How do tattoos work? [1]

Alice,

How do tattoos work? I mean, if human skin cells are always shedding and reproducing themselves, how are the pigments of a tattoo able to stay in the skin for so long?

— MOM

Answer

Dear MOM,

Trying to tease out the tech behind tattoos? To get started, it’s helpful to understand the skin’s structure — the top two layers of human skin are the dermis and the epidermis. The outer, thinner epidermis consists of four or five cell layers that provide a waterproof barrier and the skin’s pigment. The inner dermis contains blood vessels, nerve endings, hair follicles, and sweat glands. While the epidermis is constantly shedding, the dermis doesn’t shed as quickly, which is why the ink for tattoos are inserted into the dermis. The process for keeping the tattoo ink in the dermis is actually quite complicated and involves backup from the immune system. To learn more about this process, keep reading.

The process for getting ink into the skin is pretty well-known — lots of needle pokes — but it’s not really clear how the ink manages to stay there. Scientists have known for some time that tattoos are made possible by the reaction of the immune system to the injected ink. Macrophages, one type of immune cell, eat up cellular debris and foreign material to protect the body from infection. Whenever someone suffers a wound, these fighter cells come rushing in to get rid of dead cells and any foreign invaders. In the case of tattoos, the macrophages see the ink as foreign. These cells eat up the ink and actually keep it within their cellular membranes which results in the pigment staying put. When the lifespan of the macrophage is complete, it dies and releases the ink back into the skin, only to have it picked up again by another macrophage.

Though tattoos are intended to be permanent, they may change over time. The color can fade and the image may distort as the body changes in shape and size. It’s also possible that small amounts of ink are removed each time a macrophage releases the ink when it dies, before it’s absorbed again. Yet, even with this knowledge, scientists still don’t have a great way to easily
remove tattoos, and therefore they’re likely to last a lifetime in some form or another unless specific action is taken otherwise [2].

For anyone considering getting a tattoo, it’s good to understand the potential health risks as well. Inserting needles into the dermis layer of the skin can lead to an infection (and even a blood infection if the tattoo studio conditions are unsanitary), excessive scarring of the skin leading to keloids [3], and possibly an allergic reaction. For more information on tattoos, you may contact your state health department to learn about the safety and sanitary procedures for tattoos in your state. Additionally, if you’re thinking about getting a tattoo, Mayo Clinic [4] has some tips for finding tattoo studios. They also have information on taking care of a new tattoo to prevent infection and keeping it looking brand new, such as keeping it clean, out of the sun, and properly moisturized, among other tips.

Turns out the immune system does more than keep the body healthy — it can keep it decorated, too!

Alice!
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