

Saladin 7E
Answer Key
Chapter 11, Muscular Tissue

Testing Your Comprehension

1. ATP is required for both contraction and relaxation of muscle. In contraction, it must activate the myosin ATPase before myosin can bind to the active sites of actin. One ATP is needed for each cycle of cross-bridge formation and detachment. In relaxation, ATP is needed for the active transport pumps that remove Ca^{2+} from the cytosol and return it to the sarcoplasmic reticulum, and for the detachment of myosin from actin. In addition, muscle could not be stimulated to contract if not for its resting membrane potential, which is maintained by the ATP-consuming Na^+-K^+ pump.
2. Tracking a moving object and scanning a page of print require quick (fast-twitch) muscle contractions. smooth muscle contracts and relaxes far too slowly to produce such effective eye movements.
3. Filling and distension of the bladder would stretch the sarcomeres of skeletal muscle so much that there would be little overlap between the thick and thin filaments. In accordance with the length–tension relationship, when the bladder was stimulated, such overstretched skeletal muscle would contract only weakly. Smooth muscle is less dependent on the length–tension relationship for reasons explained on page 429-430. For those reasons, the molecular organization of smooth muscle is the key to understanding why it is more functionally effective in organs subject to stretch, such as the urinary bladder and stomach.
4. The A bands remain the same width because they are defined by the length of the thick filaments, and myofilaments do not shorten during muscle contraction. The H and I bands become narrower and may disappear. These are the regions in which actin and myosin do not overlap in relaxed muscle. During contraction, they are obliterated by the increasing myofilament overlap.
5. Andrew is correct; ATP is needed for both muscle contraction and relaxation. In contraction, it is used to activate the myosin heads of the thick filaments. In relaxation, it is needed to drive the active transport pumps that return calcium ions from the cytosol to the sarcoplasmic reticulum.