FOUNDATIONS OF FLIGHT
AERODYNAMICS—THEORIES OF FLIGHT

AXIS Flight School®

Brought to you by Niklas Daniel and Brianne Thompson of AXIS Flight School at Skydive Arizona in Eloy. Images by Bruce Fournier.

The previous article introduced the concept of forces; in this installment, we take a closer look at how parachutes fly. There are many theories that try to explain how wings fly. The two most relevant to sport parachutes are Bernoulli's Principle and Newton's Third Law. You don't need to choose a side between Team Bernoulli or Newton, but rather understand that flying is a complex subject and that each brilliant mind added a piece to the puzzle. Because they describe different aspects of flying through cause and effect, the two theories are by themselves incomplete. Bernoulli explains how a wing creates lift, and Newton then explains how that lift (force) acts on a body.

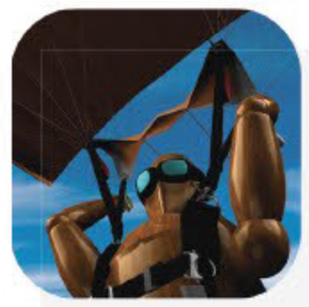
Bernoulli—Within a flow of constant energy, when fluid or gas flows through a region of lower pressure, it speeds up, and vice versa.

Objects do not require a streamlined airfoil shape to fly. Afterall, paper airplanes glide to earth just fine without teardrop-shaped wings. Airfoils are optimized shapes for flight because they have a high lift-to-drag ratio (more on those two forces later). Wings do this as they travel through an airmass by creating a pressure differential thanks to their geometry. According to Bernoulli's Principle, when air (within a flow of constant energy) flows through a region of low pressure, its velocity increases. This implies that air moving over the top of an airfoil is deflected more than the flow underneath. Counterintuitive as it may seem, the low pressure at the top skin has a greater magnitude than the high pressure below. In fact, the top of the wing experiences two thirds of the lifting force, while the high pressure makes up only a third. Therefore, if you see a small hole in your canopy's bottom skin during your control check, it may be of low concern, but damage to the top skin most likely requires the execution of emergency procedures.

Newton—For every action, there is an equal and opposite reaction.

First, we must acknowledge that air has mass. When air crashes into an object, the air imparts a force on that object. Aerodynamic forces are created when an object moves through air or when a stationary object experiences air moving past it. The force being created is lift, and the opposite force is weight (gravity). When lift and weight are balanced, the system is in level flight. If the downward gravitational force exceeds the lifting force, then the result is a negative vertical velocity (descent rate). This is what parachutes experience most of the time. But on windy days, parachutes can continue to generate lift even when the pilot is standing on the ground.

Inexperienced jumpers can run into complications after a landing when the surface winds are strong. To avoid getting dragged off like a ragdoll, jumpers should learn about methods that allow them to take the power out of their wing by creating slack in the suspension lines. Some solutions:



More educational skydiving content, as well as this free article, is available by downloading the AXIS Skydiving app on your smart device.

- Learning to kite a parachute on the ground during the right conditions and circumstances ("Foundations of Flight," March 2012 *Parachutist*)
- Altering the shape of the parachute by reeling in a brake line until you have fabric in hand
- Stepping on the bridle or deployment bag
- Positioning your body downwind of the parachute

All airfoils are not created equal, as different sizes, thicknesses and curvatures yield different flight characteristics. As an example, a parachute that is designed for high-performance canopy piloting is not appropriate for canopy formation skydiving and vice versa. The best wing is the one that suits a pilot's experience, skill, currency and application (chosen discipline or flying style).

Information about AXIS' coaching and instructional services is available at axisflightschool.com. The author intends this article to be an educational guideline. It is not a substitute for professional instruction.