The largest organ in your body isn't your liver or your brain. It's your skin, with a surface area of about 20 square feet in adults. Though different areas of the skin have different characteristics, much of this surface performs similar functions, such as sweating, feeling heat and cold, and growing hair. But after a deep cut or wound, the newly healed skin will look different from the surrounding area, and may not fully regain all its abilities for a while, or at all. To understand why this happens, we need to look at the structure of the human skin.

The top layer, called the epidermis, consists mostly of hardened cells, called keratinocytes, and provides protection. Since its outer layer is constantly being shed and renewed, it's pretty easy to repair. But sometimes a wound penetrates into the dermis, which contains blood vessels and the various glands and nerve endings that enable the skin's many functions. And when that happens, it triggers the four overlapping stages of the regenerative process. The first stage, haemostasis, is the skin's response to two immediate threats: that you're now losing blood and that the physical barrier of the epidermis has been compromised.

As the blood vessels tighten to minimize the bleeding, in a process known as vasoconstriction, both threats are averted by forming a blood clot. A special protein known as fibrin forms cross-links on the top of the skin, preventing blood from flowing out and bacteria or pathogens from getting in. After about three hours of this, the skin begins to turn red, signalling the next stage, inflammation. With bleeding under control and the barrier secured, the body sends special cells to fight any pathogens that may have gotten through. Among the most important of these are white blood cells, known as macrophages, which devour bacteria and damage tissue through a process known as phagocytosis, in addition to producing growth factors to spur healing. And because these tiny soldiers need to travel through the blood to get to the wound site, the previously constricted blood vessels now expand in a process called vasodilation. About two to three days after the wound, the proliferative stage occurs, when fibroblast cells begin to enter the wound. In the process of collagen deposition, they produce a fibrous protein called collagen in the wound site, forming connective skin tissue to replace the fibrin from before. As epidermal cells divide to reform the outer layer of skin, the dermis contracts to close the wound. Finally, in the fourth stage of remodelling, the wound matures as the newly deposited collagen is rearranged and converted into specific types.

Through this process, which can take over a year, the tensile strength of the new skin is improved, and blood vessels and other connections are strengthened. With time, the new tissue can reach from 50-80% of some of its original healthy function, depending on the severity of the initial wound and on the function itself. But because the skin does not fully recover, scarring continues to be a major clinical issue for doctors around the world. And even though researchers have made significant strides in understanding the healing process, many fundamental mysteries remain unresolved. For instance, do fibroblast cells arrive from the blood vessels or from skin tissue adjacent to the wound? And why do some other mammals, such as deer, heal their wounds much more efficiently and completely than humans? By finding the answers to these questions and others, we may one day be able to heal ourselves so well that scars will be just a memory.