NATURE'S LABORATORY

"*You cannot fly like an eagle with the wings of a wren*."
-- William Henry Hudson

Mankind has yearned to fly for untold ages. Children have yearned to fly at all young ages. Staring up at a rooftop (or down from one), entertaining schemes involving an umbrella or a pillowcase-parachute, thinking "If I just flap hard enough…" — all are part of the mental calisthenics that help children learn about the physical limitations of the human body. For those that chose to learn the hard way, gravity tends to win, and broken bones are sure to follow.

Humans aren't built to fly — we build airplanes to help us defy gravity's siren song. But there are some creatures earning frequent flier miles by the millions, some that wing through the skies with ease; birds, of course, but also some insects and mammals, not to mention ancient reptiles like pterosaur dinosaurs.

Perhaps the most obvious adaptation to flight evident in birds (and lacking in humans) are wings, which help propel birds and fellow fliers into and through the air. Feathers are another characteristic of birds that permit flight. Contour feathers along the body create a streamlined shape to make them aerodynamic, while flight feathers form the wings and tails essential to flight. Downy feathers also help birds retain heat to stay warm.

But there are other adaptations, less obvious to the naked eye, that gift birds with a reign of the skies. One of the biggest obstacles in flight is staying aloft. If you ever see an osprey catch a salmon, or a raven fly off with someone's discarded food, notice how awkward they are when weighed down. To stay light, birds have hollow bones filled with air sacs, and instead of bulky teeth and jaws, they have horny beaks. While light, they are still exceptionally strong to withstand the stress of flight. Even feathers are weightless. With regard to body size, the average bird's feathers contribute only 6-7% of their total weight.

Along the same lines, many internal organs are reduced in size, such as the female's singular, small ovary which drastically increases in size during the breeding season. Birds lack a bladder, instead excreting uric acid in solid crystals rather than in a heavier water-bound urea. Birds also have shortened tails, and specialized bones and muscles to orchestrate flying itself.

Despite all of their adaptations, flight can be tiresome, so some birds have devised ways to make flying easier still. Take for instance pelicans, which fly in the classic V formation. In flight, the V creates an air stream within which trailing birds can glide longer, allowing them to conserve wing beats, and thus energy, during long flights. When the leaders get tired, they trade off with other birds in their wake.

Not all birds fly, though. Even though their ancestors once flew, birds like ostriches, emus, rheas, penguins and kiwis are presently vertically landlocked. In exchange, they became more able runners, like the rhea, or swimmers, like the penguin. Some of the characteristics necessary for flight disappeared with disuse. For example, penguins have adapted a squat, fusiform (torpedo shaped) body for swimming underwater. Their flight feathers have been reduced to help insulate their body and to repel water, their wing bones have flattened, and the wing overall has been modified into a flipper.

Flight is important for birds in helping them escape from predators and to find mates, food, nest sites and new territories. But when a bird is blown by a storm to an island devoid of natural predators, yet full of foods and habitats within which they can thrive, environmental pressures often make flight less important. In the case of penguins, their choice of food — fish — made it more advantageous for them to swim than fly. Flippers help penguins navigate underwater like a seal, and their heavier bones make it easier to dive in pursuit of dinner.

***Hands On**:* Flight muscles attach to a bird's skeleton along the breast and consist of two types. Dark muscles (dark meat) are the strong muscles loaded with blood vessels needed to sustain flight for extended periods. Light muscles (light meat) are used for quick bursts of flight. Game birds such as turkeys that don't migrate or fly regularly have light colored muscles. Soaring birds, like eagles, have darker muscles. Birds that rely on both quick bursts and extended periods of flight, such as pigeons, have both types of muscles.

To explore the mechanics of a bird's flight muscles, examine a skinless chicken carcass from the grocer. Based on your understanding of the different muscle types, what can the chicken carcass' muscles tell you about how a chicken flies? Do chickens soar? Migrate? Make quick bursts of flight?

Compare photos of different birds to see what you can glean from their appearance. What characteristics do eagles and condors have in common? Songbirds and game birds? Ostriches and penguins?

Comparing penguins and songbirds, what characteristics make one a more able flier, the other a more able swimmer? Compare the body shapes of a penguin to a torpedo, and an eagle to an airplane? What lessons have mankind learned from nature? What can these similarities and differences tell you about how birds have adapted to different environments?

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