

How dogs can walk on ice without freezing their paws

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Scientists in Japan have solved a long-standing veterinary mystery: how dogs can stand and walk for so long on snow and ice without apparent discomfort, and without freezing their paws.

Scientists at Tokyo's Yamazaki Gakuen University wondered why dogs do not seem to feel the cold in their paws, even though the paws have less insulating fur than their trunks. The paws have pads containing a high [fat content](#), which freezes less easily than other tissues, but they also have a high surface area-to-volume ratio, which means they should lose heat easily.

In humans exposed to frigid temperatures, vasoconstriction occurs in the

extremities to reduce the blood flow and resultant [heat loss](#), and ensure the blood returning to the rest of the body does not cool too much.

The research team, led by Dr. Hiroyoshi Ninomiya, used a scanning electron microscope to study the paws of four adult dogs, and discovered that the [arteries](#) supplying blood to the pads had networks of numerous small veins, or venules, closely associated with them, and that the system essentially acts as a counter-current [heat exchanger](#).

When warm blood arrives in the paws via the arteries, heat is transferred to the venules closely associated with the arteries, thus ensuring the blood has been warmed up before it returns to the rest of the body.

The counter-current heat exchange system prevents the body cooling and ensures the paw temperature stays within reasonable limits. The same system has also been identified in other animals such as Antarctic penguins, where it occurs in their legs and wings, and dolphins, which use a heat exchange system in their fins.

The Arctic Fox (*Vulpes lagopus*) was already known to have a counter-current heat exchange system in its paws, along with numerous other adaptations to the cold, but the existence of such a system in domestic dogs had not been previously suspected or identified. The findings suggest that domestic dogs might have originated in a [cold climate](#), in which such a system would have had survival benefits.

Domesticated dogs are not all able to withstand icy conditions on their paws to the same extent, depending on their environment (such as habitually living indoors), and the breed. Common tips often suggested to help [domestic dogs](#) avoid cold feet in winter is to ensure their pads are not split or injured in any way, and to spray their paws with cooking spray before taking them out in the snow. Frostbite is very rare in dogs, but it can occur.

The paper is published in the journal *Veterinary Dermatology*.

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