



Frequent Questions

A journey to the bottom of the world

I've gotten a lot of email over the past few years about penguins. So, instead of answering each and every email (my free time is growing shorter these days), I've created this list of frequently asked questions. Hopefully you can find your answer here before asking me.

Questions and comments are greatly appreciated, especially if you note mistakes in any of the answers to these frequently asked questions. Please mail comments or corrections to kwelch@capunet.com.

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1.1 What is a penguin?

A penguin is any bird that belongs to the Order *Sphenisciformes*. That would be a strict definition. But, that doesn't mean much to an individual upon inspection. First of all, a bird is any animal that is a homeothermic vertebrate animal with a pair of modified upper limbs that support or supported flight at one time in the evolutionary development of the animal. A penguin would be any animal that belongs to the class *Aves*, which contains all birds, is incapable of flight due to loss of the proper machinery, is naturally restricted to the Southern Hemisphere, moves about by swimming and walking, nests on land, and shares similar morphological features -- mainly color and striping patterns -- between the sexes.

1.2 Where does the word "penguin" come from?

The origin of "penguin" is nebulous. Sources suggest that it comes from the Swedish *alka* from which the English "auk" was derived. From this term came the expression "great auk" or "penguin." However, both "great auk" and "penguin" did not describe what we know as penguins, rather great auks, another type of flightless bird (which happens to be extinct).

It is also theorized that "penguin" comes from the Welsh expression *pen gwyn* meaning "white head" or from the Latin *pinguis*, meaning "pin wing." Both these terms seem unlikely origins for

the word "penguin," however. I don't think anyone knows.

1.3 How many species of penguins are there today?

The number will vary depending upon whom you ask. Some say at least 18; most say at least 17, while others admit to only 16 or as few as 13. I think there are 16, or at most 17, species. The issue of speciation is debated on whether certain populations are merely hybrids of two species or distinct species. Speciation is said to have occurred when two populations of animals cease to breed and develop on their own evolutionary paths.

What is the question here is whether certain "species" of penguins are still capable of interbreeding. Two issues of contention are the Little blue penguin and White-flipped penguin whose morphologies are so similar that many will argue that they are conspecifics with subspecies differentiation. Others contest that the Fiordland and the Snares Island penguins are the same species and should be arranged into subspecies. Some say the Royal penguin is a geographically distinct race of the Macaroni penguin. Still others contest that the extent of differences in the genus *Spheniscus* does not merit their separation into four species (this is not a popular view).

1.4 Then how many species of penguin are extinct?

From the Late Eocene: 7 known species. From the Early Oligocene: 7 known species. From the Early Miocene: 7 known species. From the Late Pliocene: 2 known species. More development of this is dealt with in the section entitled [Natural Evolution](#). Please visit this section for more complete coverage of penguin evolution.

Are there any recent extinctions? No, but here is a list of the status of current penguins:

Species Name	Status
Adelie	Stable
African	Vulnerable
Chinstrap	Stable
Emperor	Stable
Erect-crested	Endangered
Galapagos	Endangered
Gentoo	Stable
Fiordland	Vulnerable
Humboldt	Vulnerable
King	Stable
Little-blue	Declining
Macaroni	Near threatened
Rockhopper	Near vulnerable

Snares Islands	Vulnerable
Yellow-eyed	Vulnerable

1.5 Why are penguins the only birds in the Order *Sphenisciformes*?

Some biologists contest this designation of taxonomy. Others argue that penguins are so unlike other avian species that this arrangement is warranted. The biology and evolution of penguins is such that no other bird amongst the *neornithes* even closely resembles them. Because the penguin is unlikely to be relatives of these birds except distantly, scientists have placed them into their own order.

1.6 I noticed that the root "sphenis-" is in the taxonomy of the order, family and in one genus. Why?

Spheniscus demerus, or the Blackfooted penguin (also known as the African or jackass penguin) was the first penguin discovered by European explorers. Hence, the root "sphenis-" was applied.

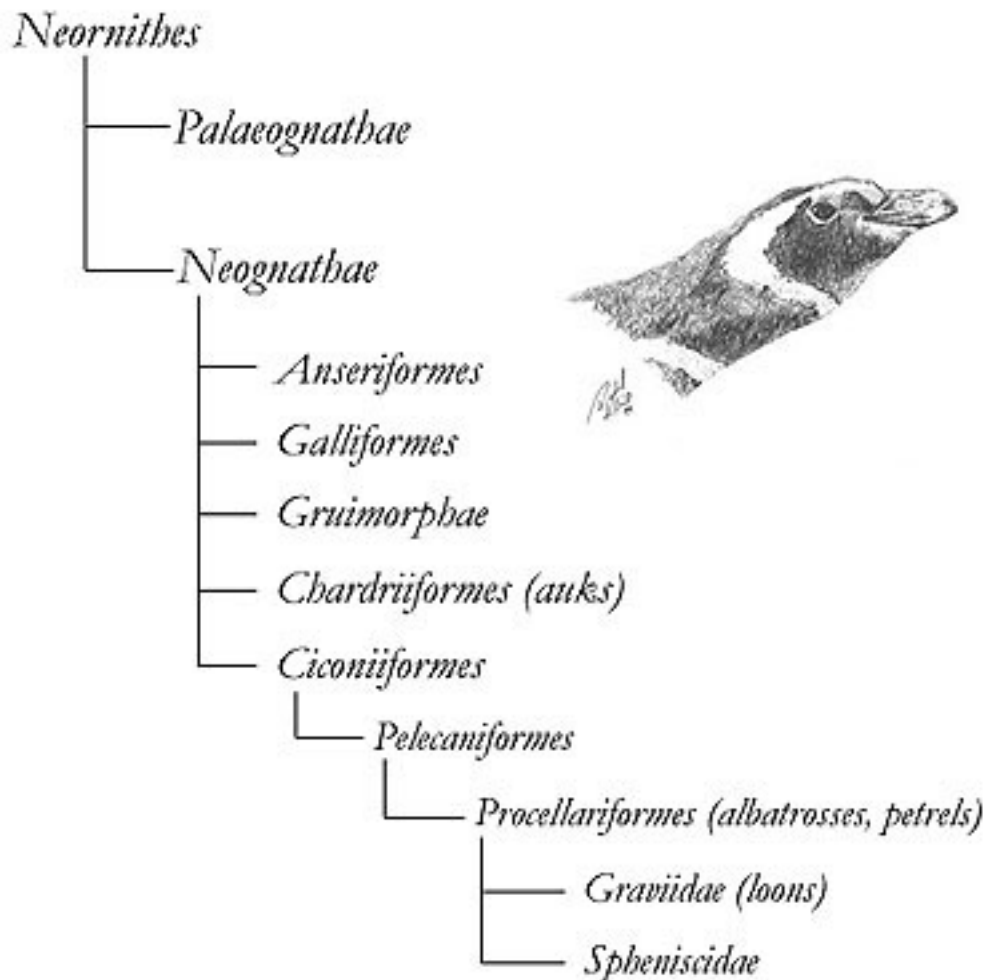
1.7 Where do penguins come from?

Basically, there is little evidence that penguins moved from any particular place to their current locations. Early fossil records date the arrival of penguins in the late Eocene - 37 million to 45 million years ago. Fossils of this period were found in Australia, New Zealand and Antarctica, all current locations of several modern day penguins. Some of these fossils suggest penguins were as tall as 6 feet! So, it is likely that a distant ancestor of penguins migrated, either by flight or by swimming, to the southern hemisphere. This common link between modern penguins and ancient flying relatives has not been found; only penguin-like fossils have been found in the southern hemisphere. More on this in the section on [Natural Evolution](#).

1.8 How closely are penguins related to other birds?

It depends on which birds you are talking about.

To remind you, *Neornithes* developed into *Paelognathes* (old jaw) and into *Neognathes* (new jaw). From this group of birds developed some other specifics, but the two of interest to us are the *Chardriiformes* and the *Ciconiiformes*. Notice that from the *Ciconiiformes* stem the *Pelecaniformes* (obviously containing pelicans), and from the *Pelecaniformes* stem the *Procellariiformes*, which gave rise to *Graviidae* (loons, etc.) and *Spheniscidae*. There's *Spheniscidae*, our old friend the penguin. So, you can see that the auks, which are often mistaken as being closely related to the penguin due to their similar size, shape and ecological niche, aren't closely related to penguins at all. However, you can see what *are* closely related to penguins: the *Procellariiformes* from which penguins descend directly, and the *Graviidae*, which is a *daughter* clade of the *Procellariiformes* with the *Spheniscidae*.



So, you can see how different, based on the phylogeny chart, penguins are from modern birds. Despite the fact that they don't fly either, ratites (ostriches, emus, rheas) aren't closely related to penguins. The closest relatives of penguins are [albatrosses](#), [petrels](#), and [shearwaters](#). They are all Neornithes. It seems ironic that even though they *look* like penguins, puffins, [razorbills](#) and murrens aren't related to penguins either.

1.9 What is the full scientific name of the _____ penguin?

It depends on which birds you are talking about, but a *generally* complete name would include the major phylogenic classifications. For example, the Humboldt penguin would be called (technically) *Animalia Chordata Vertebrata Aves Sphenisciformes Spheniscidae Spheniscus humboldti*. Notice that all the names **except** the species name (*humboldti*) are capitalized. The species names are **not** capitalized. Furthermore, because they are Latin terms being used in English text, they should always be italicized. You would abbreviate the Humboldt penguin's name with the following: *S. humboldti*. (Just like you would abbreviate *Tyrannosaurus rex* with *T. rex*, not T-Rex, not T-rex, not T. Rex or any other.

2.1 How do penguins survive in such cold temperatures?

Ironically, some penguins actually overheat in these regions. It is a noticeable trend that the

colder the region, the larger the penguin. This trend is based upon a simple physical property that the smaller the surface area to volume ratio, the smaller the extent of heat loss. In other words, if you have a lot of surface area, you have a lot of area to interface with the cold air and cold water. Therefore, it is easier to lose heat. Little-blue penguins have the largest surface area to volume ratios, so they must live in warmer climates. Emperor penguins have the smallest surface area to volume, and they retain heat easier than the smaller penguins. However, emperor penguins do have problems retaining heat. That is why they form *creches* (huddles) during the winter. I'll develop more on creches in the section on [Deconstructing Penguin Myths](#). Creches aren't necessarily what you think they may be.

In addition to body size, penguins in cold regions amass fat under the skin which performs as an excellent insulator. Nonetheless, this layer is relatively thin when one compares it to seal or whale blubber in the whole body ratio. However, it is of primary importance that **all** penguins maintain their feathers. Feather integrity is **crucial** to heat retention, and it is the primary superficial (external) mechanism whereby penguins regulate heat. Feathers "pocket" air between the skin and the environment, much like insulation in your house. The fiber glass or foam insulation has many airspaces which trap air, and in the case of penguins, this air is warm.

Lastly, birds are homeotherms, just like us. This means that their heat is maintained by their metabolism. They generate enough heat (normally) to keep warm and the fine regulation of metabolism of their bodies insures that their heat remains in a constant range. However, penguins have been noted to actually drop their body temperatures when entering the cold water. This biological event minimizes the heat loss of the body.

2.2 Why are penguins flightless?

Other than the obvious fact that their weight to wing area ratio is incapable of supporting flight, it is theorized that nature selected penguins to be flightless. Theory suggests that in penguins (and other flightless birds) food was readily accessible and that the long search flights for food were not required. Consequently, nature did not select for wings capable of producing flight. This assumption, of course, is based on the idea that all birds originated from an ancestor that flew. There is little evidence that suggests that penguins followed some alternate lineage. More on this is treated in the section on [Natural Evolution](#)

But as many people have observed, penguins do "fly." Penguins use their wings, more appropriately called flippers, to propel themselves through the water; to steer, penguins use their feet as rudders.

2.3 If penguins swim, their bodies must be well adapted to aquatic life. Is this true?

Yes, they are tremendous swimmers, but contrary to popular opinion, penguins do not achieve relatively high speeds within the water. Stonehouse suggests that speeds range anywhere from 10-12 mph. Likewise, the diving capacity of penguins seems to be overestimated as well. The record dive for a penguin was recorded at 1772 feet for 18 minutes. This feat was performed by a rather "talented" emperor penguin and is not representative of stock. Penguins typically exhale before submerging and only stay under for a few minutes, barely exceeding the time the average human being can submerge himself. Additionally, penguins dive to depths of less than 60 feet.

2.4 Do penguins have teeth? Why not?

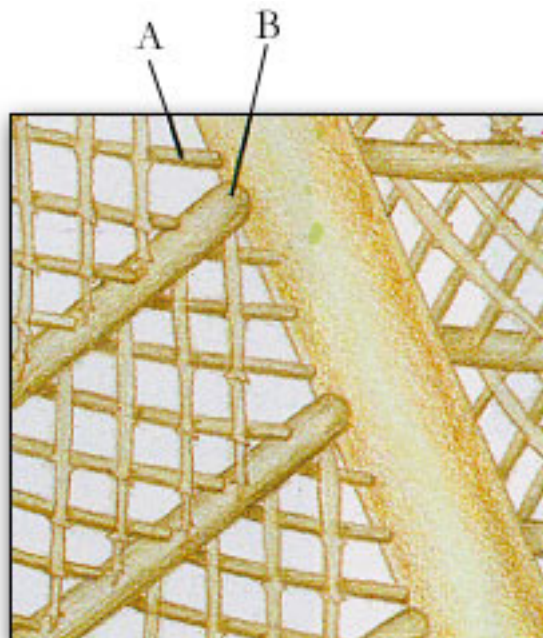
No, penguins don't have teeth. In [evolutionary past](#), birds did have teeth, but over time they lost them to reduce weight. The more an bird reduces its weight, the more able it is to fly. But, you may be thinking right now: penguins don't fly! That's right; they don't. However, penguins [evolved](#) from birds that **did** fly. Teeth are also adaptations for grinding food. Penguins, and all other birds, have gizzards which are thick, muscular structures that grind food in place of teeth.

2.5 Is a penguin beak made out of bone?

If you saw the picture of the penguin skull in the [histology](#) section, you might have thought that penguin beaks are made out of bone. This is not the case. Penguin beaks are made out of keratin, a protein that consists of two braided strands of smaller proteins. It's the same protein that makes up penguin scales, human finger nails and human hair. Penguin feathers are also made out of keratin.

2.6 What do penguin feathers look like?

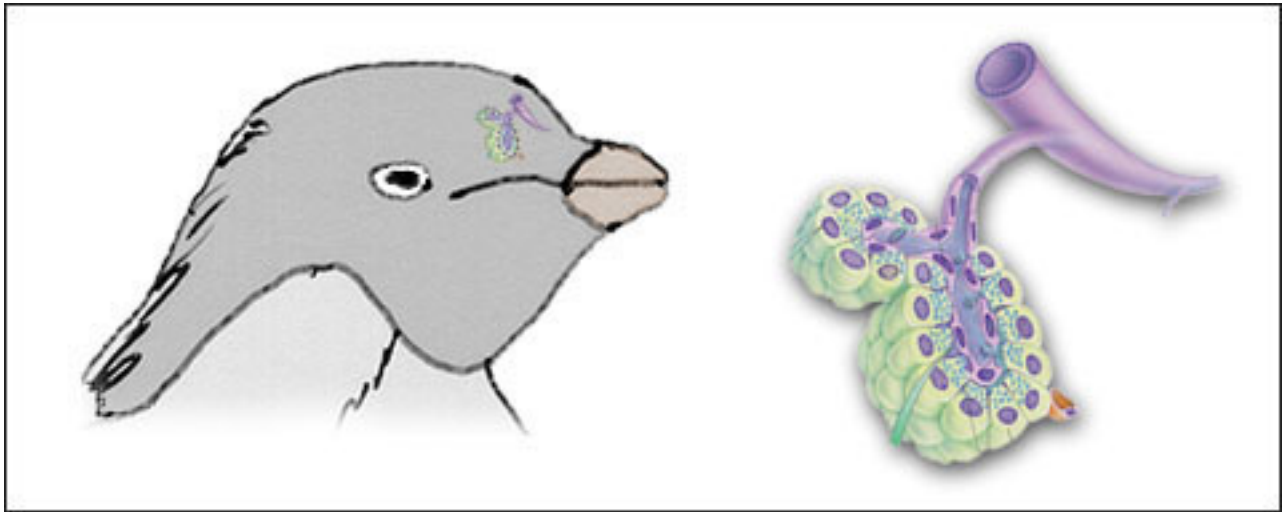
Penguin feathers look really interesting under the microscope. Basically a feather consists of 5 parts: the **quill**, the **rachis** (shaft), the **vane**, the **barb** and the **barbule**. The barb and the barbule are actually part of the vane system, but under the microscope, you can differentiate the components. The quill attaches to the tissue of the penguin wing and actually contains blood and is living tissue. The quill quickly becomes the rachis, or shaft, which is the dead, keratinized part of the feather. All along the rachis branch vanes. Each vane consists of a barb. Barbs are cross-linked by many barbules. These barbules trap air and warmth for penguins in their cold environments. Check out this picture (A = barbule; B=barb):



2.7 Why don't penguins get sick from drinking sea water?

Penguins don't drink Poland Spring or Evian every day, and some of them don't have freshwater sources since they are marine animals. The seas and oceans are high in salt concentration. If we drank salt water, we'd become very sick. Penguins don't get sick. Both penguins and other marine

birds have salt glands located beneath their skulls. These **nasal glands** have many little glands inside them that are surrounded by capillaries. As blood flows through these nasal glands, salt leaves the blood with *just a little water*. This high salt water drips through ducts that exit through the nares (nostrils). Often you can see penguins shaking their heads with what looks like gooey drippings flying from their noses! This is actually salt with water. See how the gland works below:



2.8 Do penguins get sick?

Absolutely. They are biological systems just like we are and are susceptible to bacteria and viral infections, as well as the normal maladies that affect some of us: deteriorating eye sight, cardiovascular disease, etc. However, two of the more common infections penguins get -- and this is regionally dependent -- are infection by *Aspergillus fumigatus*, a fungus, and Avian malaria parasite. Spores of the *Aspergillus fumigatus* fungus typically causes lung infections, which are demonstrated by shortness of breath in penguins. *A. fumigatus* typically hide in fecal matter and moist, anaerobic conditions. When they infect penguins, the penguin usually becomes malnourished (if it isn't already) and dies. Immunocompromised penguins die sooner than others. Avian malaria is another common infection in the Malaria belt (Africa), but it more common affects captive species. Aspergillosis and avian malaria are both much more common in captivity than in the wild. Most indications are that wild penguins die of predation or the common conditions that kill penguins "naturally."

2.9 Do penguins have parasites?

It depends on the species. Species like the Adelies and Emperors generally don't have to worry about this sort of thing since their climate is ultimately icy and cold. Species like the Rockhopper or Gentoos that live in the Periantarctic ring generally don't have to either. However, those penguins that nest in forests or in heavy grassy areas probably have problems with them. There are two particularly pesty parasites that infest penguin nests and penguins in general. The first is the **Mallophagan louse**. This louse is of the breeds of sucking lice. Generally they subsist on penguin blood and other exudate that leaves the penguin via the penetrations the louse creates. Lice can also lay their eggs in the skin or feathers of the penguin. Another parasite is the **Itch mite**. These parasites are about 0.5 mm in width and are found in penguin feathers. Small amounts of either of these parasites generally aren't a problem; however, heavy infestations can have serious health consequences for the penguin.

3.1 I saw a penguin at the Zoo. It let out a sound like the braying of a donkey. What was that?

You may have seen any member of *Spheniscus* performing a courtship display. Many penguins perform what is known as an Ecstatic Display, a display in which the penguin arches backward, throws back his wings, and brays like a donkey into the air. Ecstatic displays attract mates. Or, he may have been threatening another individual if he was crouched over and pointing directly at another penguin. This is known as a Gape. It is still possible that this male or female was simply greeting his/her mate. Mates, after periods of absence, will approach each other and perform mutual displays and mutual trumpet displays.

3.2 How do penguins greet each other?

Penguins greet each other in a variety of ways. Sometimes this is dependent upon the species; other times it is not. After periods of prolonged absence, pairs usually greet each other by reinforcing the pair bond. This is usually accomplished by something called the "mutual display." The mutual display sounds like an ecstatic display, although it's not initiated with as much effort. Both penguins engage in the act and are frequently facing each other when it occurs. Other penguins may only grunt or do nothing at all. A common practice among the *Spheniscids* is "billing." Pairs approach each other and tap their bills against each other.

3.3 Do penguins ever fight?

Certainly. Penguins fight as much as other animals, and sometimes these fights can be fairly intense. Fighting is usually most intense around the mating season. Depending on the location and species, fighting can vary from wing tapping and bickering to seemingly hateful jabbing, biting, kicking and chasing across the colony. Penguins like the King and Emperor don't lend themselves to aggression all that often. For Emperors especially, fighting during mating season is particularly expensive. Penguins like Fiordlands, Macaronis and Rockhoppers get fairly rowdy with each other.

I spent a few winters observing Humboldt penguins. I found them to be fairly amicable species that fought only rarely. They engaged in what is called "binary exchanges." This means that there were only two acts to aggression. The first act was the first aggressive act and the second act was the response to the first act. Usually the second act, or response, was to retreat or turn away from the aggression. This indicates that fighting was either not economically feasible at the point or that the fight ended with submission to the dominant individual. However, frequency of fighting and intensity (more acts) of fighting occurred around mating season.

3.4 How do penguins reproduce?

Penguins reproduce in a fairly simple way. Reproduction is by sexual means (i.e., there is the exchange of genetic information via sperm and ovum). There is fairly good development of this in the [ethology](#) and [biology](#) sections.

3.5 Are penguins intelligent?

I'm afraid to say that penguins won't be solving algebra equations any time soon. They're

probably not on the bright side of the classroom either. Experiments have shown that penguins are capable of basic Pavlovian training (e.g., reward given for following a simple command), but not much beyond that. They have been trained to stop on command and perform some of the simpler tasks domesticated dogs can do. That's about it. They're not very intelligent.

4.1 How long do penguins live?

Penguins in captivity will live longer than penguins in the wild since they are fed nutritionally balanced meals and do not have to contend with predators. Generally, penguins will live from 15 to 20 years. A female Humboldt penguin in my study group (in captivity) lived to 17 years.

4.2 Do penguins have knees?

Yes. It doesn't look like they have much in the way of legs, but their knees are hidden under their feathers. Here's a basic diagram:



Most people think that the knees on birds are "backwards." What you are actually seeing is a structure analogous to the human ankle.

4.3 Why don't penguin feet freeze after they leave the water?

The system that enables a penguin foot to not freeze is basically the system that keeps your fingers from freezing while in the cold, only that system in the penguin is much more extensive and elaborated. Imagine a section of a penguin foot. The following diagram shows the network of blood vessels in that section.



- A: Capillaries
- B: Superficial plexus
- C: Subsuperficial plexus
- D: Intermediate plexus
- E: Deep plexus

Capillaries extend into ridges of penguin skin (see [penguin histology](#)). They feed oxygen directly to the remotest parts of the skin. At this point, blood is fed from the deeper plexuses and from the larger arteries of the penguin vasculature. Ultimately, oxygen and heat supply to the skin is a function of cardiac output, or heart rate with respect to volume of blood pumped.

How does this system work? It's actually quite ingenious. The metabolic processes of the penguin -- that is, the chemical reactions that generate both energy and heat -- require oxygen. The vasculature of the penguin delivers oxygen from the lungs to the heart and eventually the rest of the body. This vasculature also delivers heat and keeps it within the body. If you look closely at the diagram, you can see loops at the top. These loops, along with loops in the deeper plexuses create what is called the counter-current exchange system. That is, when heat is lost from the arterial side of the capillaries, the venous side of the capillaries running in the opposite direction pick up that heat so it is not lost. This means that in the very remote regions of the skin, cells get oxygen but heat isn't lost through this skin. As a result, penguin feet don't freeze since heat is never lost.

4.4 Well, how do penguins cool off?

This question may make sense for penguins that live in Australia and the Galapagos Islands, but for penguins in Antarctica? Yes, all penguins overheat from time to time. However, overheating is more of a problem for penguins living in semi-tropical regions like the Yellow-eyed penguin or the desert regions like that Humboldt and Magellanic penguin.

The Spheniscid penguins, i.e. the Galapagos, Magellanic, Humboldt and African, have featherless patches around their heads. In these regions without feathers, air can't be [trapped](#), and heat is given off rapidly at this point. Despite the fact that the counter current exchange is so efficient, some heat is lost in the counter current exchange when it is overloaded. Normally this heat is trapped in the feathers, but bare patches allow it to be given off. In areas where there are feathers, penguins contract muscles called *feather erectors* which cause their feathers to become erect. This eliminates a good deal of the covered insulation feathers supply and allows heat to exchange with the atmosphere. These mechanisms allow the penguin too cool down. Furthermore, they are under **autonomic** regulation -- that is, the penguin does this automatically without "thinking" about it. Additionally, the penguin [air sacs](#) form reservoirs of air that also permit the collection and dissipation of air through respiration. That's why you might see penguins with their bills wide open panting. This is partially conscious, but it is mostly autonomic as well.

4.5 Do any penguins live in the Arctic Circle?

No. Penguins didn't evolve in the northern hemisphere, and with the exception of the Galapagos penguin, no species of penguin naturally inhabits any land north of the equator. Galapagos penguins sometimes feed and stray slightly north of the equator.