The EXROP program has helped hundreds of underrepresented minorities identify as researchers, a key step toward a science career.

By Erin Peterson
Illustration by Lara Harwood
Snow is falling steadily on an early February afternoon, but Kelley Harris-Johnson isn’t admiring the scene from her office windows at the University of Wisconsin–Madison. She’s deep in conversation with a student.

They chat about his athletic accomplishments, his volunteer work with a local hospital, and his family. They discuss his challenging course load and strong GPA. And when he expresses an interest in doing summer research, she launches into a mini master class on finding faculty members conducting research, writing targeted emails, and doing extensive interview preparation. By the time he pulls on his coat to leave, another half-inch of snow blankets the campus, and he is armed with knowledge that can propel him to graduation and beyond.

Harris-Johnson, an assistant faculty associate in Wisconsin’s biochemistry department, believes in the importance of getting to know students as people and taking the time to guide them when they ask for help. “Mentorship from key people in my life helped me reach the goals I set for myself,” she says. “It influenced me in my career and it changed my life. Any opportunity I have to give that sort of mentoring to a student, I feel obligated to do.” The shelves in her office display dozens of bright thank-you cards from students she’s worked with over the years.

A decade ago, Harris-Johnson was not unlike the young man who came for help on that snowy day: bright, motivated, and in search of the right opportunity.

In early 2003, just months before graduating from Xavier University of Louisiana, a historically black college, she learned about a new program offered by the Howard Hughes Medical Institute. It was called the Exceptional Research Opportunities Program (EXROP), and her biology professor, Michelle Boissiere, thought it was the perfect fit for Harris-Johnson, a biology major and chemistry minor. Created to provide talented underrepresented minority undergraduates the opportunity to do mentored summer research with HHMI-funded scientists, the program was designed to attract outstanding students and give them the skills and confidence to succeed in graduate school.

Celebrating its 10th anniversary, EXROP has built a trove of success stories that move beyond the singular anecdote to statistical significance. HHMI has sponsored 578 students from more than 100 colleges and universities. Of the 370 EXROP alumni who have completed their baccalaureate degrees, 362 are in science careers. A full 50 percent have pursued graduate degrees (see chart on page 17). To further support the development of EXROP students, the program recently added an ambitious component called the “capstone experience.”

Harris-Johnson, a member of the first cohort of EXROP students, credits the program with cementing her love of research. It also gave her the chance to add to her resume, which already listed two other college research experiences. For her EXROP summer, she worked in the lab of the University of Wisconsin’s Paul Ahlquist, an HHMI investigator. She studied yeast as a model to understand how viruses get help from host cells during infection. The tough project taught her to handle failures, appreciate even small successes, and experience life as a researcher. “I learned an entirely new vocabulary, a new system, and a new skill set,” she says. “And that gave me a lot of confidence.”

The next fall, she enrolled at the University of Wisconsin to obtain a graduate degree in genetics. In 2008, she graduated with a Ph.D. Today, she teaches a freshman seminar course and a large introductory biochemistry course and works closely with students. Though she no longer does her own research, she draws on her lab experience when giving advice to students and when she
wants to add context to a classroom discussion.

There were many steps along Harris-Johnson’s path to success, but she says her experience with EXROP helped her stick to the difficult but rewarding path she chose.

A New Approach
Science benefits from diversity, says David Asai, senior director of HHMI’s precollege and undergraduate science education programs. “Finding solutions to hard [scientific] problems often depends on the diversity of the problem solvers who bring to the challenge different perspectives, tools, and ways of thinking.”

The lack of diversity in science was glaring as this century began: just 7.3 percent of Ph.D. recipients in a science, technology, engineering, or math (STEM) field in 2001 self-identified as black, Native American, or Hispanic. The numbers did not reflect the growth in U.S. minority populations.

To tackle the problem, many organizations have tried an array of approaches. HHMI, for example, offered a full slate of high school and museum outreach programs for underrepresented minorities in the sciences. Tom Cech, HHMI’s president from 2000 to 2009, says the Institute was proud to have brought 50,000 students through such programs over the years.

Because of that record, Cech invited Freeman Hrabowski, a longtime proponent of minority participation in the sciences and president of the University of Maryland, Baltimore County (UMBC), to discuss programming back in the early 2000s. To Cech’s surprise, Hrabowski delivered a challenging message. “We expected that he would give us a giant pat on the back,” Cech recalls. “Instead, he looked at the data and said, ‘You haven’t done anything.’” Though HHMI could point to vast numbers of students going through the programs, the organization didn’t know how many students more seriously pursued a career in the sciences as a result.

After Hrabowski’s harsh appraisal, HHMI looked at other approaches. Summer research looked promising. Undergraduates who participate in hands-on research are more likely to pursue advanced degrees and careers in science, according to dozens of studies. At the time, UMBC had a decade’s worth of success with the Meyerhoff Scholars Program, which was designed to provide support to African American students committed to earning a Ph.D. in math, science, or engineering.

A summer research approach could help HHMI encourage students to consider careers as researchers. Hrabowski also suggested to Cech that this kind of work might boost the number of underrepresented minorities who choose careers as professors, where they would be at the front of the classroom and could influence future generations of students. And HHMI could track results to stay laser focused on the program’s efficacy.

To be sure, other organizations were using summer research as a tool to get students excited about science careers. The Amgen Foundation, for example, offers hundreds of undergraduate students the opportunity to do hands-on research each summer, though it does not focus on underrepresented minorities. The National Science Foundation, meanwhile, provides colleges and universities with funding for hundreds of students through its Research Experiences for Undergraduates program. The schools themselves select the students for lab work.

HHMI needed to do something valuable and distinctive. Peter Bruns, then vice president for grants and special programs at HHMI, realized that the ingredients for such a program could already be found within HHMI. The organization had long supported top research scientists across the country. It was also giving grants to colleges to develop and run innovative science education programs for undergraduates.

“With EXROP, we could join both sides of the house,” Bruns says. Faculty at the colleges and universities could serve as “talent scouts,” nominating promising students to participate and serving as advocates for them throughout the process. And HHMI investigators could give students experience in top-notch labs. HHMI investigator Mike Summers, who helps lead the UMBC Meyerhoff Scholars Program, assisted in designing the EXROP program.

In 2003, HHMI launched the program with 32 students. In its 10 years, the number of participants has increased; the 2013 class includes 77 students. This year’s budget is $1.2 million. The total budget for the 10 years climbs to about $6.4 million. And the diversity of the students who have participated over the program’s history is significant: 42 percent are African American, 34 percent are Hispanic, 10 percent are Asian, and 1 percent is Native American. Women make up 58 percent of EXROP participants.
Building Confidence

EXROP is designed to give students challenging and meaningful research experiences with exceptional researchers. But the program is also designed to provide emotional and career support to students through mentoring, networking, and other opportunities. In addition to the 10 weeks of summer research, EXROP students spend time at HHMI headquarters meeting other EXROP students and hearing from scientists who were in their shoes just a few years earlier.

The reason behind these extra program components is that it’s often not enough for students to “know” that they can do research. They must also internalize that idea, “to believe it with their hearts as well as their minds,” according to Asai. A significant obstacle for underrepresented minorities isn’t necessarily the process of research but the mental barriers that undermine their confidence.

Harris-Johnson, for example, says that her fantastic grades and previous research experience at Xavier weren’t enough to convince her she could be successful. “At Xavier, most of my instructors looked like me, and I was grateful for that,” she says. “But I didn’t know if I could cut the mustard at a majority school.” It didn’t help that family members encouraged her to settle into a more traditional lifestyle—husband and kids—instead of pursuing a research career.

These cultural pressures could have limited her, but her experience with EXROP helped change her mind. Support from Ahlquist and the postdocs in his lab—combined with significant progress throughout the summer—convinced her that she had the skills and tenacity to do research. “At one point, after making a mistake, I remember talking to a postdoc about research and saying, ‘I’m not ready to do this.’ And he looked at me and said, ‘Kelley, you’re more than ready to do this.’ I will never forget that as long as I live.”

Kayla Lee, a senior at Hampton University, a small, historically black institution in Virginia, says that her 2011 EXROP experience under the guidance of HHMI investigator Ron Breaker at Yale University was eye-opening way beyond the research experience; it made her rethink her job options. “I am convinced there is an unwritten blueprint somewhere that says that students—especially minority students—who enjoy science have to grow up to be doctors,” she says. “[Research] is not a well advertised career path. Luckily, through a series of my own questions and amazing professors, research found me.”

Lee adds that her EXROP faculty sponsor at Hampton, biology professor Edison Fowlks, supported her throughout the process. “His mentorship is one of the main reasons that academia is a very important part of my future career,” she says. “Without him, it would have taken me a lot longer to [reach] my goals.” Lee, who received a 2013 Gilliam Fellowship from HHMI that will fund four more years of advanced study, will begin a Ph.D. program at Harvard this fall.

For Cornelius Taabazuing, the EXROP-funded research that he did in 2009 with Cech at the University of Colorado, Boulder, led to a coauthored study published in Cell in 2012, a validation unlike any other. “After the program, I had the self-confidence to know that I can perform research at the highest level and be successful in a career as a scientist,” he says. Today, he is studying for a Ph.D. in chemistry at the University of Massachusetts at Amherst.

HHMI investigator and Nobel Prize winner Eric Kandel, who has mentored 14 EXROP students at Columbia University, says that while he’s happy to reassure students who may feel insecure about their abilities, success is its own confidence builder. “If you do well in the lab, that’s very satisfying,” he says. “Sometimes, that’s all the certification you need.” It’s a sentiment borne out by outcomes data: undergraduate researchers from HHMI-funded summer research programs routinely say that self-confidence is one of the many benefits they gain from their experience. These markers of achievement—praise from a top researcher, success with an experiment, and even publication in a journal—can provide the reinforcement that continues to motivate students to take science seriously.

To help underrepresented students stay in the sciences, HHMI offers an array of options to EXROP alumni. For example, some
alumni visit Woods Hole for a few days to encourage them to participate in a summer course at the Marine Biological Laboratory. And the HHMI Gilliam fellowships provide extended support to EXROP alumni who attend graduate school. These options help students maintain their momentum after their EXROP summer is over.

Thanks to the efforts of HHMI and other organizations, more underrepresented minority students are receiving Ph.D.s. While the number of doctorates in STEM fields climbed from 11,823 to 15,910 between 2001 and 2011, the proportion of Native American, black, and Hispanic recipients has grown even faster, from 858 (7.3 percent) to 1,641 (10.3 percent). There remains a great deal of work to bring the number of minority Ph.D.s to reflect the talent pool (currently, about 31 percent of undergraduates interested in STEM are minorities), but the nation appears to be headed in the right direction.

From Capstone to Career
The EXROP outcomes data demonstrate the power of a summer research experience, but they raise a question: If one summer of research is good, would two be better?

Logically, it makes sense. Students who return to their host lab for a second summer don’t have to devote precious time learning to use the equipment and getting up to speed on the research. Other benefits recommend the practice as well. In a 2012 study published in the journal *CBE–Life Sciences Education*, for example, students with multiyear research experiences were more likely to develop higher-order scientific thinking skills, including the ability to analyze and interpret data, solve problems, and identify the next steps of an experiment. They developed greater confidence, intellectual independence, and a larger sense of ownership of their work.

In 2012, armed with those ideas and data, HHMI began offering a capstone summer research experience for students who want to do research for a second summer in the same lab. Last year, 31 of the 81 EXROP students from 2011 took advantage of the capstone experience. This summer, 34 of 60 will participate.

According to Asai, early results are encouraging. “We launched the capstone experience on the premise that a second experience will reinforce students’ identities as scientists,” he says. “Comments from last year’s ‘capstoners’ support this rationale: they speak of already feeling that they belonged to the lab and that they were able to make more significant contributions, rather than feeling like a temporary guest.”

Izzy Cerullo, a senior at Columbia University, first participated in EXROP in 2011, when she worked in the lab of HHMI investigator Michael Rosbash at Brandeis University. She studied certain groups of neurons and how firing those groups can control circadian rhythms and affect periodic behavior in fruit flies.

Cerullo loved the work and was eager to return; when HHMI offered the capstone experience, she signed on. “I didn’t have to be taught the basics,” she says. “[The second summer] was really productive.”

While she plans to take some time off from school after she graduates this spring, she’s already applied for research-related positions in several labs so that she can stay sharp for the next steps in her career.

Buoyed by this kind of enthusiasm and compelling data, Asai hopes to see other institutions, both public and private, find ways to replicate HHMI’s efforts by connecting top scientists with top students from underrepresented groups. He also hopes other organizations can find more ways to reinforce scientific identities in these students. In the coming years, he’d like to see EXROP come full circle. “My greatest hope for EXROP is that the students who have come through the program will continue to grow, thrive, and excel so that one day some of our EXROP alumni will themselves be HHMI investigators and professors.”

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**WEB EXTRA:** See video and slideshows of EXROP students reflecting on their experiences at [www.hhmi.org/bulletin/spring2013](http://www.hhmi.org/bulletin/spring2013).