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## Lab Consumer

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## Hands-On Power

The next-best thing since paper, personal digital assistants are transforming science, medicine, and education | **By Mike May**

Courtesy of Mike Curtis



**⚙️ TAG, YOU'RE SICK!** School children learn about communicable diseases with handheld computers and a program called Cooties.

In the 1830s, Charles Darwin used a pen and paper to document finches and other fauna and flora in the Galápagos Islands. For the next century and a half, most scientists relied on the same tools to take notes or collect data. Today, [Dave Anderson, associate professor of biology at Wake Forest University](#), follows in Darwin's footsteps--walking the Galápagos coast, searching for albatrosses and Nazca boobies. Instead of using a pen, however, he collects data with a personal digital assistant (PDA). He's not the only one: Handheld devices now appear in science classrooms, experimental laboratories, and medical settings. These minicomputers have the potential to push science ahead at a faster pace and with more accurate results.

For the most part, anything that a scientist does on paper can be done on a handheld device. Just an ordinary Palm or Pocket PC, along with some specialized software, can perform scientific feats, as well as typical handheld tasks. Researchers can program a PDA or electronic tablet with a form for collecting data. Several manufacturers also make add-on probes enabling handheld devices to collect data such as temperature or location using a global positioning system. Perhaps most importantly, data flow easily from a handheld device to a personal computer for storage or analysis. Downloading saves time and

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eliminates errors that crop up when keying in data by hand. Like all computers, though, handhelds rely on software, and the options for programs remain limited. Many scientists write their own.

**AN OUTSIDE ADVANTAGE** Dave Anderson started taking handhelds to the field five years ago. Each year, he completes a census of Nazca boobies in the Galápagos. Before the advent of PDAs, Anderson and his team wrote down a number from a band on each bird's leg, and Anderson says, "Sometimes, we'd transcribe a number wrong to a file, so you had to do the whole thing twice to check for errors." Some studies, he says, required three to four person-months to enter data. Now, using Symbol PDAs, the band numbers go from PDA to PC with the click of a key.

Anderson lets the handheld show him data as he works. "The PDA can give you a report," Anderson says. "You enter a band number and can see a file on that bird. It helps us make connections between data sets that we might have missed." Sometimes, the bird reports just save time. For example, Anderson and his colleagues can easily figure out the sex of a bird by accessing its file, rather than examining it manually.

Anyone who ever worked in the field, though, knows that instruments have to be able to take a beating. Before switching to PDAs, Anderson needed proof of their durability. "I watched somebody bang one on a table 10 times and then throw it against a wall," he says, "and it was okay after that." That's not to say problems don't occasionally happen. "PDAs break down sometimes," Anderson says, "and you lose data." Nonetheless, handheld devices can be designed with a wireless backup system to protect data collected in the field.

Even when a handheld performs flawlessly, it may not be enough. "It's not the solution to everything," Anderson points out. "It's good for some targeted uses, but I want flexibility in how I enter some data. With a PDA, you need to anticipate the categories of data. If you can't anticipate that well, then you need to just write down the data."

**PDAS IN THE PARK** Jane Swanson, a research associate for the Protected Area Social Research Unit at the University of Washington, can anticipate one thing every year: The US national parks will draw large crowds. What Swanson and her colleagues do not know is exactly who will come to a given park and how they will enjoy it. To find out, Swanson and her colleagues poll park visitors.

In the "old days," back in 1995, Swanson talked to guests at Mt. Ranier National Park in Washington about overcrowding. That study involved several surveys, each with more than 800 visitors, spawning a pile of paperwork and lots of data to type into a PC. Swanson knew that there had to be a better way to collect those data, and she turned to an NEC handheld device called the Mobile Pro 770, which comes with a keyboard and a touch screen. Now, Swanson and her colleagues carry electronic forms that can be filled out in the field--big fields, including Kenai Fjords National Park and Alagnak Wild River, both in Alaska. Swanson says, "We use our handhelds in the field to administer contact

interviews and then electronically send that information from the field via a laptop to our office at the University of Washington."

Other scientists are bringing their PDAs outdoors to study skyrocketing algae populations in various bodies of water. Some algae species produce toxins that can harm fish and even humans, so researchers need a way to quickly and accurately identify algae types. Linda Medlin and her colleagues at the Alfred Wegener Institute in Bremerhaven, Germany, turned to a handheld "early warning system" as a solution.

Medlin's team adapted a glucose sensor made by Inventus Biotech to create their device, replacing the glucose-reading chip with a DNA chip that can detect ribosomal RNA. So far, Medlin's device can detect three species of toxic algae. In addition, it gives an accurate measurement of the number of algae in a sample, even at concentrations as low as 60 cells per liter, which is less than the level that forces closure of mussel beds by the European Union.

**AN EDUCATIONAL EDGE** In addition to helping scientists collect and handle data, handheld devices could help educate the next generation of scientists. "With 55 million K-12 school kids," says Elliot Soloway, codirector of the University of Michigan's Center for Highly Interactive Computing in Education, "We'll never have enough money to buy them all a laptop or desktop computer. But, we could get a handheld for all of them tomorrow."

To make handhelds useful in classes, Soloway and his colleagues develop programs. For instance, a program called Cooties helps eighth-grade students study communicable diseases. Students run around a classroom with PDAs, firing infrared messages that represent viruses from one PDA port to another. "This gives students an enjoyable way to learn how diseases are spread," says Soloway.

Handhelds also educate physicians. Developers have packed entire medical textbooks and drug guides into PDAs. Other programs calculate drug doses or track a patient's treatment and progress. Paul G. Auwaerter, associate professor of medicine at Johns Hopkins University School of Medicine, says he believes handhelds will improve medical care by granting doctors quick access to important information. Auwaerter is also the managing editor for the ABX Guide, an antibiotic treatment database that can be used on a variety of handheld devices. "We already have published some abstracts," Auwaerter says, "that document improvement in physicians' knowledge base and medical care with use of our guides on handhelds." He adds, "I think these sorts of applications will soon become as commonplace as the physician's stethoscope."

Handheld devices also can track clinical trials. Ann Boris, chief technical architect and a scientist at Numoda, says that she and her colleagues use handsets in everything from Phase 1 to Phase 4 clinical trials. Moreover, Numoda's researchers can design a clinical trial that gives a handheld device to everyone involved: investigators, study coordinators, patients, and scientists in the clinical labs. Whether

Numoda uses PDAs or electronic tablets "depends on the complexity of the work that's being done and the complexity of the view," Boris says. "If you need a patient to see a screen in some fashion, put a tablet on their lap and say, 'Touch the screen.'"

In large part, Numoda tries to simplify clinical trials. At the start, a doctor uses a handheld device to enroll subjects. Once a trial gets underway, a Numoda system sets up communication between every person and device in the trial. For example, a bar code on a specimen can be scanned by a refrigerator, which keeps track of the sample's temperature. When that sample gets measured, say for cell count, the data from the cell reader gets beamed to a handheld. "The biggest errors come from moving data by hand," Boris says. "So we set up machine-to-machine communication." She adds, "This could be used in any lab."

In a few years, PDAs and tablets could be as common in science as a lab notebook. From a crowd of kids playing Cooties to physicians fighting microbes, handheld devices go beyond improved speed and accuracy. As Soloway says, "Handhelds give us tools that we never had before."

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