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Catching Air



Written by Jeffrey B. Fuerst

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Skydivers jump from an airplane.

Air and Flight

Look, up in the sky! Is it a huge bird? Is it Superman? No, it's a regular person flying high, or "catching air," while hang gliding, skydiving, or parasailing. Maybe you'd like to try one of these wind-powered sports and soar and swoop through the wide-open skies. All you need is a sense of adventure, the right equipment, and an understanding of how wind works.

First, let's look at air. You can't exactly *see* air, which is a collection of gases, and you can't really *feel* it unless it is moving. But air has weight and temperature, and takes up space (volume). Air moves around. When air heats up, it becomes lighter and rises. Air becomes wind when cooler, heavier air rushes in to replace the warmer, lighter air that is rising. A light wind can move leaves; a heavy wind can move the whole tree!



Hot-air balloons rise because the heated air inside the balloon is a higher temperature than the cooler air outside.

Wind-sport enthusiasts pay attention to their natural surroundings. They know areas of land heat up faster than areas of water. They need moving air, so they like tall slopes and cliffs. As warm air rises from land, a cooler wind from the sea rushes in to replace it. When this wind strikes the face of a cliff, it is deflected upward. This strong updraft of air creates lift—and a great ride!

Often, wind-sporters look to birds for flying advice. Hawks or seagulls circling lazily overhead are riding a rising column of air called a **thermal**. Smart wind-sporters will also try to catch thermals for rides.



Wind-sporters catch updrafts to give them a boost into the sky.

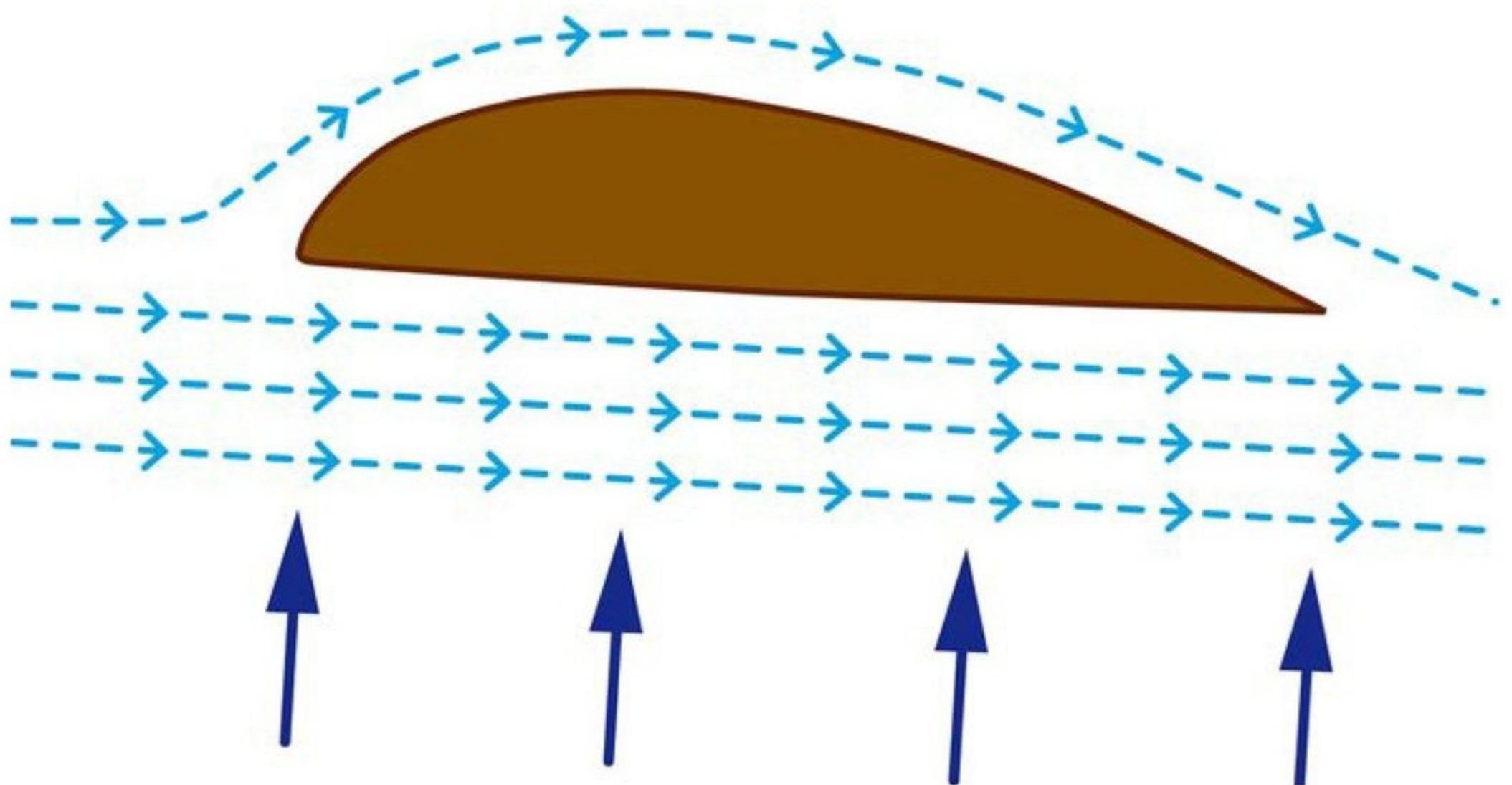
Hang Gliding

The hot summer sun sits high in the mid-afternoon sky. A gentle breeze blows in from the sea. A woman with a triangular-shaped, winged contraption on her shoulders runs down a slope and leaps from the cliffs rising about 915 meters (3,000 ft) above the shore. Yikes! What is she doing? The wing fills with air and billows out, and up she goes!

The pilot has stretched out flat and is hanging from a cocoon-like harness attached to the wing. To climb up or dive down, she pushes or pulls back on a long metal control bar. To turn left or right, she *leans*. The edge of the wing tips down, and the glider banks and turns gracefully through the air.



A hang glider pilot launches from a cliff-top ramp to sail over the beach far below.



Air moving over the top of a wing moves farther and faster than air under the wing.

She is hang gliding! And she may sail in the sky for hours if conditions are good—and if she understands a few principles of **aerodynamics** (air-oh-die-NAM-iks), or, the study of how objects move through the air.

The special shape of the wing produces lift as the glider moves through the air. The curved top surface of a wing is a longer distance than the straight underside of a wing. Air moving over the longer, curved top has to move faster than the air moving under the wing. As the air moving over the top of the wing speeds up, the air molecules spread out—which decreases the **air pressure**. The greater air pressure underneath the wing creates lift and causes the wing to rise.

How to Hang Glide

To take off, the pilot runs down a steep slope to gain speed, create airflow over the wing, and create lift for the glider. He's off!

Hanging from the harness, or a special chair seat, the pilot steers along the winds. He catches and rides one updraft, then another. But this isn't a place to relax and daydream. The pilot has to pay attention as he turns, circles, climbs, and dives.

When the pilot pulls the control bar back, the glider gains speed but loses **altitude**, or height. (For every 1.22 meters, or about 4 feet, that the glider moves forward, it also drops about 30 centimeters, or 1 foot.) When he pushes the control bar forward, the wing edge tips up and the glider rises, but it loses speed. The natural downward force of Earth's gravity will pull the hang glider down if it **stalls**, or stops moving forward. To stay up in the air and keep riding along the wind, the pilot keeps the glider moving forward.



The glider's harness keeps the pilot's body straight to cut wind resistance.

What It Takes

Equipment: Harness, helmet, goggles, parachute, glider, and flotation gear if near water.

Clothing: Wear a heavy jacket, jeans, and gloves. It can get very cold at higher altitudes. (Air temperature falls by about 2.2 degrees Celsius, or 4 degrees Fahrenheit, about every 300 meters, or 1,000 feet, up.)

Size: Harnesses are designed to fit a person who is 1.5 to 2 meters (5 to 6½ ft) tall and weighs 40 to 113 kilograms (90 to 250 lbs).

Skills: The ability to carry an 18-plus kilogram (40 lb) weight on your shoulders while jogging. But balance and endurance are more important than strength or speed. Good reflexes and an ability to make fast decisions are a must.

Requirements: Age 16 or older and able to pass a three- to six-month training course.

Cost: \$5,000 to \$6,500 to train and to purchase your hang-gliding equipment.





The Story of Icarus

People have been fascinated by the dream of flight for thousands of years. A Greek myth tells of the inventor Daedalus (DEH-duh-lus) and his son, Icarus, who were imprisoned on an island. Their only way out: to fly. Daedalus watched birds. Then he fashioned wings for himself and his son from feathers held together by wax. They escaped! But Icarus ignored his father's cautious warning and flew too high in the sky. The heat of the sun melted the wax, and Icarus fell to the sea and drowned.

Icarus is a good story but not good science. People could never flap their winged arms fast enough to generate sufficient power to overcome the pull of gravity.



Lilienthal's first glider

Do You Know?

In the 1800s, German inventor Otto Lilienthal discovered that a properly engineered wing would help a person stay aloft for hours at a time. The Lilienthal glider from around 1895 is designed like a bird's wing, with a curved upper surface.

The Wright Brothers used information from Lilienthal's experiments to invent the first airplane.

Hang Glider **Fun Facts:**

- The longest hang glider ride lasted 36 hours.
- Hang gliders typically travel 160 to 320 kilometers (100 to 200 miles). The farthest flight on record is just more than 700 kilometers (435 miles), which was set July 17, 2001, in Zapata, Texas, by Austrian Manfred Ruhmer.
- Flight heights can range from as low as 1.5 meters (5 ft) above the ground to more than 4.8 kilometers (3 miles) high!

Skydiving

A small plane buzzes overhead. At an altitude of 3,048 meters (10,000 ft), the passenger door opens. A person crouching in the doorframe leaps out, arms and legs spread wide. Within 10 seconds, the skydiver is **free-falling** at 193 kph (120 mph). That's twice as fast as a car zooming by on a highway.

You watch, astonished, as the skydiver sharply drops . . . and drops . . . and DROPS for the next 45 seconds. *Release the parachute! Release the chute!* you think.

Finally, at about 762 meters (2,500 ft) above the ground, he pulls the ripcord. Out comes the small **drogue** chute that pulls out the **canopy**, or larger chute. It fills with air, and the skydiver is jerked upward. He continues to fall, but now at a leisurely 16 to 20 kph (10–20 mph). For the next 3 minutes, he enjoys the view and the ride before landing on his feet in a clearing.



A skydiver begins her free fall.

How a Parachute Works

Gravity pulls the free-falling skydiver down toward Earth at speeds of 193 kph (120 mph) or more. When the parachute opens, it fills with air and slows the skydiver's speed. Air trapped in the canopy (the "umbrella" part) presses up against the chute, providing **resistance** that slows the fall. The skydiver glides to Earth.

Buttons Away!

What you need: Four-holed button.
Four 15-inch-long strands of thread.
Scissors. Plastic bag. Tape.

What you do:

1. Cut a 20-centimeter (8-in) square from the plastic bag.
2. Tape one end of each strand of thread to a corner of the plastic.
3. Thread each strand through a different hole in the large button.
4. Tie the threads together.
5. Gently hold or pinch the top side of the plastic in its center, and let the button dangle.
6. Drop your homemade parachute from a high spot, such as off the side of a deck.
7. Watch the button glide to the ground.





A diamond formation

Skilled skydivers can free-fall in formations. To *decrease* their free fall speed, they hold their arms and legs outstretched in the “spread-eagle” position and join hands. Multiple bodies provide more wind resistance, so the divers can float for a longer time. To *increase* free fall speed, skydivers learn to fall in a standing, or vertical, position.

Now that you know how to skydive, what’s next? Experienced skydivers, or sport parachutists, compete in such events as landing accuracy, free fall speed, and freestyle. They put on shows and do stunts in the air, such as passing a baton to each other or creating group formations in the sky.

What It Takes

Equipment:

Jumpsuit, helmet, goggles, main parachute, reserve parachute, harness with attached backpack that holds both. An automatic activation device opens the reserve chute if something goes wrong.



Skills: Have enough strength to carry about 16 kilograms (35 lbs) of equipment and control the toggle switches that steer the chute. Be able to deal with the shock of the chute opening, as well as extreme changes in temperature.

Size: Harnesses are designed to fit a person who is 1.5 to 2 meters (5 to 6½ ft) tall and weighs 40 to 113 kilograms (90 to 250 lbs).

Requirements: Age 16 or older and in good shape. Pass eight training levels, including many jumps with instructors. A student must make 20 solo jumps and pass a written test.

Cost: \$3,000 to \$6,000 for training and equipment.

BASE Jumping

If skydiving from a plane doesn't get your pulse racing, how about parachuting from a tall **B**uilding, **A**ntenna tower, bridge **S**pan, or cliff high above **E**arth? Welcome to the sport of BASE jumping.

Most BASE jumps are made from around 305 meters (1,000 ft) high, which is considerably less than the height at which skydivers open their parachutes. BASE jumpers have just 20–30 seconds in the air to open their chutes and land in a small safety zone. Crazy? Maybe. But only expert skydivers with a minimum of 200 jumps can attempt such daredevil feats, and many places that could be used for BASE jumping have made it illegal because of the danger.



A BASE jumper leaps from a cliff.

Skydiving **Fun Facts**:

- Expert skydivers can land on a tiny target that is about the size of a tennis ball.
- The highest and fastest skydive on record occurred in 2012, when BASE jumper Felix Baumgartner jumped from a capsule attached to a high-altitude balloon floating at about 39 kilometers, or 128,000 feet. That's over 24 miles high! During his free fall descent of 4 minutes and 22 seconds, Felix reached speeds of over 1,340 kph, or 833 mph. He was the first person to break the sound barrier without using an airplane or other vehicle!



Felix Baumgartner leaps from the capsule to begin a record-setting free fall of over 24 miles.

Parasailing

A 10-year-old girl standing on shore straps a harness over her life jacket. She adjusts her helmet and gives the driver of the speedboat the “thumbs-up” signal. The motor roars, the boat scoots forward, and the towrope connecting the girl to the boat tightens. She takes a few steps and begins to glide on the water. Is she water-skiing without skis?

No, she is parasailing! As the boat zooms into the bay, the colorful parachute dragging behind her fills with air. The girl rises like a human kite, 61 meters (200 ft) into the sky.

The boat moving forward provides **thrust**, the power to take off. The air rushing into the parachute provides lift. As long as the towrope stays tight, the flyer sits back and enjoys the ride—and the admiration of all those watching from the ground.



A parasailor soars aloft as he launches from a beachside float.

When towing a parasailor, the speedboat cruises between 24 and 48 kph (15–30 mph). It



Parasailing high above the water

needs to go fast enough to create lift but not so fast that a wave will make it lose control. When turning, or if a strong gust of wind blows from behind, the boat needs to speed up. Slack in the towrope will cause the parasail to fall. Parasailing is not recommended

when the wind is blowing stronger than 24 kph (15 mph).

The height a flyer reaches depends on the speed of the boat and length of the towrope. On average, recreational parasailors reach the height of a 20-story building; maximum height is 183 meters (600 ft) over oceans and 91 meters (300 ft) over large lakes and bays. Some special-attraction parasail rides can go as high as 305 meters (1,000 ft).

Unlike hang gliding and skydiving, parasailing has no minimum age requirement. There is no special training for the parasailor, though the boat driver needs to have experience. There are many ways to parasail. Strap on a harness or sit in a specially designed chair. Ride alone or with a friend. Parasailing is usually done on oceans, lakes, and bays. Flyers take off from the shore from a barge in the water or from a boat equipped with a **winch**. Rides from parasailing companies typically last around 10 minutes and can cost \$50 or more. A basic parasail, plus accessories, can cost \$1,000 and up.



Parasailing History

1918 • Developed during WWI.

A German U-boat (submarine) captain wanted to be able to see above the fog when his boat surfaced.

1948 • Dr. Francis Rogallo developed what he called a Delta kite, the basis for the kind of parachute used in parasailing.

1960s • Parascending was invented, an inexpensive way to teach parachuting.

A parachuter and towrope were attached to a car driven fast enough to raise the parachuter to 305 meters (1,000 ft) before being set free.

1970s • Parasailing became a recreational activity.

Paragliding

Paragliding combines elements of three wind sports: parasailing, hang gliding, and parachuting. Paragliders wear a wing-shaped parachute, and some attach a frame harness with a motor that looks like a big fan. They may take off from a tall cliff or snowy mountainside. Often, paragliders compete to see who can cover the greatest distance or make the best time along a specific airborne course. They may take photos of reference points along the way to prove they passed a designated spot.



Paragliders can stay in the air for hours at a time and travel great distances.

Glossary

aerodynamics (<i>n.</i>)	the study of how objects move through the air (p. 8)
air pressure (<i>n.</i>)	force of the gases that make up air combined with gravity (p. 8)
altitude (<i>n.</i>)	height above a surface (p. 9)
canopy (<i>n.</i>)	a large parachute that slows fall to the ground (p. 13)
drogue (<i>n.</i>)	a small parachute that pulls out the canopy (p. 13)
free-falling (<i>v.</i>)	falling rapidly through the air (p. 13)
lift (<i>n.</i>)	upward aerodynamic force (p. 6)
resistance (<i>n.</i>)	force that slows motion (p. 14)
stalls (<i>v.</i>)	stops moving forward (p. 9)
thermal (<i>n.</i>)	a rising column of air (p. 6)
thrust (<i>n.</i>)	forward aerodynamic force (p. 19)
winch (<i>n.</i>)	a crank with a handle used to lift a person or object (p. 21)

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Explore More

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Some searches to try: *paragliding*, *BASE jumping*, *altitude*, or *parachute*.

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