

Only skin deep

## Description

With *Captain America: The Winter Soldier* movie now out in theaters for a few weeks (it is quite good and I recommend everyone go see it), I have had the Marvel Universe on the brain. I find myself giddy with anticipation over the upcoming *Guardians of the Galaxy* film, which opens in August, and ravenous for any news about the Avengers sequel next year, entitled *Avengers: Age of Ultron*.

And with Marvel thoughts running around rampant in my brain, I began to dwell on the upcoming multiple mini-series that will premiere on Netflix next year, featuring Jessica Jones, Iron Fist, Daredevil and Luke Cage, eventually culminating in a giant team-up event called *The Defenders*. There is so much news and excitement coming in the next few years that the comic fan in me cannot stand it!

But the scientist in me began to ponder about superpowers, namely of these so-called “street level” heroes and if they could actually exist. Luke Cage, also known as Power Man, is one of the most durable superheroes in the Marvel Universe, thanks to his unique set of powers that allow him to have superhuman strength, and most notably, unbreakable skin due to being exposed to a variant of the Super Soldier serum that created Captain America.



[Source](#)

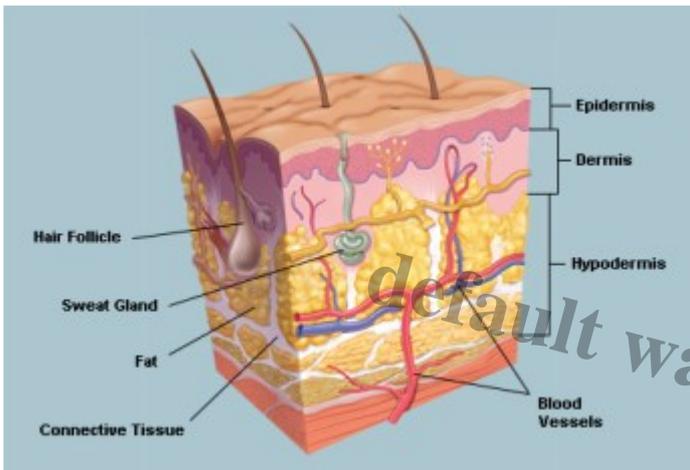
Luke Cage started out in a street gang, but due to some events with a girlfriend of a friend, he was framed for heroin possession and locked up in Seagate Prison. There, he was “volunteered” for experiments, which resulted in his superpowers. He started a group called “Heroes for Hire,” which was a for-profit superhero business, and eventually joined the Avengers and headlined the New Avengers.

According to the official [Marvel comics database](#), Cage’s™ powers are that his skin is steel-hard and his muscles and bone tissue are super-dense and resistant to damage. “He can withstand conventional handgun fire at a range of four feet and cannot be cut by the sharpest of blades, although

in the event of required surgery, his skin can be lacerated by an overpowered medical laser. He can withstand up to one-ton impacts or blasts of 150 pounds of TNT without serious injury, and is impervious to temperature extremes and electrical shocks. His recovery time from injury or trauma is usually one-third that of an ordinary human.â€•

But what about the skin on everyone else?

Skin is separated into different layers: the epidermis, dermis and subcutis (or hypodermis).



[Source](#)

The epidermis is the outermost layer, which has the nerve cells, melanin (which creates the colour of your skin), and immune cells to protect against infection. The epidermis heals itself very quickly and leaves no scars, unlike the lower layers. While the epidermis is what is shown to the world, it really varies in thickness across your body â€“ from 1.5 millimetres (mm) on the palm of your hands to only 0.5 mm on your eyelids.

The dermis is right below the epidermis and is much thicker, up to 1.5 mm thick, which makes up around 90 percent of the total thickness of the skin. It is used mainly to help regulate body temperature and blood supply. The dermis is also where blood vessels are, along with hair follicles, sweat glands and many more. Because it is below the epidermis, it doesnâ€™t heal as quickly, so when it is injured, special cells come and fill up the hole that are not as sensitive or flexible, which create scars.

The last layer, the subcutis or hypodermis, is where fat is stored and serves as a way to protect the organs, regulate body temperature and use fat as an emergency energy reserve for the body.

In total, the average skin thickness is 2.5 millimetres thick â€“ but how thick would it have to be to, like Luke Cage, survive the shot of a conventional handgun fired at a range of four feet?

According the Federal Bureau of Investigation, all handguns must be capable of 12 inches of penetration in order to run the greatest chance of injuring vital organs and incapacitate the subject in order to be used by agents in the field. The 12-inch guideline accommodates for the presence of bones, vital organs, etc., as most people are far less than 12 inches thick. In fact, Iâ€™m only about 7.5 â€“ 8 inches thick at my torso; so being shot by a bullet that can penetrate over 1.5 times that is more than enough. So, that seems like a pretty good baseline to start with.

Penetration power of a handgun is usually achieved by firing it at a block of ballistics gel, which estimates tissue density and viscosity (or how solid and liquid a substance is) to estimate the force of the shot. While the gel simulates muscle tissue, which has a density of 1.06 kg/litre, fat has a density of 0.92 kg/litre. Therefore, since skin is a mix of both, as well as some extras thrown in, the density is probably around 1-1.1 kg/litre. Therefore, while ballistics gel is not optimal to gauge skin penetration, it serves as a good ballpark figure. Therefore, if the FBI requires that its handguns be able to penetrate a minimum of 12 inches of ballistics gel, it is time for some math.

12 inches = 30.48 centimetres = 304.8 millimetres

And average skin thickness = 2.5 mm

If we divide the thickness of the handgun penetration into ballistics gel by the average skin thickness, we can calculate how much thicker your skin would need to be in order to be at the maximum end of the minimum FBI ballistics requirements.

$304.8/2.5 = 121.92$ , or roughly **122 times** the thickness of skin.

What that means is that hypothetically, if your skin were to be **123 times** thicker than normal (around 307.5 mm thick), you *might* be able to survive being shot by a bullet from the end of an FBI standard issue handgun, but it would still hurt. Probably a lot. You would probably be better off wearing a bulletproof vest, which slows down bullets extremely quickly to a survivable level, or simply not getting shot at all.

### Sources

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### Category

1. Science
2. superheroes

### Tags

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3. Marvel
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