# Science in Italian Renaissance Art

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Throughout the Renaissance, classical antiquity as well as science heavily influenced Italian artists. The goal of many Renaissance artists was to mimic the natural world and use painting and sculpture to show the human form accurately. The study of anatomy and the natural human form is essential to the development of Italian Renaissance art, and without this emphasis on science in the Renaissance movement, painters and sculptors would not have been able to effectively convey the naturalistic movements of the figures they depicted. The most important characteristic of Renaissance art is its valuation of science, which presents itself consistently through the paintings, sculpture, and architecture after the Middle Ages.

The rediscovery of classical antiquity was the catalyst for the ideas of the Renaissance. Ancient Roman and Greek sculpture provided the inspiration for much of the art in the 15th to 17th centuries, with many Renaissance artists believing classical antiquity produced the most sophisticated art. During this time, artistic genius was seen as the ability to naturally depict human form and movement. Throughout the Middle Ages, there was little interest in the mechanics of the physical body, because of the belief that the soul was the pinnacle of meaning and that nudity was perverse. This impacted the art world, resulting in a lack of accurate human forms in art from this period. This is heavily contrasted by the unshameful depictions of the naked body in Renaissance images which explore anatomical reality and value the human body as a source of beauty rather than something obscene.

Ancient Romans learned a lot about the fundamentals of human physiology through their observations of gladiators after fights.[1] As doctors treated their wounds, they learned about the inner workings of the human body. It was illegal to dissect human bodies at the time, but animal dissections were common. Knowledge from these studies was incorporated into Ancient Roman

[1] Habbal, Omar. "The Science of Anatomy: A historical timeline." *Sultan Qaboos University medical journal* vol. 17,1 (2017): e18-e22. doi:10.18295/squmj.2016.17.01.004

sculpture and art, exemplified by the accurate portrayal of ligaments in *Augustus of Primaporta,* created circa 20 BC. Even before this, Ancient Greeks studied and employed scientific knowledge in their creations, with Hippocrates's systematic dissections of animals in 400 BC.[2] These discoveries and those like them led to many sculptures which show the artists of antiquity had a deep understanding and interest in humanism and science that faded during the Medieval Period. After the revival of classical Latin and Greek culture, Italian artists began to tap back into these ideas and focus more on scientific realities in their creations. This developed a renewed sense of importance for the sciences and led to Renaissance artists studying anatomy and physiology to effectively communicate Renaissance ideas like naturalism.

Leonardo Da Vinci is recognized as one of the most important Renaissance artists, although in life he wasn't known for his paintings. Maybe the best example of a Renaissance man and the person from whom the term originates, he considered himself an architect, inventor, and engineer above anything. He was very interested in science and the inner workings of the world, which shine through in his art. Deeply passionate about science and invention, Da Vinci studied physics to accurately depict light, anatomy to show the natural range of human movement, and botany to show the world more precisely. [3] *The Last Supper,* which he finished in 1498, incorporates many of these elements in its execution.[4] After being commissioned by Duke Ludovico Sforza and Beatrice D'Este to create the painting on the wall of the Santa Maria delle Grazie Monastery in Milan, Da Vinci used the opportunity to explore his studies on the effects of light and optics. He utilizes one point perspective to lead the viewer's gaze to the head

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[2] Zelazko, Alicja. "Last Supper." Encyclopædia Britannica. Encyclopædia Britannica, inc. Accessed January 27, 2023. https://www.britannica.com/topic/Last-Supper-fresco-by-Leonardo-da-Vinci.
[3] Capra, Fritjof. *Learning from Leonardo*. 1st ed. BK Currents. Oakland: Berrett-Koehler Publishers, 2013.
[4] Da Vinci, Leonardo. *The Last Supper*, 1495-1498. Tempera, gesso, mastic, and pitch on stone wall. 15'1 in. by 29'0 in. Santa Maria delle Grazie, Milan.

of Jesus, and experiments with shadows and light. This is accomplished effectively only because of Da Vinci's background in the study of physics, and would not have yielded the same results without it. His interest in chemistry led him to mix his own paints to create the muted effect of many of his works.[5] His scientific pursuits are ever-present in his creations and are crucial to understanding not only Da Vinci's work, but Renaissance art as a whole. Even the *Mona Lisa* incorporates Da Vinci's scientific research.[6] Her archaic smile is achieved from hours of studying facial muscles to accurately depict a smirk. The shading of her eyes creates the effect that she can actually see the viewer, showing the years that Da Vinci spent studying optics and learning that light rays hit the entire retina rather than one specific spot in the eye.[7] Even this tiny, 30-inch painting carries evidence of Da Vinci's dedication to science.

His journal drawing, *Vitruvian Man* -–the icon for Italy and one of the most well-known pen and ink drawings in history-– was not intended for display anywhere and was a simple sketch in Da Vinci's notes.[8] This was a personal drawing to demonstrate the proportions of the human body and increase his own understanding. Although modern viewers see this image as an incredible work of art, Da Vinci created it out of his interest in science. The image demonstrates human proportions and symmetry, but also represents the natural and spiritual worlds in the square and circle that encompass the man, respectively. Without this understanding of the importance of anatomy, physics, and proportion in Leonardo Da Vinci's work, it's impossible to understand his motivation for creating the art he did. Da Vinci's lifelong interest in science and

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[5] Zelazko, Alicja. "Last Supper." Encyclopædia Britannica. Encyclopædia Britannica, inc. Accessed January 27, 2023. https://www.britannica.com/topic/Last-Supper-fresco-by-Leonardo-da-Vinci.
[6] Da Vinci, Leonardo. *Mona Lisa.* 1503. Oil on canvas. 2'6 in. by 1'9 in. Louvre Museum, Paris.
[7] Ackerman, James S. "Leonardo's Eye." *Journal of the Warburg and Courtauld Institutes* 41 (1978): 108–46. https://doi.org/10.2307/750865.
[8] Da Vinci, Leonardo. *Vitruvian Man.* circa 1490. Ink on paper. 1'2 in. by 0'10 in. Gallerie dell'Accademia, Venice.

invention was a key factor in the art he made and led to his creation of journal entries that were not intentionally created as art but are considered such today.

The writings of the ancient Romans and Greeks influenced the majority of Renaissance artists, but few as much as Donatello. Profoundly interested in the revitalization of ancient Greek and Roman sculptures, he used classical ideas about idealism and the elevation of the human form in the creation of his sculptures. Donatello studied one-point perspective and was one of the first sculptors to depict anatomically correct human forms, most notably in his bronze *David,* which he sculpted between 1430 and 1440. While Michelangelo's *David* heavily skewed proportions to allow the details in the face and arms to be seen from many meters below, Donatello's *David* strived for total realism. Donatello's *David* stands naturally with contrapposto after the beheading of Goliath, his natural positioning and the accurate portrayal of muscles showing the care and research that Donatello put into studying the body. Donatello was also highly interested in perspective, took into account the angle the viewers would view the bronze sculpture from, and altered the length of the torso and arms slightly to appear more natural.[9] Accomplishing this requires a developed understanding of proportions as well as perspective, which has origins in scientific thought. This shows the importance of Donatello's scientific research as it related to his art. Understanding the value that artists regarded science with helps viewers gain a deeper understanding of Renaissance art as a whole.

He also drew from Roman ideas about realism and incorporated these ideas in his portrayal of Mary Magdalene in *Penitent Magdalene.*[10] Strongly contrasting other depictions of biblical imagery, this version of Mary Magdalene isn't romanticized. Instead, it aims to show

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[9]Tarr, Roger. "Brunelleschi and Donatello: Placement and Meaning in Sculpture." *Artibus et Historiae* 16, no. 32 (1995): 101–40. https://doi.org/10.2307/1483565.

[10] Donatello. *Penitent Magdalene.* 1455. Wood sculpture. Museo dell'Opera del Duomo, Florence.

what Donatello believed to be a more naturalistic depiction of the poverty that Mary Magdalene would have experienced as a follower of Christ. Her hair is matted, her face is aged, and she isn't portrayed in the typical idealized fashion that would have been considered appropriate in the Middle Ages, which represents a natural shift from the stiffness of gothic art back into the expressiveness of Roman art that Renaissance artists tried to pull from. Her hands are almost together in prayer, but are slightly parted to emphasize the motion about to happen, pulling the viewers further into the piece. Magdalene's sunken cheeks and shockingly realistic facial expression were not well received by contemporaneous viewers, and the wooden sculpture was received unfavorably because of the strong realism of the sculpture and the true-to-life way it depicts Mary Magdalene, without the elevation she was typically afforded.

Michelangelo, a lifelong admirer of Donatello, also studied the sciences and incorporated this into his work. He dedicated his life to studying the human form and science as a whole, and the understanding of how science impacted his work is crucial to analyzing his creations. His most famous sculpture, *David,* which he began at only 26 years old, demonstrates the many hours that he spent studying the circulatory system and jugular muscles.[11] His accurate portrayal of *David'*s protruding jugular vein as a result of the excitement of the coming battle came a century before scientists fully understood this part of human physiology.[12] This comes from many years of studying the human body to be able to translate it into his sculptures and paintings. Along with studying the body, similar to Leonardo Da Vinci, Michelangelo focuses on the recreation of light and how it affects color, which he employs through his paintings of the ceilings in the Sistine Chapel. Michelangelo used his work studying the effects of light and color

[11] Michelangelo. *David.* 1501-1504. Carrara marble. 17 ft. by 6.5 ft. Accademia Gallery, Florence.
[12] Breakey Neal. "David, Brutus, and Caracalla—A Sculptural Chronology of Anatomical Observation." *JAMA Cardiol.* 2020;5(10):1200. doi:10.1001/jamacardio.2020.2852

as well as the perspective of viewers who would be looking directly up at the Sistine Chapel ceiling to create images with depth. Although dissection was still looked down upon, Michelangelo was permitted to study the corpses of socially undesirable people like prostitutes and criminals.[13] This, along with observing others and being in contact with physicians at the time, led to his depth of understanding of the human body.

Michelangelo's disdain for painting the ceiling of the Sistine Chapel was not only because of the discomfort of painting upside down and his hatred for the corruption of the papacy, but also because he felt called to continue sculpting and looked down on painting as an artistic practice. He viewed sculpting as the highest form of artistic expression and believed that it was God's will for him to study the human form and anatomy through his chosen medium.[14] In his execution of the Sistine Chapel ceiling, he still tried to incorporate his studies of the human body in his paintings. Found in the neck of God in the fresco *The Separation of Light and Darkness*, a fully anatomically correct brain stem is visible.[15] Michelangelo hid elements like these throughout his paintings on the ceilings of the Sistine Chapel and his other works, demonstrating his years of work analyzing human physiology.

Influenced by Michelangelo and Leonardo Da Vinci, Raphael also took up an interest in studying the physical form. The ways that he was influenced by science manifests itself in his fresco *The School of Athens* which he completed in 1511.[16] This painting shows the depth of Raphael's elevation of learning and the significance of science. Raphael includes not only

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[13] Eknoyan, Garabed. "Michelangelo: Art, Anatomy, and the Kidney." *Kidney International* 57, no. 3 (2000): 1190-201.
[14] Balestrieri, James. "Body of Work Michelangelo: Mind of the Master." Antiques And The Arts Weekly , September 24, 2019. https://www.antiquesandthearts.com/body-of-work-michelangelo-mind-of-the-master/.
[15] Ashford, J. Wesson, and Sue Binkley Tatem. "Michelangelo's Presentations in the Sistine Chapel: Brain Evolution and the Relationship of the Brain to Specific Cognitive Functions." *The Neuroscientist (Baltimore, Md.)*, 2022, 107385842211360-0738584221136091.
[16] Raphael. *School of Athens.* 1511. Fresco. 16'5 in. by 25'3 in. Raphael Rooms, Vatican City.

himself in the painting, but also Michelangelo. The painting places a high level of importance on scholarly figures like Plato and Aristotle. These are two significant men in science and philosophy, which Renaissance ideals elevate. They're also both Greek figures, who were respected more after the revitalization of classical antiquity that led to the Renaissance. Along with these figures, there are also other notable mathematicians, scientists, and philosophers who are given an elevated status by their inclusion in this image. While Plato points up to represent his philosophical work that has to do with spirituality and the meaning of life, Aristotle is depicted with a palm facing the ground, representing his ideas about politics, ethics, and the ways that humans act in the physical realm. The two men are conversing, as others take notes or demonstrate their own separate scientific discoveries, and this painting shows Raphael's reverence for the sciences as well as classical Greek and Roman culture.

Raphael's 1520 *Transfiguration* uses the study of light to create a mystical air in the painting.[17] Raphael paints his figures with highly naturalistic expressions to demonstrate not only his artistic ability, but also the ways that he can convey the precise human form as a result of studying anatomy. The shadows that show accurate patterns of light also exemplify the studying that Raphael has done. This further emphasizes the importance that scientific study had on the arts, and establishes the necessity of the "Renaissance man," who dabbles in a variety of sciences to pull from in his art.

Contrapposto is critical to the understanding and study of Italian Renaissance art because a main keystone of the Renaissance was the focus on naturalism and how the human body moves organically. Contrapposto is an important element of art throughout the Renaissance, and at least a basic understanding of anatomy is required to execute it properly. The stiff, rigid forms of

[17] Raphael. *Transfiguration.* 1516-1520. Oil tempera on wood. 160 in by 110 in. Vatican Museum, Vatican City.

Gothic sculpture didn't concentrate much on showing the ways that figures would realistically stand, and the main focus in Byzantine art is the mystical element of the divine rather than the physical world that humans inhabit. While contrapposto originated in Ancient Greek sculpture, it was revived during the Renaissance and the use of contrapposto is another key element in Renaissance art that elevates science in art.[18] Employing these methods to create lifelike human forms required years of studying and meant that artists of the Renaissance had to not only be skilled in the way of sculpting and painting, but also in scientific pursuits. The emphasis on contrapposto and the portrayal of natural movement shows the emphasis of science on the work of Renaissance sculptors and painters.

Like many of the other Renaissance men, Titian also studied anatomy to gain a deeper understanding of musculature and how the body functions to translate into his art. His pupils followed suit and also studied the sciences. Titian and his student John the Calcar collaborated on the first modern book of anatomical illustrations, which served artists and physicians alike. [19] Titian's work toward a higher understanding of the human body helped him not only as an artist, but also as a scientist. One of Titian's other pupils, Tinoretto, likely also contributed to the creation of the book Vesalius's Anatomy. Tintoretto was mainly interested in studying the ways that back muscles function, depicting them in some of his personal drawings.[20] Tintoretto also dissected cadavers to more thoroughly understand how the human body works, despite the disapproval from the Catholic church which viewed autopsying as a desecration of the human body. Tintoretto demonstrates his mastery of anatomical drawing in the anatomically correct

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[18] "Contrapposto". Accessed January 28, 2023. https://www.nationalgalleries.org/art-and-artists/glossary-terms/contrapposto#:~:text=The%20Ancient%20Greeks%20first%20invented,had%20a%20stiff%2C%20rigid%20quality.

[19] Meijer, Bert W. "Titian Sketches on Canvas and Panel." Master Drawings 19, no. 3 (1981): 276–353. http://www.jstor.org/stable/1553583.

[20] Tintoretto. *Study*. 1551. Chalk on tinted paper. In private collection.

muscular figures he includes in his paintings. All of these artists utilized their knowledge of anatomy in their work and demonstrated how important the sciences are to Italian Renaissance art. These artists are considered geniuses of their time because of the way they effectively showed the natural human form as well as their own individual style. Renaissance art values naturalistic forms above the stiff, rigid figures of the Gothic Era, and relied on scientific studies to execute.

While ars gratia artis, or art for art's sake, was a large idea of the Renaissance, the driving force behind a lot of the art that was produced during the Italian Renaissance was a deep interest in the sciences and the universe. The artists of the Renaissance required a deep understanding of anatomy and general science to be successful.

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