A person who is barefoot or wearing thin-soled shoes will be in good contact with the ground, and touching a 120-V line with a wet hand can result in a current

$$I = \frac{120\ \text{V}}{1000\ \Omega} = 120\ \text{mA}.$$

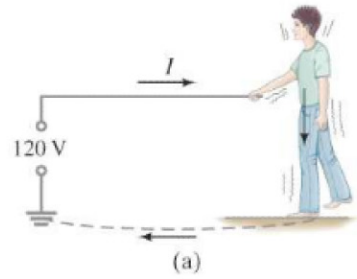
As we saw, this could be lethal.

A person who has received a shock has become part of a complete circuit. Figure 19–25 shows two ways the circuit might be completed when a person accidentally touches a "hot" electric wire—"hot" meaning a high potential such as 120 V (normal household voltage) relative to ground. The other side of building wiring is connected to ground—either by a wire connected to a buried conductor, or via a water pipe into the ground. In Fig. 19–25a, the current passes from the high-voltage wire, through the person, to the ground through his bare feet, and back along the ground (a fair conductor) to the ground terminal of the source. If the person stands on a good insulator—thick rubber-soled shoes or a dry wood floor—there will be much more resistance in the circuit and consequently much less current through the person. If the person stands with bare feet on the ground, or is in a bathtub, there is lethal danger because the resistance is much less and the current greater. In a bathtub (or swimming pool), not only are you wet, but the water is in contact with the drain pipe that leads to the ground. It is strongly recommended that you not touch anything electrical when wet or in bare feet.

In Fig. 19–25b, a person touches a faulty "hot" wire with one hand, and the other hand touches a sink faucet (connected to ground via the pipe). The current is particularly dangerous because it passes across the chest, through the heart and lungs. A rule of thumb: if one hand is touching something electrical, keep your other hand in your pocket (don't use it!), and wear thick rubber-soled shoes. It is also a good idea to remove metal jewelry, especially rings (your finger is usually moist under a ring).

You can come into contact with a hot wire by touching a bare wire whose insulation has worn off, or from a bare wire inside an appliance when you're tinkering with it. (Always unplug an electrical device before investigating[†] its insides!) Another possibility is that a wire inside a device may break or lose its insulation and come in contact with the case. If the case is metal, it will conduct electricity. A person could then suffer a severe shock merely by touching the case, as shown in Fig. 19–26b. To prevent an accident, metal cases are supposed to be connected directly to ground by a separate ground wire. Then if a "hot" wire touches the grounded case, a short circuit to ground immediately occurs internally, as shown in Fig. 19–26c, and most of the current passes through the low-resistance ground wire rather than through the person. Furthermore, the high current should open the fuse or circuit breaker.

[†]Even then you can get a bad shock from a capacitor that hasn't been discharged until you touch it.



(a)

(b)

FIGURE 19–25 A person receives an electric shock when the circuit is completed.

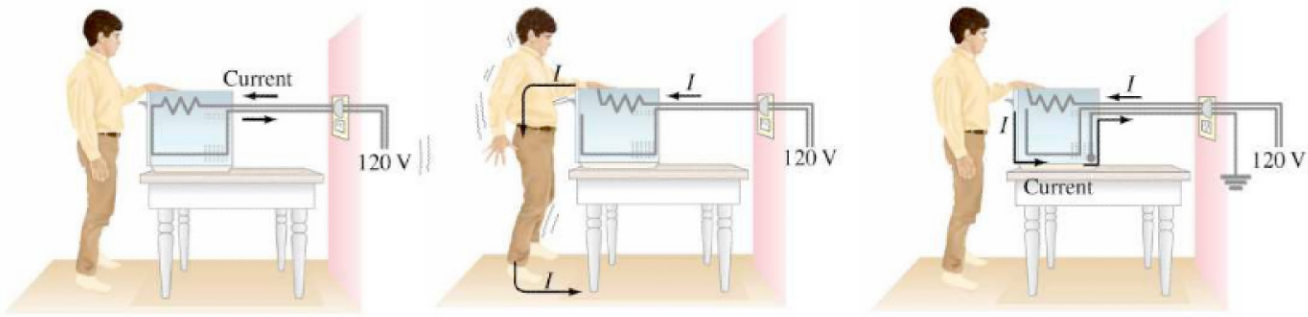
CAUTION

Keep one hand in your pocket when other touches electricity

PHYSICS APPLIED

Grounding and shocks

FIGURE 19–26 (a) An electric oven operating normally with a 2-prong plug.
(b) Short to the case with ungrounded case: shock.
(c) Short to the case with the case grounded by a 3-prong plug.



(a) (b) (c)