

The Polar-ICE Project: Using Authentic Polar Data to Teach Data Literacy Skills Across a Variety of Grades and Levels

BY JENNIFER SMOLYN AND JACQUELINE KATZ

At Princeton High School, located in Princeton, NJ, we have implemented the *Sci-I Polar-ICE project* at three levels: Biology I In-Class Resource Program (ICRP), Biology I Accelerated, and the Science Research Program (see Hunter-Thomson article for more information on the Sci-I program). It was also used as the basis for a summer science experience for middle school students, focused on building scientific reasoning skills in underrepresented populations. This project allowed students to collaborate with polar scientists, analyzing real-time data (from <https://pal.lternet.edu/data>) as it was generated in Palmer Station, Antarctica. This project was in collaboration with Rutgers University, through a grant funded by the National Science Foundation, and data was collected on students' perceptions of scientists and the scientific process. The unique nature of having real-time, authentic data available to our students and the flexibility to use it, as deemed appropriate, made this project accessible across a variety of grades and class levels.



FIGURE 1. A student from our middle school builds her own glider. Courtesy of Jacqueline Katz

At the freshman Biology ICRP level, the focus of implementation of this project was on the scientific process. This project was carried out over the entirety of the school year, with the students working about once a week on the different components in a co-taught classroom. We began by introducing the project using the *Antarctic Edge* movie and providing background information about a region largely unfamiliar to most of our students. From there, the students began wrestling with vast amounts of data, using the metadata (descriptors of the data collected) as a guide, to see the information available. Next, working in small groups, students developed testable questions and hypotheses based on variables of interest to them. To determine the relationship between these variables, the students created graphs that were incorporated into a scientific poster, which they then presented at an end-of-year symposium to other students working on the project and the scientists who collected the data.



FIGURE 2. Middle school students spend a day with Rutgers scientists at sea, learning about lab techniques used in Antarctica. Courtesy of Eddie Cohen

In freshman Biology I Accelerated, the Sci-I program was also utilized to reinforce the understanding of the scientific process, but the work was concentrated at the beginning of the school year. The steps of the program, including testable question writing, hypothesis generation, data analysis, and graphic creation, were infused throughout the first unit. The first step was to expose students to sample polar datasets to develop the skills necessary to carry out their own scientific study. To maintain student engagement in the project, we invited Dr. Josh Kohut, Polar Researcher, Rutgers University, and Kristin Hunter-Thomson, Polar-ICE coordinator, into our classroom to provide background on the datasets and feedback on the students' final products. Throughout the process, the students were consistently engaged and worked through many of the problems that typically come with big data analysis. The skills and resiliency developed by the Sci-I program in this first unit served the students well throughout the remainder of the year as they conducted future labs and analyzed collected data.

In addition to implementing the Sci-I program with our freshman students, it was also utilized at our school's Research program. This is a three-year experience, to which students must apply and be accepted in order to participate. In the first year, sophomores establish the foundation of key research skills, including reading and writing scientific papers, applying for grants, and analyzing data using statistics. They also experience authentic research in conducting a molecular biology project to identify novel protein sequences in the duckweed plant, a project done through the Waksman Student Scholars Program at Rutgers University. Then, as juniors and seniors, the students design and carry out an independent research project of their choosing, ultimately presenting their work at various competitions and symposia. We have utilized the Sci-I program with sophomores in Research as a way to establish data analysis skills. This was a way to introduce our students to the concept of "big data" and learn important statistical tests for scientific research, including T tests, Chi squared tests, ANOVAs, and regression. Additionally, it provided students with the chance to think about various methods of data presentation and alternative

ways to graph data. After presenting their graphs to their peers, the students were able to provide high quality, specific feedback to one another in order to make their graphs as clear as possible.

Lastly, Princeton Public Schools runs a summer program for middle school students to reinforce the skills of scientific research and cultivate excitement for the sciences in underrepresented demographics. During the first year of this program, the focus was the Sci-I project and Polar research. For three weeks, the students learned about the glider technology used for data collection in Antarctica, developed testable questions, analyzed big data, and generated graphic representations of the data. The data presented at this level was cleaned and organized by the teacher, prior to presenting it to the students, to improve student understanding and avoid excessive frustration. The students simultaneously worked on building a model glider using helium balloons and styrofoam. The experience was complemented by several trips to Rutgers University, where the students were able to ballast and launch a real glider into the Raritan River. The Sci-I project allowed this summer program to meet its goals and exceed expectations of keeping students excited about science, while strengthening their critical thinking skills.

Overall, the Sci-I Polar-ICE project provided our students with an authentic experience in the scientific process and data analysis. Our students were able to use the cross-cutting concepts and science and engineering practices of the Next Generation Science Standards throughout this project, developing essential scientific and critical thinking skills. Because this project was used across such a variety of grade levels and classes, many of the students at Princeton High School benefitted from this rewarding experience at multiple levels.

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