Dr Linda Bailey Hayden is a professor of computer science at Elizabeth City State University, North Carolina, and is also a director of the Center of Excellence in Remote Sensing and Research. Her current work includes a project that provides research experiences to undergraduate students, graduate students and aspiring teachers in the polar regions and scientific gateways, with the aim of advancing the careers of a diverse group of future science gateway users, gateway developers and polar scientists. She is responsible for over $25 million in funded projects.

The polar regions are the most distant reaches on our planet, and are largely untouched by our influence. They are inhospitable, often facing extreme weather conditions and experiencing wide variations in light levels throughout the year, meaning that the polar regions are not as well understood as other areas of the Earth. The Arctic and Antarctic are vulnerable to climate change, and the increasing temperatures associated with global warming cause polar ice sheets to melt and break. This is an issue as it can impact the habitat available to polar species, as well as influence sea levels, rendering polar research highly important.

Historically, polar science and the broader STEM field has seen limited diversity in the workforce, but as social understanding has advanced, increasing numbers of women and those from minority groups have entered STEM careers. Dr Hayden of the Elizabeth City State University has spent a long career in polar and cyberinfrastructure research, and has conducted numerous programs to encourage women and minority students to enter further study and careers in STEM by providing training, research experiences, and field work opportunities in polar science and cyberinfrastructure.

**CYBERINFRASTRUCTURE AND POLAR RESEARCH**

A suite of programs, CReSIS, Polar Grid, and AaA, funded by the National Science Foundation, are addressing the problems associated with the impact of melting ice sheets on sea level rise. CReSIS, the Center for Remote Sensing of Ice Sheets, led by Dr Gogineni, was founded in 2005 with the goal of developing and supporting technology and computer models that monitor the mass balance of ice sheets. The Polar Grid project, which commenced in 2007, led by Dr Geoffrey Fox, aimed to develop a cyberinfrastructure from the North to the South Poles, which consisted of a computer grid of rugged laptops and clusters in the polar regions and two large-scale clusters at the Indiana and Elizabeth City State Universities. Polar Grid made it possible for researchers to collect and analyse data without making multiple trips to these regions, reducing the cost of polar research. The REU Site: Arctic and Antarctic (AaA-REU) Project with Research Experience for Teachers, led by Dr Hayden, began in 2013 and aimed to integrate education and research in the poles to drive a diverse group of students into polar careers. This has successfully improved the research skills and confidence of the participating students, encouraging them to consider pursuing further study or careers in STEM.

Similarly, the Science Gateways Community Institute, founded in 2016, is at the forefront of cyberinfrastructure (CI). The SCGI greatly enhances the ability of students and scientists to use science gateways (web-based interfaces that allow remote access to storage systems), significantly improving the productivity of researchers by providing easy access to specialist, shared resources for scientific or engineering disciplines. The SCGI also incorporates Workforce Development, which aims to inspire, educate, and train the next generation of science gateway users and developers. Its mission is to educate and train a diverse population of graduate/undergraduate students, faculty, and IT personnel, and to provide training opportunities for undergraduate students as a pathway to graduate education. This will be achieved by providing financial support, workshops, internships, mentoring and access to a Young Professionals Network to both students and educators to support their growth in the field.

**WORKFORCE DEVELOPMENT**

Dr Hayden can be found at the forefront of both polar science and CI, helping to shape the workforce development efforts and aggressively reaching out to women.

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Jerome Mitchell's academic career is one of the many students that have proven to be vital for encouraging the next generation of a diverse group of science gateway users, gateway developers and polat scientists. Her current work towards providing research experiences to undergraduate and graduate students as well as aspiring teachers in the polar region and scientific gateways, with the objective of advancing the careers of the future generation of a diverse group of science gateway users, gateway developers and polat scientists.

What are some of the common challenges in conducting research in the polar regions? Traditionally, data collected during polar research expeditions could not be extensively analysed until expedition scientists returned to their home labs. Scientists could not evaluate data accuracy and quality until an expedition had ended, and experiments could not be repeated or expanded until returning to the field the following year. Polar Grid helps to improve data quality and reduce the time between data collection and scientific discovery.

How valuable are research experiences, such as the ones discussed here, for aspiring scientists? Polar and CI research and educational experiences are the foundation of the program. The vision for this project is driven by the compelling need to draw on the integration of research and education. Equally important is that it encourages undergraduate students to pursue graduate school in a STEM field. The research experience not only provides valuable knowledge, but also involves undergraduates in collaborative, interdisciplinary teams that might not otherwise experience during their undergraduate education programs. In previous years of executing REU programs, mentor-relationships with technical and scientific research staff, faculty, and graduate students have proven to be an extremely important component of successful REU experiences, and may be the determining factor in whether or not a participant opts to attend graduate school. Training also includes seminars on the code of ethical research; formatting a professional paper; preparing for graduate school; writing a professional statement; resume writing; and designing a research poster.

How has your university and SGGI benefitted from your Poral research? The products of these experiences have resulted in astonishing research and education results. Not only have these experiences benefited the next generation of students in the polar and computer science fields, but so that STEM will become more inclusive and a viable career path for all. The models of engagement for all projects include research training, professional development activities and field work or internships, providing students with a range of skills needed for polar and cyberinfrastructure research while working closely alongside their peers and experienced scientists in those fields. This has kickstarted the careers of hundreds in scientific research, 80% of whom were African American or Native American, and 55% of whom were women, all of which are groups that have been underrepresented in STEM fields. Although the SGGI has only been operating for approximately one year, it is expected that the internships and programs it offers will inspire a wide range of students to pursue STEM as a career path. Such programs are important as, in the past, many talented aspiring scientists have been overlooked, or their careers in STEM discouraged due to their background. Engagement models have made valuable research experiences available and viable for talented and bright minority students, or those of a lower socio-economic status, ultimately encouraging them to remain in STEM and pursue careers in this field.

A VALUABLE EXPERIENCE

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