

Is there Math on Mars?

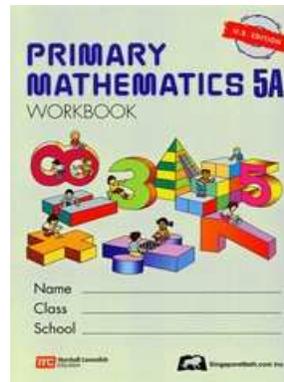
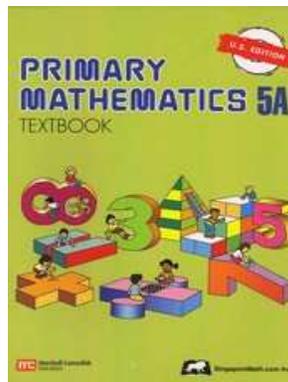
By Alexander Givental

Admitting publicly your love for math is likely to produce the same effect as announcing yourself a Martian.

Alas, mathematics is cherished by us, Martians for being a spectacular combination of beautiful art and deep science. Often challenging, yet enjoyable and most transparent of all subjects in school, it is a prominent and enlightening companion in life.

Well, if your eyebrows are up, look up what *math* means in Martian:

“The central idea of all of mathematics is to discover how it is that knowing some few things will, via reasoning, permit us to know much else — without having to commit the new information to memory as separate facts, — writes Madge Goldman, the president of Rosenbaum Foundation, in her preface to teacher’s guide to “Primary Mathematics,” the core elementary school math curriculum from Singapore, whose US edition was arranged for by the Foundation. — Mathematics is economy of information, not its unnecessary proliferation. Basic mathematics properly presented conveys this lesson. It is the connections, the reasoned, logical connections, that make mathematics manageable. Understanding the structure of mathematics is the key to success. Everyone can be ‘good at mathematics,’ and this textbook series, as has been proved in Singapore, shows how.”



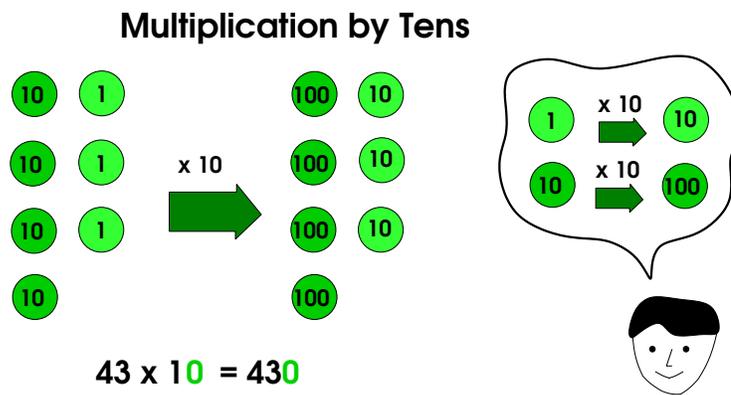
Given the immense dedication of Tehiyah families to learning, there is little doubt that our remarkable, talented, inquisitive, intelligent kids, literally all of them, deserve and have the potential to, not just be good at math, but become true “Martians.” In this article, we highlight the necessary prereq-

uisite for such promise to come true: the strength of our math program in Elementary School.

The math books from Singapore currently enjoy high acclaim and this year are even being put up for adoption by the California public school system. It is good to know therefore that our school began using them (namely *Primary Math* intended for grades 1–6, and *Earlybird Math* for the grade K) in Fall’04, i.e. way before they came into such fashion, and hence for reasons more sound than acclaim. What could the reasons be?

Mathematicians familiar with the present curriculum landscape attest that, unfortunately, there is not much choice. Strange as it sounds, Singapore math programs are virtually the only available elementary math curricula that don’t make a Martian cringe in embarrassment over every other page. Relying on most other programs seems just as wise as inviting Russian emigres to teach your kids English.

There is a good news too: Thanks to decades of stability in the country’s education system, Singapore math programs have evolved into materials nearly perfect pedagogically. To illustrate the point, we reproduce a textbook sample:



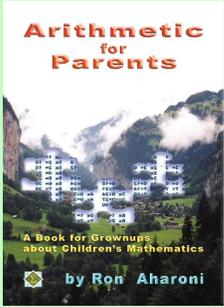
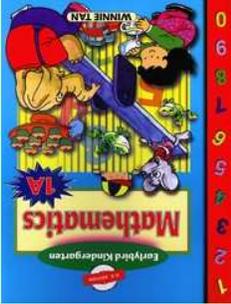
Perhaps mute and cryptic to the uninitiated, this is actually a *text* representing to the Martian eye a *theorem* (although we don’t call it so in elementary school) and its *proof* (i.e. an explanation of *why* the theorem holds true). The statement of the theorem is: *Multiplication of a whole number by 10 results in adding a zero on the right.* This is not a “rule,” one of many to be memorized and followed blindly, about senseless *symbols* on paper, but a result of *reasoning*, employing several facts about *quantities*. The reasoning

is explained in an example, as good as any other, of the whole number 43. The left column of the picture reads: The sign 43 stands for 4 tens and 3 ones. The key idea is revealed in the boy's thought bubble: 10 ones is a ten, 10 tens is a hundred (because that's what *a hundred* means). Therefore 43 times 10 becomes 4 hundreds and 3 tens, i.e. 430. The zero is highlighted to help us realize that adding it on the right of 43 results in upgrading ones into tens, and tens into hundreds.

However basic, this example allows one to derive several general conclusions (such as the unexpected depth, and a nested structure of elementary school math) that cannot be done justice here. For this, we refer to the book *Arithmetic for Parents* by Ron Aharoni, a mathematician from Technion (Haifa) who dedicated much effort to implementing Singapore math in Israel.

What is a whole number?

Be the first reader of
Tehiyah Shelanu
to answer correctly,
and win a copy of:

A correct answer
can be found in:
Hint:

Email your ideas to: givental@math.berkeley.edu

Yet, we want to point out that the ability to reconstruct the reasoning outlined in a text — no matter, verbal or pictorial — is perhaps the single most critical challenge present in this example, in mathematics, and in education. In fact such active *reading* skill is that infusion of “Martian blood” that gives one the access to the rich culture and great literature of mathematics which is available indeed at the middle school and higher levels. This is what the

school's math program should aim for.

What else can be done to maximize the impact of a strong curriculum?

Our Hebrew teachers have little trouble figuring out if a kid's family speaks the language. By the same token, if Martian is not spoken fluently at home, 5 x 45 *min* per week might not do the trick: Further affirmative actions toward math may be needed.

To nurture the Martian habit of keeping a home math library, it is a good idea to collect the Singapore math textbooks from year to year — unlike many other textbooks, these are worth doing it. For this, the textbooks which are recycled by the school (unlike the workbooks which belong to students) also need to become student's property. We hope that the school will eventually be able to adjust its policy; meanwhile the books are available at a modest price from SingaporeMath.com.

Having secured the *ownership* of the books, it would make sense to also *read* them. It isn't a bad idea to keep track of what your kids study in school. Ask them to explain to you what the text says: E.g., can they tell *why* 43 times 10 is 430? If you still don't get it, Aharoni's book may prove handy. But it should be fun learning Martian from your own kids, shouldn't it?