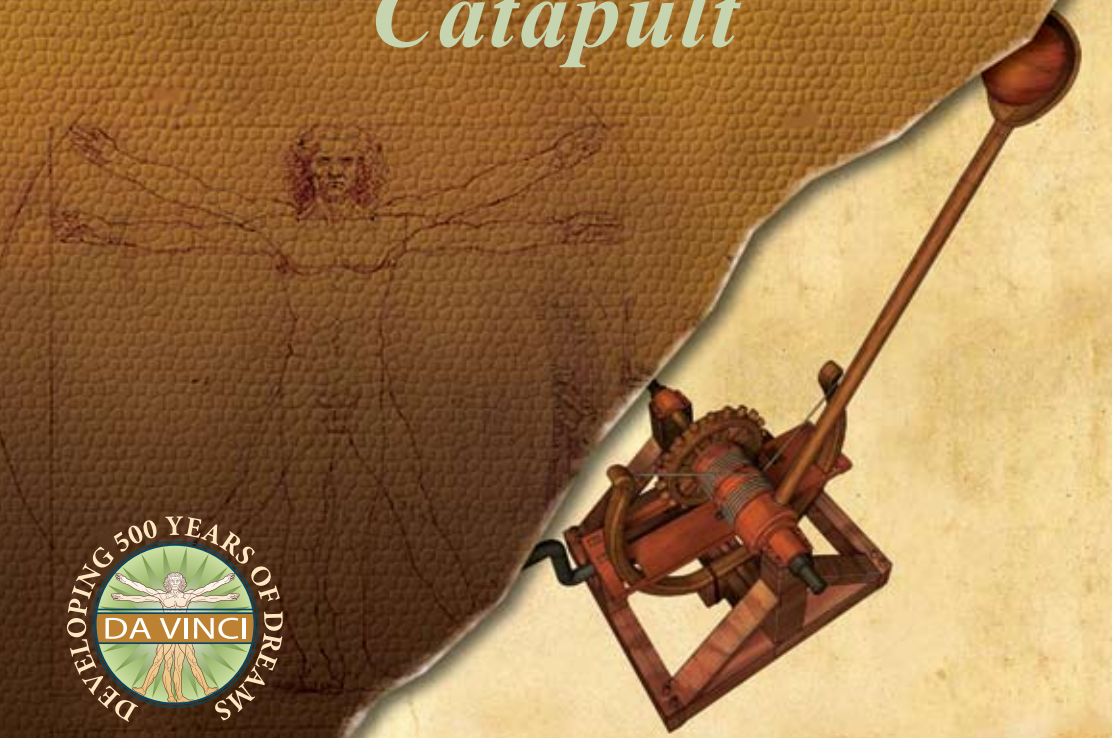
AGES 8+

LEONARDO DA VINCI

Genius is Timeless

Catapult



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 of his own. 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

Virtruvian Man (circa 1487)

It is important to remember that Da Vinci is not only and 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.

The Mona Lisa (circa 1503)

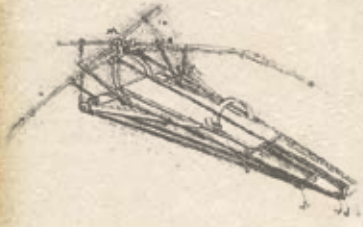
The Last Supper (circa 1498)

Da Vinci's Notebooks

Da Vinci's notebooks are now more than 500 years old. They 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.

Leonardo Da Vinci

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. Melzi did not fully comprehend the value of the information and published only a portion of the volumes. He placed the notebooks in his home where they were viewed by guests who sometimes took pages with them as souvenirs.After Melzi's death, an additional 13 Da Vinci notebooks disappeared 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.

Catapults

To understand siege weapons, it is important to discover the way battles were fought during Da Vinci's time. Sieges were commonplace and occurred when an army surrounded an enemy castle with the intent of forcing surrender. This method potentially took time since a castle under siege could hold out for months or even years, as long as they had adequate provisions and supplies. Invading armies needed new siege engines to speed up the process. These devices were used to bring down massive stonewalls that defended castles, which brought the siege to a quicker and more favorable end for the attackers.

Types of Siege Engines

The Battering Ram

A large object, like the trunk of a tree, used to break down the doors of a castle. Larger ones were used to directly attack stonewalls. These battering rams were often part of a structure called a siege tower, which was a fortified building on wheels that could be rolled up against the walls of the castle. Inside the structure was the battering ram that would break down walls.

The Catapult

In the early middle ages, catapults were used to hurl objects directly at the castle walls. The catapult was a heavy siege engine and used a lot of resources to build. It was typically built in the attacking armies homeland and then transported to the location of the siege.

The Trebuchet

In the late middle ages the trebuchet came to the forefront as the weapon of choice for siege warfare. It was easier to build and could hurl larger objects for further distances.

Da Vinci And Catapults

In 1502, Leonardo Da Vinci was named the architect and Engineer General in service to the Duke of Valentinois. During that time he worked on a variety of catapults and other siege weapons and created improved versions It may appear strange that Da Vinci spent time improving upon mechanical throwing machines, common in medieval times, but in these were still formidable weapons in the fifteenth century. Weapons of the late fifteenth and early sixteenth centuries were a combination of old mechanical artillery and newer gunpowder weapons and Leonardo also delved into modern devices like cannons and guns.

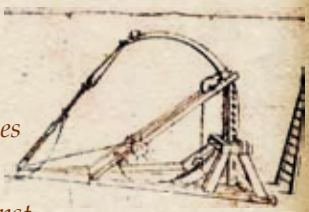
Trebuchet

Fixed Counterweight Trebuchet

The Trebuchet (tray-boo-shay) was developed as a siege weapon. It was used during the twelfth century to catapult boulders at castle walls or towers in an attempt to breach the walls. A trebuchet consists of five basic parts: the frame, counterweight, beam, sling and guide chute. The frame supports the other components and provides a raised

platform from which to drop the counterweight. The counterweight is pulled by gravity and rotates the beam, which then pulls the sling. The guide chute leads the sling through the frame and supports the enclosed projectile until acceleration is sufficient to hold it. The sling accelerates and holds the projectile until released. Da Vinci designed a fixed counterweight Trebuchet with the counterweight rigidly attached the beam. His drawing shows a device, which may be an idea for winding down the beam to load the catapult. Da Vinci's Trebuchet was improved during the time when grenades or gunpowder-filled devices might have been used.

Spring Catapult



Spring Catapult

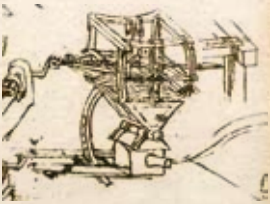
The Spring Catapult employs a bent spring that gets its throwing power by bending back the arm. The arm is fitted with a sling and a cup so that it is able to hurl two projectiles simultaneously, and at two different ranges. The arm of Da Vinci's Spring Catapult has its bottom end resting against a transverse base timber, rather than relying on being set into the ground. A winch on the diagonal support, pulls the arm down and a trigger, whose lanyard can be seen draped to the rear of the machine, holds the sling.

Complex Spring Catapult

Complex Spring Catapult

In this design Leonardo takes the idea of the basic Spring Catapult and adds more springs to the device. The throwing arm is boosted by being pushed forward by two additional "arms," which have their back ends pulled up by three additional springs. In order to wind the beam down, Da Vinci used a screw winch in a tray at the base of the catapult.

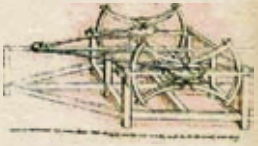
Springald on a Swivel Mounting



Springald on a Swivel Mounting

Da Vinci's drawing of an existing device, the framed torsion weapon, is called a Springald. The inward-facing bow arms are clearly drawn, as are the torsion bundles that power the device. This machine is a bolt thrower, and the tip of the bolt can be seen projecting forward of the frame at the right. Leonardo has modified the arms and bundles to show two modest bundles holding a square structure connected to four arms in a cross. Da Vinci may have determined that four arms would allow more tension to be applied to the bundles.

Bowed Springald



Bowed Springald

Da Vinci explored the idea of making a new version of an existing torsion-powered device by mounting the twisted rope bundles on bow-like springs. This machine appears to be an attempt to take the Springald concept of the frame-mounted torsion weapon with inward-facing arms, and adapt it to use powerful springs to create the same motion. In this rendition, the projectile is a ball (perhaps a gunpowder grenade, perhaps a stone) and it rests on a narrow track on the top of the frame.

Double Onager

This machine is similar to the bowed Springald, but here Da Vinci takes the concept even further, making the bows larger and using their tips rather than the middle of each bow. He also modified the fitting the system with two throwing arms rather than a bowstring. One arm is fitted with a sling, the other appears to have a rock set on a flat rest rather than a sling. As with the other double-projectile machines, the hurled objects can be expected to have quite different ranges, with the one in the sling going significantly further.

Catapults In Later Use

World War I

The last large scale military use of catapults was during the trench warfare. During the early stages of the war, catapults were used to throw hand grenades into enemy trenches. Grenades were eventually replaced by small mortars.

Aircraft Catapult

Aircraft catapults are used to launch planes from land bases and sea carriers when the takeoff runway is too short for a powered takeoff. Catapult devices are often used to launch airplanes from aircraft carriers. This form of assisted take off consists of a track built into the flight deck, below which is a large piston or shuttle that is attached through the track to the nose gear of the aircraft.

Components

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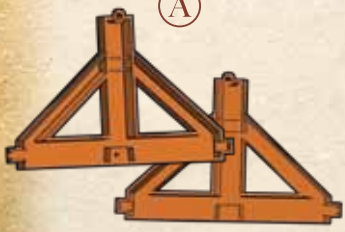

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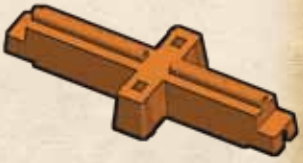

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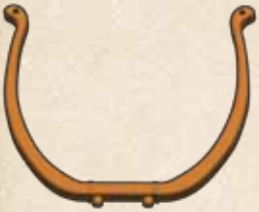

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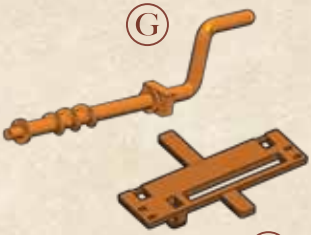

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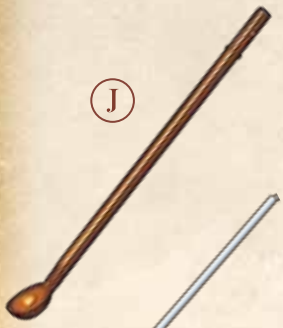

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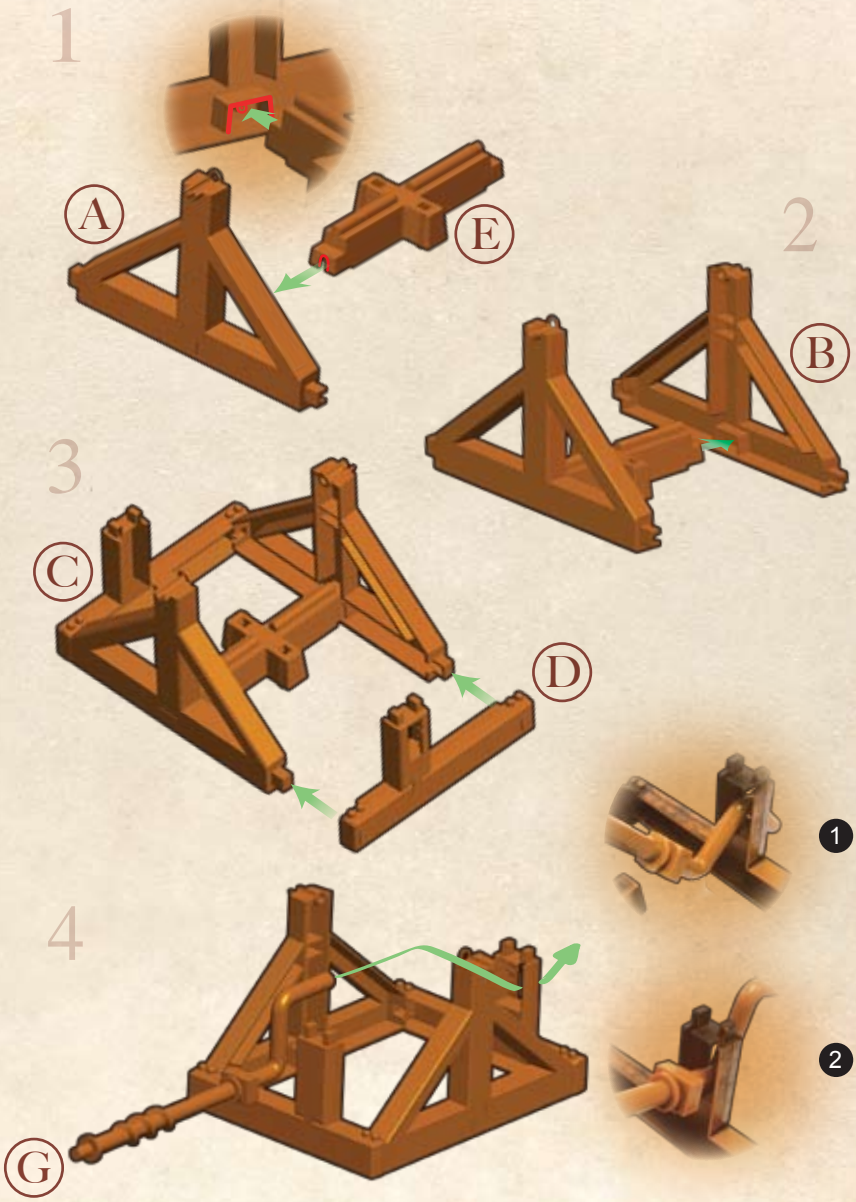
How to Assemble



How to Assemble

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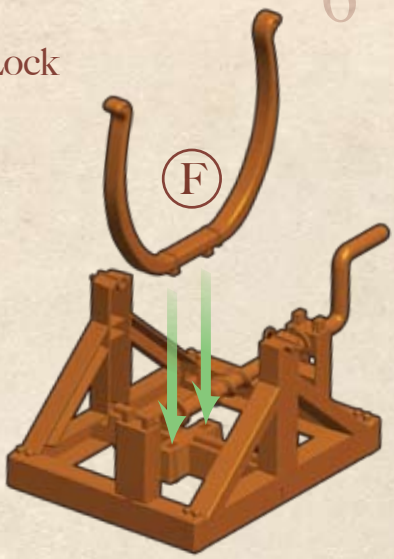

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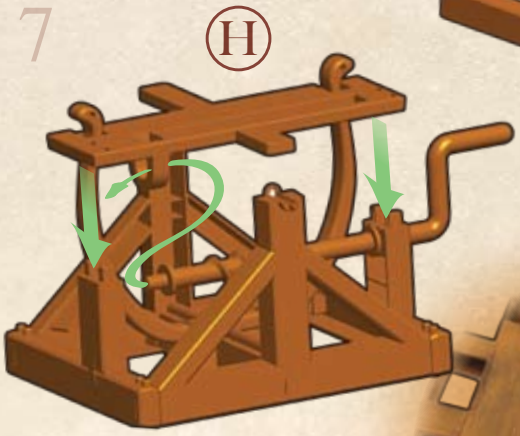
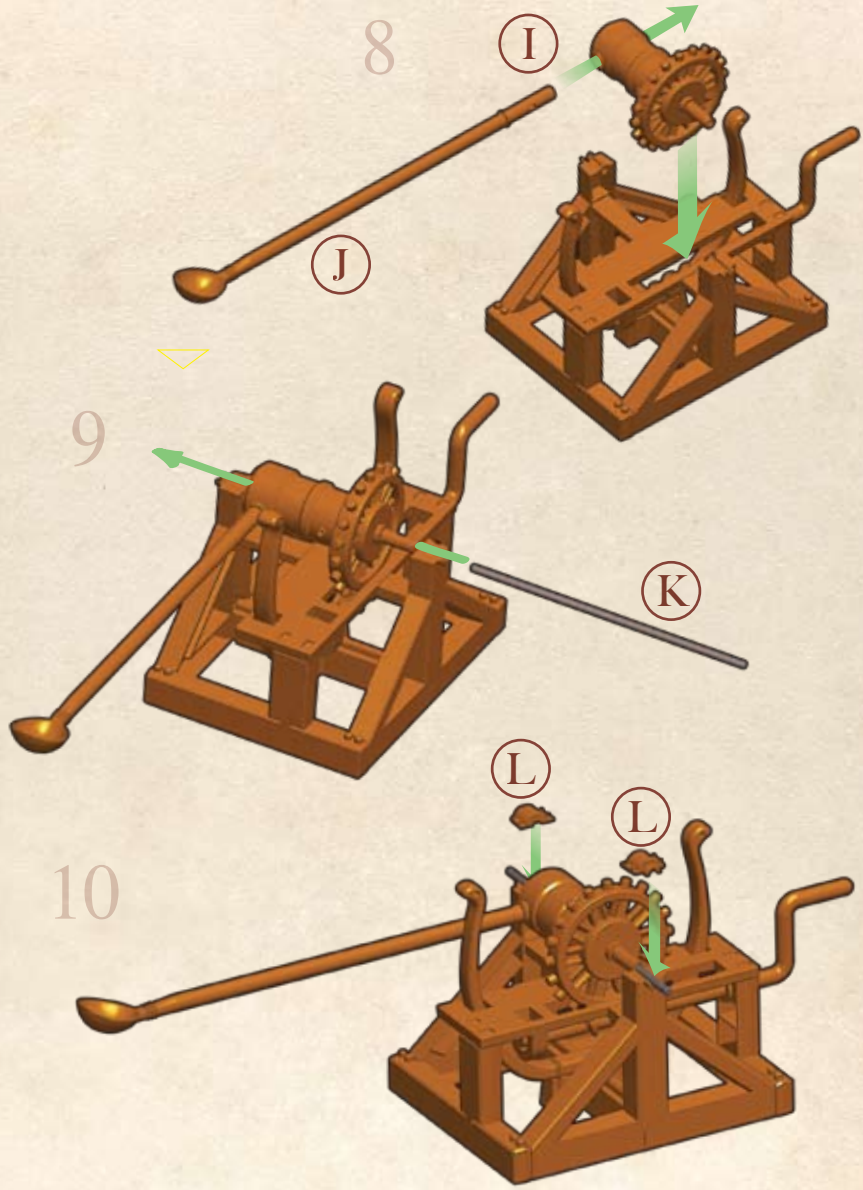
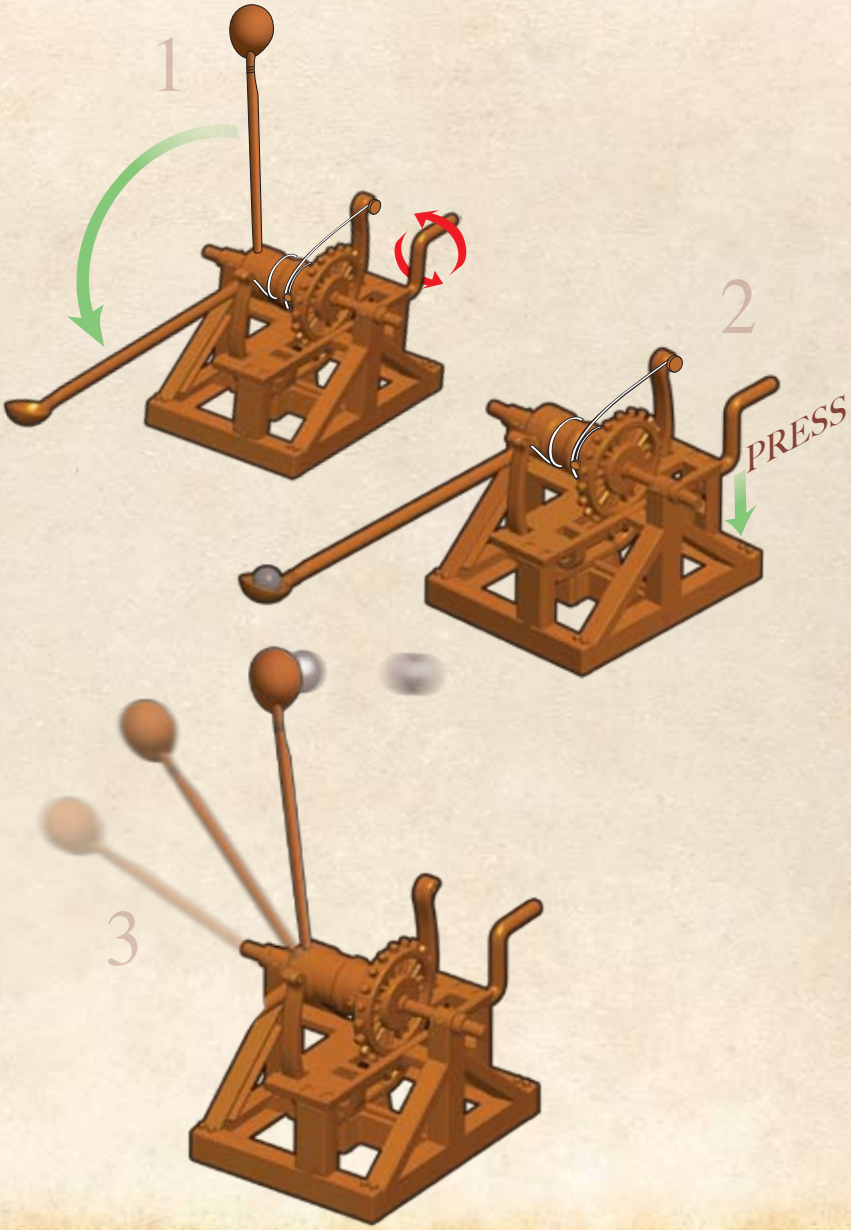


How to Assemble



How to Assemble

How to Operate the Catapult



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

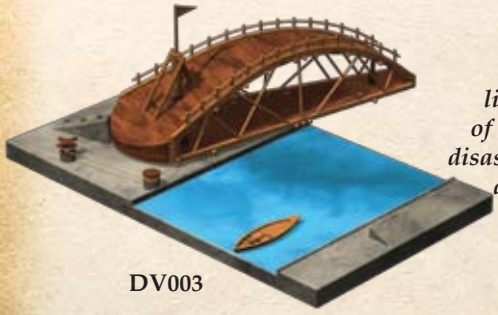
Mechanical Drum

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 device off the ground.

DV002



DV003

Swing Bridge

The Swing Bridge was a portable, lightweight bridge intended to span a body of water for armies to cross, and then quickly disassemble in order to tow away. Equipped with a rope and wheels, the lightweight bridge was designed for easy transport.

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 12-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

Leonardo Da Vinci

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. This precursor to the automobile was one of the many inventions that Leonardo created dealing with locomotion and transportation.

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

Notes

WARNING: CHOKING HAZARD-
Toy contains small ball. Not for children under 3 years.

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

EDU-TOYS

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CE

REUSE
RECYCLE

P38-DV010-81001000 Printed in China