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Leonardo da Vinci

The Genius of Wonder

by Kathryn Erskine

illustrated by Ivan Pesic

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Leonardo da Vinci

The Genius of Wonder

by

Kathryn Erskine

illustrated by *Ivan Pesic*

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1

Curious Child

Serpents will be seen at a great height in the air, fighting with birds.

Answer: *snakes carried by flying birds*

As a boy, Leonardo loved exploring the hills around his village. One day, he discovered a cave and stepped inside. He shivered as he felt the cold air and heard his footsteps echo. As his eyes adjusted to the dim light, he noticed something shocking embedded in the cave wall.

A whale fossil! How did a whale fossil get inside a cave? Up in the hills? Far from the ocean?

In the fifteenth century, there appeared to be no answers to many questions, or at least none that made sense. People often believed in superstitions or attributed anything they didn't understand to acts of God. If Leonardo wanted answers, he would have to try to find them himself.

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embedded: enclosed or inserted
fossil: a preserved piece or impression of an ancient plant or animal
superstitions: beliefs not based in fact
attributed: explained as being caused by

And Leonardo had a *lot* of questions. Why was the sky blue? How were clouds made? What made water flow? What made mountains high or low? How did birds fly, and could humans fly too?

Fortunately, Leonardo had a tool that helped him make discoveries. It was a simple tool that everyone has: observation. He watched—carefully—how birds used their wings. He looked at the shape, movement, and color of clouds and how water flowed around rocks in a stream. He loved animals, so he enjoyed observing cats stretching, dogs running, and horses pulling carts.

Leonardo da Vinci

Leonardo was born on April 15, 1452, near the town of Vinci, Republic of Florence (now part of Italy). Leonardo da Vinci *means Leonardo from Vinci. He was baptized in a local church that still stands today. He lived with his mother until he was five, then with his nearby grandparents, as his father worked in the city of Florence.*

Leonardo loved birds in particular. He was fascinated by their ability to fly. One of his earliest memories was of a kite, a bird that's like a hawk. It swooped down to his cradle. The bird didn't hurt him, and Leonardo wasn't scared. He was simply, as always, curious.

observation: the act of watching carefully to gather information
baptized: dipped in or sprinkled with water to become part of a Christian community

Observation Game

To improve observation skills, Leonardo made up a game. Draw a line on a wall (or a piece of paper or whiteboard). Have your friends stand some distance away and try to cut a piece of straw to the same length as the line. Whoever comes closest is the winner.

Leonardo was excellent at drawing. He sketched plants and nature even as a young boy. Leonardo's artistic talent and keen observation skills probably helped him understand what he observed. They helped him see the connections in nature. For example, he sketched rivers as they branched off into smaller streams, just like how the trees he sketched branched off into smaller branches and twigs. He wondered . . . were blood vessels in the human body designed that way, too?

Leonardo had plenty of time to explore and observe as he roamed the countryside around his small village. His father, a notary, lived in the big city of Florence with his stepmother. A notary was like a lawyer. Usually, the son of a notary would train to be a notary, too. He'd attend a Latin school with classes that included Latin, Greek, literature, philosophy, and debate. However, the guild, or association, of notaries didn't allow children of unmarried parents to become notaries.

blood vessels: small tubes that carry blood through the body
philosophy: the study of ideas about knowledge, truth, and the meaning of life

Leonardo's parents never married, so he wasn't sent to a Latin school. That was likely a relief for Leonardo. He was a daydreamer and easily distracted. He preferred roaming the hills, exploring, thinking, and sketching.

Renaissance Games

People in Leonardo's time played some of the same games we still play today—cards, marbles, dice, and board games like chess and backgammon. Outdoors, children played tag, leapfrog, hopscotch, and ball games.

He may not have gone to a Latin school, but Leonardo knew he wasn't ignorant. He wrote, "Odi somma stoltizia di quelli i quali biasimano coloro che 'mparano da la natura." That means it's foolish to fault people who learn from nature. Being curious, observing nature, thinking, and questioning were all skills that helped him understand his world. He was on a mission to discover answers to many of the unresolved questions of his time. And he was in luck. A recent invention could well help him.

The same year Leonardo was born, 1452, Johannes Gutenberg, the inventor of the movable-type printing press, opened his publishing house. Now many more books on a variety of topics were available. Most were in Latin,

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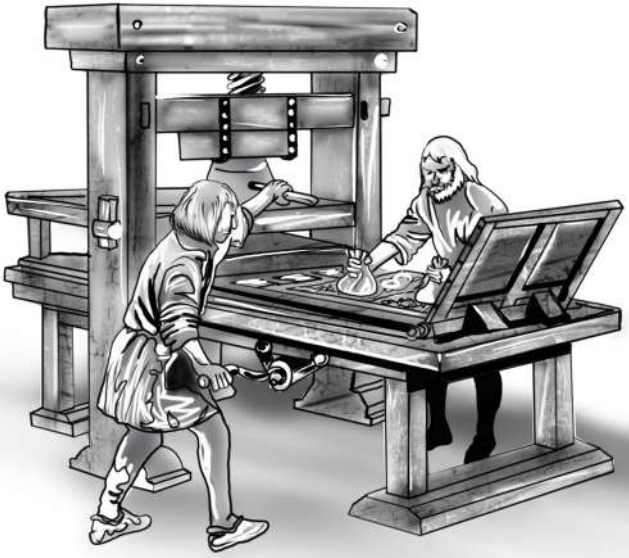
Renaissance: a period of European history from about the 1300s to the 1500s when renewed interest in ancient Greek and Roman ideas led to new ways of thinking about the world

movable-type printing press: a machine that can be used to mass-produce printed pages by arranging individual metal letters to form the text on each page

which Leonardo couldn't read. And they were expensive, so he couldn't afford them. But his father, a wealthy notary in Florence, could. If only Leonardo lived close enough to borrow those books. If only he had the ability to read them.



The Printing Press: A Revolutionary Invention

Before the invention of the printing press, books had to be written by hand. That meant there weren't many books in the world. In Europe, most were religious texts that monks painstakingly copied. Very few people owned even one book. After the printing press, many more books were available, and while they weren't cheap, it was possible to own some, or at least read them. Because there was no TV, radio, Internet, phones, or newspapers, books gave people access to information they'd never had before.

monks: men who live apart from society and devote their lives to religion

Leonardo's Riddles

Leonardo was curious and loved learning. He also loved to have fun, whether by playing outside or making up riddles like this one:

The skins of animals will cause men to shout.
Answer: *balls made from animal skins, used to play games*

See if you can solve Leonardo's riddles at the beginning of each chapter!

2

Student

Food shall be taken out of the mouth of many.

Answer: *an oven*

When Leonardo was twelve, his life changed. His father brought him to live with him in Florence. Unlike the small village of Vinci, Florence was a city of forty thousand people. It had expanded beyond the medieval walls that once surrounded it. Inside the walls, it was crowded and noisy. People shouted, hawked their wares, and called out the daily news.

The city was also smelly. The animals smelled, and so did the people. There was human waste in the street as well as horse and ox droppings. People sometimes wore pattens, or wooden platform attachments for their shoes, to stay above the mud and muck. They didn't bathe often because there was no running water, so it was a chore to

medieval: of or relating to the period of European history from about 500 CE to about 1300–1500
hawked: offered for sale
wares: items for sale

haul and heat water to take a bath. Germs and disease spread easily. Rats and fleas were common.

It must have been quite an adjustment for Leonardo. Curiosity took over, though, alongside his observation skills. With less nature around him, he spent his time watching people. How could he draw faces that looked realistic? There were so many to choose from! He wondered how the buildings were constructed. The cathedral was so huge, it could be seen from fifteen miles away. How did such giant buildings stay upright? That tower in Pisa was already leaning.

Carnival in Florence

An extravagant festival called Carnival was held in many European cities as a final party before Lent, the forty-day period before Easter. Lent was a time for fasting and prayer. Florence's Carnival was especially grand. There were torchlit parades and musicians, and everyone was allowed to dance in the street. Lorenzo de' Medici, who ran Florence, even wrote songs for the event.

In Florence, Leonardo went to school for the first time. It was an abacus school. Unlike a Latin school, an abacus school mostly taught math. It was considered the most practical subject for the working world. Leonardo loved math. And he did what he always did. He asked a

cathedral: a church headed by a bishop
extravagant: extremely elaborate
Lent: a period of forty days before Easter that some Christians observe by fasting and repenting for sins

lot of questions. "Al pittore è necessario le matematiche" (The painter needs mathematics), Leonardo wrote. His teacher was often unable to answer Leonardo's questions.

Reading and writing were important in Leonardo's family. The year he moved in with his father, the first printing workshop opened in Italy. It was soon followed by others. These workshops printed books in Italian rather than Latin, so Leonardo could read them. And he did.

Leonardo read whatever he could. He had so many questions about the world. He wanted to learn what people had already discovered—great minds like Aristotle—and what people were currently discovering. More knowledge helped spur his own ideas. "L'acquisto di qualunque cognizione è sempre utile allo intelletto" (The acquisition of any knowledge is always useful to the intellect), he wrote.

His father probably helped him learn to write. In fact, Leonardo's handwriting ended up looking like his father's, except for one thing. Leonardo wrote backward.

Leonardo's Mirror Writing

Some people think Leonardo wrote backward because he was being secretive and writing in code. It's more likely he wrote that way for a practical reason. Being left-handed meant smudging wet ink as you wrote. If you could write backward, the paper wouldn't get smudged. People could always hold your writing up to a mirror to read it!

acquisition: the act of gaining something

In his spare time, Leonardo liked to have fun. He enjoyed practical jokes and making up riddles. He continued to draw and explore the city.

When Leonardo was fourteen, the Arno River flooded. The river ran through Tuscany, the region where Florence is located. Leonardo was awed by the power of water. It left a random mess of items everywhere. He wondered, was there a way to prevent a flood? Could you use the power of water for good? What if you could channel water out of the way to save lives and prevent damage to property?

Something else momentous happened when he was fourteen. It was time for him to be apprenticed. That meant finding an expert in some trade for Leonardo to live and work with. For the price of hard work, an expert would provide a novice with room, board, and training in their trade.

Leonardo's father had done some notary work for one of the most famous artists and engineers in Florence, Andrea del Verrocchio. When he showed Verrocchio some of Leonardo's sketches, Verrocchio was impressed. He happily gave Leonardo an apprenticeship.

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random: having no clear pattern or purpose
momentous: extremely important
apprenticed: assigned to work for, and learn from, a skilled worker
trade: type of work
novice: beginner
engineers: people who design or build structures or machines

Leonardo may have been both nervous and excited as he moved into Verrocchio's studio with the other apprentices and employees. They would be like his new family. He would eat and sleep above the workshop. During the day, he'd do what he loved and learn from an expert in his field.

Leonardo's Meals

In Leonardo's time, it was customary to eat only two meals a day: lunch and dinner. Both meals were likely to consist of bread and soup. If people ate anything in the morning, it would be something simple like a piece of bread to tide them over until lunch. The word breakfast *means to break the fast between dinner and the next meal.*

Cityscape

Florence, like many cities, was a jumble of large, wealthy homes, small cottages, and workshops, all mingled together. However, very smelly businesses such as slaughterhouses and tanneries weren't allowed in the city center. Also, if a business was dangerous, it had to be on the outskirts of the city. The furnaces used in glassmaking posed a fire hazard. In Venice, another Italian city made up of many islands, glassmakers' workshops were only allowed on the island of Murano.

customary: usual
tanneries: places where animal skins are made into leather
furnaces: enclosed structures in which heat is produced

3

Artist

Feathers will raise men, as they do birds,
toward heaven.

Answer: *by the letters that are written with quills*

At his father's house, Leonardo had been the only child. At Verrocchio's bottega, or workshop, he was now a part of a group of boys—girls were rarely apprenticed—and craftspeople. They loved art like he did. Even chores like making brushes and crushing clay and minerals to create paints were more fun with a group.

Verrocchio was a great teacher. He showed Leonardo the importance of anatomy, geometry, and light and shadow in art. He was also very kind. Because he was not particularly good at meeting deadlines himself, he wasn't strict with Leonardo, either.

For one of Leonardo's early projects, his father brought him a wooden shield that someone back in Vinci wanted to have painted. Leonardo decided to create something

minerals: naturally occurring nonliving materials
anatomy: the study of the structure of living beings
geometry: a kind of math that deals with shapes and figures

spectacular. He made the shield look like a scary dragon head. He covered it with parts of actual snakes, bats, lizards, and insects. It took him so long that the dead animal parts began smelling up the bottega! The monster's face was so realistic that when Leonardo's father saw it, he jumped back in surprise. He was impressed! Leonardo's father bought another shield to give to the man in Vinci so he could keep Leonardo's creation for himself.

With practice, Leonardo improved his drawing and painting. He learned about proportion, perspective, and chiaroscuro. Chiaroscuro is the contrast between light and shadow. These techniques helped him create people and objects that looked three-dimensional and realistic. That was important to him. He wrote, "Il pittore . . . è come lo specchio" (The painter . . . is like the mirror).

In addition, he perfected a technique called sfumato. Sfumato involves blurring colors and edges into each other. Leonardo didn't outline elements in his painting. Instead, he blended paint into shadow. He often used many layers of paint. Sometimes he even used his finger to spread the paint and blur edges. It made the people and scenery in his paintings look more natural. Leonardo's use of sfumato changed how artists approached painting portraits.

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proportion: the relationship between parts of different sizes
perspective: point of view
three-dimensional: having length, width, and height

Proportion and Perspective

Proportion is the relative size of elements in art. For example, a baby's head makes up about one-fourth of the body. An adult's head is only about one-eighth of the body.

Perspective refers to the way things look smaller and more clumped together the farther away they are. As Leonardo put it, "Among objects of equal size, that which is most remote from the eye will look the smallest." Think about looking at a road stretching into the distance. It looks wider right in front of you. As you look down the road, the sides seem to get closer. Eventually, they disappear into a point in the distance. This is called the vanishing point.

Verrocchio let Leonardo help with a painting that included a dog and fish. Because Leonardo had studied nature and animals so much, he was able to paint them very realistically. Next, Verrocchio allowed Leonardo to paint one of the angels in a painting called *The Baptism of Christ*. Leonardo's angel was so much more natural and realistic than the angel Verrocchio painted that after seeing Leonardo's work, Verrocchio apparently said he would never paint again.

Leonardo was gaining a reputation as an incredibly talented artist. What made him stand out was how he painted people, animals, and nature so realistically. Instead

angels: spiritual beings who serve God

of painting stiff, symbolic caricatures, Leonardo made everything look natural, so people felt they were looking at something real rather than a stylized work of art.

Verrocchio was given a special project that Leonardo would be part of. He was to work with a team to put a two-ton ball on top of Florence's cathedral dome. The project involved math, physics, and engineering, and Leonardo enjoyed it even more than painting. It took two years and a lot of machinery. Leonardo was fascinated by the cranes and hoists and gears the workers used. He sketched many pages of designs for cranes and gears, which helped him understand how they worked.

Leonardo also enjoyed making items for shows and pageants. The wealthy Medici family ruled Florence and held glamorous stage events. There was plenty of opportunity for Leonardo to use his creativity—and his gears and cranes. He made devices that could suspend actors over the stage as if they were flying.

When Leonardo turned twenty, he was deemed a master painter. That meant he could open his own studio. However, he liked his life at Verrocchio's bottega

symbolic caricatures: drawings that use symbols instead of realistic representations to identify their subjects
dome: a rounded roof
cranes: machines with swinging arms used to carry heavy weights
hoists: machines used for lifting things
gears: wheels with points around the outside edge of a machine or mechanism
pageants: elaborate shows

so much that he stayed another five years. During that time, he produced two Madonna and Child paintings, or paintings of the Virgin Mary with a young Jesus. He used his baby stepbrothers as models for the chubby infant Jesus's short, stocky arms and legs.

One time, Leonardo went to Vinci to visit his mother and walked around the hills like he had as a boy. He sat down and made a detailed sketch of just the landscape. This was unusual because artists at the time only used landscapes as backgrounds for people or religious figures. This sketch is considered the first drawing of a landscape in Western art. It's also the first drawing that we have from Leonardo.

Detecting Leonardo's Work

Because multiple painters in a bottega often worked on one painting, it's not always easy to tell who painted what. But there are some clues that can help. Verrocchio used egg tempera and Leonardo used oil paint, so anything in oil is more likely by Leonardo. Even in sketches we have a clue. When right-handed people draw diagonal marks for shading, the slashes usually go from bottom left to top right. The left-handed Leonardo drew them from bottom right to top left. Finally, Leonardo left his fingerprints on his artwork because he used his fingers to spread the paint.

religious figures: people or other beings who are important in a religion
egg tempera: a kind of paint made with egg yolk
diagonal: slanted

While still at Verrocchio's bottega, Leonardo created his first nonreligious painting. It was a portrait of sixteen-year-old Ginevra de' Benci. The portrait was not only very realistic, it also revealed how she was feeling. Leonardo wanted to show not just realism but also emotion. Her heavy eyelids made her look sad. Looking at each eye individually, it seems as if Ginevra is staring at the onlooker.

One way Leonardo was able to "get under the skin" and understand his subjects was to, literally, get under the skin. He dissected animal and human bodies to see how the muscles and tendons and bones were connected. Learning anatomy helped him see how bodies worked and moved. It helped him paint more realistic people and animals.

Medicine in Leonardo's Time

Leonardo's dissection work was groundbreaking because even people in the medical field didn't understand anatomy very well. Medicine in the Middle Ages and early Renaissance relied heavily on herbs and folk remedies rather than rational explanations or scientific facts. For example, because wild pansies have heart-shaped petals, they were believed to help, or ease, problems of the heart. They were even called "heartsease."

dissected: cut up into separate parts to study them
tendons: tough bands of tissue that connect muscles to bones
groundbreaking: introducing new ideas or methods

At twenty-five, Leonardo opened his own bottega. It was not a commercial success. He received three orders for paintings, but he didn't finish two of them and never started the third. Even the unfinished paintings, *Adoration of the Magi* and *Saint Jerome in the Wilderness*, were recognized as being groundbreaking. However, he could only get paid for finished work.

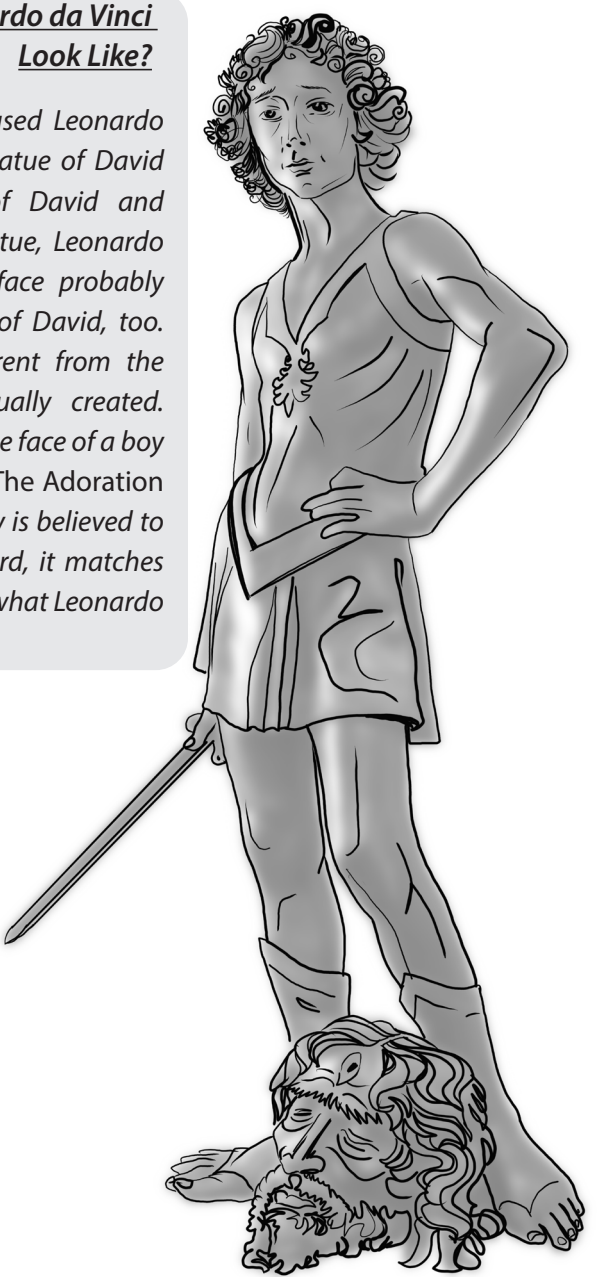
Perhaps Leonardo had such trouble finishing projects because he was a perfectionist. He didn't think he'd be able to produce an entire work at the high level he and others expected. Or perhaps he had so many ideas that he couldn't focus on just one thing. "La mente salta 'n uno attimo dall'oriente all'occidente" (The mind leaps in an instant from East to West), he wrote.

So much is unknown about Leonardo himself, but we know a great deal about the things he created—creations that offer their own kind of window into the man that he was. What he felt or thought about a number of issues in many ways remains a mystery.

perfectionist: someone who expects themselves to do things perfectly

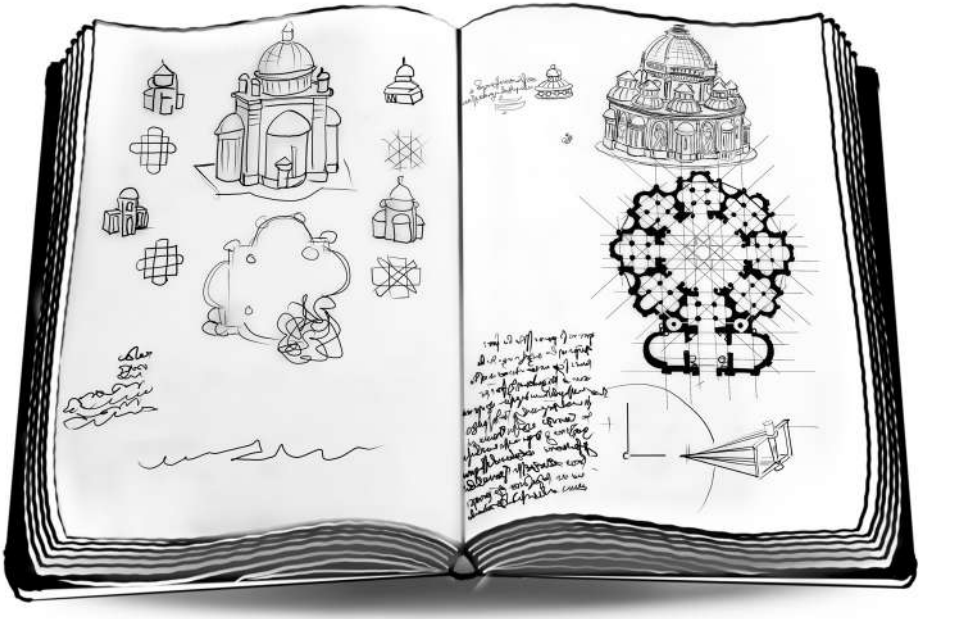
What Did Leonardo da Vinci Look Like?

Verrochio likely used Leonardo as a model for his statue of David (from the legend of David and Goliath). Like the statue, Leonardo had curly hair. His face probably looked like the face of David, too. Why? First, it's different from the faces Verrocchio usually created. Second, it looks like the face of a boy Leonardo painted in The Adoration of the Magi. *That boy is believed to be a self-portrait. Third, it matches other descriptions of what Leonardo looked like.*



Leonardo's Commonplace Books

A commonplace book is like a journal for sketching and writing down ideas. Leonardo's commonplace books contain everything from recipes and riddles to tanks and towers. We call them notebooks or codices (singular codex), another name for books. They're often named after the person who owns them or the place where they're kept. For example, the Codex Ashburnham was bought by Lord Ashburnham in 1870. The Codex Madrid is in Madrid, Spain. The Codex Atlanticus is so called because Leonardo's notes were pasted onto large sheets of paper the size of an atlas. You can search some codices online and see Leonardo's actual sketches and notes. Today, about 7,200 pages of his notes exist—probably only about one-quarter of the pages he produced. Imagine writing 30,000 pages of your ideas!



4

Polymath

Oxen will be the cause of the destruction of cities.

Answer: *Oxen pulled carts that held cannons.*

Leonardo wanted to create machines as well as art. In 1482, shortly before his thirtieth birthday, he decided to move to Milan—a city three times the size of Florence. It was filled with polymaths like himself. A polymath is someone who is good at a wide array of subjects. In addition to being skilled at art and science, Leonardo was also a musician. He had an excellent singing voice. He taught himself how to play the *lira da braccio* (literally, "arm lyre"), an instrument resembling the violin.

When Leonardo left for Milan, Lorenzo de' Medici, ruler of Florence, sent him with a gift for the powerful Ludovico Sforza, the acting—though not yet official—Duke of Milan: a lira da braccio. Leonardo had made it partly out of silver and in the shape of a horse's head. Lorenzo hoped that the duke would be pleased with the beautiful instrument—and with Leonardo. He was

duke: a ruler of a territory called a duchy

probably hoping Milan would want to be allies with Florence. Leonardo was probably hoping that Sforza would hire him.

The ruler of Milan needed polymaths. He wanted them to create machines, design buildings, make huge statues, and invent weapons for battle. Leonardo wrote to Sforza and told him all the things he could do. He knew that Sforza wanted to keep Milan among the most powerful of the Italian city-states, so Leonardo emphasized the war machines he could make. He said he could make big guns, attack vehicles, and bombardment machines that would frighten and confuse the enemy. Despite being a renowned artist, he only mentioned at the end of his letter that he could also paint, almost as an afterthought.

Italy in Leonardo's Time

In Leonardo's time, Italy was not united as one country. There was often warring between the city-states. Florence was a republic, so people voted for their leaders. However, it was basically run by the Medici banking family. Milan was a duchy, not a republic. It was ruled by the powerful Sforza family, led first by Francesco Sforza, then later by his son Ludovico. Milan was a military threat to Florence.

bombardment: the act of hurling large stones or other missiles
renowned: well-known and celebrated
republic: a government in which citizens vote for people to represent them
duchy: a territory ruled by a duke or duchess

Leonardo opened a bottega in Milan. However, just like in Florence, Leonardo didn't make much money because he didn't finish his work. Still, he kept paying his employees. He even hosted his friends despite being almost broke. He likely borrowed money from his father, who often helped him get commissions for individual art projects.

Leonardo was kind and generous and charming. He cared more about people than about money. He was a supporter of the arts. For example, one of his pupils, Atalante Migliorotti, was musically gifted. Leonardo taught him to play the lira da braccio. When Atalante decided he liked music better than art, Leonardo didn't try to make him stay at the bottega. Atalante went on to a career in music and making musical instruments. Leonardo wanted Atalante to be able to pursue his dream, just like he was.

As always, Leonardo loved animals. When he saw someone selling birds in cages, he'd buy the birds and immediately let them fly away. In fact, he cared so much about animals that he was a vegetarian. He wondered why anyone would eat animals when there were plenty of combinations of plants to make interesting dishes.

commissions: works produced upon request in exchange for payment
vegetarian: someone who does not eat meat

Leonardo the Vegetarian

Leonardo's favorite meal was minestrone soup. It appears he was also a fan of salad because he wrote at least a partial salad dressing recipe in his notebook:

- *10 parts parsley*
- *1 part mint*
- *1 part thyme*
- *vinegar*
- *salt*

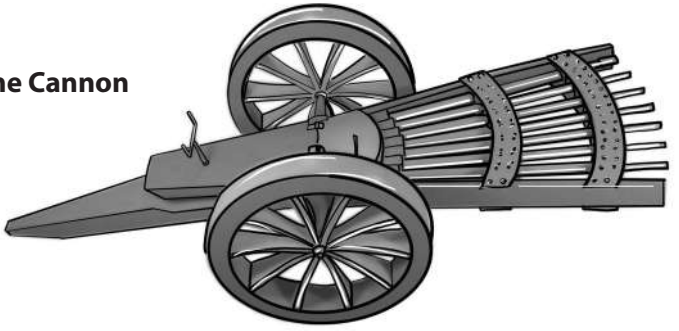
If you combine these ingredients with three times as much olive oil as vinegar, you can make a tasty dressing!

Leonardo had made sketches while in Florence, but in Milan he became serious about keeping notebooks. However, paper was expensive. Because of that, he wrote in tiny letters, usually on both sides of the page, and filled in any empty spaces with recipes and shopping lists.

Leonardo applied to Ludovico Sforza for commissions, like designing a tower for Milan's cathedral, but was rejected. Perhaps it was because the ruler of Milan didn't want someone from Florence. Or maybe he didn't want someone who wasn't well educated. Whatever the reason, Leonardo refused to give up. He wanted Sforza to be his patron. A patron was someone who paid an artist to produce art, either in cash or in room and board. A particularly wealthy or generous patron might provide a regular salary, a personal studio, property, or even a title.

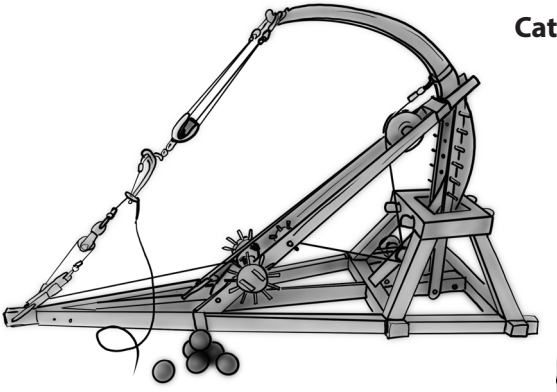
title: a word or phrase attached to someone's name that shows noble rank

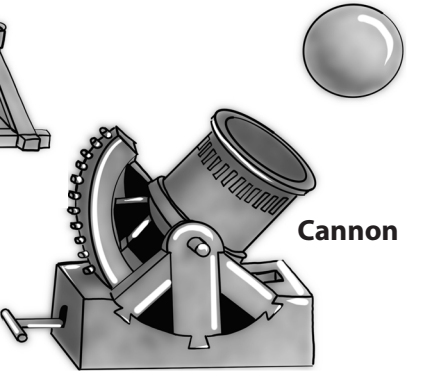
In between his artwork and inventions, Leonardo continued to design a variety of weapons, such as tanks, guns, and catapults. He wanted to show Sforza that he could be a valuable military engineer. But only one of Leonardo's military inventions—the wheel lock, a part for a gun—was ever actually built.



Multi-cane Cannon

Catapult





Cannon

catapults: machines used for hurling missiles

Leonardo tried to solve all kinds of problems, even the plague that hit Milan in the 1480s. It spread fast and was deadly. Although no one knew it then, the disease was spread by bites from fleas. The fleas were carried by rats that traveled on ships. Leonardo saw that the disease spread quickly in the dirty, crowded streets of Milan. In the countryside, the disease was much less prevalent. How could he design a city that would improve sanitation and promote health?

Leonardo's city plan had wide streets on two levels. The top level was for homes and pedestrians, and the bottom was for carts and deliveries. Leonardo's design certainly would've helped prevent the spread of disease and many deaths. However, it would've been a huge undertaking and very expensive to put into place. Would the ruler of Milan take Leonardo's advice for a healthier city?

plague: a disease that spreads quickly and has a high death rate
sanitation: the process of keeping things clean
pedestrians: people who are walking

5

Renaissance Man

Happy will they be who lend ear
to the words of the dead.

Answer: *Those who learn from reading will be happy.*

When Ludovico Sforza finally hired Leonardo, it wasn't to be a city planner, or a military engineer, or even a sculptor or painter. The plague had died down, and the duke wanted to have fun. He asked Leonardo to join his court to produce pageants and be an entertainer.

Leonardo had done that in Florence, but now the spectacles were grander, featuring flying mechanical birds and winged people, actors portraying gods and planets. He painted the sets, designed the special effects, and made lavish costumes.

To further amaze the guests, he built a self-propelled cart and a robot knight. The knight had hidden gears inside so it could sit and stand. It could also raise the visor of its armor and wave its hand. Leonardo likely created the first humanoid robot ever.

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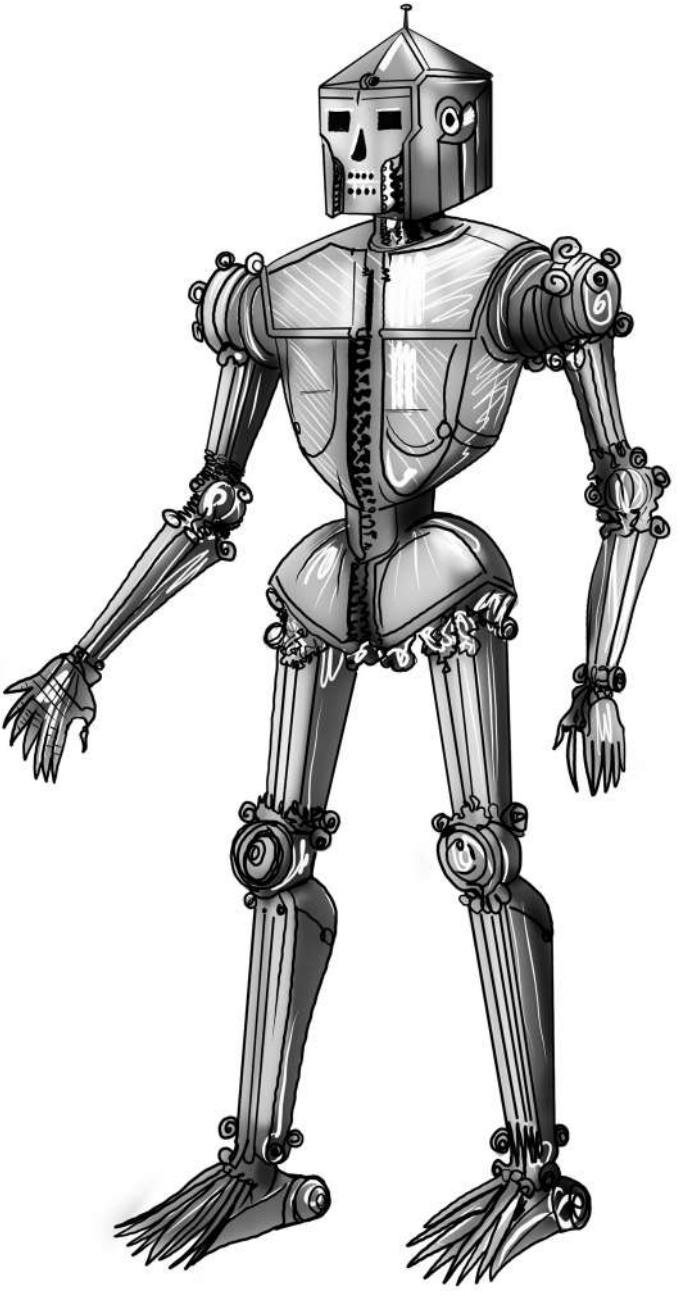
court: the residence, officers, and advisers of a ruler
lavish: excessive
self-propelled: able to move by its own power
humanoid: having the form of a human



Leonardo's Robot Lion

After his robot knight, Leonardo later built an automated lion. It could walk and shake its head, so it looked alive. Leonardo created it for a procession welcoming the French king to Milan after the city's conquest by France. Because lilies are a symbol of France, the lion opened its chest and threw balls full of lilies into the procession.

Being part of Sforza's court allowed Leonardo to spend his time with other great polymaths, like his friend Donato Bramante, a famous painter and architect. Bramante produced pageants with Leonardo and told stories. Sforza hired Bramante to design a dining hall for the Santa Maria delle Grazie convent—the same place where he would later hire Leonardo to paint *The Last Supper*.

Another friend, Luca Pacioli, helped Leonardo understand geometry. And with Francesco di Giorgio, an engineer, Leonardo discussed measurements and proportions. Leonardo was fascinated to learn about Vitruvius, a Roman engineer and architect. Vitruvius said that the ideal human form was to have a height identical to one's arm span, among other things. From these ideas, Leonardo came up with his own work on human proportions, called the *Vitruvian Man*.

automated: able to operate on its own
architect: someone who designs buildings

Renaissance Man

The Renaissance, meaning rebirth, began in the fourteenth century in Italy. Over the next couple of centuries, it spread to the rest of Europe. It was a rebirth of ideas discussed in early Greece and Rome: science, literature, architecture, and philosophy, including questioning and examining ideas. Calling someone a Renaissance man today means they have a lot of knowledge, talents, and interests. What we call a Renaissance man was called a "universal man" in Leonardo's day. That meant a polymath and also someone who had skills like being a good conversationalist and a responsible citizen.

Leonardo helped entertain the court by writing fables and parables, along with his riddles. Sometimes he sang his stories while he played his lira da braccio.

Leonardo's Parable of the Cedar Tree

Here's a story Leonardo wrote. What do you think it means?

The cedar was arrogant because it knew it was beautiful. It ordered the removal of all the ugly trees around it. However, those trees had been protecting the cedar from the wind. The wind now tore up the cedar by its roots and threw it on the ground.

When he wasn't working for the duke, Leonardo still found time to entertain his friends. He played tricks on them, but he also did his best to awe them. Sometimes, he made small, hollow wax animal figures that he filled

conversationalist: someone who is good at talking to people
fables: short stories intended to teach a lesson
parables: short stories intended to teach a moral or religious idea
awe: amaze

with warm air. Because warm air rises, the wax figures would float above his friends' heads, creating a delightful spectacle, until the air cooled.

Seven years after Leonardo moved to Milan, Sforza finally hired him to create a huge bronze statue of a horse ridden by Sforza's father in full armor. Leonardo first created a clay model that was about twenty-four feet high. At that time, France was vying with Spain to control parts of Italy. This meant that Leonardo was unable to work in bronze because the metal had to be used to make weapons for the war instead. So the statue was never cast in bronze, and sadly, the clay model did not survive.

The duke also commissioned Leonardo to paint the ceiling of a room in his palace. Leonardo set to work. His vision was to make people feel like they were standing under trees and looking up through leafy branches, barely able to see the sky.

While Leonardo did the creative work, his assistants handled chores like grinding pigments for paint, just as he had when he was a boy in Verrocchio's bottega. And, like Verrocchio had done for him, Leonardo taught his apprentices about proportion, perspective, chiaroscuro, and sfumato. One boy Leonardo took on was a ten-year-old boy from a poor family. Gian Giacomo

bronze: a metal made of copper and tin
vying: competing
pigments: substances that give color to other materials

Caprotti became more like a son. He was soon nicknamed Salai, or imp, because he was a rascal. He stole money regularly. He broke things. He wasn't even a very good artist.

Still, Leonardo cared for him. He bought Salai lots of stylish clothes and shoes. Once Salai even stole the leather for his own clothes and sold it for candy. According to Leonardo's notes, Salai "cienò per 2 e fece male per 4" (ate dinner for two and did mischief for four). He even wrote in his notebook that Salai was "ladro, bugiardo, ostinato, ghiotto" (thief, liar, obstinate, glutton). But every day, Leonardo would pass abandoned children on the street. It was a fate he likely wanted to keep Salai from.

Abandoned Children

Children whose parents had died or couldn't care for them had to fend for themselves on the streets. Many children died of disease or starvation. Sometimes the Church tried to help, or someone would take them in, at least temporarily. There was no foster care system, and orphanages were a relatively new concept. The oldest orphanage in Florence, Ospedale degli Innocenti (Hospital of the Innocents), fed and sheltered children and tried to find families for them. By the time they were Salai's age, boys were sent to be apprentices in a variety of trades, and girls became servants or worked in the cloth industry.

fend: try to get along without help
foster care: a system in which children live with and are cared for by people other than their birth or biological parents
orphanages: places where children without parents live and are cared for
concept: idea

Leonardo cared about his appearance. He was tall and handsome. He liked to dress in stylish, colorful outfits, and he had similar ones made for Salai. Unlike the custom at the time, Leonardo wore bright colors and short tunics. He kept a small notebook attached to his belt to jot down ideas or make sketches.

When Leonardo saw people who had interesting faces or unusual features, he followed them. He sketched them as models for potential characters in his paintings. He was curious to see how they walked and talked because how the body moved was important to him. He wanted the people in his artwork to look realistic. That way, everyone who saw his paintings would feel like the people he'd painted were alive and thinking and moving.

Eventually, Sforza, now officially the Duke of Milan, commissioned Leonardo to work on what would become one of his most famous works—*The Last Supper*, a painting of Jesus Christ's last meal with his twelve apostles—at the convent of Santa Maria delle Grazie. A common method of mural painting at the time was fresco, a process that uses paint on wet plaster and requires speed because the plaster dries quickly. But Leonardo wanted to take his time. So instead of using the fresco method, he prepared the plaster wall by adding a layer of

tunics: loose shirts
potential: possible
mural: a large painting on a wall

ground stone and then painting it with a white primer. For the painting, he used a mixture of oil- and water-based paints.

Because *The Last Supper* was on the wall above eye level, Leonardo needed to find a way to lift the viewer's eyes upward. He did this by using perspective. He made Jesus the central figure and placed the vanishing point behind him. Leonardo also helped him stand out by painting him in front of a brightly lit window and making him larger than the disciples.

Leonardo was a slow and methodical worker. He wanted to make sure the work was done perfectly. Often, people would watch him work. Leonardo had become famous, and people wanted to see not only the art he created but also how he created it.

The prior who headed the convent, however, was frustrated that it was taking Leonardo so long to finish the painting. Sometimes, Leonardo wouldn't show up at all. He was having trouble with how to paint the face of Judas, the apostle who betrayed Jesus. Leonardo would wander the city, sketching faces, trying to find the meanest, nastiest face to represent Judas.

When the prior complained to the duke, asking him to make Leonardo hurry up and finish, the duke talked to Leonardo. After explaining the Judas problem, Leonardo

disciples: people who follow someone and spread their teachings

said that if the prior didn't mind being the model for the traitor Judas, the problem would be solved. The duke thought this was hilarious and told the prior. The prior quickly decided Leonardo could take his time.

But things were about to change for Leonardo, for the French invaded Milan in 1499, and the duke fled, leaving Leonardo without a patron once again. He and Salai wandered between cities looking for work: first to Venice, then back and forth between Florence, Milan, and Rome. Leonardo painted more masterpieces, but he spent most of his time focusing on inventions and figuring out how things worked. And no matter where he went, he brought his dozens of books with him.

The Last Supper and Restoration

Even at the time, The Last Supper *was praised as groundbreaking. It shows the story from the Bible in which Jesus tells his disciples that one of them will betray him. Leonardo needed to capture each disciple's reaction, whether surprised or sad or upset, and he did. Unfortunately, after about twenty years, the base began to separate from the wall, taking Leonardo's art with it.* The Last Supper *wasn't properly restored until the late twentieth century. Leonardo's painting on the ceiling in Castello Sforzesco, the Sforzas' castle in Milan, also had to be restored because the French military had painted over it. Only hundreds of years later were remnants of Leonardo's work found under the paint.*

remnants: remaining traces

6

Engineer

The high walls of great cities will be seen upside down.
Answer: *City walls are reflected in the water of moats, ditches, or rivers surrounding them.*

In his wanderings, Leonardo ended up back in Florence, where he was welcomed like the renowned artist and polymath that he was. Two years before his return, Florence had been under the severe rule of a radical friar who had burned books, art, clothing, and cosmetics. Leonardo was likely a welcome sight in his pink hat, purple velvet cape, and red stockings.

"Bonfire of the Vanities"

In 1494, devout Dominican friar Girolamo Savonarola led a religious rebellion against the ruling Medici family. He criticized their wealth and referred to clothing, jewelry, makeup, books, and paintings as "vanities." During the normally festive Carnival in 1497, Savonarola convinced people to burn books, clothes, art, and everything else he considered frivolous or offensive. The event came to be known as the Bonfire of the Vanities. The following year, Florence's citizens overthrew Savonarola's repressive rule, and he was hanged.

friar: a member of a religious order

Although Leonardo's work was in high demand and he produced several paintings, he didn't really want to paint. He now possessed more than a hundred books on a variety of topics like literature, philosophy, science, astronomy, geometry, and medicine. He wanted time to read them and ask more—or even find the answers to—questions about life.

Reading, however, did not pay the bills, and Leonardo needed to support himself, Salai, and his employees. He ended up working for Cesare Borgia, a ruthless military tyrant famous for murdering anyone who got in his way—including, it was rumored, his own brother. He had an army so large and a greed so insatiable that he forced Florence to pay him protection money just to keep him from taking over the city for himself. It's possible that Florence even asked Leonardo to work for Borgia as part of the deal to keep the city safe.

Leonardo, the peaceful person that he was, was probably not too pleased with his new boss. Still, he went on the road with Borgia's army. Most of his work entailed visiting castles, making sure they were in good working condition, and proposing plans to improve them if they weren't. He suggested using curved castle walls to better deflect cannonballs. He built a bridge with only pieces

tyrant: a ruler with unlimited power
insatiable: impossible to satisfy

of wood and no fasteners for Borgia's army to cross a river. Solving such problems made Leonardo feel like a military engineer without designing weapons.

Leonardo also sketched maps. For Leonardo, the maps were a way to examine nature and the contours of hills and the flow of water. He was struck, as always, by the power of water. For Borgia, the maps let him know the best route for his army to take when they went on attack. He recognized how useful the maps were, especially Leonardo's detailed aerial views of cities and towns.

Leonardo wanted his maps to be accurate and consistent, so he designed a tool to help him measure distances: an odometer. His odometer looked a little like a wheelbarrow. Every time the wheel made a full rotation, a stone fell into a bucket. He could count the stones and know the length of a building, a wall, or a road, then translate those distances on a smaller scale to his maps. This was just one of many inventions that made Leonardo's maps the forerunners of military maps used today.

After less than a year, Leonardo left Borgia and returned to Florence. Although he was fascinated by the mechanics of wartime machinery, he was a pacifist. War, he said, was "pazzia bestialissima"—a most beastly madness.

odometer: an instrument that measures distance traveled
pacifist: someone opposed to settling disputes with war or violence

Florence was delighted to welcome Leonardo back as its famous painter. He was revered by dukes and kings, but also by the people of Florence. As a result of his fame, he was commissioned to commemorate in a mural a historical victory of Florence, the Battle of Anghiari.

On the wall opposite Leonardo's mural, Michelangelo, another famous artist of the time, was hired to paint his own fresco. Neither of the artists completed his work, but both made copies, sketches, and notes that hint at the final pieces they envisioned. From these, it's clear that Leonardo wanted to depict war realistically and intended to show panic, pain, and grief in the soldiers' faces.

The Big Three: Leonardo, Michelangelo, Raphael

While these three artists were known as the masters of Renaissance art, Michelangelo (1475–1564) was hot-tempered and ungracious toward both the older Leonardo (1452–1519) and the younger Raphael (1483–1520). Part of his behavior was from jealousy. Leonardo and Raphael received more attention because they were personable and popular. Leonardo avoided Michelangelo as much as possible. When they were both working on frescoes in the same room, however, that was difficult. Perhaps that's part of the reason Leonardo never finished The Battle of Anghiari*—that and having trouble with the paint sticking properly, his perfectionism because the light wasn't right, and his usual inability to finish projects. Raphael*

commemorate: celebrate a past event
envisioned: imagined

was happy to learn from both, although he died young. He followed Leonardo's lead in using sfumato and chiaroscuro. Michelangelo stuck with painting sharply outlined faces.

Leonardo next tackled an engineering project that would divert the path of a river from nearby Pisa to Florence. That would provide access to the sea so explorers could sail directly from Florence to explore the world. Leonardo was curious about how water might be diverted from one area to another. Although the canal he proposed was never built, the project gave him time to observe how water carved out mountains and eroded the earth. For Leonardo, observation was often as rewarding as designing and inventing—and observations usually led to fascinating and important discoveries.

He noted that water moves faster when a river is narrower. He believed that water would reduce the earth to a perfect sphere if it could. From his readings and observations, he knew that the earth had to be much older than people believed at the time. Mountain ranges had risen—the result, as we know now, of tectonic plates colliding. Seas had receded. The mountains and oceans he observed were different than they had been eons ago.

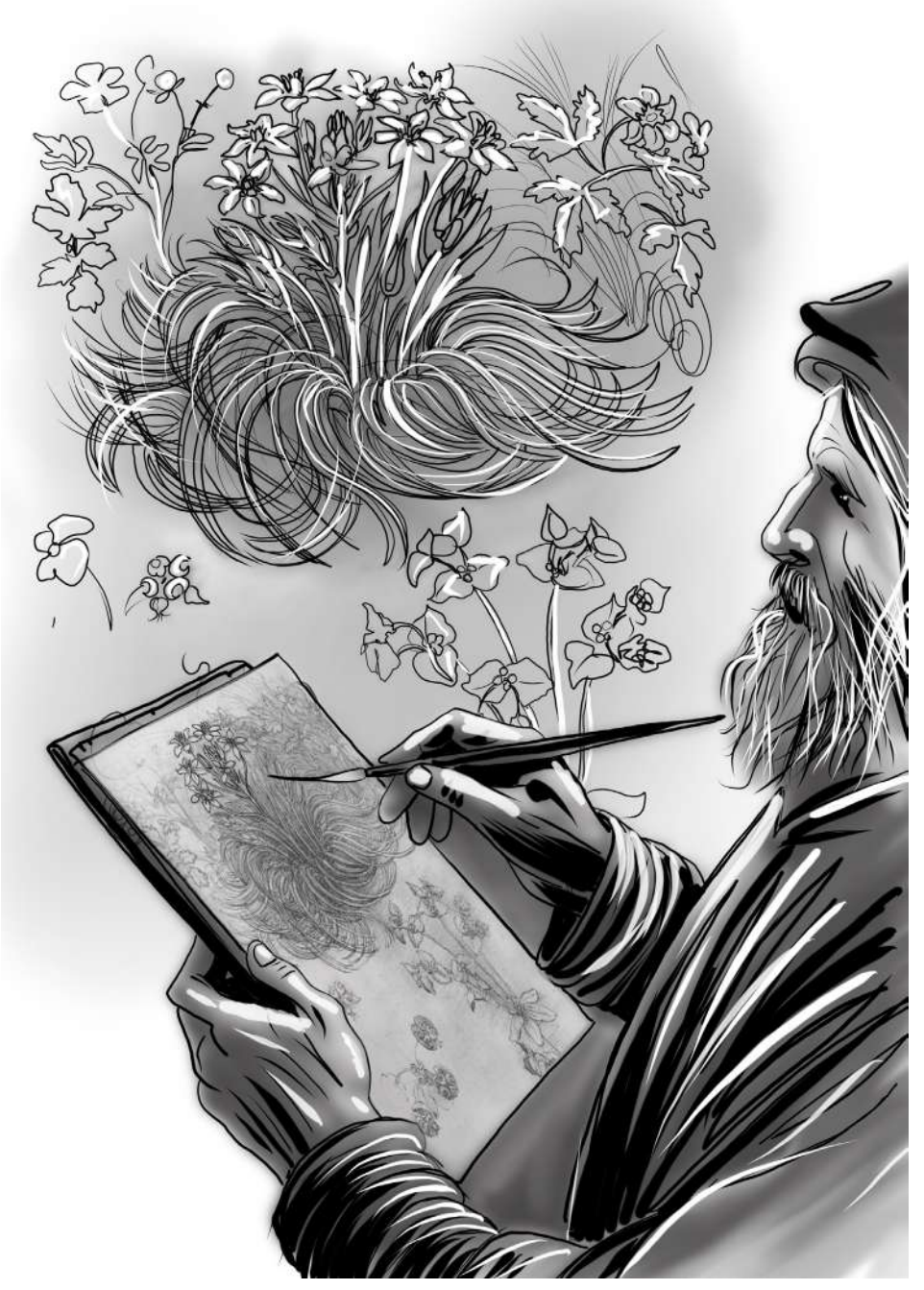
divert: redirect
eroded: wore away over time
sphere: a three-dimensional circle, like a ball
tectonic plates: large pieces of Earth's crust that move very slowly
receded: moved back
eons: extremely long periods of time

Leonardo thought back to his question from when he was a boy. How did whale fossils end up in a cave in the hills, far from the ocean? When he observed fossil remains, they showed groups of the same kinds of animals. He'd seen the Arno River flood when he was fourteen. He knew it was wild and left a mess, randomly scattering items everywhere. A flood didn't sort items neatly into groups. The cave, he realized, had originally been underwater. It was where the whales had lived.

As always, Leonardo looked for connections in nature. He compared the swirling star-of-Bethlehem flowers and other plants to swirling water. He also made connections between nature and humans: curling hair looked like flowing water.

Leonardo's observations of the natural world helped him become a great artist, but they also helped him become a groundbreaking scientist and engineer. Leonardo saw spirals in water, plants, and even animals, like snails. He applied the spiral design to building. The seemingly delicate design proved to be surprisingly sturdy, as in a spiral staircase.

As he continued making connections between the patterns he saw in water and air, Leonardo wondered like he had as a boy: How do birds fly? Could humans fly, too?



7

Scientist

Much of the sea will fly up to heaven,
and for a long time will not return.

Answer: *how clouds and rain are made*

Leonardo observed that wind and water behaved in similar ways. Air currents were like water currents. Air and water both flowed in spirals, so air was a type of fluid. He had tested how water traveled and swirled by throwing seeds or leaves into it and watching how they moved. He decided to conduct similar experiments with air.

He began by testing other scientists' ideas, even those that had been accepted for centuries. For example, Aristotle believed that air held up a bird like water holds up a boat. Leonardo saw that when a bird wasn't flapping its wings, it held its wings at a downward angle. Doing so causes lift, the pressure difference between the air above and below the wing. That, he realized, was how birds fly, solving another question from his childhood.

Some of Aristotle's ideas were blended with religious beliefs, something that Leonardo refused to let misguide him. Leonardo preferred to apply critical thinking, rather than religious teachings, to his observations and experiments. These differences led to his many disagreements with Aristotle's long-accepted theories.

After he studied the wings and flight patterns of bats and birds, it was time for Leonardo to start inventing. He invented an early form of the parachute as well as a device called an *ornithopter*, which means bird wing. An ornithopter is a machine that flies by flapping mechanical wings. One of Leonardo's designs required the pilot to lie down on a board and use their feet to push pedals that would make the wings above them flap like a bird's.

Leonardo wrote in his notes that one of his flying machines would take off from Mount Ceceri, but he never wrote down if that test flight ever happened. Legend states that a friend of Leonardo's, Tommaso Masini, attempted the flight and crash-landed, breaking his leg.

parachute: an umbrella-shaped device made of cloth that slows down falling objects

It Really Flies!

Leonardo designed an aerial screw. It was a personal aerial vehicle that would take off vertically and carry a person through the air. In 2020, a group of Dutch aerospace engineering students built a model based on Leonardo's design, with some modifications—and it worked! Their aerial screw could hold a person who weighed up to 132 pounds and travel almost three miles at a height of more than three feet off the ground.

aerospace: Earth's atmosphere and the space beyond

Leonardo's discoveries were rarely ever isolated. Often, one discovery led to another. While studying the connections between air and water, he happened upon the answer to another question—that of how clouds are formed. He realized that water evaporates and condenses into clouds.

Thinking of clouds and the sky led Leonardo to solve yet another question from his childhood. Why is the sky blue? He realized that the sun lights up tiny particles of moisture in the sky, making it look blue. This is because blue light has shorter wavelengths and is scattered around more. That makes it easier for the human eye to see than longer red wavelengths.

Beyond the sky and clouds, Leonardo looked at the moon. He discovered what causes the entire moon to glow even when it's not full, a phenomenon called *earthshine*. Earthshine is the glow caused by sunlight reflected off of Earth. It is the less bright part of the moon, while the brighter part is reflecting light directly from the sun.

Beyond the moon, Leonardo observed the sun. People in his day believed Earth was the center of the universe and the sun revolved around it. Before Copernicus and Galileo, both of whom argued that the sun was at the

evaporates: turns from a liquid into a gas
condenses: turns from a gas into a liquid
wavelengths: the distances from one point on a wave to the same point on the next wave
phenomenon: an important or interesting fact or event

center of the universe, Leonardo wrote in his notebook, in large letters, "Il sole nó si muóve" (The sun does not move).

Although we're not sure what he was thinking when he wrote those words, it was important enough to write large. Whatever the reason, it shows that Leonardo was always thinking and wondering and questioning.

The Sun Does Not Move

Was Leonardo arguing that Earth revolves around the sun? He didn't elaborate. It might've been instructions for a performance or even a random thought. Maybe he wrote it in large letters because he'd had an argument with someone and was shouting it into his notebook even if no one else believed him.

Now, of course, we know that while the sun is at the center of our solar system, it's not the center of the universe. And it's true that the sun doesn't move around Earth, but it—and the rest of the solar system—does revolve around the center of our galaxy, the Milky Way!

8

Connections

Huge figures will appear in human shape,
and the nearer you get to them,
the more their size will shrink.

Answer: *shadows cast by someone holding a light*

In his constant search for work, Leonardo ended up back in Milan, where he opened a bottega and sought out commissions. He was particularly impressed with one of his apprentices. Fourteen-year-old Francesco Melzi was talented, and his personality was like Leonardo's—calm and kind. His father was an engineer for the Duke of Milan, so Francesco had grown up in the duke's court. Leonardo spent time with the Melzi family talking about art and engineering. He and the Melzis became so close that Leonardo adopted Francesco.

Why would the Melzis let Leonardo adopt their son? Because Francesco had been educated in the duke's court and his father worked for the duke, he would've been expected to become an engineer like his father.

Francesco wanted to pursue art. Not only was Leonardo a family friend, but he was also the most famous artist in Europe (not to mention an accomplished engineer). The king of France had even tried to take *The Last Supper* off the monastery wall and bring it to France, but it was too difficult to remove, so he gave up. Because of Leonardo's skill and fame, as well as his kindness, the Melzis knew he would be a great mentor and father figure for Francesco.

From Leonardo's perspective, he had no family. He wanted a son to whom he could pass down his paintings and notebooks. Francesco had a gentle temperament, and he was much less demanding and easier to get along with than Salai. By this point, Salai was twenty-seven and still expecting Leonardo to support him. He was also difficult, as we can see from the weary words in Leonardo's notebook: "Salai, I want peace, not war. No more wars, I give in."

While Francesco worked in the bottega, Leonardo spent more time producing pages and pages of notes on geometry, architecture, astronomy, and a wide variety of other subjects. One topic that fascinated him, and always had since he was a boy, was anatomy.

He thought of the human body as a microcosm, or miniature version, of the world. Leonardo wanted to see inside bodies to understand how muscles and tendons worked. That way, he could make the people in his

paintings look more realistic. As he observed, "Human movement may be understood through knowledge of the parts of the body." He wanted to know even details like how eyes and lips move.

Leonardo went to the morgue to dissect and study bodies. It was gruesome, and he didn't recommend it, but he felt it was necessary. He became friends with a young doctor and anatomy professor at the University of Pavia, Marcantonio della Torre. Leonardo performed many dissections with him. He often watched the doctor work while drawing meticulous diagrams of what he saw. Sadly, in 1511, the plague hit Milan again, and Marcantonio della Torre died.

Plague and Paranoia

Waves of the plague hit Europe for centuries after it first appeared in 1347. In the first few years Leonardo was in Milan, almost one-third of the city's population died. The plague spread quickly in dirty, crowded streets. It wasn't uncommon to lose family members and friends.

People were frightened, and finding a scapegoat, or someone to blame, made them feel better. Because Jews were already discriminated against for their religion, some people decided to blame them for the plague, even though it wasn't true and they had no evidence. Jews died from the plague just like anyone else. Still, some people refused to look at the facts and instead clung to rumors.

morgue: a place where dead bodies are kept before being laid to rest
meticulous: very careful and precise

Leonardo and Francesco went to live with the Melzis during the plague, along with Salai. The Melzis' home was in the countryside outside of Milan. While there, Leonardo continued to study anatomy. Because he no longer had access to human cadavers, he dissected animals. He discovered how organs such as the heart, eyes, thyroid, gallbladder, and liver work. He disproved old theories about how the brain and nervous system worked.

Boiling Eyeballs

Eyeballs are hard to dissect because they are squishy. Leonardo experimented with ways to make eyeball dissection possible. He came up with the idea of boiling an eyeball inside an egg white. That process hardened both the egg and the eyeball. Then he could slice them together and dissect the eye.

To understand how the body moves, Leonardo made layered, three-dimensional drawings of muscles in the arms, shoulders, and back. This can especially be seen in his unfinished painting *Saint Jerome in the Wilderness*, which he began early in his career. Leonardo drew the muscles of an arm, a leg, the chest, and the neck of Saint Jerome with great accuracy. He worked on the painting for many years and kept altering it as he learned more about anatomy. Eventually, he painted two separate muscles in Saint Jerome's neck, which is more anatomically correct.

cadavers: dead bodies
anatomically: relating to the structure of the body

Leonardo made connections between different subjects all the time. But his studies never stood in the way of his connections with people. The Melzis became like family, and he celebrated his sixtieth birthday at their home. Around that time, Francesco drew a portrait of him. Leonardo, too, sketched a few self-portraits, which showed him looking old and haggard and worried. Francesco's portrait made Leonardo look younger and softer and kind. Leonardo and Francesco were devoted to each other like father and son.

All the time Leonardo was dissecting cadavers and studying anatomy, he was working on his most famous portrait, perhaps the most famous painting of all time: the *Mona Lisa*. For the portrait, Leonardo chose a small canvas, about twenty-one by thirty inches. His goal was to capture his female subject in a portrait more realistic than anything of its kind at the time. He hired musicians and jesters to make her laugh, and he got what he was looking for: a mysteriously evocative smile that would stir the imagination of audiences for centuries to come.

Leonardo left many of his paintings unfinished, but he did finish the *Mona Lisa*. It seems he liked it so much, he kept the painting with him until he died. He began it in 1503 and continued to work on it until 1517, making it his last work of art.

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haggard: very thin or tired-looking
jesters: members of a court who amuse people with jokes and pranks
evocative: causing an emotional response

Why Is the* Mona Lisa *So Famous?

In the past, there was a mystery surrounding the woman in the painting. Was she really Lisa Gherardini, wife of a Florentine silk merchant? Most people now agree that she was.

Also, the painting uses Leonardo's techniques of sfumato and chiaroscuro, so it's both moody and real. Mona Lisa's face is anatomically correct because of how Leonardo observed nature and studied anatomy. She appears to be smiling engagingly—or is she? Sometimes, from different angles, it doesn't look like she's smiling. The way her eyes follow you around the room as you move makes her appear alive.

The painting gained fame because it was stolen. In 1911, Vincenzo Peruggia, a workman at the Louvre Museum, simply walked out with it wrapped in his coat under his arm. It wasn't recovered for two years. When it was returned, a hundred thousand people came to see it in the first couple of days.

More recently, scientists discovered that Leonardo used a chemical compound called plumbonacrite in the Mona Lisa. *Previously, it was thought that plumbonacrite wasn't made or used until a hundred years after Leonardo.*

Finally, the painting is famous because it has been parodied. A parody is a humorous imitation. For example, you may have seen a picture of the Mona Lisa *with a moustache or rabbit ears. It has become an iconic, or well-known, painting.*

chemical compound: a substance made of two or more different elements

9

Legacy

Men will walk and not move,
speak with people who are not there,
and hear someone who does not speak.

Answer: *dreams*

The Renaissance began in Italy, but by the early 1500s, it was spreading to the rest of Europe. The new king of France, Francis I, wanted to have Renaissance art and ideas in his court. In 1516, he invited Leonardo and Francesco to join him in Amboise, France. He gave Leonardo a manor house to live in, along with Francesco and all of Leonardo's assistants. The house, Château de Cloux (now Clos Lucé), was connected to the palace by an underground tunnel. Twenty-two-year-old Francis and sixty-four-year-old Leonardo could go back and forth to talk anytime.

Leonardo's title was "first painter, engineer, and architect to the king." Although he was technically working for Francis, the king treated him more like a guest. Francis was delighted to have one of the most

manor house: the house of the lord of an estate

famous polymaths of Europe living right next door. He said that you could ask Leonardo anything and he'd know something about it. That's because Leonardo kept reading and thinking and asking questions. By this point, Leonardo had about two hundred books—quite a large library for that time.

Leonardo enjoyed being able to work on his notebooks, and in his old age, he decided it was about time he organized them. But Leonardo had recently suffered a stroke, leaving his hand paralyzed, and even this task would require Francesco's help. His notebooks were likely more important to him than any of his paintings—they certainly were to all the artists, engineers, and scientists who followed him. He wanted them published, but that wouldn't happen until long after his death.

In spite of his stroke, Leonardo was also still putting his finishing touches on the *Mona Lisa*. He left fewer than twenty pieces of art, several of them unfinished, but thousands and thousands of pages of genius thoughts and ideas.

Leonardo was still writing in his notebook just before he died. He was working on geometry when he was called to dinner. Reluctantly, he put down his pen, but not before writing a note explaining why: "perché la minestra si fredda" (because the soup is getting cold). These were his last recorded words. Leonardo was sixty-seven years old.

Leonardo left a house and half a vineyard to Salai, whom he'd always considered part of his family. He left almost everything else to his son, Francesco, including what was most precious to him and to the world: his notebooks. He knew that Francesco would appreciate them and take care of them, which he did.

Real or Fake?

Because of Leonardo's fame, people have often claimed they've found one of his works. That's rarely true. When a painting of Christ called Salvator Mundi *(Savior of the World) was found, it was in terrible shape. Once it was restored, there were elements that made it seem like it was Leonardo's—the hair in particular. But could it have been done by one of his students? Or a forger? An infrared light revealed a palm print. We know Leonardo, unlike other painters, used his hands. There is still dispute over its authenticity, but many people now believe that* Salvator Mundi *was painted, at least in part, by Leonardo.*

Leonardo left us many designs from which we've developed useful items today, such as self-propelled vehicles, tanks, and robots, along with a wealth of other inspirations. He answered many questions in his lifetime, like how the human body works, how birds fly, why the sky is blue, and how clouds form. He stayed curious. He continued to observe and experiment and ask questions. He couldn't answer them all, but he kept trying.

infrared light: light with longer wavelengths than visible light
authenticity: the quality of being genuine

In his notebooks, Leonardo left us practical advice, too. For good physical and emotional health, he said to beware of anger and stuffy rooms, rest your head, and keep your mind cheerful. For learning about our world, he encouraged keeping an open mind: "Il massimo inganno delli omini è nelle loro opinioni" (Men's greatest deception is in their opinions). He also encouraged people to keep thinking and questioning in order to discover answers. "L'ingegno senza esercizio si guasta" (Ingenuity fails without exercise), he wrote.

Leonardo, a Bridge to the Future

In 1502, Sultan Bejazet II asked engineers to send ideas for a bridge to span the Golden Horn inlet between the city of Istanbul, Turkey, and areas beyond the city. Leonardo sent a design for a stone bridge that was 920 feet long. It was rejected because no one believed it could be built. In 2001, Norwegian artist Vebjørn Sand made a pedestrian bridge replica, in wood rather than stone, that is about one-third the size. Sand proved that such a bridge would work. In 2019, engineers at the Massachusetts Institute of Technology tested Leonardo's design by building a model out of stone. They even tested it to make sure it was earthquake-proof. The model survived, proving that Leonardo's design from five hundred years ago can work today. He was a genius ahead of his time.

More of Leonardo's Accomplishments

Leonardo's Inventions

Leonardo drew hundreds of inventive ideas. Almost none of them were ever made, at least in his lifetime. But some of them became prototypes, or models, for things we use today.

Underwater Equipment

When Leonardo was in Venice, a city of canals, he came up with the idea of breathing underwater. His mask, diving suit, and breathing tube became the basis for scuba equipment today. He specifically did not write an explanation of how these items worked "because of the evil nature of men, who might use it for murder on the sea bed."

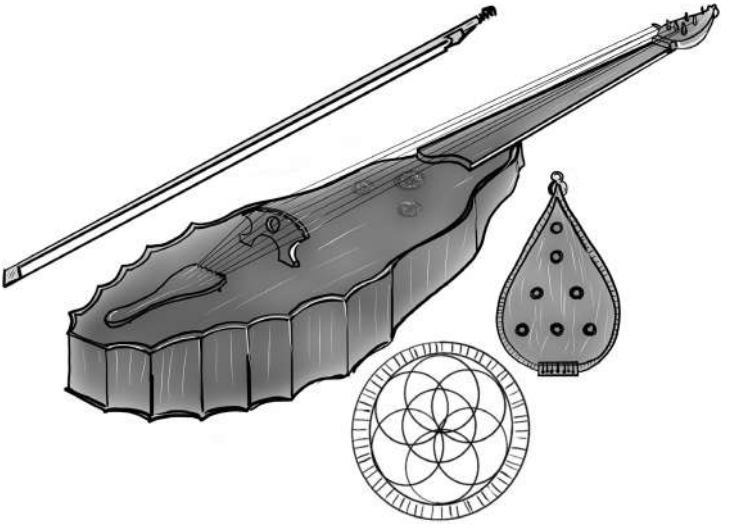
Did you know that *scuba* was originally an acronym—an abbreviation made up of the first letters of a string of words? SCUBA stands for "self-contained underwater breathing apparatus." Over time, it has become a word in its own right.

Life Jacket

While in Venice, Leonardo also created a "swimming belt," a form of life jacket, and explained that it used air to keep someone afloat.

Musical Instruments

Leonardo designed musical instruments like keyboard-operated drums and bells and the viola organista, a stringed instrument that was probably never made in his day. However, Polish pianist Sławomir Zubrzycki made a viola organista from Leonardo's plans in 2012, and it worked! In fact, Zubrzycki took it to music events all around Europe and gave concerts.



Flying Machines

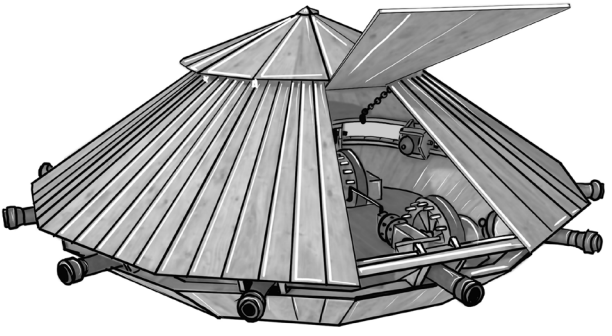
Leonardo's gliders were prototypes of the early flying machines made by inventors like Orville and Wilbur Wright. His other designs, like the aerial screw, paved the way for the development of helicopters.

Parachute

Leonardo likely did not test out his parachute design, but in 2000, Adrian Nicholas, a British hot-air balloonist, did. He jumped out of a hot-air balloon at ten thousand feet with Leonardo's prototype, along with a backup parachute, and proved that Leonardo's chute worked!

Weapons

One curious invention Leonardo designed was a type of tank. It was large enough for eight men and had armor for protection. What didn't make sense was that the front and back wheels turned in different directions, so it would only spin in place. Did he do that on purpose? If so, why? Was it only supposed to spin? Was he sabotaging the design in case it fell into enemy hands? In any case, it was never used, although the idea for a tank would be used centuries later.



Leonardo's Art

Madonnas and Religious Paintings

In the Middle Ages and Renaissance, religious art, especially Madonnas—paintings of the Virgin Mary—were popular. Rulers like the Duke of Milan wanted the support of the Church and paid for religious art to be created. What made Leonardo's religious paintings stand out was their realism, both of the people and of nature. Examples include the detailed feathered wings on the angel in *The Annunciation*, the anatomy of the saint in *Saint Jerome in the Wilderness*, the baby Jesus in all of his Madonna paintings, and the gestures, faces, and emotions of Jesus and his disciples in *The Last Supper*.

Portraits

Leonardo's portraits were unusual for his day because they weren't static, or still. He painted his portraits to look directly at the viewer. This made them look more human and approachable and allowed Leonardo to use his knowledge of anatomy to convey realistic expressions. In some portraits, the eyes seem to follow you around the room. The lips often form an expression that's almost a smile but more enigmatic, or confusing. *Ginevra de' Benci* was

Leonardo's first portrait and led to his fame in Florence. But after more than five hundred years, Leonardo's portrait *Mona Lisa*, with Lisa's enigmatic smile, is probably the most famous painting in the world.

Leonardo's Anatomical Observations

Because of all his contributions to the study of anatomy, Leonardo is not just considered a famous artist. He is also regarded as the father of modern anatomy.

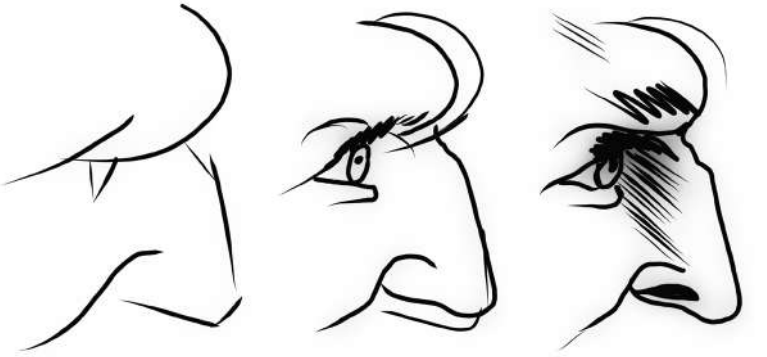
Eyes

Leonardo was fascinated by how eyes worked. He relied heavily on sight in his artistic and scientific activities. He figured out that the eye perceives an image because of the light rays that bounce off that image.

perceives: becomes aware of through sight or other senses

Nose

While studying the skull, Leonardo discovered the large sinus that helps us breathe.



Teeth

He also figured out the four types of teeth and how they grow.

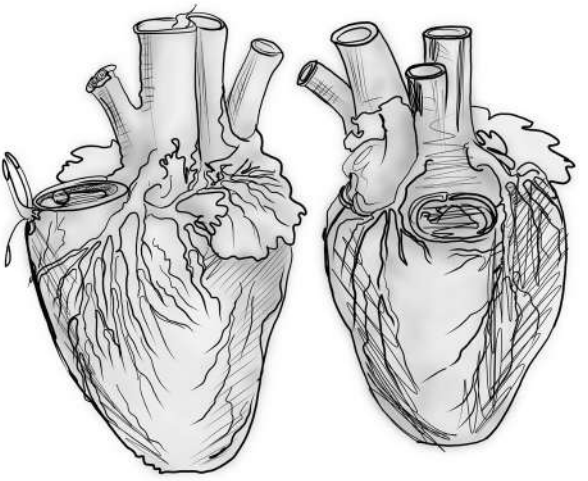
Foot and Ankle

As for how the foot and ankle work, Leonardo understood and described it so well that his basic concepts are still followed today.

Heart

Through his animal dissections, Leonardo discovered that blood travels from the heart to the rest of the body because of the heart's valve system. Leonardo's study of the heart, and the models he built to test

his theories, helped him understand how the heart works. He was the first to realize that the heart is a muscle. He understood that the heart and the pulse are related. He figured out how veins and arteries work and even described how the heart ages.



pulse: regular throbbing of the arteries caused by a heartbeat

Discussion Questions

1. What do you think is Leonardo's greatest contribution? Why?
2. Leonardo said, "Ogni cognizione è utile" (Any knowledge is useful). Do you believe that? Why or why not?
3. Leonardo was a vegetarian. If you were able to talk with him about his decision, what would you say?
4. Do you think Leonardo would be surprised that he is remembered over 500 years after his death?
5. How do you think Leonardo would react to his drawings inspiring (a) SCUBA equipment, (b) tanks, and (c) helicopters?
6. If you could ask Leonardo about some of his notebook pages that have been lost over the centuries, what subjects might he tell you they covered?
7. If you could ask Leonardo anything, what would you ask and why?
8. Would you have liked to live during the Renaissance? Why or why not?

9. If you could have been an apprentice, what trade would you like to have learned?

10. What current mystery in our world would you like to solve and why?

11. Do you think the *Mona Lisa* deserves its fame? Why or why not?

12. What inventions today do you think Leonardo would be most amazed by?

13. Leonardo loved books. What are some books you would share with him that you think he would like?

14. Why do you think some people like having a scapegoat when something goes wrong? What is the effect of scapegoating people?

15. Why might it be important to save Leonardo's notes even though his inventions are now out of date?

16. Is there anything about Leonardo's life or work that inspires you? What are you inspired to do?

Meet the Author

Kathryn Erskine grew up in Europe, Africa, Canada, and the United States. She attended eight schools and four universities. She was a lawyer before becoming an author. Her experiences inspire much of her writing.

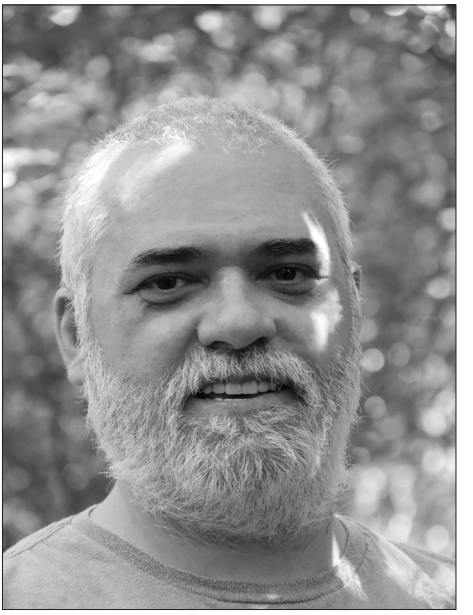
She loves to travel and talk with readers around the world. She has been lucky to visit schools in Scotland, Italy, Brazil, Panama, and Singapore as well as on Zoom. She also loves research, and even became a pharmacy technician while researching a new novel.

She has published seven novels including National Book Award winner *Mockingbird* and three picture books. As always, she has several books in progress. Her books have won multiple awards. What is most important to her is that readers enjoy her books and realize that, like the characters in books, they have the power to achieve their goals.

Following Leonardo's example, she keeps a notebook of ideas, lists, and sketches.

Visit Kathryn Erskine online at ***kathyerskine.com***.

Meet the Illustrator



Ivan Pesic was born in Blace, Serbia, in 1975. In 2000, Ivan moved to Belgrade, Serbia, where he studied graphic design in college. Unhappy with the political and economic situation in Serbia, Ivan emigrated to Virginia, USA, in 2005. Ivan and his wife, Alisa, have two children, Tara and Luka. His work can be seen in many galleries in Virginia, Washington D.C., North Carolina, and Georgia. Ivan has also donated his paintings to public schools and charity organizations. The primary medium Ivan uses is acrylic and oil paints; however, he also likes to experiment with different mediums and techniques.

Aside from painting, Ivan has done pencil drawings, wall murals, mixed media art, photography, graphic design, and more. In his work, he reconstructs dreams, fairy tales, nursery rhymes, lullabies—the pieces of our lives and memories that are a part of us. Every piece of his artwork tells a story, stories with a hero, a villain, with action, movement, and other elements that give his work life and energy. Ivan's work can be viewed on his website: ***www.ipartstudio.com***.

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