

By modern standards, Mona Lisa would not be considered beautiful, yet her mysterious little smile still fascinates those who look upon her. Her ageless image can be found on everything from socks and bathing suits to shower curtains and wristwatches. Leonardo da Vinci is perhaps best known for painting the *Mona Lisa*, but here you will discover the equally lasting mark he made across many fields of science.

from *Leonardo da Vinci*

by DIANE STANLEY

The world saw Leonardo as courtly¹ and charming. But at heart he was a solitary man. “If you are alone,” he once wrote, “you belong entirely to yourself If you are accompanied by even one companion you belong only half to yourself, or even less.” In the peace of his aloneness, Leonardo could imagine, create, and dream. It is easy to picture him, then, in his room by himself, writing in one of his famous notebooks.

He began them when he was about thirty. Over the years he filled thousands of pages with the outpourings of his amazing mind. There were drawings of grotesque faces, drafts² of letters, sketches for future paintings, lists of books he owned, plans for inventions, moral observations, pages copied out of books he had borrowed, notes of things to remember, designs for weapons, drawings of anatomy,³

1. **courtly** (kōrt'lē): dignified and polite; elegant.
2. **drafts** (drafts): first copies that will be revised.
3. **anatomy** (ə-nat'ə-mē): study of the human body.

BIOGRAPHY

SCIENCE ●

HISTORY ●



▲ *Mona Lisa* by Leonardo da Vinci.

You Need to Know...

Born in a small town near Florence in 1452, Leonardo da Vinci (lē'ə-nār'dō də vēn'chē) became one of the greatest thinkers of all time. He was a master painter, sculptor, architect, scientist, mapmaker, and military engineer. He has come to represent the very essence of the phrase “Renaissance man”—a person whose knowledge and talents cover a broad range of subjects. For over half of his long lifetime, da Vinci recorded ideas, plans, and sketches in a series of incredible notebooks. Though none of his sculptures and only a few of his paintings have survived, his notebooks remain to give us a rare glimpse into the mind of a genius.

grotesque (grō-tesk'): distorted; bizarre; ugly.

moral (mōr'al): relating to correct behavior or thinking; knowing the difference between right and wrong.



▲ Self-portrait by Leonardo da Vinci.

dissected (di-sekt'id): cut into pieces to be examined.

and observations of nature. On one page, for example, you can find geometry problems, a plan for building canals, and the note "Tuesday: bread, meat, wine, fruit, vegetables, salad."

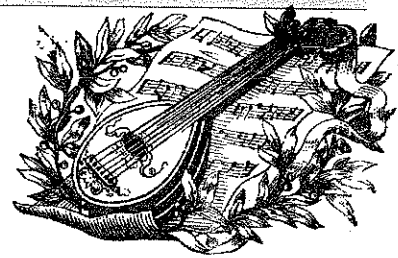
All this was written in a peculiar backward script, going from right to left. You must use a mirror to read it. This has led to the myth that he wrote that way to keep his notebooks safe from prying eyes. In fact, Leonardo was left-handed and found it much easier to write that way. When he *really* wanted to keep something secret, he wrote in code.

Perhaps the most stunning drawings in Leonardo's notebooks are those that show his careful study of anatomy. During the Renaissance, painters often studied the human body so they could learn to draw it correctly. Leonardo did this too. But soon his interest had grown far beyond his work as an artist. He approached anatomy as a scientist. Over a period of twenty-five years he dissected some thirty bodies, making almost two hundred painstaking drawings of them. Besides that, he dissected bears, cows, monkeys, birds, and frogs, comparing their structures to that of humans.

He developed a way of drawing anatomy that medical artists follow to this day. To show the inside of the head,

Church Chants and Love Songs

Not only was Leonardo da Vinci an accomplished artist and scientist, but he could sing, too! Leonardo had a beautiful voice, and he played the *lira*, an early form of violin, with great skill. He also designed musical instruments. Music itself was changing in Leonardo's time. Earlier music was composed mainly for religious worship. Monks sang "plainsong" or "chant," in which all voices sang the same melody. During the Renaissance, people began singing in harmony, combining different tones to produce a pleasing balance of sounds. In addition, musicians began writing new music, both sacred (for the church) and secular (for everyday life). Secular songs often told amusing stories or celebrated love. New musical instruments were invented, such as the lute, a sweet and gentle-sounding type of guitar. Another instrument is still popular today—the recorder, a wooden instrument that sounds like a flute.



for example, he drew a cross section. To clarify the organs in the abdomen, which lie on top of one another, he drew the ones in front as if they were transparent.⁴ And he often drew features from several different views, as if he were turning them in his hand.

Over the years he filled thousands of pages with the outpourings of his amazing mind.

It is hard to imagine the fastidious⁵ Leonardo doing such work. “If you have a love for this,” he wrote, “you may be turned from it by disgust in your stomach; and if that does not deter⁶ you, you may be afraid to stay up at night in the company of corpses cut to pieces and lacerated and horrible to behold.” Not to mention the fact that the bodies began to decompose before he could finish examining and drawing them. Yet for Leonardo the human body was a wondrous thing. Though he was not a religious man, he wrote that the more he studied the body, the more he was struck by thoughts of God, “who creates nothing superfluous⁷ or imperfect.”

All nature fascinated Leonardo. His notebooks are filled with descriptions of his extraordinary scientific studies. Based on this evidence, he has been called the first modern scientist. In those days people answered questions by looking them up in the Bible or in the writings of the ancient Greeks. Leonardo said that people who did that were using their memories, not their minds. Instead he followed what today we call the scientific method.

First he observed things carefully—the movement of water, the arrangement of leaves on a stem, the flight of birds. That led him to ask questions. Why does a pot lid jump up and down when water starts to boil? Water must expand when it turns to steam, he decided. In attempting

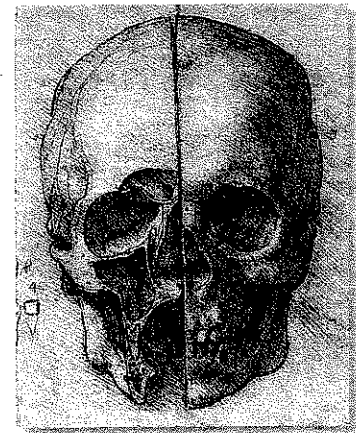
4. **transparent** (trans-per'ənt): able to be seen through.

5. **fastidious** (fa-stid'ē-əs): overly critical; easily disgusted.

6. **deter** (dē-tər'): stop; discourage from.

7. **superfluous** (sə-pər'flū-əs): extra; unnecessary.

decompose (dē'kam-pōz'): to rot or decay.



The Granger Collection, New York

▲ This pen-and-ink study done by Leonardo da Vinci appeared in one of his notebooks.

Going and Going and Going . . .

In the pages of his notebooks, Leonardo drew ideas for new machines, some of which were actually invented hundreds of years later. Here are a few examples:

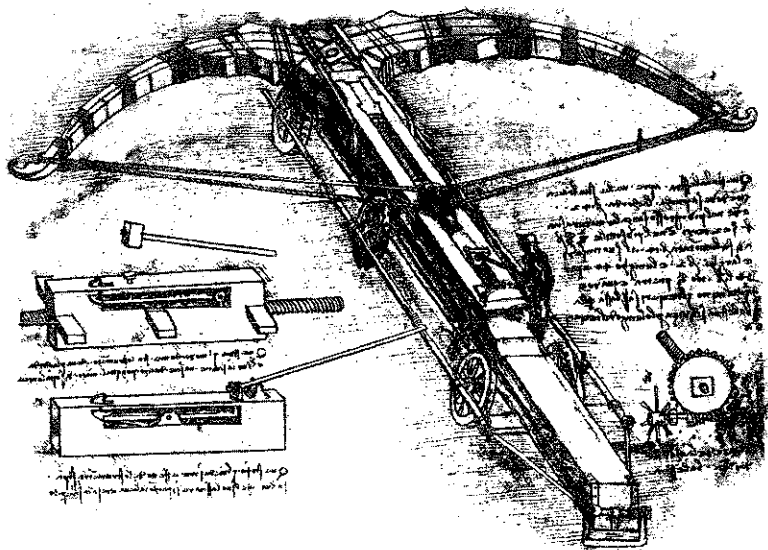
- armored car
- giant crossbow
- glider
- flying ship
- parachute
- self-propelled automobile
- drilling machine
- pulleys
- machine for digging trenches
- floats for walking on water
- boat with paddle wheels
- deep-sea diving suit

hypothesis (hī-pāth'ə-sis): possible reason or explanation meant to be tested.

to explain what he observed, Leonardo was making a hypothesis. But then he had to prove it, and often he wasn't satisfied until he had also measured it. So he set up an experiment. He made a glass cylinder and put water and a piston inside. Then he measured how far the piston rose when the water was heated to boiling. Leonardo was so keen on measuring things that he invented all sorts of devices for that purpose—to measure humidity, altitude, distance traveled, angle of inclination,⁸ the speed of wind and water, and the intensity of light.

He often made astonishing mental leaps. When he threw a pebble into a pond, he noticed that circular waves formed around it, expanding steadily outward. From this it occurred to him that sound and light must also travel in waves through the air. What's more, he remembered that he always saw lightning before he heard thunder. He therefore concluded that light waves must travel faster than sound waves.

8. **angle of inclination** (in'klā-nā'shən): the measure of how steep or shallow a sloped or slanted surface is.



▲ Among the war machines Leonardo designed was this giant crossbow. ■ If it had been built, how would this crossbow have worked? Does it seem like a practical invention? Why or why not?

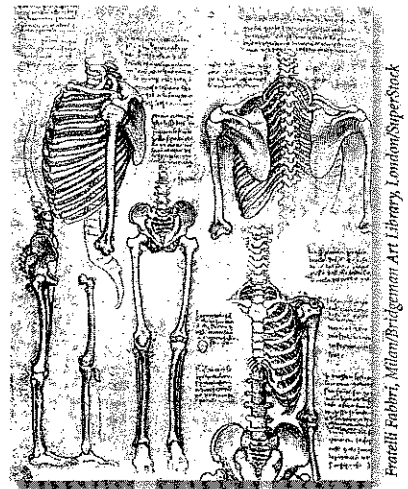
He trusted his own observations, even if others disagreed with him. For example, up in the mountains he saw fossils of shells, fish, and coral. How had they gotten there? The popular theory of the time was that they had floated up during the great biblical Flood. But Leonardo knew that shells were heavy and did not float. It seemed clear to him that the rock that now formed a mountain once lay at the bottom of the sea. Today we know that in this—as in so many other things—he was correct and far ahead of his time.

✓ Reading Check

1. Why did Leonardo da Vinci prefer to be alone?
2. Why did he use “mirror writing” in his notebooks?
3. How did he learn so much about anatomy?
4. What steps did he follow in his scientific studies?
5. What was Leonardo’s theory to explain why fossils of fish and shells were found on mountains? How did it differ from the usual thinking of his time?

MEET THE *Writer*

Diane Stanley (1943–) is an award-winning author who grew up in a house full of books. She has written and illustrated biographies of Peter the Great, Queen Elizabeth I, and William Shakespeare. She also enjoys creating humorous stories and has written her own version of the Rumpelstiltskin fairy tale, *Rumpelstiltskin’s Daughter*.



▲ Leonardo's study of human anatomy included all views of the skeleton.