From laboratory to classroom

Dr Bradley Hoge coordinates the University of Houston-Downtown's pioneering Noyce Teacher Scholarship Program. With the goal of encouraging more science graduates to go into teaching, the Program is an important step towards improving science education in Texas

How did you become involved in STEM education?

Prior to beginning my PhD, I earned a post-baccalaureate teaching certification at Louisiana State University and taught for three years. I was looking for a career in which I could use my skills and experience in both science and education – when I saw the advertisement for the Director of Houston Urban Network for STEM (HUNSTEM) position at the University of Houston-Downtown (UHD), I felt that it was a perfect fit.

HUNSTEM is an online learning community within the Natural Sciences Department at UHD. It works with schools, STEM professionals, informal science centres and community leaders to identify the best STEM education resources, programmes and opportunities in the greater Houston area, and acts as a liaison between the STEM learning community and students, parents and classroom teachers.

How extensive is the lack of STEM teachers and what has led to this situation?

The Texas Business and Education Coalition (TBEC) commissioned a report that shows the majority of science teachers in the State of Texas are teaching with provisional certification and are not properly certified to teach science. Furthermore, the Texas Closing the Gaps initiative reported that science teacher certifications declined by 23 per cent from 2011 to 2012, continuing a trend in the state.

While numerous studies have tried to identify causes for this situation, no one explanation has emerged as a satisfactory answer to why it is so difficult to recruit and retain good STEM teachers. Teacher salaries, especially compared to STEM salaries in other sectors, have often been cited. However, surveys of teachers leaving the profession show that salary is not ranked as the primary reason. They usually cite a lack of cooperation with parents and school administration in dealing with student discipline, and a lack of control in their own curriculum.

Why was the UHD-Noyce Teacher Scholarship Program created for UHD College of Science and Technology Scholars Academy (SA) members?

The UHD-Noyce Teacher Scholarship Program was designed to be an integral part of the UHD College of Sciences and Technology SA. The SA programme at UHD has dramatically increased retention and graduation rates for science majors at UHD, most notably among minority and female students. In each graduating class, the numbers of students entering science-related fields, especially graduate schools and professional schools, has steadily increased.

Prior to the UHD-Noyce Program, students occasionally entered alternative teacher certification programmes to pursue teaching. Many others mentioned teaching as a future career goal on department exit interviews. Given the variety of activities related to science education already in place in the Natural Sciences Department and the SA, the UHD-Noyce Program provided a great opportunity to increase the Department's effort to bring more accomplished science students into teaching careers.

Students selected for the Scholarship Program are required to serve for two years at an at-risk secondary school for every year of scholarship support after earning their BSc from UHD. What is expected of them and why is this compulsory?

Statistics show that the quality of teaching in urban and underprivileged schools is lagging behind more affluent areas. The National Science Foundation (NSF) built into the call for proposals the requirement that teachers funded through Noyce commit to teaching in high-needs schools. NSF's focus was one of the reasons this funding opportunity was attractive to UHD since we serve this community already.

Which groups/individuals is the Scholarship Program specifically aimed at and what does it provide?

The UHD-Noyce Program provides US $8,000 scholarships for students, along with a $2,700 stipend for summer research activities. Participants pursue both a science degree through the Natural Sciences Department and teacher certification through the Urban Education Department. The UHD-Noyce Program accepts students from the SA who are in either their junior or senior years.

Students fulfil their obligations to the Program by participating in teacher training activities and research both during the academic year and the summer. During the academic year, students participate in classroom observations at one of our collaborating middle or high schools, work with children on specific experimental exercises and prepare an academic topic in science during their two years participation in the Program. UHD-Noyce students also take part in up to two science education conferences.

STEMing urban disadvantage

To improve the quality of education in Texas, the **University of Houston-Downtown** has launched the innovative UHD-Noyce Teacher Scholarship Program to nurture a bold generation of science teachers through an engaging and interactive curriculum

AFTER YEARS OF decline in science teacher recruitment, the groundbreaking University of Houston-Downtown (UHD)-Noyce Teacher Scholarship Program stands set to better prepare science students for the world of education. Scholarships are being provided to 26 undergraduate science students at the UHD College of Science and Technology Scholars Academy (SA) to prepare them for a career in STEM education, and help urban schools in desperate need of high-quality, free-thinking teachers and support staff.

INSPIRING THE NEXT GENERATION

Since its formation in 1999, the College of Science and Technology SA has received praise from across the State and the rest of the country for its success in encouraging more minorities, females and first-generation college students to undertake STEM degrees and pursue science-based careers. The most recent initiative, coordinated by Dr Bradley Hoge, Associate Professor of Natural Science and Science Education at UHD, brings together expertise from both the Natural Sciences and Urban Education Departments at UHD, as well as middle schools and high schools across the Aldine Independent School District. The latter is an urban area of Houston where the majority of the population are from minority ethnic backgrounds.

Hoge believes that UHD science graduates are best suited to motivate school pupils in high-need areas: "Since many attended high-risk schools, they would most likely return to these schools to teach," he explains. Forming part of the Houston Urban Network for STEM (HUNSTEM), the Program was therefore designed to tackle three main areas of concern in science education in Houston. First, since the introduction of new standards requiring pupils to study STEM subjects for four years, the need for highly qualified science teachers has increased. However, since recruitment and retention levels for science teachers have been falling for two years in a row, this became the second focus area. This teacher deficit is most keenly felt by high-need schools in urban areas, which generally have the largest proportion of pupils from minority communities, and as such the Network felt this should become the third area of investigation. This all serves to create specialists in their fields who can inspire young people to strive for careers in STEM subjects despite a disadvantaged background.

TAKING RESEARCH TO THE CLASSROOM

Students who receive the US $8,000 scholarship emerge from the Program with both a degree from the Natural Sciences Department and a teaching qualification from the Urban Education Department. An extra US $2,700 stipend ensures that the students are also able to carry out at least one semester of undergraduate research alongside their teacher training. The Program is thus structured to provide participants with the tools they need to translate their experience as researchers into stimulating classroom material that will motivate and engage pupils.

Over the course of their studies participants are encouraged to use their own research knowledge and experience to create materials for science lessons. For instance, undergraduate field research into wetland ecology has been subsequently adapted and developed by participants into interactive lessons for secondary school classrooms. This is facilitated by the fact that the Natural Sciences Department at UHD is home to both scientific researchers and science education specialists. "In this community of learners, the UHD-Noyce Scholar benefits by participating as a 'novice' and learning first-hand about the challenges and rewards of teaching through participation in the classroom and in-depth discussions," adds Hoge.

During their training, students also work with mentor teachers from associated middle and high schools to develop ways to make their classes more hands-on and stimulating for pupils. In term time they work with pupils and observe lessons while during the summer they attend Teacher Enhancement Workshops, which provide the opportunity for students to collaborate with teachers to develop the curriculum and make science learning more practical and engaging. Integrating research

UHD Noyce Scholar Claudia Turcios (far right) participating in a workshop at the annual Noyce Conference in Washington DC, USA.

THE UHD NOYCE TEACHER SCHOLARSHIP PROGRAM

OBJECTIVES

To motivate minority and financially needy students by their middle/high school science courses to pursue university degrees and careers that are science based.

KEY COLLABORATORS

Larry Spears, original PI, Founder of University of Houston-Downtown (UHD) Scholars Adademy • **Jon Aoki**, Co-PI, Associate Professor of Science Education, UHD • **James Uzman**, Co-PI, Interim Dean of the College of Science and Technology, UHD • **Anjoo Sikka**, Project Evaluator, Dean of the Ella Cline Shear School of Education, State University of New York at Geneseo

PARTNERS

UHD Departments of Natural Science and Urban Education

Aldine Independent School District (a minority dominant urban district in Houston)

The Harmony Academy of Science

The Houston Urban Network for Science, Technology, Engineering and Mathematics (HUMSTEM)

FUNDING

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BRAD HOGE is a science educator as well as a scientist, which happened purely by accident and has helped him fill a niche role at UHD.

Hoge is Associate Professor of Ecology and Science Education, and Director of HUNSTEM, the Houston Urban Network for STEM, a learning community for teachers, students, parents and STEM professionals. These two roles allow Hoge to liaise between the community and scientists, build collaborations and facilitate relationships, all while educating the next generation of scientists and science teachers. He also mentors students in the UHD Scholars Academy, and conducts research on the ecological succession of mitigationed wetlands. His teaching style is hands-on, project-based learning and involves field experience, which the students love.

topics into the curriculum not only motivates students to perform well in their exams, but also exposes them to the real-world applications of their science lessons; in doing so, students foster talents and vested interests in STEM for further study or a career within these domains.

A NEW PARADIGM IN SCIENCE EDUCATION

Given the achievements of the SA so far, the UHD-Noyce Program will no doubt make a considerable difference to science students in Houston. The SA has awarded over 3,800 scholarships to primarily minority and female students since it was founded in 1999 and this new scheme will build on this progress. It creates a feedback loop between pupils in the classrooms of high-needs schools and science graduates from the same milieu to boost the number of young people who would otherwise not consider a career in science due to their lack of confidence and/or restricted access to learning.

However, it is difficult to overstate the scale of the problem the UHD-Noyce Program is taking on. Despite the rapid diversification of the population of the US, 70 per cent of the American STEM workers are white, with African-Americans and Hispanics collectively accounting for <5 per cent. Hoge is certainly under no illusion about the scale of the inequality, but remains positive about the fact that change can be made through the new hands-on approach to science education promoted by the UHD-Noyce Program: "The limited science that is taught in elementary schools focuses too much on rote memorisation (repetition) of content and incomplete and inaccurate demonstrations of how science is carried out since teachers can rely on templates rather than hands-on experiences," he emphasises. With a deficit of teachers with science backgrounds, many pupils lose interest in the subject before they reach secondary school. Increasing the number of positive role models that emphasise the practical applications of scientific knowledge and engender a more informal, experimental approach to science lessons aims to change pupils' perceptions of science, in particular the damaging idea that boys are more suited to STEM subjects than girls.

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There is still a long way to go, but it is extremely encouraging that those who have already completed the scheme have found themselves in high demand for jobs and workshops, reporting high levels of satisfaction overall. The UHD-Noyce Program is cementing the UHD's reputation as a committed institution, seeking to serve the needs of all in its diverse community. By strengthening links between the University's science departments and the region's science classrooms, the scheme is set to overhaul science education in Houston and cultivate a new generation of budding scientists.

UHD Noyce students Jesus Zepeda, Dulce Guevara and Natalie Yacovodonato show off their artwork from a field trip with the Artist Boat during the 2011 Noyce Summer Environmental Science Workshop.