

## FLIGHT IN BIRDS

For flight to occur in birds four physical forces, (thrust and drag, lift and weight) must all work together. In order for birds to balance these forces certain physical characteristics are required. Asymmetrical wings, found on all flying birds with the exception of hummingbirds, help in the production of thrust and lift.

Anything that moves produces drag due to friction forces. The aerodynamic body of a bird can reduce drag, but when stopping or slowing down a bird will use its tail and feet to increase drag.

Weight is the largest obstacle birds must overcome in order to fly. Flight birds have dropped weight through evolutionary weight reducing characteristics. Pneumatic bone is bone which is hollow or composed of air sacs. These pneumatic bones are one way in which weight is reduced. The loss of teeth, gonadal enlargement, and fusion of bones are all ways to reduce weight. The loss of teeth have been replaced by a lightweight bill made of keratin<sup>1</sup>, the chewing mechanism occurs in the birds gizzard<sup>2</sup>.

Other physical characteristics required for flight are a keel for the attachment of flight muscles, an enlarged cerebellum<sup>3</sup> for fine motor coordination, and the presence of a furcula<sup>4</sup> which enhances skeletal bracing for the stresses of flight.

<sup>1</sup> Keratins are a family of fibrous structural proteins; tough and insoluble, they form the hard but un-mineralized structures found in reptiles, birds, amphibians, and mammals.

<sup>2</sup> A gizzard is a specialised stomach constructed of thick, muscular walls used for grinding up food.

<sup>3</sup> The cerebellum is a region of the brain that plays an important role in sensory perception, coordination and motor control.

<sup>4</sup> The furcula is a forked bone found in birds. Often referred to as the "wishbone".

R.V.C. with help from Wikipedia