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SELECT REVIEWS

I love science and math, but sometimes my enthusiasm is not enough to instill a love of these subjects in my 7th and 8th grade students. Leonardo da Vinci Gets A Do-Over is just the ticket! Learning about Leonardo da Vinci’s creative genius 500 years ago and watching as he struggles in the present day is both delightful and educational. Definitely a better way to learn than reading multiple textbooks!

—Pamela Breitberg, NBCT, Lead Science Teacher, Emiliano Zapata Academy, Chicago, IL

Friedlander has skillfully embedded academic concepts into this inventive and entertaining story. Through Leonardo’s time travel and the middles schoolers’ teamwork, this book makes social studies, language arts, foreign language, science, technology, engineering and math new and exciting!

—Mary Smigel, BSED/MSED, Elem./Gifted Education, Montessori Academy of Lancaster

What happens when present day American 8th grade students and their teachers go on a school trip to Florence, Italy and run into a man who claims to be Leonardo da Vinci arisen from the dead? In Leonardo da Vinci Gets A Do-Over, readers are treated to an intriguing view of history, mathematics, and science as these cross-century characters meet and exchange questions and explanations that help each other span a five century-long gap in knowledge. A fascinating and well-written story!

—Daniel J. Bisaccio, Director of Science Education, Brown University, Providence, RI

Teachers have a powerful new tool in this clever book. It beautifully blends one story across the entire curriculum. With non-stop action and fascinating content, students will be on the edge of their seats—making discoveries all along the way. Crossing the curriculum has never been so much fun!

—Sonya Smith, Curriculum Specialist, Center for Technology Outreach, Mississippi State University
Why Leonardo da Vinci?

Many know da Vinci as Florence’s leading artist. Indeed, he is best known as the artist who painted the Mona Lisa and The Last Supper.

Leonardo’s interests and achievements expanded well beyond his artistic talents. An illegitimate child, he was self-educated. He became famous in fields as far reaching as architecture, physics, astronomy, botany, geology, anatomy, hydraulics, machines, military weapons, and the concepts for hundreds of inventions.

In his quest to understand the workings of the human body he performed over 30 human dissections and diagramed in detail the human anatomy. He is considered by many to have been the father of the scientific method.

His note books, now referred to as codices, contained his observations on matters of philosophy and of science, nature and the human anatomy, mixed with his ideas for machinery involving gears and pulleys as well as inventions such as flying machines, a parachute, a submarine, a diving suit, an automobile, a bicycle and various military weapons.

Scholars consider Leonardo da Vinci as the genius of the Renaissance.

Leonardo was ambidextrous and often painted with either hand or sometimes with both hands. He was basically left handed and following the practices of Hebrew and Arabic writing. He wrote easily from right to left instead of left to right. This created his famous mirror writing which can only be read by looking at the writing in a mirror.

Translated from the mirror printing by Leonardo da Vinci from a codex not yet discovered.
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- Religion

Supplemental Resources

- Teacher’s Guide
- Glossary
- Further Reading
- More about Leonardo da Vinci
- Index
Excerpted from the Prologue

His last memory was of dying. It was May 2, 1519. As he lay in bed, trying to ignore the pain in his body, he felt life ebbing from him. The words that rang in his ears on that final day were words a strange gypsy woman has uttered when she had slipped into the bedroom in the early predawn hours a few days before. She spoke softly.

“Leonardo da Vinci, son of the high born notary, Ser Piero da Vinci and Caterina, a peasant woman, with whom he was not joined by law or the divine, your birth into this life was not as planned,” intoned the gypsy. “Your destiny was to have been for a future time. Your birth was a mistake. To correct this, you will be given a second chance, a chance to do what you might have done. This chance is yours because your potential has yet to be reached. You have more to give. But know this,” she warned, raising a crooked finger, “If you do not wish to die a second and more painful death, you must not waste your genius. You must invent or discover something for the betterment of all mankind.”

He was being rewarded as an admission that an error had been made in the scheduling of his birth. He should never have been born in the fifteenth century. He was being granted a do-over.
4. THE BICYCLE

The group flowed out of the Piazza della Signoria into the Via dei Leoni, which was lined with four-story houses and apartments. Each house had a front entrance with an arched, eight-foot door. The windows were shuttered and, at the roof level, a small overhang provided protection from the rain. Even in daylight, the narrow street stayed dark in shadows. The sidewalks on each side of the street were not wide enough for two people to walk side-by-side.

They had only walked a block when they reached the slightly wider Piazza di San Firenze. There, a few tables and chairs stood empty outside a small café. Just beyond were rows of bicycles standing in racks. Seeing the bicycles, Leonardo stopped and stared.

“My double-wheeled carriers,” he breathed, taking hold of Max’s arm and gripping it tightly to stop him, as well. “There they are. Look at them! Beautiful. Even more beautiful than I had imagined.”

In the latter part of the 15th century, Leonardo da Vinci had drawn a design for a bicycle. His design embraced all the details of a modern bicycle: both wheels were of the same size and driven by pedals attached to a large sprocket that drove a chain. The chain, in turn, drove a small sprocket affixed to the rear wheel. The only difference in concept was that his double-wheel carrier was to have been built entirely of wood with spokes of wooden rods for a wheel rimmed by an iron band. The “chain” was designed with leather loops.
Leonardo’s face reflected his total delight at the sight of the bicycles. He could clearly remember the moment when the idea had occurred to him. He had been in Milan under the employ of Ludovico il Moro Sforza, the Duke of Milan. To honor il Moro’s father, Duke Francesco Sforza, Leonardo, with the aid of his assistant Zoroastro, had carved a clay statue of a magnificent horse, 25 feet tall, to stand in the center of the Piazza del Castello. The clay statue was to be later cast in bronze to stand as a gigantic monument to the Duke’s late father. This would become the pride of Milan, just as the 17-foot statue of David in the Piazza della Signoria was the pride of Florence.

The concept of a bicycle had come to him when the city of Milan was on holiday with great pageants, parades, tournaments and triumphant processions. During the festivities, he noticed a young boy at play, rolling a wheel that had fallen from a cart. He thought about the fact that as long as the wheel rolled, it remained upright. It struck him that if he could connect two wheels with a frame and a pedal with a gear ratio such that a large gear connected to a smaller gear on the axle of the rear wheel, then a man seated on top of the frame between the two wheels would remain balanced, so long as he was moving. He would then have a vehicle to provide a fast mode of travel.

After calculating the mechanical advantage it could offer a traveler, he had longed to find a way to build such a machine. Unfortunately, he was not able to build it; the needed materials were never available. Now, here was his machine. He was ecstatic.

“Magnificent! It is exactly as I had envisioned. The whole concept is a mathematical marvel. Do you know what I mean?” He let go of Max, who rubbed his arm indignantly, while Leonardo waved his arms in his excitement.

Miss Willoughby laughed. “Your guide is delightful,” she said to Dr. Kastleboro.

“Ummm, Max?” Gina asked, turning to her friend. “What does a bicycle have to do with math?”

Max, still rubbing his arm from where the Maestro had gripped it tightly, responded, “Gina, the speed of the bicycle is related to gear ratio and the advantage one gear gives another.”
“What?”

“The gear in the front is a big wheel sprocket connected to the pedals. The smaller gear is a small wheel sprocket connected to the rear wheel. If the wheel sprocket on the pedals has, for example, 44 teeth, and the wheel sprocket on the rear has 11 teeth, then when the rider turns his pedals through one revolution, 44 teeth will go all the way around once, while the rear wheel sprocket will have had to spin around four times. This means that the rear wheel is going faster than the pedals are turning. It’s a simple matter of ratios: 44 to 11, or four to one.

“Next, you can figure the speed. If we took a measuring tape and measured from one edge of the wheel through the very middle of the wheel to the opposite edge of the wheel, we would know the diameter of the wheel. Let’s say that’s 28 inches. Oh, and no matter what that measurement was, you would have to use a tape measure of that length 3.14 times to go all around the wheel. When you round it, 3.14 is the number mathematicians call ‘pi.’ Then, using simple arithmetic and the formula for circumference—diameter times pi or, in this case, 28 x 3.14—we calculate that the circumference of each bicycle wheel is ...

here, Max paused for a moment to do the math. “... 87.92 inches. Then, if we divide that by the number of inches in a foot, 12, we would know that the circumference of the wheels on a 28-inch bike is 7.33 feet.”

Gina, who had been translating for Leonardo’s benefit, interrupted Max. “Slow down! Trying to understand what you’re saying is difficult enough without me having to figure out how to say it in Italian, too!”

Max grinned sheepishly and waited for Gina’s go-ahead before he kept talking. In the meantime, he took out a notepad and started jotting down numbers. When she nodded that he could continue, he showed them his calculations and said, “So each time you turned the pedals around once, the bicycle would travel 4 x 7.33 feet, or 29.32 feet, along the road. That’s because of the ratio I explained earlier, four to one: the rear wheel would turn four times for each revolution of the pedals. If you pedal at 60 revolutions per minute, you would go 1,759.20 feet along the road every minute. To figure out how far that is in an hour, you multiply the feet traveled each minute by 60, the number of minutes in an hour. That gets you 105,552 feet. There are 5,280 feet in a mile, so we would divide the 105,552 feet by 5,280 to get 19.99
miles traveled in an hour. That's essentially 20 miles per hour, much faster than you could walk.”

“Or you could just buy a speedometer,” said Neville, rolling his eyes.

“Now,” continued Max, ignoring Neville, “if you are using a 10-speed or even a 24-speed bike, there would be a lot more gear-ratio combinations to consider.”

“I think you’ve explained enough, Max,” said Tad with a grin. He was well acquainted with Max’s explanations and knew he could keep talking for at least another hour.

Leonardo had dropped to his knees to look more closely at the bicycle. “The materials. How extraordinary! And the wheels. Soft, yet strong. What is it?”

“That’s rubber,” Dr. Kastleboro explained. “Rubber is an elastic, flexible, tough material fabricated from the sap of a rubber tree. Here it is for a pneumatic tube.”

“Excuse me?”

“Pneumatic. It means that the rubber tube, or tire, is filled with air for a faster, softer, smoother ride.”

“What are these two-wheeled carriers called?”

“Bicycles.”

“Are they used by many people?”

“Millions and millions, all over the world,” said Dr. Kastleboro, wondering if this actor was enjoying the joke of feigning total bewilderment. He had to be admired, though, because he seemed so genuine.

Leonardo was astonished. “ Millions?” If his invention was being used by people throughout the world, then he had already invented something for the betterment of mankind! He turned to Kastleboro. “How long has my machine been used?”

“Sorry, Maestro, but it is not really your machine.”

“But my design?”

“Unfortunately for humankind, your codices were lost for many centuries after your death. You surely remember that you left all of your notebooks with your assistant, Francesco Melzi. Well, he tried to organize them, but he never finished. When he died, his family gave them away, and soon, they vanished. It was several
centuries before many of your notebooks were discovered. The one with your bicycle drawing wasn’t discovered until your Codex Atlanticus was being restored in the middle of last century.

“No one knew about your design when the first bicycle was invented. The first practical bicycle was built out of wood with metal wheels in 1865. In the first design, the front wheel was larger than the back wheel and the pedals to turn the big front wheel were connected directly to the wheel itself. Obviously, the larger the wheel, the more distance covered with each revolution and the faster the bicycle could go. So people kept making the front wheels bigger and bigger. By 1870, the bicycle was made entirely out of metal with solid rubber tires. It took another generation to develop a bicycle like the ones you see here, and like the one you designed. Your concept was correct, it’s just that it wasn’t seen until long after the bicycle as we know it was invented.”

Leonardo knelt beside a bright red bike and ran his hands over the machine, testing the texture of the black plastic seat, the metal frame, and the rubber tires. He studied the chain.

“Magnifico! It is almost exactly as I had envisioned. And the materials! How wonderful ...”

At that moment, a young man in his late teens or early twenties came out of a café and approached the group. His hair was long, and he wore an oversized Levi jacket, low-crotched pants, and a backward Dodgers baseball cap.

“Hey, whatcha doing with my bike?” he said in Italian.

Gina responded first. “Niente, niente. Our friend was just admiring it. Believe it or not, he’s never ridden a bike.”

“It’s a beautiful machine,” said Leonardo.

“Yeah. Hey, you kiddin'? Never rode a bike before?” he asked.

“They didn’t exist when I grew up.”

“Man, what century you been living in?”

“You have no idea,” said Gina.
“This is cool,” said the boy. Then he added, “Look, signore. I like your gig,” pointing to Leonardo’s leggings, tunic and cape. “I’m thinking about acting, too, when I finish school. Look, if you’d like to give the bike a try, I’ll show you how.”

“I would be honored,” said Leonardo.

The youth removed the bike from the rack. “Hop on,” he said. “I’ll give you a little push and you’ll be ...”

Before he could finish his sentence, Leonardo was astride the bike.

The youth continued. “When I give you a push, you’ve got to pedal to keep your speed and balance.”

“Tell him about the brakes,” said Max.

Gina quickly stepped up to the Maestro and said, “The brakes to stop the bike are on the handle.” She pointed to the two brake levers. “Squeeze the right one for the rear wheel and the left one for the front wheel,” and she demonstrated. “But be sure to squeeze the right one first.”

Before more could be said, the boy gave Leonardo a hard push. The bike and rider went flying down the narrow street, his purple cloak flapping behind him like a fluttering flag and the bicycle wobbling dangerously. “The right handle first!” shouted Gina.

“Vai! Vai!” The boy hollered with great enthusiasm.

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