

## Why Does Our Body Shiver When We're Cold?

**Shivering** is a bodily function found in all warm-blooded animals in response to cold or early hypothermia (when an organism's temperature drops below what is required for normal metabolism and bodily functions). Normal body temperature in humans is 98.6°F. When the core body temperature drops, the shivering reflex is triggered in 3 stages as a way to generate heat.

**Stage 1:** body temperature drops by 1.8-3.6°F below normal temperature. Mild to strong shivering occurs – the hands become numb, blood vessels in the outer extremities contract, lessening heat loss to the outside air. Breathing becomes quick and shallow.

Muscle groups around the vital organs begin to shake in small movements in an attempt to create warmth by stimulating the muscles to release heat as they work. The primary motor center for shivering is located in the hypothalamus and is activated by cold signals from the skin and spinal cord that may be just a fraction of a degree below crucial temperature levels.

Goose bumps (*cutis anserine*) also form, as tiny erector muscles (*arrectores pilorum*) that are each connected to the base of a single hair follicle contract, raising the hair vertically straight (a function called *piloerection*), so as to form an insulating layer of air to trap heat. Goose bumps in humans form mostly on forearms and legs. Because humans have little hair, the goose bump reaction is not as efficient as in animals with fur coats.

Goose bumps may also appear as a response to fear or anger. For fear, think of a cat, hissing with its back arched and hair standing on end (acting as a survival mechanism, as the upright hairs make the animal appear larger). For anger, think of an angry dog, barking and growling with the hair down its back standing on end. In both of these cases, the hair standing on end is due to the tiny erector muscles contracting at the base of each hair.

In humans, goose bumps may also be generated by feelings of awe – defined as experiencing emotions generated by viewing a greatness with which nothing else can be compared and which is beyond all possibility of measurement or imitation; often used when referring to nature and its vastness.

**Stage 2:** body temperature drops by 3.6-7.2°F. Shivering becomes more violent. Movements are slow and labored. Surface blood vessels contract further as the body focuses its remaining resources on keeping the vital organs warm. The victim becomes pale. Lips, ears, fingers and toes may become blue.

**Stage 3:** body temperature drops below approximately 90°F. Shivering usually stops. Difficulty speaking, sluggish thinking, and amnesia start to appear; inability to use hands and stumbling are also usually present. Cellular metabolic processes shut down. If there is no immediate warming available, then major organs fail and clinical death occurs.