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Introduction

MIT is defined by its focus on the future, but we are guided by the mission our founding President, William Barton Rogers, articulated nearly 150 years ago: "the advancement and development of science and its application to industry, the arts, agriculture, and commerce." During the last century and a half, however, the context in which we carry that mission out and the means by which we do so have changed enormously.

The Context for Higher Education: Opportunity and Preparation

As I look at the context for American higher education today, two issues seem central: opportunity and preparation.

Expanding Opportunity

Higher education is now the key route to success in American society, and the basis of our national strength as a knowledge-based economy. Today's college graduation rates are closely correlated to family income: To sustain our robust democracy and to compete in a global marketplace, we need to send an even higher percentage of our population on to college and graduation. As a nation, we espouse a commitment to expanded educational opportunity, but we must recommit to policies and practices that make higher education accessible to young people from every socioeconomic group.

For more than four decades, MIT has admitted undergraduates on the basis of academic merit alone, without reference to their ability to pay; awarded MIT scholarship aid solely on the basis of need; and met the full need of all admitted students. Next year, 57 percent of our 4,000 undergraduates will receive need-based scholarships from MIT, averaging $25,500 per student. We recently announced that beginning next fall MIT will match the federal Pell Grant for all eligible students, significantly reducing the debt burden of our students with the greatest financial need.

Tuition covers only a fraction of the cost of educating our students, and next year MIT will grant more than $60 million in scholarship aid. Few colleges or universities have the resources to make investments comparable to ours, and even for MIT there are significant opportunity costs. The funds we spend on financial aid are not available for other educational investments, such as the extremely expensive classroom and laboratory facilities needed to teach science and engineering today.

The correlation between graduation rates and family income is a signal that we have to follow the money trail if we are serious about expanding access. Yet Congress recently cut more than $12 billion from the federal budget for student loans over the next five years, and the maximum amount of a Pell Grant has been frozen for the last four years, while the cost of quality higher education—especially in the sciences and engineering—is rising.

Higher education is the best recipe we have for improving economic opportunity and the quality of life for our citizens. I hope the Commission will help us develop a better understanding of the relationships between financial resources and college success—an essential prerequisite to an informed public discussion of how the nation can pay for the education our young people need.

Strengthening Preparation

Just as we need to expand opportunity for higher education, we also need to strengthen preparation for it—especially in math and science. I urge the Commission to bear in mind that our colleges and universities cannot do their best work unless we improve K-12 education.

Colleges and universities are not qualified to take on the core work of primary or secondary education, nor can we divert our attention from our primary obligation to our own students' educations. But we can build better bridges between K-12 education and college, and at MIT we want to do all we can to help:

- We are currently working on ways to build new secondary school science courses that will use problem-based learning to better involve students.
- Our faculty and students work with K-12 students and teachers in a wide variety of settings, from local schools to summer programs whose participants come from around the country.
- And as we develop exciting new ways to use technology in college education, we are exploring how to translate those models to the K-12 arena.

In an era whose major policy issues are increasingly shaped by science and technology, citizenship itself requires mathematic and scientific literacy. Today I give you my pledge that MIT will look even more closely at its own efforts to strengthen K-12 math and science education, and work with our faculty to expand the most promising efforts.

Fostering Educational Innovation

The issues of access and preparation affect MIT just as they do all other American colleges and universities, but our education reflects our nature as a research university.

American research universities integrate teaching and research more closely than any other universities in the world. At MIT, our most distinguished researchers are deeply committed to undergraduate education: Professor Richard R. Schrock, who received the Nobel Prize in Chemistry in December, is teaching this term's introductory course in inorganic chemistry. And our undergraduates participate in cutting-edge research.

Such integration of teaching and research allows innovations to flow from research into teaching in real time, and the resulting educational system has been spectacularly successful. One respected rating system recently concluded that 17 of the world's top 20 universities are in the U.S.—and the reality is that the U.S. is home to most of the top 500. This success has depended on our ability to foster innovation in teaching as well as research. What does this mean for the future?

Curricular Innovation

Today, barriers between existing scientific and engineering disciplines are breaking down because of unprecedented opportunities at the intersections between them. Perhaps the most compelling example comes from the convergence of the life sciences with engineering and the physical sciences. In just the last few years, MIT has launched new undergraduate majors in biological engineering and chemical-biological engineering, and a new graduate program in computational and systems biology. These programs bring biology, chemical engineering, chemistry, computational science, materials science and engineering, and other fields together in ways we could hardly have imagined a decade ago.

Such curricular innovation is entirely compatible with rigor and excellence. Indeed, a solid grounding in the fundamental disciplines is especially important for students working in interdisciplinary areas, and those in our new majors complete the same core requirements as all MIT undergraduates, including six courses in science and mathematics and 8 courses in the humanities, arts and social sciences. Each institution needs to have the flexibility to define the central features of its educational program.

The development of our new educational programs parallels the emergence of important new research collaborations in areas such as genomic medicine, and the implications of such cross-disciplinary work for the economy and human health are enormous. Curricular innovation is not optional for U.S. universities. It has been and will continue to be the source of our vitality and our ability to respond to changes in the world.

Innovative Connections to Practice

Just as we need to innovate in the curriculum, we also need to develop new ways to connect the learning in our classrooms and laboratories to the world our students will enter when they graduate. At MIT, we have launched a number of innovative programs that take students into the world of practice:

- The longest running of these is the Undergraduate Research Opportunities Program, which allows undergraduates to work directly with faculty in cutting-edge research. Some 85 percent of MIT undergraduates now participate in UROP before graduation.

- UROP served as the model for the Undergraduate Professional Opportunities Program in our School of Engineering. UPOP integrates internships into engineering education, providing students with the experiences and the understanding they will need in the professional world after graduation and providing real-life context for their classroom learning. UPOP now attracts about 40 percent of sophomores in the School of Engineering.

- Today's students also need to gain first-hand experience of foreign societies and ways of working. MIT's alternative to the traditional junior year abroad—the MIT International Science and Technology Initiatives (MISTI)—places students in intensive professional internships in companies, research laboratories, and universities around the world, from Beijing to Berlin. Both MISTI and UPOP embed their internships in a rigorous curricular framework.

Innovative Uses of Technology

A third important stream of educational innovation is the use of technology. Here I will highlight just two major MIT initiatives:

- MIT OpenCourseWare has made available free web access to the materials for well over 1200 MIT courses. Our Dean of Engineering, Professor Thomas L. Magnanti, spoke about OCW at the Commission's San Diego field hearing early last month. As he explained, OCW is not a distance-learning program; instead, it allows educators and students around the country to benefit from the teaching materials created by our faculty and to join a learning community in which knowledge and ideas are shared openly and freely. The primary audience for OCW is outside MIT, but it has also strengthened education on our own campus.

- MIT's iLabs allow students to conduct real laboratory experiments remotely from any Internet-accessible browser. These remote laboratories enable much more efficient use of laboratory equipment, can be shared across a university and across institutions, and vastly increase the scope of experiments to which students have access in the course of their studies.

Since OCW and iLabs have proven so effective, we are exploring how their models might be adapted for use in secondary schools. This is one important way we hope do our part to help address the challenges in K-12 math and science education.

Flexibility and Diversity

As the Commission considers institutional accountability, I urge members to keep in mind that educational innovations like those I have described depend upon institutional flexibility, diversity, and competition. An interventionist approach—whether in the form of standardized curricula or more mandatory testing—will stifle the educational innovation our country needs.

Consider, for example, computer science. The Computer Research Association, which includes some of MIT's computer science leaders, is very concerned about how to encourage students to enter this vital and fascinating area of study, which faces declining enrollments. High school students are able to take an Advanced Placement examination in computer science. While AP courses can provide advanced students the inspiration of a higher-level academic challenge, the AP computer science test focuses only on programming language skills, and it sends students and educators precisely the wrong message. It encourages courses on programming rather than on the emerging areas of creative work—logic, systems, simulations, modeling, robotics, and reasoning machines. It is discouraging intellectually ambitious students from entering the field.

At the college level, standardized curricula or testing would limit our ability to educate, to develop new curricula, and to train the innovators we need. MIT voluntarily and continually assesses with great rigor the progress and success of each student and academic program. Regardless of their major, we expect all of our graduates to develop the abilities to solve problems and think critically at a very high level, and our curriculum is designed to foster these skills. The flexibility to do so without a standardized curriculum or mandatory testing is a vital component of the continuous improvement and innovation we seek in our educational programs.

My own belief is that strengthening those aspects of higher education at the root of our success—access, innovation, and competition—will be more effective than standardization, mandates, and penalties in promoting real, long-term improvements. As the Commission considers its own recommendations, I hope it will ask of each suggestion, "Will this foster educational innovation?"

Conclusion: The Innovative University

I have asked the Commission to help our nation expand educational opportunity, strengthen K-12 preparation, and foster educational innovation.

In the decades ahead, American economic growth and social opportunity will require highly innovative businesses. It will be equally important to have highly innovative universities. I will close with a few thoughts on what these innovative universities will look like:

- They will incorporate technology into education and research in new ways, while nurturing mentor-based teaching.

- They will produce research that plays a catalytic role in a knowledge-based economy.
- They will play a critical role in local communities, at the heart of regional clusters of talent and economic growth.
- They will tackle our era's great challenges—from advancing medicine to developing sustainable energy technologies.
- Through innovation, they will be more agile as they compete on a global playing field.
- They will build continuing quality improvements into institutional traditions that are often inherently conservative.
- They will graduate students who are capable of citizenship, leadership, and innovation.
- They will foster continuous learning.

We have come a long way from America's first small Colonial colleges—with their rigid curricula and their commitment to preserving, rather than advancing, knowledge—and we must go even farther. I urge the Commission to encourage diversity and flexibility, not standardization, and to see America's colleges and universities as one part of a complex, dynamic system of education whose parts must work together if we are to build a better future for generations to come.