LOOKING FORWARD TO IMP

What makes IMP unique? Read these forewords from the IMP student texts to learn the views of a student, superintendent, mathematician, and engineer.

Foreword, Year 1

Several years ago, I was in your shoes, a ninth grader, starting off my first year of IMP. The "real world" was years away, and I hadn't even pondered getting into college yet. All I knew was that I liked my new mathematics class. The social aspects of the class are what really drew me to IMP. Hearing students talk was a nice alternative to my other six classes where the teachers spoke for the entire class period. Because of these opportunities to interact, I was able to meet many more people than I did in any other classes. Since IMP was not tracked like many classes, I met a broader range of people. But the social aspects of IMP weren't just about making friends. Because we were able to talk through mathematics problems and present our conclusions in front of our peers, I was able to learn how to communicate my ideas. I not only learned how to solve very complicated problems but also how to explain my methods for solving them to others.

Every time I sat down to write up a Problem of the Week, I had to rethink how I solved the problem and go over my explanation so that the reader would understand my thought process. Isn't this skill the most important part of the problem? An answer is more convincing if you can explain it to someone else. While I did a lot of learning through talking, I would definitely say that the majority of my learning took place through listening. By listening to what my peers had to say about a problem, I realized that not everyone tackled problems in the same way I did. The benefits gained from being exposed to a variety of ways to think about problems seemed obvious. However, as I compared my experiences in IMP with my experiences in more traditional mathematics classes, I realized that it wasn't necessarily that straightforward for everyone. For example, in my senior year I decided to take AP Calculus concurrently with IMP 4. The strongest impression that remains is how everyone in my calculus class tended to think alike because of doing most problems one way—the way the book did it. And because they were in other classes together, many of these students limited themselves to a select group of friends. How boring! It helped me to really appreciate the diversity of my IMP 4 class.

People from all sorts of backgrounds took part equally in the class. Not everyone had identical backgrounds, and not everyone thought alike. My peers would come up with ways of solving problems that surely were not published in mathematics textbooks, and they would work just as well as the more standard methods. This is what I truly loved about IMP. There was no one way to solve a problem. We didn't rely on memorization or on mimicking what we were told. Instead, we were constantly challenged to think carefully and deeply about problems. I appreciate having acquired an in-depth knowledge of mathematical concepts, but this mathematical knowledge is not the sole reason IMP was such a positive experience for me. IMP also helped me to develop the communication skills I use daily. The ability to persuade people and to effectively argue an idea has been priceless to me in both personal and academic situations. I encourage you to realize the importance of the non-mathematics skills along with the mathematics skills that IMP stresses.

Kaley Klanica is a member of the Class of 1996 of Eaglecrest High School in Colorado and the Class of 2000 of Haverford College in Pennsylvania.

Foreword, Year 2

Is There Really a Difference? asks the title of one Year 2 unit of the Interactive Mathematics Program (IMP).

"You bet there is!" As Superintendent of Schools, I have found that IMP students in our District have more fun, are well prepared for our State Testing Program in the tenth grade, and are a more representative mix of the different groups in our geographical area than students in other pre-college math classes. Over the last few years, IMP has become an important example of curriculum reform in both our math and science programs.

When we decided in 1992 to pilot the Interactive Mathematics Program, we were excited about its modern approach to restructuring the traditional high school math sequence of courses and topics and its applied use of significant technology. We hoped that IMP would not only revitalize the pre-college math program, but also extend it to virtually all ninth-grade students. At the same time, we had a few concerns about whether IMP students would acquire all of the traditional course skills in algebra, geometry, and trigonometry.

Within the first year, the program proved successful and we were exceptionally pleased with the students' positive reaction and performance, the feedback from parents, and the enthusiasm of teachers. Our first group of IMP students, who graduated in June, 1996, scored as well on PSATs, SATs, and State tests as a comparable group of students in the traditional program did, and subsequent IMP groups are doing the same. In addition, the students have become our most enthusiastic and effective IMP promoters when visiting middle school classes to describe math course options to incoming ninth graders. One student commented, "IMP is the most fun math class I've ever had." Another said, "IMP makes you work hard, but you don't even notice it."

In our first pilot year, we found that the IMP course reached a broader range of students than the traditional Algebra 1 course did. It worked wonderfully not only for honors students, but for other students who would not have begun algebra study until tenth grade or later. The most successful students were those who became intrigued with exciting applications, enjoyed working in a group, and were willing to tackle the hard work of thinking seriously about math on a daily basis.

IMP Year 2 places the graphing calculator and computer in central positions early in the math curriculum. Students thrive on the regular group collaboration and grow in self-confidence and skill as they present their ideas to a large group. Most importantly, not only do students learn the symbolic and graphing applications of elementary algebra, the statistics of *Is There Really a Difference?,* and the geometry of *Do Bees Build It Best?,* but the concepts have meaning to them.

I wish you well as you continue your IMP path for a second year. I am confident that students and teachers using Year 2 will enjoy mathematics more than ever as they experiment, investigate, and discover solutions to the problems and activities presented this year.

Reginald Mayo
Superintendent
New Haven Public Schools
New Haven, Connecticut

Foreword, Year 3

Students must be prepared for the world that they will inherit. Whether or not they choose to enter college immediately after high school, we must equip them to handle new problems with confidence and perseverance. Our ever-changing world requires that students grow into critically thinking adults who are prepared to absorb new ideas and who will become lifelong learners. The Interactive Mathematics Program (IMP) aids in this development.

IMP enhances students' understanding of mathematics by obliging them to present reasoned arguments. The group activities in IMP foster teamwork and the development of oral and written communication skills. These skills are honed by requiring students to write intelligible explana-

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tions about the processes that they followed to reach their conclusions.

As a parent of an IMP student, I have found that IMP enables students to experience mathematics in action and to recognize that mathematics is not simply an esoteric subject. On the other hand, IMP also offers students the opportunity to experience how beautiful and open-ended mathematics is.

As a professional mathematician, I believe that IMP teaches mathematics in the way that it should be taught. Mathematics does not arise naturally in nicely defined semester-long modules labeled Algebra I, Geometry, Algebra II, and Trigonometry/Precalculus. IMP effectively breaks down the artificial barriers created by such divisions.

I have found the Problems of the Week exceedingly interesting and intellectually stimulating—sufficiently so that I have shared several of them with members of my faculty. It is so refreshing to interact with my son around mathematics that is quite challenging to me also. He can appreciate my excitement and that mathematics can be fun.

As a parent and educator, I know the concerns that students, parents, school officials, and others have about colleges' expectations of entering students. What I value most, as do many of my colleagues at other top institutions, is that students have experienced good teaching in well-constructed courses that emphasize communication and creative thinking, and in which the learning that takes place is genuine and meaningful.

At Colorado School of Mines, a school of engineering and applied science, we require that our students develop strong communication skills and learn to work effectively as team members. To help our students enhance these skills further, we have established a writing center staffed by qualified professionals. In the beginning courses in calculus in our Department of Mathematical and Computer Sciences, we emphasize the working of real problems provided by the science and engineering disciplines. Students learn to think creatively and not be tied to one notation system. We also require our seniors to take turns at presenting reports on a research topic at weekly seminars. The other students submit reviews of their classmates' presentations and learn from the preparation of their assessments, in addition to providing valuable feedback to the presenter.

We expect that our students will not simply reflect their professors' thinking. Students have a responsibility to engage in independent thinking and to understand the power of thought as distinct from the power of authority. Students have a head start when they enter college courses with prior knowledge in solving complex problems that go beyond calculation and in coping with ambiguity.

The Interactive Mathematics Program helps prepare students for life, not just for college calculus. Because the Program emphasizes creative thinking, communication skills, and teamwork, it should serve our students well.

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Foreword, Year 4

"I hated math" is an often-heard phrase that reflects an unfortunate but almost socially acceptable adult prejudice. One hears it from TV announcers, politicians, and even football coaches. I'll bet they didn't start their education feeling that way, however. According to the Third International Mathematics and Science Study, American fourth graders score near the top of their international peers in science and math. Surely mathphobia hasn't broken out by that grade level. By twelfth grade, however, students in the United States score among the lowest of the 21 participating nations in both mathematics and science general knowledge. Even our advanced math students—the ones we like to think are the best in the world—score at the very bottom when compared to advanced students in other countries. What happened? Is there something different about our students? Not likely. Is there an opportunity for improvement in our curriculum? You bet.

Traditional mathematics teaching continues to cover more repetitive and less challenging material. For the majority of students, rote memorization, if not too difficult, is certainly an unenlightening chore. The learning that does result tends to be fragile. There is little time to gain deep knowledge before the next subject has to be covered. American eighth-grade textbooks cover five times as many subjects in much less depth than student materials found in Japan. Because there is no focus on helping students discover fundamental mathematical truths, traditional mathematics education in the United States fails to prepare students to apply knowledge to problems that are slightly different and to situations not seen before.

As an engineering director in the aerospace industry, I'm concerned about the shrinking supply of talented workers in jobs that require strong math and science skills. In an internationally competitive marketplace, we desperately need employees who have not only advanced academic skills, but also the capability to discover new, more cost-effective ways of doing business. They need to design with cost as an independent variable. They need to perform system trades that not only examine the traditional solutions, but explore new solutions through lateral, "out of the box" thinking. They need to work in teams to solve the most difficult problems and present their ideas effectively to others.

Programs like IMP foster these skills and fulfill our need as employers to work with educators to strengthen the curriculum, making it more substantive and challenging. I can attest to the value of IMP because, as the father of a student who has completed four years of the program, I've discovered that something *different* is going on here. My son is given problems around a theme, each one a little harder than the one before. This is not much different from the way I was taught. What is different is that he is not given the basic math concept ahead of time, nor is he shown how to solve upcoming problems by following the rule. By attacking progressively harder problems in many different ways, he often learns the basic mathematical concepts through discovery. He is taught to think for himself. He says that the process "makes you feel like you are actually solving the problem, not just repeating what the teacher says."

This process of encouraging discovery lies at the heart of IMP. Discovery is not fragile learning; it is powerful learning. My son thinks it can be fun, even if he won't admit it to other students.

I have another window on IMP as well. As the husband of a teacher who helped to pioneer the use of IMP in her district, I've learned that teaching IMP is a lot more than letting the students do their own thing. Lessons are carefully chosen to facilitate the discovery process. Points are given for finding the correct answer, and points are given for carefully showing all work, which is as it should be. Because the curriculum encourages different ways of solving a problem, my wife spends more than the typical amount of time teachers spend in reading and understanding students' efforts. The extra time doesn't seem to burden her, however. I think she thinks it's fun. She even gets excited when she sees that the focus on communicating and presenting solutions is measurably improving her students' English skills.

Let me conclude with a word of encouragement to all of you who are using this book. I congratulate you for your hard work and high standards in getting to this, the fourth and final year of IMP. IMP students have performed well in SAT scores against their peers in traditional programs. Colleges and universities accept IMP as a college preparatory mathematics sequence. I know that your efforts will pay off, and I encourage you to take charge of your future by pursuing advanced math and science skills. Even if you don't become an aerospace engineer or computer programmer, this country needs people who think logically and critically, and who are well prepared to solve the issues yet to be discovered.

Larry Gilliam
Scotts Valley, California

Larry Gilliam is a parent of two IMP students and works as the chief test engineer for Lockheed Martin Missiles & Space in Sunnyvale, California.