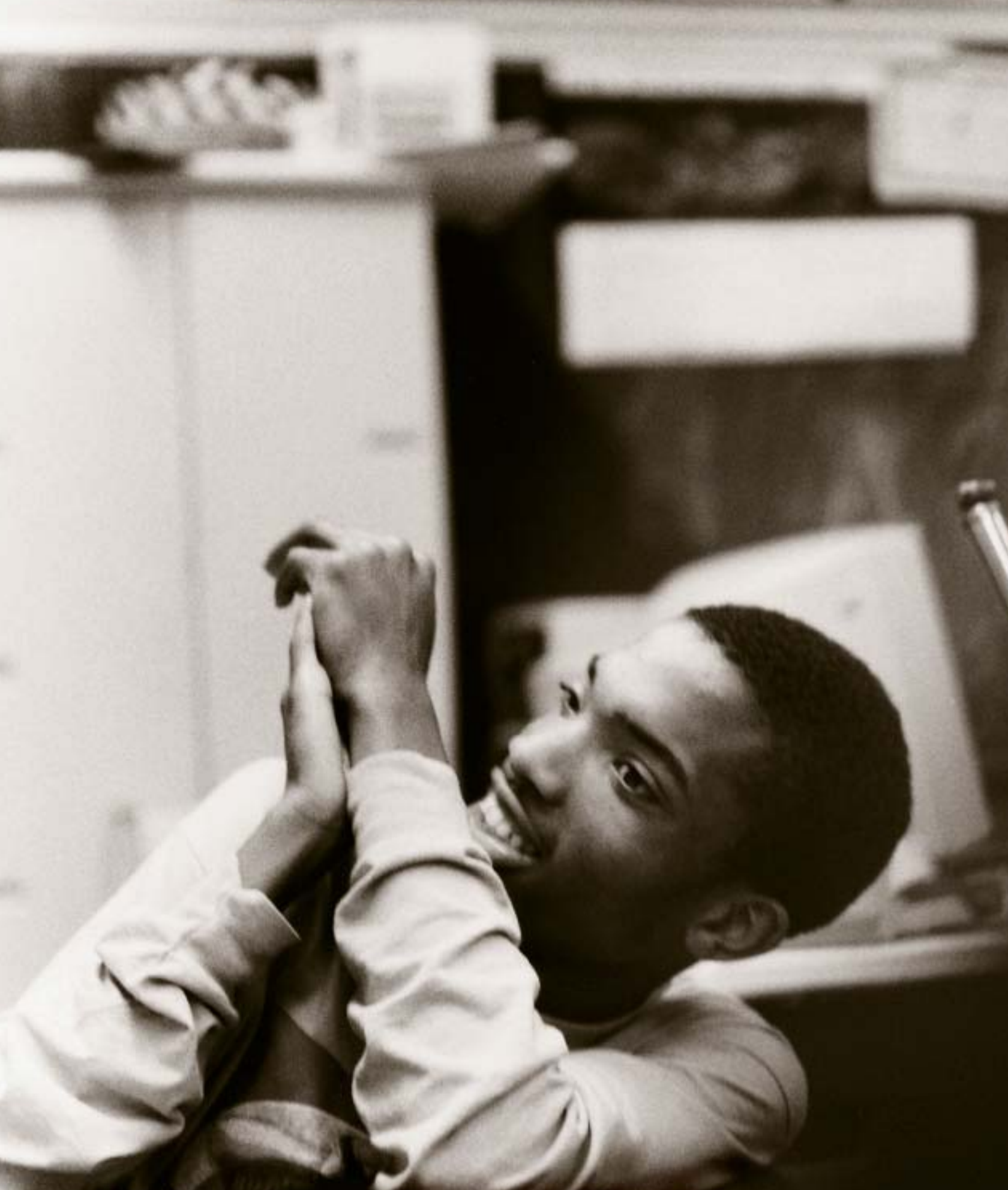


✦✦✦ In an attempt to raise the quality of education for all, an inner-city high school offers its first-ever AP Calculus course.

# a calculated risk

by rachel deyette werkema  
photographs by kathleen dooher



✦✦✦ In 1995, Algebra I was the most advanced math course offered at the Jeremiah E. Burke High School in Boston.

**The sound of teenagers** chattering barely pauses as the bell indicates the start of the class period. As a few last stragglers enter the room and take a seat, a firm but friendly voice penetrates the chatter. § “Good people, look up at the board. You have five minutes. Everybody take out a sheet of paper, no talking. It’s all about speed. Five solid minutes, you know it or you don’t, people. If you don’t have it, turn in what you do have for partial credit. Let’s have it quiet. In three...two....” The room falls quiet before the countdown reaches one. On the whiteboard in the front of the room is the statement: *Quiz: Find the derivative of  $f(x) = 4\sin(2x^3)$ .*

Some 20 students stare at the board, pick up their pencils, and work on the problem with varying degrees of concentration. It is early November, and this could be a calculus class at any high school in America. Fluorescent lights hang from the ceiling, lighting the work spaces for the students sitting in groups of four to six at four rectangular tables. The teacher has decorated the room to set a tone appropriate for an advanced placement (AP) calculus class. Above the whiteboard a banner states, “Theme for 213: Excellence not Mediocrity.” Across the room, a poster reminds students that “Your life is a product of your choices... Choose carefully!” Another encourages each member of the class to “Be a problem solver, not a problem maker.”

Being a problem solver is a highly valued quality in this classroom, where students struggle daily to master advanced mathematics.

“Time’s up, people. We’re going to have these every day. You’ve gotta know this stuff,” announces Michael Dixon, the leader of this journey through calculus. An African-American product of the Chicago public schools and a graduate of MIT, Dixon may not be a typical math teacher. His youthful appearance disguises his near-decade of experience teaching physics in two affluent Massachusetts towns. But AP Calculus is a new course for him, as it is for this particular school, whose faculty he has recently joined.

This classroom is also not a typical AP class-

room. According to the College Board, nearly two-thirds of all AP test-takers are white, and the percentage among calculus examinees is even higher. But the students working through this “speed quiz” are nearly all students of color: African-American students, students from Cape Verde, Vietnam, Hong Kong, and Haiti. The sole white student is a recent immigrant from a war-torn region of the world. Many come from homes below the poverty line, and most would be the first in their families to go to college. Although this sets them apart from the typical AP test-taker, it unites them with the rest of the students in their school, the Jeremiah E. Burke High School, where 97 percent of the pupils are students of color and many come from poor households.

The Burke is located in Boston’s Grove Hall neighborhood, which straddles the city’s Dorchester and Roxbury communities. No entrance exam is required. Students come here because of the bilingual instruction in Cape Verdean Creole (about one-third of the Burke’s population is “limited English proficient”); or because brothers, sisters, and cousins have attended the school; or because the district’s computer system assigns them here. Now students have another reason: the opportunity to take up to four advanced placement courses, in calculus, physics, U.S. history, and English.

This is quite a change from 1995, when the Burke’s curriculum was deemed so weak and its facilities so poor that the New England Association of Schools and Colleges stripped the school of its accreditation.

Math was a particularly weak spot. Steve Leonard, who took over as the Burke’s headmaster shortly after the loss of accreditation, remembered piles of letters from colleges asking for explanations of courses like Consumer Math and Stretch Algebra. “They were holding up people from this school from playing athletics, getting accepted, using scholarships—anything—because the curriculum was nonexistent,” he said. Among

**Many Burke students come from homes with low incomes; most would be the first in their families to go to college.**



other shortcomings, the math curriculum's most advanced class was Algebra I, and that was offered "only for an elite group of children," noted Nicole Bahnam, who was appointed assistant headmaster in charge of academic instruction at the beginning of the 1995–96 school year.

The Burke has come a long way since then. It has revamped its educational philosophy, raised expectations of student performance, and, perhaps most important, has been able to claim the resources necessary for the school to operate effectively. For the Burke to transform itself required nothing short of a revolution in the way the school viewed itself and its students, and in the way it was viewed by the school system. That such change could be—and was—undertaken is an encouraging sign, and may provide a model for other urban schools looking to shed reputations of low achievement and low expectations. But the fact that the Burke had to sink to such depths before the city heeded its cries for help provides a cautionary backdrop, especially as the Boston public schools enter the 2002–03 academic year facing a budget shortfall—the same circumstances that preceded the Burke's prior rise and demise.

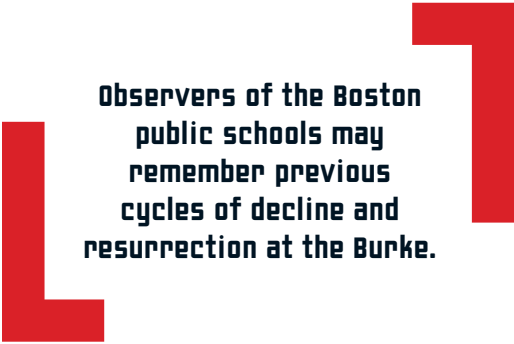
#### **HISTORY REPEATS ITSELF**

Observers of the Boston public schools over the past few decades may recall previous resurrections of the Burke. In the 1980s, the high school was seen as a dumping ground, plagued by gang violence, drugs, and a "criminal" image. By 1990, however, the school was touted as an oasis of learning and was receiving praise for its remarkable success in sending students to college. This praise would prove to be short-lived, as fiscal pressures resulted in budget cuts in the early 1990s, gutting programs and slashing teacher positions across Boston. While all the city's schools suffered, the damage at the Burke would prove to be especially costly.

The high school lost teachers across all subject areas, forcing it to drop French and business from its curriculum. Its librarian position was eliminated, rendering the library virtually unusable. The guidance staff was cut from two counselors to one. Other cuts in support staff and security limited after-school programs. Throughout this period, enrollment at the school was rising, from 650 to 800 to close to 1,000 students by 1995. This imbalance between students and resources proved too much for the New England Association of Schools and Colleges, the regional accrediting body, which voted to strip the Jeremiah E. Burke High School of its accreditation in May 1995, the first decertifi-

cation of a New England high school in over a century.

The public embarrassment caused by decertification served as a call to action. The central school office assigned Steve Leonard, who had turned around other troubled schools, to lead the Burke. Leonard was well aware of the ironic advantages brought about by the accrediting association's decision. Losing accreditation, he observed, "was the blight that everybody wanted to go away as fast as possible." No doubt a complaint filed by Burke parents with the United States Department of Education's Office for Civil Rights, charging the district with short-changing their predominantly black high school relative to schools with higher white enrollments, also helped to move things along. The district doubled the school's budget from \$2.5 million to \$5 million and reduced its enrollment. The school used these funds to hire staff and rebuild the Burke's academic programs as well as its attitude.



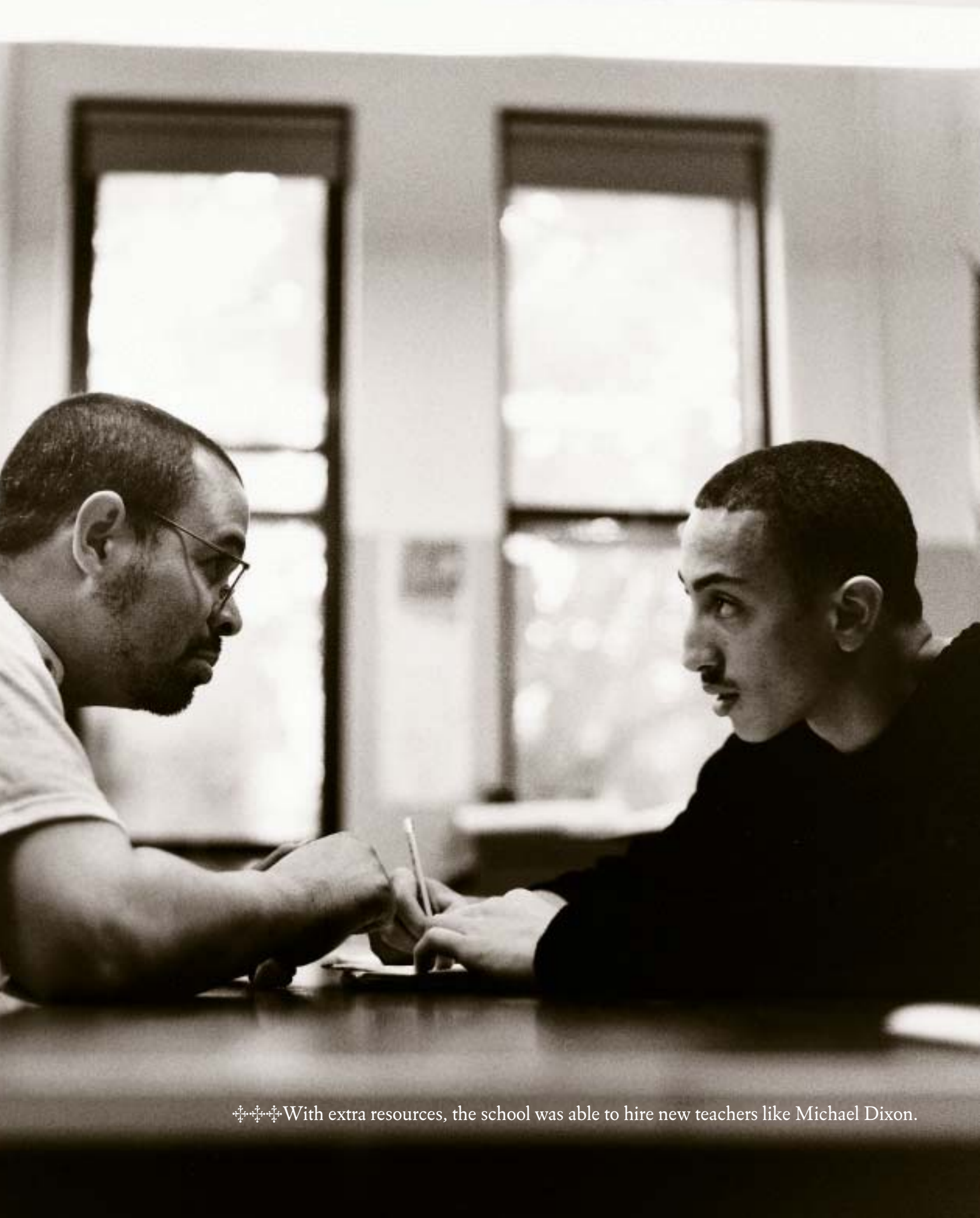
**Observers of the Boston public schools may remember previous cycles of decline and resurrection at the Burke.**

Though the normal waiting period to reapply for accreditation is five years, Leonard was determined to regain it for the Burke in just three. As Leonard tells it, the first priority was creating an environment conducive to learning and teaching, and that meant establishing order. "The place was not running like a school," he said. "There were rules, but they were rules on paper. So we spent, literally, two years changing the whole way that people operate."

The school addressed a host of issues, ranging from basic standards of behavior to school-wide academic expectations. Students were not permitted to roam the halls, and there were to be no excuses for poor student performance.

Everyone at the school was responsible for sending consistent messages about acceptable personal conduct and work standards. "A whole cultural change had to take place," Leonard recalled. "The staff really had to believe that the same kids who were running around here... were just as able to come to school, sit in their classes,





✦✦✦ With extra resources, the school was able to hire new teachers like Michael Dixon.



✦✦✦ Boston's Grove Hall neighborhood, home to the Burke, straddles the communities of Roxbury and Dorchester.





**"The staff had to believe that the same kids who were running around . . . (could be) motivated to higher education."**

pay attention, learn, and be motivated to higher education."

The changes involved major shifts in what teachers expected not only of students but also of themselves. "We had to put in place a culture that said, 'No excuses for nonperformance of students.'" He informed both current and prospective teachers that they had to be prepared to go above and beyond the responsibilities spelled out in their contract. The new Burke was going to exert intense demands on their time, energy, and creativity. "Every man, woman, and child in this building

had to change everything he or she knew about how education happens in the Boston public school system."

In exchange, the school offered teachers who signed on for the program greatly increased support and intensive professional development. The first target was the culture of low expectations. "We tackled attitude," said Bahnam. "The message we were sending was very consistent. If you want to work with us at the Burke High School, then you believe that our children can learn." In addition, content experts and instructional "coaches" helped to fill holes in teachers' knowledge of their subjects and to support literacy and technology initiatives.

School administrators also took steps to encourage teachers to try new things. "We understand that everything isn't going to work," Leonard noted. "That doesn't mean we don't evaluate people, performance-wise. As a matter of fact, the fastest way to get a bad evaluation... is to do the same thing over and over again, and expect different results." Instead, he gave teachers credit for risk-

## Expanding Access to Advanced Placement

The Advanced Placement (AP) program began in 1955 for a small group of academically elite high school students, mainly in private and suburban high schools. Since then, it has expanded to serve over 800,000 students in over 13,000 high schools, offering exams in over 30 subjects. However, a recent study on the future of the AP noted that despite substantial growth of the program beyond its initial target audience, 43 percent of the nation's high schools still do not offer AP courses.

In recent years, the College Board has placed increasing emphasis on providing AP opportunities in traditionally under-represented schools, among them the non-selective urban public high schools like the Burke. There has been some success: Over the past ten years, the number of students taking AP exams in Boston has more than doubled. However, until very recently well over 90 percent of candidates attended one of the city's three schools that require an entrance exam for admission.

### AP Advance

*The number of public high school students taking at least one AP test per 100 12th graders has increased in Boston's non-exam high schools.*

	BOSTON NON-EXAM*	BOSTON INCLUDING EXAM	MA	U.S.
1991	NA	NA	12.6	11.8
1992	0.2	10.2	13.8	12.6
1993	0.4	11.2	14.6	14.0
1994	0.2	10.4	16.4	14.4
1995	0.6	13.5	17.8	16.4
1996	1.2	16.6	19.4	16.7
1997	0.9	17.1	21.7	17.5
1998	1.5	18.9	22.6	18.7
1999	2.3	21.4	25.0	20.4
2000	2.4	21.4	27.0	21.7
2001	7.5	24.1	28.7	NA

\* Boston public high schools, such as the Burke, that do not require an entrance exam for admission  
SOURCES: U.S. Department of Education, Massachusetts Department of Education, and the College Board



taking. “Do something different to get students to move toward the goal.”

### A CALCULATED RISK

Certainly, the decision to offer AP courses at the Burke was something different. Leonard had instructed his assistant headmasters, led by Bahnam, to craft a curriculum that would, at a minimum, provide every Burke graduate with the skills to gain acceptance to a technical college or that would impress an employer. To prepare students for admission to four-year colleges, the school restored classes in subjects like foreign language and added more advanced classes in other subjects.

AP Calculus went a step further. Calculus rarely is listed as a formal requirement for high school graduation or a prerequisite for college admission, unlike Algebra II. However, calculus on a high school transcript is a positive sign for college admissions officers, especially those at the most competitive schools. The Burke’s strengthened curriculum would prepare its students better for higher education, but without some marquee courses such as calculus, Burke graduates would have a hard time competing for slots at top colleges or for admission to certain college majors.

By 1999, the groundwork was in place for AP Calculus. Mathematics course offerings had expanded to pre-calculus, and Bahnam was eager to offer the next step in the math sequence. Having closely observed the upgrading of the math curriculum, course by course—and witnessing the students’ success with each increasingly sophisticated level of mathematics—she felt that the time was right, and the students were ready.

A few hurdles remained, though. One was convincing students to sacrifice part of their summer vacation for a 7:30 a.m. pre-calculus class at Northeastern University that would help them prepare. The Northeastern course, attended by rising seniors in other Boston high schools, helped fill a void created by the typical mathematics track in the Boston public schools. Most students in Boston begin the college prep math sequence of Algebra I, Geometry, Algebra II, and Pre-calculus in grade 9, leaving them no time to reach Calculus by senior year without some kind of acceleration. Bahnam gathered a group of juniors identified both for their math skills and their motivation, and personally implored them to accept the calculus challenge.

The second hurdle was finding a calculus teacher. As luck would have it, Michael Dixon, a doctoral student at Boston College, had come to do research at the Burke through an initiative to

connect graduate students with K-12 schools organized by the Northeastern University mathematics department. Dixon’s experience and background, plus his desire to teach inner-city students, meshed with the Burke’s need for a calculus teacher willing to launch an AP course. By September 1999, the Burke had primed more than 20 seniors for its inaugural calculus class.

From the beginning, Dixon created a culture of high expectations. His classroom was constantly humming with group work, problem-solving, and project demonstrations. Students were confronted with mathematical problems from the moment they walked into class. A typical class would begin with a speed quiz. Dixon would then work through the quiz with the class to provide immediate feedback. Next, he would introduce the day’s topic through a demonstration problem, solving it step by step with input from the class. Finally, several more problems would go up on the whiteboard, and the students would go to work, helping each other while he circulated around the room.


Throughout the term, conventional tests were interspersed with less traditional term projects. In one project, students combined their knowledge of physics and calculus to predict the duration of a roller-coaster run; in another, they traveled to an elementary school to explain math concepts to fourth graders.

Dixon pushed the students to tackle the sophisticated subject matter with a balance of encouragement and, when necessary, gentle admonishment. In one class, a group effort to take the first derivative of a complicated exponential function met with enthusiasm from some corners and blank and indifferent stares from others.

“What’s the rule that we need?” Mr. Dixon began the discussion.

“The chain rule,” a voice called out. Dixon acknowledged the answer and then prompted the class for more.

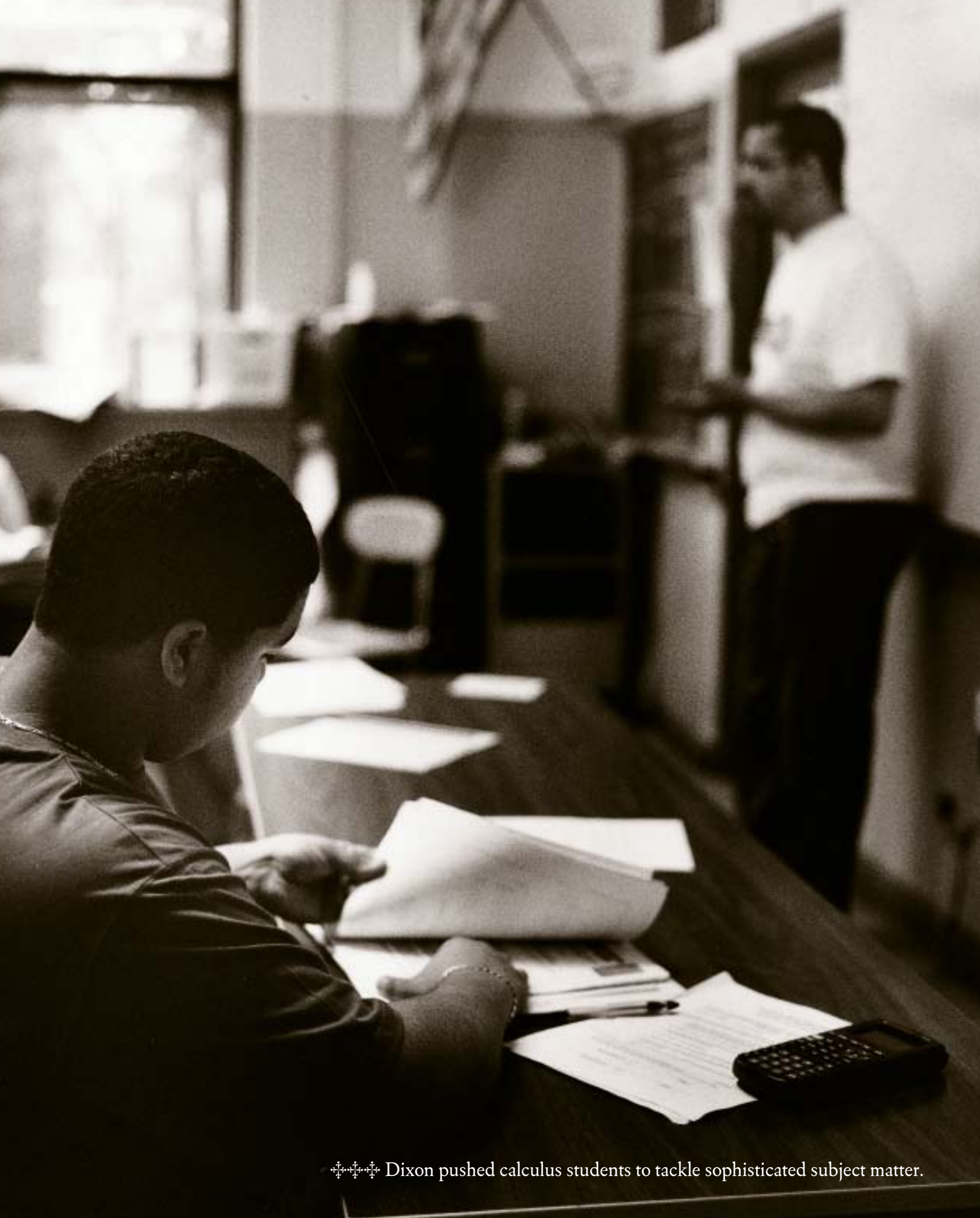
“The derivative of  $e^x$  is  $e^x$ ,” offered one of the



**School administrators encouraged teachers to take risks, try new things, and “do something different.”**







✦✦✦ Dixon pushed calculus students to tackle sophisticated subject matter.

✦✦✦ Urban schools can find themselves continuously pitted against each other in a struggle for clout and resources.







**Staff are wary that the Burke will be a victim of its own success, as money moves to deal with the next public crisis.**

top students in the class.

“Yes,” agreed Dixon. “But, what about the product rule? Anybody remember the product rule?”

Another strong student talked the teacher through the formula. Pressing further, Dixon called on two students to help him take the derivative. Their respective responses of “I don’t know” and a shrug of the shoulders triggered Dixon’s impersonation of a college admissions officer:

“He wants to come to Hampton? Well, how hard is he willing to work? What does his teacher recommendation say?”

Dixon wrapped up the discussion with his characteristic “Good people, you’ve got to know this.” As the class ended, he continued to push. “You have to practice. We have to fill the holes. I’m here after school; I’m willing to meet on Saturdays.”

While he knows the students at the Burke may have extra hurdles to jump, Dixon is clear that in his view this is insufficient grounds for low expectations. “Kids in the suburbs succeed much more easily... . The whole culture is set up for them to succeed. These guys are no less talented than the folks in the suburbs. They may have a long way to go, but they can do it.”

**WHY CALCULUS MATTERS**

Now two years later, students from that first year of calculus see the value of the class. “Calculus was a lot of work,” recalls one student. “But Mr. Dixon’s class made me better prepared when I got to college.” “Dixon, he really knew his stuff,” said another. “I didn’t believe that we would really

see all those things again; but in my college calculus class, a lot of the material was what we had done at the Burke.”

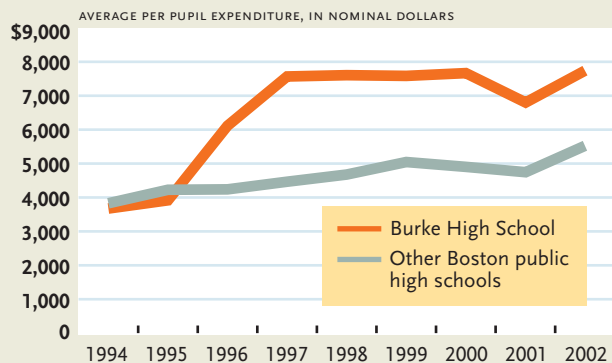
While a few students were able to translate their work directly into college credit, most saw the class as a boost to their college applications and to their belief that they belonged in the competitive academic atmosphere of a college campus. One student studying business remarked, “Everyone here had taken calculus. I don’t know what I would have done without it.”

Not only does studying calculus in high school help prepare students for college, but as the building block for advanced study in mathematics, science, engineering, medicine, business, and the more quantitative social sciences such as economics, calculus also opens doors to careers in these fields —many of them fields in which people of color are underrepresented.

Since schools that serve high concentrations of poor students and students of color have traditionally offered limited opportunities to study advanced math, the relative dearth of engineers, computer scientists, mathematicians, and other technical professionals from African-American and Latino backgrounds is not surprising. Yet, these technical fields are key to future economic growth, and schools that do not equip their students for mastery of advanced mathematics contribute to the growing gap between the needs of the U.S. economy and the ability of educated workers to fill them.

**Budget counts**

*Boston’s public high schools vary widely in the programs they offer and the students they serve, making spending comparisons difficult. Nonetheless, we do know that the Burke’s rise closely tracks the size of its budget, and school staff worry about their ability to maintain progress.*



Per pupil expenditure is the sum of the district budget amounts allocated to each school divided by the sum of the total enrollment at each school in each fiscal year. Schools include those with at least 400 students, including Boston High, Boston Latin, Boston Latin Academy, Brighton, Charlestown, Dorchester, East Boston, English, Hyde Park, Madison Park, O’Bryant, Snowden, South Boston, and West Roxbury.

SOURCE: Boston Public School District and Massachusetts Department of Education



Providing a course like AP Calculus also helps a school like the Burke to break free from stereotypes. While not every student will take AP Calculus, especially when a majority of students are still not passing the math portion of the grade 10 Massachusetts Comprehensive Assessment System (MCAS), schools like the Burke should not neglect the higher end of the curriculum, argues Bahnam. “The kids are going to have to pass the MCAS test, which is a rigorous test.” But she noted, “There has to be another level. And the higher level is going to be the AP.”

Already people are rethinking their opinions of the Burke. At the city’s annual Showcase of Schools, people who paused at the Burke’s table looked twice when they saw the AP course offerings. “The Latin School was right next to us,” Bahnam reported. “And we could say, ‘Yes, it’s the exact same test. If your child doesn’t make it to the Latin School to take advantage of the AP, we have the same opportunity.’”

#### WHAT MONEY CAN BUY

Today, the Burke is hailed by many as an urban school reform success story, in part because of the higher academic standards represented by the addition of AP courses, such as calculus, to the curriculum. In just four years, it transformed itself from a public school without accreditation, whose math curriculum topped out at Algebra I, to one graduating over 20 seniors with a year of calculus under their belts.

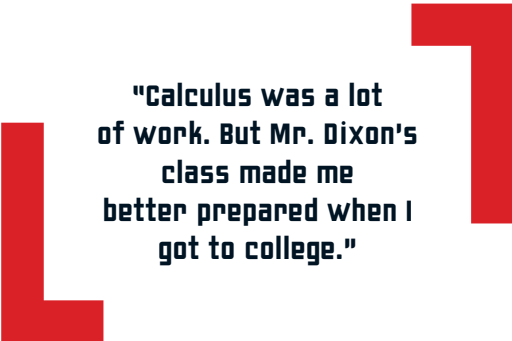
And the school has made other impressive academic strides over that same time frame. Its performance on the MCAS has improved at a rate faster than the district overall; after finishing last among the city’s tenth-graders in the first MCAS administration in 1998, the Burke’s test scores now place it solidly in the middle of the city’s district high schools. The share of Burke students taking the SAT has climbed; and in 2001, the school succeeded in getting virtually all of its graduates accepted at two- or four-year postsecondary institutions. This latter achievement resulted in a \$25,000 Inspiration Award from the College Board.

Though the Burke has seen steady improvement, the staff remains wary that the school will be a victim of its own success. In the political reality of urban school districts, the school department must allocate limited resources among a large number of schools, all with serious needs. The result is schools that are continuously pitted against each other in a struggle for political clout and the “above formula” funds and staff that come with it.

Steve Leonard has seen that resentment. As the

school department showered the Burke with extra resources throughout its restructuring, other principals complained that the Burke worked because it had resources. But Leonard points out that what the Burke was given—the supposed “extras”—are actually what every urban school needs to serve its students. “What the Burke has is what we need. That’s the mantra that has to come out of every head in this city,” he stated. “What is the main obstacle to everybody doing this? One thing. The resources.”

The Burke’s turbulent journey over the past decade—from showcase school to symbol of



**“Calculus was a lot of work. But Mr. Dixon’s class made me better prepared when I got to college.”**

blight to steady renewal since 1995—closely tracks the size of its budget (see chart on page 21). As Massachusetts and the city of Boston battle the current fiscal crisis, the fragility of the school’s turnaround is evident. While great things are happening, those connected to the school fear an inevitable slide as the school’s needs begin to appear less pressing, and money and other resources move elsewhere to deal with whatever crisis commands public attention. “Making urban school systems work for urban kids is so doable,” contends Leonard. But this is a tough goal to accomplish with limited resources.

As of September 2002, the Burke lost eight of its “extra” staff, and the current administration is wondering how the school can continue to do more with less. As Leonard said, “If you do the math, we know how to destroy the schools, and we know how to fix them.” Unfortunately, doing more with less is the kind of mathematics problem that even Mr. Dixon’s AP Calculus students can not solve. \*

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✦✦✦ Public schools need to equip students with the technical skills that are key for future economic growth.

