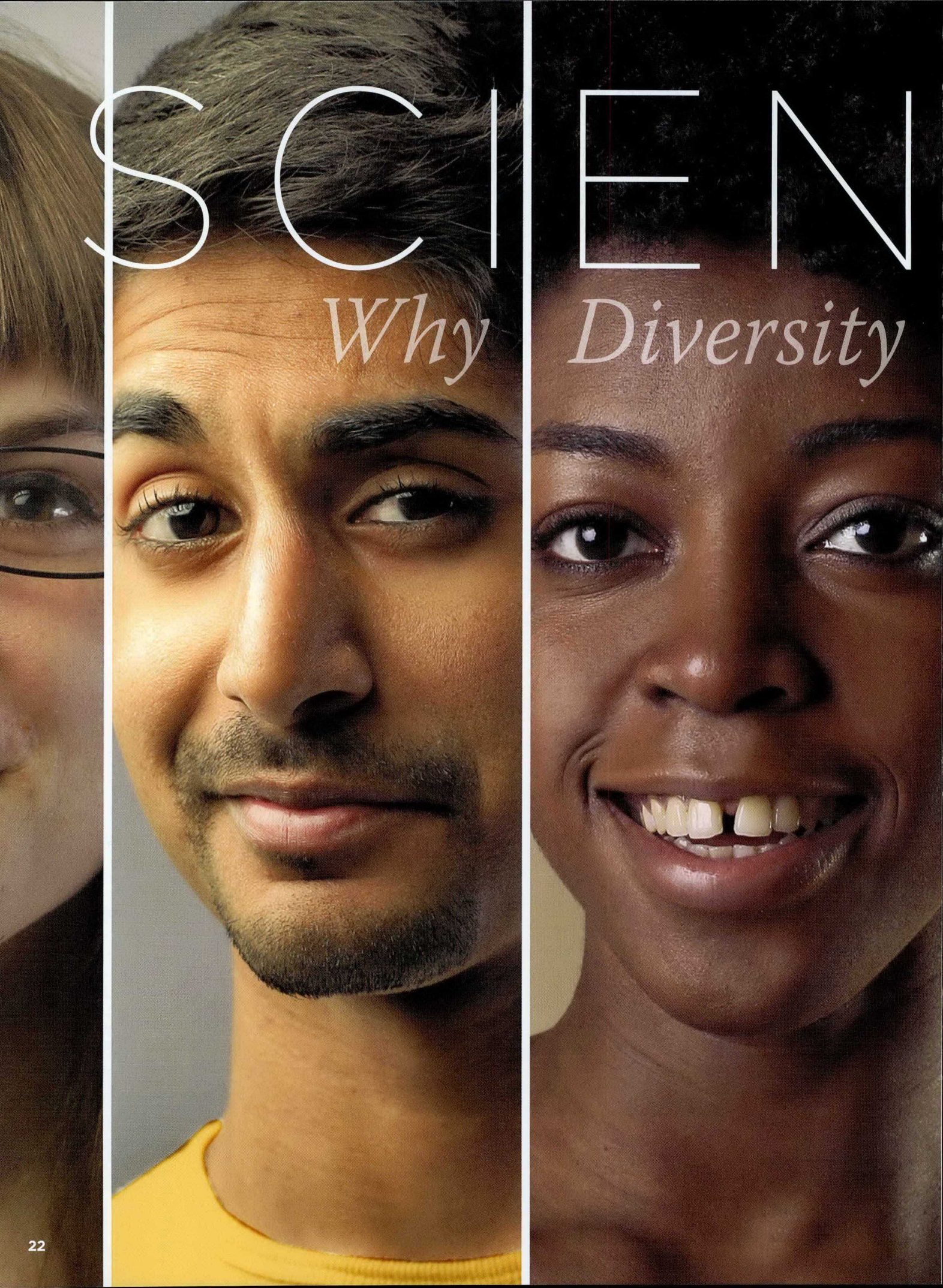
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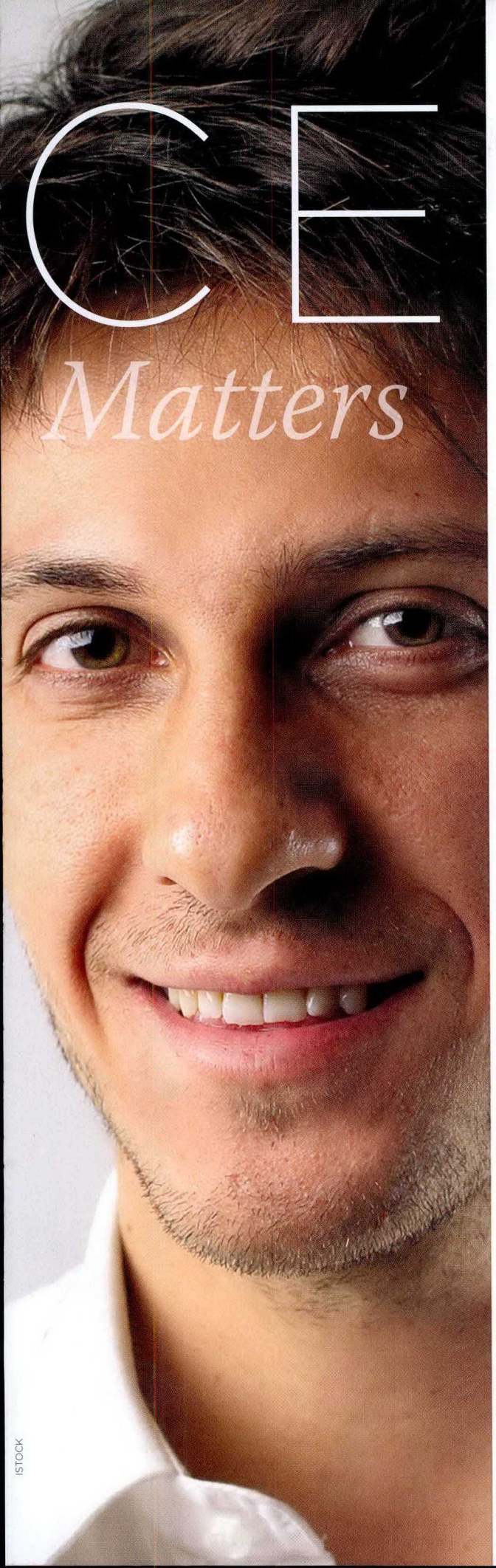
Why Diversity



CE *Matters*

BY VICKI VALOSIK

IT MIGHT SEEM COUNTERINTUITIVE: In the laboratory, engineering workshop, and other academic spaces where science gets done, math-based principles rule supreme, and numbers have no language, no cultural inflection, and no gender—why should it matter who the scientists are and where they're from?

And yet it does: Greater geographical and ethnic diversity is correlated to stronger research and more innovation. At a juncture when diversity—particularly international diversity—is under heightened scrutiny, a critical mass of findings is pointing toward its quantitative and qualitative advantages.

Better Outcomes

"More than ever the complexity of science requires group efforts as teams of scientists from diverse backgrounds work together to make discoveries and solve problems," according to *The Scientific Basis of Individual and Team Innovation and Discovery*, a report from the National Science Foundation.

Indeed, a 2014 comprehensive review of 1.5 million scientific papers written between 1985 and 2008 found that papers written by ethnically diverse teams were more often cited than papers by ethnically homogenous groups of scientists. The review, by Richard Freeman, director of the Science and Engineering Workforce Project at Harvard University, and Wei Huang, a Harvard economics PhD candidate, also noted that the strongest of these papers were created by scientists from geographically different areas working together.

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It's not as if the benefits of diversity are limited to science. A 2015 McKinsey & Company study of companies in the United Kingdom, Canada, Latin America, and the United States across a range of industries found that those in the top quartile for ethnic diversity were 35 percent more likely to financially outperform the industry median. The study also found that the most gender-diverse companies were 15 percent more likely to outperform the median.

But scientists and observers say scientific achievement has the misplaced and outdated reputation of occurring in isolation, and overcoming the stereotype of a lone scientist tinkering in a laboratory is key to understanding that diversity directly powers the highly collaborative nature of inventions and life-saving cures: Ideas are generated within teams and then tested and strengthened in conversation with others, often across disciplines—a process that benefits from a wide range of perspectives.

"When we consider scientific research as group problem solving instead of the unveiling of individual brilliance, diversity becomes key to excellence," writes Kenneth Gibbs, program director at the National Institute of General Medical Sciences, in *Scientific American*. According to *The Difference: How the Power of Diversity Creates Better Groups, Firms, Schools, and Societies*, by Scott E. Page, the Leonid Hurwicz Collegiate Professor of Complex Systems, Political Science, and Economics at The University of Michigan, groups that include individuals from varying ethnic and cultural backgrounds are better at solving problems due to the wider range of perspectives and experiences they bring to the task at hand.

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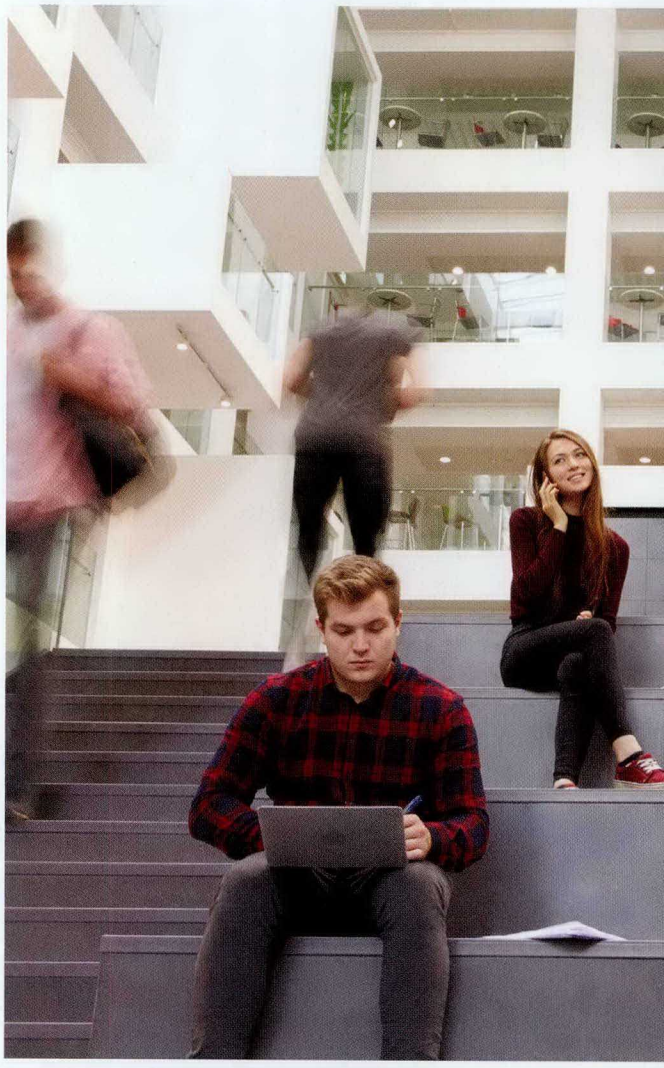
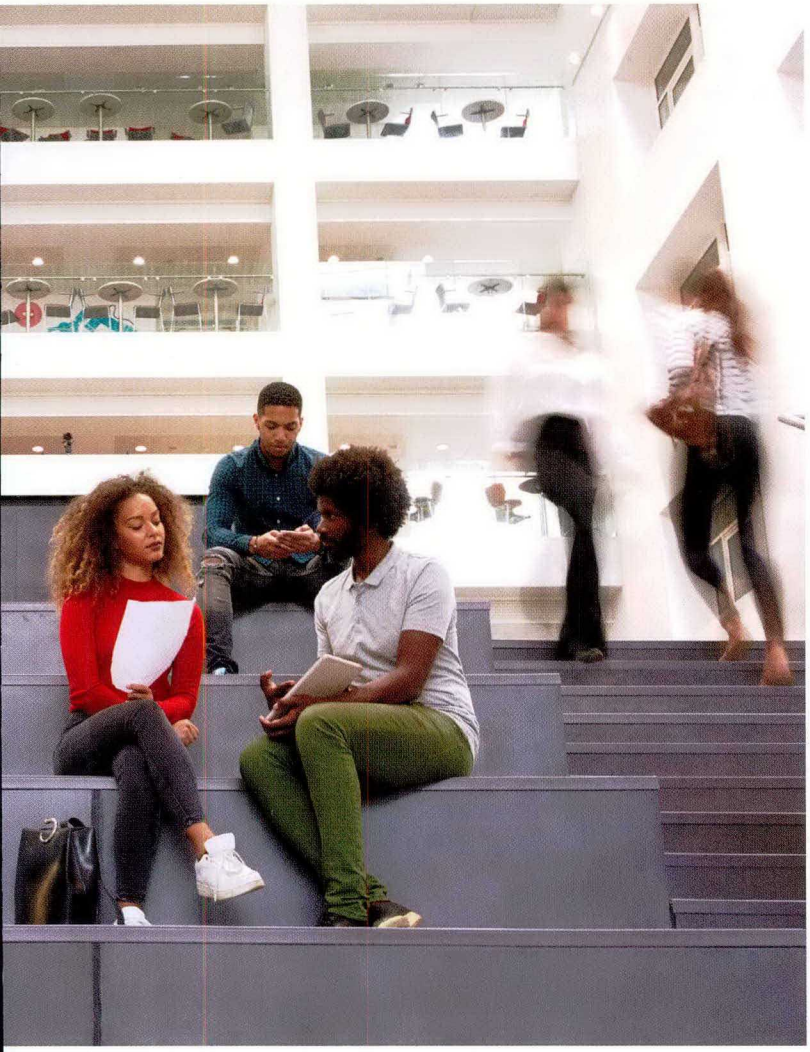
Leveraging Difference

For scientists, one's cultural and social identity doesn't just impact how questions get answered—it also impacts which questions get asked in the first place. For example, early primate studies, conducted predominantly by Western men through an evolutionary-biology lens, focused on male dominance and sexual competition, assuming female passivity. Their conclusions guided assumptions of primate behavior until Jane Goodall's work, which included closer observation of female chimpanzees, along with the research of Japanese primatologists, which assumed greater importance of social structures within groups, and provided important insights on individual behavior as well as group competition and cooperation among chimpanzees.



Diversity within the sciences can also ensure that research is addressing a fuller spectrum of society's needs, says Brenda Andrade, a PhD candidate in chemistry at the University of Illinois at Urbana-Champaign (UIUC) and president of the UIUC chapter of the Society for the Advancement of Hispanics, Chicanos and Native Americans in Science. "Diabetes disproportionally affects Latinos, blacks, and Native Americans over other ethnic groups," says Andrade. "Being a part of the scientific community can empower these traditionally underrepresented groups to use their voice to address issues that affect their communities specifically."

Today the questions scientists ask, and their answers, have greater reach and impact than ever, and students with international exposure are better prepared to succeed in the global job market. A 2017 study conducted



by the Council of Graduate Schools (CGS), which included interviews with senior leaders from science, technology, engineering, and mathematics (STEM) employment sectors, found that employers are looking for teamwork experience. "Communication and leadership skills in an American context are great," says Daniel Denecke, vice president for best practices and strategic initiatives at CGS, "but increasingly that's not enough since those values change in other contexts." Employers, he adds, want to see that STEM hires can move nimbly in international settings, navigate cultural differences, and communicate effectively not only to lay audiences but also within multicultural and interdisciplinary teams.

The Imperative of International Diversity

Cornell University's School of Civil and Environmental Engineering is equipping its students with such international experience through an exchange program with the University of Cantabria in Spain. Participating

Best Practices:

A Checklist for Successful International Collaborations

International scientific collaborations are growing at an astonishing rate—the proportion more than doubled between 1990 and 2015, according to a 2017 report by researchers at The Ohio State University—both within academia and industry. Drawing from the expertise of leaders and practitioners, here is a selection of best practices and practical strategies for successfully launching and maintaining international collaborations.

- **Develop learning objectives** for global and intercultural research experiences, whether these take place at home or abroad.
- **Establish a research agenda** prior to initiating international student exchanges.
- **Develop an application process to address the minority gap** to improve participation among women and minorities.
- **Discuss authorship in advance.** Practices surrounding authorship differ across countries.
- **Respect reciprocity** and recognize both material and non-material contributions.
- **Foster an atmosphere** where diverse opinions can be discussed, shared, and addressed.
- **Think beyond academia.** Collaborations or internships with STEM companies abroad can expose students to a wider range of career options.
- **Look at outside funding opportunities.** The following entities directly or indirectly support international research activities for graduate or undergraduate students:
  - The National Science Foundation
  - The Fogarty International Center at the U.S. National Institutes of Health
  - The U.S. Department of Education
  - Centers for Disease Control and Prevention
  - The Agency for International Development
  - The American Association for the Advancement of Science

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students from Cornell spend their junior year in Santander, Spain, take Cornell-equivalent engineering courses in English, and go on site visits to see the profession in action. On alternating years, cohorts of Cantabria students come to Cornell's campus, making the program a true exchange. Edwin Cowen, director of the program, says students "gain a sense of a different set of value metrics around engineering design, engineering systems, the interaction of public policy with those systems, and how the public adopts technology and new ideas in engineering—and all within another culture."

Although highly rewarding, establishing this type of international partnership can be daunting and sometimes cost-prohibitive, and even successful programs often have low participation rates (about 5 percent of eligible engineering majors participate in the Cornell-Cantabria exchange program). As such, Denecke says it's important for universities to also provide multicultural experiences within their own campuses and in the classroom by fostering international diversity and remaining cognizant of creating "an inclusive cohort of students," rather than focusing recruitment efforts on a single country or region.

Kevin Pitts, associate dean for undergraduate programs in the College of Engineering at the University of Illinois at Urbana-Champaign, has seen the impact this kind of international diversity can have. Over the past decade, his college has made a concerted effort to improve international diversity—currently 22 percent of undergraduates and 50 percent of graduate students at the college are international. "Now teamwork in the classroom is international almost without effort just because the student body is so diverse," he says. And multiculturalism in the classroom can have a domino effect: "More international students on campus leads to more cross-cultural exposure and friendships," says Pitts, "which makes students more willing to pursue an international experience [in college], which then gives them confidence that they could do something

like that in the job market." Pitts, whose own work at a national particle accelerator lab in northern Illinois involves regular collaboration with colleagues from around the world, says, "Engineering is a global discipline, so it made sense to recognize and take advantage of that fact to expose our students to a more global culture."

As much as international students enrich the academic experience of domestic students by bringing new perspectives to discussions and group work, the contributions they make to U.S. higher education reach much further. At the graduate level, high percentages of foreign students in STEM programs provide important research labor, enabling universities to attract top faculty and as a consequence sustain the competitiveness of their programs: Foreign nationals accounted for 70 percent of full-time graduate students in the United States in electrical engineering, 63 percent in computer science, 60 percent in industrial engineering, and more than 50 percent in economics, chemical engineering, materials engineering, and mechanical engineering in 2010, according to the National Science Foundation.

Recent federal policy shifts have also highlighted the economic horsepower that international students add to U.S. economic competitiveness and innovation. Between 2006 and 2012, immigrants started 33 percent of U.S. venture-backed public companies in the United States, and of these immigrant founders, 38 percent first entered the United States as international students, according to the National Venture Capital Association. Also, for every 100 international students who earn PhDs in STEM fields in the United States, the country stands to gain 63 future patent applications, according to a 2005 World Bank report.

Those on the front lines say all these outcomes ultimately sprout from the day-to-day work that scientists of all backgrounds do together: Science has no borders, and both the problems and opportunities of the twenty-first century require collaboration among the brightest minds and most innovative thinkers, regardless of where in the world they are.

Cowen says his own collaborations with Spanish colleagues at Cantabria University and elsewhere have brought this idea home. "In the end," he says, "it's one small planet and we have to value how all of us look at it and seek solutions to the global problems we face." ■

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