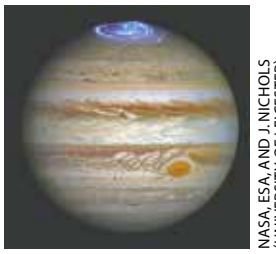
NSTA Member Poll: Should Work Be Assigned During School Breaks? 18

NSTA Reports
National Science Teachers Association



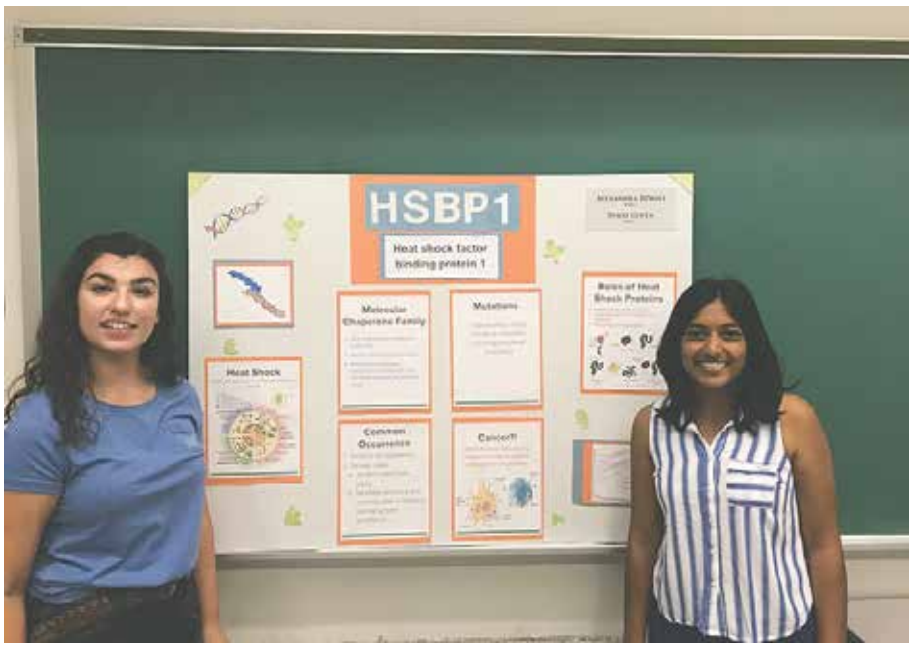
NASA, ESA, AND J. NICHOLS (UNIVERSITY OF LEICESTER)

It's the End of the World, Yet Again 14

CONTENTS

Engaging in Authentic Research

Looking for an opportunity for you and your students to do authentic scientific research? Then programs like Rutgers University's Waksman Student Scholars Program (WSSP) might be for you. "Since 1993, we've been conducting the [WSSP], a year-long program that engages high school teachers and their students in an authentic research project in molecular biology and bioinformatics [the computational analysis of biological data]. Each year, the program begins with a summer institute, then continues back at each school, when additional students contribute to the investigations," explains Sue Coletta, a senior science education specialist with Rutgers University's Waksman Institute of Microbiology in Piscataway, New Jersey.



High school students participating in Rutgers University's Waksman Student Scholars Program spend a year conducting research projects in molecular biology and bioinformatics—the computational analysis of biological data—with their teacher and scientists.

The WSSP began with six schools and 18 students. "Now more than 50 schools and 1,400 students [are participating] this year alone," says WSSP Project Director Andrew Vershon, a professor in the Waksman Institute and Rutgers' Department of Molecular Biology and Biochemistry. The program has "spread beyond New Jersey to other locations: Johns Hopkins University in Baltimore, Maryland, and Lawrence Livermore National Laboratory in Livermore, California," Vershon reports. Schools in those states and in Hawaii and Pennsylvania are also now active in WSSP, doing projects like the 2017–2018 cohort did: "analysis of the mRNA population of *Landoltia punctata*, a duckweed…to determine which genes are expressed in this organism, and how they compared with expressed genes from other species," according to the program's website (*https://wssp.rutgers.edu*).

Typically, schools apply for WSSP. "We get a commitment from the school and the teacher," Vershon notes. "Sometimes the science supervisor identifies a teacher" who would be a good candidate, he adds.

The program begins with a two- to three-week summer institute at Rutgers for the teachers, who each bring with them one or two students. "We go over DNA sequencing, background, experiments, and the rationale [so that teachers] learn how to conduct the experiment," Vershon relates. "They learn how to fit the experiments into their schedules and integrate the program in their setting, how to manage a class of 12 to 24 students to conduct experiments." During their first two years, teachers receive a stipend for the summer program, he adds.

Teachers and students then do the project with other students back at their schools in a classroom setting or in after-school clubs during the academic year. "We [support the teachers by providing] some reagents and loan participating schools the equipment needed to conduct the experiments," explains Vershon. "Some of the equipment is very expensive and not common to high school settings. "

See Research, pg 4

Research, from pg 1

Participating schools are responsible for supplying consumables, such as tubes and pipettes. "We make sure schools are aware of the [monetary] and space commitment and the need for computers [for] computational modeling programs," he relates. "There's a lot of database searching involved, using databases that scientists worldwide use."

Students use molecular biology laboratory protocols to isolate and analyze DNA samples. The samples are sequenced, and students determine whether the sequences are similar to genes from other organisms using online programs. As they carry out the work during the year, "we stay in contact with the students, teachers, and schools. Six follow-up meetings are held during the school year, and teachers can bring up to 10 students [with them] to each meeting," says Vershon.

During these meetings, "teachers can troubleshoot together," and teachers and students "learn what other schools are doing. It's like a graduate student seminar [because students] present [their work] to the group, [have an] exchange of ideas and findings," Vershon points out.

Students who discover new findings have their results published. "The students can actually contribute to science, and the materials they're contributing are available to scientists for their own research," Vershon relates. "Our goal is to have every participating student be able to publish a DNA sequence analysis on the databases that are maintained by the National Center for Biotechnology Information, which is part of the National Institutes of Health." He estimates 90% of students participating in classes are able to publish, while "68% to 70%" of students in after-school clubs have their findings published.

"The year ends with the annual WSSP Forum [Poster Session], when teams present their findings," says Coletta, and "students [get to] see themselves as members of a community of practice," she concludes.

Astronomical Research

For teachers of astronomy, IPAC at the California Institute of Technology (Caltech) has offered the NASA/IPAC Teacher Archive Research Program (or NITARP) since 2009. (IPAC provides infrared data processing and analysis support to NASA's long wavelength observatories.) NITARP partners groups of U.S. educators with mentor astronomers to do year-long research projects using NASA data from space- and ground-based telescopes, says NITARP Director Luisa Rebull, a research scientist for Caltech/IPAC. After the project concludes, participants are asked to provide professional development based on their experiences to colleagues in their school districts.

While ideally, teachers should have some experience using astronomy data in the classroom, Rebull notes that most participants "have never done real scientific research, or even in some cases, worked with real data." To teach the *Next Generation Science Standards* (*NGSS*), she contends, "teachers have to step up their game, do real science with real data and real tools…This is a gap in teacher education."

NITARP is "very popular and highly competitive…We typically have nearly five times as many teachers apply as spaces available," reports Rebull. Applications become available in the spring and are due in late September to allow teachers time to work on them over the summer. (To learn more, visit *https://nitarp.ipac.caltech.edu*.)

Most participants are high school teachers, but teams have included middle level, community college, and informal educators. Teachers can involve their students in NITARP throughout the project. Teachers, students, and scientists collaborate remotely via conference calls and online.

NITARP is unusual because the program funds three trips. Participants attend two January meetings of the American Astronomical Society (AAS), the first in conjunction with an initial NITARP workshop and the other a year later to present their research findings in a science poster session. Educators produce two posters: a scientific poster that educators defend along with the scientists, and an education poster "to jump start their reflection on what they learned and how it will affect their teaching," Rebull explains.

Teachers also visit Caltech in Pasadena, California, in the summer to work on the data with their team. NITARP funds the attendance of teachers and two of their students at the Caltech meeting and the second AAS meeting.

Often teacher alumni raise their own funds to attend additional AAS meetings after their project ends "because it's so much fun that they want to come back and keep learning," Rebull reports.

"NITARP helps teachers tackle a seemingly impossible project," she maintains. "We help them feel comfortable with not knowing everything [at the start]. Scientists are used to [this, so we tell teachers], 'It's okay to [not know everything]: It's part of being a scientist.'" ●