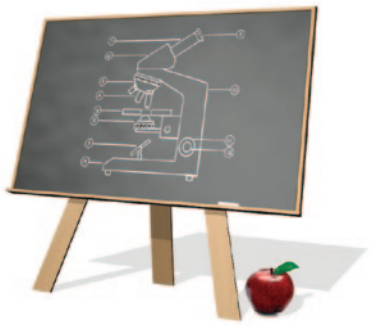
Discovery on Wheels: the Biobus



Emily Elert
Independent science writer, former New York City science teacher, and an occasional volunteer on the Biobus.

emily.elert@gmail.com

The night before I'm scheduled to volunteer on the Biobus, Dr. Ben Dubin-Thaler—the bus's owner and educational director—calls to give me directions: Take the 5 train to the Bronx, get off at the second-to-last stop. Make two rights and then a left on Baychester Avenue. Walk to John Philip Sousa Middle School. "We'll be parked out front," Dubin-Thaler tells me. I hesitate, imagining picking my way through a sea of frenzied children and identical school buses. "You'll see us," says Dubin-Thaler.

The next morning, turning onto Baychester Avenue, I discover that the Biobus is, in fact, impossible to miss. Painted in bright blues and yellows, the vehicle stands out from its gray-brown winter surroundings like a colored horse in *The Wizard of Oz*. It has the bubbly, cartoonish look of the 1970s. Above the roof, a front-mounted turbine spins in the wind.

When I reach the bus, the mechanical doors slide open with a mechanical hiss, and Dubin-Thaler grins down at me. "Come on in! Welcome to the Biobus!" he says (Figure 1). Onboard, Dubin-Thaler rubs his hands together and smiles again. He's wearing a stocking cap, fleece jacket, hiking boots, and looks ready for a field trip, which, I realize, is appropriate: the Biobus is essentially a portable field trip, a mobile microscopy lab that brings the fun side of cell biology to students and schools all over New York City.

Today's students are scheduled to arrive in just a few minutes, and I watch as Dubin-Thaler and his assistant, Ric, set up the lab. Dubin-Thaler starts a fire in the woodstove and then turns his attention to two microscopes, which he lifts off the floor, plugs in, and attaches to a video monitor and a camera. As he works, Dubin-Thaler shows me the highlights of each microscope: We can make time-lapse videos of yeast cells moving and reproducing on the phase contrast microscope. The other one—a fluorescence microscope—lets us peek in at the DNA and cell skeleton in a sample of neuron cells (Figure 2).

This is research-grade equipment, stuff you wouldn't see in most high school lab classrooms. This is especially significant for the Biobus because half of the students Dubin-Thaler serves attend poorly performing schools in low-income communities. Some schools have no science lab materials at all, and for those that do, large class sizes often limit their use to rote, "cookie-cutter" experiments. Part of the Biobus's mission is to bring real science to students who would otherwise miss out entirely. "There are millions of students who have access to first rate science education," Dubin-Thaler says, "but there are millions more who do not. With the BioBus we are leveling the playing field between the 'haves' and the 'have-nots.'"

In the back room of the bus, Ric sets up the computer lab, lifting monitors onto a table and plugging in parts. As he works, Ric explains that all of the bus's electrical needs are met with eight golf-cart batteries, which are charged by two sources: the solar panels on the roof and the wind turbine. Dubin-Thaler leans over and checks a small monitor under the microscopes. "You wouldn't expect this on a day like today, but we're actually getting great solar right now."

The first group of students arrives just as Dubin-Thaler picks up a vial containing sugar, water, yeast, and bacteria—the sample we are to use today. It's frozen solid. Without missing

Figure 1: The Biobus in New York City.

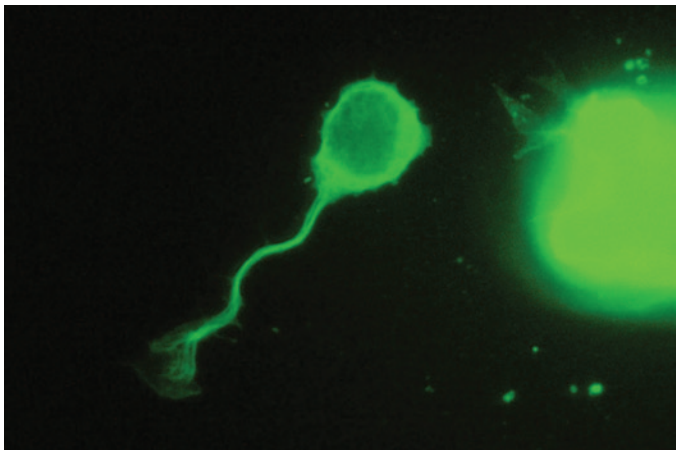


Figure 2: Microscopes on the Biobus produce high-quality images like this fluorescence image taken on an Olympus DP12.

https://doi.org/10.1017/S1551929511000447 Published online by Cambridge University Press

a beat, Dubin-Thaler welcomes the students, a group of six eighth-graders, to the Biobus. He then holds up the frozen yeast sample and explains that it was left onboard overnight, which leads the students into a discussion about what happens to water when it freezes (Figure 3).

"So, what do you think?" Dr. Dubin-Thaler asks. "The yeast and bacteria have been frozen. Do you think they'll still be alive?" The students raise their hands for yes, no, or undecided, and Ben encourages them to develop their hypotheses using what they know about bacteria and yeast. One student suggests that, because bacteria can still be alive in hamburger meat after it has been frozen, the bacteria in our sample may still be alive, too.

With a few drops of thawed sample (Dubin-Thaler has been rubbing the vial between his hands while the kids talk), he shows the students how to prepare a slide and gives a quick tutorial on the microscope. Then it's time to test the frozen hamburger hypothesis.

Impromptu investigations like this—what educators call "teachable moments"—have been a part of the Biobus since day one, in the spring of 2008. Dubin-Thaler had prepared a lesson on cell motion, and the students were looking at sample of goldfish scales under the microscope when they noticed something "huge" flapping around. It was a parasitic nematode; the students named it "Two-Lips."

"The thing about microscopes is that you never know exactly what you're going to see," Dubin-Thaler says. "When things come up, we say, 'this is unexpected, but what can we do to look at it and find out what's going on here? How are parasites related to other organisms?'"

When I visit the bus again, in spring, the students are looking at samples collected from a nearby puddle. Suddenly, a bee flies in through the open doors. Two minutes later, in a quick transformation from disruption to specimen, the bee is caught in a clamp on a dissection microscope—the bus's newest donation. The message is clear: the world is interesting and perplexing, and the closer you look, the more interesting and perplexing it gets.

Dubin-Thaler bought the bus with his own funds in the spring of 2007, a couple of months after finishing his Ph.D. in biology at Columbia University. The idea for a mobile microscopy lab had come to Dubin-Thaler a few years earlier during a cross-country bus tour with a group of friends. "We were driving somewhere between Santa Cruz and San Francisco on a bus just like this—actually, it was this same bus—same make and model." The bus is the 1974 GM "Fishbowl," the model featured in the movie *Speed*. "My friend was sitting next to me and she was musing about how the bus would make a great bookmobile. Being a biology grad student, all I thought about was microscopes, and I thought 'it could make a great library, but it could also make a great lab.'"

Figure 3: Inside the Biobus with Dr. Ben.

Dubin-Thaler spent his first summer with the bus at the Flower Shop, an artists' compound in San Francisco, where friends helped him build a lab and convert the engine to run on vegetable oil. The Flower Shop was a bare-bones operation; its members worked to minimize consumption and make use of all available materials, and the Biobus was renovated in this same spirit. "The bus retains a lot of the for-better-or-worse qualities of the Flower Shop," Dubin-Thaler notes. "It's 85–90% recycled materials, which is great, but at the same time it's a little grimy—it's not slick and sleek, not laminated or shiny."

It may not be fancy, but that doesn't seem to dull its appeal to students. When I catch up with some students to ask them what they thought of the Biobus, one freshman boy tells me, "If my science class was this fun, I would come to school every day!" Another student says, "I've never thought about being a scientist before, but this is so cool!" The feedback Dubin-Thaler has received from student surveys has also been encouraging. On a scale of 1 to 5, students were asked to rate their interest in pursuing science as a career. Before going on the bus, the average score was three. When asked the same question after their trip to the Biobus, students rated their interest at an average of 4.5.

"That's a short timescale," says Dubin-Thaler. "Minutes after getting off the bus, they're really interested in becoming scientists. The question is, is that a long-term impact? And I think it is for some students."

Indeed, demand for the Biobus and "Dr. Ben," as the students know him, appears to outweigh supply (Figure 4). The Biobus is booked through next fall with visits to schools, libraries, festivals, and museums—it will even make an appearance at the Six Flags amusement park later in the year. At virtually every school he visits, students and teachers ask the same question: When will you come back? As the students depart, I hear Dubin-Thaler say, "Unfortunately there are over a million of you and just one Biobus."

That may not be true for long. The Biobus now has two full-time staff members, and Dubin-Thaler hopes to add another bus to his organization. This spring, Dubin-Thaler's colleague, Sarah, is teaching a nine-week course on *C. elegans* to a group of middle-schoolers. "We're hoping that the worm model will become the basis for another bus, which will be 100% focused on that organism," says Dubin-Thaler. The worm bus would be devoted to more in-depth, longer-term courses—courses that could offer students a glimpse of the scientific life. "Our goal is to show students what's beyond—what kinds of things they'd be able to do in college or grad school. To really light that fire underneath them."

All of the instruments on board have come by way of donation (together, the microscopes are worth much more than the bus itself), and operation of the Biobus relies heavily on the volunteer teaching efforts of more than 100 scientists. "What we

Figure 4: Ixe on the Biobus at Earth Fair 2009.

need most right now," Dubin-Thaler says, "is money." Financial donations are critical to sustaining Dubin-Thaler's non-profit organization; they allow the Biobus to visit schools that can't afford to pay, the schools the Biobus was built to serve. "Poor grad students and post-docs should come volunteer in lieu of a donation," Dubin-Thaler says.

There are other ways for scientists to get involved, too. Dubin-Thaler's newest project, called Microglobalscope, is an online forum designed to start a dialogue between students and scientists all over the world. To get that dialogue going, Microglobalscope sent science kits—digital cameras, collecting equipment, and microscopes—to ten schools around the world and began issuing challenges. "We'll say, 'Okay, this week, go out and get all the bugs you can find,'" Dubin-Thaler says, "and the kids in Australia will go out and get bugs from Australia, and the kids in China will go out and get bugs from China, and the kids in Hawaii will go out and get bugs from Hawaii . . ." The students post their findings on the online blog, and scientists can log on and post comments. "We really need scientists who are interested in being a part of that online forum," Dubin-Thaler says. "We want to change the way that students and scientists see each other."

You can find both projects on the web. Go to http://biobus.org for information about donating and volunteering. To find out how you can get involved with Microglobalscope, go to http://microglobalscope.com.

MT