Michael Nash has cerebral palsy—specifically, spastic quadriplegia—the result of oxygen deprivation at birth. Born with no heartbeat, he would never have drawn breath had it not been for a doctor at Cape Cod Hospital in Barnstable, Massachusetts, who gave him mouth-to-mouth resuscitation for 45 minutes. Today, at 14, Michael cannot speak. He cannot control his body except for some facial muscles. He is completely dependent on others to
hoist him into his wheelchair, to feed him through the tube that empties into his stomach and to change his diapers.

Until two years ago Michael was assessed as having the intelligence of a three-month-old, a diagnosis confirmed by specialists in Connecticut, Massachusetts and Virginia. So from ages six through 12, the boy was enrolled in programs for the severely retarded, most recently in an isolated wing of West Bridgewater High School, 40 miles from his home in Marshfield, Massachusetts. At West Bridgewater, a typical student’s goal for a given school year might be to grasp a spoon or to track a teacher’s finger from left to right with the eyes. “And a lot of those kids couldn’t do it,” says Maureen Gates, who has known Michael since he was eight, when she ran a van service for the school and worked there as an aide, tending half a dozen pupils in two large, open rooms. At West Bridgewater, she says, Michael became increasingly unresponsive to his teachers’ demands. His attention drifted, and his eyes grew glassy, seeming to con-
firm the system's assessment of his intelligence. Gates disagreed with that assessment. She knew there was an intelligent mind inside that flailing body. "He would laugh at my puns, usually faster than the staff," she says. Other staff members remained skeptical, however.

One night in the late summer of 1994 Michael's mother, Kathy Nash, caught the end of a television report about a computer that could be operated by the eyes alone. The system, Eagle Eyes, had been developed by a team of faculty members at Boston College. The news clip showed kids with disabilities similar to Michael's; only they were moving a cursor around a computer screen by flicking their eyes back and forth. In September Kathy Nash called one of the researchers, computer scientist James Gips, and begged him to include her son in the system's pilot phase. Gips agreed.

A week or two later she brought then-12-year-old Michael in to the Gasson Hall basement lab of Joseph Tecce, where Gips and fellow computer scientist Peter Olivieri were waiting. Michael was wheeled directly in front of the computer, and Maureen Gates sat at his side, comforting him. A student assistant daubed the boy's face with a blue gel containing spun glass, designed to rough up the skin for better adhesion. Next the student gently affixed dime-sized patches containing electrodes around one of Michael's eyes. The entire process took perhaps a minute. In a few more minutes the system was calibrated and ready to run. Michael's first test came quickly. On the screen before him flashed the letters of the alphabet. "Michael, how many of these letters can you identify?" someone asked, calling out A, then B. In short order the boy selected all 26.

Michael was so excited, Kathy Nash says, "that he was screeching and laughing."

On another visit, he was asked to identify blocks of color on-screen. Asked to find the purple shape, he did. Then the blue shape. When he was asked for the red shape, though, he just stared at the BC student administering the test. "No, Michael, find the red," urged the group clustered around him. Finally it dawned on them: the student had bright red hair. Michael was making a joke.

One morning this spring Maureen Gates pulled her van into the Nashes' driveway in suburban Marshfield, to pick up Michael for school. She wheeled him outdoors and backed the chair onto the van's motorized ramp. Up he went, squealing and honking, emitting high, piercing trills of glee; his arms were flung forward

In September 1994 Kathy Nash called one of the BC researchers, computer scientist James Gips and begged him to include her son in the system's pilot phase.

like penguin flippers, and a handkerchief was knotted jauntily around his neck to absorb the drool from his protruding tongue. Maureen locked his wheelchair in place and climbed into the driver's seat. The van moved uphill, onto the quiet residential lane that winds among new colonial-style houses and wispy groves of pine.

The Martinson Middle School in Marshfield is a low, sprawling facility that serves approximately 600 sixth and seventh graders. Last year the town's superintendent of schools was visiting BC's Campus School on unrelated business, when he saw Michael at work on Eagle Eyes. As Kathy Nash tells it, the superintendent said, "Why isn't this boy in our school system?"

Gates quit her old van-driving job to work full-time with Michael as a tutor and aide, and since
Are you just doing this because you’re sick of me asking you the same dumb question twice in a row?” Gates asked. Bang.

A flash of pale blue as Michael’s eyes shot up. That was a yes, loud and clear.

September she has accompanied Michael to school each day. As she wheeled him down the hall that morning, other kids routinely tapped him on the shoulder and hailed him by name. For the first class that day—language arts, taught by Martine Anderson—Gates positioned Michael’s wheelchair in a corner of the classroom and sat beside him. The subject was parts of speech, and Anderson pointed here and there, asking students to suggest a noun. Gates quickly fetched a white message pad from a bag hanging on the back of Michael’s wheelchair. With a black felt-tip pen, she dashed off two words: “house” on the left, “went” on the right, with a line down the middle. “Which one is it, Michael?” she asked softly. “Which one is the noun?” Almost undetectably, Michael glanced left. “Good boy,” Gates murmured, patting him on the chest.

After a few drills, Anderson announced that the class needed some wake-up exercise. The kids poured from behind their desks and trotted around a table at the middle of the room, shrieking. With Gates pushing, Michael glided among them. “OK, out in the hall; let’s go to the water fountain and back,” commanded Anderson. The pack funneled through the doorway, heels, elbows and black tires churning. A few minutes later they poured back in, with Michael reared back in his seat, honking and screeching, a look of ecstasy on his face.

The class broke into teams to discuss proper nouns. Leah, Tony and John drew their chairs around Michael’s wheelchair. “Hey, what’s up, Mike?” each said in turn. With Leah—a shy, pretty girl and one of his favorites—so near, Michael had trouble focusing on the lesson. His eyes kept tugging in her direction. Michael’s interest in girls is as ardent as that of any other 14-year-old boy, his mother confides. “We in the family laugh at a lot of it right now,” she says. “If he’s eyeing a girl, we sort of say, ’Michael, try to be a little more discreet.’”

“Mike, Mike,” repeated John, a chubby kid with blondish hair, still trying to get his friend’s attention. “Which is the person?” He’d written “Leah” on one side of the slate and “ball” on the other. In a flash, Michael picked the name.

The next class entailed a move with four other students—Tony, Leah, Emily and Diane—down the hall to the school library, a cool, quiet room redolent of aged books and floor wax. There, Gates led a discussion about Tuck Everlasting, which the class was reading. Michael seemed to be fading. Drooling, he moaned softly and rhythmically, unuh, unuh, unuh. When a snatch of music drifted in from the hall, his eyes wandered toward the door.

“Michael, just to see if you’ve been listening, what are these characters going to get in the diner—coffee or tea?” Gates asked abruptly. “This side for coffee, this side for tea. You’re on the spot now.” With a big, knowing smile, Michael picked coffee.

At the end of class, after Michael had departed, the four other kids lingered to discuss their impressions of him with a visitor. “I just think he’s cool, real cool,” Leah volunteered.

“What was it like, meeting Michael?” they were asked.

Emily, freckled, with her hair in dark braids, conceded that it was awkward at first. “But now,” she said, “he’s just one of us.”

“Is he as smart as you guys?”

“Oh, yeah,” Leah said with an upward roll of her eyes, “probably smarter. He does his homework.”

“One time in class, Chris made a joke about Mrs. [X], and Michael laughed,” Emily said.

Mrs. X is a teacher who doesn’t believe Michael should be at Martinson, the kids say. She “doesn’t even think Mike can see her,” one kid elaborated. “She’ll go like this—’Oh, hi-i-i-i,” waving a hand broadly from side to side in front of an imaginary person’s face. “But she doesn’t do that for us. She should just treat him like everyone else.” The other students nodded.

When Michael decides he’s had enough of something, though, he shuts down, retreating into the cave of himself. Gates describes him as “one of the most stubborn people I know.” She theorizes that he developed this reflex during the 12 years of his life before Eagle Eyes came along; shutting down was his sole means of exerting control.

At an evening presentation for BC freshmen and their parents last June, Michael was a featured performer. He was wheeled onto the Robsham Theater stage, hooked up to a computer and asked to move the cursor to an image of Grandma in the animated video the crowd was watching on a screen.
overhead. He did it. Then he was asked to highlight the word “grandma” in the adjoining block of text. He did that, too. And then, despite an auditorium full of people eagerly awaiting more bravura moves, Michael quit. He’d had enough.

Late one morning this spring, Gates wheeled Michael into a large room with a bed and sink in order to change his diaper. She was explaining to a reporter that Michael can eat just about anything that can be pureed and fed to him through a tube. “Didn’t you have hamburger yesterday?” she asked Michael. “Could you ask him to repeat the answer so that I can see his response?” the reporter requested. No response. Michael gazed straight ahead and then down to one side. Gates prodded him again; again he refused to engage her. “Are you just doing this because you’re sick of me asking you the same dumb question twice in a row?” she asked finally. Bang. A flash of pale blue as Michael’s eyes shot up. That was a yes, loud and clear.

The technology behind Eagle Eyes is in ways remarkably simple. Five electrodes are attached to a user’s face: four, around the dominant eye; and the fifth, to the forehead as a ground. They enable the computer to detect and measure minute electrooculographic changes—electrical signals that indicate movement of the dominant eye. Amplified 5,000 times, those signals are translated by custom software to trigger the movement of a cursor on screen. The system was a finalist in the 1994 Discover Magazine Awards for Technology Innovation, losing out to the Pentium computer chip.

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“There’s so much in there waiting to come out,” says Campus School curriculum specialist Frank Curran (left) in his office with school director Phil DiMattia, student assistant Andy LaMora ’97, Michael and Gates.)
Eagle Eyes' invention was a lucky accident. Gips and Olivieri were brainstorming at lunch four or five years ago about what sort of project they'd like to undertake if they had no constraints. It quickly came out that devising a means for people to communicate directly with computers was their mutual passion. So they decided to try it. "We were doing it for pure research," Gips says. "It was just an interesting, even crazy project."

They approached Tecce, an expert in the measurement of eye blinks, for help. A handful of undergraduates who were working as Gips' research assistants also pitched in, and before long the team had a functioning system. They used it to play video games.

Not until Gips spoke to Phil DiMattia, the director of the Campus School, did the technology's potential become apparent. Gips, Olivieri and Tecce tested several Campus School students, and the results were encouraging. The students, by focusing on a small area of the screen and lingering there for 1.6 seconds, could highlight that area the way a conventional mouse click does. Instead of being limited to stark yes-or-no choices, they were free to pick among a range of possibilities.

To refine the system, the Eagle Eyes team received funding from Andersen Consulting and software help from Apple Computer. Michael's uncle, who works at LTX, a local computing company, got his employer to lend the talents of an electrical engineer to miniaturize the system's components, making it more portable. A signal amplifier, once as bulky as a window air-conditioner, is now the size of a matchbox.
An estimated 100,000 people nationwide suffer from severe paralysis—victims of muscular dystrophy, spinal-cord injury and stroke, as well as cerebral palsy. Many could benefit from Eagle Eyes if the technology was widely available. University officials are discussing commercial licensing arrangements with a number of companies.

A typical Eagle Eyes session these days finds Michael’s wheelchair positioned in front of the screen that’s set up in a bright corner room at the Campus School. Gates sits beside him, her arm intertwined with his, frequently stroking his arm to calm him down, or patting him on the chest, or wiping spittle off his chin, or guiding him through the next task. Andy LaMora ’97, sits opposite, handling the technical calibration and selecting programs. Michael now comes twice a week, for a two-hour session.

A day’s tasks might include creating a brief message by selecting letters one by one or identifying parts of speech in a paragraph or something more fun, such as animating musical segments of a commercially available video based on a children’s book. Usually the session is a mix. Part of Gates’s job is to see that the material covered at BC meshes with Michael’s sixth-grade course work.

Frank Curran, a curriculum specialist at the Campus School, often stands behind Michael, egging him on. On a recent visit Michael was attempting to spell out his name. Having found M-I-K, he was tired, grunting and arching his back in frustration. His eyes had glassed over. “Mike, do you see this?” Curran asked, fishing in his pocket and then slapping something down next to the computer. “Here’s a dollar. That’s for you if you can get that last letter.”

The others in the room picked up the cry. “C’mon, Mike, get it. You can do it,” said Gates. “You can do it, Mike,” DiMattia said quietly. “That dollar’s yours if you do it,” Curran repeated. Michael made a few wild stabs with the
cursor, and finally hit the "E." Everyone cheered.

Curran now has 20 users enrolled in the Eagle Eyes program, 15 of them students at the Campus School. They range in age from three to 20. Users of any age may benefit, however. The family of a 55-year-old stroke victim recently drove the man up from his home in New Jersey to try out the system. An avid sports fan, he was delighted to be able to browse the Internet through the motion of his eyes and scan the Sports Illustrated home page.

For each of his regular users, Curran is inventing a curriculum as he goes. Initially, he explains, the aim was to teach Michael basic skill control. Through repeated drills, many disguised as games, Michael was moving toward proficiency, even fluency, in moving the cursor around the screen. But "I don't want Michael watching Mickey Mouse for the rest of his life," Curran says. "I want him to be as learned as he can be." Devising a more functional alphabet system is one immediate hurdle. Having 26 "hot points" on-screen simultaneously is overwhelming to users, and the current solution—breaking the alphabet into blocks of five or six letters to make selection easier—is still too cumbersome.

Fatigue is a problem, too. Moving Eagle Eyes' cursor is not easy. A slight delay occurs between selecting a spot on screen and seeing the cursor go there, and the system's calibration slips periodically. The more tired a user gets, the harder it is to control the cursor, and anxiety only increases the problem. That is why those close to Michael are so often trying to calm him. On a recent visit, several newcomers milled around while Gates quietly urged him to complete a difficult assignment. Michael became flushed, his breath spasmodic. Gates draped a handkerchief across his face until he settled down.

Kristin Nash, 11, was looking around for rope to tie her brother’s wheelchair to her bike and take him for a ride. She and her sister, Melissa, nine, had already pushed Michael up the long, steep driveway in front of their house and let him go spinning down, nearly toppling and crashing into the van parked at the bottom of the grade.

Michael Nash Sr. stood nearby, saying apprehensively, "I don’t know . . ."

"Let him have some fun," Kathy said. So a length of rope was found, a knot secured, and off the girls went, one running and the other pedaling hard, towing their brother behind.

When Michael got home from school a half hour before, Maureen Gates, Michael and Kathy celebrated the events of the day together in what has become a regular routine. Kathy stood directly in front of her son’s wheelchair, leaning forward eagerly until their noses almost touched. Gates recited Michael’s achievements at school as he beamed and wheezed, switching his head from side to side, and his mother looked as proud as a person could be.

The whole Nash clan buzzes around Michael like bees around a hive. Most afternoons Melissa tutors him in math at an easel she has set up in the basement. Kristin helps her brother write stories. Kathy reads to him nightly and sees that he does his homework. Michael Sr. engineers the equipment needed to give his son mobility and takes him to sporting events.

One of Kristin and Melissa’s jobs is to grind up Michael’s pills every morning in a mortar and pestle. Asked his dosage, either girl can tell you: a milligram-and-a-half of Lioresal, a milligram-and-a-half of Valium—both muscle relaxants. The girls get to pick Michael’s food, too. He likes spicy food, which they place on his tongue. “The hottest sauce, he loves,” Kristin volunteers. Lemons, no.

All that sisterly attention takes its toll sometimes. Down in the basement with their mother and Michael, the girls hopped on and off the sides of his wheelchair, poking him in the side and touching his hair. At one point, Kristin suddenly told him to look left. He did, away from her, and she yelled “Boo!” Michael was startled half out of his skin.

“Loser,” muttered Melissa under her breath.

As Michael gets older and larger, new problems related to his care will arise. The doctors won’t hazard a prognosis for him, says Kathy, because so much depends on the quality of care he gets. She is determined never to place her son in an institutional setting; if necessary, the Nashes will hire someone full-time to help at home and at school. “I’ll be taking care of him when I’m 90 years old,” Kathy laughs. Almost in the same breath, she says she’d like to see Michael complete college.

Bruce Morgan is this magazine’s associate editor.