What happens at the neuromuscular junction?

One motor neuron (nerve cell) may stimulate a few muscle cells or hundreds of them, depending on the particular muscle and the work it does. One neuron and all the skeletal muscle cells it stimulates are a motor unit. When a long threadlike extension of the neuron, called the nerve fiber or axon, reaches the muscle, it branches into a number of axon terminals, each of which forms junctions with the sarcolemma of a different muscle cell. These junctions are called neuromuscular (literally, “nerve-muscle”) junctions. Although the nerve endings and the muscle cells’ membranes are very close, they never touch. The gap between them, the synaptic cleft, is filled with tissue (interstitial) fluid.

Now that we have described the structure of the neuromuscular junction, we are ready to examine what happens there. When the nerve impulse reaches the axon terminals, a chemical referred to as a neurotransmitter is released. The specific neurotransmitter that stimulates skeletal muscle cells is acetylcholine, or Ach. Acetylcholine diffuses across the synaptic cleft and attaches to receptors (membrane proteins) that are part of the sarcolemma. If enough acetylcholine is released, the sarcolemma at that point becomes temporarily more permeable to sodium ions (Na⁺), which rush into the muscle cell and to potassium ions (K⁺) which diffuse out of the cell. However, more Na⁺ enters than K⁺ leaves. This gives the cell interior an excess of positive ions, which reverses the electrical conditions of the sarcolemma and opens more channels that allow Na⁺ entry only. This “upset” generates an electrical current called an action potential. Once begun, the action potential is unstoppable; it travels over the entire surface of the sarcolemma, conducting the electrical impulse from one end of the cell to the other. The result is contraction of the muscle cell.