

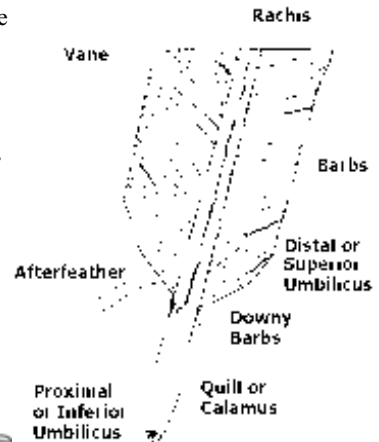
# Bird Feather Types, Anatomy, Growth, Color, and Molting

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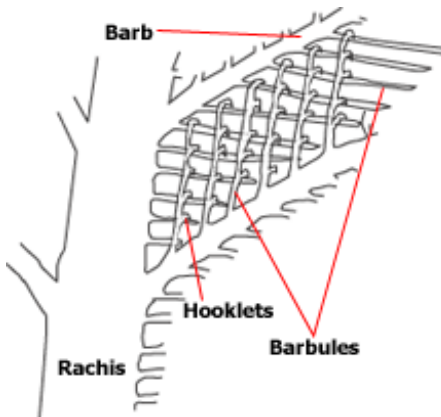
Feathers evolved from the scales of reptiles, and set birds apart from all other animals. Feathers are necessary for flight, insulation, and courtship displays. Feather colors and shapes help us distinguish between different species of birds and, in some cases, between males and females. Because feathers are so different, there are many different anatomical and technical terms used in their descriptions. This article will help you learn some of this terminology and understand more about these amazing adaptations.

## Feather anatomy

Feathers are made out of keratin, the same protein found in hair and nails. Feathers have a central shaft. The smooth, unpigmented base, which extends under the skin into the feather follicle, is called the **calamus**. The portion above the skin, from which the smaller barbs or branches extend, is termed the **rachis** or **scapus**. On each side of the rachis there is a set of filaments, called **barbs**, which come off at approximately a 45° angle. This portion of the feather that has barbs is called the **vane**. In the larger feathers, these barbs have two sets of microscopic filaments called **barbules**. Barbules from one barb cross the adjacent barbs at a 90° angle. Barbules, in turn, have **hooklets**, sometimes called **hamuli** or **barbicels**, which hook the barbules together, like a zipper, forming a tight, smooth surface. These maintain the shape of the feather. Without these strong linkages, the feather would not be able to withstand the air resistance during flight. The barbs or hooklets may become separated from each other; if this occurs, the bird can reattach them while preening. At the base of the feathers, there are often barbs that are not hooked together. These are called **downy barbs**.



Feathers with barbules and hooklets are termed "**pennaceous**," and one can think of them as the feathers that would be used for a quill pen. Feathers without barbules and hooklets, such as down feathers, are called "**plumaceous**" and have more the appearance of a plume. Some feathers have both pennaceous and plumaceous portions. Some feathers have what are called **afterfeathers**, or **hypopenae**, at the base of the vane in an area called the **distal umbilicus**. These, really, are barbs without hooks, which help trap air and offer some insulation.



Feathers are not arranged haphazardly on the bird, but in major distinct tracts called **pterylae**. The featherless areas between the pterylae are called **apteria**.

## Types of feathers

As there are different types of hair on furred animals, birds have different kinds of feathers, each having a particular function. The types of feathers include:

- Feathers with Vanes: Contour and Flight Feathers
- Down
- Filoplume
- Semiplume
- Bristle

**Contour feathers:** Contour feathers cover most of the surface of the bird, providing a smooth appearance. They protect the bird from sun, wind, rain, and injury. Often, these feathers are brightly colored and have different color patterns. Contour feathers are divided into flight feathers and those that cover the body.

### Contour Feather



**Flight feathers:** Flight feathers are the large feathers of the wing and tail. Flight feathers of the wing are collectively known as the **remiges**, and are separated into three groups.

The primaries attach to the metacarpal (wrist) and phalangeal (finger) bones at the far end of the wing and are responsible for forward thrust. There are usually 10 primaries and they are numbered from the inside out.

The secondaries attach to the ulna, a bone in the middle of the wing, and are necessary to supply "lift." They are also used in courtship displays. There are usually 10-14 secondaries and they are numbered from



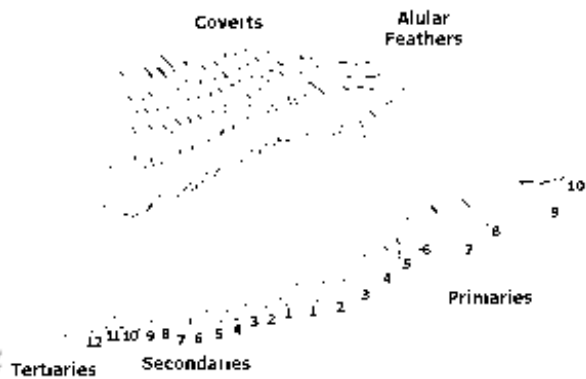
the outside in.

The flight feathers closest to the body are sometimes called **tertiaries**.

The tail feathers, called **retrices**, act as brakes and a rudder, controlling the orientation of the flight. Most birds have 12 tail feathers.

The bases of the flight feathers are covered with smaller contour feathers called **coverts**. There are several layers of coverts on the wing. Coverts also cover the ear.

**Down feathers:** Down feathers are small, soft, fluffy, and are found under the contour feathers. They are plumaceous, and have many non-interlocking barbs, lacking the barbules and hooklets seen in contour and flight feathers. This makes it possible for them to trap air in an insulating layer next to the skin, protecting the bird from heat and cold. They are so efficient, humans use these feathers for insulation, too, in down jackets and comforters.



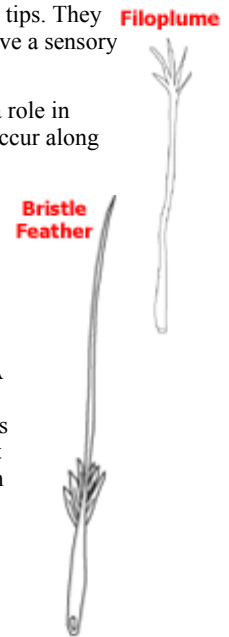
There are special types of downy feathers called **powder down feathers**. When the sheaths or barbs of these feathers disintegrate, they form a fine keratin powder, which the bird can spread over its feathers as a water-proofing agent. The powder also assists in cleaning as the bird preens. The absence of powder down in birds such as cockatoos and African greys can be a sign of disease, including [beak and feather disease](#).

**Filoplumes:** Filoplumes are very fine, hair-like feathers, with a long shaft, and only a few barbs at their tips. They are located along all the pterylae. Although their function is not well understood, they are thought to have a sensory function, possibly adjusting the position of the flight feathers in response to air pressure.

**Semiplume** Semiplumes: Semiplumes provide form, aerodynamics, and insulation. They also play a role in courtship displays. They have a large rachis, but loose (plumaceous) vanes. They may occur along with contour feathers or in separate pterylae.



**Bristle feathers:** Bristle feathers have a stiff rachis with only a few barbs at the base. They are usually found on the head (around the eyelids, nares, and mouth). They are thought to have both a sensory and protective function.



#### Feather growth

Like hair, feathers develop in a specialized area in the skin called a **follicle**. As a new feather develops, it has an artery and vein that extends up through the shaft and nourishes the feather. A feather at this stage is called a **blood feather**. Due to the color of the blood supply, the shaft of a blood feather will appear dark, whereas the shaft of an older, mature feather will be white. A blood feather has a larger quill (calamus) than a mature feather. A blood feather starts out with a waxy keratin sheath that protects it while it grows. When the feather is mature, the blood supply will recede and the waxy sheath will be removed by the bird.

Although an adult bird will typically replace all of its feathers during a molt, the loss of feathers is staggered, often over several months, so the bird has enough feathers for flight and insulation. A molt is usually triggered by the change in day length or may occur after breeding. Some wild birds, such as goldfinches, who molt twice a year, change from a bright plumage during the breeding season to a more somber plumage for the rest of the year.

#### Feather color

Feather color is determined by the presence of various pigments, including melanins, carotenoids, and porphyrins.

- Melanins are brown to black pigments that are also found in mammals. In addition to adding color to the feather, melanins also make the feather denser and more resistant to wear and breakdown by sunlight.
- Carotenoids are generally yellow, orange, or red in color. They are synthesized in plants, and absorbed by the bird's digestive system, and then taken up by the cells of the follicle as the feather is developing.
- Porphyrins are red and green pigments that are produced by cells in the feather follicle.

The next time you look at a bird, you will be able to better understand how its feathers protect it and make it possible for the bird to fly. Down to the microscopic level, you can appreciate the complexity and specialization that make birds such a unique part of the animal kingdom.