Oceanography for the Visually Impaired

Kate Fraser

A scientific collaboration helps visually impaired students explore oceanography firsthand

Amy Bower is a physical oceanographer and senior scientist at the Woods Hole Oceanographic Institution (WHOI) in Woods Hole, Massachusetts—she has also been legally blind for 14 years. Through her partnership with the Perkins School for the Blind in Watertown, Massachusetts, the oldest K–12 school for the visually impaired in the United States, students have the unique opportunity to learn from a practicing research scientist who shares their particular disability.

This article describes the project, called OceanInsight, which provides visually impaired students with an interactive way to study oceanography, including field trips to Woods Hole and school visits by Bower and other WHOI scientists (see "OceanInsight background"). As a Perkins middle and high school science teacher involved in OceanInsight, I was able to join Bower on a research expedition to the Labrador Sea, which lies between Canada and

Greenland. With the help of technology, my students at Perkins communicated with us while we were on the ship. We continue to follow Bower's research on the project's website (see "On the web" at the end of this article), and my students participate in corresponding classroom projects.

Field trips to Woods Hole

In the first year of the OceanInsight partnership, which began in the fall of 2006, Woods Hole welcomed our students into their community and provided them with hands-on experience in oceanography. At the WHOI exhibit center, students handled whale bones usually covered by display cases and examined small sea creatures with aquarium staff. They marveled at a Styrofoam cup that had shrunk to the size of a thimble from the pressure in the ocean depths and listened to the sounds of dolphins and whales. Students also got to sit in a model of the deep-ocean research submersible Alvin.

In the research labs, students examined equipment that was under construction by the project's engineers, including profiling floats, which are 1.5 m tubes containing sensors that measure ocean temperature and salinity, and current meters that measure and record the speed and direction of the ocean water. This equipment would be used to collect data on Bower's research expedition to study the Irminger Rings, a group of eddies in the Labrador Sea (see "More on Irminger Rings," p. 32).

During these field trips, our students also had the opportunity to explore the *R/V Knorr*—the same research vessel I would later sail on with Bower and her crew. After climbing the steep stairs between the decks and visiting the scientists' sleeping quarters, students ate bag lunches in the mess hall. In the ship's lab areas, students checked out the lab tables with raised edges, similar to a very large cafeteria tray, that were designed to keep equipment from slipping off while on the high seas. Then, the group moved onto the stern, where large cranes were moving equipment on and off the ship, and examined the chains used to fasten equipment to the deck and to moor the ship in the harbor.

The *R/V Knorr* is a typical research vessel. While aboard, Bower uses a white mobility cane to give her information as she moves about, just as our students did on this visit. A person who is blind can detect doorways, drop-offs, stairs, and turns using a mobility cane. Special accommodations on this ship would include letting a visually impaired person know if a piece of equipment is being moved and storing equipment in an organized, predictable way (which scientists like to do anyway!).

Scientists in the classroom

During several visits to Perkins in the fall of 2006, Bower met with introductory high school physics and chemistry classes (grades 9–11), as well as middle school science classes. These visits occurred just a few weeks after the students' first field trip to WHOI. Bower described her field and office work at Woods Hole to students and introduced them to the basic principles of her research and her September 2007 expedition to study the Irminger Rings in the Labrador Sea. In her research, Bower is us-

OceanInsight background.

The OceanInsight collaboration started with a grant application. Amy Bower, oceanographer and research scientist at WHOI, created an outreach project as part of a grant request to the National Science Foundation (NSF). Bower proposed that students at Perkins School for the Blind be a part of her latest research project studying the Irminger Rings—eddies in the Labrador Sea. The NSF reviewers loved the idea, giving the proposal high ratings, both on its scientific merit and the outreach component.

Bower asked the president of Perkins to write a letter in support of her grant application. The president's letter reflected the school's excitement about developing a relationship with Bower, and when the grant was approved, Perkins secondary program science teachers met with her to chart the relationship between them. Together, they decided the project would include student field trips to Woods Hole, visits by Bower and other WHOI scientists to the school, creation of curriculum for teaching physical oceanography, development of a website, and teacher participation on a research voyage.

PHOTO COURTESY OF LEN RUBENSTEIN

Student (right) uses a tactile map in an introductory physics class to locate Europe before finding Greenland, the destination of the *R/V Knorr*.

ing newly designed technology to measure temperature and currents to detect eddies breaking off from the Labrador Current. The technology is part of a large mooring installation containing profiling floats that are released into the heart of the eddies (the Irminger Rings). These floats have the capacity to adjust their buoyancy and come to the surface to send data to the scientists at Woods Hole via satellite. Through her research, Bower hopes to find out what happens to the warm eddies of water in the cold center of the Labrador Sea.

As Bower explained her research expedition, students learned how working scientists use skills such as measuring temperature and density, recording data, and making graphs, which made science labs become more meaningful to students. During her visits, students frequently asked Bower to share how she used adaptive equipment designed for the visually impaired to facilitate her job (see "Special tools"). Bower demonstrated the software program called Job Access with Speech (JAWS), a screen reader that tells a visually impaired person what is on the computer screen. This delighted students, as many of them had used JAWS for many years to read assignments and do homework. While meeting with the high school physics class, Amy and the students used their laptops to locate information on buoyancy experiments to illustrate the way a profiling float's air bladder raises and lowers it to various depths in the Labrador Sea. Although neither Amy nor the students could see the information, they navigated their way through it with the use of the JAWS, as the program read aloud all the information on the screen.

Students also attended a presentation Bower made at Boston's Museum of Science, in which she shared information about her research in the Labrador Sea and demonstrated how she uses adaptive technology, such as computer screen readers, in entering and accessing data used in her work.

Special tools.

Video magnifier

Since Bower still has some sight, she can use what is called a video magnifier, or closed-circuit television. It has a large screen and a camera that shows anything on a piece of paper at a larger size so that she is able to see. She has one at work for looking at important papers and pictures of her data. She also has two at home—one for paying bills and looking at photographs, and another in the kitchen for reading recipes.

Screen magnifier

Bower's vision is not good enough to see a regular computer screen, so she uses a special computer program that makes everything on the screen bigger and changes the colors around to make them easier to see. She has been using this screen magnifier for about 10 years, which has facilitated her ability to do her job. The magnifier allows her to see the latitude and longitude lines and parts of maps of the sea.

Screen reader

When the screen magnifier does not do the trick, Bower uses a screen reader on her computer. This is a computer program that enables the computer to "read aloud" or "speak" words that appear on the monitor. She uses this program to read e-mails and find information for research on the internet. The screen reader also reads everything she types, so she uses it to write reports and e-mails. Screen readers are also used by people who have no sight at all, which has really opened up the whole world of computers and the internet to visually impaired people.

Scanner/reader

Another tool Bower just started using is one that combines a video magnifier and a screen reader. It consists of a small portable camera and some computer software. The camera takes a picture of anything put under it, and a few seconds later, the text or pictures appear on the computer screen and a voice begins to read it aloud.

(**Note:** Information adapted from the "Cool tools" section of the OceanInsight website.)

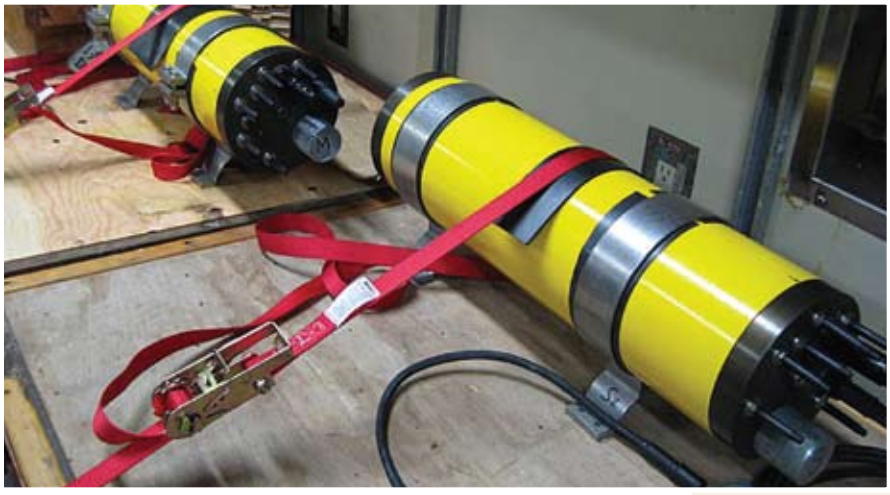

PHOTO COURTESY OF THE AUTHOR

As part of the mooring installation, computers will signal a release into the Labrador Sea in 2009.

Student participation and assessment

As the first year of the collaboration drew to a close, students grew more excited about Bower's research cruise (which departed in September 2007). In response to their excitement, the teaching staff at Perkins arranged for students to participate in their own educational cruise in Woods Hole Harbor. This experience allowed the high school physics and chemistry students to test the experiments they had designed for the science team on the *R/V Knorr* to carry out as they traveled toward the Irminger Rings. Students sailed on the *Ocean Quest,* a moving vessel that conducts educational cruises in Woods Hole Harbor for students and families. Since the program offers all hands-on activities, few accommodations were needed for our students beyond the precautions given to other visitors—to follow directions and keep hands inside the boat. In addition, the staff tied knots for every meter in the rope used for depth-finding and collecting water samples. As it rained hard during the trip, students also got a taste of the less appealing aspects of life as an oceanographer at sea.

One of the student-designed experiments for the team on the *R/V Knorr* was comparing the density of the water in Woods Hole Harbor to the density of the water in the Labrador Sea at a given latitude and longitude and depth. Students' hypothesis was that the water in the Labrador Sea would be denser because the water is colder there. Students also predicted that the salinity of the water in the Labrador Sea would be lower than the salinity of the water in Woods Hole Harbor because the melting of the icebergs may have added fresh water. (**Note:** In fact, students later learned that the salinity of the water in the Labrador Sea was greater because of the lack of coastal influx of fresh water.) Students were graded on their work, which included a laboratory report.

Teacher onboard

When it came time for the research cruise to depart in September, I joined Bower's team aboard the *R/V Knorr,* a 91 m ship best known for its role in locating the wreckage of the *Titanic*. This research cruise finally deployed Bower's equipment into the Labrador Sea and began the data collection needed to study the formation, life, and travels of the Irminger Rings. While at sea for 10 days, Bower and I created audio postcards featuring highlights of the trip. Using an iPod with an iTalk attachment, we spent part of each day interviewing crew members and the scientific team. By listening to these recorded messages, students could hear, for example, the sounds of the engine room and an interview with the captain. In addition, satellite phone calls connected us, while still at sea, to the classrooms back at Perkins. The diverse conversations included discussions of the latest research, such as the salinity samples being collected that day or their results, and the lunch menu on the ship. (**Note:** These conversations can be found on the OceanInsight website.)

Despite coping with seasickness and 6 m seas, I did

PHOTO COURTESY OF THE AUTHOR

A Perkins student checks out a model of the *Alvin* at the Woods Hole Exhibit Center.

How to get involved.

Teachers and students across the country are welcome to join in the OceanInsight collaboration. To get involved, students and teachers can e-mail Bower from the "Ask Amy" link on the OceanInsight website. To learn more about the OceanInsight project, students and teachers can view and follow Bower's work through the OceanInsight website. In addition, secondary schools can use this project as a model to start collaboration with a research facility near their own schools.

(**Note:** Interested teachers can also learn more by attending the presentation "Accessible Science: Collaborations with the Scientific Community" at the NSTA National Conference on Science Education in Boston [March 27–30, 2008].)

gain a greater understanding of data collection, salinity, temperature, density, and computer graphing. I also learned about the tools Bower uses to help her do her job, including the use of magnifying and voice output software (see "Special tools," p. 30). She also made other small accommodations, such as marking her coffee cup with an elastic band, to help her be a part of life on the ship.

PHOTO COURTESY OF THE AUTHOR

Satellite phone calls connected Fraser (left) and Bower (right) to Perkins students.

Life after *Knorr*

After my time at sea, I returned to my life as a classroom teacher. However, the relationship still continues with Bower and WHOI—there will be additional student field trips to Woods Hole and more scientist visits to Perkins. As the instruments in the Labrador Sea send back data, students record the information and plot the travel of the floats by longitude and latitude. Perkins students also have the ability to ask Bower questions and receive answers via the project's website, which provides many ways for them to be involved. Bower's written descriptions of her research create word pictures for the students. The site also offers audio of Bower introducing herself and describing her work. During classes, students often e-mail her with questions about her project and about physics.

Now that the floats have begun to collect data, the students are eager to learn more about how the air bladders inside adjust the depth of the floats. In the classroom, students have experimented with balloons to model the inflation and deflation of the bladders. In a recent meeting with students, Bower described how one of the floats is heading north toward the Artic ice, rather than remaining contained in a well-formed eddy. She asked the students to brainstorm possible solutions for helping the float avoid damage by the Artic ice. Students' suggestions included sending a message via satellite to the float to stay on the ocean bottom until spring, or attempting to adjust the float's buoyancy to land in a current heading south.

As a final part of the project, Bower will advise us in developing a physical oceanography unit as part of the introductory physics course taught in ninth grade, which will be a great way to introduce students to lab skills and basic physics concepts.

Conclusion

As stated on the OceanInsight project's website, the goal is to communicate to visually impaired students the importance of understanding how the Earth works, to instill the excitement of oceanographic research, and to introduce them to careers in the geosciences that they might not have otherwise considered as accessible to them. In this respect, Bower has served as a role model for Perkins students. She has conveyed to them her belief that if you find something you love to do, you can overcome any obstacle. ■

More on Irminger Rings.

Bower descibes her research on the OceanInsight website:

"We want to find out more about the currents of warmer and cooler water in the Labrador Sea. In one specific area, a current of slightly warmer water flows around the outer edge of the sea without mixing into the cold water in the center of the sea—a little like a warm breeze flowing past a cool, quiet, shady courtyard but not coming in. Once in a while, though, a bit of the current breaks away from the main flow and carries a blob of spinning, warmer water into the center of the sea—a little like a stray swirl of wind coming into the courtyard. These are called 'Irminger Rings.' What happens to warm eddies in the cold center of the Labrador Sea? Where do they go? Do they fall apart? Do they stay warm for a long time? That is what we are going to find out using the measuring and recording instruments we will put into the Labrador Sea on this expedition."

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On the web

WHOI OceanInsight: *www.whoi.edu/projects/oceaninsight*