

### 3 Getting Real

## High Tech High, San Diego, California

Yet Kyle wasn't a computer prodigy, and I didn't find him slaving away in a software hothouse. Instead, he was in a computer lab at High Tech High, a bold new high school that has put technology at the center of an inventive educational strategy: teaching students academic subjects through a series of independent and group projects. At many high schools technology is treated as a vocation, as a subject to be studied; at High Tech High, students use technology to learn geometry, biology, history, and other traditional subjects in a markedly different way.

High Tech High opened with two hundred ninth and tenth graders in the fall of 2000 under a charter from the San Diego public school system, drawing its students from throughout the San Diego metro area, and has since added eleventh and twelfth grades and is now fully enrolled at four hundred students. As a "charter school" it is publicly funded but largely independent of San Diego school authorities.

High Tech High's founder and the designer of its technology-based teaching strategy is Larry Rosenstock, a transplanted Bostonian with a career as unconventional as his new school. A carpenter turned lawyer turned vocational-education teacher, he became principal of the Rindge Manual Training School, a leading technical high school in Cambridge, Massachusetts, in 1990. After Rindge merged with 350-year-old scholastic powerhouse Cambridge Latin he ran the combined school in the mid-1990s,

When I met Kyle McDonald it would have been easy to think he was doing what's typical of teenagers today: playing a computer game. As the San Diego tenth grader worked a keyboard and a mouse, a ghoulish creature materialized on a monitor.

But Kyle, a lanky fifteen-year-old who sported cargo pants, sneakers, and braces, wasn't playing a game. He was making one. He was constructing a monstrous being out of cones, spheres, cubes, and other geometric shapes as part of an ambitious project to create an animated game to teach students keyboarding. Eventually, the creature would become one of many that students would blast from their screens during touch-typing exercises.

before leaving to lead a federally funded study of urban high schools.

Rosenstock says that the study and his many years in vocational education taught him that urban high schools that successfully educate students outside of the academic elite share two qualities: They establish respectful, adultlike environments for students, and they work hard to make academics relevant to students' lives. "Too much of the traditional high school curriculum today is made up of fragmented and decontextualized knowledge that doesn't have any meaning for many students," he says. "Project-based learning works because it gives students a reason to embrace the academic curriculum; they recognize that they have to know math or history or physics to complete their projects."

Technology, Rosenstock says, is a catalyst for the hands-on learning that he favors. "It's a tool," he said, eating a peanut butter and jelly sandwich and drinking a Dr. Pepper at his desk at High Tech High.

Such thinking has led Rosenstock to design a high school that is physically and organizationally very different from the norm in America, a small, coherent learning community, where nearly every aspect of school life promotes a distinctive educational strategy.

High Tech High is housed in a renovated warehouse on a sprawling former Navy training base a couple of miles from

downtown San Diego. Half the building is a vast open space under thirty-five-foot-high, sky-lit ceilings, from which hang brightly painted ducts and drop lighting. The space is divided with waist-high walls into four "work station suites," each with clusters of desks and Internet-linked computers for twenty-eight students. Each suite also has a glassed-in classroom with conventional high school desks for the same number of students. Because of the low partitions, one can stand just about anywhere and watch the goings-on throughout the Great Room, as the large open space is called.

The other half of Rosenstock's warehouse high school contains traditional offices for Rosenstock and other administrators; half a dozen conventional classrooms (each with a "Smart Board," a four-foot by six-foot screen on the wall that projects the contents of a laptop computer); and laboratories for mechanical engineering, biotechnology, video production, and animation.

The way students spend their days at High Tech High is as different as where they spend them. School starts late, at 8:45 in the morning, in response to new research showing that adolescents need a lot more sleep than they typically get, and runs until 3:45 in the afternoon. In place of traditional attendance-taking, students and teachers "scan-in" a fingerprint when they arrive in the morning. When I was at High Tech High the first half of the day was broken into two blocks. One day they would spend an hour-and-a-half on

humanities and another hour-and-a-half on mathematics, often in the school's classrooms. The next day they would study math and had "independent setting," an hour-and-a-half of independent computer time, where they would work on a wide range of projects at their workstations. The third day they would have independent setting and humanities. And then they would repeat the progression.

Each afternoon brought another three hours of project work under the tutelage of nine "project teachers," generalists who helped students on a range of individual and group initiatives in a role akin to that of athletic coaches. Because the school's server permits any student or teacher to log on at any computer in the building, students often migrated to different parts of the Great Room during project periods, with the school's blessing. There was, as a result, a very informal atmosphere during project periods—and a great deal of informal teaching and learning going on between students. In many ways, High Tech High seemed more like a high-tech workplace than a school.

Kyle McDonald was working in the school's animation lab during my visit. In the Great Room I met Yasmin Rahman, a ninth grader with long, jet-black hair and a shy smile. She and two classmates were deciphering an electrical diagram so they could build a "current board" that they would use to remote-control a yellow robot about the size of a playground dump truck. Eventually, said project advisor Ben

Daly, a twenty-seven-year-old physics graduate from Haverford College, Jasmin and the others would maneuver the robot via the Internet, using a computer chip that they would program themselves.

At the other end of the building project teacher Lee Walters had gathered nineteen students in a conference room to discuss one of the school's largest projects: a documentary on the decommissioned Navy base around High Tech High. The sprawling complex was about to be razed and put to commercial and residential uses and High Tech High's students and staff had hit on the idea of preserving the base's past in a documentary.

Technology would be at the center of the students' work. They would use the Internet to search the San Diego and Navy archives for photographs and other material for a book on the base's history and its decommissioning at the end of the Cold War, which they would design themselves using desktop publishing software. And they would make a digital documentary film about the base that they would edit on computers in the school's video-production lab. To record the base's demolition, they would use a computer-assisted drafting program called AutoCAD to design a robot equipped with a video camera, because students wouldn't be permitted to wander around the base once demolition had begun. Students would also communicate their work a third way, through a website.



Walters, a chemistry Ph.D. and university professor turned high school teacher, ran a no-nonsense meeting. He sounded like a corporate CEO.

"Where are we finding people to interview?" he wanted to know.

"Here are sample ads that we've written for three local newspapers asking Navy veterans to talk about their time at the base," responded ninth grader Van Whiting.

Walters nodded. "Film people, I've got four documentaries here for you to watch and I've ordered screenplays for two of them. I want you to study the relationship between the screenplays and the films. For tomorrow, I want you to report on how filmmakers use storyboards."

Then a screen descended at one end of the conference room and two students gave a PowerPoint presentation outlining how they planned to document the base's demolition photographically.

Technology helps promote the adultlike atmosphere at High Tech High that Rosenstock values by increasing students' opportunities to be self-sufficient learners. In particular, many High Tech High students use the Internet to do advanced work independently. Zak Zelin, an easy-going ninth grader ("I'm last on every list") with spiky, blue-green hair, was among them. He had already completed a conventional honors algebra class in the first four months of the school year and Jeff Blount, his teacher, had sent him to the

Internet in pursuit of advanced work. His textbook was the Yahoo search engine. With it, he found sites like [www.algebra.com](http://www.algebra.com) where there were plenty of tough problems.

To further promote the adult-ness of the High Tech High educational experience—and to help students grasp the relevance of what they are studying—students must complete an off-campus internship of at least one hundred hours during their junior or senior years. Most students are placed by Caleb Clark, the school's full-time internship coordinator, with San Diego's 715 high-technology companies. But being at technology sites isn't necessarily the point. "The key is connecting kids to adults," says Rosenstock. "As John Dewey would say, occupations offer a context, not an outcome."

Treating students as adults rather than adolescents, in part by having them build relationships with adults who are making use of academic material in their work lives, pays tangible dividends, Rosenstock says. The federally funded study he headed found that urban students with well-constructed internships went to college at significantly higher rates than those who lacked strong mentor relationships with adults.

Technology also pays other, more modest, dividends at High Tech High. Though big advances in computer hardware and software and the rise of the Internet have turned many heads in recent years, one of the first educational uses of computers—for tutoring in basic skills—continues to be a

valuable one, says Walters. "Computer tutorials are step-by-step, and individualized; they take students where they are and build from there." Students studying math, typing, and Spanish are among those who routinely use such tutorials at High Tech High.

Also, says Walters, a slight, quietly intense man with wire-rimmed glasses and closely shorn gray hair, word-processing technology makes students more facile editors and thus encourages them to draft and redraft written work, a valuable part of learning to write effectively, but one that students who have to rely on bad handwriting and even typewriters often shun. "The screen is a great leveler among students," says Rob Riordon, a former teacher at Rindge and Latin and now a consultant to High Tech High.

And though technology is first and foremost a learning tool at High Tech High, the school requires students to think reflectively about how they deploy technology in their studies. Each trimester they have to select three technologies that they've used in their projects—digital cameras, say, or the Internet—and report on several things about each technology, including how they would use the technology more effectively in the same project if they were to repeat the project. During my visit, Branden Lundy, one of biology teacher Leslie Woollenweber's students, was embarking on a project that contemplated technology in a particularly innovative way: he was going to compare a computer virus

to a human virus, contrasting, for example, how the two viruses are transmitted and how they affect their hosts.

Nor does High Tech High's emphasis on technology-as-tool mean that students don't learn about technology per se at the school. Though there aren't any courses on web design, say, or the BASIC programming language (the school's single technology course—in Cisco network training—is taught after school), the school supplies the software for such programs to students, who tend to teach it to themselves or to each other as they need the skills in the course of completing their projects. Rosenstock estimates, for example, that half of High Tech High students can design web pages using Dreamweaver software.

It's the culture at High Tech High—the school's project-based teaching strategy and its emphasis on student self-sufficiency—that leads many students to acquire tech skills themselves, says architect and teacher David Stephen, a former High Tech High administrator who helped design the school. High Tech High, he says, does not admit only technophiles. Yes, the school has a hackers club and one of its members, within a span of a week, worked his way into both Stephen's e-mail account and the school's financial files. And the school does require applicants to demonstrate a pretty strong desire to be in a technology environment (students have to apply to the school, attend an on-site orientation, write an essay about why they want to go to High Tech

High, and have a parent or guardian and two teachers or counselors write to the school on their behalf). But the school admits students with a wide range of academic abilities ("Some are reading and writing at the third and fourth grade levels, some could go to college next week," says Stephen) and about a third of High Tech High's students don't have computers at home. About a third also come from families on public assistance. Only about a fifth of the school's students are technology wonks, the sorts of students who might have business cards for web design and software security businesses that they run after school.

Apart from its overarching attempt to use technology as a catalyst for project-based learning, High Tech High is trying out other new uses of technology in education. It is conducting experiments within an experiment.

One of them involves pilot testing a digital humanities textbook for a division of publishing giant Houghton Mifflin. Jeff Robins's world history students spent two weeks just before I visited the school studying Napoleon and the French Revolution using a "textbook" that existed only on the Internet. The Houghton Mifflin subsidiary put the entire multimedia instructional unit—complete with animated battle maps and audio renditions by actors of statements by key historical figures like Marie Antoinette—on an Internet system built strictly for Robins's class. "The effect," says Robins, "was to bring the period to life for students in ways that traditional paper textbooks simply can't."

Rosenstock and his staff have also built an electronic student tracking system, an endeavor that has put them on the cutting edge of a nationwide movement to report student performance more fully and more clearly.

In traditional comprehensive high schools, commentary on individual student performance is either fragmented (a student's math teacher never talks to the student's history teacher, say, or students' standardized testing reports aren't cycled back to the students' next year's teachers) or superficial (schools rarely publicize the level of difficulty of their courses, making it hard to gauge the significance of students' grades).

In response, High Tech High has created a "digital portfolio" for each student. Housed in the school's computer system, it includes traditional things such as students' transcripts and standardized test scores. But in an effort to paint a richer picture of students' learning experiences at the school the portfolios are also being designed to include "performance rubrics," measures of the school's "learning goals."

High Tech High has half a dozen "learning goals"—general themes and related "essential questions" that it hopes will inform the way students think about every subject they study. They include Collaboration ("How do I work with others?"); Technology ("How do I use technology as a tool?"); Communication ("How do I take in and express information?"); Art and Design ("How do I give shape and form to my ideas?"); Ethics and Responsibility ("How do my beliefs



inform my actions?"); and Habits of Mind ("How do I think critically?"). The school's "performance rubrics" measure students' progress in each category.

High Tech High's staff has set standards for students in each category and then detailed what students must do to achieve the standards. In the "Communications" category, for example, students have to demonstrate their proficiency in "organization," "delivery," "audience," and "language." To make the grade in "organization," as an example, students have to make presentations that are "succinct," last for "an appropriate length of time," "convey a clear purpose," contain "smooth transitions" between elements, "build on main ideas," and end coherently. Jared Wells, High Tech High's assessment director, has developed templates that let teachers give students both numerical scores, on a scale of one to five, and written comments in every rubric subcategory.

Students also contribute to their digital portfolios, items such as their project reports, each trimester's reflections on the technology that they've used in their work, and other samples of the body of work that they build up at High Tech High. At the end of each school year students make presentations about what they've learned that year, using the contents of their portfolios as the basis for their presentations.

By gathering student-performance information in a single place and delivering it electronically, High Tech High's

digital portfolios "help make the school's work more transparent," says Wells. Parents, for example, can review their kids' progress from anywhere via the Internet, and teachers with concerns about students can readily tap into other teachers' commentary on the students' performance. As a result, Wells says, digital portfolios promote constructive conversations about students. In contrast, he says, "paper reports frequently pile up and are forgotten."

Yet High Tech High's work to build a new-style high school with technology hasn't been without challenges. And High Tech High's responses to them are no less instructive than the innovations the school has achieved with technology in its short history.

Though students like Zak Zelin have used technology to push themselves academically (he and another student were doing the AutoCAD robot design for the Navy base documentary project), other High Tech High students haven't. A number of students weren't working particularly hard during their independent project time when I visited the school. "I'm just hanging out, I don't really have anything to do," a couple of students told me as I walked around the Great Room.

Nor have all students taken their digital portfolios seriously. During my visit a group of teachers gathered early in the morning to debate ways of encouraging students to put

more effort into their portfolio entries. After rejecting a suggestion to make the quality of the portfolios a factor in students' humanities grades, they decided to make strong portfolio work a "competency" that students would have to meet to advance to the next grade. (The digital portfolios also have proven to be a burden for teachers. Because they've had to write their performance-rubric responses on paper and then enter them into the school's computer system, some haven't kept up with the task, "even among our most conscientious teachers," says Wells. As a result, Wells is planning to simplify teachers' work by putting rubric software on their laptop computers.)

One reason for some students' failure to embrace technology on High Tech High's terms is that, in spite of the school's attempts to explain its technology philosophy to applicants, a significant number of students enter the school believing that High Tech High is a technical school, where they would learn about technology on the way to more advanced training or a job in the San Diego high-tech sector. "This isn't what I expected and it's not what I want," ninth grader Aaron Dimsdale told me, as he played fantasy basketball on the Internet during his afternoon project period. It's also difficult for students who have been taught in traditional, teacher-led classrooms to adjust to High Tech High's expectations that they use technology to be more independent learners.

But Rosenstock, who, like his staff, wears a prefaded denim shirt with the High Tech High logo over the breast pocket, after the fashion at many high-tech firms, believes that the school was also responsible for some students' low levels of engagement. In early 2001, midway through the school's first year, he had already concluded that students' independent computer time wasn't "structured enough." Having a lot of powerful technology at their disposal wasn't enough, in the absence of more guidance from teachers, to spur students to be productive. In its second year, as a result, the school cut its three-hour afternoon project block in half and used the extra time to give students more formal instruction. A year later, in the fall of 2002, Rosenstock and his staff began having students do projects that were drawn directly from their course work, which led the school to eliminate independent project time in the Great Room for freshmen, sophomores, and juniors altogether. They now work in the Great Room when their subject-area teachers reserve the space for their students to do projects related to the topics they're studying in math, history, and other courses.

High Tech High, says David Stephen, hadn't done enough to ensure that student projects were sufficiently demanding. "Some teachers," he says, "weren't making projects rigorous enough, they weren't robust, in-depth." Even with state-of-the-art technology, designing high-quality inde-



pendent projects requires a lot of hard work by teachers, High Tech High learned. In response, the school drew up prototypes of strong projects and trained its teachers to replicate their quality. It began having teachers of different subjects work together to create interdisciplinary projects. It added conventional courses in science. And some of the school's teachers began doing more traditional, front-of-the-classroom teaching to ensure that students learned key material. Biology teacher Woollenweber, for instance, started giving lectures on diseases and on environmental topics, trying to strike a balance between teacher-led learning and independent study. "The self-directed project work is critical," she told me when I visited the school. "It makes the subject matter interesting. And they aren't going to learn anything if they aren't motivated. But they also aren't going to get everything they need to know about immunology on their own."

Another hurdle for High Tech High—and for schools trying to replicate High Tech High's model—has been the \$1.5 million price tag for the school's myriad technology. Rosenstock raised most of the money from outside sources, primarily high-tech entrepreneurs Irwin Jacobs, the co-founder of San Diego-based Qualcomm; his son, Gary Jacobs (the school's official title is the Gary and Jerri-Ann Jacobs High Tech High); and the State of California.

But Rosenstock also has taken steps at High Tech High

that have helped make the school's operating technology budget affordable: Because he believes that high schools should have only a limited number of instructional priorities, High Tech High has no athletic teams, marching bands, or art or music departments. It doesn't even have a gym or a cafeteria. As a result, the school spends less per student (\$7,400 versus \$7,600) than traditional San Diego public high schools, with lower student-teacher ratios.

Yet as High Tech High works to increase the rigor of its projects and to get all of its students using technology productively, it has had to spend additional money on teacher training. Says Riordon, the consultant, "You cannot be so invested in technology that you underinvest in human resources, because it's the human resources that are going to help kids use the technology wisely." Or as Rosenstock puts it: "A computer isn't a human being, and it isn't inherently project-based."

High Tech High's early difficulties in using technology to make students more independent learners converged at a long, trying meeting between the school's teachers and administrators and nearly fifty students at the end of the school's first year. It was organized by two students who were giving serious thought to leaving the school because, they said, the school wasn't challenging them academically. Many of the students crowded into the school's conference room complained that they were earning credits for sub-

jects that they hadn't mastered. "I'm spending a lot of time on sea turtles," said one, "but I don't think I'm learning enough biology as a whole." Many wanted High Tech High to become more like traditional high schools, with traditional teaching.

Rosenstock and his colleagues believed strongly in the ability of projects to make demanding academic subjects meaningful to students and to make them more independent, more self-confident learners. And they had seen flashes in High Tech High's first year of the exciting ways in which technology could promote project-based learning. So they set about strengthening rather than scrapping their bold school design in the wake of their students' demands for change. The retraining of their teachers and the other steps they achieved over the next twelve months to make the school's project-based instruction more coherent and more rigorous are a testament both to the level of educators' earnestness in small, autonomous schools, and to the academic dexterity of such schools.

Fittingly, the leaders of the student protest stayed at High Tech High, becoming president and vice president of the school's student body in 2002-03. That year, one applied to Stanford and New York University, the other to Stanford and UCLA.

## 4 Bond Brokers

### The Met, Providence, Rhode Island

Bianca Gray, a deputy policy director to Mayor Vincent Cianci Jr. of Providence, Rhode Island, wasn't a teacher. But she was among the most important people in Tawana Ruiz's high school life.

Tawana (not her real name) recently graduated from the Metropolitan Regional Career and Technical Institute—The Met for short—an alternative public high school in Providence serving mostly troubled students that has taken the radical step of organizing its instruction around internships that its students do with Providence-area professionals. As a junior, she spent two days a week at city hall, where Gray, fifty-four, was her mentor.

Despite its name, The Met isn't a vocational school and