



# **Towards a More Humane Genetics**

**Teaching about  
human genetic  
difference is not  
socially neutral.**

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# THE ISSUE

Racism is a serious problem in the United States. Research has shown that the biology curriculum can affect how students think about race. It can lead students to believe more strongly in **three misconceptions**<sup>(6)</sup> :

1. People of the same racial group are genetically uniform.
2. People of disparate races are categorically different.
3. Biologically-influenced abilities cannot change.

Individuals often justify racism with these misconceptions by arguing that it is pointless to try and reduce social inequality, because race biologically determines ability<sup>(4-6)</sup>.

# OUR FOCUS

How can such beliefs be  
(un)learned through  
biology education?

# WHAT WE'VE LEARNED

Insights from our research have begun to illustrate how biology education affects the development of racism, for better or worse.

We've learned:

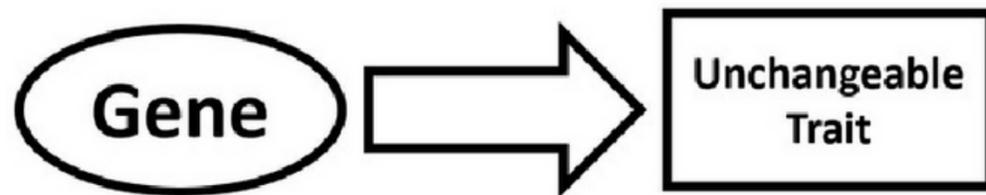
- When biology education causes youth to perceive too much genetic variation between racial groups, it can increase prejudice<sup>(6)</sup>.
- Conversely, the way we teach biology can reduce racial prejudice by helping students understand that there is more genetic variation within racial groups than there is between them<sup>(5)</sup>.

# ASSOCIATED WITH INCREASED PREJUDICE

# ASSOCIATED WITH DECREASED PREJUDICE

## Misconception:

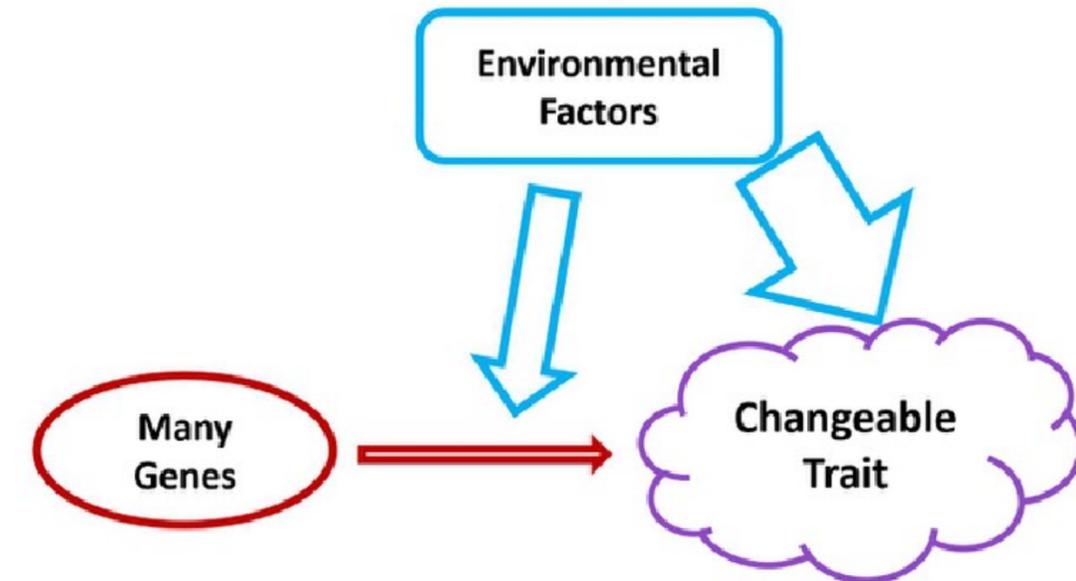
Mendel's simple model of genetics explains complex traits.



Current teaching practices in biology can indirectly increase prejudice and stereotyping by validating naïve understandings of genetics<sup>(1,2)</sup>. When the curriculum focuses mainly on a Mendelian model of genetics, students may incorrectly explain all human traits with that model<sup>(2)</sup>. However, most complex human traits are explained by a multifactorial model of genetics<sup>(3)</sup>. Moving students from a Mendelian model to a multifactorial model of complex human traits undermines genetic determinism<sup>(1,2)</sup>. Since genetic determinism is used to rationalize racial inequality, a more humane genetics education could challenge genetic determinism by teaching students about multifactorial genetics and how genes are used, incorrectly, to justify inequality<sup>(4,5)</sup>.

## Correct Model:

Mendel's simple model of genetics explains complex traits.



Each circle represents the total number of alleles (gene variants) in the human genome found within a particular group.



African Ancestry



East-Asian Ancestry



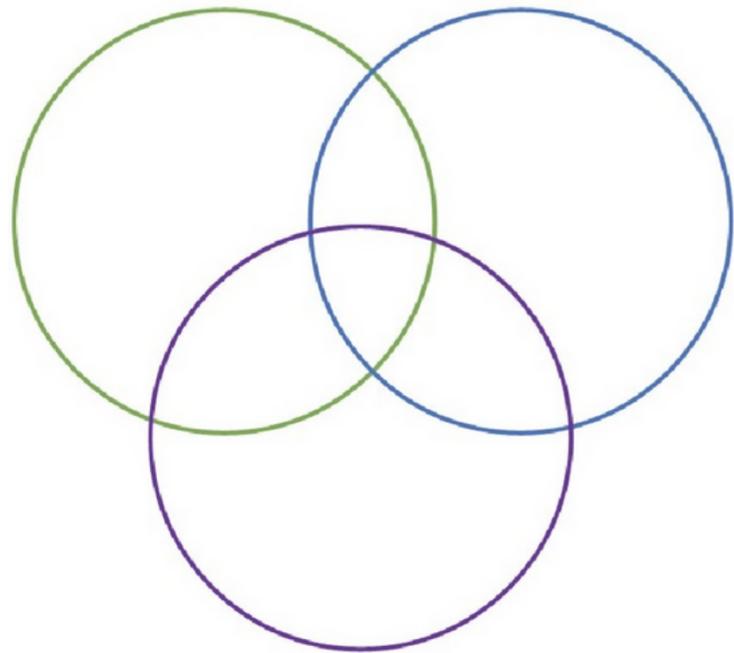
European Ancestry

## ASSOCIATED WITH INCREASED PREJUDICE

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### Misconception:

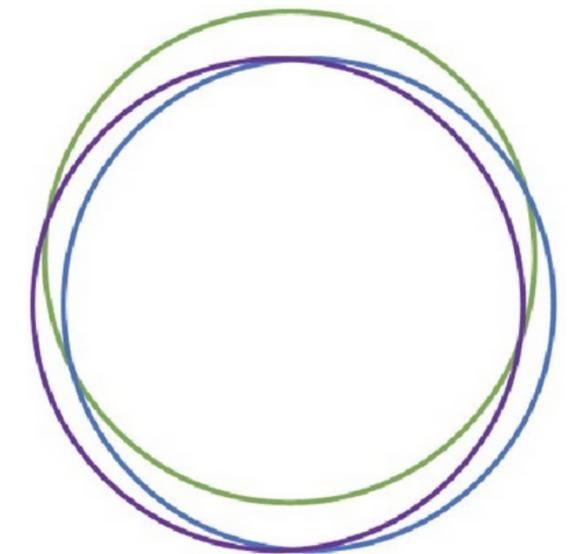
Human ancestral groups do not share many alleles.



Depending on the way in which biology is taught, it can either lead to misconceptions about human biological variation or a more correct understanding of it<sup>(5,6)</sup>. Biology textbooks can indirectly lead to prejudice by reinforcing the misconception that ancestral groups do not share most alleles<sup>(4)</sup>. This reinforcement can occur when learning about diseases like sickle cell anemia<sup>(6)</sup>. However, on average, different ancestry groups are only 4.3% more different from each other than individuals within the same group<sup>(7)</sup>. When students understand this finding, it can indirectly reduce their prejudice<sup>(6)</sup>. Additionally, our current research suggests that understanding multifactorial genetics helps students understand human genetic variation. Since misconceptions about genetic variation are used to justify racism<sup>(4)</sup>, a more humane genetics education could confront racism by teaching students a more correct model of human genetic variation and by helping students understand how findings about human genetic variation are distorted to justify racism<sup>(4)</sup>.

### Correct Model:

Each region contains a majority of the alleles found worldwide.



Each circle represents the total number of alleles (gene variants) in the human genome found within a particular group.



African Ancestry



East-Asian Ancestry



European Ancestry

# IMPLICATIONS FOR TEACHING

## What genetic concepts can I teach biology students?

- ▶ Scientists agree that race and racism are socially real, but race has little biological validity, because <sup>(3,4,8)</sup>:
- Individuals of the same racial group are genetically different <sup>(7,8)</sup>.
- U.S. racial groups are genetically alike because they share similar sets of differences <sup>(7,8)</sup>.
- Human genetic diseases are not race-specific (e.g. sickle cell anemia occurs in African, European, and Middle Eastern populations) <sup>(4-6)</sup>.
- Complex human traits are best explained by a multi-factorial model, not a Mendelian model <sup>(1-3)</sup>.

## What social science concepts can I teach biology students?

- Genetic claims about racial difference historically have been used to rationalize genocide and discrimination <sup>(4,5)</sup>.
- Racial inequalities are not consequences of genetics. They are, in part, consequences of incorrect beliefs about genetics <sup>(6)</sup>.
- People tolerate and/or perpetuate social inequalities when they believe these inequalities are caused by genes <sup>(4-6)</sup>.

## How does this connect to NGSS?

- ▶ Students' racial biases can potentially be reduced through NGSS-aligned curriculum and instruction <sup>(5)</sup>:
- Materials should be designed to engage students in data analysis, argumentation, and modeling to learn about the core idea of genetic diversity.
- These scientific practices can help learners make sense of cross-cutting concepts (ex: cause and effect in genetics).
- NGSS curriculum and instruction can reduce students' biases by changing how they perceive human genetic variation.

**Biology education framed by this kind of curriculum and instruction <sup>(5)</sup> ...**





## **May reduce students' beliefs that:**

- People of the same racial group are genetically uniform.
- People of disparate racial groups are categorically different.
- Biologically-influenced abilities are unchangeable.





For an overview of our research studies and access to select papers, visit [bscs.org/humane-genetics](https://bscs.org/humane-genetics).

For more information on NSF-Core Award #1660985, contact Dr. Brian Donovan at [bdonovan@bscs.org](mailto:bdonovan@bscs.org).

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