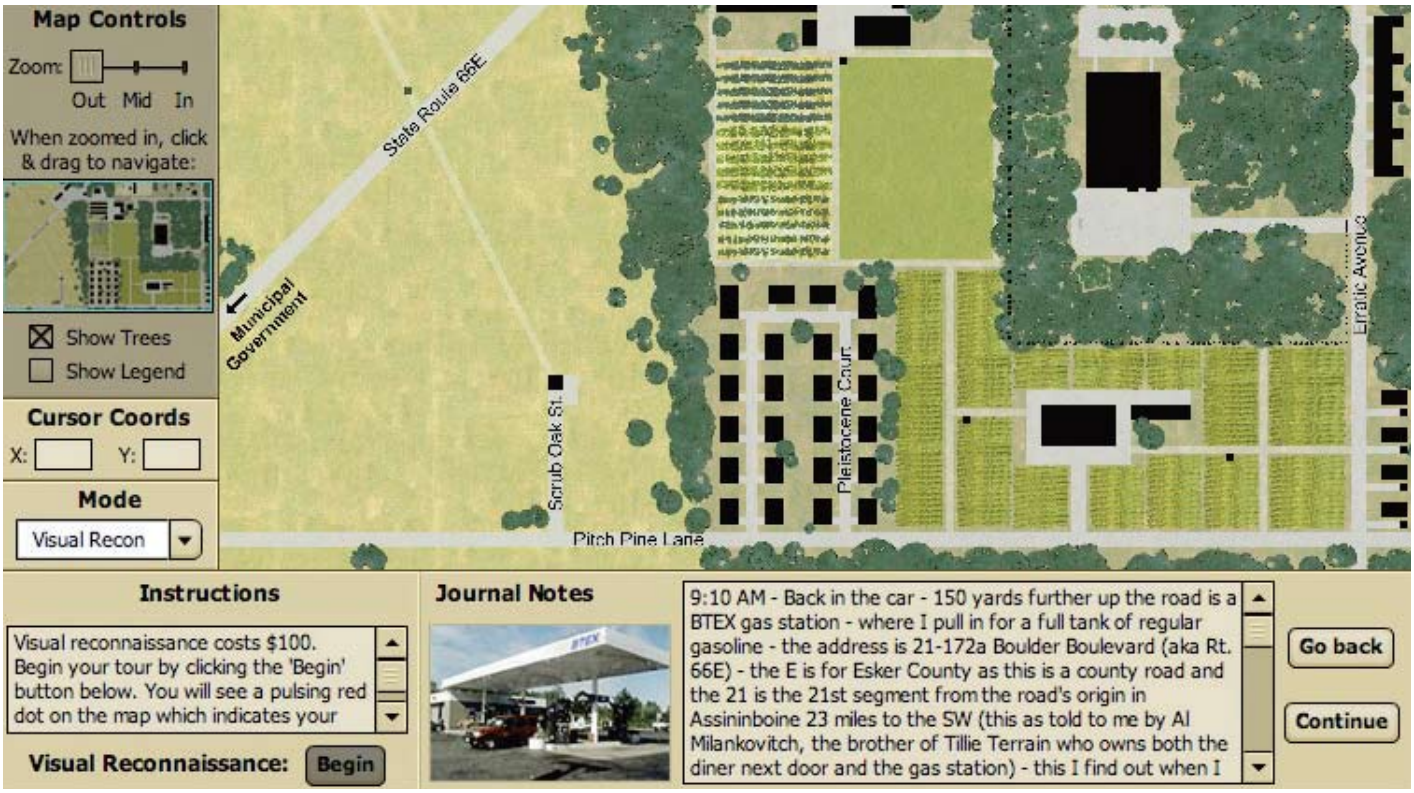
by Wesley Yang

Image courtesy of Peter Bower



A screen shot from a portion of Brownfield Action.

CLEAN UP ACT

Turning students into environmental consultants, Brownfield Action offers a firsthand experience into the complexity, ambiguity, and risk involved in environmental site assessments.

In an unassuming but forthright way, senior lecturer Peter Bower, who has taught an introduction to environmental science course at Barnard for more than two decades, is a determined enemy of the status quo. Eight years ago, Bower worked with technologist Ryan Kelsey of Columbia University's Center for New Media Teaching and Learning (CCNMTL) to create a computer simulation—called Brownfield Action—that models the complexity, uncertainty, and impact of real-life practices on the environment. The first major undertaking of the center, the program went on to win wide acclaim and it was named a "model course" by the Association of American Colleges and Universities in 2003. With the aid of a $450,000 grant from the National Science Foundation, it is now poised to spread to classrooms around the country.

"The traditional lab-science curriculum is what I call 'cookbook,'" explains Bower from his office in Altschul Hall. "That is, if you do the assignments and follow the instructions, you know that within three hours you should be able to do what you need to and come to a conclusion." The pattern remains the same with the traditional lecture portion of a course. Students absorb information presented in class or cram it in order to pass the exam.

Such habits are totally at odds with the way science works in the real world. Outside the classroom, choices have to be made when investigating questions without the aid of a road map. The questions and answers are tied to very real consequences. For example, polluted groundwater can be sickening or even deadly; the character and safety of a community may hang in the balance; millions of dollars could be at stake.

The students enrolled in the semester-long course built around Brownfield Action are paired up into environmental consulting firms hired by a developer to search for contamination on an abandoned factory site. They explore a parcel of land modeled in three dimensions with more than two million pieces of information, including topography, water tables, soil composition, and contamination plumes. The land is a part of a virtual town populated by 50 residents with a newspaper, a television station, and a municipal building housing the city's health, water, and sanitation departments.

The consulting firms hunt for clues to the site's condition in municipal records, news accounts, interviews with government officials and residents, and through visual inspection of various parts of the town. The investigators then deploy tools

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SYLLABUS: ENVIRONMENTAL SCIENCE

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to test the site's bedrock, groundwater, and soil. Everything they do costs money drawn from a budget of $60,000 per team. There's a reality embedded in those two million data points that everyone is searching for, but there are as many ways to go about discovering that reality as there are teams engaged in the search.

"I have to tell students upfront," says Bower, "that if you're experiencing ambiguity or stress as a result of this—well, that's right, that's what we intended."

During lectures, Bower provides his students with everything they'll need in order to master the complex fictional world of the simulation. He lectures on basic chemistry, nuclear chemistry, water tables, geology, and toxins—the full array of topics taught in more traditional environmental science courses—working without a textbook. He relies instead on *A Civil Action*, Jonathan Harr's nonfiction account of a groundbreaking environmental lawsuit, to introduce students to the vocabulary of the field and the human stakes of the work done by environmental scientists. He also lectures on civics (Bower was once the mayor of Teaneck, N.J.), economics, and legal terms. Students' final reports reflect a range of skills directly applicable to the real world. "The students have to unlearn [typical] academic behavior," notes Bower. In order to keep up with the simulation, they must work and remain engaged all the way through the course.

Ryan Kelsey, associate director of education research at the Center for New Media, which has designed computer simulations for economics and humanitarian aid courses, focused on Brownfield Action in his dissertation. Through a series of interviews held throughout one semester, Kelsey followed a group of students as they dealt with the site's challenges. He was struck by the different ways in which the students, drawn from various classes and majors, found value in the experience. "It became quite obvious that this is a powerful thing," he says.

The program has created great demand from teachers interested in adopting the program. It's being used for both introductory courses and upper-level hydrology classes at Georgia College & State University, Lafayette College, and Connecticut College. But because the program was written in a now defunct computer language and hosted on an Internet server with limited capacity, Bower had to turn away many of those interested teachers. The National Science Foundation grant, awarded in February, has financed a complete rewriting and upgrade of the program and its user interface, as well its re-installation on a server large enough to handle virtually unlimited use of the program. (The expansion was unveiled at a mini-conference held at Barnard in mid-August.) It opens the way for an expansive future for Brownfield Action, which Bower intends to share freely. He foresees the program eventually being adopted and used in creative ways not just by other professors but also by professional training programs, government, and community groups. And he expects it to serve as a resource and model for experiments in teaching designed to convey the skills most relevant to students entering the workforce.

Brownfield Action teaches the single most important skill a college student can acquire in a way that traditional curricula overlook, Bower says. It forces students to develop what he calls "self-renewing intellectual resourcefulness"—the ability to confront ambiguous situations and learn from them. Today's flexible workforce calls on employees to skip from job to job, orient themselves quickly to new surroundings, collaborate easily with others, and discover the resources to tackle a shifting set of problems. "You need to be able to reform yourself continuously," says Bower. "And education should be preparing students for that by giving them real-world problems that don't have one single pathway to the answer."

THE SALON: NATALIE ANGIER

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knew what we were looking for. I don't think we compete with each other: He's more of a news person, keeping up with current events and policy, and I just like the weird and offbeat stories that I do." In the past year, for example, her subjects have ranged from springtime's nitrogenous odors to rat personalities to seeing red, literally.

But if Angier's oeuvre and writing voice has its share of whimsy, her intent with *The Canon* is completely serious. She wrote the book not just as a "whirligig tour" but as a direct response to what she sees as the critical decline in Americans' scientific literacy. Not only does she consider it a threat to the United States' technological and economic primacy, but also a sociopolitical concern, especially when hype and opinion spread faster than fact through pop culture and media. "What I'm trying to accomplish is to train people's way of thinking, to get them to appreciate the grand enterprise of understanding the universe, and this is the power of science," she says. "A lot of anecdote does not equal evidence; we need to get people thinking quantitatively and analytically so that they're not bamboozled. Once you see probability shake out, you tend not to be as impressed by coincidence or risk, and that gives you the opportunity not to be cheated or made hysterical.... So we need to see science as utterly indispensable. If you don't have that, your country's sunk. Our future depends on loving science."

BRIDGING THE GENDER GAP

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engineering departments. The results have been revealing: "There are too many departments where women represent less than 15 percent of the faculty, and ultimately those departments are suffering," says Chapman. "According to our statistical analysis, where there are more women on the faculty, mentoring programs work better, students are better supported, and faculty are better supported."

With Chapman on the case, that scenario will continue to improve, both at Barnard and nationally.