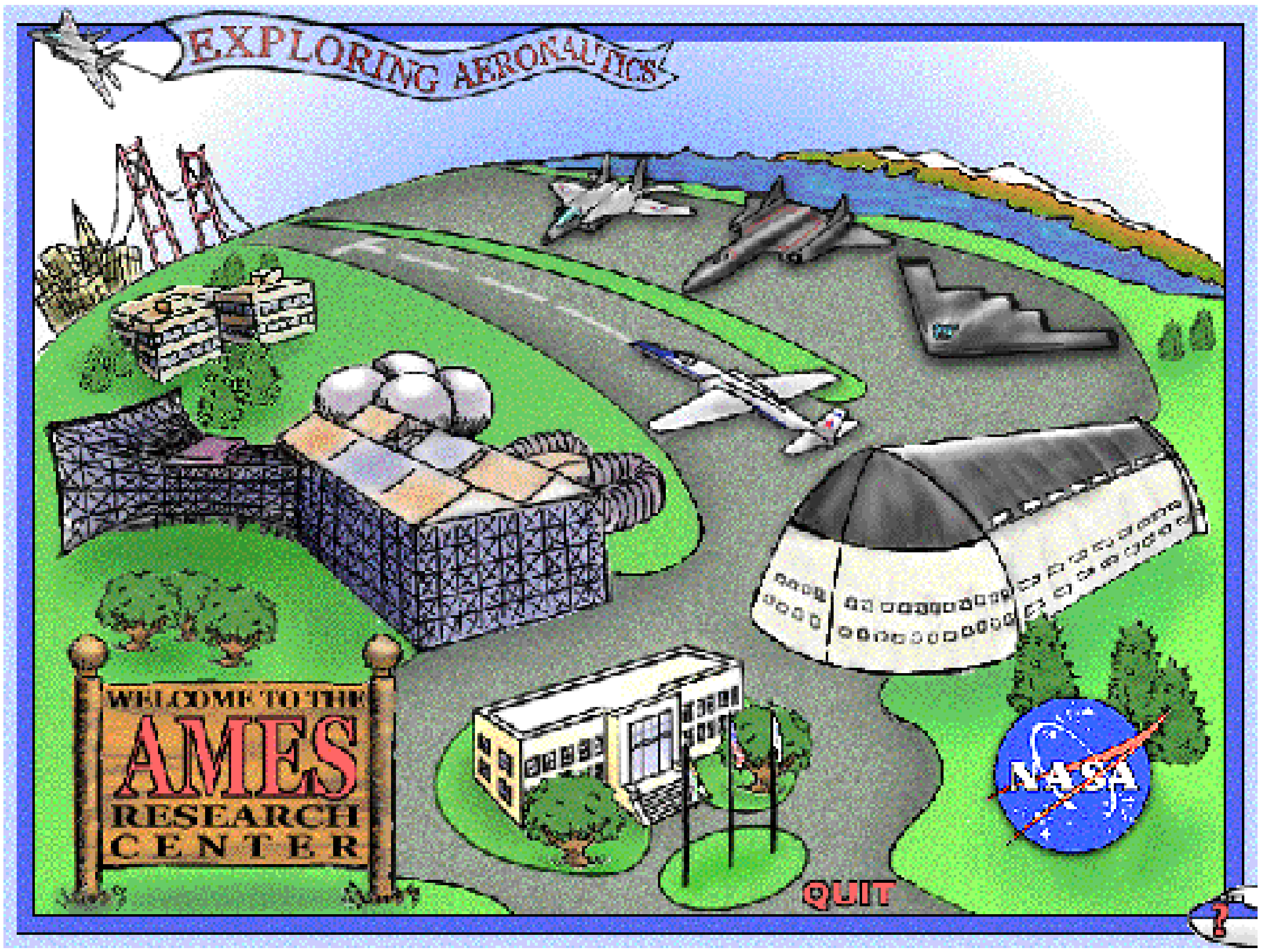
# Aircraft Types

## A Supplemental Aeronautics Guide




To accompany EXPLORING AERONAUTICS CD-ROM
and Supplemental Unit *Integrating with Aeronautics*
A curriculum in Aeronautics for the 5th through 8th
grade level

aero-nau-tics \-iks\ *n pl but sing in constr* **1**: a science of dealing with the operation of aircraft **2**: the art or science of flight

# Aircraft Types

## A Supplemental Aeronautics Guide

*produced by the*

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# Table of Contents

## Aircraft Types

## Aircraft Types: Supplemental Literature Guide

# Program Goals

1. To stimulate and increase student awareness of, interest in and achievement in science. Specifically, to stir young people's imagination and fuel their enthusiasm for the study of science, mathematics and technology using the fundamental themes of aeronautics.

2. To engage students in learning activities that increase their understanding of aeronautics-related concepts.

# Goals and Objectives

## Goal 1

To use the Scientific Method to answer a question or solve a problem.

### *Objectives*

The Learner will be able to:

- recite the steps of the scientific method;
- develop each part of the scientific method:
  - identify a question,
  - identify a hypothesis,
  - construct an experiment;
- list procedures which will complete experiment:
  - list materials needed to perform experiment,
  - perform the experiment,
  - record results of the experiment,
  - write a conclusion;
- observe and accurately record what has been observed;
- identify a new question brought about by the experiment.

## Goal 2

To understand that there are different types of aircraft which have been designed to fly for specific purposes and in specific ways.

### *Objectives*

The Learner will be able to:

- identify and describe each different type of aircraft;
- compare aircraft types based upon their flight characteristics;
- compare aircraft types based upon their structure;
- compare aircraft types based upon how each generates lift;
- compare each aircraft type based upon how each is controlled;
- define the speed of sound;
- describe the phenomenon of flight at the speed of sound;
- identify and describe how sound travels in waves.

# Goals and Objectives – *continued*

## ***Goal 3***

To understand how lift is generated for different types of aircraft.

### ***Objectives***

The Learner will be able to:

- name and define the parts of an aircraft that generate lift.

# Correlation to the National Science Education Content Standards

## Unifying Concepts and Processes

- Systems, order and organization
- Evidence, models and explanation
- Form and Function

## Content Standard A

Students should develop abilities necessary to do scientific inquiry.

- Identify questions that can be answered through scientific investigations.

Students should design and conduct a scientific investigation.

- Use appropriate tools and techniques to gather, analyze, and interpret data.
- Develop descriptions, explanations, predictions, and models using evidence.
- Think critically and logically to make the relationships between evidence and explanations.
- Recognize and analyze alternative explanations and predictions.
- Communicate scientific procedures and explanations.

Students should develop understandings about scientific inquiry.

- Current scientific knowledge and understanding guide scientific investigations.
- Technology used to gather data enhances accuracy and allows scientists to analyze and quantify results of investigation.
- Scientific explanations emphasize evidence, have logically consistent arguments, and use scientific principles, models, and theories.
- Scientific investigations sometimes result in new ideas and phenomena for study....

## Content Standard B: Physical Science

All students should develop an understanding of motions and forces.

- The motion of an object can be described by its position, direction of motion, and speed. That motion can be measured and represented on a graph.
- An object that is not being subjected to a force will continue to move at a constant speed and in a straight line.
- If more than one force acts on an object along a straight line, then the forces will reinforce or cancel one another, depending on their direction and magnitude. Unbalanced forces will cause changes in the speed or direction of an object's motion.

## Content Standard E: Science and Technology

All students should develop understandings about science and technology.

- Many different people in different cultures have made and continue to make contributions to science and technology.
- Science and technology are reciprocal.
- Perfectly designed solutions do not exist.
- Technological designs have restraints.
- Technological solutions have intended benefits and unintended consequences. Some consequences can be predicted, others cannot.

## Content Standard F: Science in Personal and Social Perspectives

All students should develop an understanding of science and technology in society.

- Science influences society through its knowledge and world view.
- Societal challenges often inspire questions for scientific research....
- Technology influences society through its products and processes.
- Science and technology have advanced through contributions of many different people, in different cultures, at different times in history.
- Scientists and engineers work in many different settings....

## Content Standard G: History and Nature of Science

All students should develop understanding of science as a human endeavor.

- Women and men of various social and ethnic backgrounds...engage in the activities of science, engineering.... Some scientists work in teams, and some work alone, but all communicate extensively with others.
- Science requires different abilities, depending on such factors as the field of study and type of inquiry.

All students should develop understanding of the Nature of Science.

- Scientists formulate and test their explanations of nature using observation, experiments, and theoretical and mathematical models.
- It is part of scientific inquiry to evaluate the results of scientific investigations, experiments, observations, theoretical models, and the explanations proposed by other scientists.

# Daily Lesson Planner

## Day 1

- Hand out copies of the *Aircraft Types* information sheets and read and discuss the information contained therein.
- Use the student note taking guides and assign individual or small group note taking on each aircraft type.

## Day 2

- If students have not previously used a comparison chart, go through the process of making a comparison using two different aircraft types of your choice.
- Student Activity Sheet: Make Your Own Comparison: Fixed-Wing / Rotating Wing.

## Day 3

- Choose one or more activities listed under the Additional Student Activities/ Projects section from the Aircraft Types section.
- Student Activity Sheet: Make Your Own Comparison: Airships/Fixed-Wing.

## Day 4

- Review procedure for the experiment "Rotating-Wing Craft."
- Hand out procedure card and lab sheets.
- Review results with the class and model a well-written hypothesis and conclusion.
- Student Activity Sheet: Make Your Own Comparison: Gliders/Airships.

## Day 5

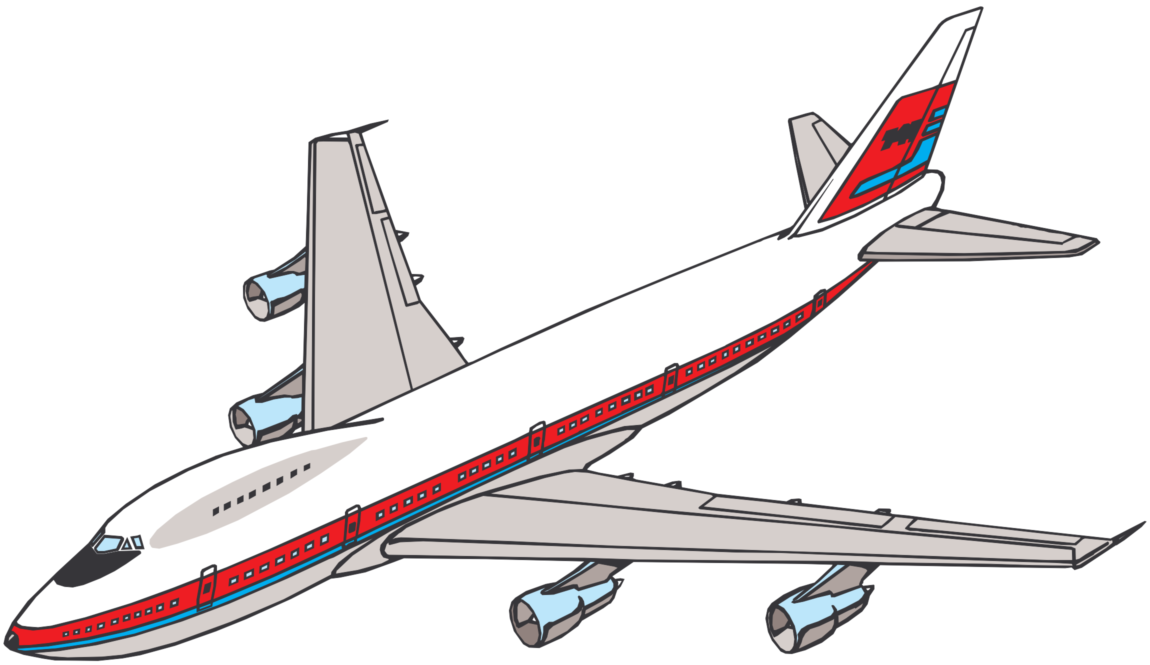
- Review procedure for the experiment "Hot Air Buoyancy."
- Hand out procedure card and lab sheets.
- Review results with the class and model a well-written hypothesis and conclusion.
- Student Activity Sheet: Make Your Own Comparison: Balloons/Gliders.

## Day 6

- Choose another activity from the Additional Student Activities/Projects section.
- Student Activity Sheet: Make Your Own Comparison: Kites/Balloons.

# Teacher Readings

## Aircraft Types



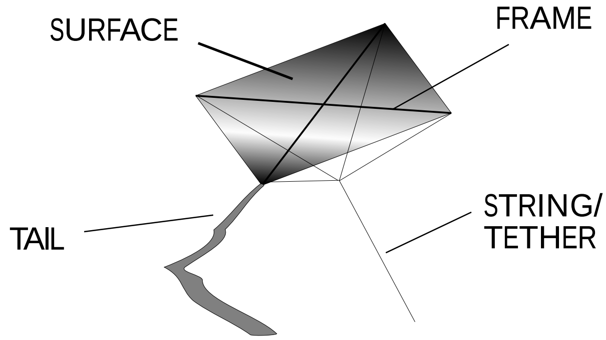
# Teacher Reading
## Kites

## Introductory History

The true origins of kites are lost in history. The earliest records of kite flying date back to China in the fourth century B.C. There is also evidence that the Chinese used kites to raise humans aloft to check on the position in the battlefield. Today, kites are used in activities ranging from recreational and sports events to lifting scientific instruments.

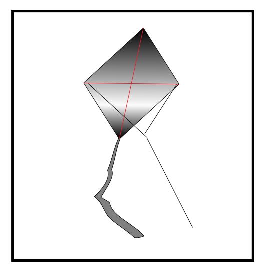
## Basic Structure

- **Frame**
- **Surface**
- **String or Tether**
- **Tail**

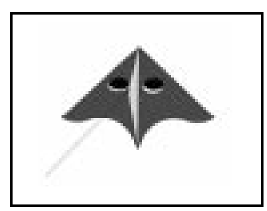



## Different Types

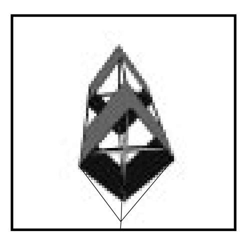
- **Diamond**
  Flies well in light to moderate winds, but requires a tail for stability.



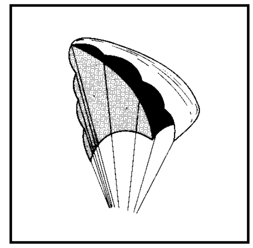
- **Delta-Shaped**
  Flies well in all winds, does not require a tail.



- **Box-Shaped**
  These kites have high lift and do not require tails.



- **Parafoils**
  These are part-parachute and part-airfoil and produce more lift than box kites. They do not have a frame and can be folded.



## How they stay up in the air

- A kite operates by using the action-reaction principle. As the kite is pulled through the atmosphere, moving air pushes against the kite's surface creating a force that is equal and opposite to that of the pull. This reaction force generates lift, keeping the kite in the air. It is then balanced by drag.

## How the four forces work on them

- Lift is created by moving air or wind, pushing against the kite and reacting against the pull or force of the string.
- Thrust or forward propulsion is provided by the pull of a string or tether.
- Weight is due to gravity.
- Drag is due to air friction.

## How they are controlled

- As the kite is moved face first into the wind, it is controlled by a person pulling on its tether or string. One or more control strings can be used to perform simple to complex maneuvers with the kite.

# Teacher Reading
## Balloons

### Introductory History

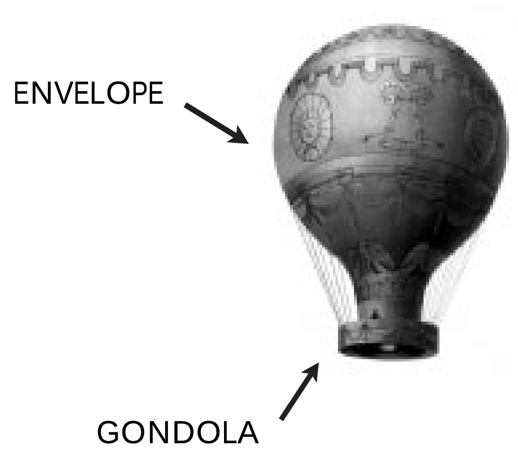
The first widely-recorded, public demonstration of a balloon took place on June 5, 1783. On this date, two brothers, Joseph and Jacques Montgolfier, flew a balloon 105 feet in circumference. Later, in Annony, France, they launched their balloon to an altitude of 6,000 feet. This balloon (named for the paper oblong bag or *balon* used in their early experiments) made use of heated air to displace the heavier, surrounding air. This allowed the balloon to float within the atmosphere, because hot air rises. Hot air is less dense, therefore it is buoyant.

A few months later, a hydrogen-filled balloon designed by Professor Jacques Alexander Charles was successfully launched in Paris. By the end of that year, both types of balloons were being used to carry passengers.

The invention of the balloon started a new period of explorations. The early "aeronauts" competed with one another to travel higher and farther. Today, balloons are used mostly for sports and recreational purposes. They are also used for high-altitude scientific research and meteorological research (some balloons are able to reach altitudes of 34 miles).

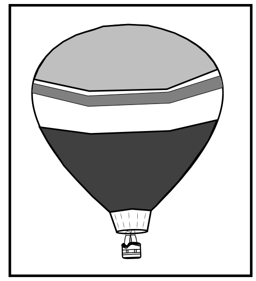
### Basic Structure

- **Envelope**
- **Payload, Basket or Gondola**



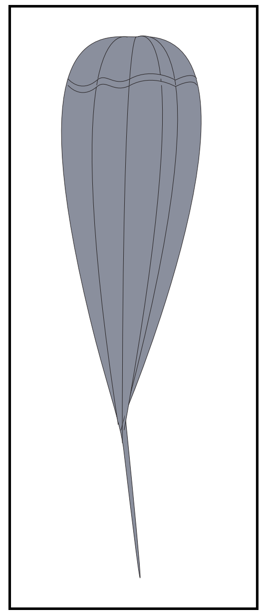
## Different Types

- **Hot - Air Balloon**
  These balloons are used mainly for sport and recreational uses. They use air heated by a burner to provide a lifting force to carry the basket or gondola that holds passengers. To descend they release the hot air from the envelope, or wait for it to cool.



- **Meteorological Balloon**
  These balloons operate at altitudes up to 25 miles (40 km) carrying lightweight instruments. They are used to measure such atmospheric conditions as pressure, temperature, humidity and wind velocity. They are constructed of rubber and filled with either hydrogen or helium.

- **Zero - Pressure Balloon**
  These balloons float at altitudes of 100,000 to 140,000 feet (30 to 42 km) carrying different kinds of scientific instruments. They are made of a thin material called polyethylene. They are shaped like an upside-down teardrop at launch. The gas inside expands as the balloon climbs into the less-dense upper atmosphere.



## How they stay up in the air

A balloon traps lighter-than-air gases (helium, hydrogen, hot air) in a container or envelope. These gases then displace the heavier surrounding air, creating an upthrust or buoyancy force that lifts the envelope and its payload.

## How the four forces work on them

- Lift is produced by lighter-than-air gases contained in the envelope.
- Weight is due to gravity.
- Drag is due to air. Air applies pressure on the balloon and there is also friction between air and the surface of the balloon.

## How they are controlled

A balloon has no means of propulsion to move it in a specific direction. It simply drifts with the wind. The aeronaut can only control the upward and downward movement of the balloon by adding hot air into the balloon or by releasing the hot air out of the envelope. An aeronaut can also drop sandbags. This will enable the balloon to climb very quickly in an emergency.

# Teacher Reading
## Gliders

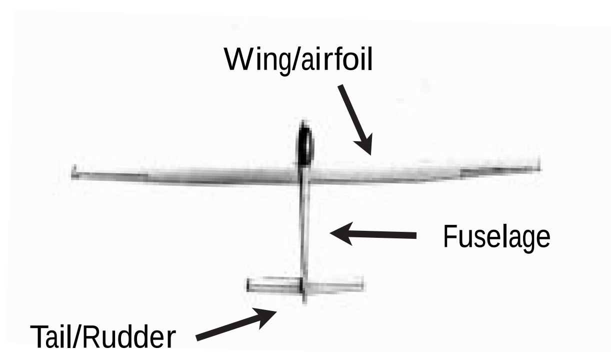
## Introductory History

Gliders are winged aircraft without a propulsion (power) system of their own. They make use of external forces to provide thrust at the beginning of the flight. This is done by connecting a line from the glider to a powered airplane that pulls it up into the air and then releases it. Once airborne, gliders fly like any other airplane. However, they can only gain altitude by riding wind currents that are moving upward, such as winds blowing off of hills and rising convection currents (thermals) in the atmosphere. Gliders are able to perform soaring maneuvers using the lift generated by their wings until eventually they are pulled to Earth by the force of gravity. Otto Lillienthal of Germany performed some of the earliest known flights of gliders. He made hundreds of flights and tested several designs in the late 1800s.

Lillienthal

## Basic Structure

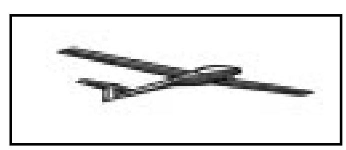
- **Fuselage**
- **Airfoil or Wing**
- **Tail and Rudder**

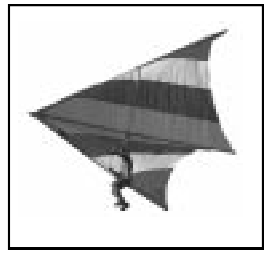



## Different Types

- **Sailplane**

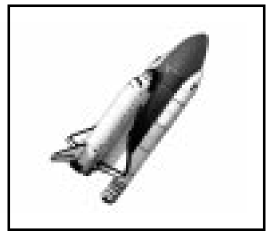
Sailplanes are airplanes without engines that have long narrow wings and very small fuselages (typically the size to carry one or two people). The small fuselage reduces weight and drag. They have risen to altitudes of 46,000 feet (14,000 m) and flown distances of 500 miles (800 km). Sailplanes are launched by using cars or powered aircraft to tow them, or by using winches to catapult them.





- **Hang (Flexible-Wing) Glider**
  Hang gliders achieve lift the same way as all other fixed-wing aircraft do. They use A-shaped flexible wings which are braced with tubing. These gliders have flown over 100 miles (160 km) and 20,000 feet (6000m). They are typically launched on foot from cliffs, hills and other high-altitude locations.

- **Space Shuttle**
  The Space Shuttle acts like a huge glider. When the Shuttle returns to Earth after a mission, it uses its entire body and stubby, A-shaped wings to slow its descent and glide to a soft landing.



## How they stay up in the air

A lifting force is generated by its wings using an airfoil shape. The airfoil causes air traveling over its top surface to move much faster than the air traveling underneath it. This difference in speed produces a corresponding difference in pressure, which results in the wing being pulled upward.

## How the four forces work on them

- Lift is created by the airfoils or wings.
- A glider is able to use control surfaces on its airfoils to control its direction of flight.
- Thrust for launch is provided by forces external to the glider such as cars or aircraft.
- Weight is due to gravity.
- Drag is due to air friction.

## How they are controlled

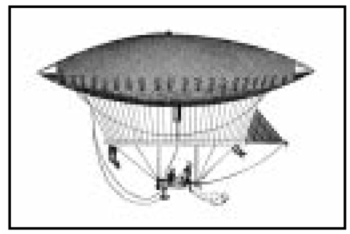
- Sailplanes use movable panels on the wing along with the tail and rudder to change the direction of air moving about these airfoils. This changes the direction of the aircraft. (See Fixed Wing Aircraft, page 19)
- For hang gliders, the aircraft is controlled by the pilot usually shifting his/her weight in the direction he/she wants to move.

# Teacher Reading
## Airships

### Introductory History

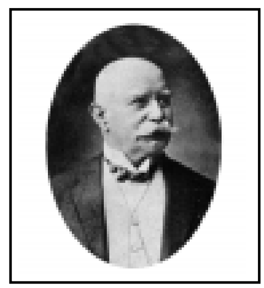
Soon after the balloon's invention, it was used to carry passengers or "aeronauts." However, these early pioneers of aviation discovered that the balloon was limited as a practical vehicle for transportation. Balloons cannot be steered through the air, but instead must follow the pathways of the winds. They also have no controllable source of propulsion--they depend once again on the wind.

After much effort and many false starts, the first steerable airship or dirigible was launched on September 24, 1852 in Paris. This airship, designed by Henri Giffard, was 144 feet long and 40 feet in diameter. It used a small steam engine to drive three, large propeller blades and reached a speed of 6 mph. Giffard also used a triangular sail to serve as a rudder and improved the ability to steer the aircraft.



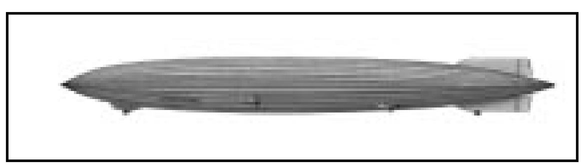
Giffard's Balloon

Although the airships that followed the *Giffard* improved in their navigation capabilities, they could not operate in strong winds because their engines were not powerful enough to give sufficient propulsion for those conditions. These difficulties would not be overcome until the creation of the rigid airships by Count Ferdinand von Zeppelin in 1900. These airships combined lighter, more powerful engines with a rigid frame (that used separate gas containers) to get controllable flight at faster speeds.



Von Zeppelin

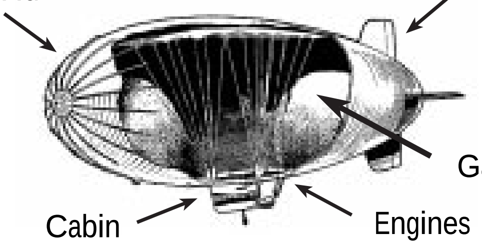
These airships enjoyed a heyday in the 1930s when they were used by the Zeppelin Company of Germany to ferry passengers across the Atlantic. Their use came to a close in the early 1960s when the U.S. Navy decommissioned the last of its airship fleet.



Hindenburg

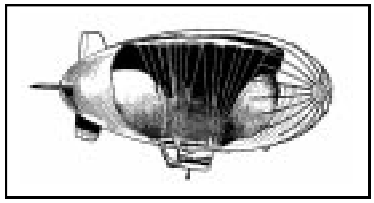
## Basic Structure

- **Envelope/Hull:** a large envelope with air ballonets or a covered rigid framework with gas cells
- **Engines**
- **Tail Fins and Rudder**
- **Cabin**

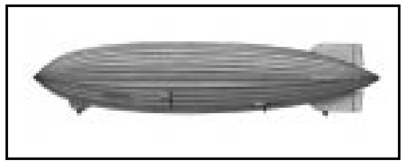



## Different Types

- **Non-Rigid Airship or Blimp**
  Best known for advertising or flying over a sports event, these airships are usually made up of a flexible envelope that is filled with a slightly pressurized, lighter-than-air gas.The altitude is controlled by expanding or shrinking air compartments (ballonets) inside that cause the airship to rise and fall by changing the pressure in the envelope.



- **Rigid**
  Best known for the *Hindenburg* and other vehicles designed by the Zeppelin Company, these airships had a covered, metal framework.These frameworks contained a number of gas cells that can expand and shrink to control how high the airship goes.



## How they stay up in the air

- As with balloons, lighter-than-air gases in the envelope displace the surrounding air, creating an upthrust or lift called the buoyant force.

## How the four forces work on them

- Lift is provided by lighter-than-air gases.
- Thrust is provided by engines.
- Weight is due to gravity.
- Drag is due to air friction.

## How they are controlled

- These vehicles are controlled through the use of control panels on the tail and rudder. The engines can also be rotated to point in different directions, thus changing the vehicle's course. They climb or descend by changing their buoyancy.

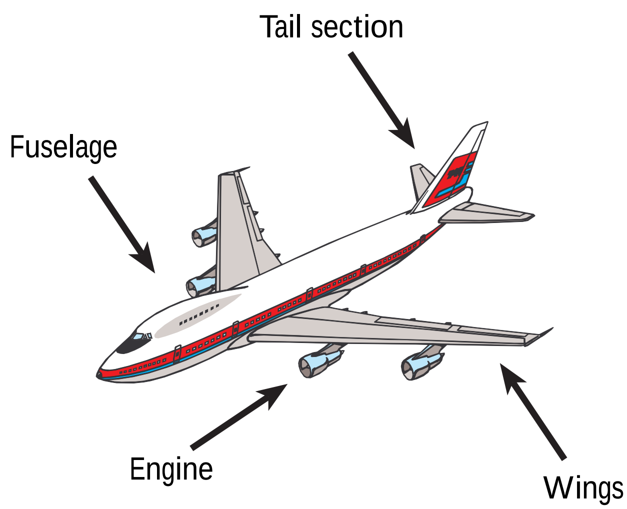
# Teacher Reading
## Fixed-Wing Aircraft

## Introductory History

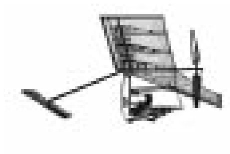
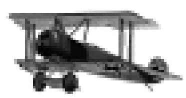
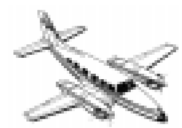
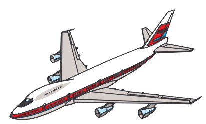
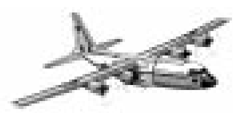
Although many European and American inventors attempted powered flight, the Wright Brothers are given credit for being the first. During those early days, trial and error was the method for trying out new ideas in flight. Later, more engineers and scientists began closely observing the movement of air and experimenting in wind tunnels. The shape of the airfoil and the fuselage took on an improved form that created greater lift and less drag. As technology improved, so did the ways of studying airflow around the aircraft through the use of computers. Improvements in control surfaces and the covering of aircraft made them safer and more efficient. Improvement in engine design with stronger wing and fuselage structure made it possible to safely increase aircraft speed.

## Basic Structure

- **Fuselage**
- **Wings**
- **Tail Section**
- **Engine**



## Different Types

- **Pedal-Powered Plane** 
- **Biplanes** 
- **Light Aircraft** 
- **Airliner** 
- **Air Cargo Aircraft** 
- **Jet Fighter** 
- **Sailplane** 

## How they stay up in the air

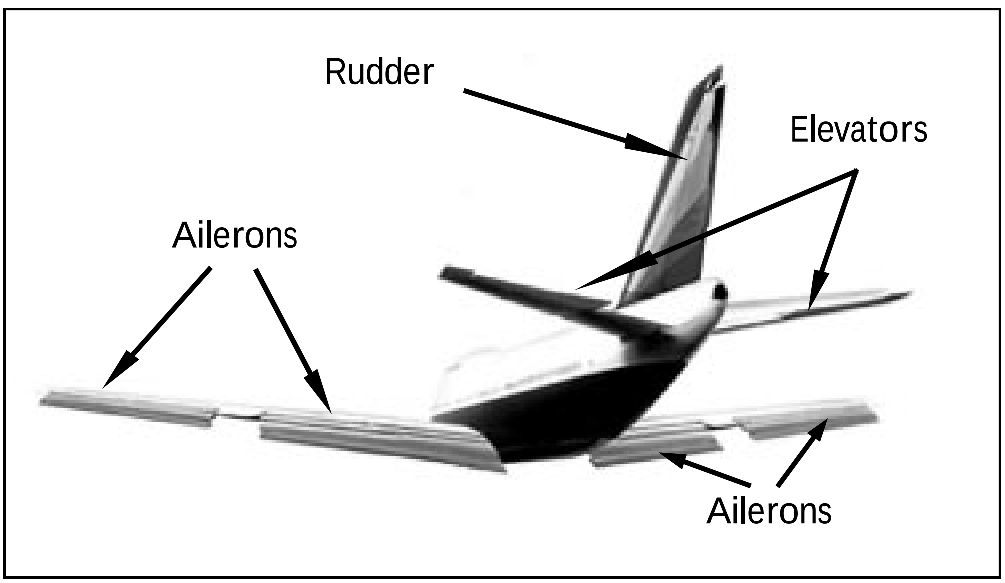
- Lift is maintained by the movement of air around its airfoils or wings.

## How the four forces work on them

- Lift is created by the movement of air around its airfoils or wings.
- Thrust is provided by an engine.
- Weight is due to gravity.
- Drag is due to air friction.

## How they are controlled

- Thrust is provided by an engine.
- Moving panels on the wing and tail sections (control surfaces) are used to control the direction of flight.
- Control Surfaces: aileron, rudder, elevators.

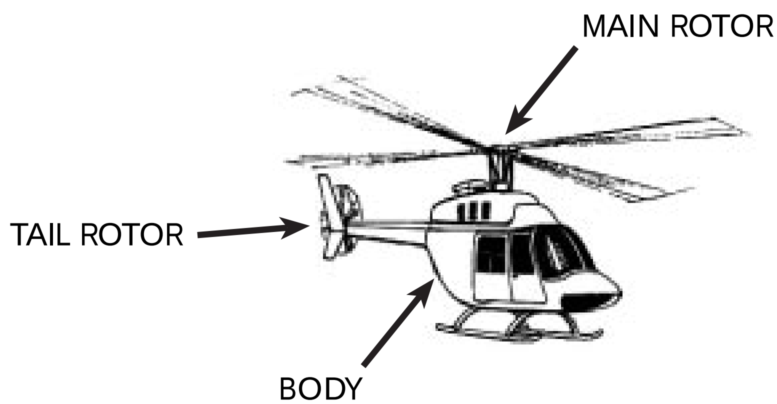


# Teacher Reading
## Rotating-Wing Aircraft

## Introductory History
Leonardo da Vinci is usually given credit for being the first to sketch and describe a helicopter in 1483. The helicopter was perfected between 1936 and 1941 by Igor Sikorsky. He created the single-rotor type which became a practical aircraft able to carry a heavy load of cargo and people.

## Basic Structure

- **Main Rotor**
- **Tail Rotor**
- **Body**




## Different Types

- **Single-Rotor Helicopter**

- **Twin-Rotor Helicopter**

- **Heavy-Lift Helicopter**

- **Tilt-Rotor Aircraft**

- **Tilt-Wing Aircraft**

## How they stay up in the air

The blades of the helicopter's main rotor have an airfoil shape like the wings of a plane. But while an airplane must move quickly through the air for the wings to develop enough lift for flight, the helicopter only needs to move the rotor blades. As the blades circle, they produce lift to support the helicopter in the air. They are then tilted to move the whole vehicle in different directions.

## How the four forces work on them

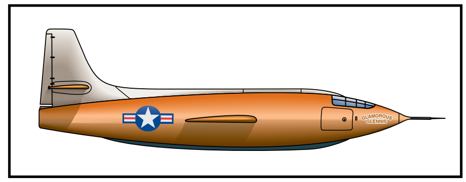
- Lift is created by spinning the main rotor, which causes air to move around the airfoil-shaped blades.
- Thrust is provided by tilting the main rotor.
- Weight is due to gravity.
- Drag is due to air friction.

## How they are controlled

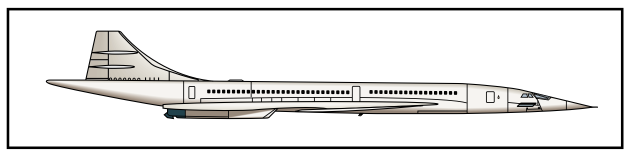
The main rotor blades (the large ones on top) and the tail rotor control the direction and speed of the helicopter. The tail rotor adds balance and keeps the vehicle from spinning like a top when the rotor blades are in motion. The angle at which the main blades are set determines how the helicopter flies — hovering, vertical, forward, backward or sideways.

# Teacher Reading
## Supersonic

## Introductory History



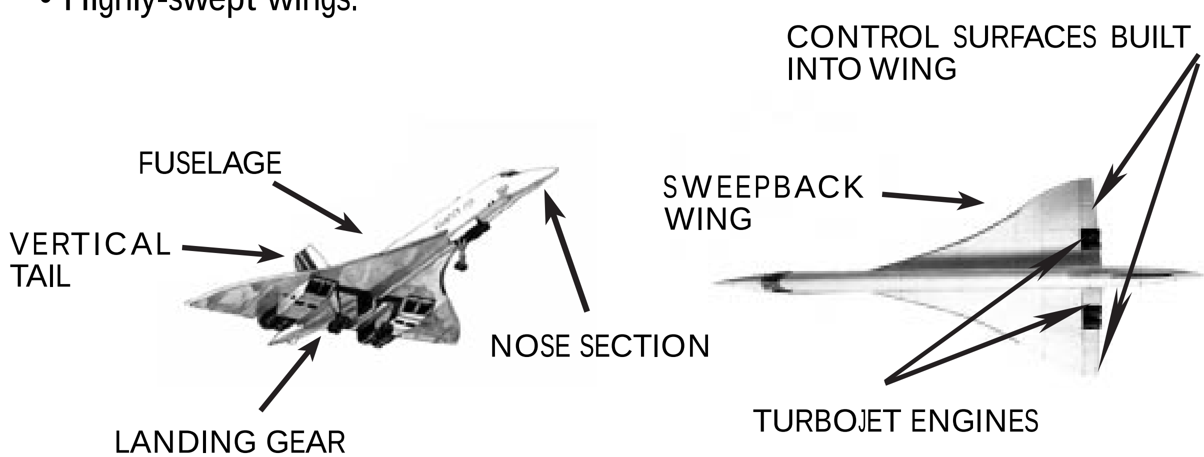
During the 1940s the Bell Aircraft Company developed an airplane powered by a rocket. This airplane, the X-1, was designed to travel faster than the speed of sound (about 760 miles per hour). On October 14, 1947, Chuck Yeager flew the X-1 faster than the speed of sound, breaking the "sound barrier." As the project continued its development, Scott Crossfield became the first pilot to fly at twice the speed of sound (Mach 2). These flights helped to collect information on high-speed aerodynamics.



The first supersonic commercial airliner was developed by teams from Great Britain and France. This airliner, the Concorde, made its first flight in 1969. It travels through Mach 1 and cruises at Mach 2 at 60,000 feet, far above other planes. The nose section droops on takeoff and landing so the crew can see ahead, but before reaching flight speed the nose lifts and a wind screen cover slides into place.

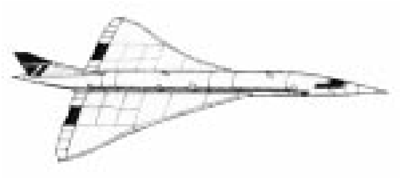
## Basic Structure

- Ultra-slim fuselage.
- Highly-swept wings.

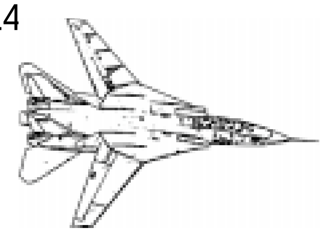


## Different Types

- Concorde



- F-14

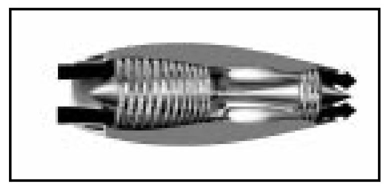


## How they stay up in the air

- Jet engines provide the powerful propulsion to maintain the Mach speeds as the wings maintain the necessary lift.

## How the four forces control them

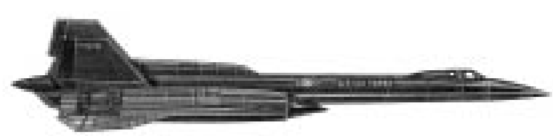
- Lift is provided by the wings.
- Powerful thrust is provided by the turbojets to maintain the Mach speeds.
- Weight due to gravity.
- Drag due to air friction.
- Most supersonic aircraft are powered by turbojets.



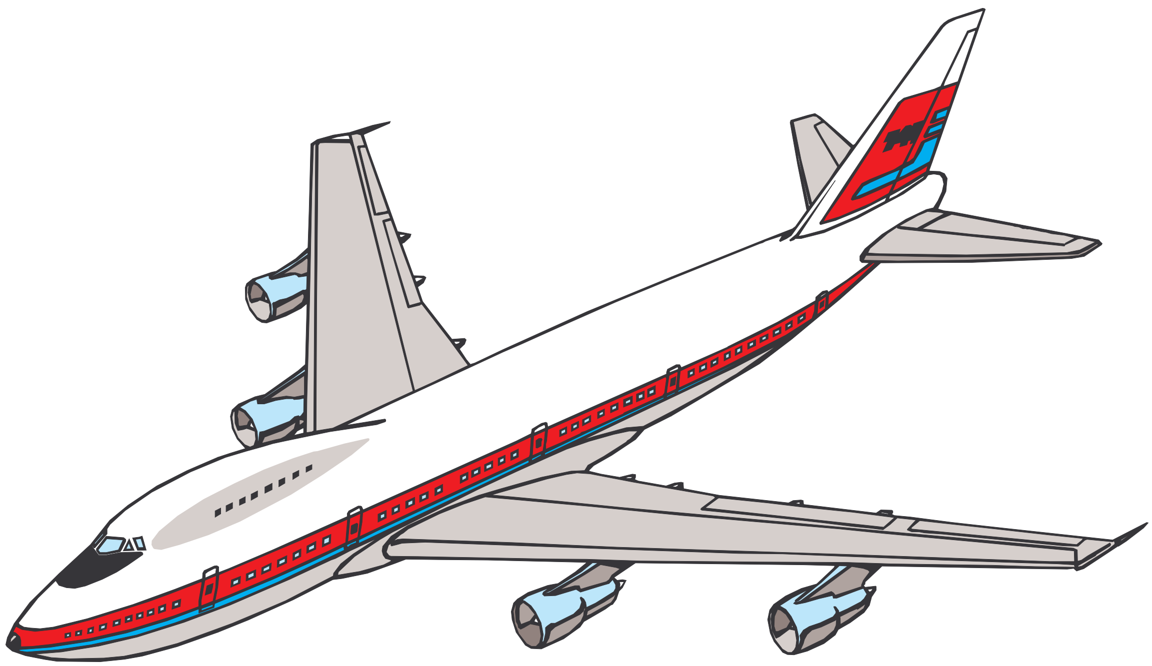
TURBOJET ENGINE

## How they are controlled

- Highly sophisticated computer equipment monitors the complex flight maneuvers required to fly at such high speeds.
- The SR-71 uses ramjets to provide thrust.



# Student Readings
## Aircraft Types



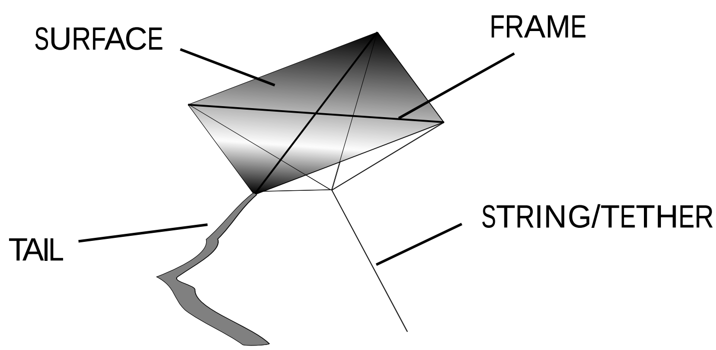
# Student Reading
## Kites

## History

The earliest records of kite flying date back to China in the fourth century B.C. There is also evidence that the Chinese used kites to raise humans into the sky to check on the enemy's position in the battlefield. Today, kites are used in activities ranging from fun and sports events to lifting scientific instruments.

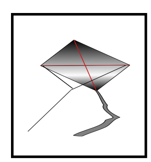
## Structure

Kites come in all shapes and sizes. Their basic structure is the same though. A kite has a lightweight frame and is covered with paper, plastic or cloth. Attached to the kite is a long tether or handheld cord. This tether is used to control the kite. The flat, diamond-shaped kite is perhaps the simplest kite shape. It is formed by tying two sticks together to form a cross shape. The covering is then attached to this frame. Because it is a single-surface shape it needs a tail for balance and stability. The frame can be bowed to make a curved shape which will give it greater lift.

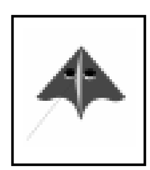



## Different Types

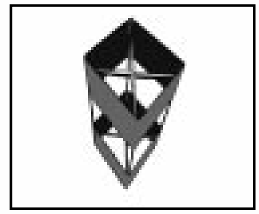
- **Flat Diamond** Flies well in light to moderate winds, but requires a tail for stability.



- **Delta-Shaped** Flies well in all winds; does not require a tail.

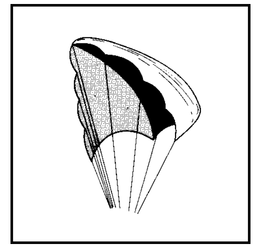


## Box-Shaped



These kites were first invented by the Australian Lawrence Hargrave in the 1890s. It was the first three-dimensional kite. It had greater stability than the flat-surfaced kites.

## Parafoils



These are part-parachute and part-airfoil and produce more lift than box kites. They have no frame, but are shaped by the wind as they fly.

## How They Stay Airborne

A kite operates by using the action-reaction principle. As the kite is pulled by its tether through the sky, moving air pushes against the kite's surface. This creates a force that is equal and opposite to that of the pull on the tether. This reaction force gives lift and keeps the kite in the air. To keep flying, the kite's surface needs to be held at an angle against the wind. This angle is called the angle of attack. The tether is used to control the angle of attack.

## How They are Controlled

As the kite is moved face first into the wind, it is controlled by a person pulling on its tether. It can be directed left or right, and can be made to dip or climb.

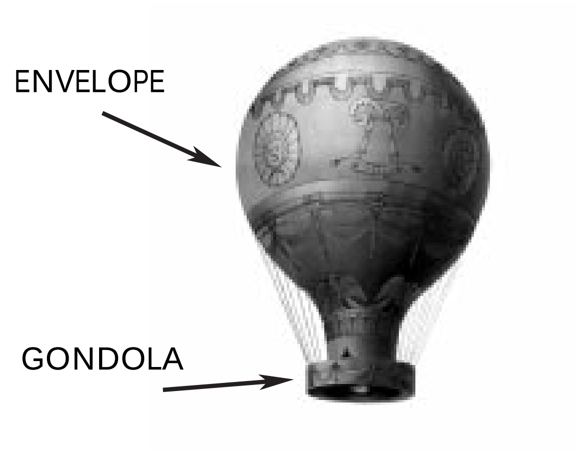
# Student Reading
## Balloons

### History
The first widely recorded, public demonstration of a balloon took place on June 5, 1783. On this date, a 105-foot circumference balloon, designed by the brothers Joseph and Jacques Montgolfier, was launched in Annony, France and rose to an altitude of 6,000 feet. This balloon or *balon* was named for the oblong paper bag used in their early experiments. The brothers made a fire and used the smoke and heated air to displace the heavier, surrounding air. Because hot air rises, the balloon was able to float upward.

A few months later, a hydrogen-filled balloon designed by Professor Jacques Alexander Charles was successfully launched in Paris. By the end of that year, both kinds of balloons were being used to carry passengers.

The invention of the balloon started a new period of explorations. The early "aeronauts" competed with one another to travel higher and farther. Today, balloons are used mostly for sports and recreational purposes or for high-altitude scientific and meteorological research. These research balloons are able to reach altitudes of 34 miles.

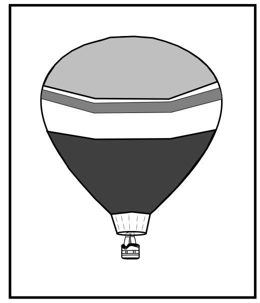
### Structure
There are two main parts of a balloon: the balloon itself which is called the envelope, and the basket or gondola. The gondola is attached by strong cables to the envelope. The envelope is made of a gas-tight fabric.



# Different Types

## Hot - Air Balloon

These balloons are used for sport and recreation. They use air heated by a burner to give the lifting force to carry the gondola and its passengers and cargo. To rise higher, more hot air is put into the envelope. This is done by pulling on a cord that releases the flow of liquid propane from its storage cylinder through a tube towards the burner. The liquid is heated by a flame which warms it and turns it into a gas. The gas then reaches the burner. Flames are released from the burner which warms the air in the envelope. To descend, they release the hot air from the top of the envelope. This causes the air inside the balloon to become cooler. The balloon then descends.

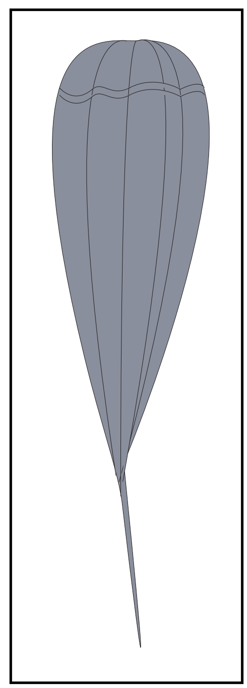


## Hydrogen Balloons

A hydrogen balloon works just like a hot-air balloon except that it does not use a burner. It uses a gas called hydrogen which is lighter than air. So when the envelope is filled with hydrogen, it naturally rises.

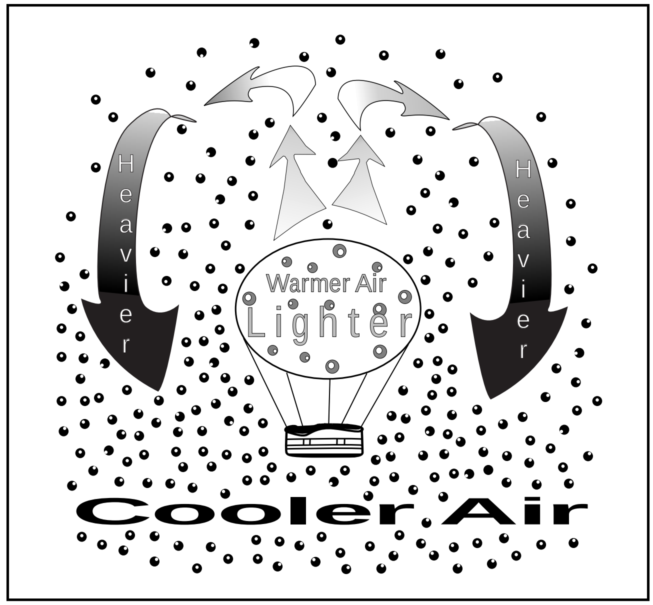
## Meteorological Balloon

These balloons usually do their work as they ascend up to 34 miles above the ground. They carry lightweight instruments that measure such atmospheric conditions as pressure, temperature, humidity and wind velocity. They are made of lightweight rubber and filled with either hydrogen or helium.



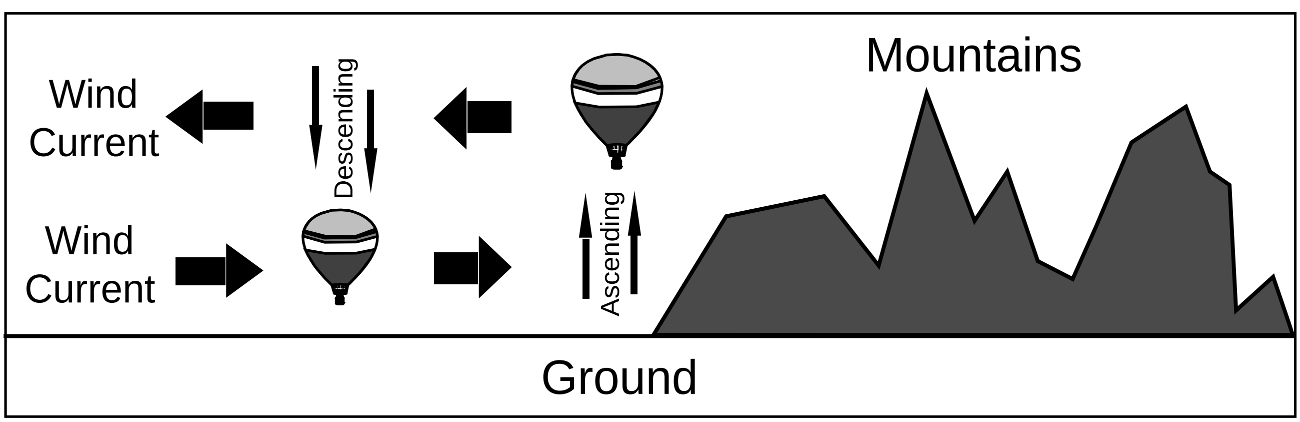
## How They Stay Airborne

The balloons get their lift from Archimedes' Principle. A balloon traps lighter-than-air gases (helium, hydrogen, hot air) in the envelope. These gases then displace the heavier air surrounding it on the outside. This creates an upthrust or buoyancy force that lifts the envelope and the gondola.




## How They Are Controlled

The aeronaut can only control the upward and downward movement of the balloon. To ascend, the aeronaut adds hot air or more lighter-than-air gas into the envelope. To descend, the aeronaut releases the hot air or the lighter-than-air gas out of the envelope. A balloon has no means of propulsion. A balloon's side-to-side movement cannot be controlled as it drifts with the wind. To change direction, the aeronaut must ascend or descend and catch a wind current moving in the direction he or she wishes to fly.



# Student Reading
## Gliders

### History

Once aviation pioneers understood that wing-flapping was not the way towards flight, they spent time studying gliders. Eventually they began to understand the importance of lift, drag and thrust. They recognized the importance of camber to the wing and the need for stability and control.

Otto Lillienthal of Germany performed some of the earliest known flights of gliders. He made hundreds of flights and tested several designs in the late 1800s.

George Cayley is given credit for creating the first design of an aircraft that actually looked like a modern airplane. Cayley began in his early 20s experimenting with gliders in 1789.

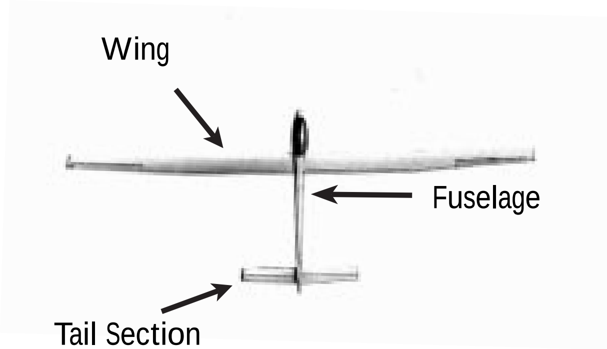
Other pioneers like Percy Pilcher and Californian John Montgomery also contributed to the study of flight using gliders.

The Wright Brothers were able to fly a stable glider before they turned their attention to the problems of powered flight.

During WWII, Germany used gliders as military transports to carry troops aloft. Today, gliders are used for sport and fun.

## Structure

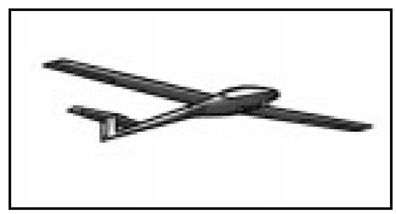
Gliders are shaped similar to airplanes. They have a narrow fuselage that can hold one pilot and one other passenger. Attached to the fuselage are long, slender wings and a tail section. Gliders have slender wings that are longer and narrower than the average airplane wing. This gives the wing a high aspect ratio. This allows the glider to get greater lift at slower speeds.




## Different Types

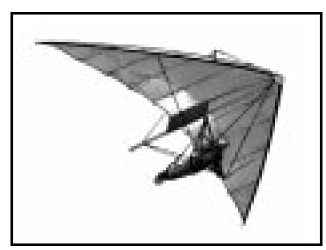
### • Sailplane

Sailplanes are airplanes without engines that have long, narrow wings and very small, narrow fuselages (typically the size to carry one or two people). The narrow shape reduces weight and drag. They have risen to altitudes of 46,000 ft (14,000 m) and flown distances of 500 miles (800 km). Sailplanes have been launched by using cars or powered aircraft to tow them, or by using winches to catapult them.

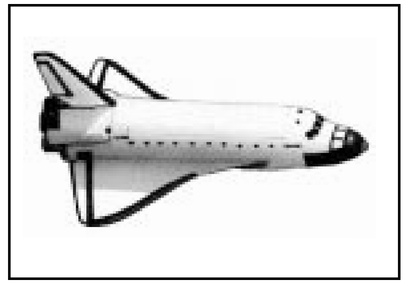


### • Hang (Flexible-Wing) Glider

Hang gliders get their lift by using A-shaped, flexible wings which are braced with tubing. These gliders have flown over 100 miles (160 km) and as high as 20,000 feet (6000 m). They are typically launched from cliffs, hills and other high-altitude locations.



- **Space Shuttle**
  The Space Shuttle acts like a huge glider. When the Shuttle returns to Earth after a mission, it uses its entire body to slow its descent and glide to a soft landing.



## How They Stay Airborne

Gliders are winged aircraft without a propulsion (power) system of their own. To give the glider its lift at the beginning of its flight, a tow line is connected from the glider to a powered airplane that pulls the glider up into the air and then releases it. Once airborne, gliders ride the wind currents. They are able to perform soaring maneuvers using the lift generated by their wings, until eventually they are pulled to Earth by gravity. Gliders can also use winds blowing off of hills and rising convection currents (thermals) in the atmosphere for lift.

A lifting force is created by the glider's airfoil-shaped wings. The airfoil shape causes the air traveling over the top of the wing to move much faster than the air traveling underneath the wing. This difference in speed changes the air pressure above and below the wing. The air pressure above the wing is lower than the air pressure underneath the wing. This difference in air pressure pulls the glider upwards.

## How They Are Controlled

Sailplanes use movable panels on the wing, along with the tail and rudder to change the direction of air moving about these airfoils. This changes the direction of the aircraft.

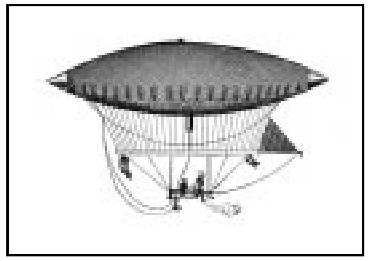
Hang gliders are controlled by the pilot usually shifting his/her weight in the direction he/she wants to move.

# Student Reading
## Airships

### History

Soon after the balloon's invention, it was used to carry passengers or "aeronauts." However, these early pioneers of aviation discovered that the balloon was limited as a practical vehicle for transportation. Balloons cannot be steered through the air, but instead must follow the pathways of the winds. They also have no controllable source of propulsion--they depend once again on the wind.

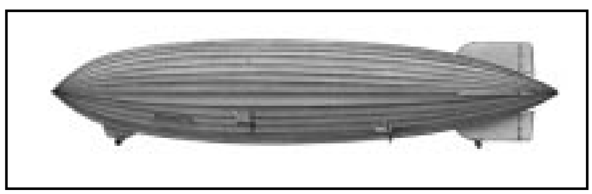
After much effort and many false starts, the first steerable airship or dirigible was launched on September 24, 1852 in Paris. This airship, designed by Henri Giffard, was 48 meters long and 13 meters in diameter. It used a small steam engine to drive three, large propeller blades and reached a speed of about 9 km/h. Giffard also used a triangular sail to serve as a rudder and improved the ability to steer the aircraft.



Giffard's Balloon

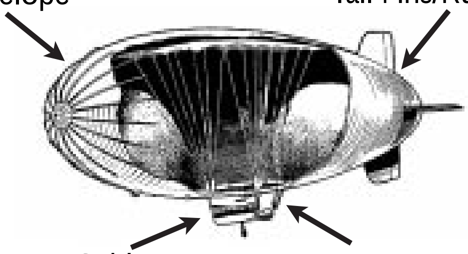
The airships built after the *Giffard* improved in their ability to navigate. However, they could not operate in strong winds because their engines were not powerful enough to give sufficient propulsion for these conditions. These difficulties would not be overcome until the creation of the rigid airships by Count Ferdinand von Zeppelin in 1900. These airships combined lighter, more powerful engines with a rigid frame that used separate gas containers to get controllable flight at faster speeds.

These airships enjoyed a heyday in the 1930s when they were used by the Zeppelin Company of Germany to ferry passengers across the Atlantic. Their use came to a close in the early 1960s when the US Navy decommissioned the last of its airship fleet.



Hindenburg

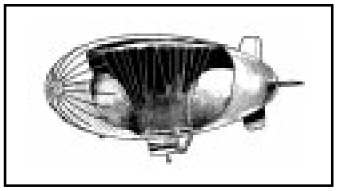
## Structure



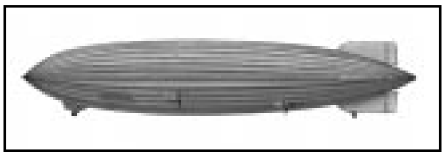

The large airships of long ago used a rigid frame that held separate gas bags. Today, most airships are non-rigid. This means that their envelope is made of a flexible fabric. The envelope is filled with helium. Inside are two large air compartments, called ballonets, that hold air. One is located at the front end and one is at the back of the envelope. The ballonets hold air. For the airship to ascend, air is released from the ballonets. This makes the airship lighter and it rises. For the airship to descend, air is pumped into the ballonets making the airship heavier and it descends. Attached to the envelope by strong cables is the gondola. From here the crew guides and controls the airship. Passengers and cargo are also carried in the gondola.

## Different Types

- **Non-Rigid Airship or Blimp**
  Best known for advertising, these airships are usually made up of a flexible envelope that is filled with a slightly pressurized, lighter-than-air gas. The altitude is controlled by expanding or shrinking air compartments (ballonets) inside that cause the airship to rise and descend by changing the pressure in the envelope.



- **Rigid**
  Best known for the *Hindenburg* and other vehicles designed by the Zeppelin Company, these vehicles have a covered metal framework. These frameworks contain a number of gas cells that can expand and shrink to control how high the airship goes.

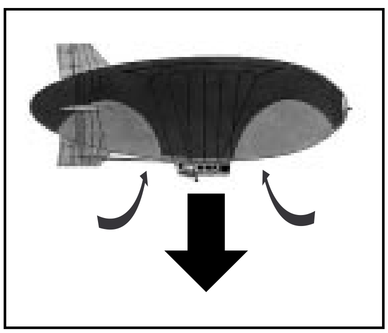


## How They Stay Airborne

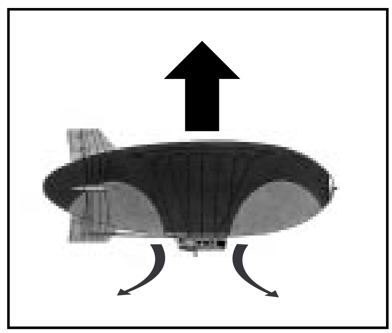
Airships use the Archimedes' Principle just like balloons. The lighter-than-air gases in the envelope displace the surrounding air. This creates an upthrust or lift called the buoyancy force.

## How They Are Controlled

The envelope of an airship is filled with helium. Inside are two large air compartments, called ballonets that hold air. One is located at the front end and one is at the back of the envelope. For the airship to ascend, air is released from the ballonets. This makes the airship lighter and it rises. For the airship to descend, air is pumped into the ballonets. This makes the airship heavier and it descends. These vehicles are controlled through the use of control panels on the tail and rudder. The engines are connected to the propellers through a shaft. The propellers spin and create thrust. To turn the airship in different directions, the engines are rotated in that direction.



Balloon Descending

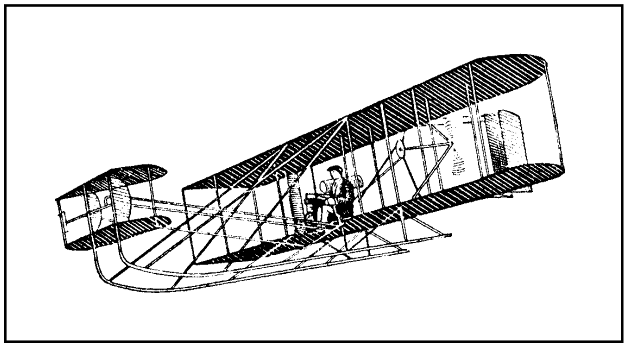


Balloon Ascending

# Student Reading
## Fixed-Wing Aircraft

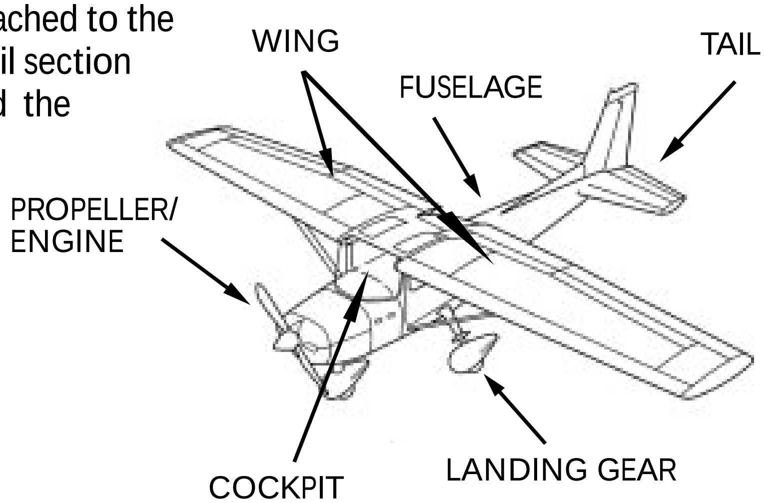
## History

Although many European and American inventors attempted powered flight, the Wright Brothers are given credit for being the first. During those early days, trial and error was the method for trying out new ideas on flight. Later, as more engineers and scientists began closely observing the movement of air and experimenting through wind tunnels, the shape of the airfoil and the fuselage took on an improved form that created greater lift and less drag. As technology improved, so did the ways of studying airflow around the aircraft through the use of computers. Improvements in control surfaces and the covering of aircraft made the airplanes safer and more efficient. Improvement in engine design and stronger wing and fuselage structure made it possible to safely increase aircraft speed.



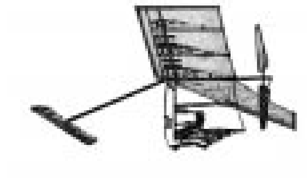
## Structure

An airplane has five basic parts. The fuselage is a tube-like piece that holds the cockpit, cargo and passenger compartments. Attached to the fuselage are the wings. The wings on most aircraft hold the propulsion system or the engines. The wings also have control surfaces called ailerons. Also attached to the fuselage is the tail section. The tail section has two control surfaces called the rudder and the elevators. The undercarriage is also called the landing gear, which supports the plane during landings.

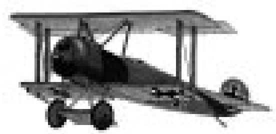


## Different Types

**Pedal-Powered Plane**

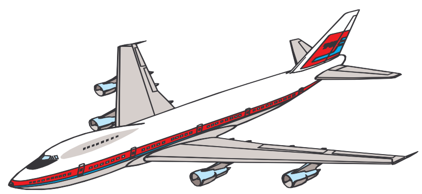


**Biplanes**



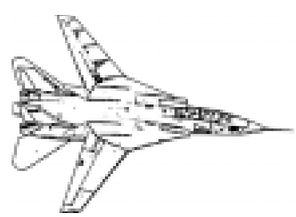
**Light Aircraft**

**Airliner**



**Air Cargo Aircraft**

**Jet Fighter**



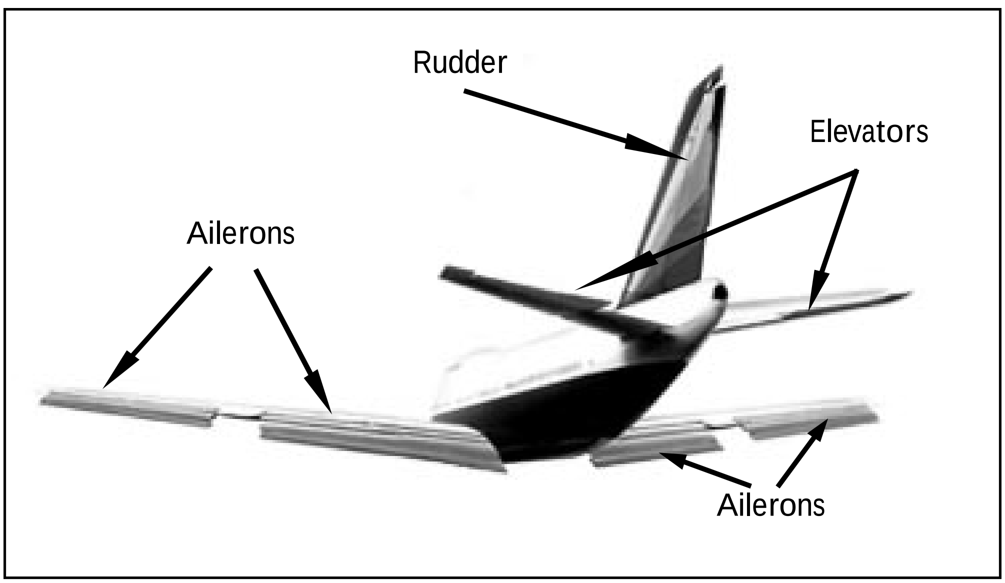
**Sailplane**

## How They Stay Airborne

The engines of the airplane create the thrust that moves the plane forward. In order to get lift, the airplane needs to move forward at a high rate of speed. The wings then work to create lift. A lifting force is created by its airfoil shape of the wings. The airfoil shape causes air traveling over the top of the wing to move much faster than the air traveling underneath the wing. This difference in speed changes the air pressure above and below the wing. The air pressure above the wing is lower than the air pressure underneath the wing. This difference in air pressure pulls the airplane upward.

## How They Are Controlled

The wings and the tail section have control surfaces on them that control the airplane during flight. The ailerons located on the each wing direct the airplane to roll. The elevators on the tail section direct the airplane's nose to pitch up or down. The rudder directs the nose of the airplane to move side to side.



# Student Reading
## Rotating-Wing Aircraft

## History
Leonardo da Vinci is usually given credit for being the first to sketch and describe a helicopter in 1483. In 1935, helicopter made by Louis Breguet and Rene Dorand in France was successfully flown.The helicopter was perfected between 1936 and 1941 by Igor Sikorsky with the creation of the single-rotor type which became a practical aircraft able to carry a heavier load of cargo and people.

## Structure
There are four main parts to a single-rotor helicopter.The main rotor creates lift.The tail rotor stabilizes the helicopter once the main rotor starts up.The body of the helicopter holds the pilot and any passengers or cargo.The skids are attached to the body and are used for landing.

## Different Types

**Single-Rotor Helicopter**

**Twin-Rotor Helicopter**

**Heavy-Lift Helicopter**

**Tilt-Rotor Aircraft**

**Tilt-Wing Aircraft**

## How They Stay Airborne

The blades of the helicopter's main rotor have an airfoil shape like the wings of an airplane. The helicopter's engine turns the main rotor blades. As the blades rotate, they produce lift that is great enough to support the helicopter in the air. The tail rotor spins in the opposite direction of the main rotor and keeps the body of the helicopter from spinning. It is used to stabilize the helicopter's motion.

## How They Are Controlled

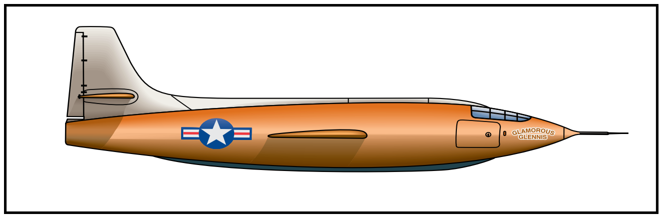
The main rotor blades and the tail rotor control the direction and speed of the helicopter. The tail rotor adds balance and keeps the vehicle from spinning like a top when the rotor blades are in motion. The angle at which the blades are set determines how the helicopter flies - hovering, vertical, forward, backward or sideways.

UPWARD FLIGHT    FORWARD FLIGHT    BACKWARD FLIGHT

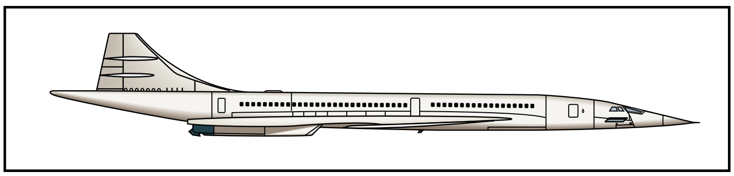
# Student Reading
## Supersonic

### History

During the 1940s the Bell Aircraft Company developed an airplane powered by a rocket engine. This airplane, the X-1, was designed to travel faster than the speed of sound (760 miles per hour). On October 14, 1947, Chuck Yeager flew the X-1 faster than the speed of sound, breaking the "sound barrier." As the project continued its development, Scott Crossfield became the first pilot to fly at twice the speed of sound (Mach 2). These flights helped to collect information on high-speed aerodynamics.

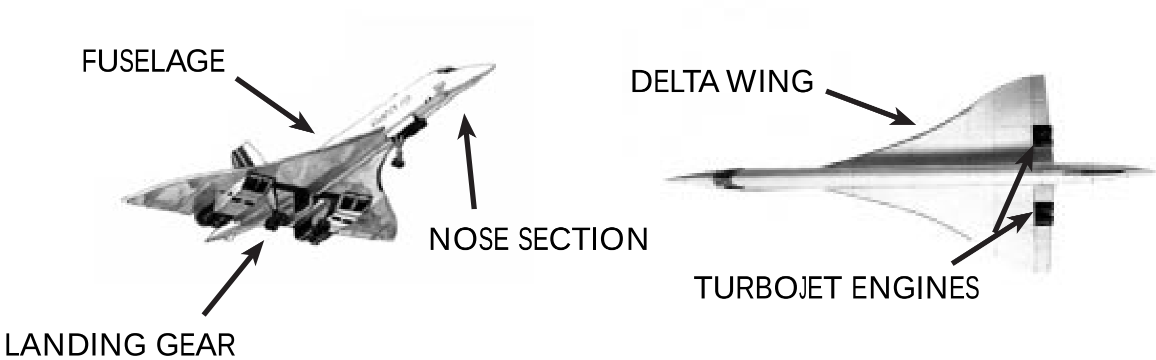


The first supersonic commercial airliner was developed by teams from Great Britain and France. This airliner, the Concorde, made its first flight in 1969. It travels through Mach 1 and cruises at Mach 2 at 60,000 feet, far above other airplanes.



### Structure

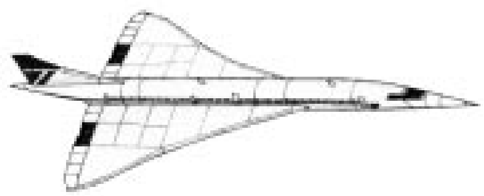
The supersonic transport, the *Concorde*, is designed to fly at twice the speed of sound (about 2,125 km/h). It is powered by four turbojet engines with afterburners. These powerful engines provide the great amount of thrust it needs to get lift and gain altitude quickly. The *Concorde* has a narrow fuselage with a slim, coned nose. The airplane is set on its undercarriage at a high angle from the ground. This gives it greater lift as it races



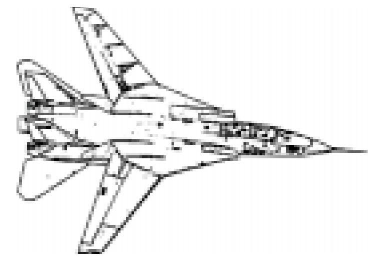
down the runway. To improve the pilot's view during takeoffs and landings, the nose (which holds the cockpit) hinges downward. Attached to the thin fuselage are steeply swept delta wings. The leading edges of the wings are slightly curved. The trailing edges have elevons that control both pitch and roll.

## Different Types

**Concorde**



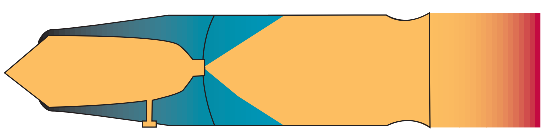
**F-14**



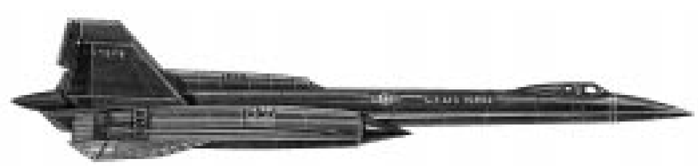
## How They Stay Airborne

Ramjets provide the powerful propulsion to maintain the Mach speeds, as the delta wings maintain the necessary lift.

**Ramjet Engine Cross Section**



**SR-71**



## How They Are Controlled

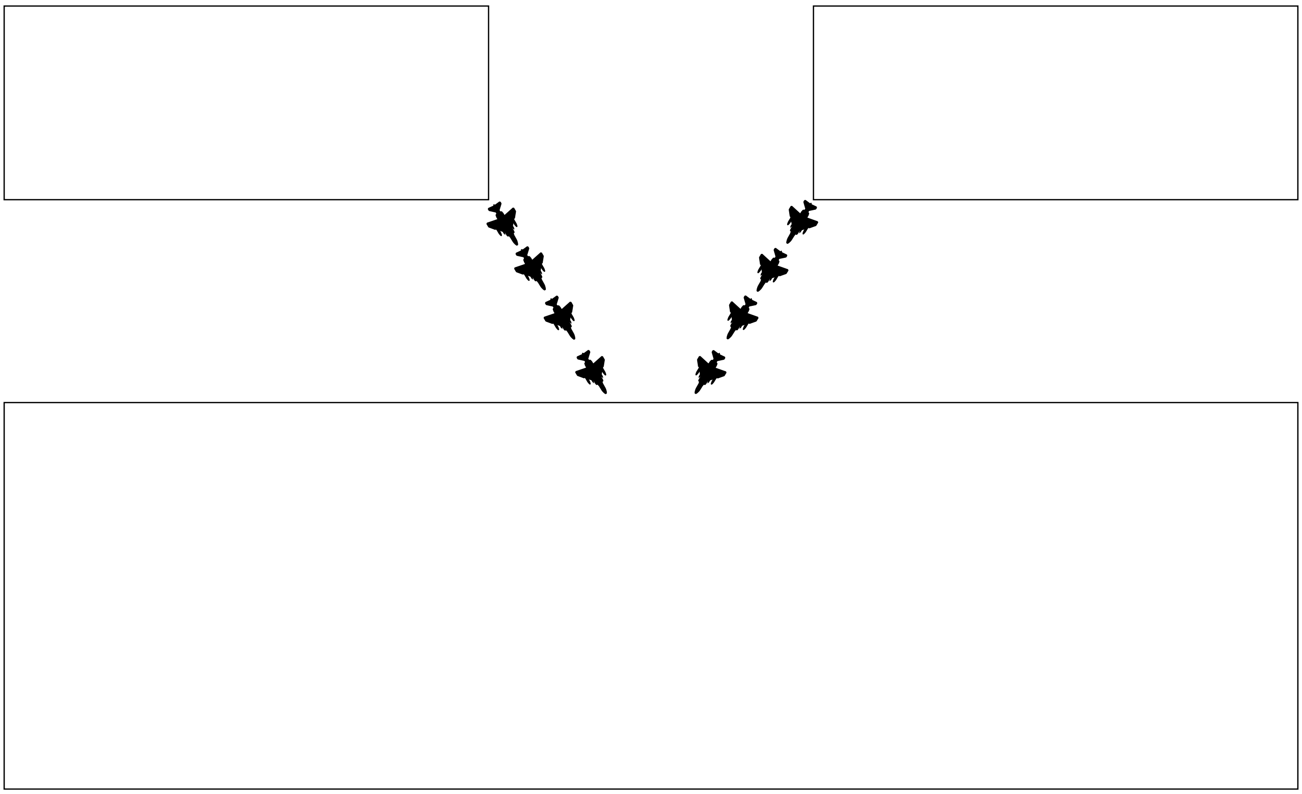
Highly sophisticated computer equipment controls the complex flight maneuvers that are needed to fly at such high speeds

# Student Note Taking Guide
## Aircraft Types

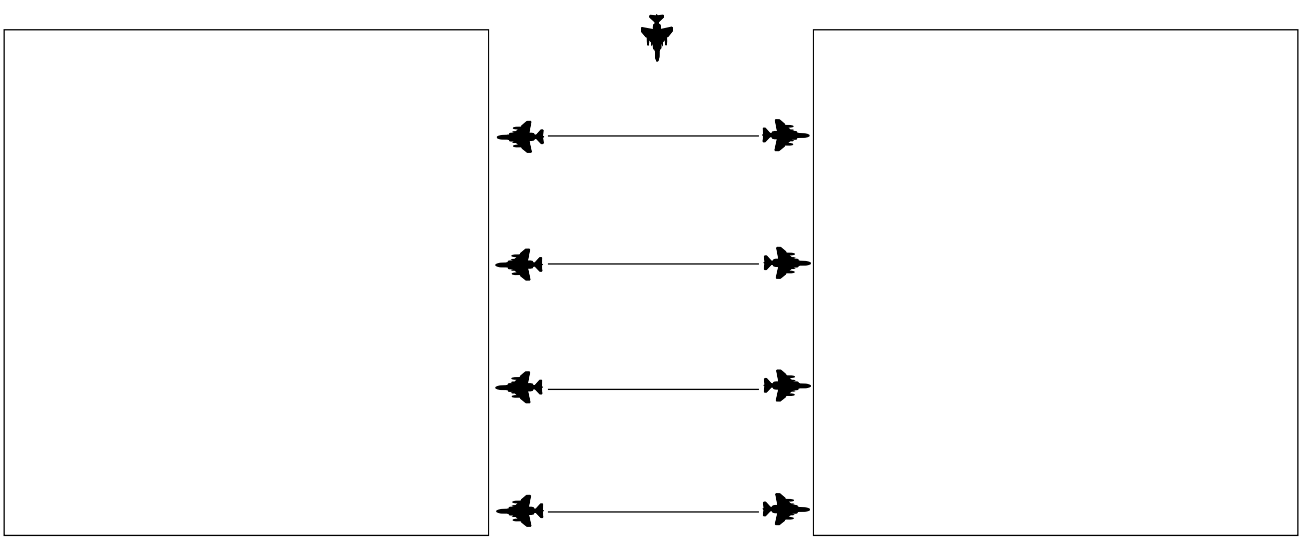
| Big Ideas | Important Little Details |
|---|---|
| Aircraft Type | |
| History | |
| Structure | |
| Different Types | |
| How They Stay Airborne | |
| How They Are Controlled | |

# Student Activity Sheet: Make Your Own Comparison

## How Are They Alike?



## In What Ways Are They Different?



# Make Your Own Comparison - Key
## Fixed- and Rotating-Wing Aircraft

### How Are They Alike?

**Fixed-wing aircraft**

**Rotating-wing aircraft**

**Can carry cargo and passengers**

**Have an engine**

**Use airfoils**

### In What Ways Are They Different?

| Fixed-wing aircraft | | Rotating-wing aircraft |
|---|---|---|
| Fuselage, tail section, wings | Shape | Main rotor, tail rotor and body |
| More streamlined, less drag | Drag | Not as streamlined, more drag |
| Airfoils are pushed by the thrust of engines horizontally through the air | How lift is created | Main rotor blades spin to create lift |
| Tail motion with wings | Balance | Tail rotor |

# Make Your Own Comparison - Key
## Airships and Fixed-Wing Aircraft

### How Are They Alike?

**Airships**

**Fixed-wing aircraft**

**Fly**

**Can carry passengers**

**Have a tail and rudder for control**

**Have an engine for thrust**

### In What Ways Are They Different?

| | | |
|---|---|---|
| Buoyancy | Flight principle | Airfoils for lift |
| Large envelope of air ballonets covering a frame with engine and cabin | Shape | Fuselage, wings, tail section, undercarriage |
| Bulkier shape has more drag | Drag | More streamlined, less drag |
| Flies 0-50 mph | Speed | Flies 50-350 mph |

# Make Your Own Comparison - Key
## Gliders and Airships

### How Are They Alike?

| Gliders | | Airships |
|---|---|---|

**Fly**

**Have a rudder for control**

**Can carry a human into flight**

**Have a tail fin for control**

### In What Ways Are They Different?

| Gliders | | Airships |
|---|---|---|
| Airfoil lift | Flight principle | Buoyancy |
| Wings for lift | Lift | Lighter-than-air gases for lift |
| Does not have one | Engine | Has one or more |
| Fuselage, wings, tail | Shape | Large envelope with air ballonets covering a frame with engine and cabin |

# Make Your Own Comparison - Key
## Balloons and Gliders

### How Are They Alike?

| Balloons | Gliders |
|---|---|

**Fly**

**Up and down motion can be controlled**

**Horizontal motion controlled by wind currents**

**Can carry a person into flight**

### In What Ways Are They Different?

| Balloons | | Gliders |
|---|---|---|
| Uses lighter-than-air-gases | Lift | Uses wings to develop lift |
| Gondola with balloon | Shape | Fuselage, tail and wings |
| Can rise on its own | Beginning flight | Needs external propulsion |
| Has none | Control surfaces | Has them on tail and wings |

# Make Your Own Comparison - Key
## Kites and Balloons

### How Are They Alike?

**Kites**

**Balloons**

**Fly**

**Control up and down motion**

**Both encounter gravity and drag**

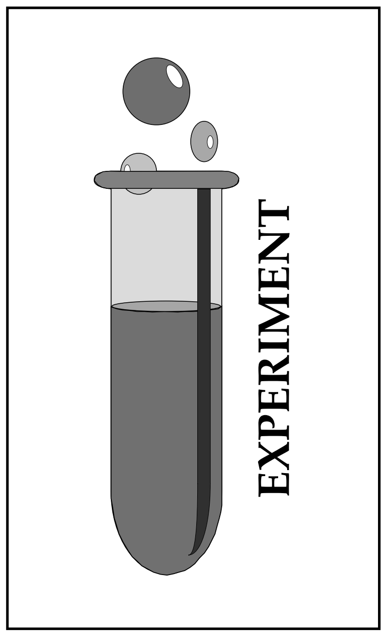
**Can carry a person into flight**

### In What Ways Are They Different?

| Kites | | Balloons |
|---|---|---|
| Action - reaction | Flight principle | Buoyancy |
| Uses wind to create lift | Lift | Uses lighter-than-air gases |
| Flat surface area | Surface shape | Rounded balloon |
| Pull on tether | Thrust | Wind |

# Experiments: Student / Teacher

All Experiments can be located by finding the Experiment Test Tube logo.



# Experiment: Rotating-Wing Craft
## Procedure Card

### *Materials*

pre-drawn rotors on card stock

two plastic straws per group of students

scissors

cellophane tape

pencil

single-hole punch

ruler

stopwatch

observation chart

safety goggles

large, inside area

### *Experiment Set Up*

Cut the rotors from the card stock your teacher gives you, carefully following the pattern.

Punch holes in the center of each rotor (strip).

Push the straw into the hole of rotor "A" so that the rotor is only 1 to 2 cm from the top of the straw. You might want to secure the rotor to the straw with a small piece of tape.

On rotor "B" use your straight edge to fold back the strip along the dotted lines near the two notched edges.

Firmly and cleanly tape down the folds on rotor "B". Tape the strips down on the same side of the rotor.

Push the straw into the hole of rotor "B" so that the blade is only 1 to 2 cm from the top of the straw. You might want to secure the rotor to the straw with a small piece of tape.

## ***Experiment Procedure***

1. Write down your prediction on your scientific method sheet describing how you think rotor "A" will fly and how long it will remain in flight.
2. Have one person hold the stopwatch, ready to time.
3. Have the other person hold the straw with rotor "A" in between the palms of his/her hands so that the rotor end is up.
4. Rapidly move the hands in opposite directions to set the straw spinning.
5. Let go quickly and observe. Make sure the other person times the flight with the stopwatch.
6. Repeat steps 2-5 two more times and record the observations as well as the flight times.
7. Do steps 1-5 using the straw with rotor "B".
8. Repeat steps 2-5 using the straw with rotor "A".
9. Complete your scientific method sheet as well as your observation chart.

# Observation Chart
## Rotating-Wing Craft

| Rotor "A" | Description of Flight | Length of Flight |
|---|---|---|
| Flight 1 | | |
| Flight 2 | | |
| Flight 3 | | |
| **Rotor "B"** | **Description of Flight** | **Length of Flight** |
| Flight 1 | | |
| Flight 2 | | |
| Flight 3 | | |

# Observation Chart - Key
## Rotating-Wing Craft

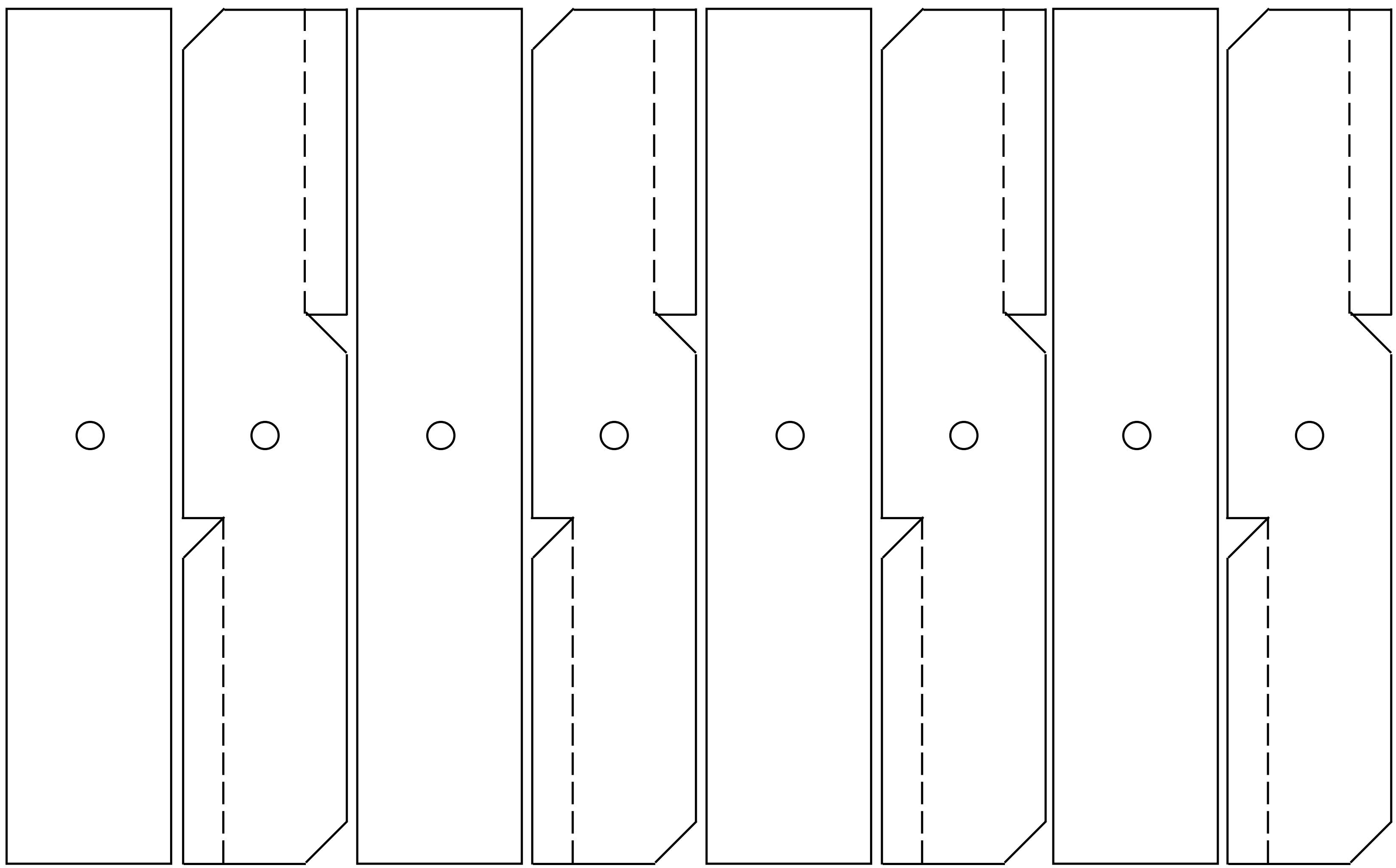
| **Rotor “A”** | **Description of Flight** | **Length of Flight** |
|---|---|---|
| **Flight 1** | *Gains little height and falls quickly to the floor.* | *Times will vary, but this rotor should fall to the floor faster than Rotor “B”.* |
| **Flight 2** | *(Same as above)* | *(Same as above)* |
| **Flight 3** | *(Same as above)* | *(Same as above)* |

| **Rotor “B”** | **Description of Flight** | **Length of Flight** |
|---|---|---|
| **Flight 1** | *Rises from initial position where it was released, then floats gently and slowly to the floor.* | *Times will vary, but this rotor should stay in the air longer than Rotor “A”.* |
| **Flight 2** | *(Same as above)* | *(Same as above)* |
| **Flight 3** | *(Same as above)* | *(Same as above)* |

# Model
## Rotating-Wing Craft

(Note: Run on cardstock)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Rotor "A"** | **Rotor "B"** | **Rotor "A"** | **Rotor "B"** | **Rotor "A"** | **Rotor "B"** | **Rotor "A"** | **Rotor "B"** |



# The Scientific Method
## Rotating-Wing Craft Experiment

| Steps | Data |
| --- | --- |
| **1. State the problem.**<br><br>**QUESTION**<br><br>*(What do I want to know?)* | |
| **2. Form a hypothesis.**<br><br>**PREDICTION**<br><br>*(What do I think is going to happen?)* | |
| **3. Design an experiment.**<br><br>**MATERIALS & PROCEDURES**<br><br>*(What steps will I take to do this experiment? What things will I need?)* | |

# The Scientific Method
## Rotating-Wing Craft Experiment

EXPERIMENT

| Steps | Data |
| --- | --- |
| **4. Perform the experiment.**<br><br>**OBSERVE and RECORD DATA**<br><br>*(What information did I gather during this experiment?)* | |
| **5. Organize and analyze data.**<br><br>*(Make a graph, chart, picture or diagram.)* | |
| **6. Draw conclusions.**<br><br>*(What do my results mean? Was my hypothesis right or wrong? Can I explain why?)* | |

# The Scientific Method - Key
## Rotating-Wing Craft Experiment

| Steps | Data |
|---|---|
| **1. <u>State the problem.</u>**<br><br>**QUESTION**<br><br>*(What do I want to know?)* | *How does a helicopter fly?*<br><br>*OR*<br><br>*How does a rotating-winged craft get lift?* |
| **2. <u>Form a hypothesis.</u>**<br><br>**PREDICTION**<br><br>*(What do I think is going to happen?)* | *I think that rotor A/B will spin quickly and move up and out away from me.*<br><br>*OR*<br><br>*I think it will fly for 5 to 10 seconds. I think that rotor B/A will not spin very fast and fall to the ground. It will fly for 2 to 4 seconds.* |
| **3. <u>Design an experiment.</u>**<br><br>**MATERIALS & PROCEDURES**<br><br>*(What steps will I take to do this experiment? What things will I need?)* | *Materials:*<br>*pre-drawn rotors on cardstock • 2 plastic straws per group of students • scissors • cellophane tape • pencil • single-hole punch • ruler • stopwatch • observation chart •safety goggles • large, inside area*<br><br>*Procedure: (See attached page)* |

# The Scientific Method - Key
## Rotating-Wing Craft Experiment

### Steps

**3. Design an experiment.**

**MATERIALS & PROCEDURES**

*(What steps will I take to do this experiment? What things will I need?)*

### Data

*Procedure:*

1. *Write down your prediction on your Scientific Method sheet describing how you think rotor "A" will fly and how long it will remain in flight.*
2. *Have one person hold the stopwatch, ready to time.*
3. *Have the other person hold the straw with rotor "A" in between the palms of his/her hands so that the rotor end is up.*
4. *Rapidly move the hands in opposite directions to set the straw spinning.*
5. *Let go quickly and observe. Make sure the other person times the flight with the stopwatch.*
6. *Repeat steps 2-5 two more times and record the observations as well as the flight times.*
7. *Do steps 1-6 using the straw with rotor "B".*
8. *Complete your Scientific Method sheet as well as your observation chart.*

# The Scientific Method - Key
## Rotating-Wing Craft Experiment

| Steps | Data |
|---|---|
| **4. <u>Perform the experiment.</u>**<br><br>**OBSERVE and RECORD DATA**<br><br>*(What information did I gather during this experiment?)* | *Rotor "A" wobbled and fell to the ground. It was in the air only 2 seconds. It really didn't fly. It kind of fell.*<br><br>*Rotor "B" spun quickly and rose up in the air. It stayed in the air 8 seconds.* |
| **5. <u>Organize and analyze data.</u>**<br><br>*(Make a graph, chart, picture or diagram.)* | *Have students organize results on pre-made charts.* |
| **6. <u>Draw conclusions.</u>**<br><br>*(What do my results mean? Was my hypothesis right or wrong? Can I explain why?)* | *Rotor "A" was flat, but Rotor "B" was folded over, so it had a different shape — it was not flat, it was rounded. I think this rounded-on-the-top shape has something to do with making it fly. It kind of acts like a propeller and a wing together.* |

# Experiment: Hot Air Buoyancy
## Procedure Card

### *Materials*

yard (meter) stick

string

tape

two lunch-sized paper bags

candle or hot plate

### *Experiment Set Up*

Locate the center of gravity of the stick with a length of 10 inches and attach a string to that point.

Cut two pieces of string, 10 inches long each.

Open one of the bags and tape one end of a string to the center of the bottom (outside) of the bag.

Attach the other end of the string to one end of the stick.

Repeat this procedure with the other bag and string.

Plug in hot plate and turn it on to the highest temperature setting.

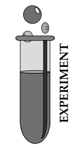
### *Experiment Procedure*

1. Hold the stick horizontally by the string attached at its center of gravity.
2. Observe and record.
3. Hold the stick again with one of the bags' openings 5 to 10 inches directly above the hot plate.
4. Observe and record.
5. Repeat step 3, but place the other bag over the hot plate.
6. Observe and record.

# The Scientific Method
## Hot Air Buoyancy Experiment

| Steps | Data |
|---|---|
| **1. <u>State the problem.</u>**<br><br>**QUESTION**<br><br>*(What do I want to know?)* | |
| **2. <u>Form a hypothesis.</u>**<br><br>**PREDICTION**<br><br>*(What do I think is going to happen?)* | |
| **3. <u>Design an experiment.</u>**<br><br>**MATERIALS & PROCEDURES**<br><br>*(What steps will I take to do this experiment? What things will I need?)* | |

# The Scientific Method
## Hot Air Buoyancy Experiment




| Steps | Data |
|---|---|
| **4. Perform the experiment.**<br><br>**OBSERVE and RECORD DATA**<br><br>*(What information did I gather during this experiment?)* | |
| **5. Organize and analyze data.**<br><br>*(Make a graph, chart, picture or diagram.)* | |
| **6. Draw conclusions.**<br><br>*(What do my results mean? Was my hypothesis right or wrong? Can I explain why?)* | |

# The Scientific Method - Key
## Hot Air Buoyancy Experiment

| Steps | Data |
|---|---|
| **1. <u>State the problem.</u>**<br><br>**QUESTION**<br><br>*(What do I want to know?)* | *What happens to air when it gets heated?* |
| **2. <u>Form a hypothesis.</u>**<br><br>**PREDICTION**<br><br>*(What do I think is going to happen?)* | *I think the bag filling with heated air will rise.* |
| **3. <u>Design an experiment.</u>**<br><br>**MATERIALS & PROCEDURES**<br><br>*(What steps will I take to do this experiment? What things will I need?)* | *Materials:*<br>*string • yard (meter) stick • hot plate (or candles) • 2 lunch-sized paper bags • tape*<br><br>*Procedure: (See attached page)* |

# The Scientific Method - Key
## Hot Air Buoyancy Experiment

**Steps**

**3. <u>Design an experiment.</u>**

**MATERIALS & PROCEDURES**

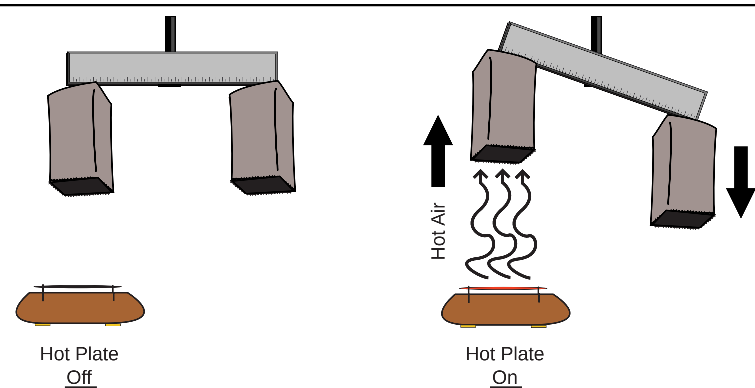
*(What steps will I take to do this experiment? What things will I need?)*

**Data**

*Procedure:*

1. *Gather materials.*
2. *Find the balancing center of the stick and tie the string around it so that the stick will be held in a balanced horizontal position by the string.*
3. *Cut two pieces of string 5 inches long each.*
4. *Open the two bags and tape one end of a string to the bottom of the bag and the other end to the end of the stick.*
5. *Take the straight pin and carefully puncture (pop) one balloon so as not to disintegrate it into smaller pieces.*
6. *Hold stick by centered string and observe and record.*
7. *Place a hot plate under one bag and turn it on.*
8. *Observe and record.*

# The Scientific Method - Key
## Hot Air Buoyancy Experiment

| Steps | Data |
|---|---|
| **4. Perform the experiment.** **OBSERVE and RECORD DATA** *(What information did I gather during this experiment?)* | *The bag which was over the hot plate slowly rose. This forced the other bag into a downward motion.* |
| **5. Organize and analyze data.** *(Make a graph, chart, picture or diagram.)* |  |
| **6. Draw conclusions.** *(What do my results mean? Was my hypothesis right or wrong? Can I explain why?)* | *The warm air seemed to rise and when it filled the bag, it made the bag rise. This means that when air gets heated, it moves upward. This is probably what happens in a hot-air balloon when it gets warmed by the burner.* OR *Warm air particles (molecules) are not as dense as cold air molecules. They are more spread out. This causes them to rise upward as colder air moves underneath.* |

# Additional Student Activities / Projects

## Map It Out

- Form groups and have each group take the information about one aircraft type and create a concept map that reproduces the information concisely and visually. Have students produce a rough draft first in a smaller form and then enlarge and embellish it onto a larger sheet of paper adding illustrations, diagrams, pictures, etc. as they see necessary. After all groups have completed this project, it can be posted for a bulletin board. See the student guidesheet on page 68 for a visual example.

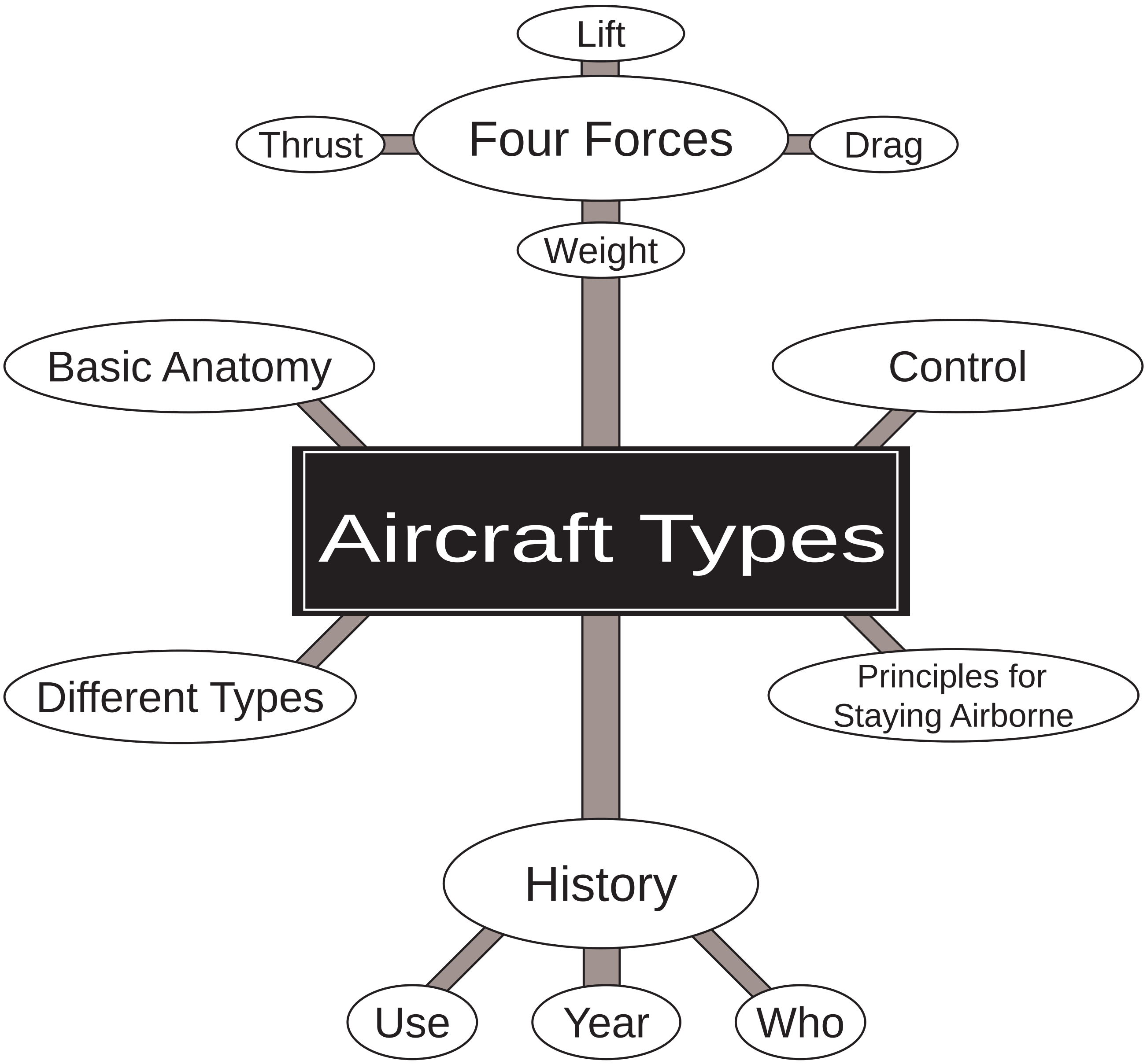
## Aircraft Types Mobile

- After completing the aforementioned concept maps, students can expand the information (in a 3-D sort of way) by turning it into a mobile. See the student guidesheet on page 69.

## Aircraft Types Trading Cards

- Assign students a specific aircraft, then have each student create a trading card. Follow the directions found on the Trading Card Student Guidesheet on page 70.

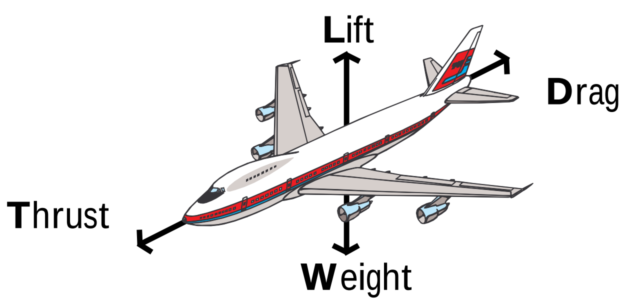
# Map It Out
## Aircraft Types



# Student Activity Sheet: Aircraft Types Mobile

**Directions:**

- Use your concept map to help you create a three-dimensional mobile in which the aircraft type is constructed as a three dimensional model. Suspend from the model the following information:
- **basic anatomy:** terms can simply be labeled directly on the model;
- **control:** surfaces can be highlighted and labeled, or enlarged and labeled to the side;
- **different types:** drawings, photos, and magazine pictures can be mounted on heavier cardboard and attached;
- **principle:** these can be written out or illustrated as a comic, mounted on heavier cardboard and attached to model;
- **four forces:** each can be identified according to a standardized position;




- **history:** written and illustrated, mounted on heavier cardboard and attached to model.

# Student Activity Sheet: Aircraft Types Trading Cards

**Directions:** Create your own Trading Card. On the front of your Trading Card put the aircraft's name and below that draw a picture of the aircraft. On the back of the Trading Card record these statistics:

- aircraft type
- diagram of its structure with labels
- explanation for how it gets lift
- explanation for how it is controlled

Use the example below to help you design your Trading Card.

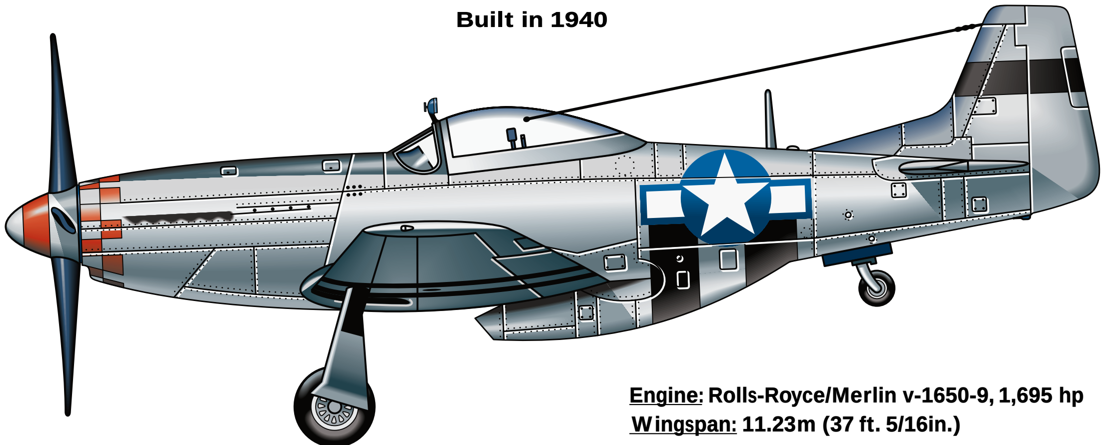
| Front | Back |
|---|---|
| **Aircraft Name**<br><br>**Aircraft Drawing** | **Aircraft /Type Category:**<br><br>**Diagram of its structure with labels**<br><br>**Explanation for how it gets lift**<br><br>**Explanation for how it is controlled** |

Use the example below to help you design your Trading Card.

## North American P - 51C Mustang

**Model NA-73X “Excalibur III”**

**Built in 1940**

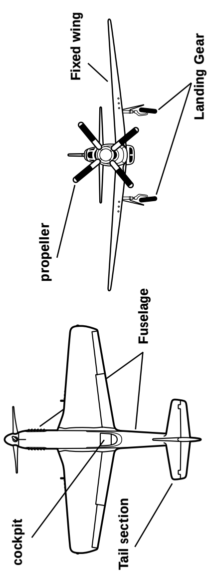


**Engine:** Rolls-Royce/Merlin v-1650-9, 1,695 hp
**Wingspan:** 11.23m (37 ft. 5/16in.)
**Length:** 9.83m (32 ft. 3in.) **Height:** 4.16m (13.8in.)
**Weight:** Gross 5,626kg. (11,600lbs.)

**Front**

**AIRCARFT / TYPE CATEGORY**

**Structure Diagram**




**Explanation for how it gets lift.**

**The airflow over the fixed wing creates lift**

**Explanation for how it is controlled**

**Ailerons**

**Rudder**

**Elevators**

**Back**

# Critical Thinking Questions

1. Name the specific kind of work you think each aircraft type was invented for.
2. Explain the feature of each aircraft type that makes it good for that type of work.
3. List and explain the aeronautical principles that are involved for each aircraft type.
4. For what purpose do think gliders were developed?
5. Draw a layout for an airport that serves only rotating-wing aircraft and explain your design.
6. Draw a layout for an airport that serves only subsonic aircraft and explain your design.
7. Draw a layout for an airport that serves only supersonic aircraft and explain your design.
8. What are airships mainly used for now? Why do you think they are not used as much now as they were in the past?
9. Predict what you think an airport of the future will look like and explain why you think it will look that way. Draw a layout of your future airport.

# Aircraft Types

## A Supplemental Literature Guide

***Title: The First Voyage in the United States***
***Author and Illustrator: Alexandra Wallner***
***Publisher: Holiday House***
***Year: March, 1996***
***ISBN: 0-823-41224-5***

## Description

The First Air Voyage in the United States is a wonderful picture book for young readers detailing the life and adventures of French-born, hot-air balloon inventor, Jean-Pierre Blanchard. The story wonderfully illustrates and details Jean-Pierre's desire to fly "free like the birds" and his attempts to build the first successful hot-air balloon. The story includes his famous European flight across the English Channel and details his adventure of flying the first successful air voyage in the United States.The author uses the French language throughout the story for authenticity and includes a helpful translation guide in the back of the book.

**Susanne Ashby – Curriculum Specialist**
**Liza Alderete – Editor**
**Amberlee Chaussee – Production Assistant**

# Table of Contents

## Aircraft Types: Supplemental Literature Guide

# Correlation to the Standards for the English Language Arts

*(1996 International Reading Association of the National Council of Teachers of English - p.25)*

**Standard 1** Students read a wide range of print and nonprint texts to build an understanding of texts, of themselves, and of the cultures of the United States and the world; to acquire new information; to respond to the needs and demands of society and the workplace; and for personal fulfillment. Among these texts are fiction and nonfiction, classic and contemporary works.

**Standard 4** Students adjust their use of spoken, written, and visual language (*e.g.*,conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes.

**Standard 5** Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes.

**Standard 6** Students apply knowledge of language structure, language conventions (*e.g.*, spelling and punctuation), media techniques, figurative language, and genre to create, critique, and discuss print and nonprint texts.

**Standard 7** Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (*e.g.*, print and nonprint texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience.

**Standard 8** Students use a variety of technological and informational resources (*e.g.*, libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.

**Standard 11** Students participate as knowledgeable, reflective, creative, and critical members of a variety of literacy communities.

**Standard 12** Students use spoken, written, and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information).

# Goals and Objectives
## Language Arts

### Goal 1

To use the writing process to express ideas related to aeronautics, aeronautical events and people.

#### *Objectives*

The Learner will be able to:

- use a prewrite (form of personal choice) to initiate the process;
- create a rough draft based upon the prompt;
- edit the rough draft;
- revise the rough draft according to the feedback received;
- produce a final draft.
- create a variety of written documents: obituary, newspaper article, poem, diary entry, short story, timeline, song, letter.

### Goal 2

To use the specialized vocabulary of aeronautics in written and oral expression.

#### *Objectives*

The Learner will be able to:

- complete a lab sheet using the appropriate aeronautical terms;
- explain aeronautical concepts using appropriate aeronautical terms with the help of charts, graphs, diagrams and models.

## Goal 3

To perform research on aeronautical events, people and principles.

### *Objectives*

The Learner will be able to:

- use various types of CD-ROM to search for information;
- use various types of print material to search for information;
- use Internet resources to search for information;
- create and use note taking guides.

## Goal 4

To read and comprehend the events in a story.

### *Objectives*

The Learner will be able to:

- sequence the main events of a story;
- complete a plotline of the story including setting, characters, problem, rising action elements, climax and resolution;
- describe the main characters and their important traits.

# Daily Lesson Planner

A few days prior to beginning the story, invite a native speaker of French or local high school students studying French to visit for half an hour each day to review the French vocabulary that is found in the story (#1 from the "Into" Activities section). During this time, the students can be assigned activity #2 from the "Into" Activities section (page 80).

## Day 1

- Show a video describing balloon flight, history, etc.
- Lead the students through a discussion of activity #3 from the "Into" Activities section.
- Assign activities #4 and #5 from the "Into" Activities section.
- Review French vocabulary words.

## Day 2

- Review the parts of a balloon and their functions.
- Do activity #6 - #8 from the "Into" Activities section.

## Day 3

- Review the parts of a balloon and their functions.
- Review French vocabulary words.
- Introduce title of story and read about the author and the author's notes.
- Do activity #9 from the "Into" Activities section.
- Do activity #1 - #5 from the "Through" Activities section as the story is read aloud to the class.

## Day 4

- Select from activities #6 - #8 from the "Into" Activities section.

## Day 5

- Do the writing activity from the "Beyond" Activities section.

# INTO ACTIVITIES

# "Into" Activities

1. The week before the class is scheduled to read the book *The First Air Voyage in the United States,* invite a speaker of French to teach the vocabulary phrases found on page 81.

2. Create individual placards with each French phrase printed on them. Give one placard to individual students. As you come across each phrase during the reading of the story, have students holding the placards display them in front of the class after the phrase is read.

3. Share the biography of Blanchard found on page 82 with the class.

4. Hand out the diagrams of a hot-air balloon found on page 83 and review its parts and their functions.

5. Hand out the outlines of the hot-air balloon found on page 85 and have students color their own balloon. Use them to decorate the classroom.

6. Hand out the diagram of the hot-air balloon without labels found on page 84 and have students name the parts.

7. Use the outline map of Europe found on pages 86 and 87 to note the locations of the following places which will be mentioned in the story: Hamburg, Nuremberg, Leipzig, Berlin, Frankfurt, Breslau, Warsaw, Vienna, Anonoy (France), English Channel.

8. Use the outline map of the Northeast part of the United States found on pages 88 and 89 to help note the following locations which will be mentioned in the story: Philadelphia, PA; Woodbury, NJ; the Delaware River.

9. Use the Poster Student Guidesheet on page 90 to guide students in creating a poster announcing Blanchard's hot- air balloon trip in America.

# Translations of French Phrases Used in Book

**Bonjour aux oiseaux!**: Good Morning to the birds!

**Jean-Pierre Blanchard**: Shawn Pee-air Blawn-shard (name)

**Adelys**: Ah-deh-leese (name)

**En haut!**: Up!

**Un, deux, trois...Sautez-vous.**: One, two, three...Jump.

**Il croit qu'il puisse voler!**: He thinks he can fly!

**Attention, Jean-Pierre!**: Be careful, Jean Pierre!

**J'ai une idee, Maman.**: I have an idea, Mother.

**Vaisseau volant**: flying ship

**Sacre bleu!**: Holy blue!

**Ca va**: All is well.

**Pauvre Jean Pierre. Il fait de son mieux.**: Poor Jean Pierre. (name) I'll be back.

**Merci Bien, Monsieur le President**:Thank you, Mr. President.

**Hourra! Nous l'avons fait!**: Hooray! We did it!

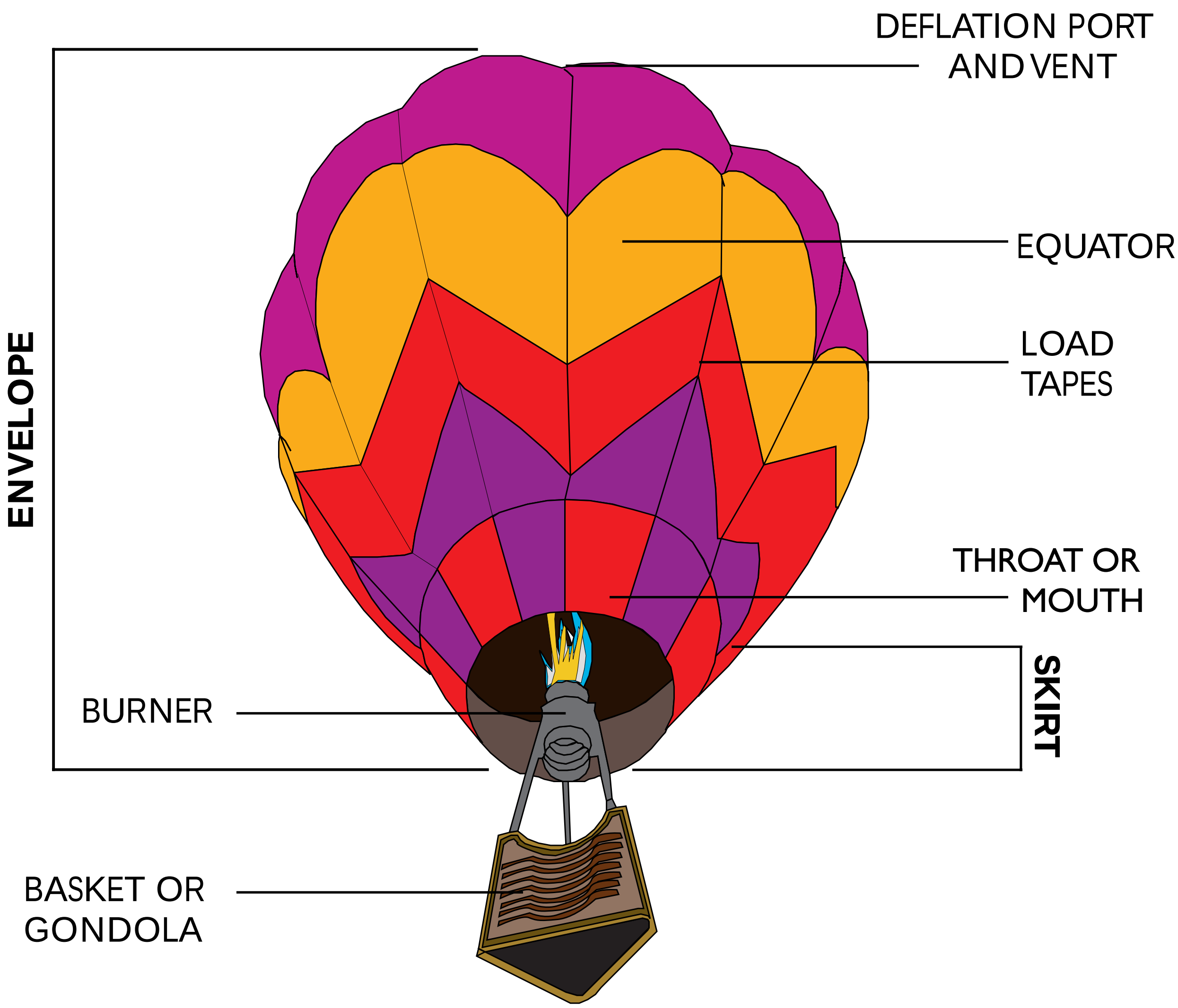
**Qu'est-ce qu'il y a?**: What's up?

**Je m'appelle Monsieur Blanchard.**: My name is Mr. Blanchard.

# Blanchard and the Balloon

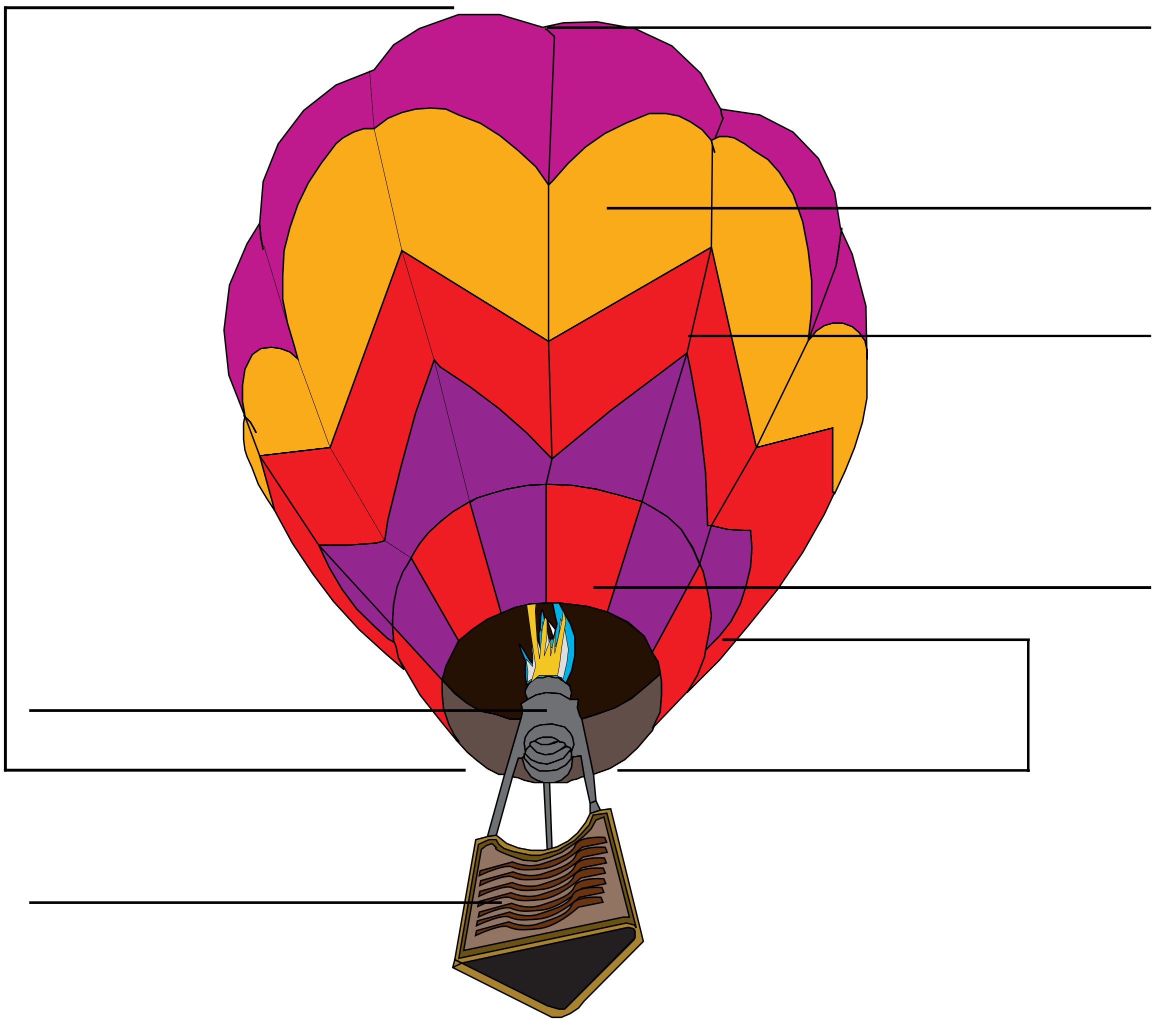
After the Montgolfier brothers demonstrated that a balloon could be used to transport animals and cargo, ballooning became very popular across Europe and the United States in the late 1700s. Ballooning became a spectator sport where large crowds would gather to watch daredevil aeronauts lift off into the skies. Jean-Pierre Francois Blanchard and his wife Sophie became pioneering balloonists or aeronauts. Jean Pierre was born in Adelys, France on July 4, 1753. It had been his lifelong dream to fly as freely as the birds, so he invented his own hot-air balloon and flew it for many years. He is best remembered for the many pioneering balloon flights he made in Europe. On January 7, 1782, American Dr. John Jeffries and Jean-Pierre Blanchard were the first to cross over the English Channel in a balloon. Blanchard was also the first aeronaut to fly a balloon over Germany and the Netherlands. In 1785, he lowered small animals from balloons by parachute to entertain spectators below. On January 9, 1793, he went to the new country of the United States and was the first to pilot a balloon over America. He flew from Philadelphia, Pennsylvania to Woodbury, New Jersey. Although he was not successful at developing his own version of manually-powered helicopters and airplanes, he was a very successful aeronaut who brought the ballooning experience to many people in both Europe and America. In 1808, while ballooning over the Netherlands, he became seriously ill. He died on March 7, 1809, at the age of fifty-five. He is considered to have been one of the greatest early aeronauts.

# Diagram of a Hot-Air Balloon

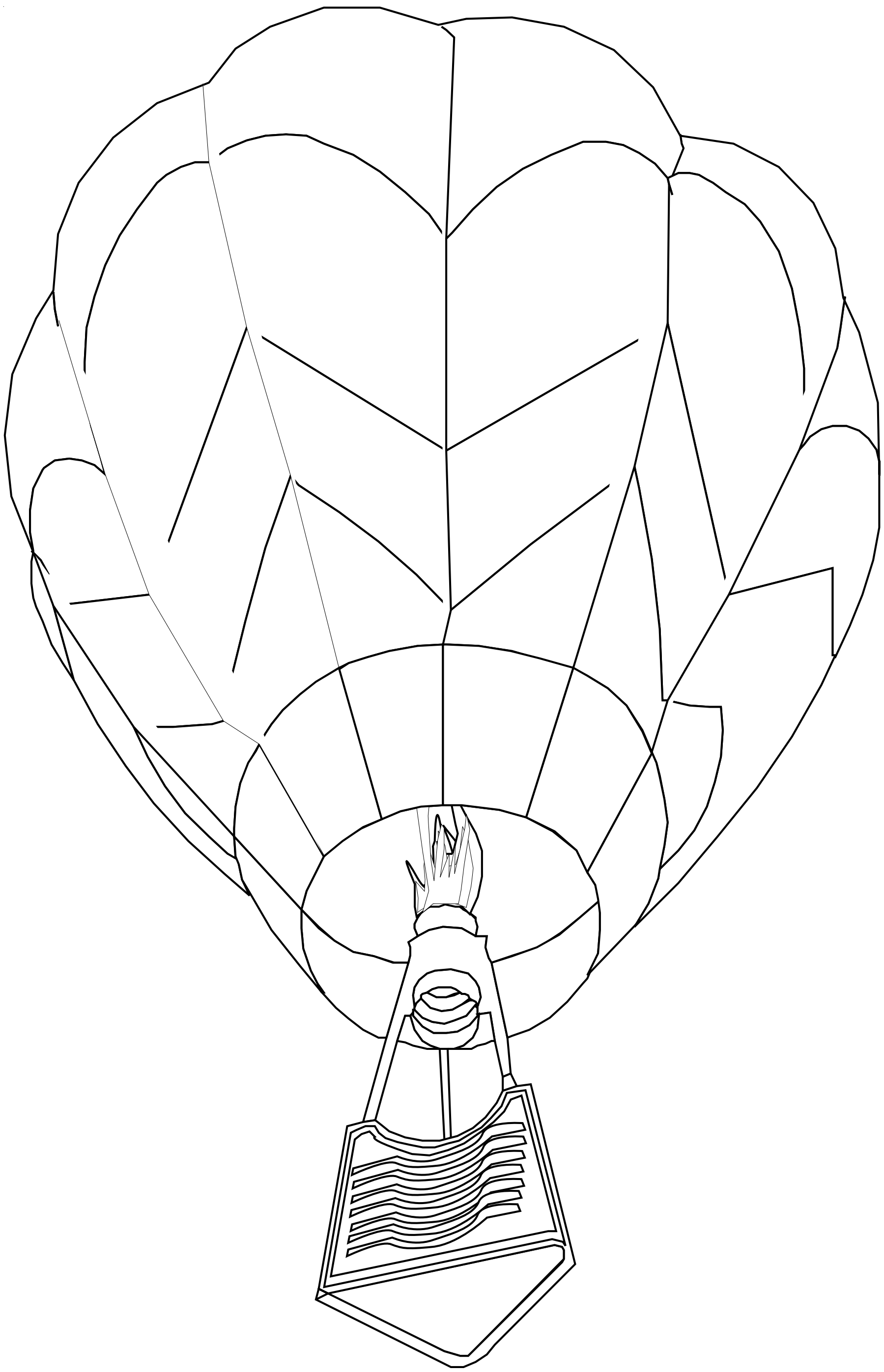


# Student Activity Sheet: Diagram of a Hot-Air Balloon

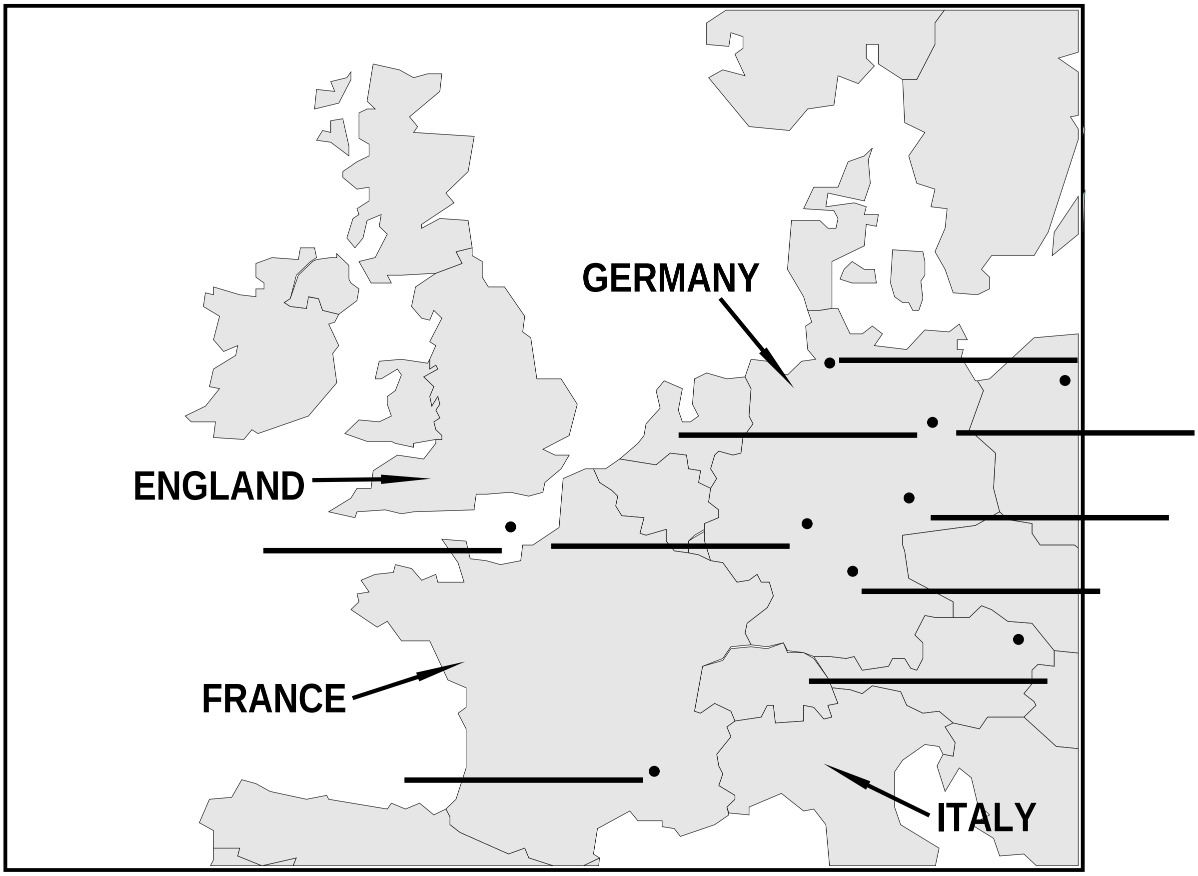
**Directions:** Label each balloon part.



# Student Activity Sheet: Outline of a Hot-Air Balloon



# Student Activity Sheet: Outline Map of Europe

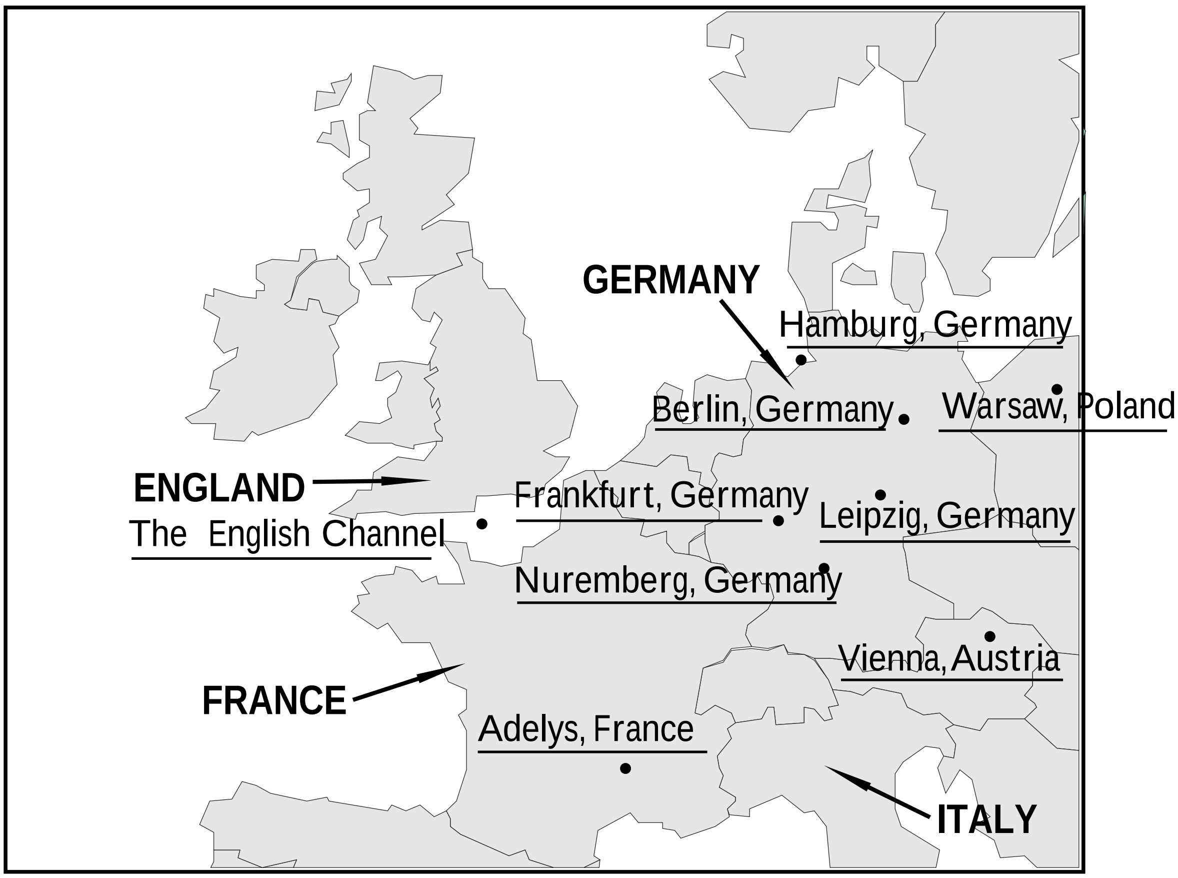



**Directions:** Label the location of each of the following:
(Please, one item per line.)

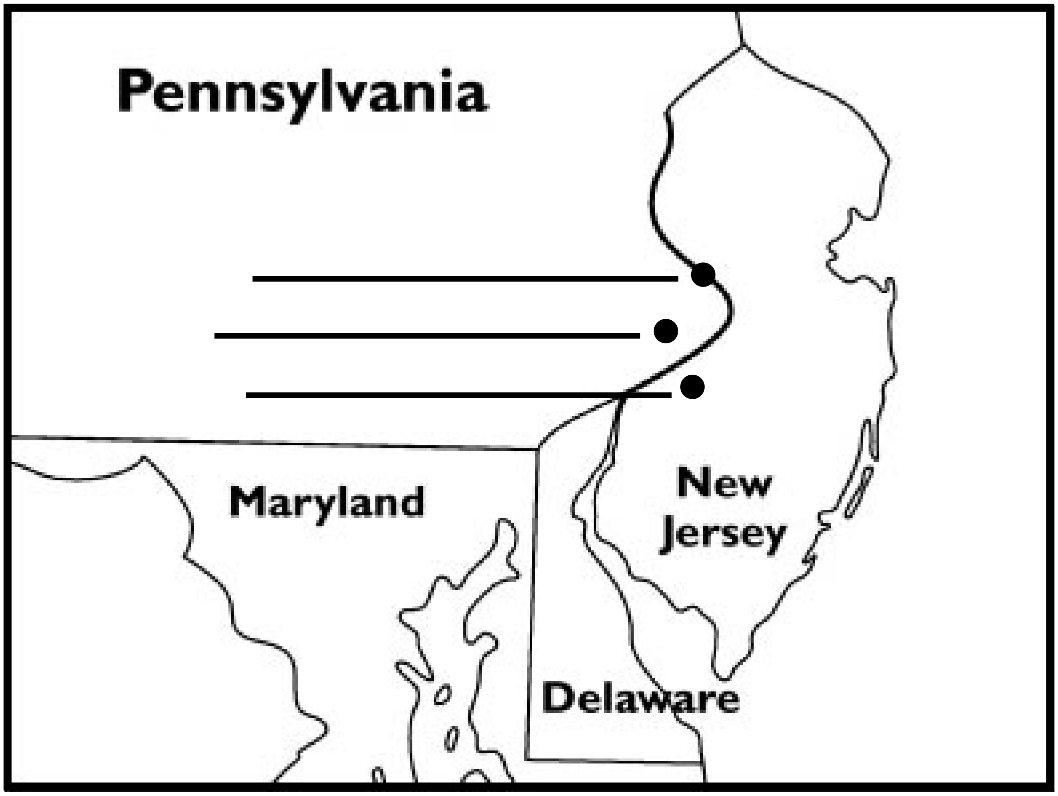
Hamburg, Germany
Nuremberg, Germany
Leipzig, Germany
Berlin, Germany
Frankfurt, Germany

The English Channel
Warsaw, Poland
Vienna, Austria
Adelys, France

# Student Activity Sheet: Outline Map of Europe
## Key



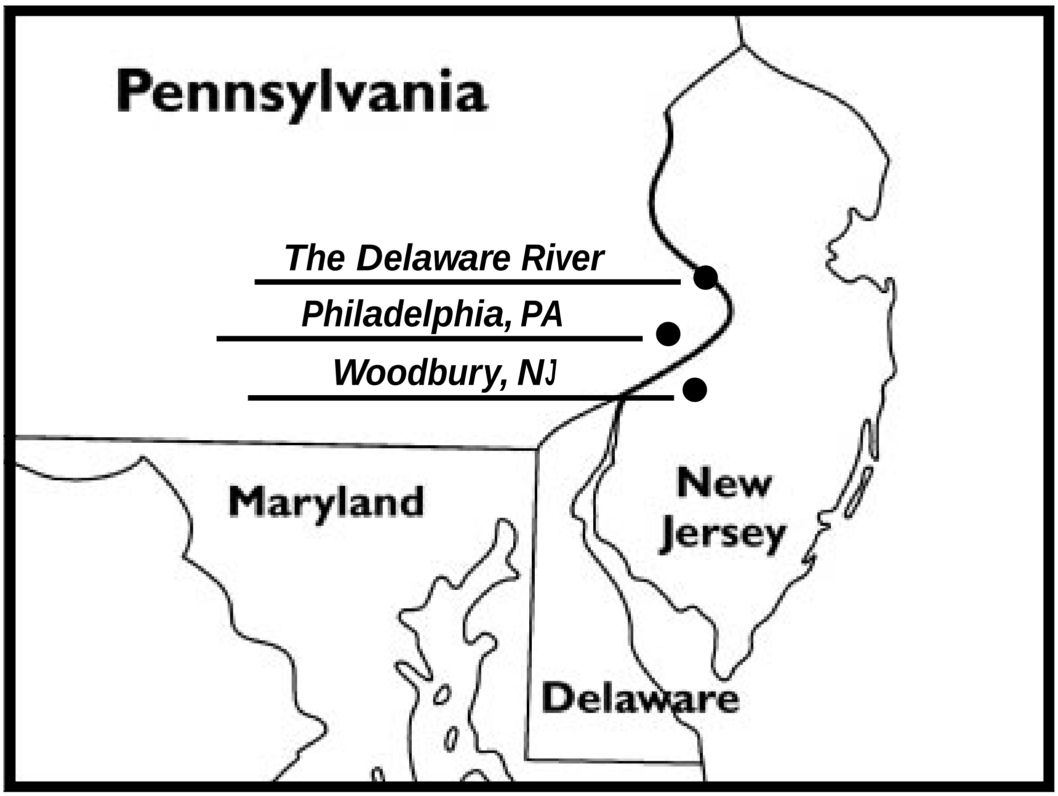
# Student Activity Sheet:
# Outline Map of Northeast United States




Label the location of each of the following:
Please, one item per line.

Philadelphia, Pennsylvania
Woodbury, New Jersey
The Delaware River

# Student Activity Sheet:
# Outline Map of Northeast United States
## Key



# Student Activity Sheet: Poster Guidesheet

Posters are used to announce upcoming events. A poster includes the following information:

1. a graphic that shows the event
2. name of event
3. location
4. date and time event takes place
5. people appearing
6. any other special activities taking place

Create a poster announcing Blanchard's attempt to fly his hot-air balloon in the United States. Use the box below to design the rough draft of your poster.

# THROUGH ACTIVITIES

# "Through" Activities

1. As the book is read aloud use the comprehension questions on pages 93-97 to promote discussion and greater understanding of and appreciation for the story.
2. Use the outline map of Europe found on pages 86 and 87 to note the locations of the following places: Hamburg, Nuremberg, Leipzig, Berlin, Frankfurt (Germany), Warsaw (Poland),Vienna (Austria),Adelys (France), English Channel.
3. Use the outline map of the Northeast part of the United States found on pages 88 and 89 to help note the following locations which are mentioned in the story: Philadelphia, PA; Woodbury, NJ; Delaware River.
4. Discuss what a thermometer and barometer measure.
5. Use the Letter of Introduction (student guidesheets on pages 98-100 for the letter writing activity).
6. Use the Simile Guidesheet on page 101 to discuss and explore writing similes.
7. Use the vocabulary words found on pages 102 and 103 to work the vocabulary crossword puzzle found on page 104.

# Comprehension Questions

1. Have any of you had something that you really wanted to do successfully (or accomplish)?

   *Allow time for sharing. Then state that this story is about a man named Jean-Pierre Blanchard. Explain that he wanted to be able to fly like the birds. He kept trying until he made his dream come true.*

2. How did Jean-Pierre try to fly like the birds?
   - *Hanging onto chickens (Why wouldn't that even work? Because chickens have limited flying ability.)*
   - *Attaching wings to his arms and being catapulted from a seesaw.*
   - *Attaching wings to his body and holding onto parachute-type devices.*

3. Why do you think Jean-Pierre put wings on his balloon? Do you think he fully understood what wings had to do with flight?
   - *Accept all thoughts to the first question.*
   - *He obviously did not understand <u>how</u> wings generate lift. If he truly did, he would have invented an aircraft with either wings <u>or</u> a balloon for lift.*

4. How did you feel when you were showing your friends how to do something and it didn't work successfully?

   *Validate all answers shared.*

5. Who first successfully launched a hot air balloon and when did it happen?

   *Montgolfier Brothers in 1783.*

6. What living things were first to ride in a balloon?

   *Sheep, rooster, duck.*

7. Why do you think the Montgolfier brothers did not put people in first?

   *Probably safety. Add that early space programs first sent animals into space before humans because of safety.*

8. Why do you think Jean-Pierre thought he was lucky that particular flight was successful?

   *Perhaps because it increased the popularity and interest in ballooning.*

9. Who else saw this event?
   *King Louis XVI, his wife Queen Antoinette and the whole royal court.*

10. Who were the first people to ride in a balloon?
    *Jean-Francois Pilatre de Rozier and the Marquis Francois d'Arlandes.*

11. What was Jean-Pierre's wish?
    *That he had been the first.*

12. Do you think he will keep trying to reach his goal of flying "free as the birds" or will he quit because someone else has already accomplished it? How do you know?
    *Validate answers and ask students to back up their prediction.*

13. Did Jean-Pierre keep trying? Why?
    *Yes, because he loved flying and wanted to share the experience with others.*

14. Why do you think landing balloons back then was so difficult?
    *They had no control of the hot air in the balloon. Back then they put hot air in and flew only where the wind blew them. When the hot air cooled or when the anchor was dropped overboard, the balloon would come down. Sometimes it would be a jolt and a bumpy landing as the gondola was dragged across the ground.*

15. Ask students to point out on a map where each location is.
    *See answer key map on page 16.*

16. Point out the reaction of each encounter on page 8 of the story. Note the humor.

17. Where did Jean-Pierre begin his crossing?
    *England - Have a student point it out on the map.*

18. Where did Jean-Pierre end his crossing?
    *France - have a student point it out on a map.*

19. Pull down a map and have students point out England and France and the English Channel. Then ask them in which direction Jean-Pierre flew.
    *N-W to S-E*

20. Did Jean-Pierre fly alone?
    *No, Dr. John Jeffries flew with him.*

21. Why do you think his flight was called the 8th wonder of the world?
    *Briefly explain the reference of the 7 wonders of the world.*

22. Even though Jean-Pierre had already made 44 flights in Europe, where did he really want to fly?
    *America.*

23. Why did he want to fly in America?
    *Since the American Revolution, he had admired the Americans' free spirit. He wanted a chance to fly where people were as free as the birds. (Here is an opportunity to relate to the students what the American Revolution meant to the rest of the world at that time.)*

24. When did Jean-Pierre get his chance?
    *January 9, 1793. Point out the locations on the map of the two cities mentioned in the story.*

25. What famous people were there for the lift off?
    *Thomas Jefferson, James Monroe, John Adams, James Madison, Dolly Madison, Betsy Ross, George and Martha Washington.*

26. What do you think a "letter of introduction" is?
    *After accepting their thoughts briefly tell them that back in those days when someone traveled to another place, they would bring with them a letter from a friend or acquaintance that told about who the bearer of the letter is. The letter would introduce the bearer.*

27. What do we do now instead of writing a "letter of introduction?"
    *1. Call the person directly and tell them.*
    *2. Send the person an e-mail.*
    *3. Mail a letter directly to the person.*

28. Why do you think Jean-Pierre took a dog with him on this flight?
    *Validate any reasonable answer. Possible responses: to see how an animal would react in a higher altitude, for company; as a favor to a friend; etc.*

29. How did the people at that time celebrate the liftoff of the balloon?
    *Cannons were fired, bands played and the crowds cheered.*

30. Point out that the author uses one type of figurative language twice on that page. Re-read page 14 and ask the students to identify the two examples and name the type of figurative language.
    *Simile*
    *...river looked like a ribbon...*
    *Clouds were like wispy cobwebs.*

31. How did Rebel react to the liftoff?
    *Rebel was nervous. Ask students to relate how a dog would show nervousness.*

32. Did Jean-Pierre then sit back and enjoy the ride?
    *No, he had agreed to do some scientific experiments.*

33. What is the purpose of the bottled-air experiments?
    *To examine what the air was like farther away from Earth.*

34. What do you think the results of such an experiment would be?
    *Validate any logical answer: different mix of elements, less oxygen, "thinner" air, fewer molecules.*

35. What do you think is the purpose of the experiment of weighing the stone?
    *Validate any logical answer: test the effects of gravity; see whether gravity is weaker, stronger or the same the higher you go.*

36. Why do you think the stone weighed less?
    *Validate any logical answer. Perhaps the balloon rode a gust of wind upward at the time of the weighing, throwing the test off. Perhaps the unstable ride threw off his results.*

37. What do you think is the purpose of the experiment of Blanchard taking his pulse?
    *Check the effects of higher altitude on the circulatory system or the heart.*

38. Why do you think his pulse rate was higher than when he was on the ground?
    *Change in altitude or his natural excitement.*

39. What got Rebel excited?
    *A passing flock of pigeons.*

40. What tilted the balloon?
    *A gust of wind.*

41. What almost happened to Rebel during the wind gust?
    *The wind gust tilted the gondola and Rebel almost fell out. Blanchard caught him though.*

42. Describe what Blanchard did to prepare for the landing.
    *1. Locked equipment securely away.*
    *2. Looked for an open space on the ground below.*
    *3.Threw out the anchor.*

43. How long did the trip take?
    *46 minutes.*

44. Why do you think the farmer was afraid?
    - *Blanchard could not speak the farmer's language.*
    - *Blanchard came down from the sky*
    - *Blanchard was shouting at him.*

45. Why were the farmers impressed with Blanchard?
    *They read the letter from George Washington and were impressed because the letter was from the President who they admired and loved so much.*

46. How did Blanchard return to Philadelphia?
    - *He deflated the balloon and put the balloon and gondola on a wagon.*
    - *Blanchard rode alongside the wagon on a "spirited horse."*

47. Blanchard and Rebel accomplished 3 firsts. What were they?
    *1. First man to fly in America.*
    *2. First airmail letter.*
    *3. First dog to fly in America.*

48. How did Blanchard accomplish his dream of "flying in the air, free like the birds."
    *He flew his hot-air balloon in a free country.*

# Student Activity Sheet:
# Letter of Introduction Guidesheet

A letter of introduction is a special form of writing. The purpose of such a letter is to introduce someone you know to another friend of yours who lives in another town. This letter lets the reader know that you can vouch for your friend's character. That means that you trust your friend to be a good person. When you write a letter of introduction, include these items in your letter:

1. How you and the person you are introducing are connected; (friend, brother);
2. How long you have known him/her;
3. Why this person is going to this area;
4. What are this person's qualifications or experiences;
5. What kind of help are you asking your friend to give to this person.

*See the example on the next page to give you a better idea of how a letter of introduction might read. The numbers to the right tell what kind of information the writer is giving.*

# Student Activity Sheet: Letter of Introduction
## Sample Letter

Kim Silvers March 13, 1997
Computeristic
123 Arrow Ave.
Moffett Field, CA 94035

Creative Education
456 Schoolhouse Way
Edville, CA 95736

Dear Michelle Olsen,

The bearer of this letter is a friend of mine. Her name is Julie **1**
Carroll. She worked for me as a computer programmer during
the last five years. Although she has been very happy working **2**
for my company, she would like to live closer to her family who **3**
lives in your town. She is looking for a job as a computer
programmer creating educational software. Working in my
company over the last five years, she helped to create an exciting
CD-ROM on Aeronautics that was widely used in schools. She **4**
received an award for being the most outstanding computer
programmer in my company. Her work is exceptional. I would **5**
be grateful if you would take the time to interview her and look
over her portfolio of work. If you do not have a job opening
now, I would appreciate it if you would recommend her to
other companies in the area who are hiring.

Thank you so much for your help.

Sincerely,
Kim Silvers

# Writing Experience:
# Directions for Your Letter of Introduction

Choose one of the two.

**A.** Pretend you are President George Washington. Write a letter of introduction for Blanchard. Blanchard will use this letter to get help after he lands his balloon. Remember to let the reader know that Blanchard cannot speak English!

**OR**

**B.** Pretend your friend is moving to the same town that your cousin lives in. You have found out that your friend will be going to the same school as your cousin. Write your cousin a letter introducing your friend and asking your cousin to help your friend feel welcome in his/her new school.

# Student Activity Sheet: Simile Student Guidesheet

Writers use special words to create images in the reader's mind. This special language is called figurative language. The author of the story *The First Air Voyage in the United States*, uses a certain kind of figurative language called simile. A simile is a way to compare, using the word "like" or "as." For example, the author of the story compares Blanchard's flying to that of the free flight of birds.

Let's try writing a simile. First, pick a thing (person, place, animal or object): a car's engine. Next pick another thing that is unlike the first: a tiger. Now make a comparison between the two.

***Example:*** *The car's engine growled like a tiger hunting in the jungle.*

Choose one word from each of the two boxes below and create your own simile. Don't forget to use the word "like" or "as" in your comparison.

| Word 1 | | Word 2 | |
|---|---|---|---|
| runner | house | jet | tree |
| wind | rose | ocean | smiling face |
| fly | pillows | sailboat | warm bath |
| man | ice skater | train | clouds |

1. Word 1: _________________ Word 2: ________________
   Comparison (use "like" or "as")

2. Word 1: _________________ Word 2: ________________
   Comparison (use "like" or "as")

3. Now try one of your own.

# Vocabulary List for *The First Air Voyage*

| | |
|---|---|
| **voyage** | to take a trip or travel |
| **operate(d)** | to make something work or perform a function |
| **lever** | a rigid bar used to exert a force |
| **disappoint** | to fail to meet one's expectations |
| **demonstrate** | to clearly show or prove |
| **enthusiastic** | to be filled with strong excitement |
| **European** | being from Europe |
| **politician** | a person who is involved in the business of government work |
| **nervous** | easily excited or irritated |
| **wispy** | appearing like a thready streak or thin strip |
| **experiment(s)** | a test following a strict procedure |
| **scientist** | a person who regularly uses the systems of knowledge found in science |
| **examine** | to test, inspect or investigate closely |
| **tilt** | to lean or slant at an incline |
| **equipment** | the tools used to perform an activity |
| **consisted of** | to be made up of something |
| **thermometer** | an instrument used to measure temperature |
| **barometer** | an instrument used to measure the pressure of the atmosphere |

# Vocabulary List for *The First Air Voyage - continued*

**experienced** made skillful through practice

**successful** gaining a positive or favorable outcome

**impressed** to get positive or favorable acknowledgment

**deflated** to release air or gas from

**spirited** lively or brisk quality

**letter of introduction**
a written communication that formally presents the bearer of the letter to the person to whom the letter is addressed

# Student Activity Sheet: Crossword Puzzle
## *The First Air Voyage*

**Directions:** Use the vocabulary words from the story *The First Air Voyage in the United States* to find the answer to the clues below. Double-check your spelling before you write the answer in the squares.

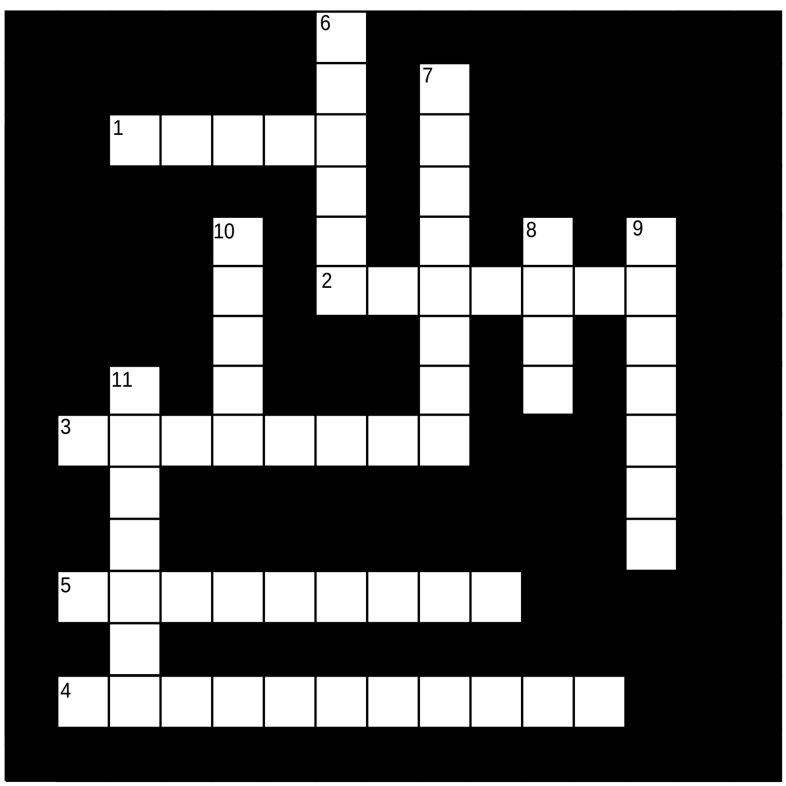
### CLUES

**Across**

1. thread-like streak
2. to investigate
3. lively
4. to clearly prove
5. an instrument used to measure air pressure

**Down**

6. take a trip or travel
7. to release air from
8. lean at an incline
9. easily excited
10. a bar used to exert a force
11. to make something work



# Student Activity Sheet: Crossword Puzzle - Key
## *The First Air Voyage*

**Directions:** Use the vocabulary words from the story *The First Air Voyage in the United States* to find the answer to the clues below. Double-check your spelling before you write the answer in the squares.

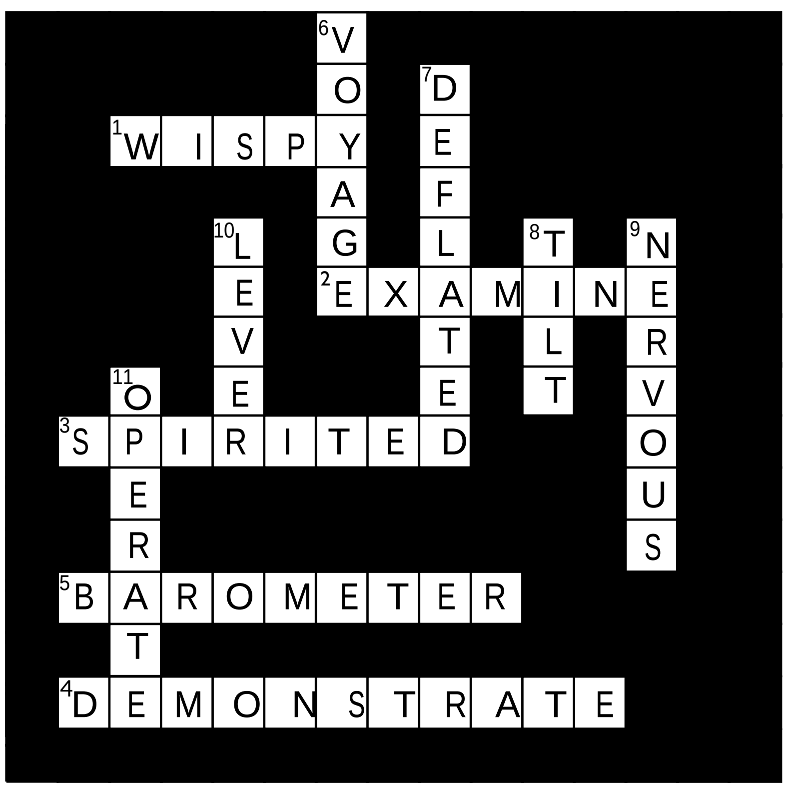
**CLUES**

**Across**

1. thread-like streak
2. to investigate
3. lively
4. to clearly prove
5. an instrument used to measure air pressure

**Down**

6. take a trip or travel
7. to release air from
8. lean at an incline
9. easily excited
10. a bar used to exert a force
11. to make something work



# BEYOND ACTIVITIES

# "Beyond" Activities

1. Use the Dog Perspective Guidesheet on page 108 to rewrite the story using Rebel, the dog's perspective. Have the students work in partners or small groups to write and to include pictures that are drawn from the dog's perspective.

2. Engage the students in a mathematics activity (Student Activity Sheet: Don't Let It Weigh You Down!, page 109-113) in which they learn about hot air balloons and payload weight capacity. Students are given various scenarios through which they determine what or who will have to be left behind.

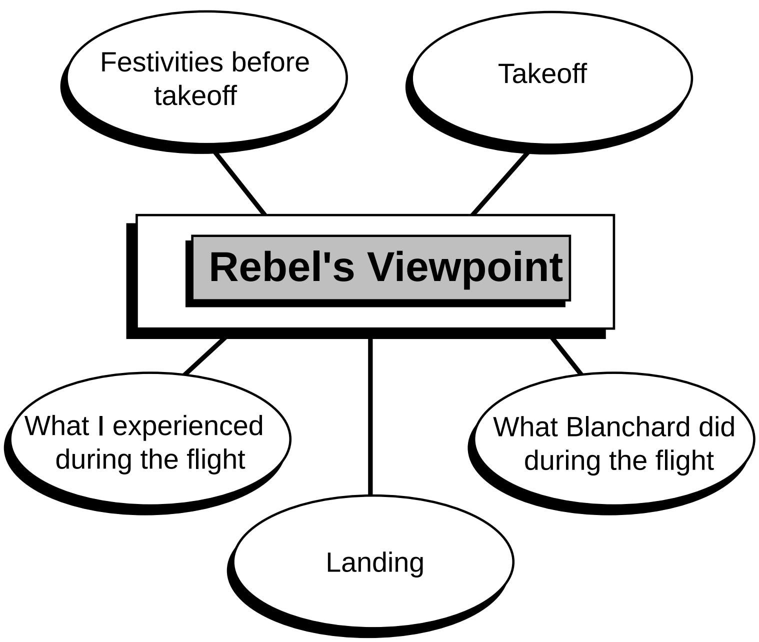
3. Create a miniature hot-air balloon out of tissue paper. See the book *Aviation and Space Science Projects* by Dr. Ben Millspaugh, 1992, TAB Books, ISBN: 0-8306-2156-3.

# Student Activity Sheet: Dog Perspective

When Blanchard made the first flight in the United States, he took along some scientific equipment to do some experiments. He also took along a dog. The dog's name was never recorded, so the author gave the dog the name of Rebel.

Pretend you are Rebel, the dog. Rewrite the part of the story where Rebel flies in the balloon with Blanchard. Tell about the festivities on the ground before the balloon took off. Describe what the takeoff felt like as you rose higher and higher into the air. Tell what you (as Rebel) would feel, see, hear and smell along the journey. Tell what you observed Blanchard doing during the flight. Describe the landing and how happy you were to be back on land.

Use the cluster below to help you organize your thoughts for your prewrite.



# Student Activity Sheet: Don't Let It Weigh You Down!

**Background:** When flying in a lighter-than-air balloon, the load you carry cannot weigh more than what the balloon can carry. Many years ago, through trial and error, methods were developed to accurately predict how much weight a balloon could carry. These methods use four measurements:

- the size of the inside of the balloon and how much gas it can carry — called the "volume" of the balloon
- how much the equipment weighs (including the balloon itself, ropes, gondola, and the gas)
- how much the aeronaut, passengers, and cargo weigh
- the density of the gas

Say that you are an aeronaut who had planned to take your three cousins on a balloon ride to see the countryside from the air. You also planned to bring a picnic lunch to feed everyone (including yourself!) and, since it is cooler up in the air, you wanted to bring some blankets to keep everyone warm. Just when you had everything ready to go, your cousin from far away paid a surprise visit and wanted to go along also. Given all the facts below, can your cousin go along?

In preparation for the flight, you had calculated the total weight of all the people and equipment you expected to bring along. Your calculations were as follows:

| **Item** | **Weight** |
|---|---|
| You (the aeronaut) | 80 pounds |
| Cousin Susanne | 65 pounds |
| Cousin Phil | 70 pounds |
| Cousin Andrew | 75 pounds |
| balloon | 250 pounds |
| gondola | 300 pounds |
| ropes and other equipment | 50 pounds |
| lunch for four people | 20 pounds |
| blankets for four people | 8 pounds |
| **Total** | **918 pounds** |

Your balloon, with brilliant red, white and blue stripes, is as tall as a three-story building and can carry 89,000 cubic feet of gas. You can say that the volume of your balloon is 89,000 cubic feet. You also know from your study of chemistry that the density of helium is .011 pounds per cubic foot.

To calculate how many pounds your balloon could carry, you multiplied the density of the helium by the volume of the balloon.

Density of the helium = .011 pounds per cubic foot

Volume of the balloon = 89,000 cubic feet

.011 pounds per cubic foot X 89,000 cubic feet = 979 pounds

So, based on your calculations, you could carry 979 pounds on your flight. On the list above, where you totaled the weight of all the items you expected to carry, you expected to carry 918 pounds.

Would you be able to fly your three cousins, plus lunch and blankets on your balloon? Yes! Because they weighed 918 pounds and you could carry 979.

But, what about your cousin Bryant who wanted to come along? Bryant tells you that he weighs 85 pounds. You add Bryant's weight to the total weight of all the items you expected to carry:

918 pounds + 85 pounds = 1,003 pounds

Oh, no! Bryant cannot fly with you! Can you tell why?

That's right! The reason is that adding Bryant causes the total weight of the items you want to carry to be too heavy for the balloon you have.

What can you do so Bryant can go along? Well, you calculated that your balloon could carry 979 pounds. How much over that limit are you if Bryant comes along?

1,003 pounds - 979 pounds = 24 pounds

So, you must remove 24 pounds from your weight list. Obviously you cannot remove the people, the gondola, the balloon or the ropes and other equipment. What's left?

Well, the total weight of the lunch and blankets is:

20 pounds + 8 pounds = 28 pounds

So, if you left the lunch and blankets at home the total weight you need to carry is:

1,003 pounds - 28 pounds = 975 pounds

Without the lunch and blankets, the total weight of 975 pounds is less than the 979-pound limit that your balloon can carry. You need to decide whether Bryant comes along on the flight and the lunch and blankets stay home, or the lunch and blankets come along and Bryant stays home. What will you do?

Use the following template to help you complete the exercises below.

# Student Activity Sheet: Don't Let It Weigh You Down!

## Template

**Step 1:** Fill in the following weight list table. List the items you want to take along in the left-hand column, and the weight of each item in the right-hand column.

| Item | Weight |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| **Total** | |

**Step 2:** Calculate the total weight your balloon can carry. Assume that you will fill your balloon with helium gas.

Density of the helium = .011 pounds per cubic foot

Volume of the balloon = ____________________cubic feet

.011 pounds per cubic foot X ___________ cubic feet = ________ pounds

**Step 3:** Determine whether the balloon can carry all of the items you want to take with you.

Is the total weight of all the items you want to carry greater than, less than, or equal to the weight the balloon can carry? Circle the correct answer

| | | |
|---|---|---|
| | is less than | |
| _________________ pounds | is greater than | ______________ pounds |
| total weight of items | is equal to | weight balloon can carry |

Will the balloon carry all of the items you want to take? ________ (yes/no)

**Step 4:** If your answer was "yes", then Bon Voyage!

If your answer was "no", then you need to go back to your Weight Table and figure out what can be left at home, then redo your Weight Table and Step 3.

What are some other steps you could take to lighten the load?