Which differences make a difference?
Practical challenges at the intersection of race and genetics

Faculty College objective
Develop a team-taught course that incorporates perspectives from biology and sociology in order to equip students for interdisciplinary research on sensitive topics at the intersection of race and genetics.

Module 1: Ancestry Testing
• Population-genetic principles that underlie ancestry testing
• Sociology of racial/ethnic category and identity construction
• Challenges in interpreting results from commercial ancestry products

Figure 1. Who is multiracial? The figure illustrates several different – but not necessarily overlapping – ways to define the population of people whose ancestry includes members of more than one race.

Questions for students
• How do commercial ancestry tests work, given the high level of genetic similarity of people around the world?
• How do people form identities – with and without ancestry testing?
• What would you include in a responsible report to customers that communicates your scientific uncertainty in an ancestry test, and clarifies what can and cannot be inferred from the results?

Module 2: Forensic DNA testing
• Racial bias in the legal system
• Statistics behind forensic DNA testing
• Relatedness profiling: case study of an effect of population differences in genetic diversity

Questions for students
• What differences make a difference?
• How do match probabilities for an individual depend on ancestry and population-genetic diversity?
• What social mechanisms cause disparate representation in databases?
• How would you design ancestry questions for donor registries to better track patient outcomes and possibly make better matches?

Module 3: Transplantation matching
• Immunological basis of transplantation matching
• Disparities in donor registries and match probabilities
• Challenges for recruiting donors and making matches

Questions for students
• How would you design ancestry questions for donor registries to better track patient outcomes and possibly make better matches?

Module 4: Disease genes
• Social determinants of racial disparities in health & disease
• Genetic admixture and disease risk
• False positives in disease association studies owing to heterogeneity

Questions for students
• How problems arise when genetic ancestry is not considered in studies that search for disease genes?
• How can we design studies to assist in understanding both the genetic and environmental determinants of population differences in disease prevalence?

Figure 2. Familial identification in forensic testing. The figure illustrates that in a low-diversity population, the chance of a false-positive match of an unrelated person to a crime-scene contributor is greater than in a high-diversity population. In the low-diversity population, two non-relatives have exact matches and one has a partial match, whereas in the high-diversity population, the non-relatives do not have exact or partial matches.

Questions for students
• In what ways is the overrepresentation of racial minorities in DNA databases a subject of concern?
• What social processes lead to differences in disease prevalence?
• What problems arise when genetic ancestry is not considered in studies that search for disease genes?
• How can we design studies to assist in understanding both the genetic and environmental determinants of population differences in disease prevalence?

Figure 3. Probabilities of identifying a matching bone-marrow donor. The figure shows that match probabilities vary substantially according to self-reported race/ethnicity.

Questions for students
• What benefits and concerns arise from differences in research participation?
• How can broader research participation be achieved?

Figure 4. Population differences in the potential for identifying a disease mutation. A disease mutation (orange rectangle) occurs on an ancestral chromosome that contains several marker alleles (green, pink, blue and yellow). Over time, recombination events (diamonds) break down the correlations between the disease mutation and the marker alleles. However, the recombination history differs for populations 1 and 2, separated by a barrier to gene flow (brown vertical line). Consequently, if the pink or blue allele were examined in population 1, then a disease association might be found, but it might not be found in population 2. A similar situation applies for the yellow allele, with the roles of the populations reversed.

Questions for students
• What social processes lead to differences in disease prevalence?
• What problems arise when genetic ancestry is not considered in studies that search for disease genes?
• How can we design studies to assist in understanding both the genetic and environmental determinants of population differences in disease prevalence?

Figure 5. Research participations in genome-wide association (GWA) studies that seek to identify genetic risk factors for disease. The figure indicates an overrepresentation of populations of European origin in GWA studies.

Questions for students
• How does overrepresentation of Europeans affect the interpretation of findings about genetic disease?
• What benefits and concerns arise from differences in research participation?
• How can we design studies to assist in understanding both the genetic and environmental determinants of population differences in disease prevalence?