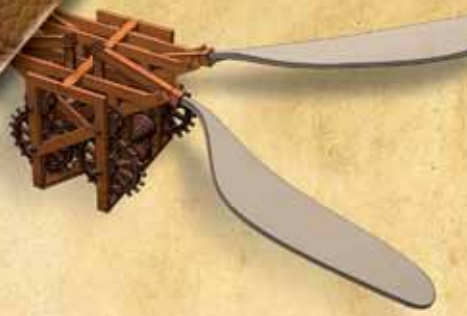
AGES 8+

LEONARDO DA VINCI

Genius is Timeless

Mechanical Butterfly



DEVELOPING 500 YEARS OF DREAMS

DA VINCI

Instruction manual

Contents

Leonardo Da Vinci

(April 15, 1452 - May 2, 1519)

"Iron rusts from disuse; stagnant water loses its purity and in cold weather becomes frozen; even so does inaction sap the vigor of the mind."

Leonardo

Leonardo da Vinci *was born April 15, 1452 in Vinci, Italy. Da Vinci was an artist, scientist, mathematician, engineer, inventor, anatomist, sculptor, architect, botanist, musician and writer. He has often been described as a perfect example of a Renaissance man, a man whose unquenchable curiosity was equaled only by his powers of invention and observation. Da Vinci is widely considered to be one of the greatest painters of all time and perhaps the most diversely talented person to have ever lived.*

At an early age, Da Vinci's talent for drawing became evident, and his father apprenticed his young son to a noted period artist, Andrea del Verrocchio. Through the coming years, the young Leonardo learned much from his mentor and at the age of thirty, Da Vinci left Florence and settled in Milan and established a workshop. During the following years, he earned his living painting commissioned pieces. He soon came to the conclusion that it was not possible for him to earn steady income doing this and began his search for employment. He began by writing a letter to the Duchy of Milan, Duke Ludovico Sforza, known by the nickname, the Moor. In this correspondence, Da Vinci stated that he had studied machines of war and had come up with improvements that would

strengthen the Moor's position in battles. The letter hinted at inventions that included portable lightweight bridges and improved designs for bombards, mortars, catapults, covered assault vehicles and weapons. The Moor eventually became Da Vinci's patron and kept him busy with everything from designing a heating system to painting portraits, to overseeing production of cannons and even decorating the vaulted ceilings in his castle.

It was during this time that Da Vinci began writing and drawing in his journals. These volumes became repositories of the outflow of Leonardo's gifted mind. He was a voracious student of the universe and his observations led to magnificent plans and concepts. Da Vinci's notebooks consist of more than 20,000 sketches, copious notes and detailed drawings. Some of his conceptual designs led to the greatest inventions of his day, while others came to fruition hundreds of years after his initial concepts were penned, simply because the machinery needed to build and power them were not yet invented. Leonardo's notebooks clearly illustrate his genius of not only improving upon existing inventions, but also conceiving a myriad of new ideas and designs.

Ultimately, the Moor was captured by the French and Da Vinci left Milan in search of a new patron. He traveled through Italy for more than a decade, working for several Dukes and rulers, including Cesare Borgia, a General intent on conquering central Italy. Leonardo traveled with Borgia as a military engineer, designing weapons, fortresses and artillery, but became disillusioned and quickly left his service with the General. It seems that despite Da Vinci's design for artillery and weaponry, he was actually a pacifist and detested war and its destruction.

Da Vinci later took positions with King Louis XII and Pope Leo X and ultimately with the King of France, Francis I. It was the King who offered Da Vinci the title, Premier Painter and Engineer and Architect of the King. Francis I valued Da Vinci's great mind and his sole function was to engage in conversations about Renaissance culture and art with the benevolent royal.

ARTISTIC MASTERPIECES OF LEONARDO DA VINCI

It is important to remember that Da Vinci is not only a great inventor, but is considered to be one of the most acclaimed artists to ever have lived, creating such masterpieces as The Last Supper (c.1498) and the Mona Lisa (c.1503). Leonardo's drawing of the Vitruvian Man is also regarded as a masterpiece. Unfortunately, only a small number of Da Vinci's paintings have survived. Leonardo experimented with new techniques, most of which did not yield long-lasting results. The master painter was also somewhat of a perfectionist with fastidious attention to detail. It is believed that when painting the Mona Lisa, the artist spent ten years perfecting the lips of this masterpiece.

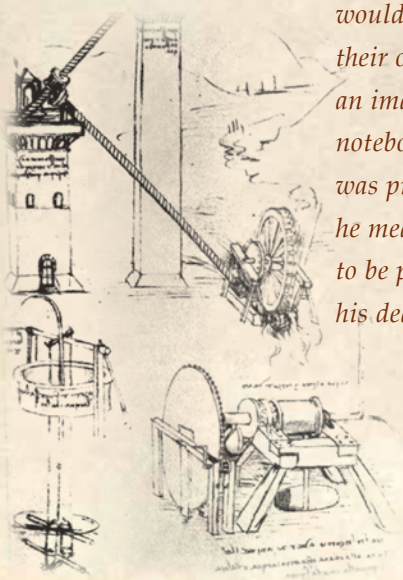
Virtruvian Man (circa 1487)

The Mona Lisa (circa 1503)

The Last Supper (circa 1498)

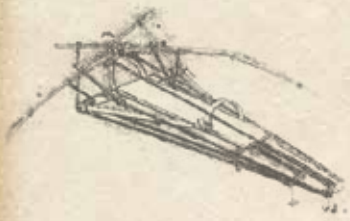
Da Vinci's Notebooks

Da Vinci's notebooks are now more than 500 years old. Most of them are not bound the way a typical book would be today, but rather comprised of loose sheets of paper gathered into collections and wrapped with fabric. Paper was scarce in Da Vinci's time, so he used every available space in a page for drawings, observations, even recipes and shopping lists, making them somewhat difficult to interpret. Adding to the difficulty in deciphering his works was the fact that Da Vinci's scripted notes were written backwards, or in a mirror image, and read from right to left. His reason for this remains a mystery, but it is thought that Leonardo's theories sometimes went against church teachings and his secret writing could have been a way to avoid scrutiny. Da Vinci also might have feared that someone would steal his designs and publish them under their own name. Ironically, Da Vinci addressed an imaginary readership in the margins of his notebooks urging the reader to make sure his work was printed into a proper book. It is presumed that he meant for the notebooks to be published after his death.



Da Vinci's Notebooks

Several common themes recur in the now fragile notebooks: nature, technology (including gears, cogwheels, screws and pulleys), aviation and vision, to name a few. Upon the death of Leonardo Da Vinci, the notebooks were given to his long-time friend, Count Francesco Melzi. After his death, Melzi's heirs did not fully comprehend the value of the information and the manuscripts were dispersed. They placed the notebooks in an attic where they were viewed by guests who sometimes took pages with them as souvenirs.In a few years Melzi's family lost all the manuscripts and soon pages were scattered across Europe.



Da Vinci's notebook extracts were published in 1883 and about half of them have not yet resurfaced so far. It is easy to imagine that had the notebooks been published earlier, the history of science might have been completely changed.

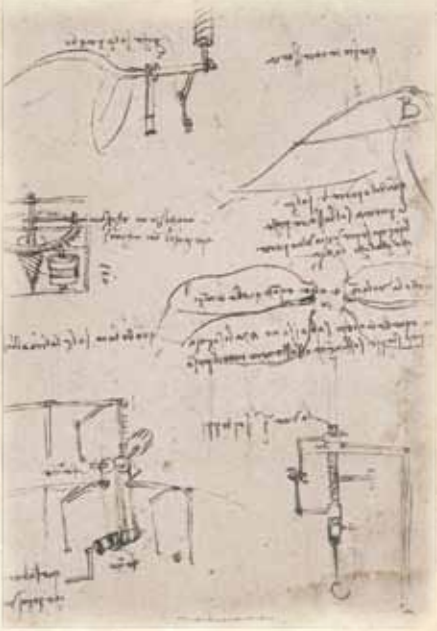
In his drawings, Leonardo strived for saper vedere or "knowing how to see." Da Vinci's illustrations are unparalleled and some experts believe that no one has since been better.

MECHANICAL BUTTERFLY

Codex Atlanticus, folio 1051v

Da Vinci was the first person to apply himself to the study of animal flight and human flight with such passion. Throughout his life Da Vinci dreamt of building a flying machine which would enable man to fly. In spite of being unable to fulfil this task, Da Vinci has the distinction of being the first person in the history of human flight to study the subject from a scientific point of view, investigating every possible solution. He even devised plans for muscle powered flying, where the pilot of the machine tries to replicate the beating of a bird's wings, gliding, without moving the wings, and mechanical flight, where the machine flies without a pilot but only thanks to the movement of mechanical parts like gears and wings. In his manuscripts, Da Vinci drew many contraptions, not all of which need a pilot. Many flying machines are merely preliminary studies, where, most of the time, Da Vinci tried to imitate the anatomy of an animal; a bird, a bat or an insect, such as a dragonfly.

One of these projects for a flying machine with no pilot is the Mechanical Dragonfly, on folio 1051v of the Codex Atlanticus. Da Vinci himself advised where one can admire these incredible flying insects: To see four-winged flying, look near ditches and you will see dragonflies. It is extremely difficult to create a mechanical replica of the natural movement of an animal. The beating of the dragonfly's four wings is particularly complex and Da Vinci was well aware of how difficult it would be to create this machine, he himself described it in great detail.



It is not simply wings beating up and down; it's a jointed motion. Whilst beating down the wings are "flat" in order to push as much air as possible, whereas when they are raised, they are angled so that they create less resistance. If the dragonfly, and therefore Da Vinci's machine, was not like this, it would not be able to fly because the power created when the wings beat downwards, would be cancelled out when the wings returned to their starting point.

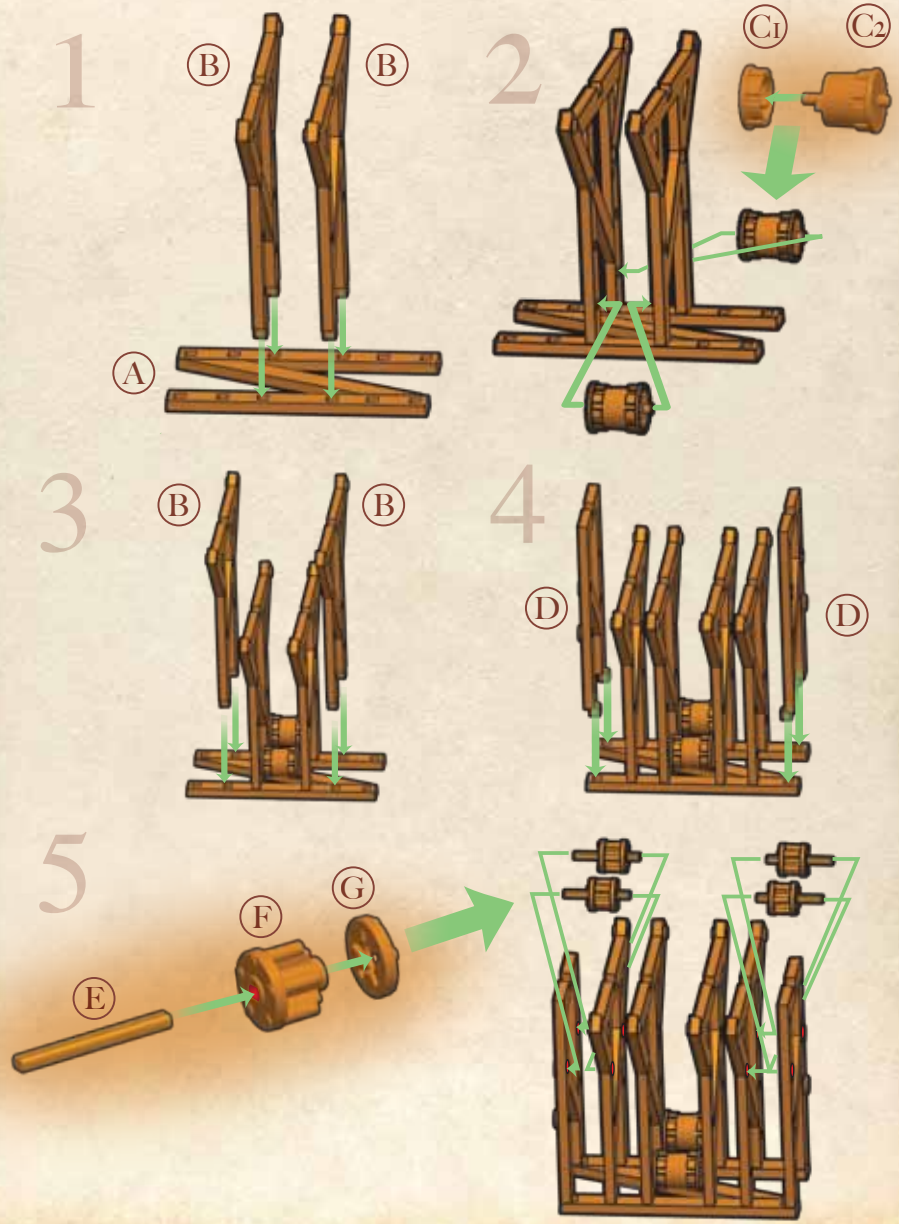
Da Vinci wrote:
The wings must return to the top very quickly, whereas pushing backwards with the part of the wing which pushes the air must be done at the speed required by the engine each individual time. The movement of each of the four wings is synchronised with the others.

Da Vinci resolved the problem by designing two pairs of wings, one for the front and one for the back, exactly as on a dragonfly. When the wings are beating, the pairs of wings both rotate around their main linch-pin. The energy for this movement is provided by two spring loaded motors which drive a mechanical system made from gearwheels, a camshaft and connecting rods which in turn allow the pairs of wings to move alternately and in synchrony. Whilst the wings move quickly up and down pushing the air, rods of exactly the right length fold the wings downwards ensuring they are angled when they come back up, exactly as it happens in the animal movement. The mechanism is very delicate and in order to make the machine work correctly it must be very finely tuned. Furthermore, the power the motors were able to supply would definitely not have been sufficient to lift the machine off the ground. In spite of this, the machine plan is absolutely fascinating and, even if they are too slow, the wings move in exactly the same way as a dragonfly's.

Components

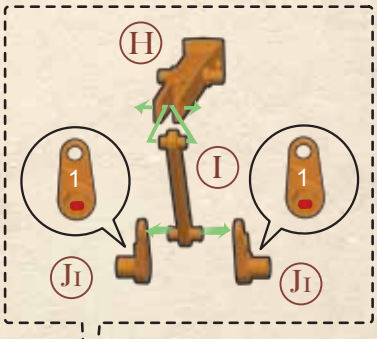

A
B X 4
C1 X 2
C2 X 2
D X 2
E X 4
F X 4
G X 4
H X 4
I X 4
J1 X 4
1
J2 X 2
2
J3 X 2
3
K X 2
L X 2
M X 4
N
O
T X 2
P X 4
Q X 4
R1 X 2
R2 X 2
S1 X 2
S2 X 2
U X 4
V1
V2
W1
W2

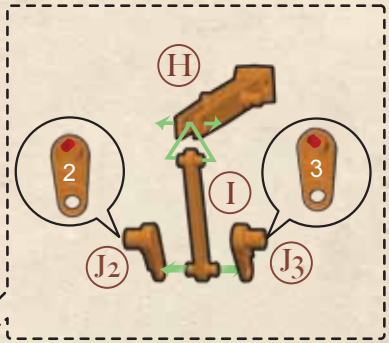
How to Assemble



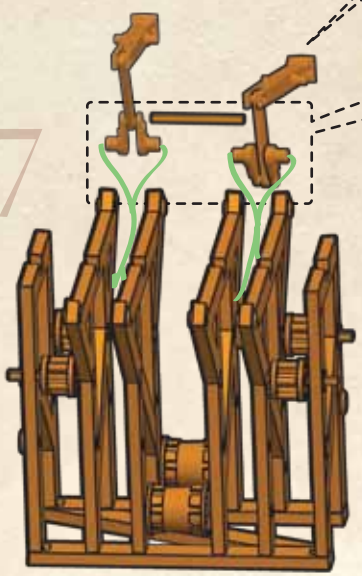
How to Assemble

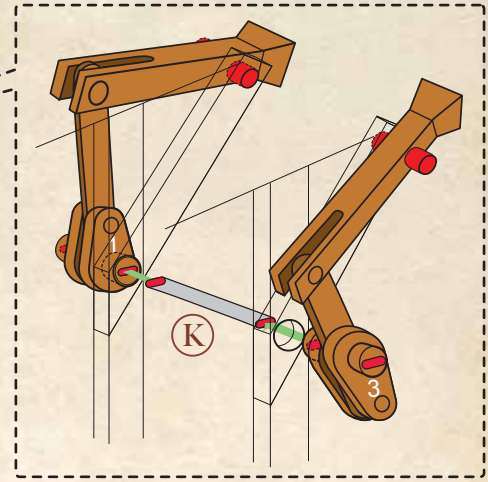
6





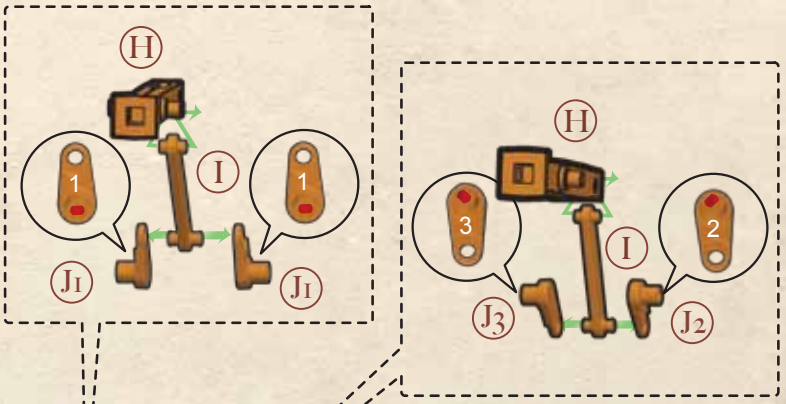
7



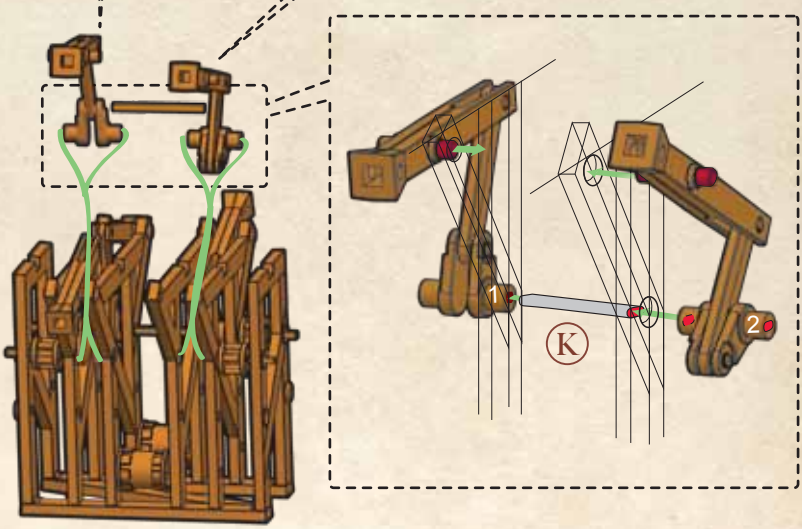


How to Assemble

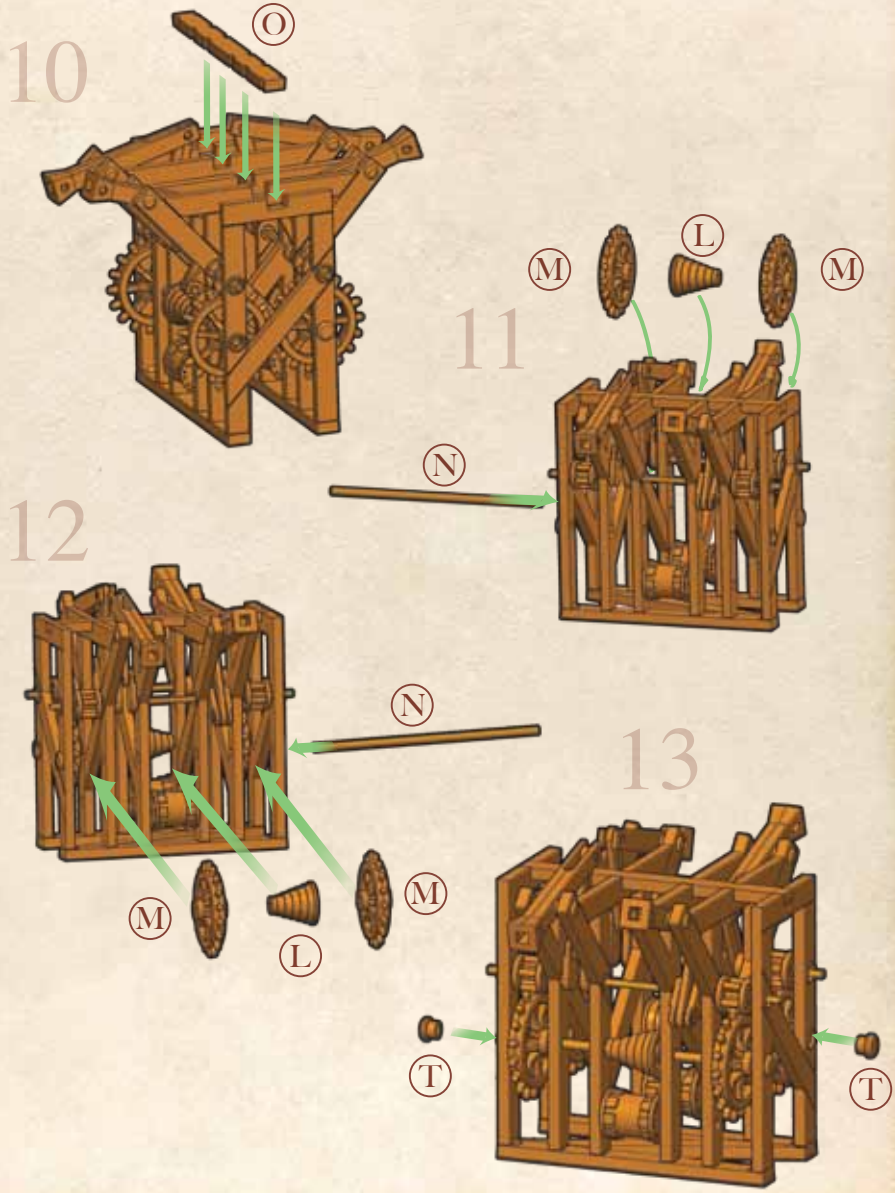
8



9

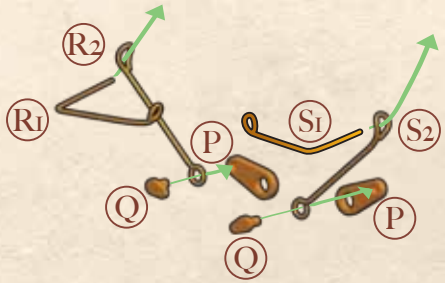


How to Assemble

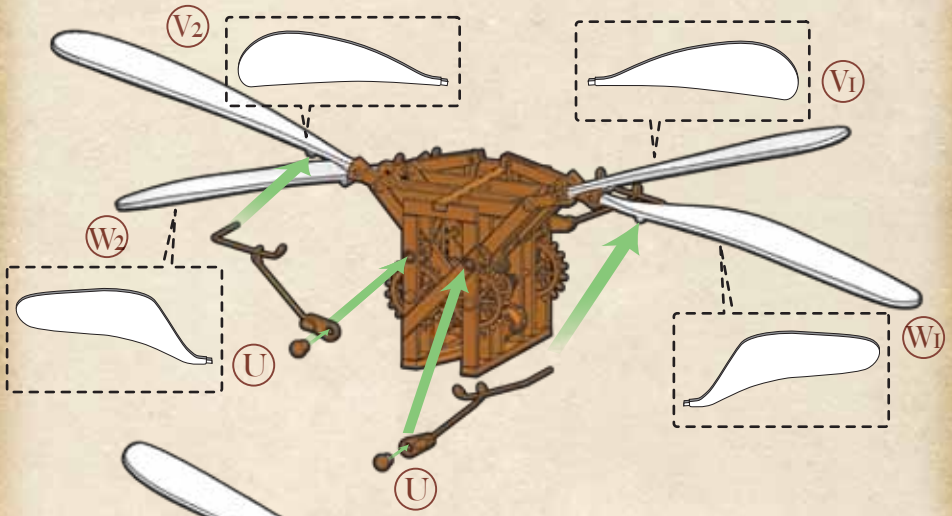


How to Assemble

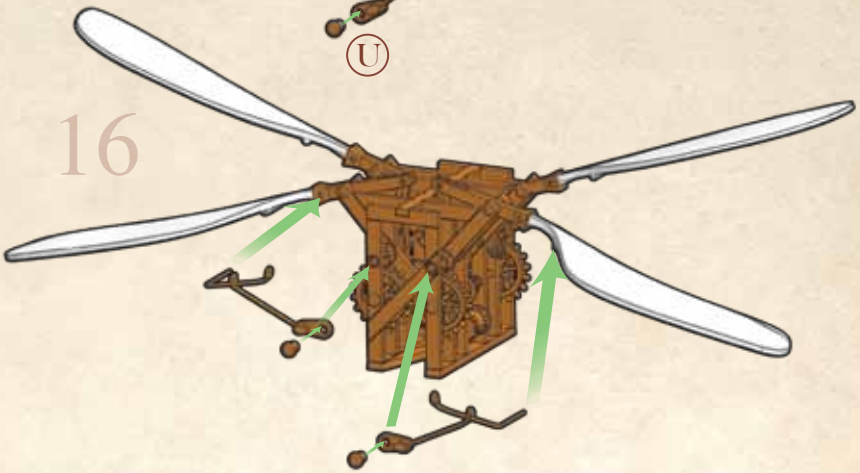
14



15

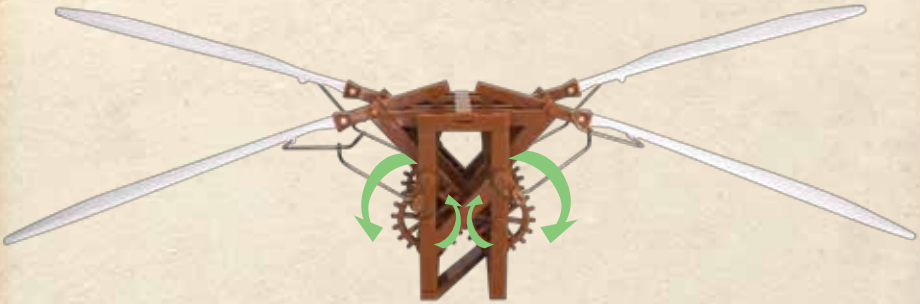


16



How to Operate the Mechanical Butterfly

1



2

The scientific genius of Leonardo Da Vinci is brought to life through articulated models offered by Edu-Science. The inventions that inspired these snap-together replicas are taken from the pages of Da Vinci's priceless and awe-inspiring notebooks.

Edu-Science Da Vinci Series Kits

DV001

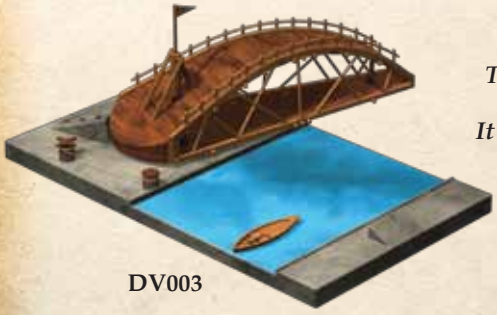
Mechanical Drum

Leonardo da Vinci's mechanical drum was designed as a cart equipped with an amply sized drum. When pulled by its handle, the gears turn the two lateral drums, which are fitted with pegs. The pegs move a total of ten drumsticks that cause them to beat the large drum.

Aerial Screw

The Aerial Screw design is a precursor of the modern day helicopter. The drawing of Da Vinci's concept illustrated the compression of air that was intended to lift the upper part (propeller or screw) the device off the ground.

DV002



DV003

Swing Bridge

This arched bridge built on a river turns on a central pivot to let boats pass. It is counterbalanced by a case of stones and turns by winches set on the river bank.

Printing Press

Leonardo da Vinci studied the Guttenberg printing press and finely-tuned it for greater efficiency. In his design, he used a hand press with an automatic system that moved the type-saddle forward and back along a tilted surface, making printing faster and easier.

DV005

DV006

Multi-barreled Canon

The 10-barreled gun carriage was developed to give the traditional canon additional firepower and was a potentially effective weapon against a line of advancing troops.

Armored Car

A precursor to the modern-day tank, the armored car was capable of multi-directional movement and was equipped with cannons arranged in a 360-degree firing range around its circumference.

DV007

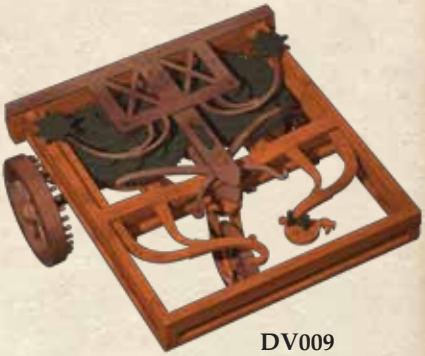
DV008

Paddleboat

In Da Vinci's time, nautical expedition was the most expedient method of communicating with the world and his design for a boat with large wheel-shaped paddles that would propel it through water offered a faster and easier method of water transportation.

Self-Propelled Cart

Da Vinci's self-propelled cart was the first to be capable of moving without being pushed or pulled manually.
But it is not a car! It is a king of robot, designed to take by self-movement a puppet on the stage of a teather. And probably with a programmed path.



DV009

DV010

Catapult

Improvements were made to the age-old military launching device called a catapult.
The new design employed a hand-crank that caused tension on the throw arm.
The spring design produced a large amount of energy in order to propel stone projectiles or incendiary materials over great distances.

Bombard

This improved cannon was designed to include projectiles that contained a quantity of mini gunpowder shots packed into petal-shaped iron pieces that formed a ball.
The device exploded into fragments that had greater range and impact than a single cannonball.

DV011

DV012

Mechanical Butterfly

Leonardo da Vinci himself advised where one can admire these incredible flying insects:

To see four-winged flying, look near ditches and you will see dragonflies.

It is extremely difficult to create a mechanical replica of the natural movement of an animal. The beating of the dragonfly's four wings is particularly complex and Da Vinci was well aware of how difficult it would be to create this machine, he himself described it in great detail. It is not simply wings beating up and down; it's a jointed motion. Whilst beating down the wings are "flat" in order to push as much air as possible, whereas when they are raised, they are angled so that they create less resistance.

Giant Crossbow

DV013

The structure of the crossbow is relatively simply. It has a rigid wooden body, on which the stock and a bow are mounted. Compared to a traditional bow, the crossbow is very compact; the bow of more modern crossbows is made from metal, is not very long, but very thick. This is why the bow of the crossbow is less flexible than that of a traditional bow, and the string is much tauter. The distinguishing feature of the crossbow is a launching mechanism similar to a trigger on modern weapons. The project follows a rather typical pattern, seen in Leonardo da Vinci's other projects – making an existing weapon more powerful by making it bigger and in some cases making it multiple launch (as in the cases of the Multiple Sling, the Armoured Tank, the Multiple Bombard and other drawings).

DV015

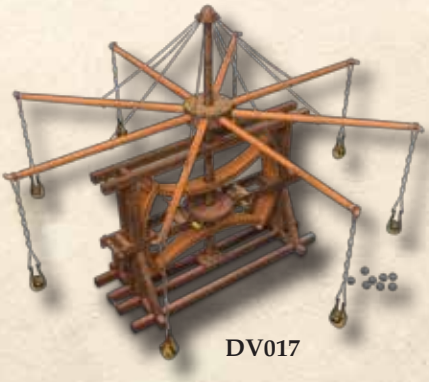
Submarine

Leonardo da Vinci himself said that because it was a lethal weapon it must not fall into enemy hands, and this may be another reason why, instead of drawing the final project, he drew it disassembled and in a way that makes it difficult to understand. A boat with sails has a part which is submerged in the water and invisible to enemies. The pilot uses a passage to get into the lower part undercover: the Mechanical Submarine. A pulley and rope system lowers the submarine which can unhook itself underwater and proceed invisibly towards the enemy. The submarine has two air chambers which can be used for steering and also for air needed by the pilot, who has a mouthpiece. Steering underwater is done by means of a mechanical system.

Great Kite

DV016

The genius Da Vinci drew inspiration for his work from his direct observation of the flight of a bird. Da Vinci described its dimensions, the materials with which it is to be built, its shape and how it works; the whole notebook revolves precisely around the construction and use of the machine. Da Vinci also imparted some "flying lessons" on how the pilot should operate the machine. The piloting must have been complex. He would use his hands and feet to activate ropes and could rotate, move and open and close the wings with his own movements. Da Vinci's design is not drawn in its entirety. We must therefore reconstruct the indispensable parts. These include: the canvas to cover the wings, some articulations and pulleys, and the tail, which Da Vinci knew was indispensable for controlling the machine.



DV017

Multiple Sling

Leonardo da Vinci's idea was to build a very powerful machine which could throw eight large projectiles at the same time.

He positioned eight long arms in a circle around a central pin, each of which had a sling capable of throwing a projectile attached to it.

This kind of project, where weapons were developed to hurl multiple projectiles to be more powerful, was common in Da Vinci's time, because doing this meant creating more powerful weapons, simply by increasing their number and power, without the need to develop new building techniques and using familiar materials. They were therefore potentially attractive weapons because they were powerful, but they were also relatively inexpensive.

Ship's Cannon with Shield

DV018

The prow of the ship and the cannon are protected by a wooden shield. Leonardo da Vinci studied this subject closely, identified the weak points and invented his own version with many more functions. First, he concentrated on the structure of the vessel which needed to be reinforced and keep the cannon firmly in the middle. The shield, which previous engineers had shown as being immobile and almost temporary, in Da Vinci's drawing was split in two and became part of the structure and mobile. A system of ropes and pulleys keeps the shields raised to protect the ship. Once the winches are locked, the weight of the shields themselves causes them to rotate outwards to uncover the cannon which can then fire.

WARNING: CHOKING HAZARD-
Small parts. Not for children under 3 years.

P38-DV012-81001000 Printed in China