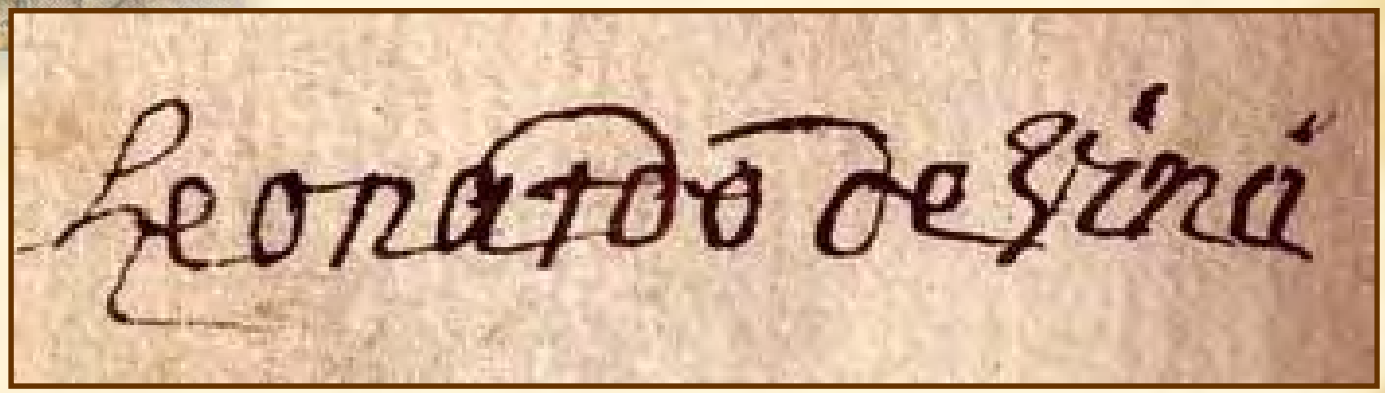
An Nguyen, Nick Hurrie, and Jane Rowland
present ...



An Exploration of Renaissance Genius

Leonardo was born on 15th April 1452, at Anchiano near Vinci in the Florence area. He was the illegitimate son of a 25 year old notary, Ser Piero, and a young woman named Caterina.

In 1457 Leonardo's father took custody of him at his home in Vinci. His mother married another man. His father married into a wealthy family.

In 1460 he moved to Florence with his father. Leonardo displayed extraordinary talent from a young age: learning to play the lyre, singing beautifully, strong in mathematics, sketching plants and animals.

In 1468, his grandfather died and his family moved to Florence. His father decided he should study with Andrea Verrocchio; a renowned sculptor, painter, goldsmith and sought after master for young apprentices. Leonardo was to study all skills.

In 1469 he began his apprenticeship in Verrocchio's workshop. Leonardo's activities would have included grinding and mixing pigments, learning geometry, preparing panels for paint, painting, and working in clay and bronze.

Leonardo had virtually no formal education and displayed contempt for ‘received learning.’ He realized that his lack of Latin shut him off from other intellectuals, and he launched a self-education program.

In 1472, he enrolled as a master in the Company of Painters; his apprenticeship to Verrocchio ended, though he stayed at his master's workshop. There are no records of Leonardo's activities between 1476-1478.

In 1480 Leonardo had established his own studio and was patronized by Lorenzo di Medici or ‘the Magnificent’, the ruler of Florence.

He was commissioned to paint the ‘Adoration of the Magi’ for the church of San Donato Scopeto. He had two years to complete it but started other works during this time and was unable to complete it.

He abandoned this commission and moved on.

In 1482 he wrote to the Ludovico Sforza, the Duke of Milan, listing his capabilities as a designer of civil and military machines.

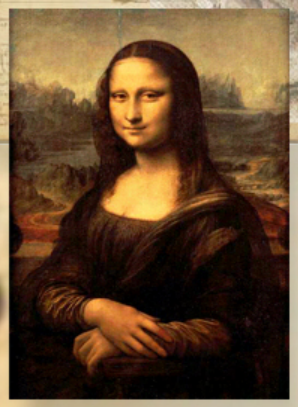
The city-states of Italy were at war and Italy was later invaded by the French.

Leonardo had many ideas for fortifications, bridges, weapons, and river diversions to flood the enemy. He also detailed his skills as an architect, sculptor, painter and musician.

Initially he painted and sculpted, producing the portrait of Cecilia Gallerani or the "Lady with an Ermine", and the first version of the "Virgin of the Rocks."

Soon after the Duke put Leonardo to work designing weapons, buildings and machinery.

He spent 17 years in Milan, during which he reached new heights of scientific and artistic achievement.

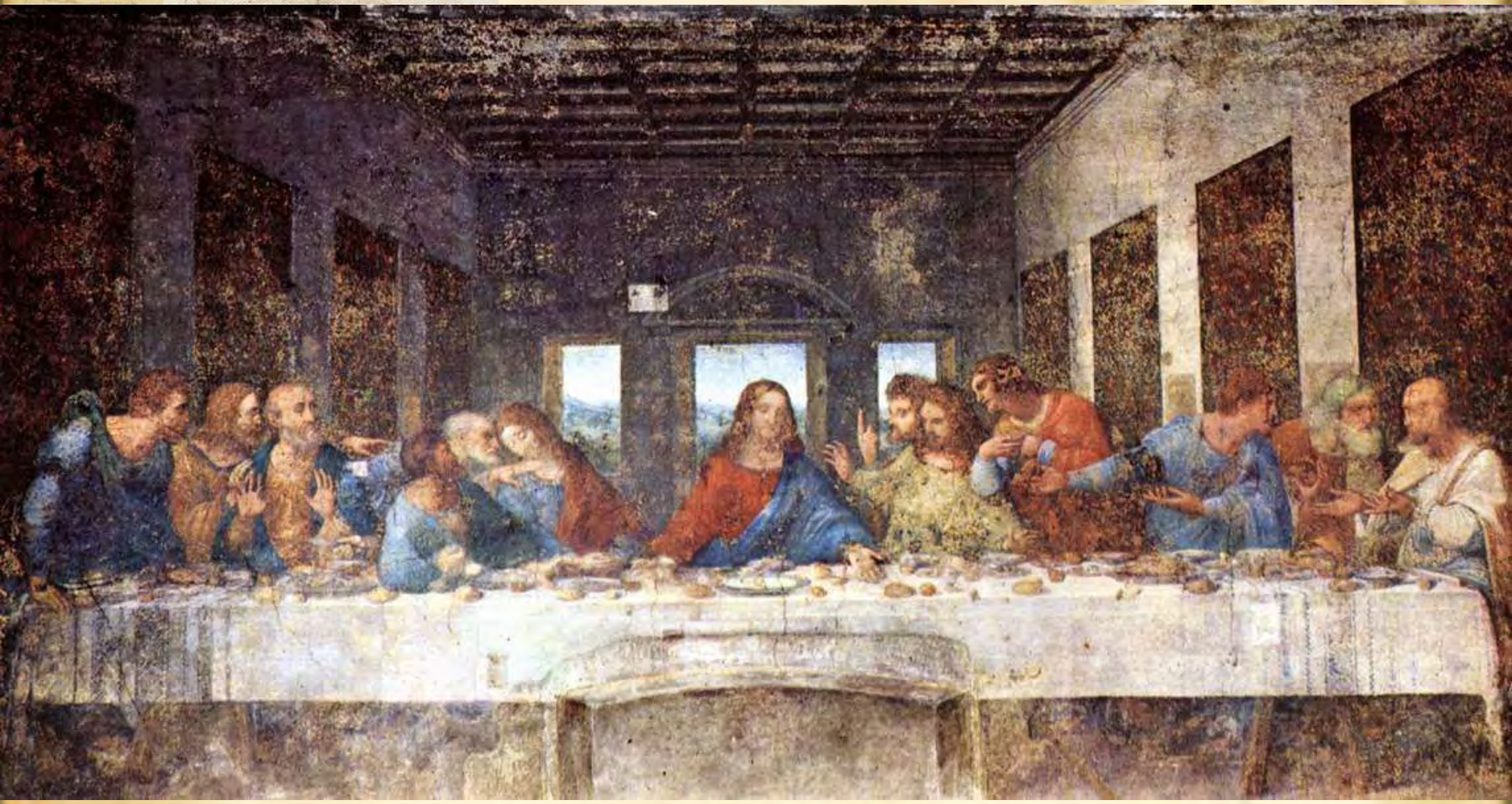


His studies from this period contain designs for advanced weapons, including war vehicles, various combat devices, and submarines. Also during this period, Leonardo produced his first anatomical studies.

Between 1490 and 1495 he developed the habit of recording meticulously in illustrated notebooks.

In 1495 he began his best known work, the Last Supper, in the refectory of Santa Maria delle Grazie. The fresco was completed in 1498.

His interests were so broad that he usually failed to finish what he started. He completed only six works in these 17 years, leaving dozens of paintings and projects unfinished.



The Last Supper (1495 – 1498)

The city-state of Milan fell under the control of the French armies of Louis XII in 1499. Leonardo left Milan to look for a new patron. By now he was a celebrated genius in both painting and engineering.

In 1500 he returned to Florence and in 1502 he began work for Cesare Borgia. He traveled for a year with Borgia's army as a military engineer.

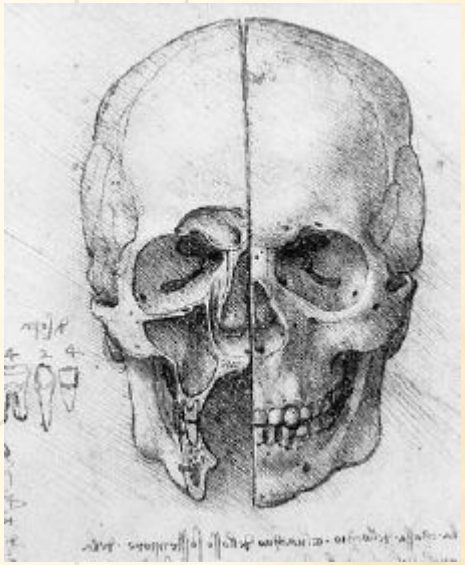
In 1503 he returned to Florence and began work on the "Mona Lisa." He also furthered his studies in anatomy and commenced a two year obsession with flying; studying and sketching both subjects in his notebooks and designing several flying machines.

In 1504, his father died and Leonardo's inheritance was kept from him by his half brothers and sisters. When Leonardo's uncle died Leonardo confronted them and inherited land and money.

He divided his time between Florence and Milan until 1508, when he settled in Milan for 6 years studying anatomy, town-planning, optics and hydraulic engineering.

In 1513 the Sforzas resumed control over Milan, Leonardo was invited to Rome by newly-elected pope, Giuliano de' Medici.

He worked for the Pope for three years working on a variety of projects. The Pope forbade him from dissecting cadavers which hindered his continued studies of anatomy and physiology. He worked on geometric and optical puzzles, experimented with flight.



Leonardo became ill and frustrated, there is little evidence that he painted from this time onwards.

In 1516 following the death of Giuliano de’ Medici; the King of France, François I, invited Leonardo to work for him.

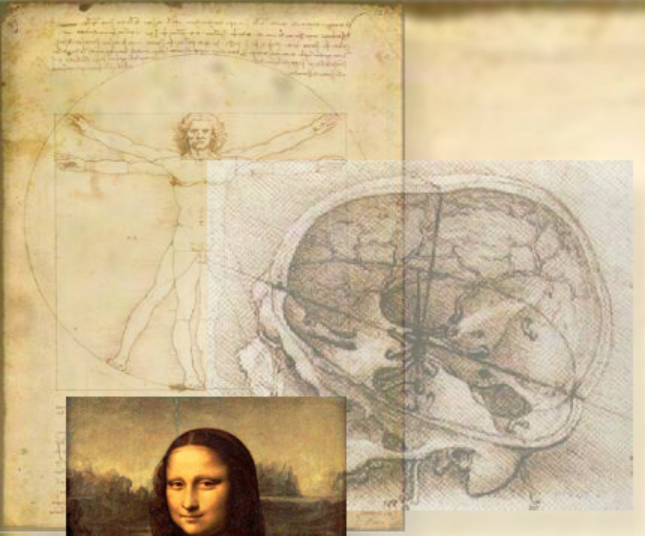
He was given the castle of Cloux and the title of “first painter, engineer and architect to the King."

Leonardo was becoming a very sick man. Despite partial paralysis in his right hand due to a stroke, Leonardo was still able to draw and teach.

The King did not demand much from Leonardo beyond suffering royal visits and planning festivals.

One of the items Leonardo made for him during this period was a mechanical lion with a breast that opened to reveal lilies.

Most of his time was spent organizing his notebooks and producing numerous studies in all areas of his interest.



Leonardo died on May 2, 1519 in Cloux, France. He was 67 years old.

The Death of Leonardo da Vinci by Ménageot, 1781

The Death of Leonardo by Ingres, 1818.

Leonardo’s Manuscripts

Due to Leonardo’s left handed script his manuscripts are difficult to read. He wrote in mirror-image script from right to left, used peculiar spellings and abbreviations, and his notes are not arranged in any logical order.

After Leonardo's death, Francesco Melzi, his favourite pupil, brought many of his manuscripts and drawings back to Italy. Over five thousand pages of drawings and notes have come down to us.

The organization of Leonardo's manuscripts today are entirely different from that during his, or Melzi’s lifetime. After Melzi's death in 1579 his heirs began to scatter the material, having no idea of their importance.

The manuscripts were split to sort the artistic drawings from the technical ones, creating separate collections which were divided further.

Some remained in Spain, some were sent to Paris by Napoleon then demanded back by the Austrian government. Only one was returned, the other twelve manuscripts, marked A to M, were lost.

Some were discovered in 1966 by chance in the archives of the National Library of Madrid.

The "Vinci Royal Commission" was established around 1900 aiming to reconstruct the original arrangement of the manuscripts.

Ten manuscripts

Codex Arundel – British Library in London.
Includes geometry, weights and architecture.
Dates from 1480 to 1518.

Codex Atlanticus – Biblioteca Ambrosiana in Milan.
Includes mathematics, geometry, astronomy, botany, zoology and the ‘military arts’.
Dates from 1480 to 1518.

Codex Trivulzianus - Biblioteca Trivulziana in Milan.
Includes architecture, religious themes and Leonardo’s efforts to improve his literary education.
Mostly dates from 1487 to 1490.

Codex 'On the Flight of Birds' - Biblioteca Reale of Turin.
Includes primarily the flight of birds, the mechanics of flight, air resistance, winds and currents.
Dates approximately 1505.

Codex Ashburnham - Institute de France, in Paris.
Includes pictorial studies and assorted drawings.
Dates from 1489 to 1492.

Codices of the Institut de France - Institut de France, in Paris.
Includes military art, optics, geometry, the flight of birds, hydraulics.
Dates approximately 1492 to 1516.

Codex Forster - Victoria and Albert Museum, in London.
Includes geometry, weights and hydraulic machines.
Three sections: between 1490 and 1496 for "Forster III", between 1495 and 1497 for "Forster II" and between 1487 and 1490-1505 for "Forster I".

Codex Leicester - purchased by Bill Gates in 1995, the only privately owned manuscript. Includes geology, astronomy, hydraulics, and the movement of water.
Dates from 1504 to 1506.

Windsor folios - Windsor Castle (Royal Collection), in UK.
Includes anatomy, geography, horse studies, drawings, caricatures and a series of maps.
Dates from different periods between 1478 and 1518.

The Madrid Codices - National Library of Madrid, rediscovered in 1966.
"Madrid I" includes studies in mechanics and is dated from 1490 to 1496.
"Madrid II" includes studies in geometry and is dated from 1503 to 1505.

http://www.bl.uk/collections/treasures/leonardo/leonardo_broadband.htm?top

Proportions and Kinetics

Seemingly to perfect his art, Leonardo strove to find the dimensions and physics at work behind the human body.

Most of his work on this was done before 1498, however, due to his perfectionist nature he continued editing and fine tuning it in the years prior to his death.

Vitruvian Man

Leonardo expanded upon the studies of the roman architect Vitruvius.

He encoded the proportions he learned within his famous drawing of the Vitruvian Man.

In addition to the drawing and examples to come, Leonardo made over 100 other proportional observations and made conjecture as to what “perfect” proportions should be.

Time to get up and move around…

Let’s do an experiment!

Vitruvian Experiment!

We will test some of the relationships from Leonardo da Vinci’s 'Vitruvian Man' and related proportional observations.

Instructions:

1. Find a partner and a piece of string.
2. Use the string to test Leonardo’s rules of human proportion found on the next slide.

1. Thumb circumference x 2 = wrist circumference.

2. Wrist circumference x 2 = neck circumference.

3. Neck circumference x 2 = waist circumference.

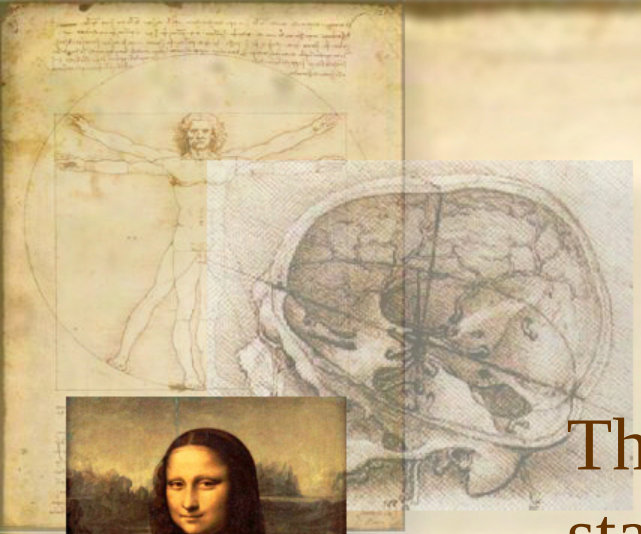
4. The length of one ear should be the same as the distance from the hairline to the eyebrow.
5. The length of the foot is equal to that of the forearm.
6. Eyes are separated by a distance of one eye width.

7. The length of the foot is equal to the height of the head
8. Elbow to fingertip is about two head lengths.
9. Wrist to fingertip is one head length.

10. One hand length is one tenth of your height.
11. The length from chin to throat equals chin to mouth.
12. The width from shoulder to shoulder is 3 heads width.

13. The distance from the hip to the toes is 4 heads.
14. No matter what your proportions everyone has the same size thumb from the tip of your thumb
to the first knuckle.

Ones to try at home ...
15. The length from top to bottom of the buttocks is 1 head.
16. The two nipples and the navel form an equilateral triangle.



18 actions of man

These included: repose, movement, running, standing, supported, sitting, leaning, kneeling, lying down, suspended, carrying, being carried, thrusting, pulling, striking, being struck, pressing down and lifting up.

These actions all effect the subject's center of gravity, in his attempt to make his art more realistic Leonardo studied these actions and their affects on the human body.

Here a man is ascending stairs, Leonardo carefully studied and represented how the body would adjust in order to complete the task. He’s able to use this information to clearly convey the action taking place.

This is a simple sketch depicting the effect that running has on balance and the center of gravity.

Virgin and Child with Saint Anne and a Lamb.

Here Leonardo applies his studies and as seen in the background, St. Anne appears to be supporting Mary.

St. Anne has a slight lean denoting the counter balance she acts as in the painting

Leonardo's Anatomy, Physiology and Biology

Leonardo was the most prolific artist of the fourteenth century to reveal new aspects of human anatomy. This advancement was essential if surgery was to become more successful.

The newly invented printing press allowed books to be produced quickly, followed by a demand for accurate information.

He studied and drew the anatomy of animals, dissecting cows, birds, monkeys, bears, frogs, and most notably horses; comparing their anatomical structure with that of humans.

He discovered structures and their functions that would not be understood for generations and in some cases centuries.

Leonardo on the Anatomy Timeline

Ancient and mediaeval medicine relied on touch; i.e. if the body was hot or cold. It also focused on visual symptoms; i.e. the patient's complexion and the colour of their urine.

The Renaissance was a revival in the ideas of ancient Rome and Greece and shifted the study of natural philosophy towards a more scientific approach.

Before Leonardo and the renaissance, Mondino de Luzzi produced the first manual for dissection in 1316. However if a surgeon discovered a condition beyond the notions of Aristotle or Galen, the subject was presumed to be deformed.

Leonardo's Anatomy Timeline

Leonardo's training in anatomy began with his apprenticeship. These studies were topographic, to understand the muscles, tendons and other visible anatomical features.

He was given permission to dissect corpses at the hospital Santa Maria Nuova in Florence and later at hospitals in Milan and Rome.

From 1489 he began a series of anatomical drawings and over the next twenty-five years he dissected about thirty human corpses.

He was to publish his studies on anatomy the doctor Marcantonio della Torre in 1510. It was eventually published in 1680 (161 years after his death).

In 1515 Pope Leo X ordered him to stop his anatomical studies.

Risk

Dissection of humans led Leonardo in breaking many religious laws of the time and put his life in risk of being put death for Necromancy.

Dissecting cadavers was a dangerous activity, not only foul in both smell and nature, the surgeon also risked contracting bubonic plague.

In 1514, Leonardo was brought to the Vatican under allegations of witchcraft and necromancy. Da Vinci's notebooks were analysed. Many containing unknown inventions and discoveries considered sacrilegious were destroyed.

Leonardo was order to cease or face the consequences. It is believed that his Genius and perceived 'divine' gift of painting saved him from being put to death.

Technique

Where earlier authors had relied almost exclusively on verbal descriptions, Leonardo
e significance of visual studies
to understanding.

He saw that during dissection blood and other tissues obscured the view and prevented
a drawing. He was the first to
e ists to make models as the basis
fo as the first to inject hot wax into organs to define the shape and size of an internal body structure.

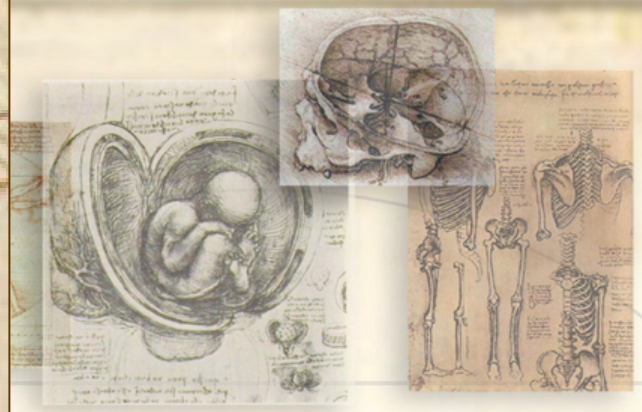
Leonardo used layers, levels, transparency, and cutaway sections to opens up the body in a new way. E.g. he made a glass model of the heart using millet seeds in clear water to demonstrate the flow of fluids.

Leonardo frequently drew multiple viewpoints of the same organ, bone or part of the body: front, behind, left side, right side, above and below.

Movements

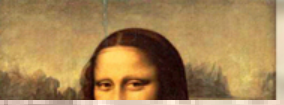
Leonardo wanted to understand motion in the human body; a mechanical device, subject to the laws of mechanics and the four powers of nature, namely, weight, force, percussion and movement.

In order to catalogue and understand how the machine of the body works, Leonardo made multiple sketches and physical and mechanical models to simulate its functions.



The switch from thinking about the movements of men to those of machines was a natural transition for Leonardo.

The spine is compared to the mast of a ship; the actions of the shoulders and arms compared with weights and balances.



Age

Leonardo was also concerned with studying changes that occur with growth and was interested in the effects of age and of human emotions on the body. He also studied facial deformities or signs of illness.

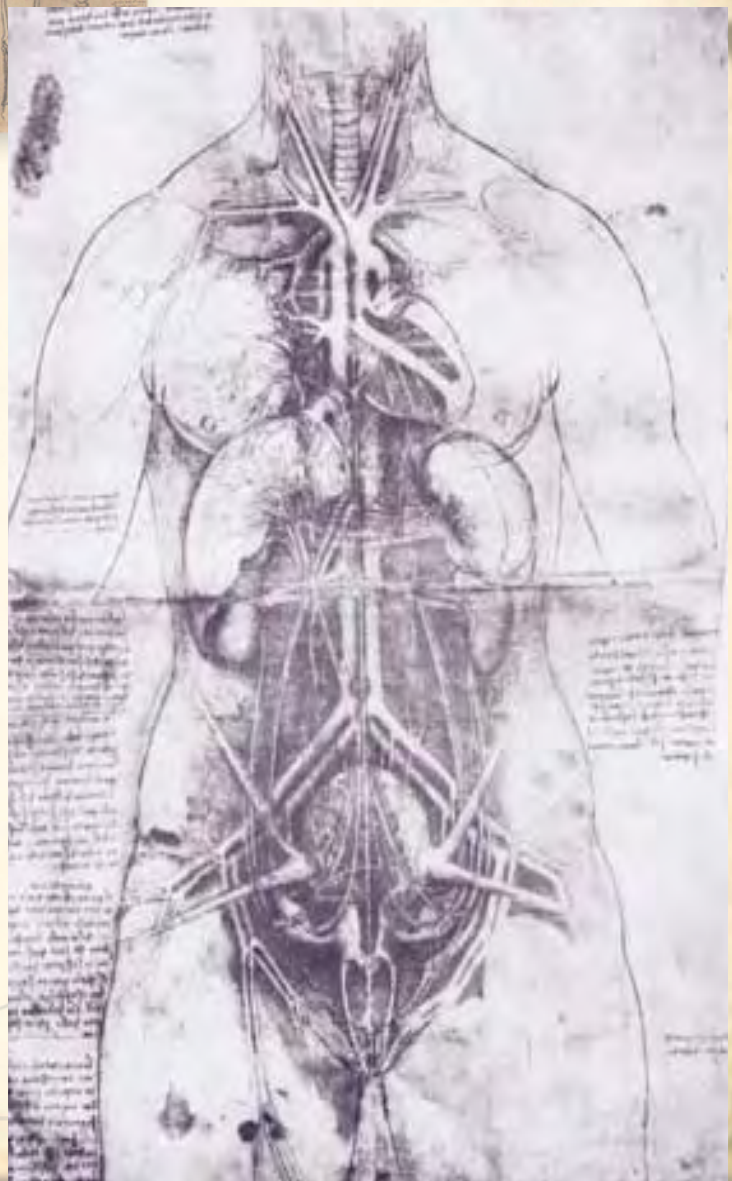
He understood that a person or a part of the anatomy once drawn would not remain the same, that organic ‘objects’ were in a constant state of flux.

During the winter of 1507-08, Leonardo embarked upon the dissection of a man who was more than one hundred years old.

Reproduction

For men of the age, the female body held no particular fascination. Leonardo understood that the female played a much larger role in the reproduction of human life than the male, which was not the ideology of the time. Leonardo's most recognised work on the female anatomy is called 'The Great Lady'.

He discussed why some children are born mute or blind and explored why a mother’s mental state can affect the health of her unborn child, since he believed that "one and the same soul nourishes the two bodies."



He made one of the first scientific drawings of a fetus *in utero*, the study of which was unheard of at that time.

Leonardo had access to a human foetus of approximately seven months.

His findings on embryology were lost before being rediscovered in the 20th century.

Heart and Circulatory System

During the final years of his life, Leonardo carried out detailed investigations of the heart. The main aim was to define how the heart and its valves operated in conjunction with the hydrodynamic turbulence of pumped blood.

In Leonardo's words

Between one and the next beat of the pulse the heart closes twice and opens once, and between one and the next opening the heart opens twice and closes once…Accordingly, in every harmonic tempo, the heart has three motions.

His studies of the heart suggest that he was on the verge of discovering the concept of circulation of the blood.

Of all of Leonardo's known discoveries his discovery of the cause of Heart disease through a build up of cholesterol could have saved millions of lives.

This would have been so if his discoveries published at the time by his peers.

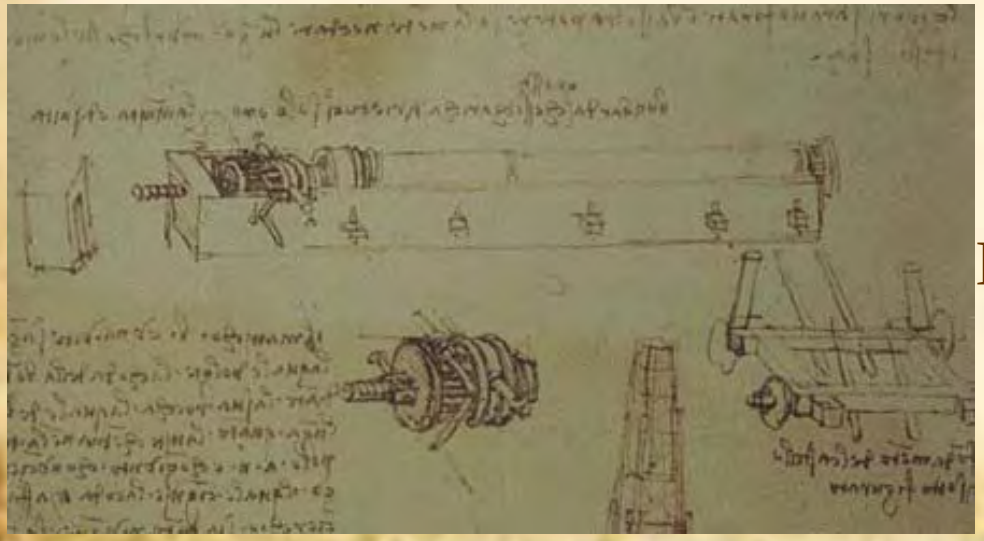
Leonardo had worked out that a substance carried though the blood and produced by what we eat imbeds itself in the arteries and blocks natural blood flow.

Biological Science Legacy

Da Vinci's anatomy drawings are so perfect to this day that many of his drawings are still being used in scientific illustration.

His studies and inventions were so far reaching that his notebooks are still being fine-combed for new discoveries. Scientists are hoping to locate possibilities that have not yet been realised over 480 years after the death of Da Vinci.

The Inventor ...



War Machines

Armoured car

Cannon with adjustable elevating arc

Three-barrelled cannon

Hull rammer

Giant cross-bow

Ballista for hurling stones

Scythed chariot

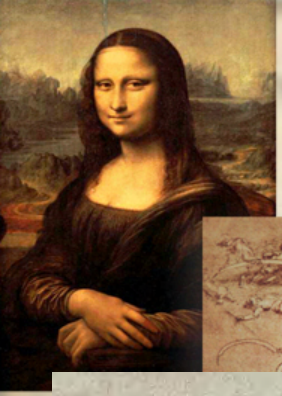
Machine for storming walls

Hoist for lifting cannons

Ladder for besieging walls

Breech-loading naval cannon

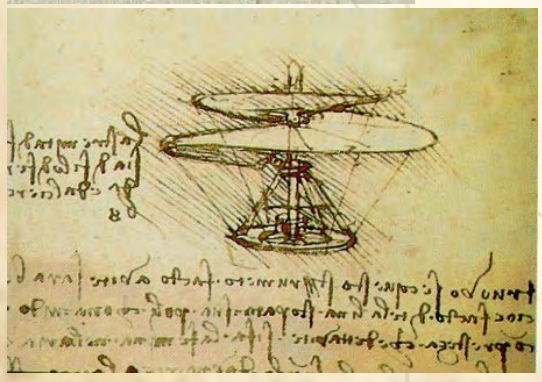
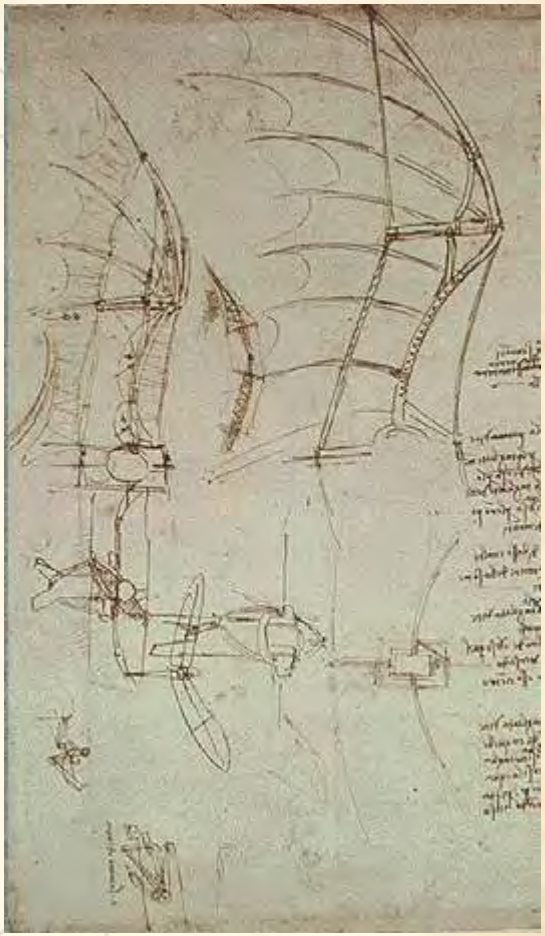
33-barrelled organ









Flying Machines

Wing structure

Aerial screw

Glider with manoeuvrable tips

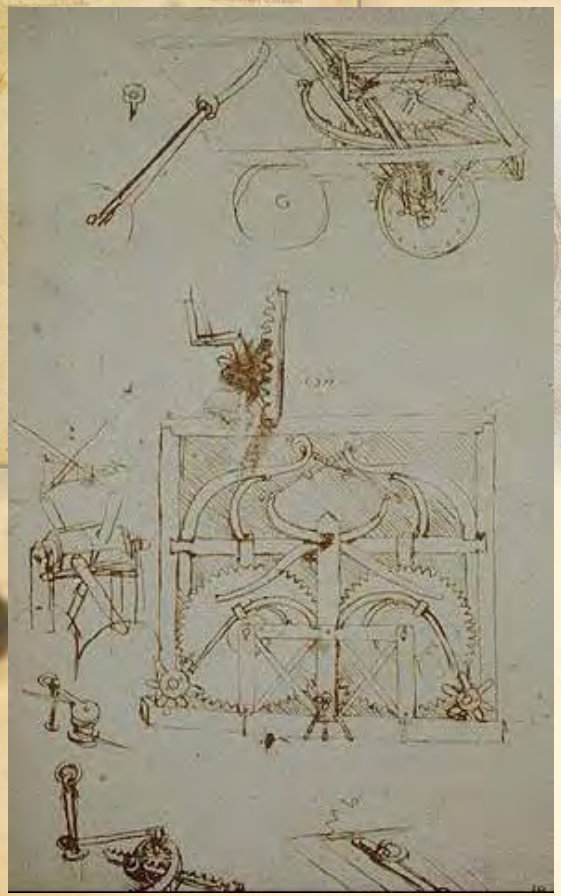
Flying ship

Parachute

Anemoscope

Flapping-wing machine

Inclinometer



Work Machines

Self-propelled car

Pillar-lifting machine

Pile driver

Drilling machine

Revolving crane

Screwtongs

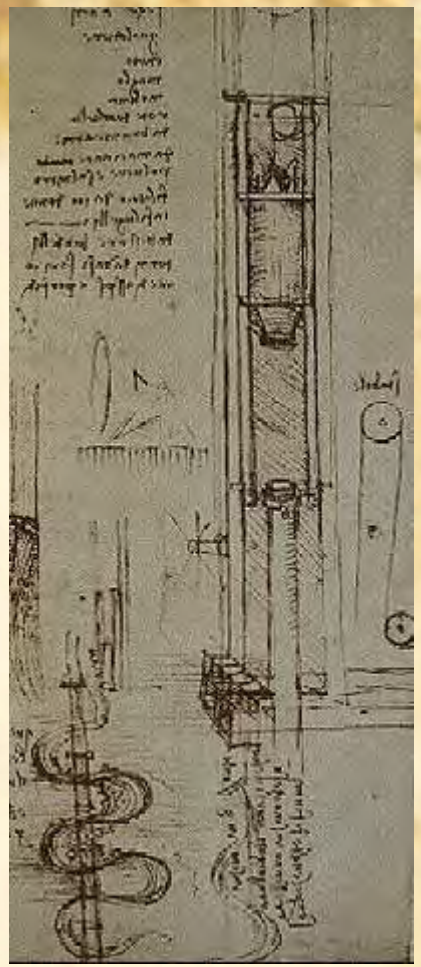
Improved alembic

Pulleys

Mechanical drum

Multiple-cylinder mill

Machine for digging trenches



Wheel for studies on the impossibility of perpetual motion

Hygrometer

Fan

Drive train device

Water and Land Machines

Sluice gate hatch

Webbed glove

Floats for walking on water

Galata Bridge

Boat with paddle wheels

Diving bell

Paddle-wheeled boat propulsion system

Mobile-ram boat (assault battleship)

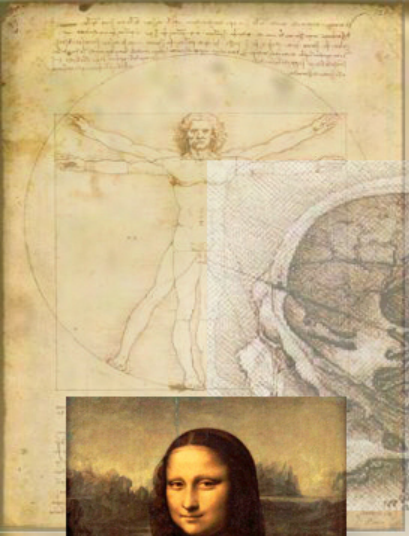
Bilge pump

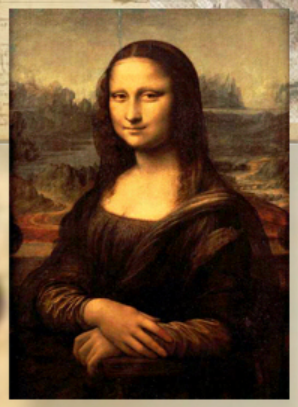
Temporary bridge on a double row of trestles

Deep-sea diving suit

Double hull

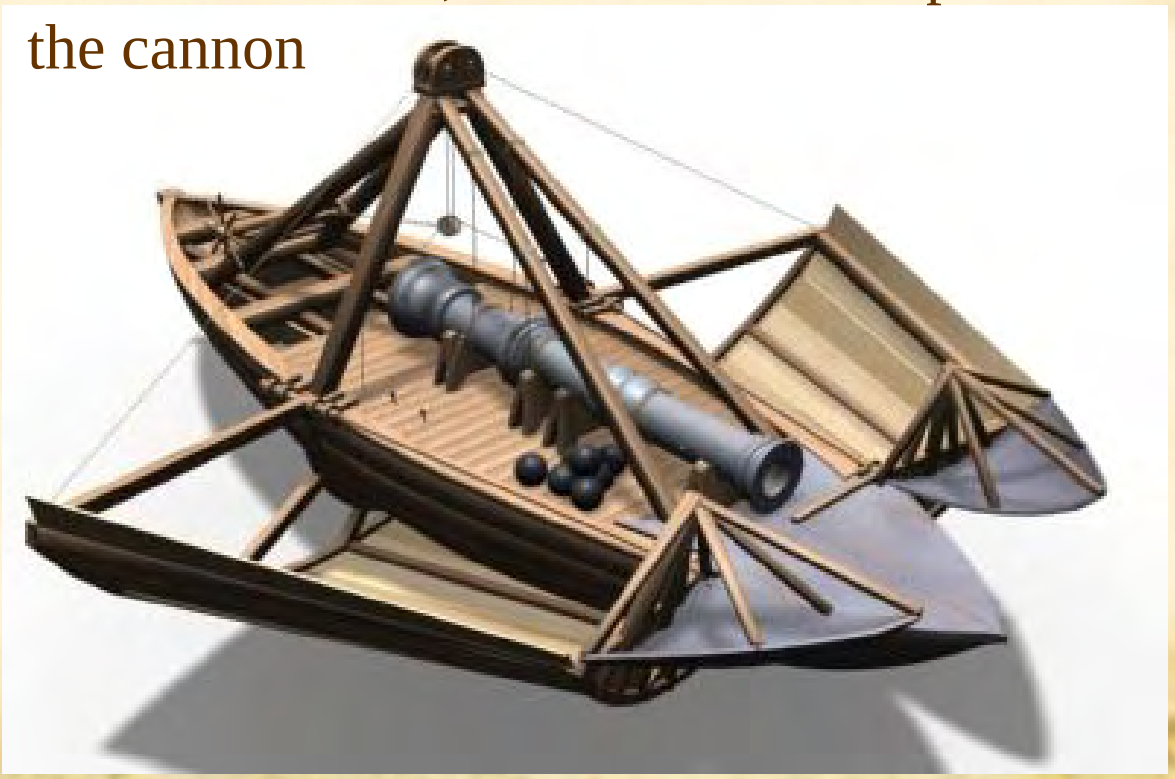
Auto-feed hydraulic saw





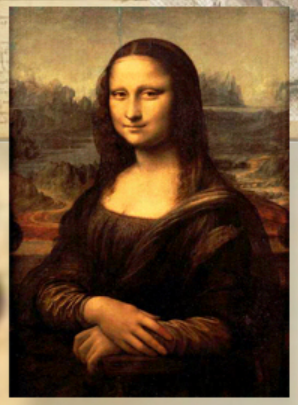
Armoured Vessels

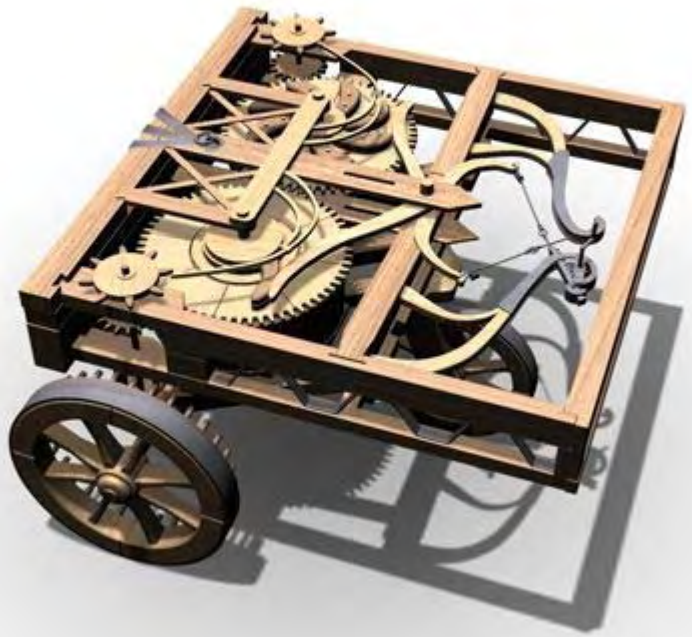
- Light vessel fitted with prow armour
- Used to ram enemy ships
- Had rotating cover shield to protect against enemy
- Shield also concealed and protected a cannon
- When rammed, shield would be opened to reveal the cannon

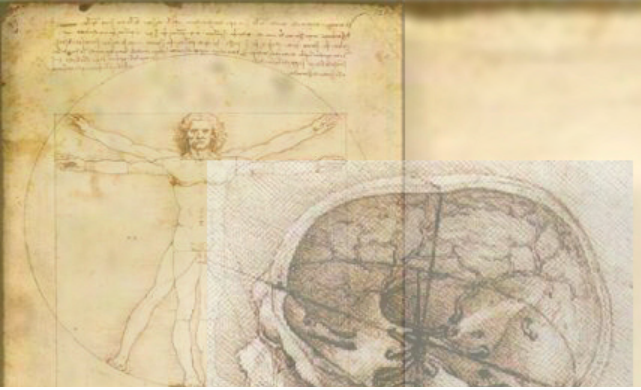


Self-Propelled Car

- Was considered to be Da Vinci's famous "Automobile" project
- One of the first automated mobile devices in history
- Uses spiral springs to move
- Used for theatre, maybe for automatons







Flying Machine

- Studied Mechanical wings for long time

- Reconstruction of one of many projects for a flying machine

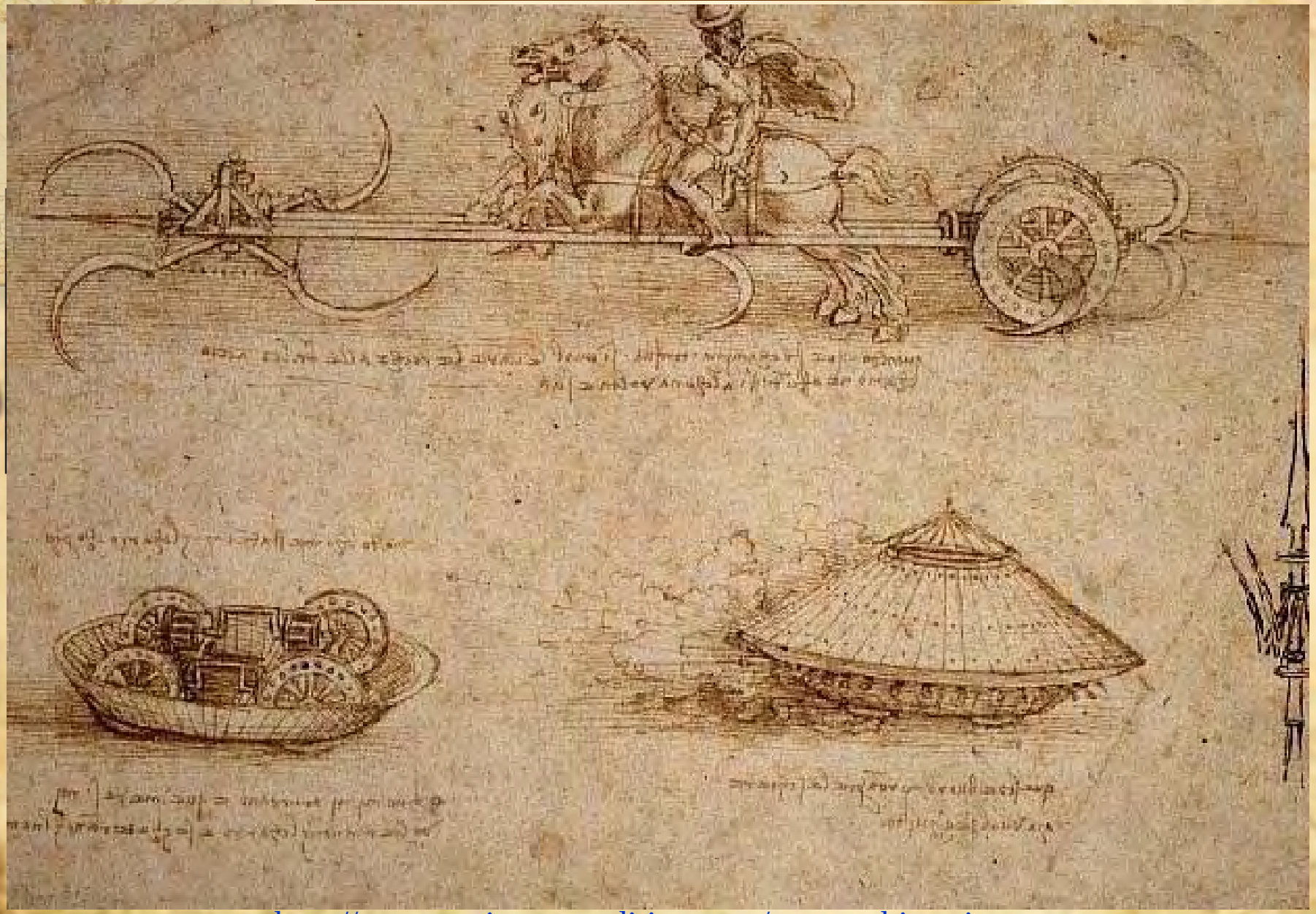
- Tried to imitated natural flight (bats, kites, & birds)

- Machine mimics the movement of a bird, called the “Great Bird”

- Mainly a study of the mechanics of folding of wings

- Suggested machine should be tested over a lake, for safety reasons

Scythed Chariot & Armoured Car



http://www.curiousexpeditions.org/warmachines.jpg

Scythed Chariot

- First drawing of this type of war machine

- As the wheels turned, the blades would rotate

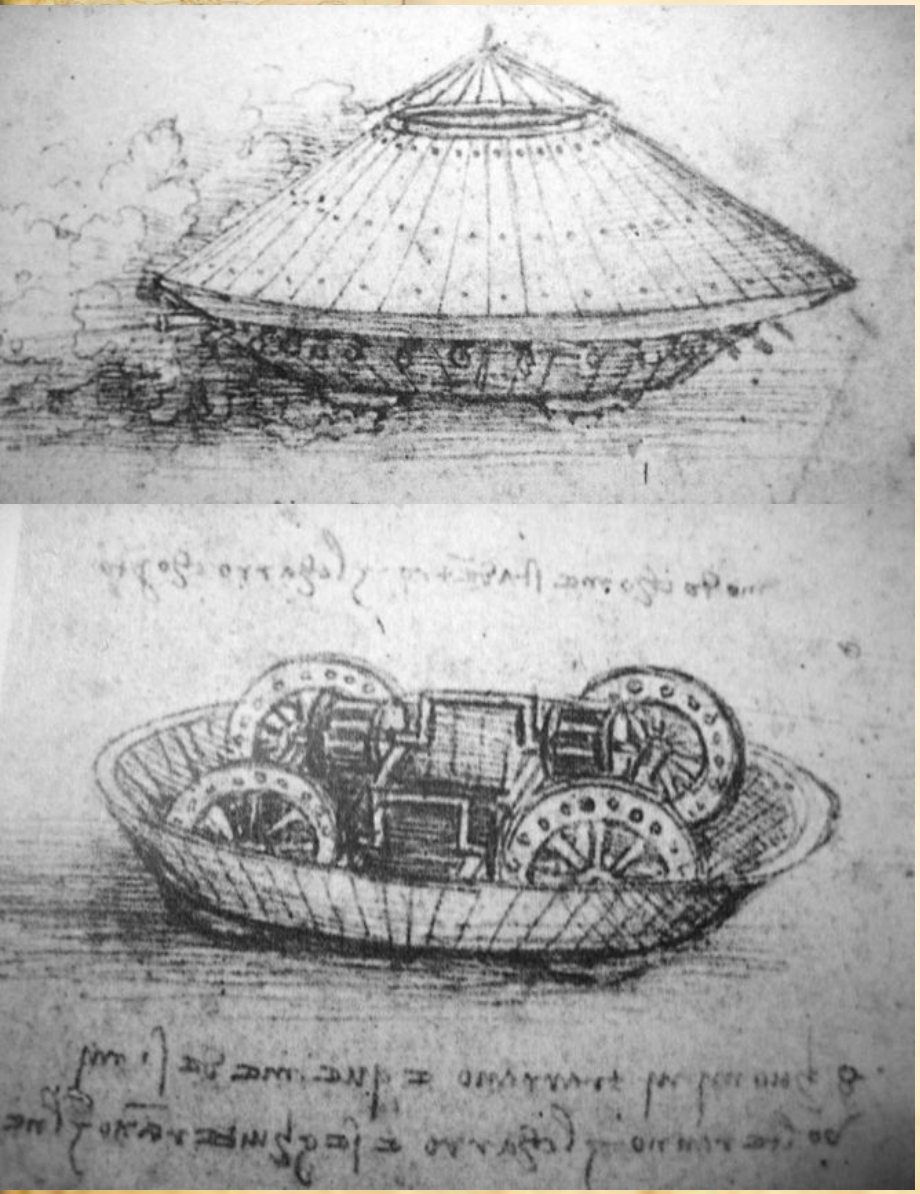
-Prevent enemies from approaching

- Pulled by horses

- Presented to Duke of Milan

-Drawing showed machine in action

Armoured Car



- Drawn for the Duke of Milan

- Quite well laid-out

- Inspired by Classical World before Renaissance

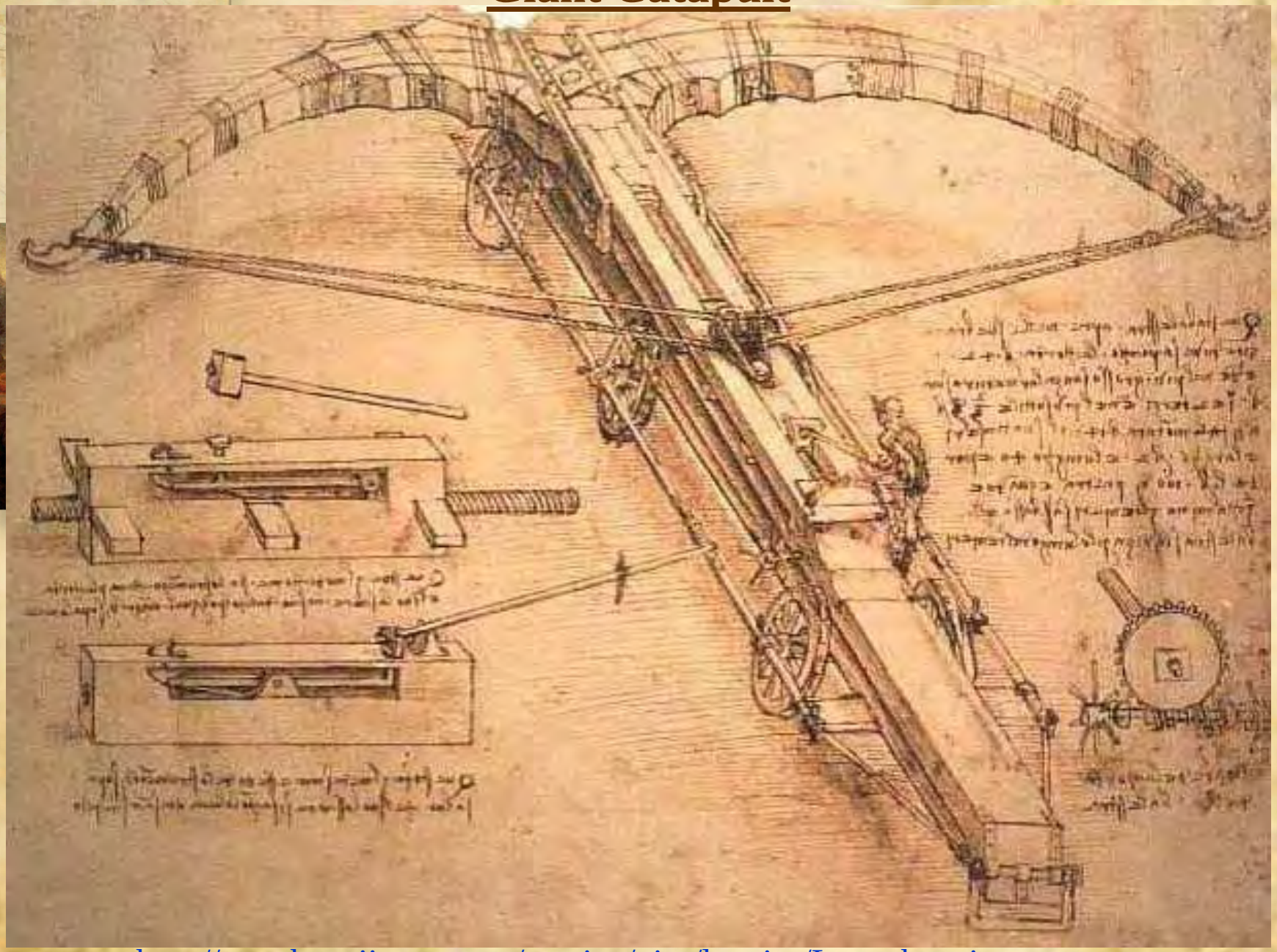
- Contained many light cannons, arranged in a circle (360 degree firing range

- Covered by conical cover with an opening at the top for a sighting turret

- Two cranks are used to move the machine

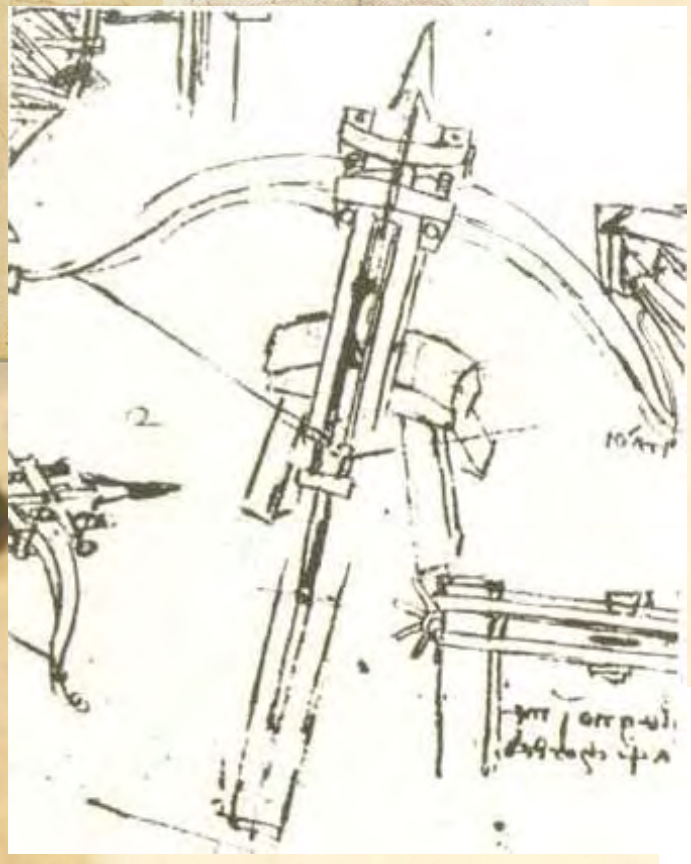
- Considered the precursor of modern tanks

Giant Catapult



http://members.iinet.net.au/~rmine/pics/leopics/Leo_xbow.jpg

Giant Catapult

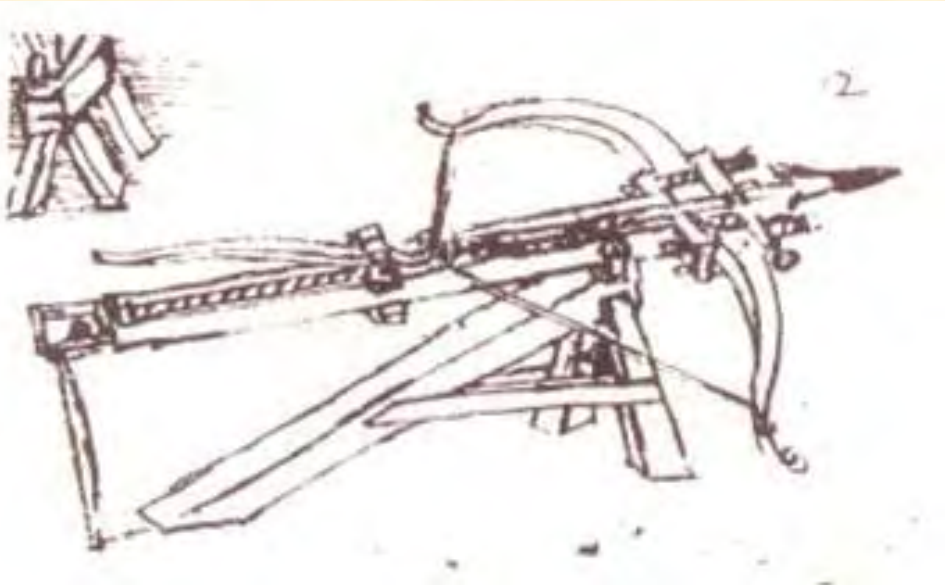


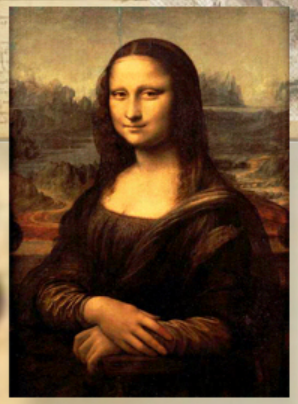
- Super-sized version of a crossbow, designed similar to heavy crossbows at the time

- Used a screw to draw back the bow string

- The six wheels were used to increase the stability of the bow

- Designed to throw heavy projectiles (rocks, balls, grenades)





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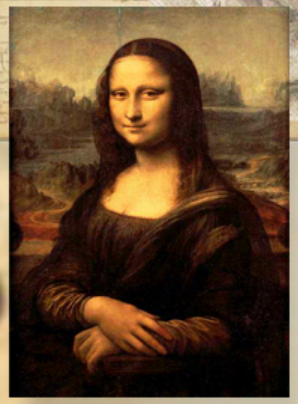

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Giant Crossbow
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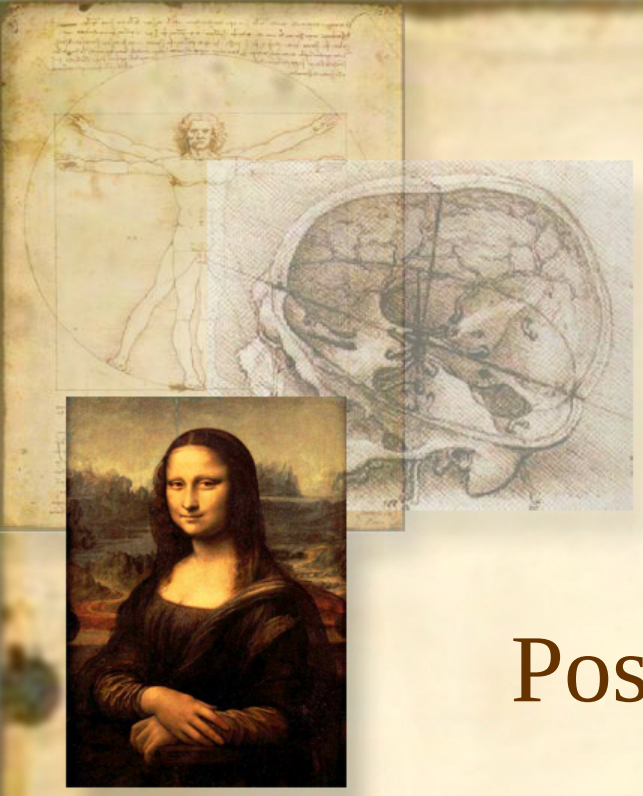
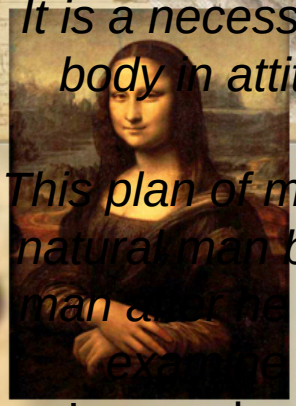


Postscript:An after-thought.

Were Leonardo alive today, what would have been his opinion...

... of Tom Hank’s hair?



Quotes by Leonardo

It is a necessary thing for the painter, in order to be good at arranging the parts of the body in attitudes and gestures which can be represented in the nude, to know the anatomy of the sinews, bones and muscles and tendons.

This plan of mine of the human body will be unfolded to you just as though you had the natural man before you. The reason is that if you wish to know thoroughly the parts of man a[illegible] he has been dissected you must either turn to him, or your eye, so that you exa[illegible] him from different aspects, from below, above, and from the sides…

Leonardo was extremely proud of his anatomical studies. He ended his unofficial career of anatomy by writing the following;

'The 120 chapters composed by me will give judgement in which I have been impeded neither by avarice nor by negligence but only by time. Farewell. ' Disturbingly however, he also wrote around the same time, 'Tell me, have I done anything of worth? Tell me if anything was ever done.'

Quotes about Leonardo

Sigmund Freud famously said of Leonardo da Vinci that he "awoke too early in the darkness, while everyone else was still asleep."

the renowned art historian Sir Kenneth Clark so appropriately called him, "the most relentlessly curious man in history," .

In the words of his biographer Giorgio Vasari:

The most heavenly gifts seem to be showered on certain human beings. Sometimes supernaturally, marvelously, they all congregate in one individual. . . . This was seen and acknowledged by all men in the case of Leonardo da Vinci. His talent was so rare that he mastered any subject to which he turned his attention. . . . He might have been a scientist if he had not been so versatile.