Mathematicians know that the mathematical landscape is ever-changing with new research completed every day. The arXiv (arxiv.org)—a website where scholars upload their work—lists 34,523 submissions during 2017 alone! Yet, many people believe that mathematics is complete, that it is a “dead science.” Students, and often even mathematics majors, learn nothing of current research; it doesn’t have a place in today’s undergraduate curriculum. Typical mathematics journals are too advanced for undergraduates, and mainstream news stories are too superficial for a math student to connect to the mathematics involved.

Enter Math Horizons. Since 1993, it has been a place where readers can learn about mathematical discoveries and feel connected to those developments. The articles include relevant and suitable details for undergraduates. They engage readers and encourage them to dig deeper. Readers have had front-row seats to many of the major mathematical advances of the past 25 years (and more). Let’s look at the first 100 issues to see how this periodical has presented recent results.

Conjectures to Theorems
Don Albers created Math Horizons at a fortuitous time—the same year one of the most famous open problems was solved. Fermat’s last theorem (FLT) states that the equation \( a^n + b^n = c^n \) has no positive integer solutions when \( n \) is an integer larger than 2. No proof of this “theorem” had been found for over 350 years despite numerous attempts by a variety of famous mathematicians.

The inaugural issue featured Gina Kolata’s article about Andrew Wiles and his proof of FLT. The following two issues included updates from Keith Devlin about gaps in the proof. Even today, these articles give aspiring mathematicians an idea about what it is to prove a statement—one should expect success, failure, and frequently the fixing of proofs, or at least some rewriting.

Math Horizons continued to draw connections to FLT throughout the years. Dorian Goldfeld (September 1996) explained the importance of Wiles’s work to the Taniyama-Shimura-Weil conjecture and the Langlands program as well as its relation to one of the next big problems: the ABC conjecture. The ABC conjecture has been in the news recently due to its potential solution by Shinichi Mochizuki. The six-year story of his proof, if its accuracy is confirmed, would make an interesting future Math Horizons article. For more about the ABC conjecture, see Richard Guy’s April 1998 article and Ravi Vakil’s September 1998 description of Noam Elkies’s work.

In the Winter 1993 article, Wiles stated that “there is a certain sadness involving the last theorem. All number theorists, deep down, feel that. For many of us, [Fermat’s] problem drew us in and we always considered it something you dream about but never actually do. There is a sense of loss, actually.” However, there is no shortage of great problems. Vakil’s essay and Devlin’s February 1998 note described the Beal conjecture: there are no integer solutions to the equation \( A^n + B^m = C^r \) when \( n, m, \) and \( r \) are all at least 3 if we require that \( A, B, \) and \( C \) have no common divisors besides 1. This conjecture might inspire future number theorists the way FLT inspired Wiles; adding fuel to the fire, a proof of the Beal conjecture is worth $1 million.

Offering money for a proof is not new—Wiles received the Wolfskehl Prize of about $45,000 for his proof. The most famous monetary problems are the seven Millennium Prize Problems, which
were selected by the Clay Math Institute in 2000. A solution to each problem is worth $1 million.

In 2003, Grigori Perelman solved a Millennium Problem: the Poincaré conjecture. Both Devlin (September 2004) and Jesse Johnson (November 2009) described the conjecture and Perelman’s solution, and Tina S. Chang (February 2008) wrote a fictional story about the conjecture. Perelman famously did not accept the Millennium Prize or the Fields Medal; some of this story is told in Stephen Abbott’s November 2009 interview with Masha Gessen, who wrote a book on Perelman. References to other Millennium problems are scattered among a variety of articles over the years.

*Math Horizons* has featured other famous number theory problems. In February 1996, Joel Chan described a few facts and conjectures about prime numbers including the twin prime conjecture, possibly the most famous open problem, which states that there exist infinitely many pairs of primes of the form \( p \) and \( p + 2 \) such as 11 and 13, 101 and 103, and 2,996,863,034,895 \( - 2^{2190000} - 1 \) and 2,996,863,034,895 \( - 2^{2190000} + 1 \) (the largest known twin prime pair).

In September 2013, Jordan Ellenberg wrote about one of the major breakthroughs in this conjecture, which was the proof of the “bounded gaps” conjecture by Yitang Zhang. Zhang proved that there are infinitely many pairs of primes that differ by at most 70,000,000. That article also included a link to the Polymath Project, a crowd-sourced effort to improve Zhang’s bound, which showed that there are infinitely many pairs of primes differing by at most 246.

**The Digital Age**

The Polymath Projects, of which you can learn more by reading Dave Richeson’s September 2015 interview of Fields medalist Tim Gowers, might have introduced students to the crowd-sourcing mathematics. But one of the first crowd-sourcing mathematics projects arose from another conjecture listed by Chan: the Mersenne prime conjecture, which claims there are infinitely many primes of the form \( 2^n - 1 \). In 1996, the GIMPS project (short for Great Internet Mersenne Prime Search) allowed users around the world to donate their “unused” computer processing power to determine the primality of relevant numbers.

In April 2000, Dale Buske and Sandra Keith discussed the GIMPS project after it found its fourth prime, \( 2^{13,912,617} - 1 \). They gave fascinating facts that we can prove about Mersenne primes and perfect numbers (numbers that are equal to the sum of their proper divisors). The GIMPS project is still alive and well; in January 2018 it found \( 2^{77,232,917} - 1 \), its 16th prime (the 50th known Mersenne prime) and the largest known prime number. The GIMPS project led to other crowd-sourced searches for primes, many of which are being tackled by PrimeGrid.com.

*Math Horizons* has grown up alongside the Internet and changes in personal computing, thus allowing authors to explain the importance of computers to mathematics research (as in the crowd-sourcing mentioned above). Much of Art Benjamin’s and Jenny Quinn’s February 2001 advice for how to search the Web for math articles is still relevant today. In February 2010, Bruce Torrence interviewed Richard Rusczyk about the *Art of Problem Solving* website—one of the first online schools dedicated to mathematics.

In April 2017, Sophia Merow wrote about the connection between the game *Set* and the famous cap set problem; she described how an article posted on the arXiv by Croot, Lev, and Pach was adapted within 10 days by Ellenberg and Gijswit independently to improve the bounds on the problem. Mathematical advances of this speed were unthinkable before the Internet.

Advances in computational power have been demonstrated by articles such as Fred Guterl’s November 1994 essay on the importance of number theory to coding theory for error-correcting data transmission and to cryptography for secure data transmission via the RSA algorithm, one of the most common methods of secure public key encryption. In February 1995, Chan followed with the story of the eight-month project to factor RSA-129, a 129-digit number, as a product of two primes, a feat my computer (23 years later) still cannot perform.
Math Horizons has also participated in the conversation around computer assisted proof: in February 1997, Kolata described a computer-created proof that might be classified as creative; in April 2001, Dinoj Surendran discussed Thomas Hales’s use of computers to prove the Kepler conjecture, which postulated the most efficient method of packing spheres; and in April 2009, Mark McClure and Stan Wagon investigated a consequence of Sipka’s November 2002 note about the four color theorem—perhaps the most famous theorem with a computer-aided proof. In his interview, Tim Gowers mentioned his interest in automated theorem proving, and in November 2015, Merow described how computers played a role in finding the 15th (and final) tiling of the plane by pentagons.

Politics and Public Service
Math Horizons provides a place for the discussion of mathematics in the political landscape. There are many articles introducing readers to the mathematical theory behind voting (see articles in the November 2000, September 2008, and September 2016 issues).

Recent Supreme Court cases on congressional redistricting have brought gerrymandering into the national spotlight. Rick Gillman’s September 2002 article explained the mathematics of gerrymandering, and interviews of Karen Saxe in September 2016 and Moon Duchin in November 2017 allowed readers to learn more about advancements in the mathematics of redistricting while encouraging engagement in the mathematics of society and public policy.

A February 2018 editorial by Jim Wiseman provided the background to understand the efficiency gap, an important method for detecting gerrymandering, and in September 2018, Jeffrey Barton presented an improvement of the efficiency gap measure. A September 2016 editorial by Katherine Crowley explained how mathematicians can contribute to the political landscape in other capacities. Such articles show how mathematics has become relevant in unexpected industries, again encouraging readers to pursue their passions from the mathematical viewpoint.

Mathematical People
Math Horizons has featured articles about or interviews with a diverse variety of interesting mathematicians including, but not limited to, Jean Taylor (September 1994), Persi Diaconis (February 1995), Fan Chung (September 1995), Karen Uhlenbeck (April 1996), Ron Graham (November 1996), Anne Hudson (February 1997), Frank Morgan (September 1997), Ravi Vakil (April 1998), Ingrid Daubechies (April 2000), Manjul Bhargava (September 2006 and November 2011), Melanie Wood (September 2004), Martin Gardner (September 2010), Steven Strogatz (February 2014), Artur Avila (February 2015), Maryam Mirzakhani (February 2015), and Eugenia Cheng (February 2018). Seeing active mathematicians like these provides inspiration for a new generation of mathematicians and demonstrates that mathematics is a thriving science.

Math Horizons encourages its readers to engage with mathematics beyond the undergraduate curriculum and inspires them in a way that traditional classes cannot. As a student, I remember excitedly reading the September 1995 article about the history of the classification of finite simple groups, and I eventually became a group theorist.

Readers interested in exploring Math Horizons’ back catalog should start with the articles mentioned in this piece, the winners of the annual Trevor Evans Writing Award (bit.ly/TrevorEvans), and The Edge of the Universe: Celebrating the First 10 Years of Math Horizons (edited by Deanna Haunsperger and Stephen Kennedy, AMS, 2006). The mathematics community is lucky to have such a resource, and I look forward to what the next 100 issues bring.

Tom Edgar is an associate professor at Pacific Lutheran University. He enjoyed reading past issues of Math Horizons and looks forward to working on future issues of Math Horizons when he becomes editor-elect in January.