FOUNDATIONS OF FLIGHT
INTRODUCTION TO FORCES

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 in this series covered airflow entering and surrounding a parachute in flight. The next set of articles will discuss the forces involved in flight. Having a better understanding of some of the physics involved in flight helps you make educated decisions and increases your skill level under canopy. If you understand the rules of the game, you can make them work to your advantage.

When objects interact with one another, they become subject to forces. Flight is a complex topic, as there are many variables. We can isolate the various concepts using free-body diagrams (graphical representations to visualize objects) and vectors (arrows that indicate the direction and magnitude of a force) to show how objects behave in the real world. It is not always necessary to include all parameters or use equations, just enough to convey an idea.

Gravity

Everyone knows, at least intuitively, that objects with mass are attracted toward earth. Unpowered flight requires starting from a raised location such as an aircraft in flight, which allows for the conversion of gravitational potential energy (altitude) into kinetic energy (movement). Gravity is the force that drives a skydiver through the atmosphere, which in turn gives rise to drag and lift.

Drag and Lift

Imagine simultaneously throwing two identical umbrellas—one closed and the other open—off a balcony. Both continue to fall until they hit the ground. Even though they are identical in weight, the closed umbrella hits the ground first. This is because the open umbrella creates more air resistance through a force called drag. Similarly, the different configurations of body and canopy during a skydive create different terminal velocities, including one that is slow enough to enable a safe landing.

An open umbrella mostly creates drag—a force that acts on you in opposition to the direction that you are moving—during its descent (just like a pilot chute). A parachute is much more complex in design than an umbrella and can produce an additional force as it travels through the air: lift. This is due to the parachute's airfoil shape (as discussed in the September 2021 "Foundations of Flight"). Lift provides the ability to descend more slowly (in some instances even climb) than being in a purely drag-producing configuration, as well as redirect the airflow in such a way that a skydiver can cover horizontal distances. (Both drag and lift will get their own articles in upcoming issues.)

Feel the Force

Being able to identify the forces produced in flight through physical sensation allows you to make theory actionable. If most of your responses are driven visually, then you are missing out on a lot of available information. You can also use wind noise (your auditory sense) to better understand airspeed. In addition to visual and auditory feedback, to be a proficient canopy pilot, you'll also use the kinesthetic sense. Being aware of your body's position in space, toggle- and riser-pressure changes with airspeed, centrifugal forces in the harness (apparent weight) and much more will contribute to the total input of information. The best way to become familiar with these forces is to apply what you have learned with drills that are specifically designed to isolate certain aspects of flight. By playing with the canopy, you will start to get a better understanding of what the system is capable of and what its and your limitations are. Through proper education and practice (the fast path) or lots of trial and error (the slow path), a trained canopy pilot can choose the appropriate responses (reflected by their equipment) to command their wing in an intuitive and effortless manner.

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.

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