

13d: Shocking! The Effects of Current on the Human Body

When dealing with electricity, obviously you must always be careful.

- The question is, what is it about electricity that can cause so much damage to a human?

There are two main ways electricity will hurt a person:

1. Electricity can block the normal functions of nerve cells, which can cause anything from a mild tingle to a major heart attack.
2. Electrical burns can be caused when electricity arcs. They are essentially treated like any other burn.

If we focus on exactly what happens when electricity interferes with nerves, we can zero in on the one property that causes damage.

- It is actually the current that will hurt you, not the voltage.
 - I can quite safely pass a 100 000 V through my body without any permanent damage as long as the current is kept very low.
- To remember this, keep the phrase “***kurrent kills***” in your mind.

| <i>Current (A)</i> | <i>Biological Effect</i> |
|---------------------------|--|
| 0.001 | The threshold for a person to even feel the current. It might be felt by the person as a mild tingling at most. |
| 0.005 | Most people will describe this as feeling painful, even if it is just for a brief moment. |
| 0.010 | Involuntary muscle contractions and spasms. |
| 0.015 | Complete loss of muscle control. |
| 0.070 | Disruptions to the nervous system will be so serious that it will be fatal if it lasts for more than about one second. |

So why is it that some people in their homes just get a little zap if they touch a bare power cord, but others are fatally shocked?

- The current the person will have going through their body depends on the voltage (***120V from North American outlets!!!***) and the resistance of the conductor (in this case, the human body).
- Different peoples' bodies have different resistances, though in most cases an average person is a pretty good conductor since we are filled with a lot of water that has a bunch of ions.
 - The resistance our bodies do have is because of the layer of dry, dead skin that surrounds us.

Dry Skin → 75 000Ω

Salt Water Soaked Body → 100Ω

Did YOU KNOW?

Apprentice electricians are often told to work with one hand behind their backs. This gets them into the habit of only using one hand at any time. If both hands are used, and the person is accidentally electrocuted, the electricity will travel from hand to hand right through the person's heart!

Example 1: Determine what the effect would be on a person if they stuck their finger into a regular wall outlet under the following conditions... (don't try this at home, folks!)

a) with completely dry skin

$$I = \frac{V}{R}$$
$$I = \frac{120V}{75000 \Omega} = 1.6e-3 A$$

This would be like the “mild” shock you get if you accidentally touched a bare bit of wire on an electrical cord with dry fingers. It doesn't feel good, but it doesn't necessarily send you to the hospital!

b) after sitting in a bathtub filled with salt water

$$I = \frac{V}{R}$$
$$I = \frac{120V}{100 \Omega} = 1.2 A$$

In this case the person would most likely be killed if the current passing through his/her body lasts for more than a brief moment.