AmplifyMath

GRADES 6–12

Mathematician profile cards

Dear educator,

At Amplify, our curriculum weaves the thematic development of mathematics with rich and poignant stories to inspire a lifelong curiosity for the subject. These mathematician profile cards are emblematic of the passion our team has for humanizing math, and for giving students the most colorful illumination of the subject.

This is just a taste of what Amplify offers, and includes present-day mathematicians found only in the program. We hope you and your students enjoy learning about the individuals who've shaped mathematics, and hope you'll check back in with us when you're ready to see everything the program has to offer.

—The Amplify Math team
amplify.com/math

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Directions:

Each profile card highlights the life and accomplishments of a mathematician. Give each student a card and have them read the profile. When they're done, students should find the two individuals holding cards that match the clues on the right-hand side of their own cards.

Abu al-Wafa' Buzjani

Abu al-Wafa' Buzjani (940–998)

Born in Buzhgan, Khorasan (present-day Iran), in 940, Abu al-Wafa' Buzjani was a mathematician and astronomer who contributed to the development of trigonometry.

Buzjani moved to Baghdad at age 19, beginning his mathematical career at a private observatory. His work included innovations in spherical trigonometry and the development of the first quadrant, a tool used by astronomers to examine the sky and astronomy. In honor of his astronomical work, a crater on the moon was named for him.

Buzjani's arithmetic work for Baghdad merchants and others included the first use of negative numbers in medieval Arabic texts. He also authored commentaries and translations of Greek and Arabic mathematicians.

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Now that you know more about Abu al-Wafa' Buzjani, find individuals who are holding the cards that match the following descriptions.

This individual invented "the Doomsday rule," which is an algorithm to determine the day of the week for any given date.

This individual was diagnosed with a rare disease at 21 years old, and was given two years to live. He lived to age 76.

Benjamin Banneker

Benjamin Banneker (1731–1806)

Benjamin Banneker was born in Baltimore County, Maryland, to a free Black mother and a father who had bought his freedom from slavery. Primarily self-taught, Banneker developed an interest in astronomy. In 1791, surveyor Major Andrew Ellicott hired Banneker to assist in the initial land survey for what would become the current layout of Washington, D.C.

When that role came to an end, Banneker continued to pursue astronomy. His research included predicting eclipses and planetary conjunctions for the year 1792. Banneker's writing was eventually published after Ellicott passed it along to an abolition group president. Banneker's initial work led to the first of a six-year almanac for the Chesapeake Bay region.

In 1791, Banneker boldly wrote a public letter to Thomas Jefferson citing Jefferson's own words in the Declaration of Independence, along with language from the Bill of Rights, to expose the contradictions between the stated ideals of liberty and equality and the continued practice of slavery. Jefferson responded but did not commit to try to resolve the contradiction. Banneker's letter continued to circulate, however, and ultimately helped influence public opinion in favor of abolition.

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Now that you know more about Benjamin Banneker, find individuals who are holding the cards that match the following descriptions.

Keira Knightley received an Oscar nomination for her portrayal of this person. However, this code expert's contributions may never be fully known due to laws regarding classified British WWII documents.

Their work as a computer programmer was so essential to the United States military, they were recalled from retirement and served an additional 20 years on active duty.

David Blackwell

David Blackwell (1919–2010)

Born in Illinois, David Blackwell graduated high school when he was just 16. He got his Ph.D. in mathematics at the University of Illinois at the young age of 22. Blackwell was Black, and objections to his employment prevented him from attaining positions at many universities. After working at three historically black colleges, Blackwell was finally offered a position at University of California, Berkeley—one of the colleges that had rejected him more than 10 years earlier.

Blackwell's work as a statistician contributed significantly to game theory, information theory, and Bayesian statistics. He was the first Black American to be inducted into the National Academy of Sciences; the first Black tenured faculty member at the University of California, Berkeley; and the seventh Black American to receive a Ph.D. in mathematics.

Blackwell was also a pioneer in textbook writing. In 1969, he wrote one of the first Bayesian textbooks, and by the time he retired he had published more than 90 books and papers.

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Now that you know more about David Blackwell, find individuals who are holding the cards that match the following descriptions.

This individual was the first Black American to receive a Ph.D. in mathematics.

This person was on the surveying team whose work led to the current layout of Washington, D.C.

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Joan Clarke

Joan Clarke (1917–1996)

Clarke was best known for her work as a codebreaker at Bletchley Park during World War II. Bletchley Park served as the home of the British Government Code and Cypher School (GC&CS). There, Clarke was the only woman to work on the Enigma Project, which decrypted Nazi Germany's secret communications and is credited with ending WWII years earlier than it otherwise might have ended. Her work is depicted in the Oscar-nominated movie *The Imitation Game*, in which she is portrayed by Keira Knightley.

Clarke continued her mathematical work after the war and, ten years later, she returned to the GC&CS, where she remained until 1977. During her retirement, Clarke assisted with research and publishing on the work done at Bletchley Park.

Due to the confidential nature of the work done at Bletchley, the full extent of her work is unknown.

Now that you know more about Joan Clarke, find individuals who are holding the cards that match the following descriptions.

This individual was awarded a Ph.D. in mathematics at age 22.

Unable to find an American publisher for their work in the 1930s, this individual sent work to many countries for publication, and was eventually published in Japan.

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John Conway

John Conway (1935–2020)

John Horton Conway was a British mathematician known for his playful attitude toward mathematics and his many important discoveries. Born in 1935 in Liverpool, England, he was interested in mathematics at a young age and studied number theory at the University of Cambridge, where he also went on to receive his master's degree and Ph.D. degrees.

Conway became famous for discovering "off-beat" algebraic structures which offered insights into a wide variety of mathematical problems in unexpected ways. He made important discoveries in game theory, geometry, topology, and number theory. Among Conway's many contributions, he provided names for the seven groups of symmetrical, infinitely long border (or "frieze") patterns: hop, step, sidle, spinning hop, spinning sidle, jump, and spinning jump. He also loved games, inventing many games and puzzles like "sprouts" and philosopher's football.

He also invented "the Doomsday rule," which is an algorithm to determine the day of the week for any given date. Conway was a professor at both Cambridge and Princeton University.

Now that you know more about John Conway, find individuals that are holding the cards that match the following descriptions.
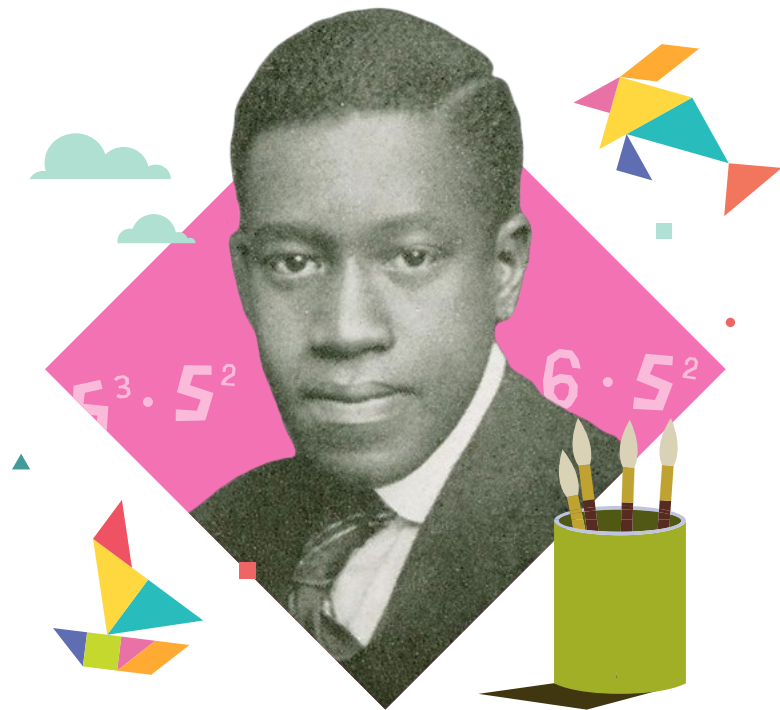
This individual was born in China and shared an affinity for both mathematics and politics.

This individual was the first woman to win the Academy of Sciences Prize.

Elbert Frank Cox

$5^3 \cdot 5^2$

$6 \cdot 5^2$

Elbert Frank Cox (1895–1969)

Elbert Frank Cox was the first Black American to receive a Ph.D. in mathematics. Born in Evansville, Indiana, on December 5, 1919, Cox served in World War I. After the war he began his career as a high school math tutor. In 1921, he applied to the Ph.D. program at Cornell. Postdoctorally, he began teaching at West Virginia State College, where he greatly influenced the math curriculum.

In 1929, he joined the faculty at Howard University. Cox attempted to publish his work but faced rejection due to his race. His work was eventually published in 1934 in Japan's *Tohoku Mathematical Journal*.

Cox is credited during his tenure with advising more master's degree students at Howard than any other professor. In 1954, he became the head of the mathematics department.

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Now that you know more about Elbert Frank Cox, find individuals who are holding the cards that match the following descriptions.

This individual was a codebreaker at Bletchley Park during WWII and was the only woman on the Enigma Project.

This individual was the first Iranian to be awarded the Fields Medal.

Annie Easley (1933–2011)

Born in Birmingham, Alabama, Annie Easley faced limited opportunities in both her education and career as a result of segregation. Still, Easley attended Xavier University in New Orleans, earning a degree in pharmacy.

In 1964, Easley moved to Cleveland, Ohio, to continue her studies. But soon after her arrival, the program she intended to take was eliminated. This setback led her to work at the NASA Research Center in Cleveland, where she worked for 34 years developing and implementing computer codes. Her work leading the software development for the Centaur rocket stage helped lay the foundation for the technology used in space shuttles and military and weather satellites. She was one of the first Black Americans to work as a computer scientist at NASA.

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This individual, despite holding a Ph.D. in mathematics, faced continued gender discrimination, anti-Semitism, and eventually expulsion from her professorship by the Nazi government.

This individual wrote the first English textbook on the subject of physical geography.

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Leonhard Euler

Leonhard Euler (1707–1783)

Leonhard Euler was born in 1707 in Switzerland, and enrolled at the University of Basel at the young age of 13.

In his lifetime, Euler made significant contributions to mathematics, physics, engineering, and astronomy. He founded the branches of mathematics called "graph theory" and "topology" and made pioneering and influential discoveries in many other branches, including number theory, complex analysis, and calculus. He proved theorems about prime numbers (including the largest known prime at the time), has two mathematical constants named after him, and developed much of today's mathematical notation. He also discovered a relationship between the number of vertices, edges, and faces of any convex polyhedron, or three-dimensional solid. He's also known for his discoveries in fluid dynamics, optics, and music theory.

Euler popularized the Greek letter π to denote Archimedes' constant (the ratio of a circle's circumference to its diameter). He was also the first to use the term f(x) to describe a function's y-axis; the letter i to express $\sqrt{-1}$; and the Greek letter ∑ to express summations.

Now that you know more about Leonhard Euler, find individuals that are holding the cards that match the following descriptions.

This individual studied the mass and volumes of black holes.

This individual was not only an accomplished mathematician, but also an accomplished trampolinist and juggler.

Sophie Germain

Marie-Sophie Germain (1776–1831)

Sophie Germain was born Marie-Sophie Germain on April 1, 1776, in Paris, France. (She always went by a shortened version of her longer name.) The French Revolution began when Germain was 13, which forced her family to stay at home. Looking for a source of entertainment, Germain began reading the books in her father's library. Her journey with math began after discovering the story of Archimedes. Germain was fascinated by how Archimedes became so engrossed in a math problem that he neglected his own safety and was killed by a soldier of Syracuse. Germain's parents disapproved of her interest in mathematics due to the the norms in France at the time, which held that math was man's work. Germain persisted and read at night, even when her father took away her blankets and lamp. Eventually, her parents relented and allowed Germain to teach herself math, including college-level calculus.

In 1794, the École Polytechnique (a higher education institute) opened in Paris, allowing students to obtain lecture notes and share solutions without attending. The school barred women from participating, but Germain was able to participate using the name of a former student, Monsieur Le Blanc. Her mathematical studies continued throughout her life, though she always faced prejudice due to her gender. Despite becoming the first woman to win the prestigious Paris Academy of Sciences Prize, she was not allowed to attend its sessions because she was a woman. Unable to find a career as a mathematician, Germain independently published her work and worked until she died of breast cancer at age 55.

Germain's work on number theory and Fermat's Last Theorem provided a foundation for mathematicians exploring the subject for hundreds of years after. Today, the Academy of Sciences awards the Sophie Germain Prize annually.

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Now that you know more about Sophie Germain, find individuals that are holding the cards that match the following descriptions.

This individual worked as a statistical clerk for the Bureau of Indian Affairs.

This individual coined the term "bug" for a computer malfunction.

Solomon Wolf Golomb

Solomon Wolf Golomb (1932–2016)

Your Bluetooth, Wi-Fi, and GPS are all powered by math. Polynomials—expressions of variables and coefficients—can be used to encode data. Who helped to develop those polynomials? A mathematician born in 1932 who could never have imagined all their future functions: Solomon Golomb.

Born in Baltimore, Maryland, Golomb earned a bachelor's degree in mathematics from Johns Hopkins University before he even turned 19. He went on to receive a master's degree and doctorate in mathematics from Harvard University.

Golomb created math-inspired fun across generations of learners and gamers worldwide. He designed a game called Cheskers, a hybrid of chess and checkers. He also coined the term *polyominoes* to describe a type of polyform made of squares, which form the basis of popular puzzle games such as Tetris.

Solomon's groundbreaking contributions to mathematics helped shape digital communications and earned him the 2011 National Medal of Science, bestowed on him by President Barack Obama in 2013.

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Now that you know more about Solomon Wolf Golomb, find individuals who are holding the cards that match the following descriptions.

This individual loved inventing puzzles and games, and is well known for games including "sprouts" and philosopher's football.

This individual enrolled in college at age 13.

Ronald Graham (1935–2020)

Born in California in 1935, Ronald Graham won a gymnastics scholarship to the University of Chicago. When his scholarship ended, he enrolled in the University of California, Berkeley, studying electrical engineering and number theory. He left Berkeley to enlist in the United States Air Force in 1955 and completed his bachelor's degree in physics while stationed in Alaska. In 1962, Graham returned to Berkeley to earn his Ph.D. in mathematics.

Graham proposed the solution to a problem called Ramsey Theory, a branch of the mathematical field called combinatorics. At the time, "Graham's number" was the largest number ever used in a published mathematical proof—so large that the observable universe is far too small to contain an ordinary digital representation.

Graham wrote six books and authored or co-authored hundreds of papers in the fields of mathematics and computer science. He worked at Bell Labs, a research and scientific development company that has won nine Nobel Prizes. He was the president of the American Mathematical Society and the Mathematical Association of America.

While at Berkeley, Graham won the California state trampoline championship and performed trampoline in a circus. He was featured in Ripley's Believe It or Not! as an accomplished trampolinist and juggler and also served as president of the International Jugglers' Association.

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Now that you know more about Ronald Graham, find individuals that are holding the cards that match the following descriptions.

This individual worked on a secretive mission to build the first American fighter jet for the Pentagon.

This individual introduced the usage of the symbol zero into written Chinese mathematics.

Amplify Math

Stephen Hawking

Stephen Hawking (1942–2018)

Stephen Hawking was born in Oxford, England, in 1942. Considered one of the most famous scientists of the late 20th and early 21st centuries, Hawking studied the mass and volumes of black holes.

At age 17, Hawking enrolled at Oxford University, followed by Cambridge University where he obtained his Ph.D. in applied mathematics and theoretical physics. While a student, he was diagnosed with a rare disease and given just two years to live. As the disease affected the motor neurons in his brain and spinal cord, he gradually became paralyzed.

Hawking threw himself into his research, studying the mass and volumes of black holes. He discovered something unexpected: Black holes can "evaporate," losing mass through a phenomenon now called Hawking radiation. Hawking was the first to set out a theory about the origin and development of the universe that included both the general theory of relativity and quantum mechanics.

Hawking became one of the most recognizable scientists of his time. His book, *A Brief History of Time*, has sold more than 10 million copies.

In 2017, Hawking celebrated his 75th birthday—an achievement that seemed impossible when he was diagnosed in 1961. Hawking passed in 2018 at age 79.

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Now that you know more about Stephen Hawking, find individuals that are holding the cards that match the following descriptions.

This individual worked as a professor of mathematics at Stanford University until the time of their death.

Their mathematical journey began with the outbreak of the French Revolution.

Grace Hopper

Grace Hopper (1906–1992)

From an early age, Rear Admiral Grace Hopper was interested in how things worked. Her fascination led to an eventual Ph.D. in mathematics from Yale. After teaching math at Vassar, Hopper tried to enlist in the Navy during World War II but was rejected for a number of reasons, including the belief that her teaching job was considered essential to the war effort. In 1943, Hopper took a leave of absence from Vassar and joined the United States Navy Reserve. Graduating first in her class, Hopper began work on computer programming.

After WWII, Hopper worked at Eckert-Mauchly Computer Corporation, where she proposed writing a new programming language using only English words—an idea so revolutionary it was rejected for three years. Hopper continued as a Navy reservist, where she developed pioneering computer technology for the Defense Department. There, she made perhaps her most commonly known and used contribution to the field: She coined the term "bug" for unexplained programming glitches and failures.

After retiring in 1966, Hopper was recalled the next year to active duty in order to standardize the U.S. Navy's computer languages. When she retired in 1986 at the age of 79, she was the oldest officer on active U.S. naval duty.

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Now that you know more about Grace Hopper, find individuals who are holding the cards that match the following descriptions.

After a personal setback, this individual eventually found work at NASA, becoming one of the first Black American computer scientists.

$E=mc^2$

This mathematician furthered Einstein's work.

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Maryam
Mirzakhani

Maryam Mirzakhani (1977–2017)

Born in 1977 in Tehran, Iran, Maryam Mirzakhani is considered one of the greatest mathematicians of her generation. Mirzakhani earned a bachelor's degree in mathematics in 1999 from the Sharif University of Technology in Tehran and went on to earn a doctorate from Harvard University in 2004. In 2008, Mirzakhani became a professor of mathematics at Stanford University.

Mirzakhani specialized in the study of theoretical mathematics, which forms the basic framework for all mathematical sciences. Mirzakhani became the first woman and the first Iranian to be awarded the Fields Medal, which is considered the most prestigious award in mathematics and comparable to a Nobel Prize. The medal is awarded every four years to outstanding mathematicians. Mirzakhani described herself as a "slow" mathematician, saying that "you have to spend some energy and effort to see the beauty of math." To solve problems, Mirzakhani would draw doodles on sheets of paper and write mathematical formulas around the drawings.

Mirzakhani died in 2017 of cancer. She is honored annually by the May 12 Initiative, which celebrates women in mathematics on her birthday.

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Now that you know more about Maryam Mirzakhani, find individuals who are holding the cards that match the following descriptions.

This individual published an open letter to Thomas Jefferson, using Jefferson's own words in the Declaration of Independence to challenge the founding father's beliefs on slavery.

This individual accepted a position at the University of California, Berkeley, almost a decade after being rejected by them.

Emmy Noether

Emmy Noether (1882–1935)

Emmy Noether was born in 1882 to a German Jewish family. She had planned for many years to teach French and English, but changed her plans when the University of Elangen announced it would allow women to attend.

Following her father's lead, she turned to mathematics. However, Noether continued to face discrimination. For seven years she worked without pay at the Mathematical Institute of Erlangen, filling in for her father when needed. When she was invited to lecture at the University of Göttingen, other colleagues opposed her hiring. Despite the challenges she faced, Noether continued her work and was influential in both mathematics and physics. Her work brought her fame, and influenced Einstein's theories and contributions to abstract algebra.

Noether continued lecturing in Germany until the Nazi government removed Jews from university positions. She eventually took a position at Bryn Mawr, a Pennsylvania college for women. Many of her students there also went on to make important contributions to mathematics.

Amplify Math

Now that you know more about **Emmy Noether, find individuals who are holding the cards that match the following descriptions.**

This individual dedicated his career to the study of set theory, number theory, function theory, and topology.

This individual is credited with popularizing the Greek letter π to denote the ratio of a circle's circumference to its diameter.

Qin Jiushao (1202–1261)

Born in China in 1202, Qin Jiushao was a mathematician, politician, inventor, and author.

Qin's primary occupation was politics. However, he is considered one of history's great mathematicians for introducing the symbol 0 (zero) into Chinese mathematics. His contributions also include the *Mathematical Writings in Nine Sections* textbook. Written in 1247, it is one of the earliest surviving Chinese texts. The text also includes sections on meteorology, surveying of fields, taxation, and military affairs.

Qin's interests extended beyond mathematics and included astronomy and meteorology, including the invention of Tianchi basins, instruments used to measure rainfall.

Now that you know more about Qin Jiushao, find individuals who are holding the cards that match the following descriptions.

This individual has a crater on the moon named in their honor.

This individual was awarded the National Medal of Science in 2013 by President Barack Obama.

AmplifyMath

Mary
Golda Ross

Mary Golda Ross (1908–2008)

Mary Golda Ross was born a member of the Cherokee Nation in 1908 in Park Hill, Oklahoma. Ross enrolled in Northeastern State University College of Education at age 16, earning a bachelor's degree in mathematics. She later earned her master's degree from Colorado State Teachers College.

Ross began her career as a teacher in rural Oklahoma, going on to work as a statistical clerk for the Bureau of Indian Affairs. She later became a mathematician in California with the aerospace and defense company Lockheed Martin, and later joined the Skunk Works team, a secretive mission to build the first American fighter jet for the Pentagon. Ross was the only woman on a team of 40 engineers. While much of her work remains classified to this day, we do know that she worked on aircraft design.

Ross retired from Lockheed Martin in 1973. Her legacy includes recognition from NASA for her mathematical contributions; encouraging young women and Native American youth to pursue engineering careers; and inclusion on the 2019 Native American $1 coin by the U.S. Mint, designed to celebrate the contributions of indigenous people to the space program.

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Now that you know more about **Mary Golda Ross, find individuals who are holding the cards that match the following descriptions.**
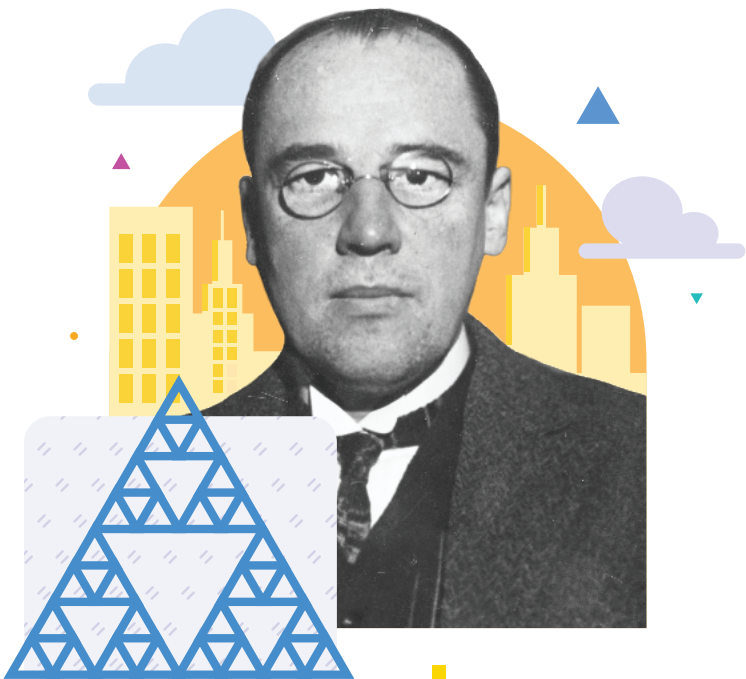
This individual earned a bachelor's degree in mathematics from Johns Hopkins University right before their 19th birthday.

This individual was born in Khorasan (present-day Iran) and translated the works of many Greek mathematicians.

Wacław Franciszek Sierpiński

Wacław Franciszek Sierpiński (1882–1969)

Wacław Franciszek Sierpiński was born in Warsaw, Poland, in 1882. Sierpiński enrolled at the University of Warsaw's Department of Mathematics and Physics in 1899 and was awarded a gold medal from the University of Warsaw for his essay on number theory in 1903. At the time, Poland was part of the Russian Empire, but Sierpiński was unwilling to publish his work in Russian. He didn't publish this important contribution to number theory for four years, until a magazine was willing to publish it in his native language, Polish.

Sierpiński worked as a math and physics teacher and dedicated his career to the study of set theory, number theory, function theory, and topology. When the school where he taught closed, he moved to Kraków, where he received his doctorate. He is perhaps best known for his creation of three fractals that now bear his name: the Sierpiński triangle, the Sierpiński carpet, and the Sierpiński curve. One way to think about a fractal is to imagine zooming in and out on a geometric pattern. If the pattern appears to be the same, you might be looking at a fractal.

Sierpiński retired as a professor at the University of Warsaw in 1960.

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Now that you know more about **Wacław Franciszek Sierpiński, find individuals that are holding the cards that match the following descriptions.**

This individual's work laid the foundation for space shuttles.

This individual was one of the first women to be nominated for the Royal Astronomical Society.

Amplify Math

Mary Somerville

Mary Somerville (1780–1872)

Mary Somerville studied mathematics and astronomy at a time when such studies by women were frowned upon by her well-connected Scottish family and by 18th-century European society in general. Somerville moved to England with her husband, but was unhappy there due to his belief that women should not pursue education. After his death, she returned to both Scotland and her studies and remarried to a second husband who encouraged her educational pursuits.

Somerville's work on the relationship between light and magnetism was published in 1826. In the 6th edition of *Connexion*, she and a group of others discussed a hypothetical planet—a prediction that came true in 1846 with the discovery of Neptune. Additionally, her 1848 book, *Physical Geography*, was the first English textbook on the subject. She also was one of the first women to be nominated to the Royal Astronomy Society.

Now that you know more about Mary Somerville, find individuals who are holding the cards that match the following descriptions.

This individual's answer to a combinatorics problem was the largest number ever used in a published mathematical proof.

This individual served until 1960 as a professor at the University of Warsaw, the same university where he enrolled in 1899.
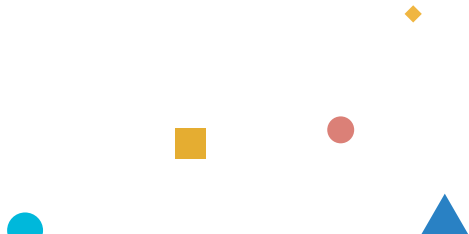
AmplifyMath

Mathematician profile cards

The Amplify Math
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on present-day mathematicians.

**Learn more about featured
mathematicians and Amplify Math
by visiting amplify.com/math.**

Answer key

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