

# RENAISSANCE MATH

AWE & WONDER | BY GREG BEILES

A colleague of mine who is a rabbi once joked that there are two subjects in a Jewish day school that parents consider Holy: math and science; and, of these, the Holy of Holies is math. Parents send their children to Jewish day school because they cherish a Jewish education. At the same time, they want to make sure that their children have the skills to be successful. Math is deemed essential in this regard.

There is precedence for this pragmatism in Jewish tradition itself. According to the Talmud, parents are responsible for three aspects of their children's education: learning a trade, learning Torah, and learning how to swim (Kiddushin 30b). Today, proficiency in mathematics is essential for many jobs, just as important as swimming was for the fisherfolk and shipping merchants mentioned in the Talmud. But, like learning Torah, math is more than preparation for the job market.

When I took university calculus – mostly because I was interested in the idea of infinity – most of my classmates were aspiring medical school students. Calculus, it turns out, is a prerequisite course for medical school, yet any doctor will tell you that differential equations are not part of their daily practice. Why, then, do universities insist that medical students master asymptotic limits?

The answer is that mathematics has become a kind of new intellectual gatekeeper. In our society, math is a test of intellectual capacity. This means that abstract reasoning, complex problem solving, and representing reality in symbolic forms should be central to the math curriculum. It means that it is insufficient to require students only to run through long lists of pencil-and-paper computations and that we must go far beyond training students for tasks that can also be done by Excel spreadsheets. Reasoning and logic are the true “basics” of mathematical proficiency; the ancient peoples who invented math understood this. If schools limit math training to rote memorization, they are not being true to both parents and children. A Renaissance in math is now needed.

I like the term Renaissance Math for a number of reasons. First, the Renaissance was characterized by a high level of craftsmanship as guilds endeavored to perfect their trades. It also typified a non-compartmentalized view of the world: a Renaissance person sees the connections between math, art, and science, and even religion. The Renaissance saw the rebirth of critical reasoning and a renewed focus on discovery and innovation. These four elements of the Renaissance – craftsmanship, integration, critical reasoning, and innovation – are central to Renaissance Math.

Let's begin with craftsmanship. Like all disciplines, math uses key materials and tools. In elementary school math, the “materials” are the digits 0–9, and the “tool” is the base 10 number system with its place values: ones, tens, hundreds, etc. Understanding the power of the number 10 is fundamental to learning math. Young students make a great discovery once they realize that they can add the series of numbers from 1 to 9 as “tens” – that is,  $1 + 9$ ,  $2 + 8$ ,  $3 + 7$ ,  $4 + 6$ ,  $5 + 5 = 45$ . Later, they realize that thinking in groupings of tens helps them add bigger numbers – for example,  $450 + 90$  is  $450 + 100 - 10 = 440$ ; and of course, knowing your tens is key to multiplying and dividing since,  $6 \times 9$  is  $6 \times 10 - 6$  and  $399 \times 4$  is the same as  $400 \times 4 - 4$ . What students commit to memory is mathematics that is rooted in fundamental and continuous understanding.

In the debate between “New Math,” which emphasizes discovery, and “Old Math,” which prioritizes memory and formula, the Renaissance approach opens a third path. Students who simply memorize “math facts” along with a few algorithms for applying them might succeed through elementary math, but, unless they simultaneously learn to think about math logically, they will hit a wall. Over and over we hear the same two comments from parents: those who are natural mathematical thinkers say, “Oh, you're teaching math the way I naturally think about it.” Those who struggle with math say, “I wish I had learned this way. I might have been able to get past Grade 10 math.”

A Renaissance approach to math recognizes the value of integrated projects that render math meaningful and show it as one way that human beings use to understand our world. In their Ancient Civilizations course at The Toronto Heschel School, students in Grades 5 and 6 study number systems used by ancient peoples. They learn how the Babylonians used a base 60 number system, which is still used today to tell time (60 seconds, 60 minutes) and measure circles ( $60 \times 6 = 360$ ). The culminating Grade 6 project sees students imagine a civilization with a fictitious number system, unique digits, and place values, such as one where a six-fingered people use six digits (0–5) only and a number system with only a ones column, a sixes column, and a thirty-sixes column. Renaissance Math engages students to play with mathematics in imaginative, fun, and challenging ways. Students be-

gin to think analytically about mathematics as a way to represent objects and ideas. This is a valuable implication for the development of higher-level thinking.

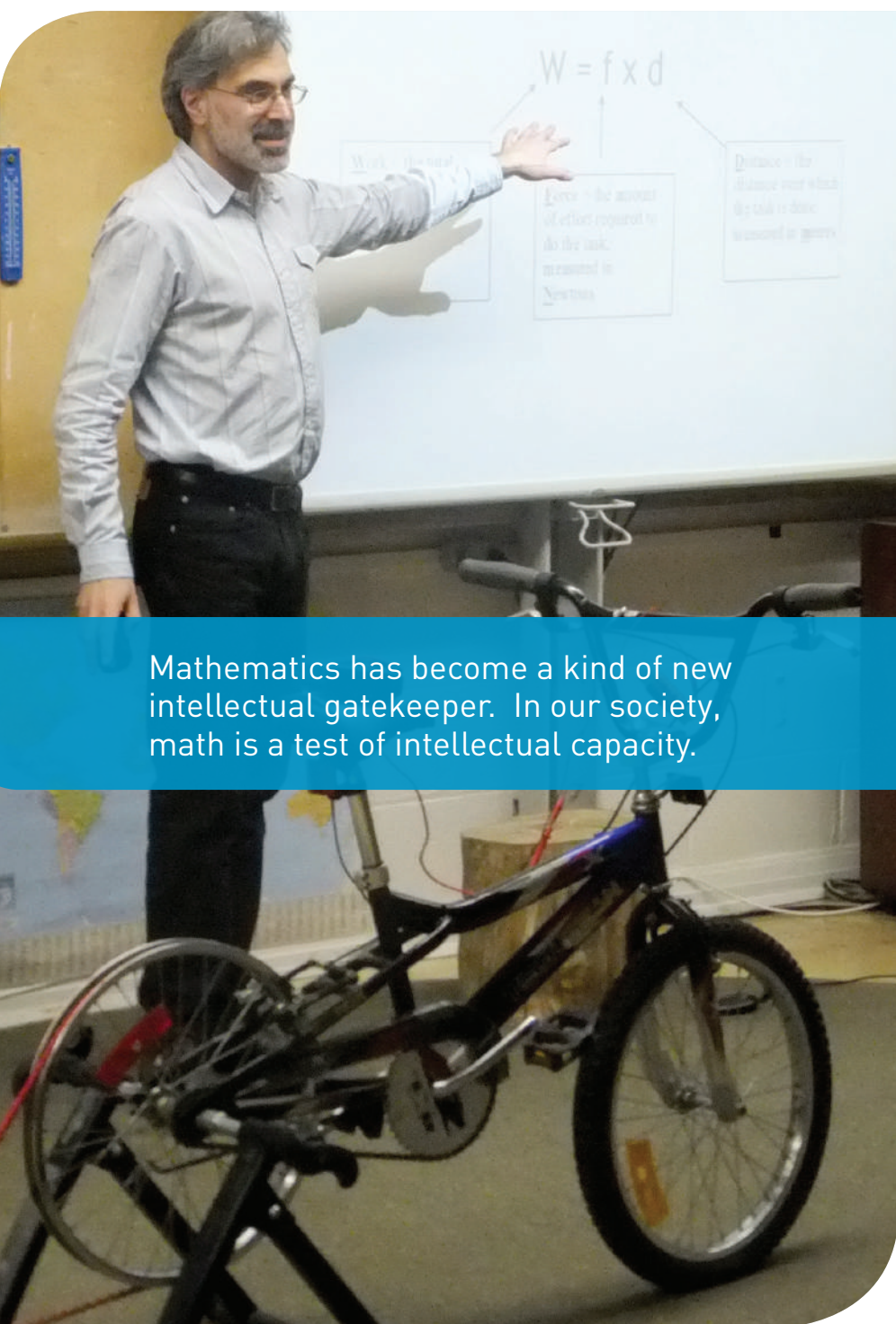
In one of my favourite Grade 8 units of study, students employ various computational skills to compare calendars from three different cultures – Gregorian, Jewish, and Muslim. The project culminates with the creation of what we call the Talmudic Clock, combining math with geography and Jewish studies. The Talmudic Clock is so named because it reflects a rabbinic notion of time that divides the day equally into two parts, demarcated by sunrise and sunset, and allocates 12 units of time called “hours” to each part. For different locations around the globe and different times of year, students calculate the length of each “hour” of the 12 daylight and nighttime units.

The project demonstrates how the experience of time – which varies with seasons – differs from standard clock time, which is uniform and constant, just as our lived experiences diverge from standardized measures. In his book, *The Sabbath*, Rabbi A.J. Heschel writes, “There are no two hours alike. Every hour is unique and the only one given at the moment, exclusive and endlessly precious. Judaism teaches us to be attached to holiness in time.” Using the tools of ratio and geometry to deepen our children’s Jewish experience of time gives them an inkling of how math can bridge the mundane to the sublime.

Mathematics is the “abstract science of number, quantity, and space.”<sup>1</sup> Renaissance Math grounds this abstraction through instruction in how numbers explain and relate to the world. It prioritizes mathematical thinking – with all the mental and written computation this entails. However children approach math, they need to practise, practise, and then practise the skills they learn. The value added by Renaissance Math is that when children approach math through relevance and meaning, what they learn sinks deeper and becomes more a part of their daily thinking and point of view. Taken together, discipline, critical thinking, and creativity generate a Renaissance in math that serves our children well.

1 Oxford Dictionaries, retrieved March 27, 2014, from <http://www.oxford-dictionaries.com/definition/english/mathematics>.

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