

What is Sweat and why do we do it?

Perspiration, or **sweat**, is your body's way of cooling itself, whether that extra heat comes from hardworking muscles or from stress.

The Sweat Gland

The average person has **2.6 million sweat glands** in their skin! Sweat glands are distributed over the entire body -- except for the lips, nipples and external genital organs. The sweat gland is in the layer of skin called the **dermis** along with other "equipment," such as nerve endings, hair follicles and so on.

Basically, the sweat gland is a long, coiled, hollow tube of cells. The coiled part in the dermis is where sweat is produced, and the long portion is a **duct** that connects the gland to the opening or **pore** on the skin's outer surface. Nerve cells connect to the sweat glands. There are two types of sweat glands:

- **Eccrine** - the most numerous type that are found all over the body, particularly on the palms of the hands, soles of the feet and forehead
- **Apocrine** - mostly confined to the armpits. They typically end in hair follicles rather than pores.

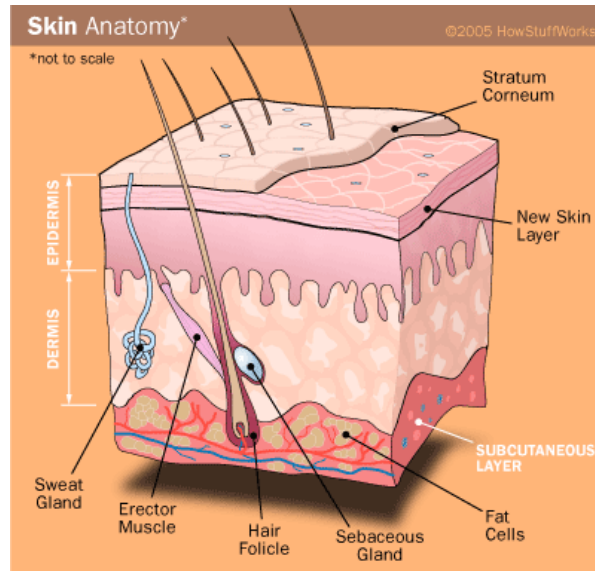
The two glands differ in size, the age that they become active and the composition of the sweat that they make. Eccrine glands:

- are smaller
- are active from birth (Apocrine glands become active only at puberty)
- produce a sweat that is free of proteins and fatty acids

How Sweat is Made

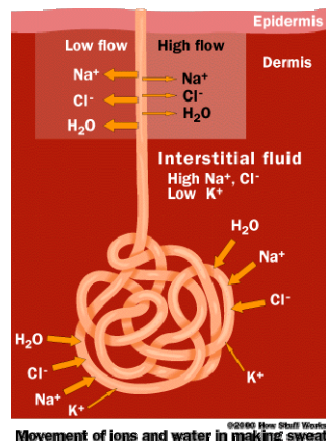
We are constantly sweating, even though we may not notice it. Sweating is your body's major way of getting rid of excess body heat, which is produced by metabolism or working muscles. The amount of sweat produced depends upon our states of emotion and physical activity. Sweat can be made in response to nerve stimulation, hot air temperature, and/or exercise.

First, let's concentrate on how sweat is made in an eccrine sweat gland.



Fun Fact

Did you know that the lining of your outer ear has modified apocrine glands called **ceruminous glands**? These modified sweat glands produce **ear wax**. Ear wax is thought to prevent foreign material from entering your ears, including insects.



Na⁺ — Sodium
Cl⁻ — Chloride
K⁺ — Potassium
H₂O — Water

Movement of ions and water in making sweat

When the sweat gland is stimulated, the cells secrete a fluid that is similar to plasma -- that is, it is mostly water and it has high concentrations of sodium. This fluid travels from the coiled portion up through the straight duct. What happens in the straight duct depends upon the rate of sweat production or flow:

- **Low sweat production** (rest, cool temperature) - Cells in the straight duct reabsorb most of the sodium from the fluid. This happens because there is enough time. In addition, water is reabsorbed. So not much sweat reaches the outside.
- **High sweat production** (exercise, hot temperature) - Cells in the straight portion do not have enough time to reabsorb all of sodium. So, a lot of sweat makes it to the surface of the skin. The sodium concentration are about half as much, and potassium is about 20 percent higher.

Sweat is produced in apocrine sweat glands in the same way. However, the sweat from apocrine glands also contains proteins and fatty acids, which make it thicker and give it a milkier or yellowish colour. This is why underarm stains in clothing appear yellowish. Sweat itself has no smell, but when bacteria on the skin and hair change the proteins and fatty acids, they produce an unpleasant odour. This is why deodorants and anti-perspirants are applied to the underarms instead of the whole body.

The maximum volume of sweat that a person who is not adapted to a hot climate can produce is about one liter per hour. Amazingly, if you move to a hot climate such as the American desert southwest or the tropics, your ability to produce sweat will increase to about two to three liters per hour within about six weeks! This appears to be the maximum amount that you can produce.

Why We Sweat

When sweat evaporates from the surface of your skin, it removes excess heat and **cools** you. This is actually due to a neat principle in physics, which goes like this. To convert water from a liquid to a vapour, it takes a certain amount of heat called the **heat of vaporization**. Typically, all of the sweat does not evaporate, but rather runs off your skin. In addition, not all heat energy produced by the body is lost through sweat. Some is directly radiated from the skin to the air and some is lost through respiratory surfaces of the lungs.

A major factor that influences the rate of evaporation is the relative humidity of the air around you. If the air is humid, then it already has water vapour in it, probably near saturation, and cannot take any more. Therefore, sweat does not evaporate and cool your body as efficiently as when the air is dry.

Finally, when the water in the sweat evaporates, it leaves the salts (sodium, chloride and potassium) behind on your skin, which is why your skin tastes salty. The loss of excessive amounts of salt and water from your body can quickly dehydrate you, which can lead to circulatory problems, kidney failure and heat stroke. So, it is important to drink plenty of fluids when you exercise or are outside in high temperatures. Sports drinks contain some salts to replace those lost in the sweat.

Nervous or Scared?

As we mentioned earlier, sweating responds to your emotional state. So when you are nervous, anxious or afraid, there is an increase in sympathetic nerve activity in your body as well as an increase in epinephrine secretion from your adrenal gland. These substances act on your sweat glands, particularly those on the palms of your hand and your armpits, to make sweat. Thus, you feel a "cold" sweat. Also, the increased sympathetic nerve activity in the skin changes its electrical resistance, which is the basis of the **galvanic skin response** used in lie detector tests.