

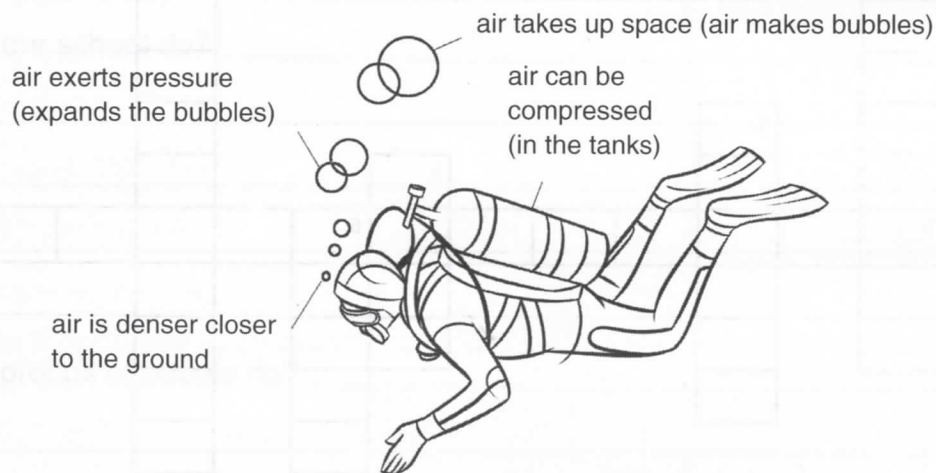
# All About Air

Air is all around you. You cannot live without air. Air makes flight possible too. Planes and rockets, birds and bumblebees—every type of flying thing uses air.

## Some Properties of Air

Unless the air around you is heavily polluted, you cannot see, taste, or smell the air. If you think you cannot feel air, take a deep breath. You can feel air rushing into your lungs.

Air also has mass or weight. A balloon weighs more after you fill the balloon with air. You experience the pressure air exerts on every surface. Closer to the ground, more air is pushing down on top on you and Earth's gravity pulls more. The higher up you go, the less air pressure there is. Air becomes thinner and more spread out.



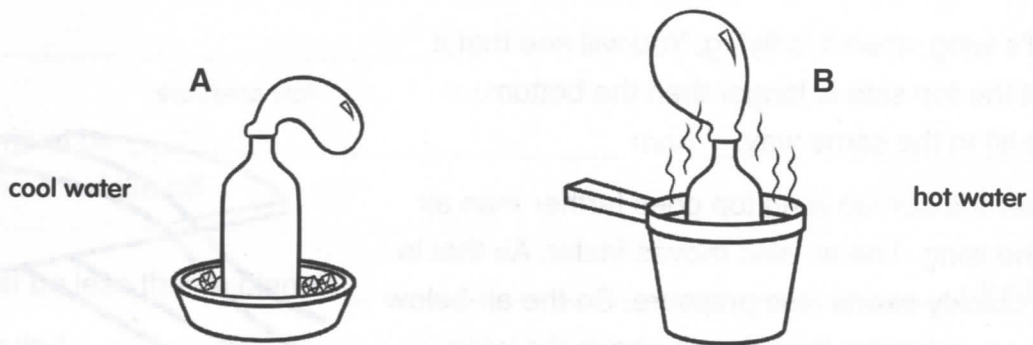
When it comes to flying, pressure is probably the most important property of air. Air pushes on every surface. Try this: Hold two pieces of paper out in front of you, about 8 cm apart. Now blow between them. Did you expect the sheets to fly apart? They move closer together because the force of air on either side of the paper is unbalanced. The air moves quickly between the two papers. The moving air exerts less pressure than the air pressing on the outsides of the papers.

*Aerodynamics* means the motion of air and how air affects everything moving through it. People who design flying things have to know all about aerodynamics. This helps them build aircraft that fly efficiently and safely through the air.

## "All About Air"—Think About It!

1. On another piece of paper, list all the things you know about air. For example, can air move? Can air move other things? Does air have a temperature? Can air rise or fall? Can air hold moisture? Write down how you know these things.
2. An experiment is shown in the diagrams below. The bottle contains only air. Diagram B shows what happened after the bottle was placed in hot water.

### Heated air expands



a) How does the hot water affect the temperature of the air in the bottle?

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b) When the bottle is placed in hot water, the balloon expands. What two things happened to the air in the bottle? How do you know?

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c) Based on this experiment, what property of air could be added to the article "All About Air"?

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d) If the bottle in diagram B is placed back in the cool water, what will happen to the balloon? Explain why.

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# Taking Flight

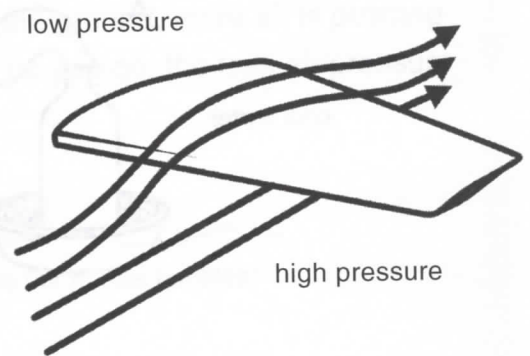
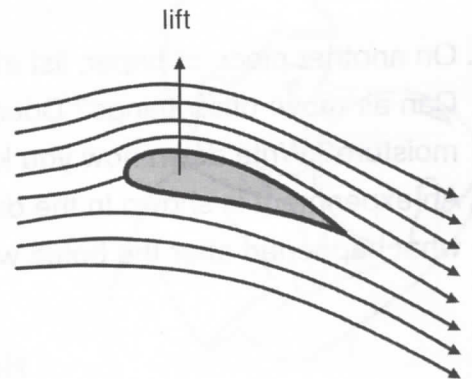
Find out about the four forces of flight: lift, weight, drag, and thrust.

## Just a Little Lift

*Lift* helps an airplane overcome its weight. Lift also helps the plane rise into the air, and stay up in the air. Many parts of a plane work together to create lift. Most lift is generated by the wings.

Look at a bird's wing when it is flying. You will see that it curves so that the top side is longer than the bottom. Planes create lift in the same way.

Air moving over the curved wing top goes farther than air going under the wing. The air also moves faster. Air that is moving more quickly exerts less pressure. So the air below the wing pushes up harder than the air above the wing pushes down. That lifts the plane into the air.



## What a Drag!

When a plane moves through the air, the plane has to overcome drag. *Drag* is a force similar to friction. Drag slows down objects moving through air. Every part of a plane generates drag, even the engines.

The more streamlined, or aerodynamic, the plane is, the less drag the plane creates. The less drag the plane creates, the faster and more easily the plane can move through the air.

## Overcoming Gravity

Earth's gravitational force makes it difficult for a plane to fly. You measure the force of gravity (weight) whenever you step on a scale. Gravity is a force that keeps a plane on the ground. The weight of plane has to be overcome before it can fly.

## Give It Some Power

*Thrust* is the force that propels an aircraft through the air. Thrust is used to overcome the plane's weight and the drag of the air on the plane.

Birds create thrust by flapping their wings. In an aircraft, thrust is generated by the engines. Thrust makes lift possible.



## "Taking Flight"—Think About It!

1. Think about how the four forces of flight are related. Use the words below to complete the sentences.

<b>drag</b>	<b>land</b>	<b>less</b>	<b>lift</b>
<b>more</b>	<b>takeoff</b>	<b>thrust</b>	<b>weight</b>

a) \_\_\_\_\_ must be greater than weight for a plane to \_\_\_\_\_.

b) Thrust must be \_\_\_\_\_ than \_\_\_\_\_ for a plane to take off.

c) Lift must be less than a plane's \_\_\_\_\_ for the plane to \_\_\_\_\_.

d) \_\_\_\_\_ has to be \_\_\_\_\_ than the drag for a plane to land.

2. Identify the force in each example: drag, lift, weight, or thrust.

a) A bird stretches out its wings for takeoff: \_\_\_\_\_

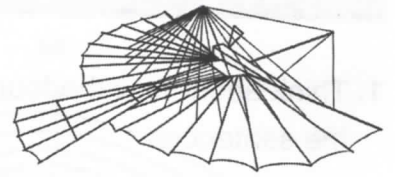
b) Sinking into mud: \_\_\_\_\_

c) Pushing with your foot to make a skateboard go faster: \_\_\_\_\_

d) Using a parachute to fall through the air more slowly: \_\_\_\_\_

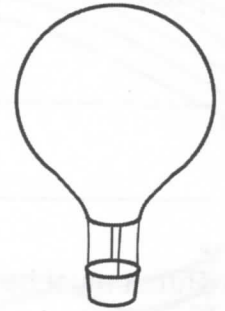
# A Short History of Flight

As far back as the year 1500, the inventor and painter Leonardo da Vinci drew airplane-like machines. He never built any of them, but he inspired other inventors.



## Hot-Air Balloons

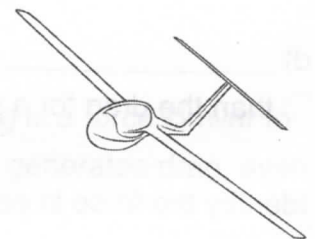
Since about 250, hot-air balloons were used as military signals in China. In 1783, brothers Joseph and Étienne Montgolfier had the idea of sending people up in a hot-air balloon. No one knew if there was air that far above Earth's surface. And, if there was air, was that air safe to breathe? Onlookers were amazed and shocked when it worked.



## Bernoulli Principle

The hot-air balloon was a step forward in air travel, but the balloon could only drift in the wind. Inventors wanted a machine they could control. Serious inventors knew of the work of Daniel Bernoulli. In 1738, Bernoulli realized that the way air flows past a curved wing pushes or lifts it into the air.

Using Bernoulli's principle, British experimenter Sir George Cayley designed several gliders. A glider depends on wind to move and stay aloft. A glider has no engine, but it can be steered. In 1849, Cayley launched a glider that carried a 10-year-old boy a short distance. That was the first time a glider had flown with a person on board.



Cayley's work inspired Otto Lilienthal, a German engineer. By 1896, he had made about 2000 glider flights. Lilienthal added an engine to power his glider, but it crashed, killing him.

## Orville and Wilbur Wright

This tragedy frightened off many aircraft builders, but not American inventors Orville and Wilbur Wright. They were determined to add power to their gliders. In 1903, the Wright brothers became the first people to fly in a controlled and powered aircraft.

Better fighter aircraft were needed during World War II. In the early 1940s, airplanes became jet propelled. Today they are used to fly people for business or pleasure. They are also used to deliver goods around the world.



## "A Short History of Flight"—Think About It!

1. Complete the timeline below to summarize information from "A Short History of Flight."  
(Use point form to list accomplishments.)

When	Who	Accomplishment

2. What do you think flight will be like 50 years from now? List your predictions on another piece of paper.