

# Take Flight!

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**Have you ever looked at the sky and wondered how things you see up there actually work?** Maybe you've seen a bird take off from a tree branch with a great flap of its wings, or glide past your window in a big circle. Perhaps you've noticed planes fly overhead, or even watched helicopters pass by, blades spinning into a blur. Even though all of these flying objects might seem very different, they all work using the same basic parts and principles. Each one takes advantage of the air that surrounds us to generate forces of flight that allow it to defy gravity.

## Before we can talk about flight itself, we need to understand a few basic ideas:

- Air is all around us, and it takes up space and has mass
- Gravity is a force that acts on all of us which pulls everything towards the center of the Earth, which we understand as keeping things on the surface of Earth
- Human designs for flying machines are based on observations made in nature

Imagine living centuries ago, before we knew how flight worked. The only inspiration humans had for how to fly came from things in nature--birds, insects, bats, and even plant parts like seed pods hinted at how moving through the air might be possible.

## The basic parts of a bird are pretty simple:

- A bird has a head with eyes that allow it to see where it's going, and usually leads in the direction of flight
- A bird has wings that help it to get in the air and stay there
- Birds have bodies, where they store their "fuel" (the energy they get from the food they eat)
- Birds have legs so they can land and not stay in the air all of the time
- Birds have tails that help them to control their flight

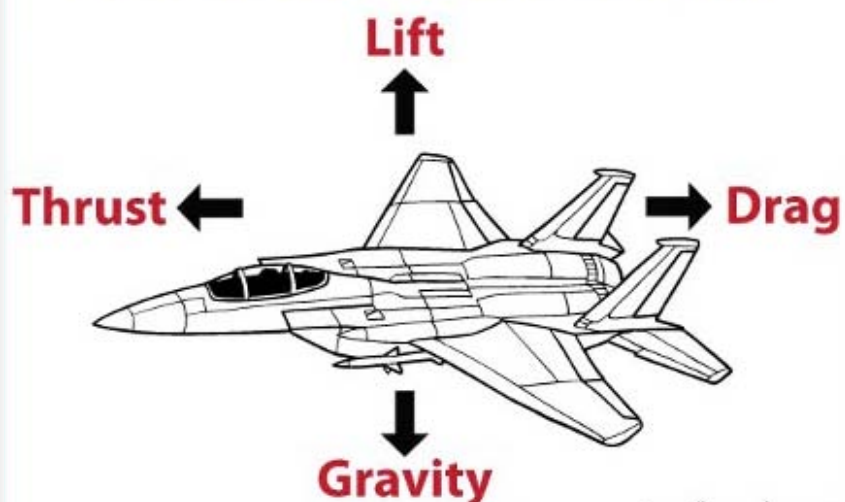


## Airplanes and helicopters have similar parts:

- A **cockpit** area with a window where a pilot can sit and see where they are going that points in the direction they want to fly
- Wings (planes) or blades (helicopter) to help them get in the air and stay there
- A **fuselage** or main body section where fuel, cargo, and passengers go
- Landing gear (planes) or skids (helicopters) to use when they are not in the air
- An **empennage** (tail) that helps to control their flight

Wings and tails are the pieces that help the most with the forces of flight that are needed to actually stay up in the air. Wings are shaped so that they allow air to pass above them and below them. The air going over a wing is forced to slow down compared to the air under the wing, which creates a difference in pressure between the top and bottom of the wing. This is an idea known as **Bernoulli's principle**.

## THE 4 FORCES OF FLIGHT



When the pressure difference is great enough, the higher pressure under the wing pushes up enough to create a force called **lift**, which, as you might have guessed, causes the flying object to go up! When lift is balanced with gravity, an object can stay in the air.

There are two other main forces of flight. **Thrust** is the force that propels an object forward. In an airplane, this is generated by engines; in a paper plane or glider, it's generated by your arm when you throw! Thrust is needed to get the air moving over the wing to create lift, which is why airplanes have to go very fast so they can get enough lift to stay up. **Drag** is the force that works against thrust to try to slow the flyer down. Drag is created by the air all around the flyer coming into contact with it and creating resistance.

## Build a Flyer!

You can build paper airplanes to experiment with the forces of flight. Check out [foldnfly.com](http://foldnfly.com) for some designs you can try based on your experience level, plus some of their tips for how to achieve certain types of flight results.

You can also build your own paper helicopter, also known as a whirlybird. Whirlybirds are tons of fun to send spinning up in a breeze or drop from a balcony. Use this template to build your whirlybird paper helicopter! Follow the directions printed on the template to help you create your flyer. (Hint: do the cutting first and the folding last, and add a paper clip at the bottom edge to help it fly better!)

