta[2,18], Hiroaki Tomita[19], Akira Kaneko[20], Mihoko Kikuchi[21], Graciela Russomando[22], Kenji Hirayama[23], Minaka Ishibashi[23], Aya Takahashi[23], Naruya Saitou[23], Jeffery C Murray[24], Susumu Saito[25], Yusuke Nakamura[25,26] & Norio Niikawa[1,2]

I explain that this SNP occurs in the coding region of an ABC transporter that pumps lipids out of cells. The C-allele is required for the transporter to be functional. The T-allele results in a missense mutation resulting in a non-functional reporter. The lipids pumped out by the functioning transporter result in wet sticky ear wax and "nutritious" sweat that bacteria grow on, resulting in "pathogenic" body odor. Why doesn't 23&me report this more interesting phenotype on body odor?

# The C-SNP is Ancestral and "Wild type"




Ishikawa T, Toyoda Y, Yoshiura K, Niikawa N. Pharmacogenetics of human ABC transporter ABCC11: new insights into apocrine gland growth and metabolite secretion. *Front Genet*. 2013;3:306. Published 2013 Jan 2. doi:10.3389/fgene.2012.00306

I use the chart on the left to explain that the C allele is ancestral and that most of the world's population has the C allele. I remind them that humans evolved in Africa and explain that the T allele likely arose as our ancient ancestors were migrating across the globe, maybe 50,000 years ago. In populations where the C allele is rare, having the C allele is seen as "abnormal," whereas in populations where it is common, it is viewed as normal. The remedy for "severe" body odor is simply underarm deodorant. This is a rare opportunity for majority-white students to experience having a genotype they likely have decried by others as "defective" or needing fixing in some way.

Note: I modified the chart (A) in two ways: I changed it to report "C/T" rather than the older "G/A" nomenclature for this SNP. Also, it is wrong. There is not 100% occurrence of either allele in any population. The paper reported that 100% of African-Americans have the C allele and this is wrong and could lead to discriminatory ideas. I swapped the reporting of African and African-American on the chart to be consistent with the understanding that the C allele is ancestral. However, even that is wrong. I looked more closely at the data and it is based on only 10 African-American individuals, and only 100 Korean individuals. So, a caution that this chart shows trends at best.

## Typical Student Responses to Blended Lecture

~~1. "I did not know that history could be so interesting!"~~

**2. "I really appreciated this lecture. I feel seen."**

~~3. "That was a long lecture that had nothing to do with science!"~~

**4. "Wow, I had no idea there were different kinds of ear wax."**

Students have not complained that the blended history/science lecture is a waste of time or just "history," as it is only a fraction of the lecture (about 1/3). However, as with the history-focused approach, the blended approach still resonates especially well with Black and Latinx students who have been and continue to be the targeted by white supremacy ideology.

## What is the impact of discussing history and ethics in genetics?

1. **Exposes** students to new ideas in history and ethics

2. **Gives students practice** discussing history/ethics

3. **Broadens student perspective** on today's ethical dilemmas around screening

** And, discussing eugenics history specifically helps to create a more **inclusive environment**. Omitting open discussion of the recent history of white surpremacy advocated by leading scientists in genetics does not help BIPOC students feel welcomed to our field.

A major goal in teaching is to help students connect what they learn to the world around them. Teaching the history of eugenics accomplishes this goal, whether using a strict historical approach or a blended approach. By coupling this kind of lecture with a writing or discussion exercise, you can give your students practice exercising a core competency goal stated in the GSA learning framework, to be able to "identify and critique scientific issues relating to society or ethics."

Note: The ear wax example gives students first-hand experience with the subjective nature of describing a trait as an "illness" or something worthy of not passing on to the next generation. In my experience of teaching over 1,000 students, this kind of approach is effective at helping students access their empathy for the possible dangers of modern day echoes of eugenics thinking.




If you have questions or want to discuss any of the material on the slides, please contact me:
Michele Markstein
mmarkstein@gmail.com