Three Aviation Myths

Over our flying careers, from our first instructor to well-meaning amateurs in discussion groups, we collect a lot of aeronautical "facts." Many of these are wrong, and some are downright dangerous. These three articles will debunk three very common myths.

Myth 2

"*The top surface of an airfoil is curved, so the air at the top has further to go. This means it goes faster, and Bernoulli's Principle says higher velocity means lower pressure, thus generating lift on the top surface.*"

Sanity Check

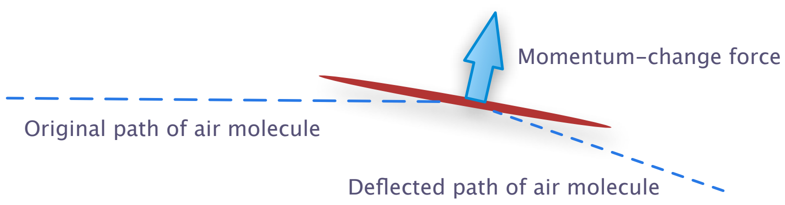
Try this experiment, but only in your head or simulator (if you have an aerobatics endorsement you've already done it for real). Fly straight and level, then do a quick 180˚ snap roll, and push the stick forward far enough to maintain inverted level flight. Hey, wait! The curved bit is on the bottom! Shouldn't we be plummeting to the ground?

Or, if you want to get hands-on, get one of those balsa gliders where the wing is perfectly flat. It flies, so the wing generates lift. Nothing to do with curvature.

The Reality

You can get completely lost in the physics and maths and argue all day about Bernoulli's Principle and the Coanda Effect and many other such ideas, but the basic principle is really simple, and based on Newton's Second and Third laws of motion: when a fluid is deflected (accelerated) by an object, it needs a force to be applied to it, and an equal and opposite force is therefore applied to the object doing the deflecting. In other words, a wing generates lift by throwing air in the opposite direction of the lift.

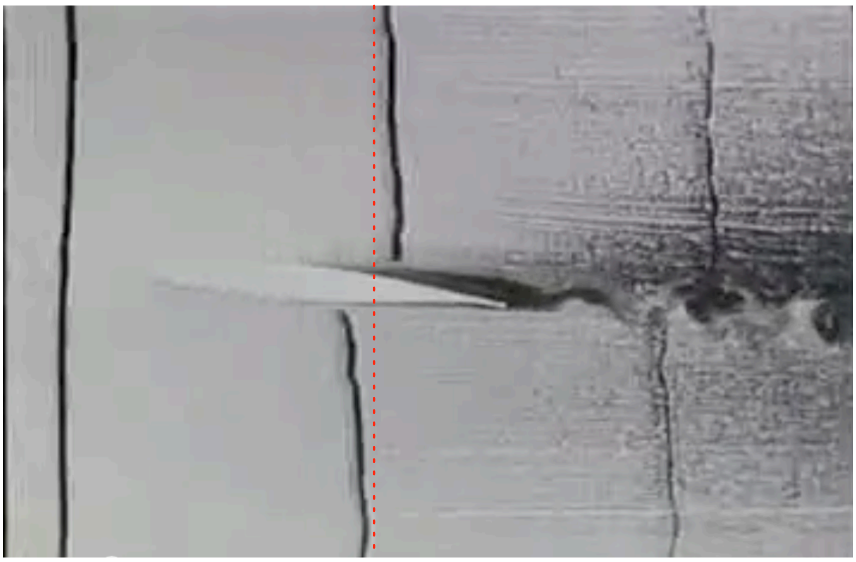
As it turns out, the air below the wing is pushed forward and so appears to go slower than the air above [1], but you don't need Bernoulli's principle to understand what that has to do with lift. Just imagine a single molecule of air racing toward the wing at the current airspeed. Suddenly it hits the bottom surface of the wing and is slowed and bounced downwards. That change of momentum imparts a force on the wing, upwards and backwards. We usually break this into the vertical and horizontal components, calling them lift and induced drag.



We can also extend this to explain the lower pressure above the wing, even for a flat airfoil — that is one having no curve at the top. Air molecules are bouncing off each other all the time, with the bounces all averaging out. However, when an air molecule passes over the top of an angled wing, the molecules below it have already been bounced out of the way by the wing's bottom surface. With no other molecules below it to bounce it back up, the molecule will be bounced down by the molecules above it. The measurable outcome of this acceleration of air molecules is lower pressure.

The purpose of the curve on the top of the wing is not to create a faster flow. Its purpose is to direct the air above the wing so that it smoothly joins the deflected air below the wing. This greatly reduces drag and also helps improve behaviour near the critical angle of attack.

If you insist on using Bernoulli's Principle to explain lift, then you have to apply it to both the top and bottom surfaces of the wing. The velocity decrease below the wing is greater than the velocity increase above the wing [1], so the pressure increase below the wing is greater than the pressure reduction above the wing. So the bottom surface provides a majority of the lift.



To sum up: the myth is that "...*air at the top has further to go. This means it goes faster...*" That is simply not true. Air above a flat airfoil is faster than the air below it, so it has nothing to do with the curvature.

References

1. See *Flow Visualization* at the National Committee for Fluid Mechanics Films, http://web.mit.edu/hml/ncfmf.html