The theme of social justice has regained cultural urgency recently. Does science have any role to play? Certainly, when one thinks of addressing the disparities of power, profit, and privilege, one typically thinks of charities, social workers, political activists, or courtroom lawsuits. Not science. The world of facts is profoundly different from the realm of values. Reasoning from empirical evidence is unlike reasoning from ethical principles. So, no (most might contend), objective science seems to transcend social issues, with all their subjectivity.

Here, however, I wish to challenge this view (this month’s Sacred Bovine) and show how, in some cases, science is most decidedly relevant to social justice (see also Yacoubian & Hansson, 2020; Shmaefsky, 2020). Further, this connection can be an effective tool to engage students who might otherwise regard abstract science as aloof from human concerns.

First, it may be helpful to review just how facts and values are related. No amount of observation or measurement, alone, will reveal or justify an ethical principle. Facts cannot be converted into values or vice versa – however much some people try to conflate them or blur the distinction. Facts describe what is, values set norms of what should be. Their modes of justification differ. Still, scientific facts can valuably inform our reasoning about values. For example, science can help document cases of injustice. Once the basic values have been established (independently!), science can help establish context, illuminate causes, elucidate consequences, or gauge the likely effectiveness of prospective solutions. Science can vitally inform – as illustrated in the following cases.

Criminal Justice

Consider the popular biology topic of DNA-based identification. Teachers often allude to the forensic use of DNA to find or confirm the culprit of a crime. But consider the converse. DNA evidence can also help determine who is innocent. Or who has been wrongly convicted. For over two decades, the Innocence Project (2020), a legal initiative, has used DNA testing to help exonerate persons imprisoned for crimes they did not commit. Since 1989, over 375 victims of injustice have been freed.

But the ethical context of science does not end there. The Innocence Project also analyzes the cases as an ensemble, looking for patterns. What can these cases collectively tell us about the root causes of injustice? While the DNA evidence helped clear the victims, what caused the wrongful conviction varies. Factors include (sadly) misused forensic science and lack of access to postconviction DNA testing. Our system needs more rigorous standards and more disciplined forensic practices to avoid scientific errors – and unjust verdicts.

Eyewitness identification is often regarded as the most reliable form of evidence. “What could be more trustworthy than direct observation?,” one might suppose. Yet 69% of the cases resolved by the Innocence Project involved mistaken reports by witnesses; 84% of those cases involved misidentification by a surviving victim. The National Registry of Exonerations (2018), in their own analysis, found that this is the most important factor in cases of sexual assault. For many decades, psychologist Elizabeth Loftus has sounded the alarm about the vagaries of human memory and the pitfalls of eyewitness testimony (Loftus et al., 2019). The documented cases of injustice bring further weight to her claims and to the importance of heeding reliable science in securing criminal justice.

Finally, the data on wrongful convictions reveal other, deeper patterns. Of the 375 DNA exonerees to date, 60% were African American. Of the cases of flawed eyewitness testimony, 42% have involved a cross-racial misidentification. Likewise, the National Registry of Exonerations (2018) documents that when groups of individuals are exonerated “as a result of a large-scale pattern of police perjury and corruption” (involving over 2500 exonerees across two decades) they are “overwhelmingly Black.” In other words, criminal injustice exhibits a strong racial bias. Jaythan Kendrick, freed on November 19, 2020, after serving 25 years for a murder he did not commit, fits the pattern well. He was misidentified by two witnesses, each originally coaxed into their testimony. Thus, people who want to pretend that there is no racial bias in the system – and thus that no remedial action is needed – are mistaken. Science does not determine the value of justice. But it does inform us how to achieve it. And lawyers are now pursuing systemic reforms based on the findings above.

Environmental Justice

Using a similar style of reasoning, science can also inform us about the distribution of environmental risks and harms across diverse segments of the populace. Ethically, of course, the burdens should be borne fairly and evenly. But scientific analysis indicates that they are not, and how they are not. In 1984, in one of history’s worst environmental disasters, a chemical plant in Bhopal, India, leaked over 30 tons of methyl isocyanate gas into the surrounding residential community. Some 15,000 persons died. Over a half-million were injured. But the harm was not distributed evenly. The neighborhood was a shantytown. (What person of means would have chosen to live next to such an industry?) The suffering thus fell disproportionately on the poor.

Bhopal may seem like an exceptional incident – a rare “accident.” But evidence is plentiful for equally dramatic “slow-motion
Bhopals.” Exposure to pollution or toxic emissions may occur gradually, but with no less overall impact. For many years in the mid-20th century, hazardous waste disposal sites in the United States were more likely to be placed near communities of color (Commission for Racial Justice, 1987). The pattern continued. For example, in 2008, four million cubic yards of waste coal ash laced with mercury, lead, and arsenic was moved from a flooded plant in Tennessee to Uniontown, Alabama. A cleanup of the toxic sludge was needed – “of course.” But why was it deposited in a small community with a median income of $14,000 and a population that was 90% Black? (Earthjustice, 2014; Milman, 2018). In 2014–2016 (in a case that students may still recall), city leaders in Flint, Michigan, allowed aging lead pipes to contaminate the public water supply, affecting the mostly African American community where 45% were living below the poverty line. Again, poverty and race featured prominently.

Similarly, the risks of climate change are not borne equally. Those who contribute least to the problem are generally those most likely to suffer the consequences. Some nations have prospered through industrial production, as they exported the long-term costs of their fossil fuel emissions to the rest of the world. Meat diets, with the associated production of methane by cattle, are primarily a prerogative of the affluent. When climate hardship comes, however, it will be the poor who are least able to afford or accommodate the changes. With increased flooding from super-storms and coastal surges from hurricanes (and probably rises in sea level in the future), those living in flood plains or along seacoasts will be more severely affected. Those areas, not surprisingly perhaps, are inhabited disproportionately by the poor. Scientists can see clearly that the effects of climate change will not be distributed fairly (Lahn, 2018; California Office of Environmental Health Hazard Assessment, 2020).

Science has helped document and clarify these injustices. Often enough, decisions about where to locate industries that pose environmental risks are based on minimizing economic cost or reducing overall harm. The criteria generally do not include local environmental history. Thus, although a decision may seem neutral and “reasonable,” if it is layered on (and functions within) an existing injustice, it merely compounds the original injustice (Shue, 1992). Ultimately, poverty itself begets further injustice – ironically, under a deceptive rationale of apparent fairness. “Reduction of risk” does not mean that all individuals are equally protected. Scientific analysis can importantly expose how inequities result, and thus how this very form of reasoning is flawed.

Other studies have shown that poverty is not the only factor in environmental disparities. For example, a 2016 study found that most toxic emissions nationwide come from just a handful of polluters and that, even when one controls for poverty as a factor, the sources are disproportionately situated near communities of color (Collins et al., 2016). Another study in 2018 examined exposure to fine particulate pollution, or soot, whether from automobile exhaust, smog, coal furnaces, oil smoke, ash, or construction dust. All lead to respiratory problems. Nationwide, African American communities – regardless of their urban, suburban, or rural setting – are more highly exposed to particulates (Newkirk, 2018). That is, there is evidence of racism. Not necessarily attributable to particular individuals, but deeply embedded in the socioeconomic system. Again, the science helps document the injustice and make it irrefutably and inescapably visible.

Remedies may then ensue. In 2016, the U.S. Commission on Civil Rights heeded the evidence about Uniontown in concluding that when the Environmental Protection Agency (EPA) approved the transfer of all that coal ash waste there, it had violated the civil rights of residents. In 2019, a local court also acknowledged evidence of harm and directed the landfill operator to institute new safeguards (Walters, 2019). Based on this and other cases, national standards for the disposal of coal ash have now been adopted. However, the deeper systemic injustice will require broader changes in legislation and enforcement to fix. And while the circumstances are complex, science is disentangling the most significant causes and informing efforts at restoring justice (Diaz, 2017).

The EPA formally instituted a program for environmental justice back in 1994. The values are clearly stated: “Fair treatment means no group of people should bear a disproportionate share of the negative environmental consequences resulting from industrial, governmental and commercial operations or policies” (https://www.epa.gov/environmentaljustice). However, the science is essential in characterizing the inequity and in determining how best to solve it. The EPA now awards small grants for local projects. Recently, they have spent over $7 million annually. Over a period of 25 years, at least 1400 communities have benefited.

COVID-19 & Health Injustice

Finally, one may consider the recent effects of the SARS-CoV-2 coronavirus. From a strictly biological perspective, one might contend that viruses are blind to race, ethnicity, and social class. The privileged and the impoverished would seem equally susceptible. Yet statistics gathered as the 2020 pandemic unfolded clearly indicated otherwise.

Data inform us that some groups have experienced COVID-19’s adversity disproportionately. For example, Blacks are more than five times more likely to test positive for COVID-19. In four states, the comparative rate for Native Americans is over fivefold. Prisons and meat-processing facilities – both high-density – have been among the top hot spots. Of those infected, the poor are nearly four times more likely to need intensive care. In addition, Blacks and Hispanics are more likely to have underlying conditions (such as diabetes, heart disease, or asthma) that worsen the health effects of an infection (a concrete downstream effect, no doubt, of the environmental injustice noted above). In some states, Blacks are dying at a rate more than 2.5 times their share of the population – and not just because of genetics (Ogedegbe et al., 2020). Finally, Blacks are more likely to be exposed to infection risk: through service-industry jobs (with no work-at-home option), through crowded workplaces or housing, through greater reliance on public transport, and so on (Turrentine, 2020; Van Beusekom, 2020; Wood, 2020).

The statistics are just abstract numbers. But numbers, appropriately interpreted, tell a story. In this case, they are not really observations about the virus or the disease. Rather, they are indirect measures of the context: the social injustice in health and health care in the United States. As noted by the Centers for Disease Control and Prevention, the evidence of disparities, when coupled with underlying social values about fairness, can ideally inform our future practices on COVID testing and prevention. It may also inform our understanding of long-term health care policy in general.

Social Justice in the Biology Classroom

For students who may regard science as cold and remote from human affairs, the link between science and social justice can
potentially be a revelation. It can be a gateway into learning science. The examples above offer ready connections to the standard topics of molecular genetics, human physiology, and human ecology. They offer compelling cases of the relevance of biology to social values.

Curricular goals for science inevitably appeal to the importance of science in public and personal decision making. Yet it is remarkable, I think, that most curricular content ironically avoids such concrete engagement. Concepts are typically presented without cultural context. Even activities in “scientific practices” or “scientific inquiry” tend to drift to black-box exercises or investigations on simple or trivial topics. Perhaps those common lessons answer to what is perceived as a more pressing aim – namely, what is manageable in a classroom. But do these alternatives help reach the targeted understanding about science in society? Usually not.

Biology teachers are generally not trained in ethical discourse or the dynamics of political negotiations. But this does not mean that they are without resources for teaching about social justice. Good old-fashioned science – collecting evidence and reasoning toward reliable conclusions – is relevant to achieving social justice in our world. Biological and environmental justice and climate justice are urgent for science inevitably appeal to the importance of science in public and personal decision making. Yet it is remarkable, I think, that most curricular content ironically avoids such concrete engagement. Concepts are typically presented without cultural context. Even activities in “scientific practices” or “scientific inquiry” tend to drift to black-box exercises or investigations on simple or trivial topics. Perhaps those common lessons answer to what is perceived as a more pressing aim – namely, what is manageable in a classroom. But do these alternatives help reach the targeted understanding about science in society? Usually not.

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NABT is accepting nominations for the 2021 awards program. Nominate yourself or a colleague for one or more of the following NABT awards by visiting nabt.org/Awards-About. The nominee will be sent the necessary information, materials, and instructions to submit their application for consideration.

BIOLGY EDUCATOR LEADERSHIP SCHOLARSHIP (BELS) ... The Biology Educator Leadership Scholarship (BELS) supports teachers who are furthering their education in the life sciences or life science education. The recipient is required to be a practicing educator who is also enrolled (or anticipates enrolling) in a graduate program at Masters or Doctoral level. NABT members with less than or equal to ten years of teaching experience are eligible. The BELS program is sponsored by NABT Members and includes a $5000 tuition assistance award, a plaque to be presented at the NABT Professional Development Conference, and one-year complimentary membership to NABT. The nomination deadline is March 15, 2021.

DISTINGUISHED SERVICE AWARD ... NABT members and friends are invited to nominate outstanding scientists, science communicators, and educators to receive the NABT Distinguished Service Award, which was established in 1988 to commemorate the 50th anniversary of the Association. Nominees should be nationally recognized for major contributions to biology education through their research, writing, and/or teaching. Recipients are honored at the NABT Professional Development Conference.

PROF. CHAN TWO YEAR COLLEGE AWARD FOR ENGAGED TEACHING OF BIOLOGY ... Sponsored by Sarah McBride and John Melville, the Prof. Chan Two-Year College Award for the Engaged Teaching of Biology is given to a two-year college faculty member who has successfully developed and demonstrated an innovative, hands-on approach in the teaching of biology and has carried their commitment to the community. This award includes $500 toward travel to the NABT Professional Development Conference, a plaque to be presented at the NABT Professional Development Conference, and one-year complimentary membership to NABT. The nomination deadline is May 1, 2021.

ECOLOGY/ENVIRONMENTAL SCIENCE TEACHING AWARD ... Sponsored by Vernier Software & Technology, the Ecology/Environmental Teaching Award is given to a secondary school teacher who has successfully demonstrated an innovative approach in the teaching of ecology/environmental science and has carried that commitment to the environment into the broader community. Vernier’s sponsorship of this award includes up to $500 toward travel to the NABT Professional Development Conference, and Vernier equipment. The recipient also receives a plaque to be presented at the NABT Professional Development Conference and a one-year complimentary membership to NABT. The nomination deadline is March 15, 2021.

EVOLUTION EDUCATION AWARD ... The Evolution Education Award, sponsored by BSCS Science Learning and NCSE recognizes innovative classroom teaching and community education efforts to promote the accurate understanding of biological evolution. The award is presented to K-12 and higher education faculty on alternating years. Undergraduate faculty are eligible in 2021. The award includes a combined $1,000 honorarium, a recognition plaque to be presented at the NABT Professional Development Conference, and a one-year complimentary membership to NABT. The nomination deadline is March 15, 2021.

FOUR-YEAR COLLEGE & UNIVERSITY SECTION BIOLOGY TEACHING AWARD ... This award, sponsored by NABT’s Four-Year College & University Section, recognizes creativity and innovation in undergraduate biology teaching. These innovations may include curriculum design, teaching strategies, and laboratory utilization. Additionally, award winners will agree to present their work during the NABT Conference. The award is open to NABT members and includes $500, a recognition plaque to be presented at the NABT Professional Development Conference, and a one-year complimentary membership to NABT. The nomination deadline is May 1, 2021.

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GENETICS EDUCATION AWARD ... Sponsored by the American Society of Human Genetics (ASHG) and the Genetics Society of America (GSA), the Genetics Education Award recognizes innovative, student-centered classroom instruction to promote the understanding of genetics and its impact on inheritance, health, and biological research. The award includes a $1000 honorarium, a recognition plaque to be presented at the NABT Professional Development Conference, and one year of complimentary membership to NABT. The nomination deadline is March 15, 2021.

HONORARY MEMBERSHIP ... The highest honor bestowed by NABT, this award recognizes individuals who have “achieved distinction in teaching, research, or service in the biological sciences” as Honorary Members. Those selected become lifetime members of the Association and receive recognition in NABT publications and at the NABT Professional Development Conference. Nominations may be made by any NABT member and must include (1) a description of the candidate's qualifications, (2) a detailed biographical summary, and (3) supporting letters from at least nine NABT members. The nomination deadline is March 15, 2021.

JENNIFER PFANNERSTILL TRAVEL AWARD ... Established to honor the memory of Jennifer Pfannerstill, this need-based scholarship provides support for a teacher who has successfully demonstrated a commitment to developing as a professional by attending the NABT Conference for the first time. Sponsored by private contributions and NABT, the recipient will receive registration to the NABT Professional Development Conference, hotel accommodations for the duration, travel reimbursement, and a one-year complimentary membership to NABT. The scholarship is open to teachers at all levels, but nominees must be current NABT members. The nomination deadline is March 15, 2021.

KIM FOGLIA AP BIOLOGY SERVICE AWARD ... The Kim Foglia AP Biology Service Award recognizes an AP Biology teacher who displays a willingness to share materials, serves as a mentor to both students and professional colleagues, creates an innovative and student centered classroom environment, and exemplifies a personal philosophy that encourages professional growth as an AP biology teacher. Sponsored by Pearson and the Neil A. Campbell Educational Trust, the Kim Foglia AP Biology Service Award includes a $1000 honorarium, a recognition plaque to be presented at the NABT Professional Development Conference, and a one-year complimentary membership to NABT. The nomination deadline is March 15, 2021.

OUTSTANDING BIOLOGY TEACHER AWARD ... Every year, the Outstanding Biology Teacher Award (OBTA) program attempts to recognize an outstanding biology educator (grades 7-12) in each of the 50 states; Washington, DC; Canada; Puerto Rico; and overseas territories. Candidates for this award must have at least three years public, private, or parochial school teaching experience. A major portion of the nominee's career must be devoted to the teaching of biology/life science, and candidates are judged on their teaching ability and experience, cooperativeness in the school and community, and student-teacher relationships. OBTA recipients are special guests at the Honors Luncheon during the NABT Professional Development Conference, receive gift certificates from Carolina Biological Supply Company, materials from other sponsors, and award certificates and complimentary one-year membership to NABT. The nomination deadline varies by state. Please contact the NABT Office at office@nabt.org for more details.

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THE RON MARDIGIAN BIOTECHNOLOGY TEACHING AWARD ... The Ron Mardigian Biotechnology Teaching Award, sponsored by Bio-Rad Laboratories, recognizes a teacher who demonstrates outstanding and creative teaching of biotechnology in the classroom. The award is given to secondary school teachers in even numbered years, college/university instructors in odd numbered years. The award may be given for either a short-term series of activities or a long integration of biotechnology into the curriculum. The award is presented at NABT's Professional Development Conference and includes a recognition plaque, a one-year complimentary membership to NABT and up to $500 toward travel to the NABT Professional Development Conference and Bio-Rad materials. The nomination deadline is March 15, 2021.

TWO-YEAR COLLEGE BIOLOGY TEACHING AWARD ... Sponsored by NABT’s Two-Year College Section and Cell Zone, Inc., this award recognizes a two-year college biology educator who employs new and creative techniques in their classroom teaching. The primary criterion for the award is skill in teaching, although serious consideration is given to scholarship, curriculum design, or laboratory utilization. Nominees must be current members of NABT. The award includes $500 toward travel to the NABT Conference, a recognition plaque to be presented at the NABT Professional Development Conference, and a one-year complimentary membership to NABT. The nomination deadline is May 1, 2021.