

Da Vinci

THE EXHIBITION



Engage



Experience



Enrich

Educator Guide



Da Vinci

THE EXHIBITION

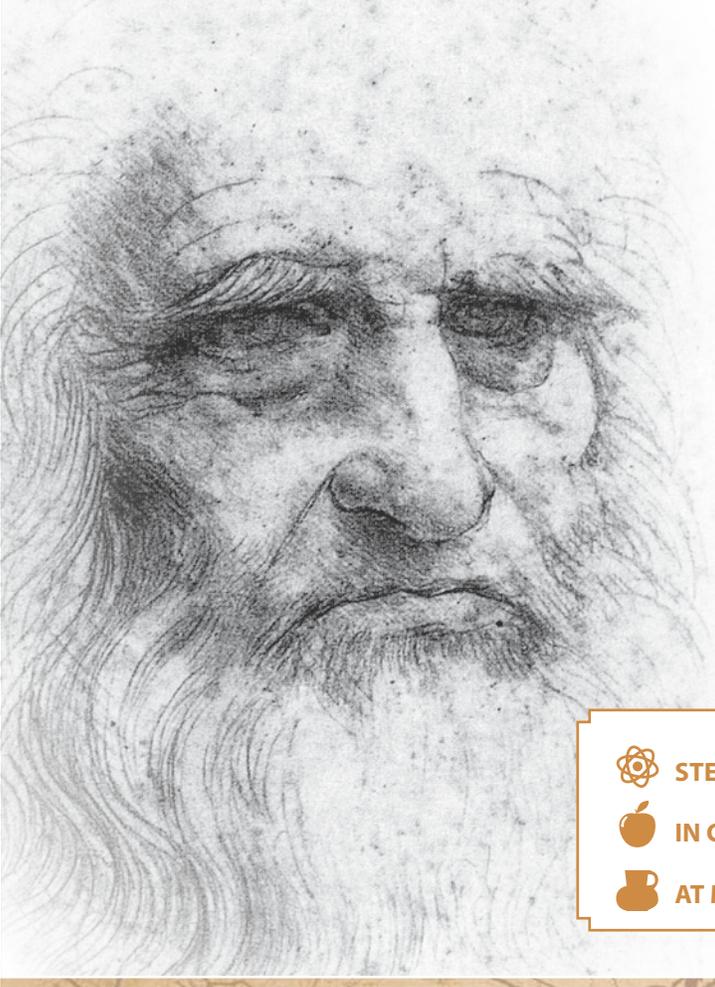
INTRODUCTION TO THE EXHIBITION

Imagine if you had the opportunity to have a conversation with one of the most famous people in the world. Who would it be and what would you ask them?

Many of us might choose our favorite hero, pop star, or sports figure. We would know what to ask that person because we have been following him or her for much of our lives. We would want to get a good night's sleep before meeting them and maybe even write down our questions so we could get the most out of our meeting.

These are all good things to consider prior to visiting **Da Vinci: The Exhibition**, where you will have a chance to have a conversation with Leonardo da Vinci, one of the most respected and famous people in all recorded history.

Unfortunately, you won't be able to speak to Leonardo in person; but you will have a chance to experience much of his life's work—from his drawings and paintings to more than 60 of his most creative inventions. Visiting the Exhibition is like stepping into da Vinci's mind, having a conversation with him, and standing alongside him as he looks far into the future, because many of his most celebrated inventions could not be created until hundreds of years after his death.



Included in this Guide

To engage with the exhibition, teachers can choose what will best fit students' needs and interests. This guide contains:

- 1 A brief overview of each gallery
- 2 Essential questions to ask students while touring the exhibition
- 3 Lesson plans with hands-on activities, many of which can be completed either in class or while visiting the Exhibition, including:
 - Debriefing questions to help students reflect on the lesson
 - Grade level adaptations for more or less complex lessons that allow teachers to modify activities for all levels

 STEAM

 IN CLASS

 AT MUSEUM

Da Vinci

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INTRODUCTION

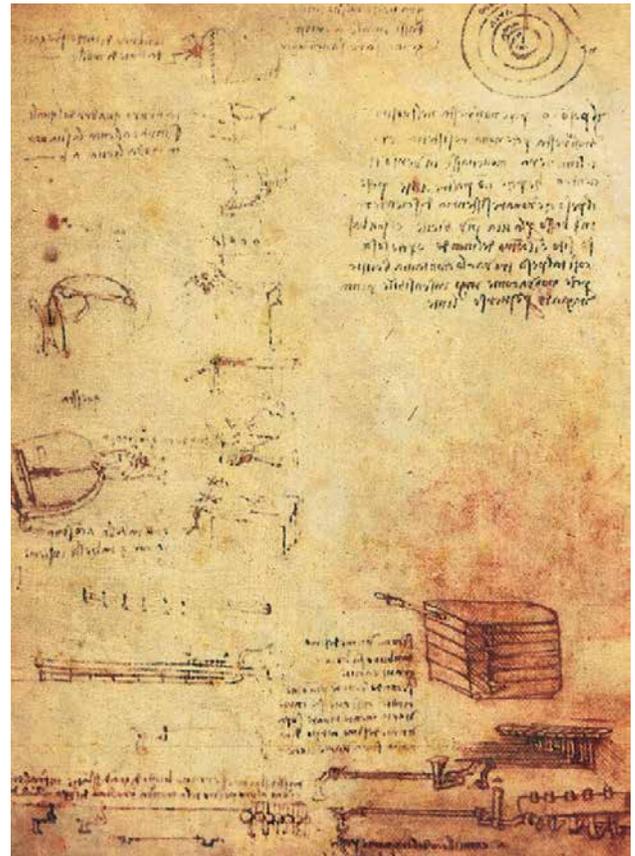
There are 10 galleries in **Da Vinci: The Exhibition**. Each introduces students to specific areas of Leonardo da Vinci's focus or study. This guide provides you with an overview of each gallery and accompanying lesson plans.

Introductory Theater + Codices

The Introductory Theater is an excellent opportunity for students to become acquainted with da Vinci's life and times as well as his major works and the Exhibition's main themes. Inspiration and inquiry are primary themes of the introductory film and it is hoped that students will find inspiration for themselves while learning about da Vinci.

At the end of the film, students will have the chance to examine faithful reproductions of two of da Vinci's Codices, or notebooks. Compiled primarily by his students after da Vinci's death, these Codices contain nearly all of Leonardo's drawings, sketches, and writings. The two Codices represented are:

- 1 Codex Arundel. Named for the Earl of Arundel (England), who acquired it from Spain around 1630, it is now housed in the British Library
- 2 Codex Forster, which contains three manuscripts of da Vinci's works, and was in the private library of John Forster during his lifetime. In 1876, it was given to the Victoria and Albert Museum (London).



"THE NOBLEST PLEASURE IS THE JOY
OF UNDERSTANDING."

—LEONARDO DA VINCI

Da Vinci

THE EXHIBITION

THE RENAISSANCE

KNOW BEFORE YOU GO

Da Vinci lived during the Renaissance (1300 – 1700). This was one of the most significant artistic and cultural periods in recorded history. Meaning “rebirth,” the Renaissance saw a resurgence in appreciation for Greek and Roman art accompanied by a myriad of new discoveries and new ways of looking at the world.

Leonardo's life (1452 – 1519) coincided with the Italian High Renaissance. During this period, several Italian families, such as the Medici in Florence and the Sforza in Milan, amassed great wealth which gave them a powerful voice in the politics of their regions and influence over the direction of the arts. These families became patrons of the arts, and certain artists in particular. They often allowed artists to travel between city-states to complete important public works, portraits and sculptures. In a time when personal interests were gaining ground in the arts, Renaissance artists were as likely to create secular works as religious ones.



Leonardo's Life

Leonardo's last name was not always da Vinci. He was born in 1452 as Leonardo di ser Piero in a small town in the Italian countryside called Vinci in 1452. As he traveled, he was identified as “Leonardo from Vinci” which is the origin of how we know him today.

Leonardo was born illegitimately to a peasant woman, which held great stigma at the time, but Leonardo's wealthy father did not try to disavow his son's birth. Instead, his father welcomed Leonardo as a “legitimate” son, and raised him on his expansive estate, arranging for his schooling and for an apprenticeship to the Florentine artist Andrea del Verrocchio. While an apprentice from age 15 – 25, Leonardo was trained in painting and sculpture. He also showed interest in technical matters such as hydraulic pumps and military machines.

ACTIVITY 1: RENAISSANCE RESEARCH

SUBJECTS ADDRESSED

History • Social Studies • Math • Science • Arts

Working in pairs or groups, students select a subject from the topics below and research it for one class period. In the following class, each group presents its findings to the class:

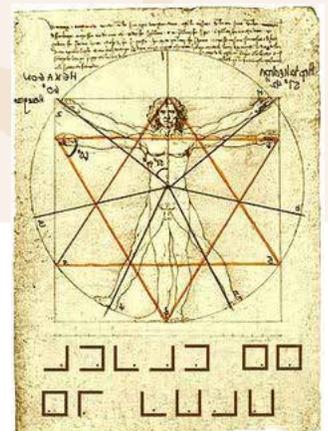
 STEAM

 IN CLASS

Did You Know?

Leonardo da Vinci is known as a Polymath—someone deeply knowledgeable across a broad range of subjects.

- 1 Changes in Astronomy during the Renaissance
- 2 The use of Mathematics in Leonardo's works
- 3 The practice of Alchemy
- 4 How far could one travel during the Renaissance?
- 5 Who were the artists during the Renaissance?
- 6 Who were the Medici?
- 7 What were the main Italian City-States during the Renaissance?
- 8 What is Bookbinding?



ACTIVITY 2: MIRROR WRITING

SUBJECTS ADDRESSED

Mathematics • Geometry • Optics

Students write backwards, first individual letters, then words, then whole sentences.

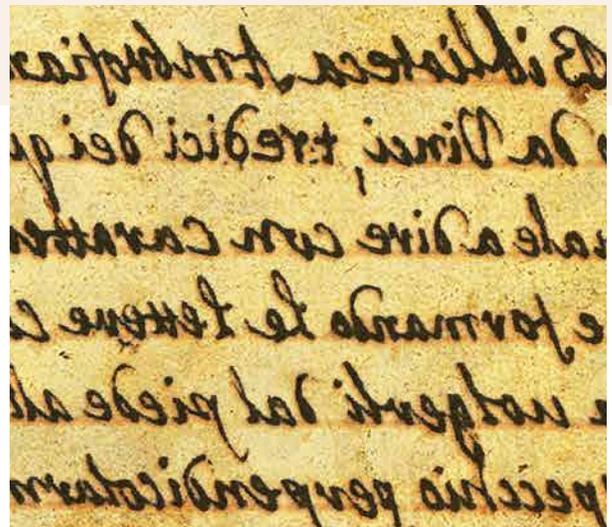
 STEAM

 IN CLASS

Did You Know?

Leonardo's notes are filled with his mirror writing. Not a secret code, his notes could easily be read by holding a mirror up to them.

- 1 Discuss the concept of symmetry as a class. How do mirrors show us symmetry?
- 2 Allow students to explore freely with mirrors, examining reflections of different objects, including text.
- 3 As students observe text through the mirror, ask: Is it easy or difficult to read reflected text?
- 4 Ask students to copy the text as they see it reflected in the mirror, starting with letters only, then moving to full words.
- 5 After practicing writing mirrored letters and words, challenge students to write a complete sentence in reflected words without the aid of a mirror.



ACTIVITY 2: DEBRIEF

- ✗ Ask students to share their thoughts on mirrored writing and discuss what techniques they used to make mirrored writing easier or more difficult.

Tips for Teachers

- ✓ Encourage students to play freely with multiple mirrors for a moderate period of time before starting the activity, even asking them to try to use multiple mirrors as a group to view an object across the room.
- ✓ Help students to understand that their mirror writing need not be perfect. Instead ask them to focus on the act of writing in reverse and feel the challenges it initially presents become less difficult as they become more accustomed.
- ✓ **For Grades 6-8**
During discussion, engage students with the concepts of skill, ability and challenged ability, as well as perspective, asking them to think of what their world would be like if they could only write in reverse.

Advanced: Additional Activity

- 1 Use multiple mirrors to create differing angles and reflections. Encourage students to try mirrored reading and writing from various mirrored angles.

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BRAIN TO
WRITE IN MIRROR

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FLIGHT

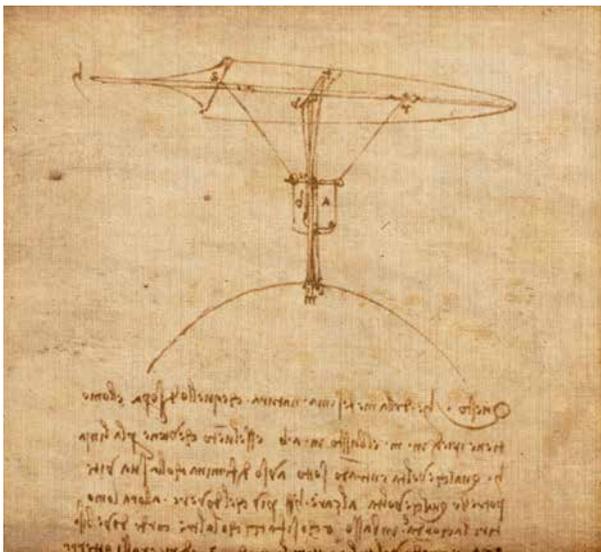
KNOW BEFORE YOU GO

The dream of human flight was very real for Leonardo. While it is unlikely that he ever attempted flight, others did try to fly during his lifetime.

Focusing on friction and resistance, Leonardo hoped that one day he could teach us all to fly like birds, but he quickly realized that human strength alone could not lift us from the ground. So, he began to look at birds' wings and other types of wings that might one day make a flying machine.

The Flight Gallery features several of da Vinci's machines used to study the principles of air and many of his flying machine concepts, including a design for the "first" helicopter—the Aerial Screw. The Aerial Screw was designed to use air resistance against a large set of rotating fabric gears to lift it from the ground.

Leonardo's concept of air resistance and center of gravity in flight are key principles in modern aviation and aeronautical engineering.



Invention Spotlight



Hang Glider

The glider project is among the most original of Leonardo's concepts on the subject of flight. Many of Leonardo's inventions were innovations in how humans interacted with machines. In this hang glider, the pilot could change the device's center of gravity and control the flight direction by shifting the position of his upper body. This machine reflected Leonardo's knowledge of both air currents and wind power and how they combined to create the power of gliding.

"A BIRD IS AN INSTRUMENT WORKING ACCORDING TO MATHEMATICAL LAW, WHICH INSTRUMENT IT IS WITHIN THE CAPACITY OF MAN TO REPRODUCE..."

**—LEONARDO DA VINCI
'OF THE BIRD'S MOVEMENT'**

ACTIVITY 3: TAKING FLIGHT

AREA OF FOCUS

Physics • Drag • Thrust • Lift • Displacement

Students select a paper airplane design and examine its effectiveness in flight.

It is not known if Leonardo ever made a paper airplane to learn more about flight, but today we will try to do just that. Depending on the aerodynamic design, paper airplanes can fly fairly far and glide through the air with ease; and they use air resistance just as Leonardo suspected.

 STEAM

 IN CLASS

Did You Know?

Paraglider Robbie Whitehall successfully flew a glider based on a design by Leonardo da Vinci. He added a tail to stabilize it and reduce his number of crashes.

- 1 Present students with optional designs for their paper airplanes (next page)
- 2 Allow students to pick their favored weight of paper (from copy paper to heavy card stock)
- 3 Ask students to fold their paper airplane according to their selected designs
- 4 Create airplane races in round robin heats, always allowing each student a chance to compete without complete elimination while grouping the more successful planes together
- 5 Ask students to focus on:
 - longest flight distance
 - most maneuverability
 - design factors including weight of paper and coloring

“REMEMBER THAT YOUR BIRD SHOULD HAVE NO OTHER MODEL THAN THE BAT, BECAUSE ITS MEMBRANES SERVE AS AN ARMOUR OR RATHER AS A MEANS OF BUILDING TOGETHER THE PIECES OF ITS ARMOR, THAT IS THE FRAMEWORK OF THE WINGS”

—LEONARDO DA VINCI ‘OF THE BIRD’S MOVEMENT’

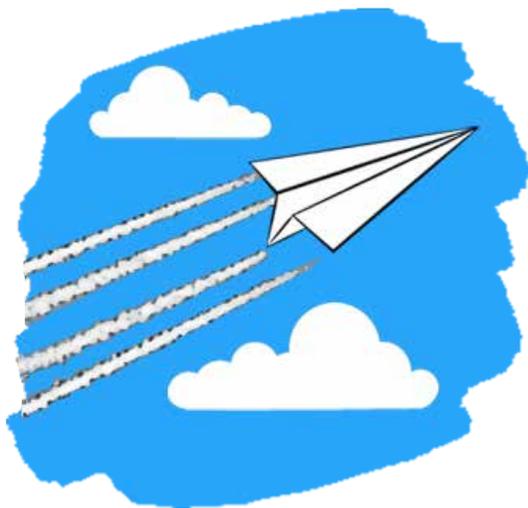
ACTIVITY 3: DEBRIEF

- ✗ **Have students discuss why certain planes went farther than others, as well as which plane they would most like to fly in.**

Learning Outcome

While different in some ways from actual airplane wings, the paper airplane is an example of Leonardo's principles of air resistance. The air underneath the paper airplanes' wings is what keeps them afloat.

To help students to better understand air resistance, ask them to move their hands through the air at different angles and feel the difference between resistance and "slicing" through any resistance. Similarly, the aerodynamics of a paper airplane will determine the distance and ease at which it flies—it needs drag to remain stable, but lightness and displacement to keep it aloft. It also needs forces of lift and thrust, provided by the student. When these four forces are used in balance, paper airplanes will fly longer. The external force supplied by students to their planes is similar to the external force that da Vinci wished he could have applied to his flying machines.

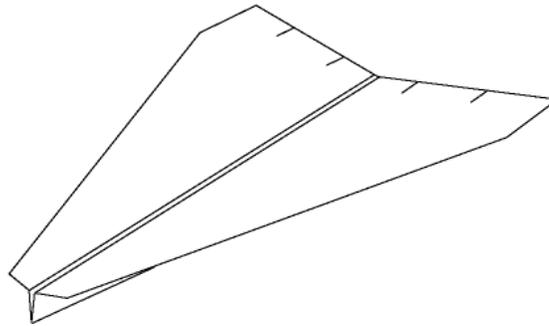


Tips for Teachers

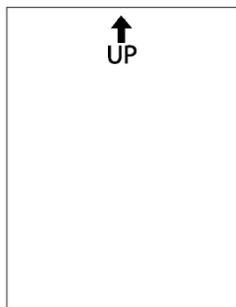
- ✓ An airplane that has balance of lift, thrust, gravity, and drag will fly longer whereas a plane that with little or no balance will have shorter flights or may possibly nose dive straight to the floor.

ACTIVITY 2: TAKING FLIGHT > ARROW

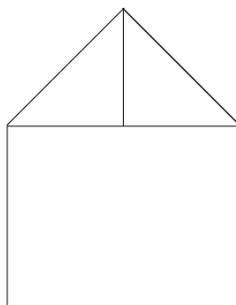
Arrow



This plane is easy to fold and flies straight and smooth. Add a small amount of up elevator for long level flights.

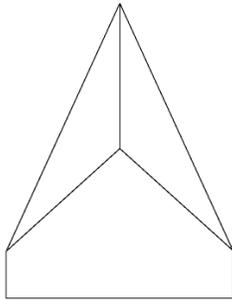


Orient the template with the “UP” arrow at the top of the page. Then, flip the paper over onto its backside, so that you cannot see any of the fold lines.

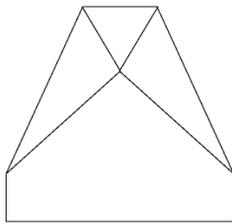


Pull the top right corner down toward you until fold line 1 is visible and crease along the dotted line. Repeat with the top left corner.

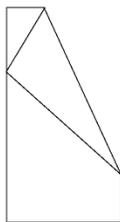
ACTIVITY 3: TAKING FLIGHT > ARROW



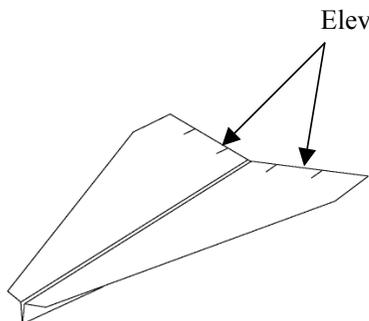
Fold the right side over again and crease along fold line 2. Repeat with the left side.



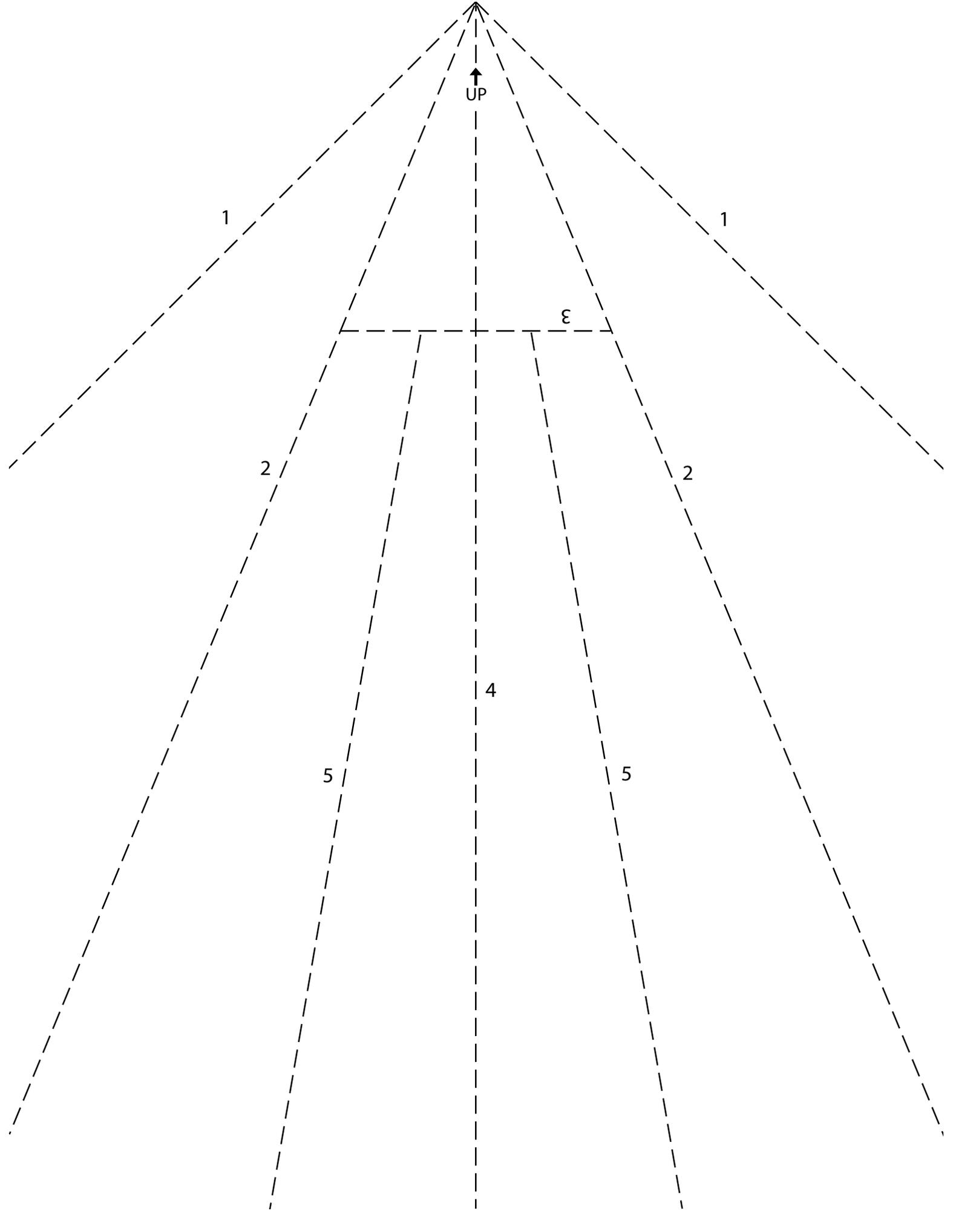
Fold the tip down toward you and crease along fold line 3.



Now, flip the paper over. Then, fold the left side over onto the right side and crease along fold line 4 so that the outside edges of the wings line up.

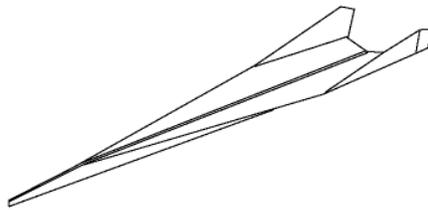


Fold the wings down along fold lines 5. Partially open the folds you just created so that the wings stick out straight. Cut two slits, one inch apart, along the back edge of each wing for elevator adjustments. Add wing dihedral by tilting the wings up slightly away from the fuselage. The wings will have a slight “V” shape when viewed from the front. Now you are ready to fly!

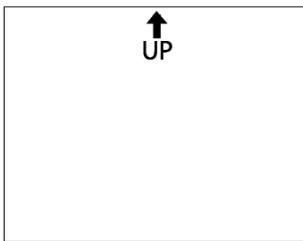


ACTIVITY 3: TAKING FLIGHT > BULLET

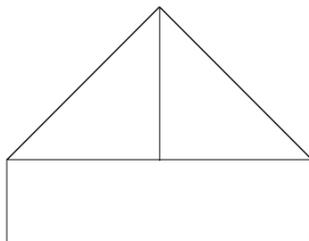
Bullet



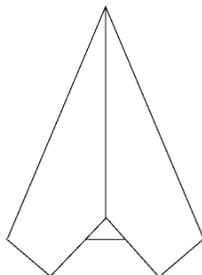
This plane flies as fast and as far as you can throw it, although it is not very stable during flight. It is a true dart and is very streamlined. The folds are very compact in this design, and accurate firm creases are critical.



Orient the template so that the “UP” arrow is at the top of the page. Then flip the paper over so that none of the fold lines are showing.

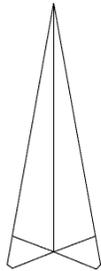


Fold the top left corner down toward you until fold line 1 becomes visible. Crease along the dotted line and repeat with the top right corner.



Fold the left side over again and crease along fold line 2. Repeat with the right side.

ACTIVITY 3: TAKING FLIGHT > BULLET



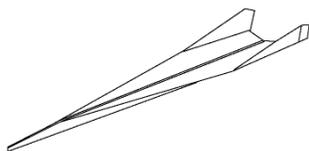
Fold the left side over once again and crease along fold line 3. Repeat with the right side. Make sure that you are making firm, crisp creases along each fold line.



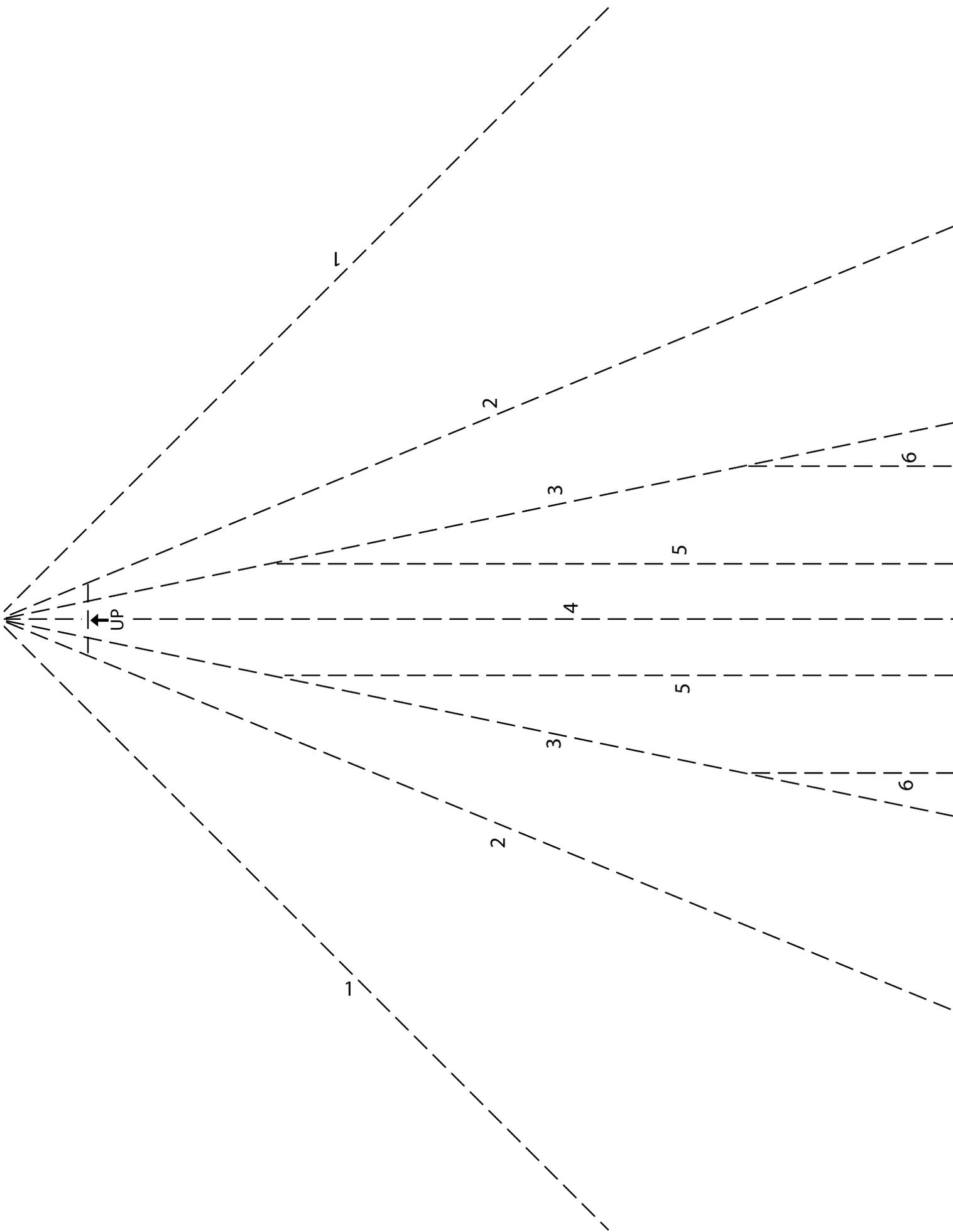
Fold the tip of the nose down toward you along the fold line.



Fold the right half of the plane over onto the left half along fold line 4 so that the outside edges of the wings line up. Again, make a firm crease along this fold.

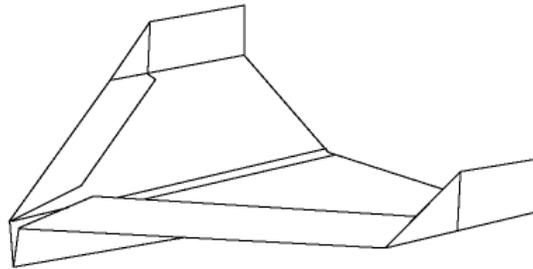


Fold the wings down along fold lines 5 and the winglets up along fold lines 6. Add wing dihedral by tilting the wings up slightly away from the fuselage. The wings will have a slight “V” shape when viewed from the front. You are ready to fly!

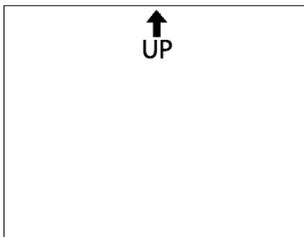


ACTIVITY 3: TAKING FLIGHT > CONDOR

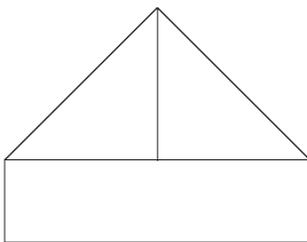
Condor



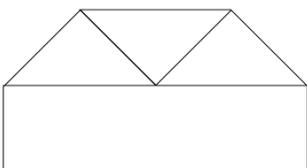
This plane produces tremendous lift at low speed, giving it a very low glide slope. It is an excellent indoor flier and will coast across the room on slow, smooth glides.



Orient the template so that the “UP” arrow is at the top of the page. Then flip the paper over so that none of the fold lines are showing.

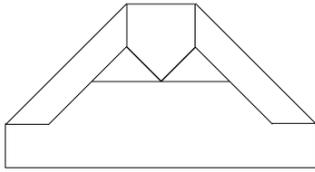


Fold the top left corner down toward you until fold line 1 becomes visible. Crease along the dotted line and repeat with the top right corner.

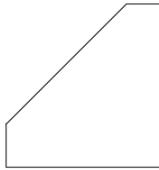


Fold the nose down until fold line 2 becomes visible and crease along the dotted line.

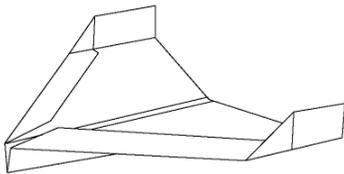
ACTIVITY 3: TAKING FLIGHT > CONDOR



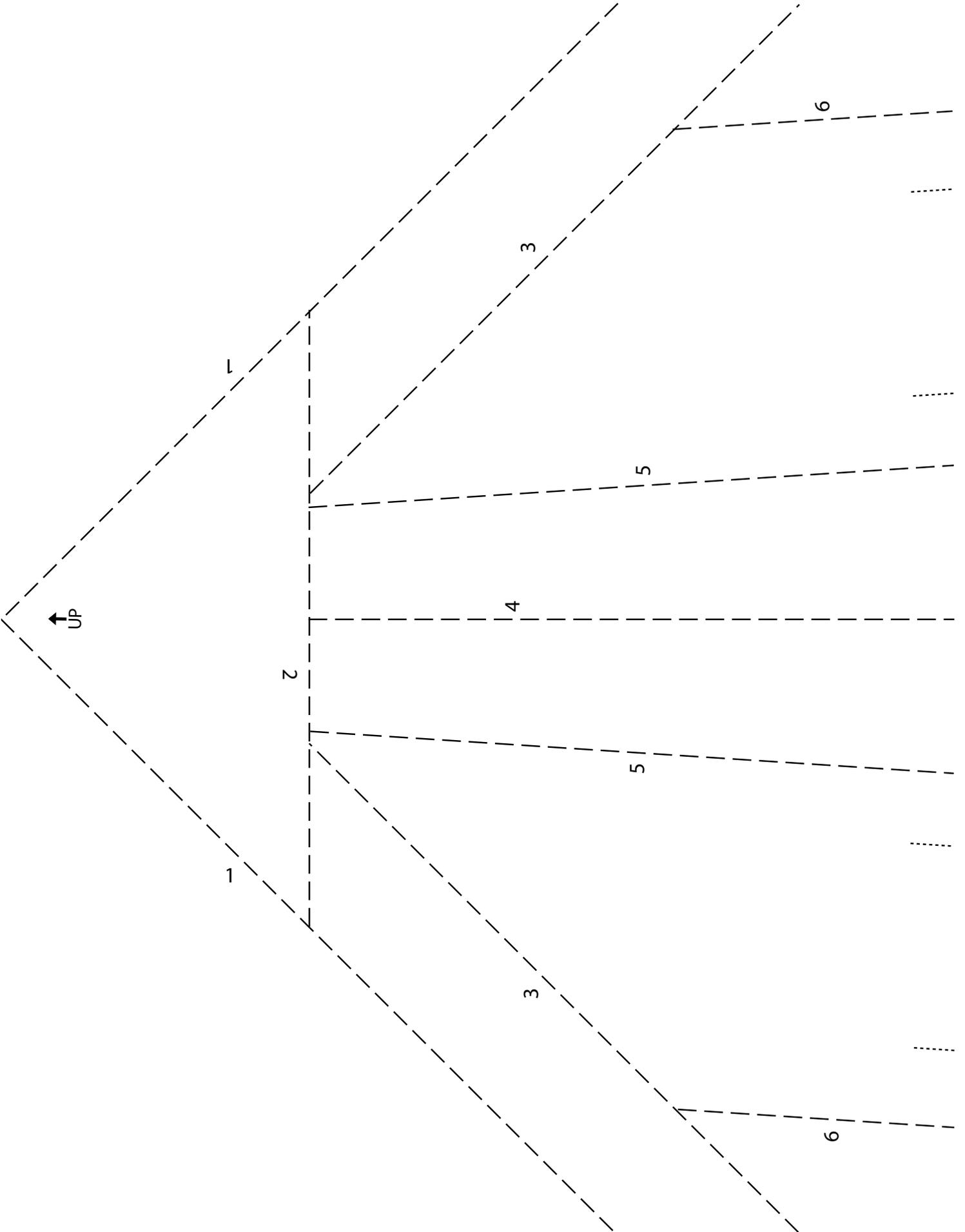
Fold the outside wing edges in and crease along fold lines 3.



Fold the right half of the plane over the left half and crease along fold line 4 so that the outside edges of the wings line up.

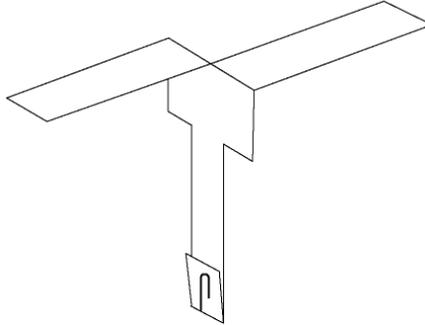


Fold the wings down along fold lines 5 and the winglets up along fold lines 6. Add wing dihedral by tilting the wings up slightly away from the fuselage. The wings will have a slight “V” shape when viewed from the front. Add elevator slits along the back edge of the wings to adjust the flight if necessary. You are ready to fly!

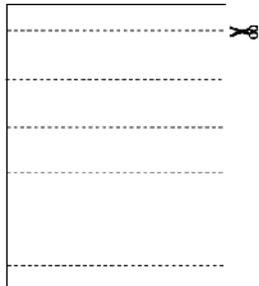


ACTIVITY 3: TAKING FLIGHT > HELICOPTER

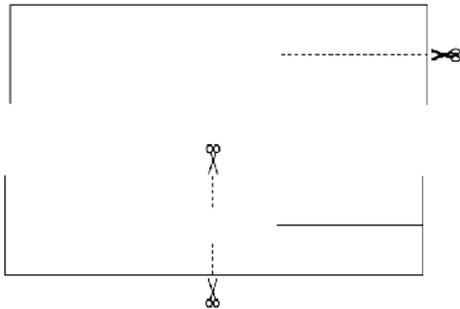
Helicopter



The helicopter is a classic design that spins rapidly as it descends. It works well when dropped from a high place. Try different amounts of weight on the bottom tab. Notice that the helicopter spins in different directions depending on which direction the rotors are folded.

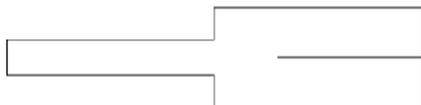


Cut out all five helicopter templates by cutting along line 1.



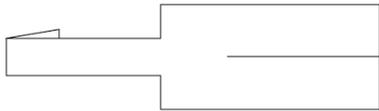
Cut along cut line 2.

Cut along cut line 3.

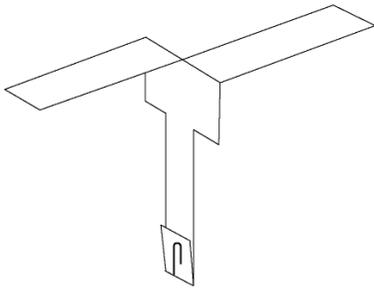


Fold flaps toward each other along fold lines 4. One will overlap the other.

ACTIVITY 3: TAKING FLIGHT > HELICOPTER



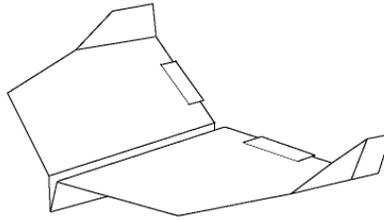
Fold up bottom tab along fold line 5.



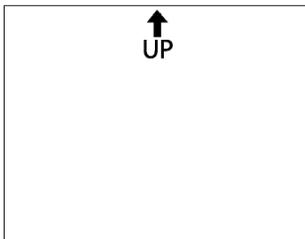
Fold rotors down along fold lines 6 in opposite directions. Attach a paper clip to the bottom tab to add weight. Drop from high over your head and watch the helicopter spin as it descends slowly.

ACTIVITY 3: TAKING FLIGHT > RAPTOR

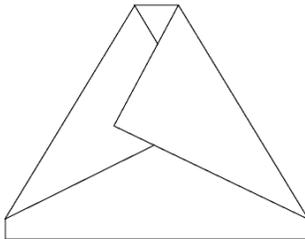
Raptor



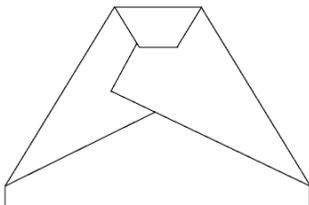
This plane is an excellent outdoor glider. Launch straight up and it will glide down in big lazy circles. Adjust the elevator on the back edge of the wing to perfect the flight characteristics.



Orient the template so that the “UP” arrow is at the top of the page. Then flip the paper over so that none of the fold lines are showing.

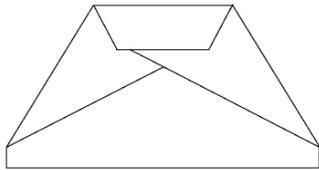


Fold the top right and top left corners in until fold lines 1 appear and crease along the dotted line.

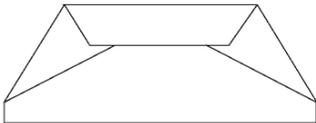


Fold the nose down toward you and crease along fold line 2.

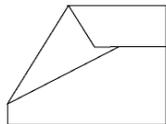
ACTIVITY 3: TAKING FLIGHT > RAPTOR



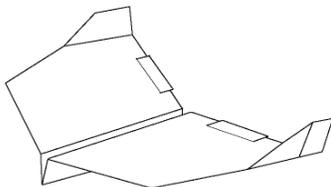
Fold the nose down toward you again and crease along fold line 3.



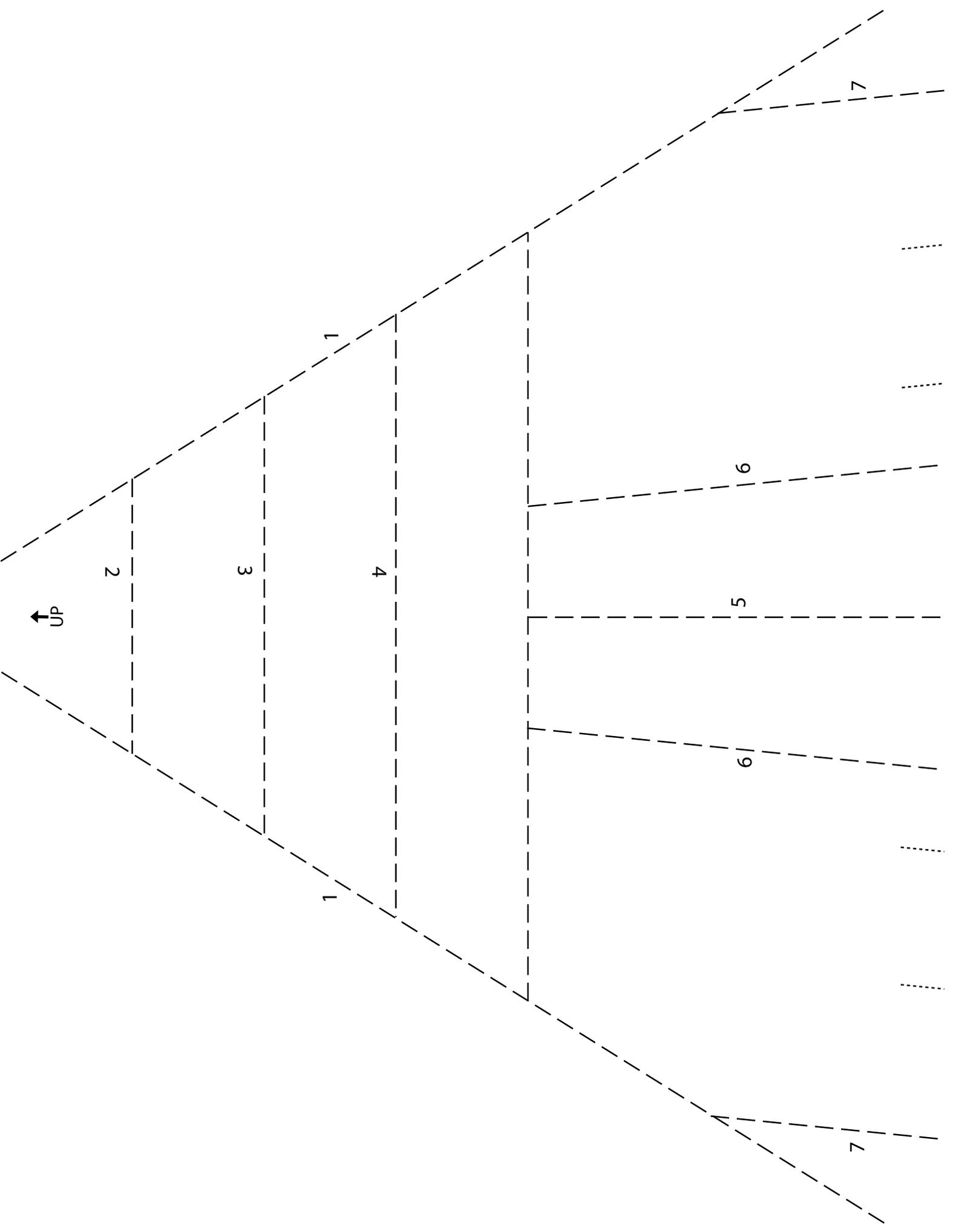
Fold the top edge down toward you again and crease along fold line 4.



Flip the plane over and fold the right half over the left half along fold line 5.

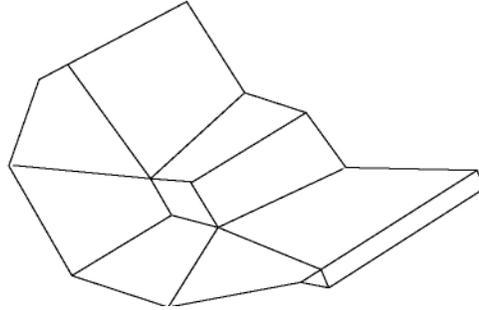


Flip the wings down along fold lines 6 and the winglets up along fold lines 7. Cut slits along the back wing edge for the elevator adjustment. Add wing dihedral by tilting the wings up slightly away from the fuselage. The wings will have a slight “V” shape when viewed from the front. You are ready to fly!

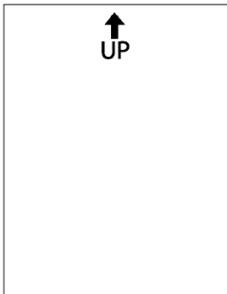


ACTIVITY 2: TAKING FLIGHT > STEALTH WING

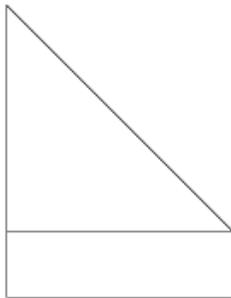
Stealth Wing



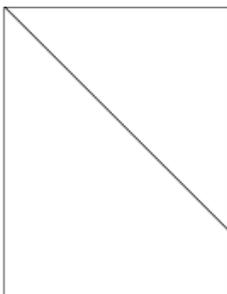
This plane is an advanced design. With careful folding, it will reward you with long smooth glides. Launch gently from high above your head or an elevated area.



Orient the template with the “UP” arrow at the top of the page. Then, flip the paper over onto its backside, so that you cannot see any of the fold lines.

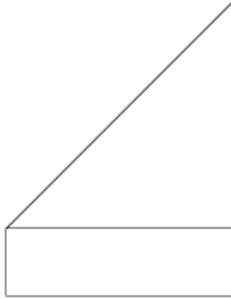


Fold the top right corner down and to the left until fold line 1 appears and crease along the dotted line.

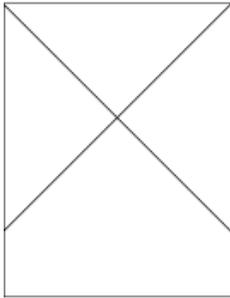


Unfold the fold you just created.

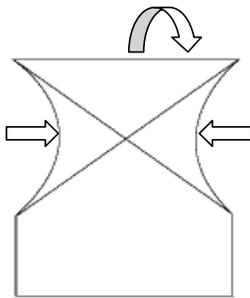
ACTIVITY 3: TAKING FLIGHT > STEALTH WING



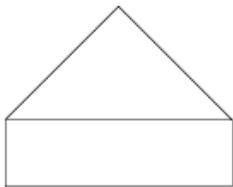
Repeat the procedure above by folding the top left corner down and to the right. Make a crease along fold line 2.



Unfold the fold you just created.

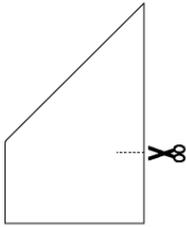


This step is a bit tricky. Lift the left and right edges of the paper and push them toward each other while folding the top triangle onto the bottom one. This will make a crease along fold line 3 so that you end up with the shape below.

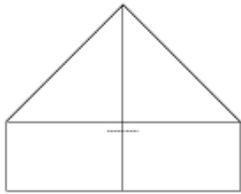


This is the shape you should have after completing the step above.

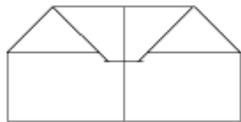
ACTIVITY 3: TAKING FLIGHT > STEALTH WING



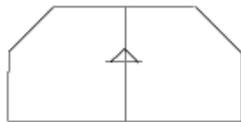
Fold the right side over onto the left side along fold line 4. Cut along the dotted cut line 5.



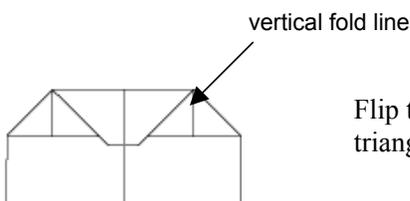
Unfold to produce this shape.



Fold the top point over and crease along fold line 6. Tuck the nose into the slit you cut along cut line 5.

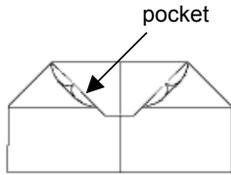


Flip the paper over and fold the nose up along fold line 7.

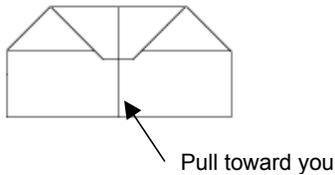


Flip the paper back over again. Fold the top layer of the triangle shaped flaps in along the vertical fold line 8.

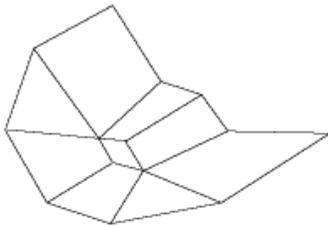
ACTIVITY 3: TAKING FLIGHT > STEALTH WING



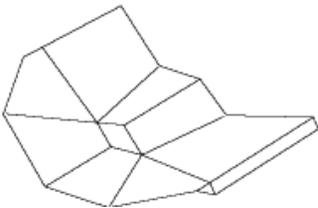
Tuck the flaps into the pockets near the nose of the plane. Push the flaps completely into the pockets.



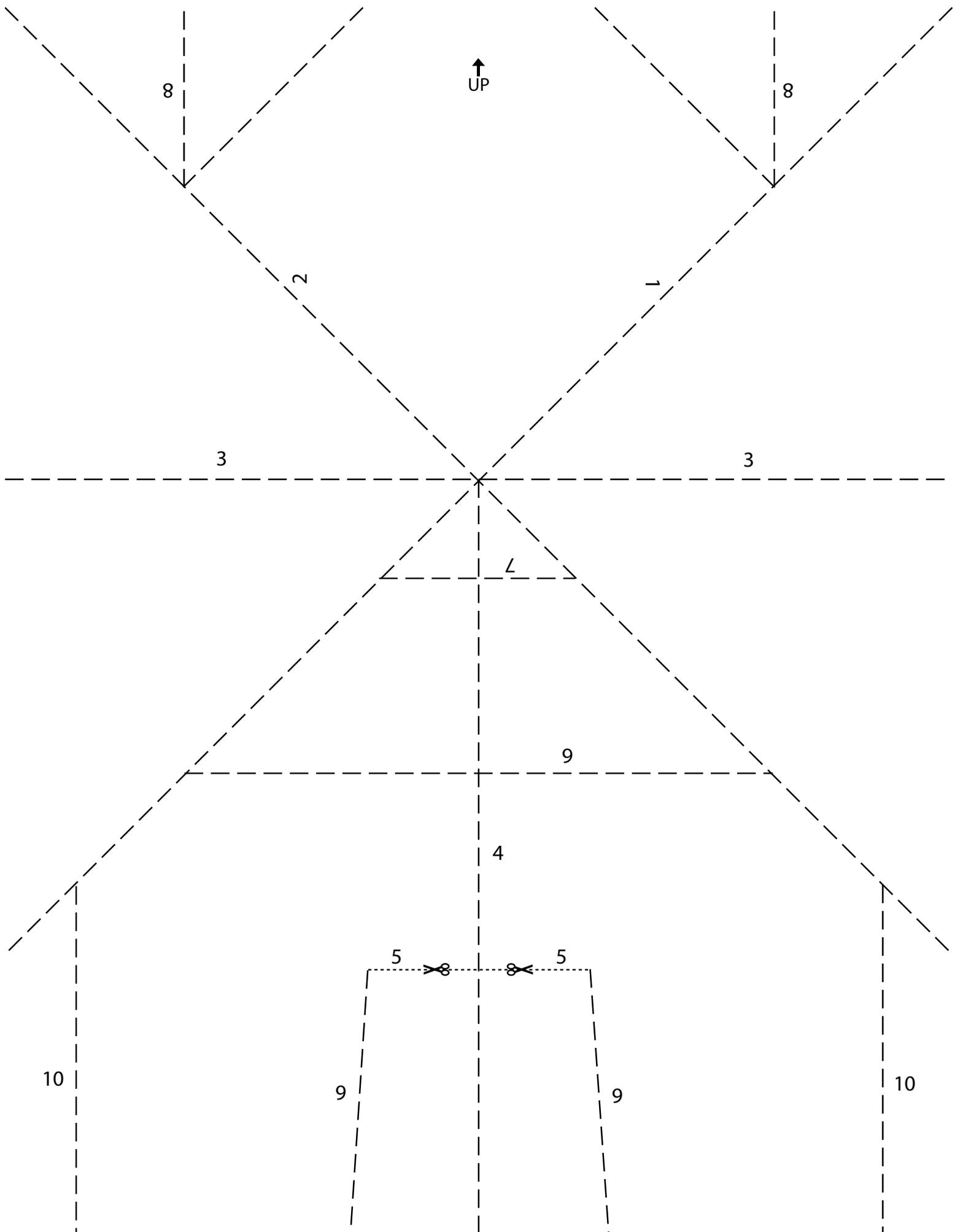
You should now see this shape. Locate the crease below cut line 5. Pull this crease toward you while also folding the plane in half toward you. This will create creases along fold lines 9.



Partially unfold the fold you just created. You should see this shape.



Fold down the winglets along fold lines 10. Now you are ready to fly! Hold the plane with your thumb against the nose and your index and middle finger behind cut line 5. Launch very gently from above your head.



Da Vinci

THE EXHIBITION

PHYSICS

KNOW BEFORE YOU GO

One key tenant of Leonardo's work focused on making life, and labor, easier. He studied human actions such as transporting large building materials or lifting heavy objects then sought to devise machines that would perform these actions, or greatly assist in their performance.

In doing so, Leonardo became a master of Physics—a branch of science focused on matter, mechanics, light, and other naturally occurring phenomena. Using his keen skills of observation, Leonardo carefully noted the human energy required to perform a task, then tried to find examples from the natural world that would help him design his machine.

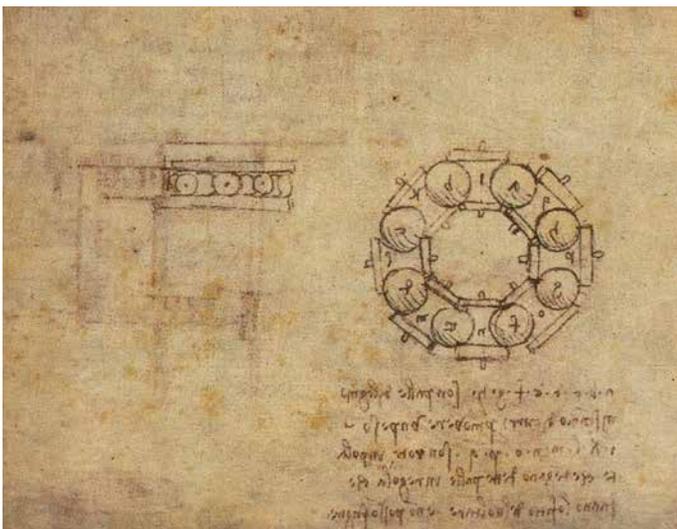
This approach to scientific thinking was completely opposite from the scientific spirit of the time, which believed that scientific truths could only be found in the Bible and that experimentation led nowhere. After Leonardo, however, scientific thinking completely changed; the Scientific Revolution, which began twenty years after his death and is the foundation for modern science, practiced his same principles of observation and experimentation.

Invention Spotlight



Ball Bearing

The first known discovery of a device that used ball bearings was during the time of the Roman Empire. Used aboard Roman ships, the device was a rotating table with balls placed underneath for smooth motion. Leonardo intensely studied the use of bearings to reduce wear and tear on moving parts of machines. Leonardo invented the ball bearing as we know it today. His ball bearing uses balls, rollers and a lubricating oil to reduce friction between two moving objects. The image to the left depicts a series of rolling spheres with turning spindles placed between each sphere. As the spheres turn freely, the adjacent spindles rotate as well, but on their own axes. By reducing friction between the two adjacent mobile parts, motion is made easier for both parts. Today, this device is found in engines, kitchen appliances and other machines. In the Codex Atlanticus, there are drawings of many similar devices, including cage gears and ball bearing schemes.



ACTIVITY 4: WORKING WITH POLYHEDRONS

AREA OF FOCUS

Math • Critical Thinking • Communication • Self Esteem



STEAM

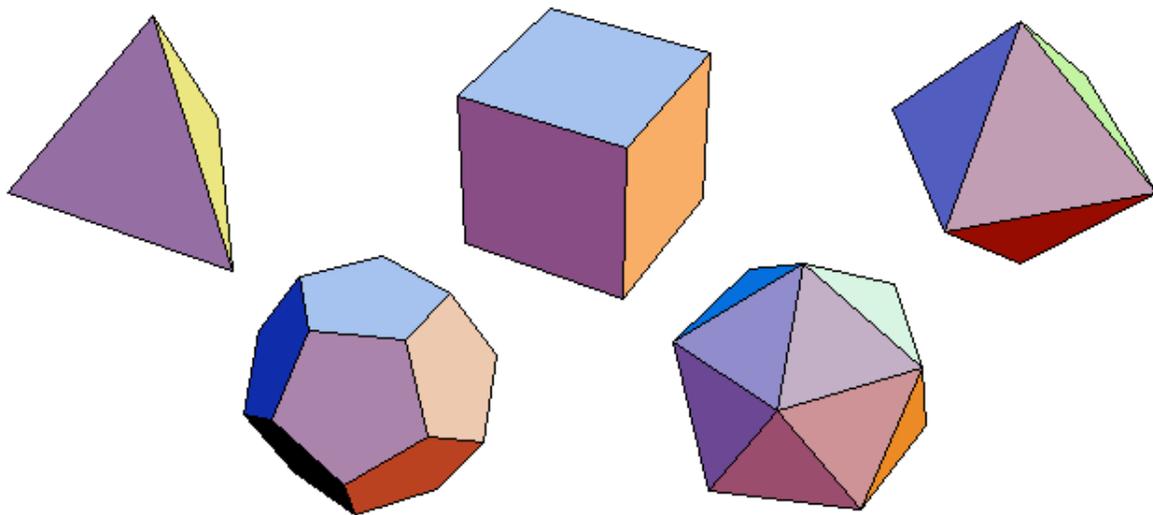


IN CLASS

Did You Know?

In the 1500s, Leonardo made drawings for a book on ratios. His models are remarkable for their precision and clarity thanks to the models used and the light on the figures.

- 1 Divide the class into manageable groups
- 2 CHALLENGE: Which group can create a shape with the highest number of faces (polyhedron)?
- 3 Available materials: chopsticks, skewer sticks, balsa wood, clips, modeling clay, cardboard, paper, scissors, glue, and tape.
- 4 Instruct the groups to collectively decide upon, design, and build a shape from smaller geometric shapes according to their characteristics: edges, angles, faces. They will also take measures of length and angles.

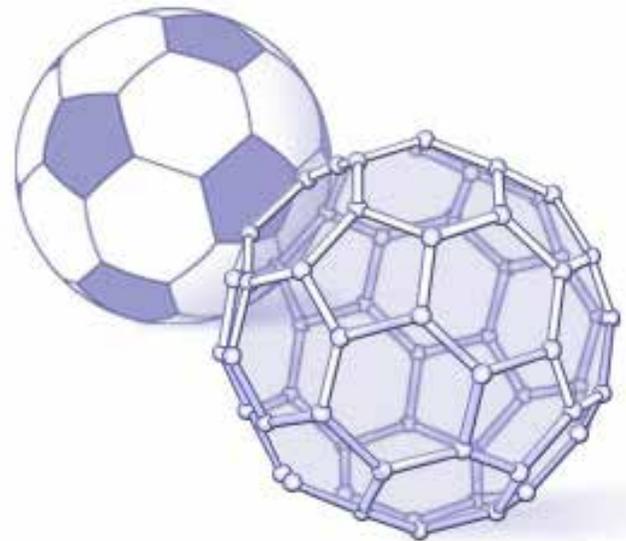


ACTIVITY 4: DEBRIEF

- ✗ Select the winning group based on greatest number of faces on the figure. Discuss with students how their working process affected the final result.
- ✗ What shapes of everyday life are shaped like a polyhedron?

Tips for Teachers

- ✓ A polyhedron is a solid figure bounded by flat surfaces and contains a finite volume. Leonardo often worked in polyhedrons in creating his machine designs.
- ✓ The more materials that are available, the more opportunities there will be to creatively use them.
- ✓ Help students identify how geometric figures are realized in 2D and 3D.
- ✓ Encourage students to use spatial thinking in creative problem solving.
- ✓ If groups are unsuccessful, help them identify what went wrong and how to improve for next time.



Advanced: Additional Activity

- 1 Propose a specific figure as a challenge, or constrain the initial materials to only pentagons (dodecahedron) or only triangles (tetrahedron, octahedron, icosahedron) or the combination of two shapes (squares and hexagons, pentagons and hexagons).

Da Vinci

THE EXHIBITION

CIVIL ENGINEERING

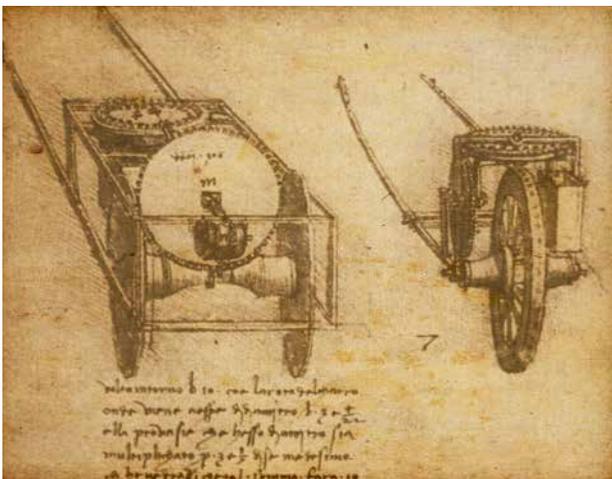
KNOW BEFORE YOU GO

Leonardo's excellent observational skills, as well as his understanding of mechanics, aided him greatly as an architect and engineer.

He was able to accurately detail vast regions of land and define city layouts in ways that foreshadowed the advent of modern map making. Leonardo also used his mechanical prowess to create machines that made labor more efficient. In the Civil Engineering gallery, you will see several examples of Leonardo, the Civil Engineer in which all of these skills came together.

The desire to ease the human workload led him to design ingenious, practical machines such as forklifts, textile machines, cranes, drills, and excavators that would aid citizens in their every day, urban life. He even designed an entire ideal city.

Seeking to create a more efficient and hygienic urban environment, Leonardo designed a city built upon a series of connected canals that could be used for commercial transport and sewage removal. The city's lower areas were intended for laborers and visitors, while its upper levels were reserved for "gentlemen." Wide streets, arranged in a grid pattern like the major cities of today, simplified navigation, and his multi-story buildings allowed for better use of space.



Invention Spotlight



Odometer

Inspired by the work of the famous Roman engineer, Vitruvius, Leonardo's odometer is an example of the basic function of the modern odometer. Today, a more complicated version of the device is used in vehicles to count miles driven. In Leonardo's simplified version, each rotation completed by the device's main gear causes a smaller vertical gear to move one point forward. Each time the small vertical gear completes a full cycle, a single pebble is released into a box, providing a physical count of the gear's revolutions and thus, a record of the distance traveled.

"THERE ARE IN THIS CITY THE MOST TALENTED MEN. THEY ARE PATIENT IN THEIR LABOR, READY TO MEET DANGER, AMBITIOUS FOR GLORY, STRONG IN COUNSEL, INDUSTRIOUS, GENEROUS, ELEGANT, PLEASANT, AFFABLE, AND ABOVE ALL, URBANE,"

**—LEONARDO BRUNI,
CHANCELLOR OF FLORENCE**

Da Vinci

THE EXHIBITION

PRIMARY CONCEPT:
GEOGRAPHY, MAPPING

GRADES: 4 & 5; 7-10

ACTIVITY 5: PERSPECTIVE MAPPING

AREA OF FOCUS

Social Science • Geography



STEAM



IN CLASS

- 1 Share with students some maps of the city or region in which you live, using both basic color block maps and more advanced maps showing roads and outlines of buildings. (If using the Internet, zooming in on Google Maps or a similar program can provide all three views).
- 2 Ask students to observe their surroundings and sketch what they see.
- 3 Now ask students to draw these same surroundings from a bird's eye view.

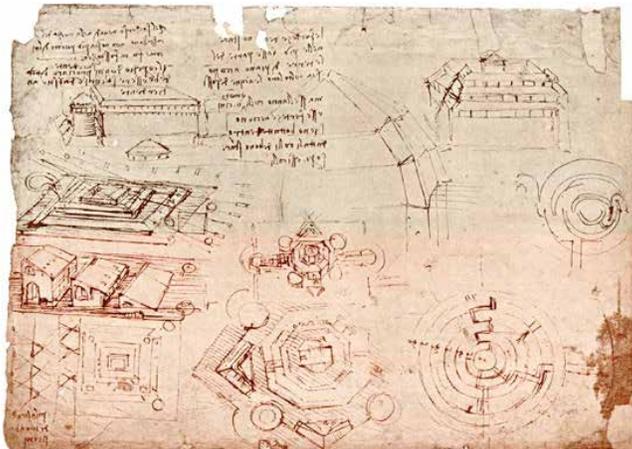


STEAM



AT MUSEUM

- 1 Ask students to draw a 'bird's eye view' map of the exhibition, or just the Civil Engineering Gallery.



Did You Know?

Leonardo liked to imagine how his city by thinking of how the city would look to a bird flying overhead.

ACTIVITY 5: DEBRIEF

QUESTIONS:

- ✗ Is it easier to only draw the top surface of an object? Why?
- ✗ How challenging is maintaining ratios of size and distance between objects at different distances?
- ✗ Try redrawing a portion of the room on graph paper using the tiles on the floor of the room—one square on graph paper represents a tile or grid marked out on the floor.
- ✗ What shapes of everyday life are shaped like a polyhedron?

Tips for Teachers

- ✓ Access to maps is a very simple part of everyday life: public transport routes, tourist maps, travel routes, etc.
- ✓ Reading maps and plans is an essential, complex exercise that develops with practice. Frequent map reading, along with use of scale, should be encouraged.
- ✓ Scale is the proportional relationship between measures of an object and the measurements of your graphic or three-dimensional representation.
- ✓ Cartography is the art and science of graphing and mapping the Earth or part of it.
- ✓ Leonardo drew many plans and maps, and was also successful at creating bird's eye views before the invention of flying machines.

Advanced: Additional Activity

- 1 Ask older students to add more complexity to their maps—expanding beyond the room to the rest of the building floor where the room is, to the school, to the entire block.
- 2 Students can make treasure maps (“geocaching”) hiding a “treasure” and offering clues through a map to find it.
- 3 Use Google Maps or Google Earth to further the idea of aerial views or “bird’s eye view.”



Da Vinci

THE EXHIBITION

HYDRAULICS

KNOW BEFORE YOU GO

When it came to his studies with water, or Hydraulics, Leonardo once again proved far ahead of his time.

Understanding the nature of water was another of Leonardo's many passions. His drawings of water—based on many experiments—reflect his desire to determine its properties and laws of motion. As his understanding grew, he began to develop plans to redirect rivers or extend their paths for urban planning, military and commercial purposes. While these plans were never achieved during his lifetime, the path he laid out for a canal from Florence to the Mediterranean was the exact route eventually used to build a highway from that city to the sea.



Invention Spotlight



Diving Suit and Bell

Long before SCUBA, Leonardo invented several devices for breathing underwater. His diving suit consisted of a bomber jacket, trousers and a mask with glasses. Two cane tubes coming from a mask allowed the diver to draw surface air while submerged. The cane tubes were reinforced with steel rings to account for water pressure. A covered buoy on the surface protected the air tubes from interference and ensured they stayed open.



ACTIVITY 6: WATER AND AIR PRESSURE

AREA OF FOCUS

Physics • Marine Biology

Approach: Show an effect of air pressure on two sheets of paper and translate it to water pressure.



STEAM

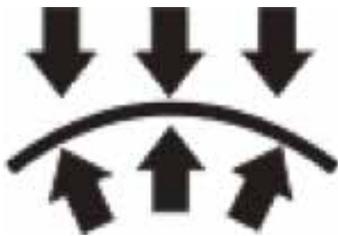


IN CLASS

Did You Know?

Leonardo was aware of the force of water pressure. He strengthened his divers' breathing tubes with steel rings to keep them from being crushed.

- 1 Lay a ruler on a table with about 3" (8 cm) hanging over the table's edge.
- 2 Lay a sheet of printer paper on the part of the ruler in direct contact with the table.
- 3 Press the paper against the table until it is flat as possible.
- 4 Press down on part of the ruler hanging over the edge.
- 5 Repeat the above steps except replace the printer paper with a large sheet of opened newspaper in the second step.



ACTIVITY 6: DEBRIEF

- ✗ The newspaper was much harder to lift than the printer paper. As the ruler lifted the printer paper, air rushed in under the rising paper and quickly allowed the air pressure to equalize on all sides of the paper. This meant that the weight of the air above the paper had no effect on the difficulty in lifting the paper.
- ✗ As the ruler lifted the newspaper, the edges of the newspaper remained in contact with the desk. Very little air was allowed to rush in and equalize the pressure on the bottom side of the newspaper. Since there was less air allowed below the paper, the pressure of the air above the paper made it much more difficult to lift.
- ✗ This is similar to water pressure—the deeper you go, the more water presses down on you from above. The weight of the water above creates added pressure.

Tips for Teachers

- ✓ We often speak of pressure in terms of atmospheres. One atmosphere is equal to the weight of the Earth's atmosphere at sea level, about 14.7 pounds per square inch. If you are at sea level, each square inch of your surface is subjected to a force of 14.7 pounds.
- ✓ In water, the pressure increases about one atmosphere (14.7 pounds per square inch) for every 33 feet (10 meters) of water depth. At the deepest part of all the Earth's oceans, Marianas Trench's (east of the Philippine Islands) depth is about 35,800 feet (7 miles/11 kilometers). The pressure of nearly 7 miles of water overhead is about 1080 atmospheres or 16,000 pound per square inch.



Da Vinci

THE EXHIBITION

TIME AND OPTICS

KNOW BEFORE YOU GO

It should be no surprise to us by now that Leonardo sought to capture the essence of two of our world's most intangible elements: light and time.

As a painter and visual artist, Leonardo had a highly intimate relationship with light. He recognized its importance in discovering the true nature of objects. He even went so far as to write a Treatise on Painting, which featured the 10 optical functions of the eye. In this Treatise on Painting, Leonardo also addresses the mathematics of perspective, geometry, and proportion.

Per his typical approach, Leonardo came to his theories on optics through experimentation. One example is his mirrored room, in which he placed a subject and was able to observe every side of it from multiple angles.

In his experiments in Optics, Leonardo may also have influenced the invention of the first telescope. He proposed that using lenses and mirrors to observe the night skies might produce planets and stars that are "much magnified" to the observer. When Hans Lippershey demonstrated his revolutionary telescope 100 years later, it utilized some of the principles that Leonardo had imagined.

While Leonardo did not invent the clock, which had been used in some form for centuries, he did improve it. His clock design included separate mechanisms to mark the minutes and hours, and included a dial to track the phases of the moon. In addition, his introduction of springs to replace weights driving the clock gears is considered a major step forward.

"HE WAS LIKE A MAN WHO AWOKE TOO EARLY IN THE DARKNESS, WHILE THE OTHERS WERE ALL STILL ASLEEP."

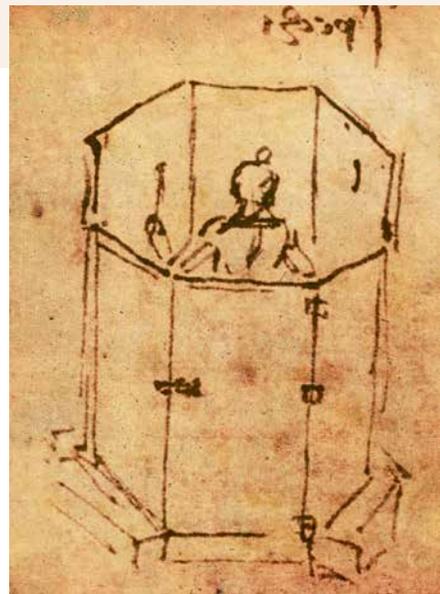
—SIGMUND FREUD,
LEONARDO DA VINCI (1916)

Invention Spotlight



Room of Mirrors

Leonardo used multiple angled mirrors to reveal multiple reflections as a way to study the human form in poses. This eight-sided enclosure allowed an individual to see their infinite reflection from all sides without moving. The device also allowed Leonardo to study the secrets of multiple reflections. During Leonardo's time, it was commonly believed that the human eye reflected light to see objects. Leonardo was the first to discover that the human eye actually captures light to allow vision.



ACTIVITY 7: ABOUT TIME

AREA OF FOCUS

Engineering • Mathematics

IDEAS, FUNDAMENTAL CONCEPTS

- ✗ Time is a concept of measurement developed by humans
- ✗ Time is also an indefinite progression of existence going from the past to the present to the future
- ✗ Materials passing from a wider space to a narrower space will naturally slow down
- ✗ Depending on their properties, some materials will move through a space more quickly than others

 STEAM

 IN CLASS

Did You Know?

Leonardo's designs for his clock also listed some of the materials with which he wanted it made, including diamonds.

- 1 Assemble materials
 - Two sets of bottles. Each set should match in size, but the two sets should be different from one another. Funnel-style necks are best for this activity (e.g.: water bottles, juice bottles, 2-liter bottles)
 - Sand
 - Tape, preferable heavier duty such as packing tape
 - Stop watch
- 2 Divide students into pairs
- 3 Ask students to add sand to one bottle from each of their two sets. The amount of sand can vary from partially full to $\frac{3}{4}$ full
- 4 Once the sand is placed in the bottle, instruct students to invert the second matching bottle and securely tape it to the first bottle so the necks are aligned
- 5 When the class is ready, ask students to estimate the amount of time it will take for the sand to pass from the full bottle to the empty one
- 6 Instruct students to turn their bottle over and measure with a stopwatch the amount of time the sand actually takes to pass from one bottle to the other

ACTIVITY 7: DEBRIEF

QUESTIONS:

- ✗ Ask each group how they came to their estimate for the time required for the sand to pass from one bottle to the other.
- ✗ Ask each group how close their estimate was to the actual time required.
- ✗ Ask the class how they might make the hour glass last for longer or shorter lengths of time.

Tips for Teachers

- ✓ The concept of time can be difficult for younger students to grasp, but older students will enjoy a more in-depth discussion.
- ✓ The hourglass is in many ways a sophisticated device. In use (most likely) from 350 AD in Egypt, it isn't known to have appeared in Europe until at least 400 years later.



Advanced: Additional Activity

- 1 Following their first activity, instruct students to create an hourglass that measures a specified amount of time and have them document their process of achieving this result.
- 2 Next, introduce a hole punch and heavy paper or card stock. Instruct each group to make their new hourglasses last longer by a certain percentage (10%, 20%, etc.). Students can only use the hole punch and card stock to make this happen—they cannot add or remove sand.
- 3 Ask students to try the same quantity of another material (salt, sugar, lentils) and determine the percentage difference that this new material is from sand when passing from one bottle to another.

ACTIVITY 8: MIRROR MAZE

AREA OF FOCUS

Physics

IDEAS, FUNDAMENTAL CONCEPTS

- ✗ **The reflection of light is the change in direction of a ray or wave caused by contact with the surface of certain mediums.**
- ✗ **The reflection of light by a mirror occurs according to the laws of reflection (angle of incidence and reflection).**
- ✗ **A periscope is a simple optical instrument that uses mirrors to indirectly observe any object or scene. A simple periscope is built of parallel mirrors placed at 45° angles.**

 STEAM

 IN CLASS

Did You Know?

Leonardo used mirrors and other optical devices frequently and in many creative ways.

- 1 Divide students into small groups with the goal of building a maze of mirrors
- 2 Collect materials:
 - Small and medium cardboard boxes
 - Scissors
 - Additional cardboard
 - Heavy duty tape
 - Flashlights
 - Several small mirrors
- 3 Instruct groups to build a maze inside of their chosen box with the additional pieces of cardboard
- 4 Next, have students place their mirrors at strategic locations and angles to aid in the reflection of light through their entire maze
- 5 Instruct students to work with their mirrors until one beam of light from a single flashlight can pass through the entire maze and out the other end. Give them a specified amount of time to complete their challenge.
- 6 Once time for building has expired, each group will present its maze to the class

ACTIVITY 8: DEBRIEF

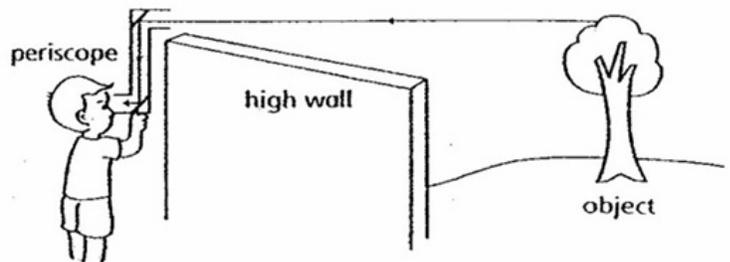
- ✗ What did you learn about communication while constructing your maze with your group?
- ✗ Why does a successful maze allow light and sight to pass through it?
- ✗ What questions did the activity answer for you about the properties of mirrors and the principles of reflection?
- ✗ How can this activity be applied to daily life?

Tips for Teachers

- ✓ Students' attempts to construct their mazes will be through a process of trial and error; encouraging them to keep adjusting the angles of their mirrors will help them grasp the principles of reflection.
- ✓ Encourage creativity in the making of the maze, including objects and colored cellophane.
- ✓ The act of attempting to create the maze is as important as succeeding.

Advanced: Additional Activity

- 1 As a follow-on lesson, instruct students to build a maze with more than one level requiring light to travel on more than one plane.



Da Vinci

THE EXHIBITION

MILITARY DESIGN

KNOW BEFORE YOU GO

In addition to his boundless thirst for knowledge in art and the sciences, Leonardo was also an extensive military thinker and strategist. Many of his inventions were created for Italian city-states as they prepared for, or engaged in, warfare.

Leonardo put his military mind to work for the city of Venice, the Sforzas of Milan, and César Borgia, the son of Pope Alexander the Sixth, who waged many battles throughout Northern Italy, and in defense of Florence.

While Leonardo only pursued his role as military engineer in order to support himself and his devotion to art, the military legacy he leaves us in his codices is impressive nonetheless. Equal parts ingenious and terrifying, Leonardo's drawings for the battlefield demonstrate that his prodigious intellect could grasp any subject. He also seems to have been quite inclined to militaristic designs as some of his earliest known sketches from his years as an apprentice have to do with implements of war.

It is unlikely that any of Leonardo's military machines, including those featured in the Exhibition, were built for contemporary warfare. Leonardo even seemed to discourage his war-minded patrons from using them, writing that new weapons like his could be as dangerous to their users as to the enemy.

"YOU DON'T AVOID A WAR, YOU MERELY POSTPONE IT TO YOUR OWN DISADVANTAGE."

—NICCOLO MACHIAVELLI

Invention Spotlight



The Catapult

Catapults were used in battles for many years before Leonardo's lifetime. To improve upon the catapult, he incorporated leaf springs to shoot faster and farther. Named for how it mimics the structure of leaves found in nature, the center of the leaf spring was thicker and harder than the existing elastic materials of the time, and the ends were thinner and easier to bend.



ACTIVITY 9: STEAM CANNON

AREA OF FOCUS

Physics • Chemistry

IDEAS, FUNDAMENTAL CONCEPTS

- ✗ The Principle of Inertia states that an object at rest remains at rest, while an object in motion stays in motion unless acted upon by an external force.
- ✗ Heating water in a closed system increases its pressure according to the formula $PV=NRT$

 STEAM

 IN CLASS

Did You Know?

Leonardo invented a Steam Cannon that fired projectiles using steam created from boiling water.

- 1 Assemble Materials:
 - Large can
 - Plastic bag
 - Heavy duty tape
 - Small, lightweight object, such as a golf whiffle ball
- 2 Cut a hole in the bottom of the can, about half the size of the can itself
- 3 Cover the top of the can with the plastic bag
- 4 Stretch the bag tightly, using tape to hold the plastic in place.
- 5 Pound on the plastic "drum", and feel the air puff out of the hole.
- 6 Place a small, lightweight object into the hole in the bottom of the can. Now, pound the plastic "drum" and attempt to launch the object out of the hole.
- 7 Experiment with various lightweight objects, such as a golf whiffle ball to see how far the cannon can launch it.

ACTIVITY 9: DEBRIEF

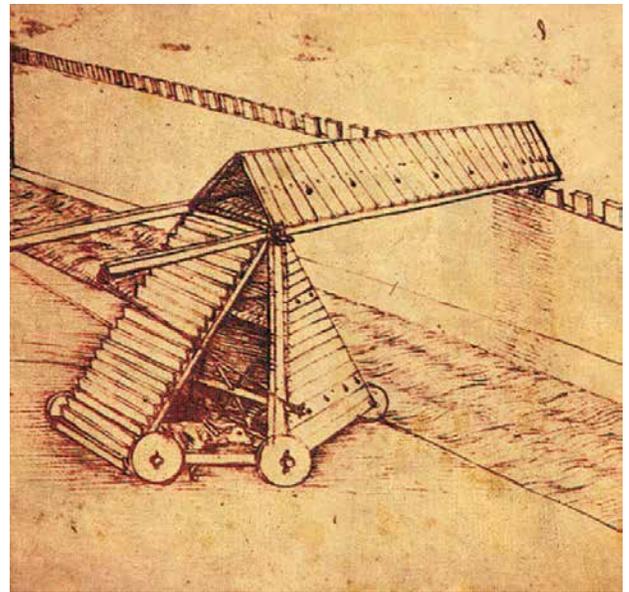
- ✗ What is the result of hitting the plastic bag “drum” cover? What do you think is happening?
- ✗ Why did certain cannons perform better than others?

Tips for Teachers

- ✓ The goal of the activity is not focused on the violence of military equipment. The physical and chemical principles Leonardo employed in creating his military devices can be translated into many machines we see around us today.
- ✓ Encourage students to try several different levels of tautness with their coverings.
- ✓ The advanced activity is an excellent opportunity to discuss the physical and chemical principles of the formula $PV=NRT$

Advanced: Additional Activity

- 1 Use a heat source, small boiler assemble, and a manual release valve in place of the plastic bag to generate additional power for the cannon and make a miniature replica version of Leonardo’s Steam Cannon. Be sure the boiler assembly has an emergency release valve to prevent dangerous overheating and perform this activity with one device that is controlled by the teacher.



Da Vinci

THE EXHIBITION

ANATOMY

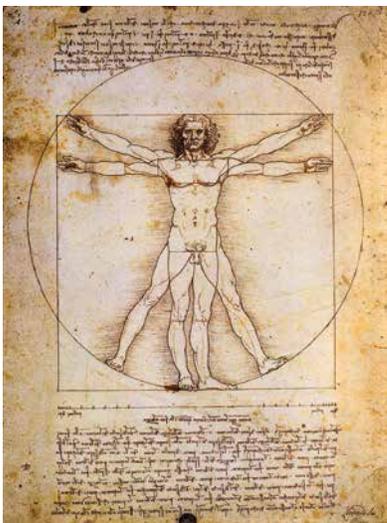
KNOW BEFORE YOU GO

Throughout his lifetime, Leonardo was fascinated with human anatomy. While this was a prevailing artistic interest of the time, Leonardo's work extended far beyond that of other amateur anatomists, and his work on the subject made a lasting contribution to medical science.

Originally studying anatomy for his artistic training, Leonardo made it an independent subject of research by the age of 40. For the next 20 years, he frequently worked at the dissection tables in Milan, followed by hospitals in Florence and Rome, dissecting an estimated 30 bodies in his lifetime.

Beginning with skeletal muscles, Leonardo then proceeded to study individual body parts and their mechanical activity. Discovering more as he went, he carried on to study the internal organs, the brain, heart, and lungs.

Leonardo's findings were recorded in his now-famous anatomical drawings. While he never intended for his anatomical work to be published in his lifetime, there is no question that Leonardo wanted to share them with the world after his death. He implored his apprentices to publish his notes on anatomy in the margins of several of his anatomical drawings. These works have been a boon to medical science and laid the groundwork for modern scientific illustration.



Invention Spotlight



Vitruvian Man

One of the most popular images in the world, Vitruvian Man was created by Leonardo da Vinci circa 1490. It is accompanied by notes based on the work of Vitruvius, the Roman architect from the first century B.C. Leonardo's drawing shows that the height of the perfectly proportioned man is eight times the length of his head. The drawing also explains that the height of man is exactly equal to the length of his outstretched arms. For the scholars of the early 1400s, these ratios and proportions became a key in explaining the structure of the entire universe. The Vitruvian Man exemplifies Leonardo's study of the body throughout his life and career. In this, as well as all of his works, one plainly sees Leonardo's rational approach to understanding the human body and how it interacts with its environment.

ACTIVITY 10: MY SELF PORTRAIT

AREA OF FOCUS

Visual Art

IDEAS, FUNDAMENTAL CONCEPTS

- ✗ Visual Art is a skill we all possess that is honed through observation and practice.
- ✗ Identity is the set of features that characterize an individual. The construction of identity and self-concept is an ongoing process throughout life. While we often compare ourselves to others, we benefit from the knowledge that we are unique.
- ✗ A portrait is a description (verbal or graphic) of the figure or character, that is, the physical or moral qualities of a person. When the author is the same as the person being described or drawn it is called a self-portrait.

 STEAM

 IN CLASS

Did You Know?

Leonardo drew and painted himself several times in his works. In order to achieve this, he often used a mirror.

- 1 Instruct students to draw a self-portrait using a mirror or a picture.
- 2 Once the drawing is complete have students write their names, ages and qualities they like about themselves on the drawing itself.
- 3 Have students join together in groups to observe and comment on the completed drawings.

ACTIVITY 10: DEBRIEF

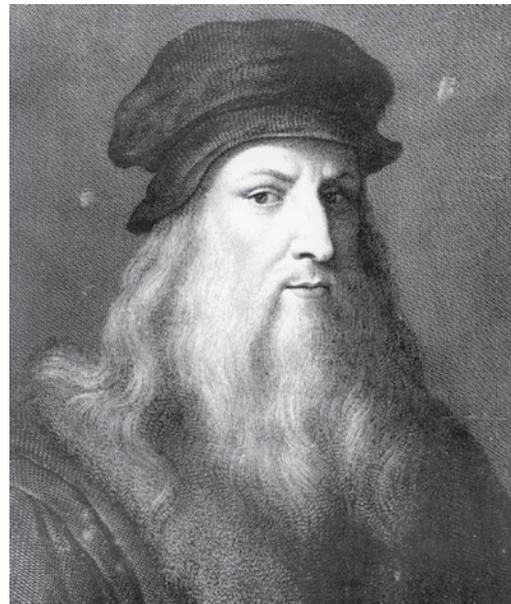
- ✗ Did the process of drawing your portrait help you understand yourself better?
- ✗ Did drawing a classmate's portrait give you a better understanding of him or her?

Tips for Teachers

- ✓ This theme allows you to explore differences, problems of acceptance or any discrimination in the student group.
- ✓ The image can be enriched if students are encouraged to include aspects beyond physical elements, such as emotions and outlook on life.

Advanced: Additional Activity

- 1 The self-portrait offers other opportunities to explore with the students:
 - The relationships in the classroom:
"Make a portrait of my friends"
 - Relationships and emotions at home:
"Make a portrait of my family"
 - Development and growth: "As I look through pictures in the family album, how do I see myself now vs then? How have I changed? Who do I look like?"
- 2 Change the self portraits using clippings of cartoons and other images. Eg. "This is how I would look with big ears." Encourage students to redraw their portraits using new characteristics.



ACTIVITY 11: DRAW YOUR OWN VITRUVIAN MAN

AREA OF FOCUS

Mathematics

IDEAS, FUNDAMENTAL CONCEPTS

- ✗ **Anatomical drawings of Leonardo.**
- ✗ **Vitruvius was a Roman architect and engineer whose studies inspired Leonardo's drawing. The Vitruvian Man is a pen and ink drawing not much bigger than a sheet of paper. It is accompanied by anatomical notes like: "The height of a man is four forearms," "the height of the ear is one-third the length of the face," etc.**
- ✗ **In drawing his Vitruvian Man, Leonardo da Vinci used certain proportions, including the fact that the length of the outstretched arms is equal to the figure's height, and the entire human body is eight times the length of the head.**



STEAM



IN CLASS

Did You Know?

The famous Vitruvian Man drawn by Leonardo represents the "Perfect" measures of the human form.

- 1 **CHALLENGE:** Organize the students into small groups and have them reproduce the drawing "The Vitruvian Man" by Leonardo Da Vinci. Use markers and paper of different sizes available – from letter size to larger sheets or rolls. Encourage students to choose the size of paper they feel will best allow them to complete their task.
- 2 Once completed, display the various Vitruvian Man drawings around the class and "invite" the students to an art gallery style reception.

ACTIVITY 11: DEBRIEF

The exercise of drawing The Vitruvian Man encourages the students to solve various problems using mathematical and geometrical proportions.

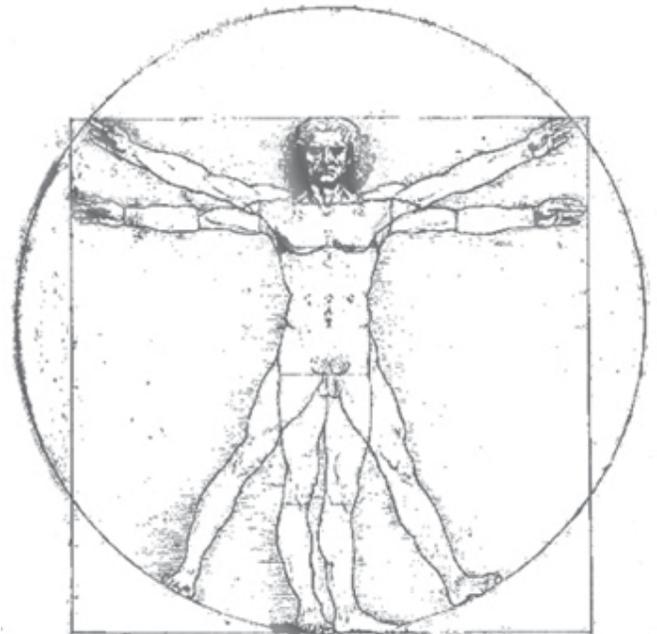
- ✗ How did each group approach the assignment?
- ✗ Did they use their own bodies as a reference?
- ✗ How did they respond to measurements or proportions that were not in keeping with the illustration?
- ✗ Was scale used in drawing the image on smaller sheets of paper?
- ✗ How effective were the circle and the square in acting as guides?
- ✗ How did the group's communication aid or challenge the result?

Advanced: Additional Activity

- 1 Ask older students to draw the human form from memory and only with the proportional rules used by da Vinci.
- 2 Explore the "Golden Ratio" as it applies to the human form and other structures in the natural and human-made world.

Tips for Teachers

- ✓ This exercise allows the students to develop a more detailed understanding of how proportions can be applied to resolve complicated drawing and design challenges.



Da Vinci

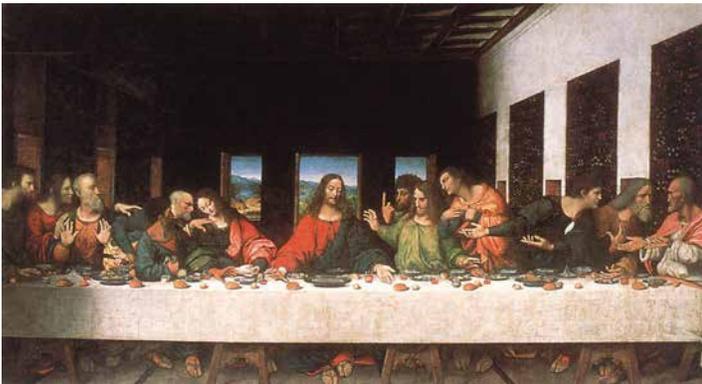
THE EXHIBITION

PAINTINGS

KNOW BEFORE YOU GO

Despite all his other interests, painting was Leonardo's first love. In his *Treatise on Painting*, he proposed that painting was a science, thus raising it from the mechanical arts to the realm of liberal arts.

Leonardo was a notoriously slow painter. Upon his death, he left many works unfinished and had completed only 15. But, those which he did complete demonstrate an intimate knowledge of the human form, a groundbreaking approach to narrative and a mastery of materials and techniques that had not been seen before his time. This gallery presents each of Leonardo's paintings as faithful re-creations of the original, true in color and size, offering you a close encounter with these masterpieces.



**"THE NATURAL DESIRE OF GOOD MEN
IS KNOWLEDGE,"**

—LEONARDO DA VINCI

FEATURED PAINTING



Last Supper

One of the Exhibition's most memorable works is the *Last Supper*. It is presented here in its exact size and as it appears now, after recent careful restoration. Depicting one of the most important moments in the Christian faith—the final gathering of Jesus and his disciples before his crucifixion the following day, the *Last Supper* has become one of the most important and famous paintings in the history of art.

Leonardo's genius in this painting begins with his narrative approach. Instead of depicting the scene as one harmonious gathering, Leonardo creates a chaotic scene following Jesus' proclamation that one of those gathered will betray him. The composition depicts the apostles huddled in separate groups, with a multitude of gestures and facial expressions, discussing what they have heard—and denying their betrayal. Only Jesus, in full acceptance of God's plan, sits silently at peace. Judas also sits silently—tormented by his thoughts.

The *Last Supper* has been an inspiration to generations of painters—including Rembrandt—and is a high mark in Renaissance art, having rightfully been placed near the top of the list of all Western art ever created.

ACTIVITY 12: MIX YOUR OWN OIL PAINTS (pg 1 of 2)

AREA OF FOCUS

Arts • Chemistry

IDEAS, FUNDAMENTAL CONCEPTS

- ✗ Leonardo mixed many of his paints by hand, with surprisingly different results. The paints used for the Last Supper, for example, began to separate from the wall on which they were painted during Leonardo's lifetime
- ✗ Paint is any liquid or liquefiable composition which, after application in a thin layer, is converted to a solid film.
- ✗ Pigments are water-and-oil insoluble natural and synthetic products that impart color to materials.
- ✗ Vehicle is the viscous solution in which the pigment particles are suspended.

 STEAM

 IN CLASS

Did You Know?

Leonardo da Vinci mixed his own paints by hand, sometimes saving up money for long periods to be able to afford more expensive pigments.

1 Gather your materials

➤ Pigment and oil

Non-toxic and non glass pigments and oils may be purchased at your local art store

Turpentine

Nitrile gloves

Tubes or jars

Mortar and pestle for non-glass pigments

Filler (extender)

Long, thin spatula

Paper towels or painters' rags

(continued on next page)

ACTIVITY 12: MIX YOUR OWN OIL PAINTS (pg 2 of 2)

AREA OF FOCUS

Arts • Chemistry

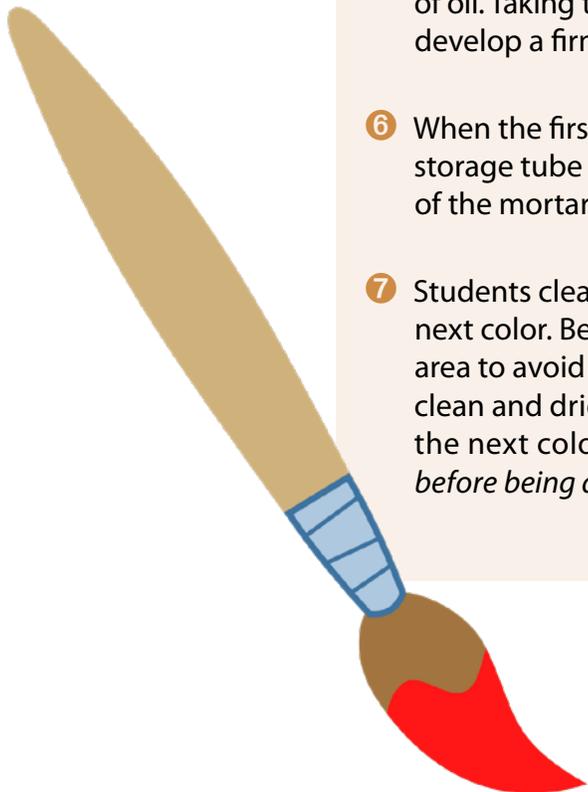


STEAM



IN CLASS

- 2 Divide the class into groups, this will allow for group communication skills while keeping material costs down.
- 3 Instruct the group to create three small batches of paint in their chosen color.
- 4 Next, instruct the students to place the pre-portioned amount of their first pigment (about 4 ounces dry measure) into their mortar and add a slight amount of oil.
- 5 Students then start grinding with the pestle while observing the absorption of oil. Taking turns at the pestle, the groups should slowly add oil until they develop a firm, colorful paste.
- 6 When the first paint has reached the desired consistency, move it to a storage tube or jar using the spatula to get as much paint as possible out of the mortar.
- 7 Students clean the mortar and pestle using turpentine before mixing the next color. Be sure they wear Nitrile gloves and clean in a well-ventilated area to avoid fumes from the turpentine. The mortar should be completely clean and dried with newspaper and painters' rags before moving on to the next color. *All painters' rags and newspaper must be soaked in water before being disposed of in a metal bin.*



ACTIVITY 12: DEBRIEF

Work with students to help them learn the following:

- ✗ Leonardo mixed many of his paints by hand, with surprisingly different results. The paints used for the Last Supper, for example, began to separate from the wall on which they were painted during Leonardo's lifetime
- ✗ Paint is any liquid or liquefiable composition which, after application in a thin layer, is converted to a solid film.
- ✗ Pigments are water and oil insoluble natural and synthetic products that impart color to materials.
- ✗ Vehicle is the combination viscous solution in which the pigment particles are suspended.



Tips for Teachers

- ✓ If a student's mixture seems too liquid and no pigment remains to absorb the excess oil, mix in an extender (such as marble dust) to help stabilize the paint. A small amount of extender will not change the color.
 - 1 For storage, tubes are most practical, since the surface of the color cannot dry out like in jars.

Advanced: Additional Activity

- 1 Having created the paints, instruct each group to agree upon a painting and create it collaboratively.
- 2 Ask students to research local fine art painters and select one or more to gift their paints to. Ask the painter to give a tour of his or her studio in exchange.

Da Vinci

THE EXHIBITION

CONCLUSION

Leonardo's thirst for knowledge, his tireless pursuit of his interests, and his ability to master any subject he encountered truly earns him the title of genius. But, perhaps more than that, his life and work captures the essence of the Renaissance spirit—the spirit of a modern "rebirth."

In our world, there is renewed interest in the search for knowledge and meaning. There is a desire to seek different solutions, and to look far into the future and make a difference for that future.

This is exactly what Leonardo did. He sought knowledge in every encounter and devoted his life to that pursuit. He created lasting works that continue to amaze us, and instruct us, today; and he left a legacy that shows us we can do the same.

Above all else, this Exhibition celebrates the spirit of Leonardo—the spirit of the Renaissance—the belief that one's ideas, one's dreams, can take flight. This is Leonardo's greatest and most lasting gift to us. And we welcome you to gather it by the handful.

**"THE ENTIRE HISTORY OF PORTRAITURE
DEPENDS ON THE MONA LISA"**

—NICCOLO MACHIAVELLI

