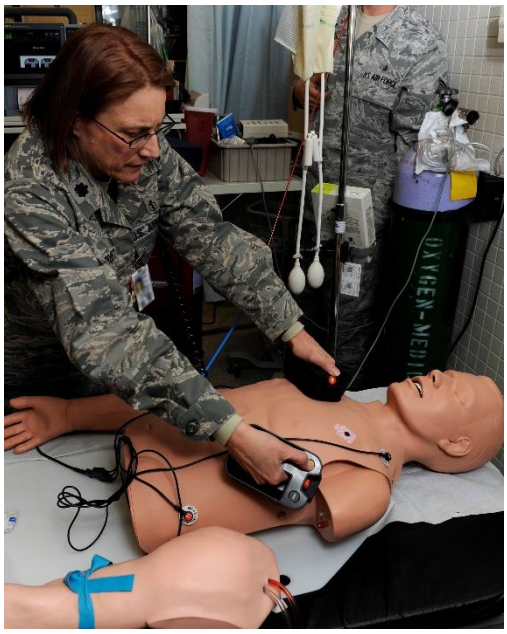
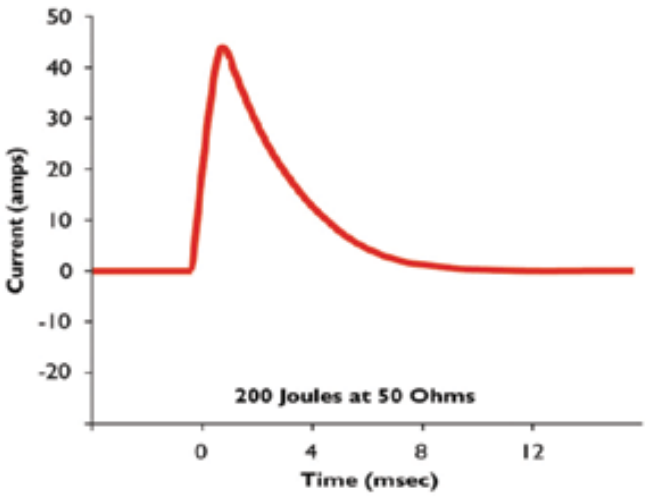
Defibrillators and Your Heart

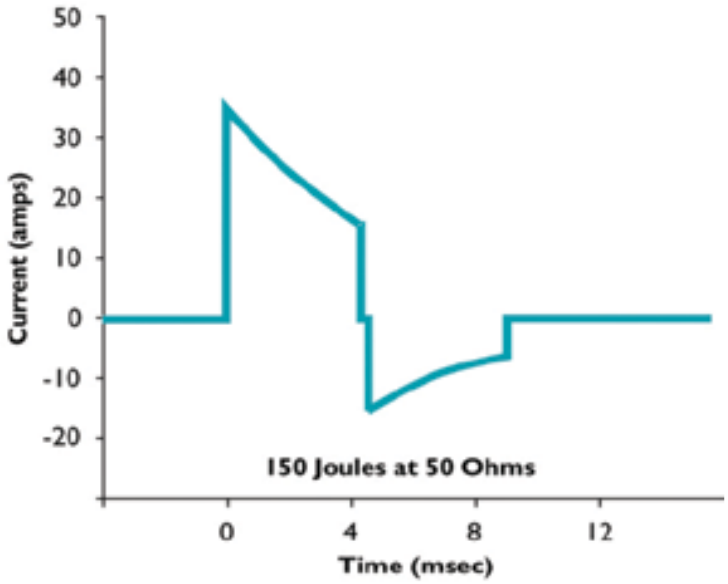
Your heartbeat follows a particular rhythm that has evolved to efficiently pump blood throughout your body. The heart creates and regulates its own rhythm, but various diseases can interfere with the process. Sometimes a heart will enter a state of Ventricular Fibrillation which prevents it from effectively pumping. That can be fatal if not corrected within a few minutes.



Defibrillators are machines used to restore the normal rhythm to a heart that is beating in a dangerously erratic manner. Defibrillators pass an electrical current through a patient's chest, from one paddle or electrode to another. This momentarily stops the dangerously erratic behavior of the heart so that its natural pacemaker may restore a healthy rhythm. The electrical current lasts for only a fraction of a second and may resemble the waveform below.



Engineers and medical researchers are constantly developing new defibrillators and experimenting with electrical currents that follow slightly different waveforms. The shape of these waveforms depends on devices inside the defibrillator called capacitors. The role of a capacitor is to store electrical energy in a way that allows it to be discharged very rapidly, far more rapidly than electricity can leave a battery or even a wall socket! Consider the output waveform of a defibrillator shown below:



1. What is being measured on the vertical (*y*) axis?

2. What is being measured on the horizontal (*x*) axis?

3. What is the duration of this electrical discharge?

4. Sometimes the current has a positive value, and sometimes it is negative. What do you suppose this shows about the flow of the electrical current?

5. In mathematical terms, is this waveform a function? Justify your answer.

6. Over what time periods is this waveform linear?

7. Over what time periods is this waveform exponential?

To learn more about the heart and defibrillators, spend some time exploring THIS website.

Waveforms from: R Dickerson (2011) The old wave, Southern African Journal of Anaesthesia and Analgesia, 17:2, 205-214, DOI: 10.1080/22201173.2011.10872780