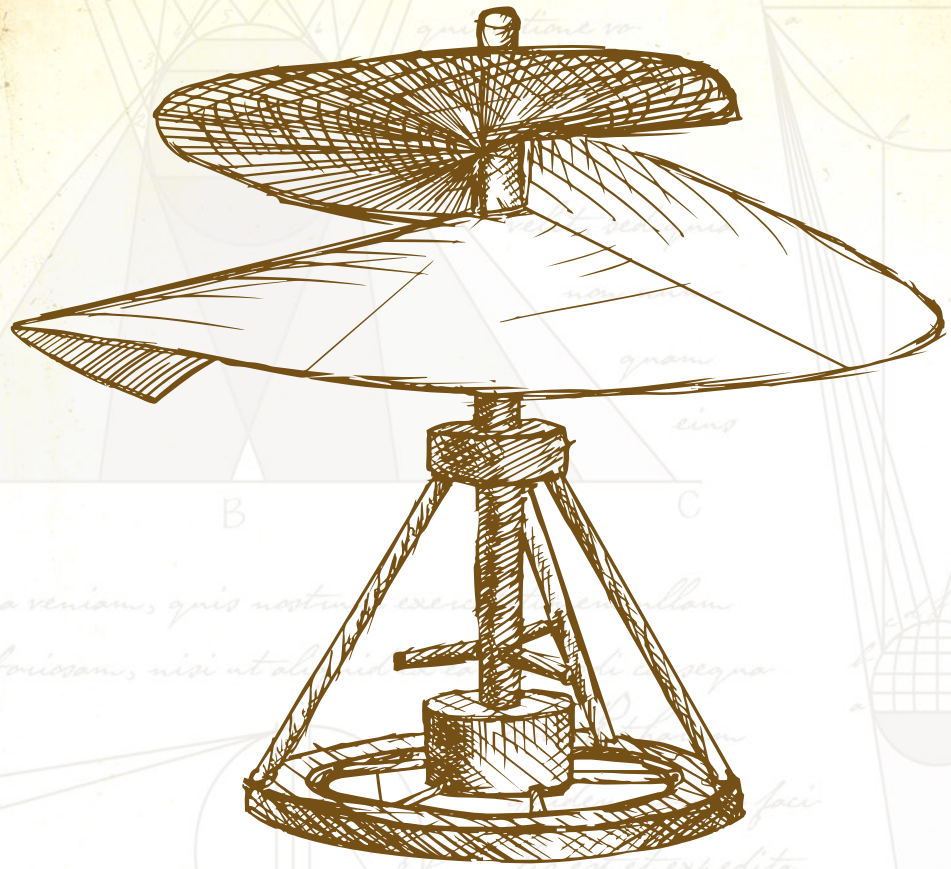


DaVinci's MACHINES

ARTISANS OF FLORENCE International

NICCOLAI TEKNOART FIRENZE

DISCOVERY PLACE SCIENCE

On Exhibition November 4 - May 6

PRESENTED BY

DUKE ENERGY®

ABOUT THE EXHIBITION

Da Vinci's Machines brings the innovations of Leonardo da Vinci to life. Featuring over 75 inventions reconstructed from his illustrations and writings, guests will encounter and test these amazing inventions, from flying machines and war weapons to diving gear and a self-propelled car.

The interactive machines are the focus of the exhibition, as visitors can touch and handle these models to gain a first-hand appreciation of how they work. Many of these recreations are scale models, though some are life sized. Explanatory notes and illustrative panels with da Vinci's drawings accompany each model.

All of the machines are presented and displayed in five interactive areas: Flying Machines, War Machines, Nautical & Hydraulic Machines, Civil Engineering Solutions and Robotics. Also featured are copies of the rare Codices, *Codex Atlanticus* (1478-1519) and *Codex on Anatomy* (1502-1513), 15 high quality reproductions of da Vinci's artwork, computer animations and film clips.

Da Vinci's Machines has travelled the world showing in major cities and centers such as Florence, Siena, Venice, Naples, Warsaw, Madrid, Berlin, Hong Kong, Dubai, Melbourne, Sydney, Perth, and Taipei. Charlotte is the East Coast debut of the exhibition in the United States, previously visiting in cities such as Hollywood, Detroit and Chicago. *Da Vinci's Machines* is on exhibition at Discovery Place Science from Nov. 4, 2017–May6, 2018.

ABOUT THE CODICES

Leonardo da Vinci dedicated himself to scientific studies in anatomy, biology, mathematics and physics. He filled dozens of notebooks, large and small, with his thoughts and drawings, recording half a century of reflections, projects and experiments. These manuscripts, known as Codices, exhibit ingenious solutions to practical problems of his time, and show that da Vinci was able to imagine future possibilities such as flying machines and automation.

These manuscripts are also unique because of Leonardo da Vinci's distinctive handwriting style. He wrote all of his ideas in mirror script, where he'd scrawl letters backwards and right to left across the page, so someone would need to use a mirror to read them. This was to help prevent people from stealing his ideas and hide controversial ideas from the church as many of da Vinci's beliefs were contradictory to religious views.

At da Vinci's death all his writings and sketches were inherited by his trusted assistant and scholar, Francesco Meltzi. He kept and catalogued them carefully, but after his death, and most of the work was dispersed. Only about a quarter of da Vinci's manuscripts have survived, most have been grouped by scholars in Codices and manuscripts of various chronology and size.

CRAFTING THE MACHINES

Each of the machines and inventions featured in *Da Vinci's Machines* were crafted by skilled local artisans using only materials that would have been available in da Vinci's time: wood, cotton, brass, iron and cord.

The artisans had to pay particular attention to the interpretation of language when deciphering da Vinci's Codices. Leonardo da Vinci used local idioms, familiar only to *Florentini*, in addition to the secret clues, decoys and encryptions he planted in his Codices as a safety measure.

Computer technology was also part of the process, utilizing the latest advancements in CAD technology to calculate the exact scale and proportion of each model.

ABOUT THE ARTISANS

Historical documents reveal that Leonardo da Vinci commissioned local artisans, the only craftsmen he trusted, to construct a few of the machines he designed. Unfortunately, none of these machines have survived to the present day. The systematic study of Vincian Technology is a recent phenomenon of the past fifty years, and museums, scholars and artisans have collaborated to interpret Leonardo's ideas.

In the late 1950s, the first museums to feature Leonardo da Vinci's machines were established in Vinci and Milan. Local artisans were commissioned by the Da Vinci Institute to construct da Vinci's machines from his Codieces. In a workshop, not far from where Leonardo learned his craft and using the materials of the time, models of the inventions came to life. Today, these models can be seen at the permanent Leonardo Da Vinci Museum in Florence, Italy.

During the 1990s, under the critical eye of eminent scholars such as Professor Carlo Pedretti of UCLA California, important discoveries were made that not only allowed for the da Vinci's drawings to come to life, but also be interactive and operational.

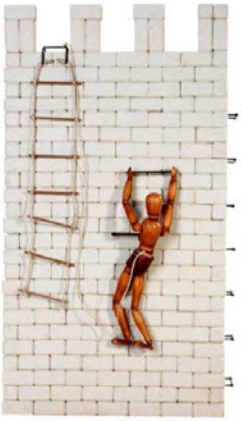
In 2002, the Niccolai family, and a group of Florentine artisans established the company Teknoart S.R.L., which is recognized today as NICCOLAI-TEKNOART SNC (FIRENZE), The Artisans of Florence Pty. Ltd.

Today, The Artisans of Florence, together with the expertise of historians and scholars produce and manage the world's largest traveling exhibitions of Leonardo da Vinci machines.

EXHIBITION THEMES:
WAR MACHINES – Theme 1

The Italian Renaissance peaked in the late 15th century as foreign invasions plunged the region into turmoil.

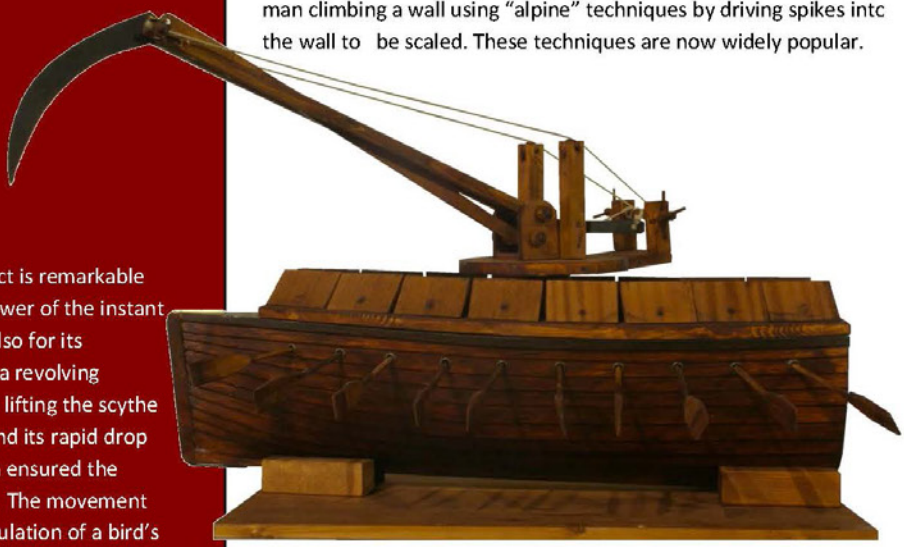
Although Leonardo's work on 'War Machines' seems to contradict his respect for nature, he was still a man of his time and the need for military engineers provided him with employment, travel opportunities and the chance to continue his scientific work unhindered.



Above: Assault techniques (Tecnica D'assalto)
LV 45 Codice Atlantico F.59v

Leonardo invented many attack and defence systems. Here we see man climbing a wall using "alpine" techniques by driving spikes intc the wall to be scaled. These techniques are now widely popular.

The Escorpio (Scorpion) project is remarkable not only for the aggressive power of the instant drop of the large scythe but also for its manoeuvrability by means of a revolving platform. The mechanism for lifting the scythe worked by crank and gears, and its rapid drop together with this mechanism ensured the effectiveness of the machine. The movement of the scythe mimics the articulation of a bird's wing – showing that Leonardo was once again a pathfinder for the new science: BIOMIMETICS



Above: Boat with blades 'The Scorpion' (Barca con Falce-Escorpio)
LV 43 Codice Ashburnham 2037 F.8r

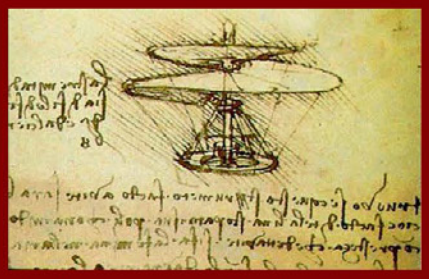
Below: Leonardo's design for an armoured vehicle made from wood and operated by eight men was made in circa 1487. The 'tank' was operated by turning the cranks. The solution of making this tank 'operational' was only achieved by the uncovering of a 'hidden mechanism'.

Above: Tank (Carro Armato) British Museum F.1030

EXHIBITION THEMES:

FLYING MACHINES – Theme2

From his childhood days, roaming the hillsides of Tuscany, Leonardo was thoroughly mesmerised by birds. He dreamed of man being able to fly. Later, he filled notebooks with sketches and studies that focused on the way wings move – their curve, their strength and their flexibility. He studied how creatures of flight become and stay airborne, noting how wings interact with air currents, demonstrating an unprecedented knowledge of aerodynamics.



Based on his observations of birds in flight, Leonardo designed many man-powered flying machines.

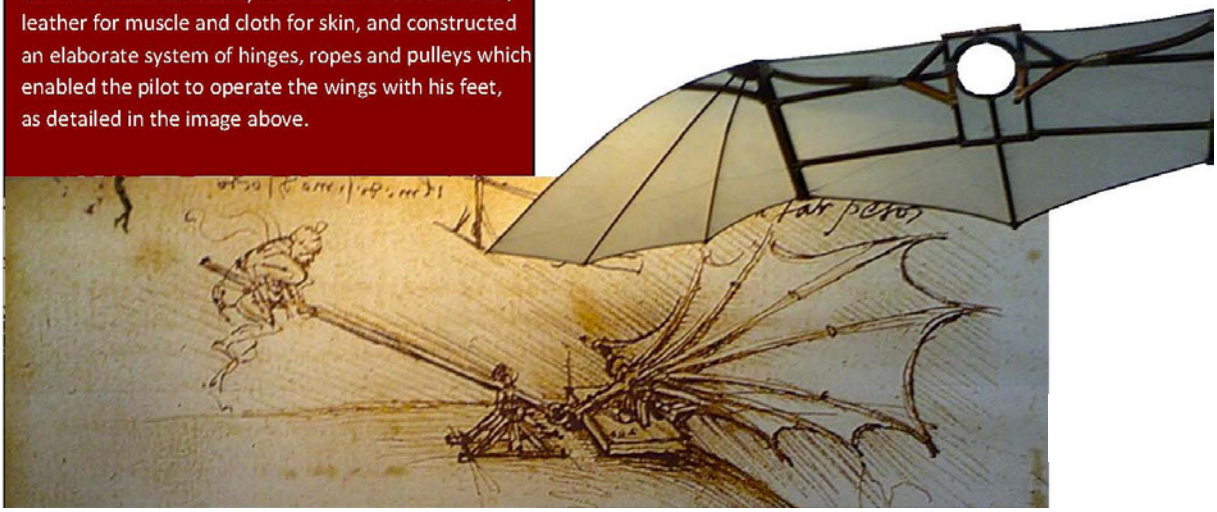
In the image below, Leonardo has based the wings on those of a bat. He usually substituted wood for bone, leather for muscle and cloth for skin, and constructed an elaborate system of hinges, ropes and pulleys which enabled the pilot to operate the wings with his feet, as detailed in the image above.

Left and Above: Air screw (Vite aerea) LV Manoscritto B F.83v

The drawing on the left is certainly one of Leonardo's most famous designs since in it one recognises an ancestor of the helicopter. This craft made of reeds, linen, and iron thread would have been operated by four men who, by rotating a shaft, could lift themselves off the ground.

It is clear that the mechanism so conceived could never have taken off, but the idea remains that with an adequate force the machine could actually have spun itself into the air and surely enough, Leonardo had hidden such mechanism into his drawing.

Above: Vertical Ornithopter 'Vertical Flying Machine' operated by one man Codice Atlantico F.824v



EXHIBITION THEMES:

NAUTICAL AND HYDRAULIC – Theme 3

The drawing of the breathing apparatus on the right is one of Leonardo's most famous ideas to aid humans to remain underwater, no doubt based on his anatomical studies on the behaviour of fluids in the lungs and the heart.

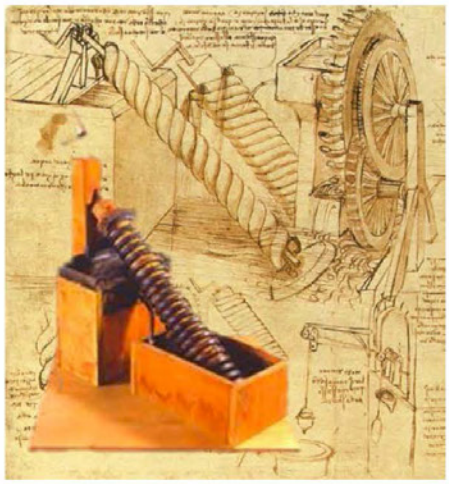
Leonardo had realized that the ancient apparatus of a single breathing tube was inadequate, if not deadly, since it did not allow for an effective air replacement; in the long run, the expired air would only stagnate in the pipe, obstructing the incoming fresh air. To function, the apparatus must then channel fresh air and stale air separately. For this Leonardo adopts two tubes, each fitted with a valve that regulates the opening and closing. The two valves are operated by breathing and work alternately: when one opens the other closes. In this way, by inhaling, fresh air flows in the first tube, while exhaling, stale air is pushed in the second and drained to the outside.

Above: Arched bridge (Ponte Arcuato) LV38 Codice Atlantico F.22r

Above is a model after one of the 'light and strong bridges' Leonardo designed and promised in a letter to the Duke of Milan. To be made of materials easy to find such as small logs and easy to carry, it was assembled by interlocking the logs without ropes or tools. It was strong enough to support the weight of a number of people and allowed for rapid and unexpected 'troop deployment'.

Above: Movable bridge (Ponte Mobile)
LV26 Codex Atlantico F.855r

Above: Diver (Palombaro) LV 55 Codex Arundel F.24v



Above: Archimedes' screw (Vite de'Archimede)
LV 02 Codex Atlantico F.26v

Above: Paddle boat (Barca a Pale)
LV 25 Manoscritto B.F.83r

EXHIBITION THEMES:
PRINCIPLES OF MECHANICS – Theme 4

Throughout his life, Leonardo da Vinci was an inventive builder who thoroughly understood the principles of mechanics of his time and largely contributed in many ways to advancing them.

According to Leonardo's observations, the study of mechanics, with which he was quite familiar as an architect and engineer, also reflected the workings of nature.

Above: Corkscrew mechanism (Meccanismo Elicoidale)
LV 07 Codex Madrid I F.17v

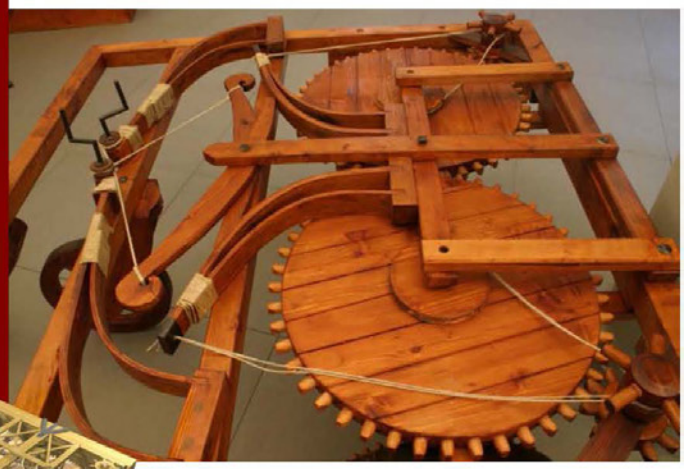
Leonardo's machines often require the transformation of motion from one plane into another using a "universal screw" – a mechanism often employed by Leonardo because it spread frictional resistant forces over the many grooves providing extra safety for its users – a concept quite revolutionary for the time.

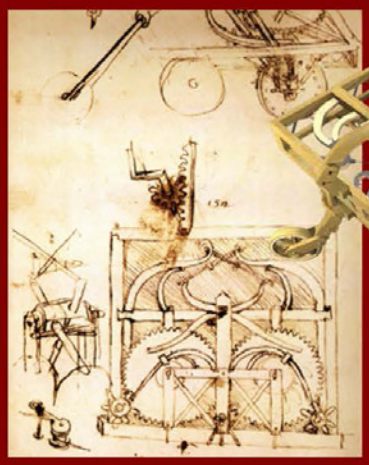
Left: Bicycle (Bicicletta) LV 31 Codice Atlanticus F.133v

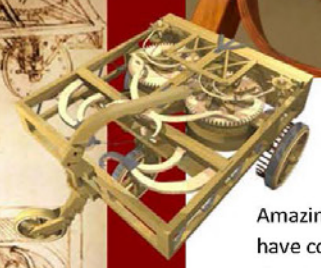
Left: This is one of the many mysteries still surrounding Leonardo's life and work. During restoration of the Codex Atlanticus, this drawing was found between two glued in pages. The lack of detail in the drawing and the signature of Leonardo's pupil, Salai, lead us to think that the drawing is not by Leonardo, but by his pupil, who may have copied the bicycle from a model seen in his master's workshop.

Right: This is one of the most famous Leonardo's inventions. It is a self moving car propelled by a complicated mechanism powered by leaf springs (balestre). The car system suggests that an operator would have to hand-load the leaf springs.

The stored energy is transmitted to the driving wheels by means of a complex set of gears. He also incorporated a small rudder-wheel to steer the car.







Amazingly, recent mechanical details and historical facts have come to light making the operation of the car much simpler and more plausible.

Left and above: Car powered by springs (Macchina a balestre)
LV 12 Codice Atlanticus F.812r

EXHIBITION THEMES:
ARTWORK (Reproductions) - Theme 5

As a child Leonardo da Vinci showed precocious genius in math, music and art.

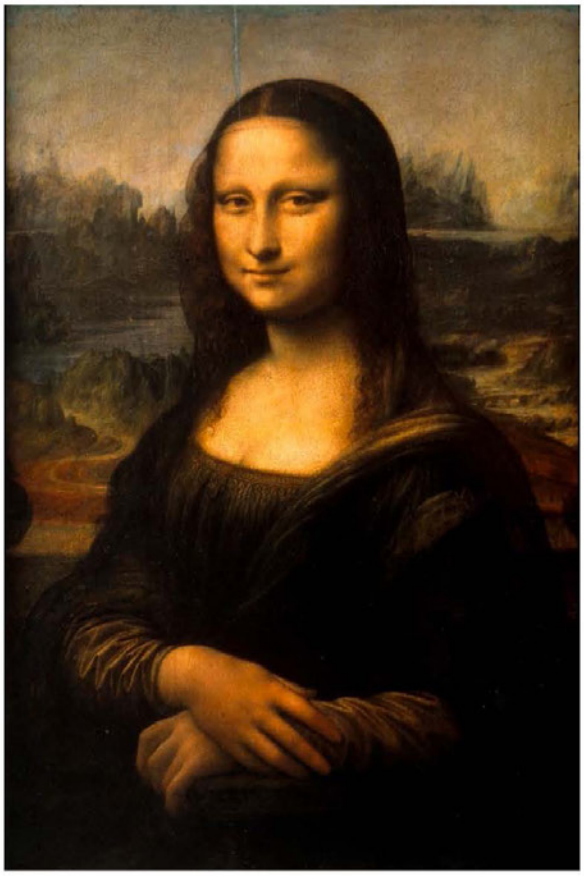
His greatest desire was to be apprenticed to a painter, a profession which was looked down upon at the time.

Eventually, his father was worn down by the boy's undeniable talent, and took him to Florence to study painting, sculpting and engineering under the great Andrea del Verrocchio.

Leonardo quickly outstripped his master (though he continued to study with Verrocchio until around 1476) and was admitted to the Florence painters' guild in 1472.

Only 15 paintings directly attributed to Leonardo da Vinci survive. There are others that remain contentious, or those that are actually lost.

The known masterpieces of Leonardo da Vinci have been reproduced for this Exhibition, including the most famous and most valued of all, the Mona Lisa. The Exhibition reveals the findings of recent scientific research including x-ray analyses, adding to the mystic of the painting that each year, six million people visit the Louvre in Paris, to view.



Portrait of Lisa del Giocondo (Mona Lisa) oil on poplar 77 x 53cm c. 1503-

Virgin and Child with St Anne c. 1502-1513

Portrait of a Musician c. 1485

The Virgin of the Rocks c. 1495-1499/1506-1508

Portrait of Cecilia Gallerani c. 1489-90

Annunciation c. 1473-1475(?)

The Last Supper c. 1495-1497