

Dermal Route

In contrast to the thin membranes of the respiratory alveoli and the gastrointestinal villi, the skin is a complex, multilayer tissue. It is relatively impermeable to most ions and aqueous solutions, and serves as a barrier to most xenobiotics.

Did you know?

[Dimethyl sulfoxide \(DMSO\)](#) has been used in research, human and veterinary medicine, and as a solvent. After applying to the skin, some people can quickly detect a garlic taste as the DMSO is absorbed and enters the body. DMSO also increases the rate of absorption of some other compounds through the skin.

For transdermal drug delivery (TDD), the big challenge is the barrier property of skin, especially the stratum corneum (SC). Different methods have been developed to enhance the penetration of drugs through the skin, with the most popular approach being the use of penetration enhancers (PEs), including natural terpenes. Terpenes, a large and diverse class of organic compounds produced by a variety of plants, are a very safe and effective class of PEs. [Limonene](#) is one example of a terpene used as a penetration enhancer. The main mechanism for the penetration enhancing action of terpenes is the interaction with SC intercellular lipids. The key factor affecting the enhancement is the lipophilicity of the terpenes and the drug molecules.



Entry of Toxicants via Skin

Some notable toxicants can gain entry into the body following skin contamination. For example:

- Certain commonly used organophosphate pesticides have poisoned agricultural workers following dermal exposure.
- The neurological warfare agent, sarin, readily passes through the skin and can produce quick death to exposed persons.
- Several industrial solvents can cause systemic toxicity by penetrating the skin. For example:
 - Carbon tetrachloride enters the skin and causes liver injury.
 - Hexane can pass through the skin and cause nerve damage.

The skin consists of three main layers of cells as illustrated in Figure 10.4.1:

1. Epidermis
2. Dermis
3. Subcutaneous tissue

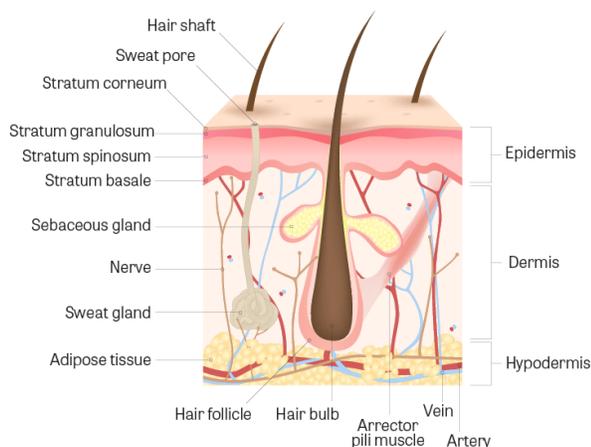


Figure 10.4.1. Layers of the skin
(Image Source: Adapted from iStock Photos, ©)

Epidermis and Stratum Corneum

The epidermis (and particularly the stratum corneum) is the only layer that is important in regulating the penetration of a skin contaminant. It consists of an outer layer of cells, packed with keratin, known as the **stratum corneum** layer. The stratum corneum is devoid of blood vessels. The cell walls of the keratinized cells are apparently double in thickness due to the presence of the keratin, which is chemically resistant and an impenetrable material. The blood vessels are usually about 100 μM from the skin surface. To enter a blood vessel, an agent must pass through several layers of cells that are generally resistant to penetration by chemicals.

Factors Influencing Penetration of the Stratum Corneum

Thickness

The thickness of the stratum corneum varies greatly with regions of the body. The stratum corneum of the palms and soles is very thick (400-600 μM) whereas that of the arms, back, legs, and abdomen is much thinner (8-15 μM). The stratum corneum of the axillary (underarm) and inguinal (groin) regions is the thinnest with the scrotum especially thin. As expected, the ability of toxicants to penetrate that stratum corneum inversely relates to the thickness of the epidermis.

Stratum corneum - **This is the correct answer.**

The epidermis (and particularly the stratum corneum) is the only layer that is important in regulating penetration of a skin contaminant.

2) The two primary factors that can increase dermal penetration are:

- a) Neutralizing pH and aerosolizing
- b) Increasing hydration and disruption of the stratum corneum
- c) Dehydrating a substance and increasing particle size

Answer

Increasing hydration and disruption of the stratum corneum - **This is the correct answer.**

Water plays an important role in dermal absorption. Normally, the stratum corneum is partially hydrated (~7% by weight). Penetration of polar substances is about 10 times as effective as when the skin is completely dry. Additional hydration can increase penetration by 3-5 times which further increases the ability of a polar compound to penetrate the epidermis. Any process that removes or damages the stratum corneum can enhance penetration of a xenobiotic.

This page titled [10.4: Dermal Route](#) is shared under a [CC BY-NC 4.0](#) license and was authored, remixed, and/or curated by [ToxMSDT Online component](#) via [source content](#) that was edited to the style and standards of the LibreTexts platform.