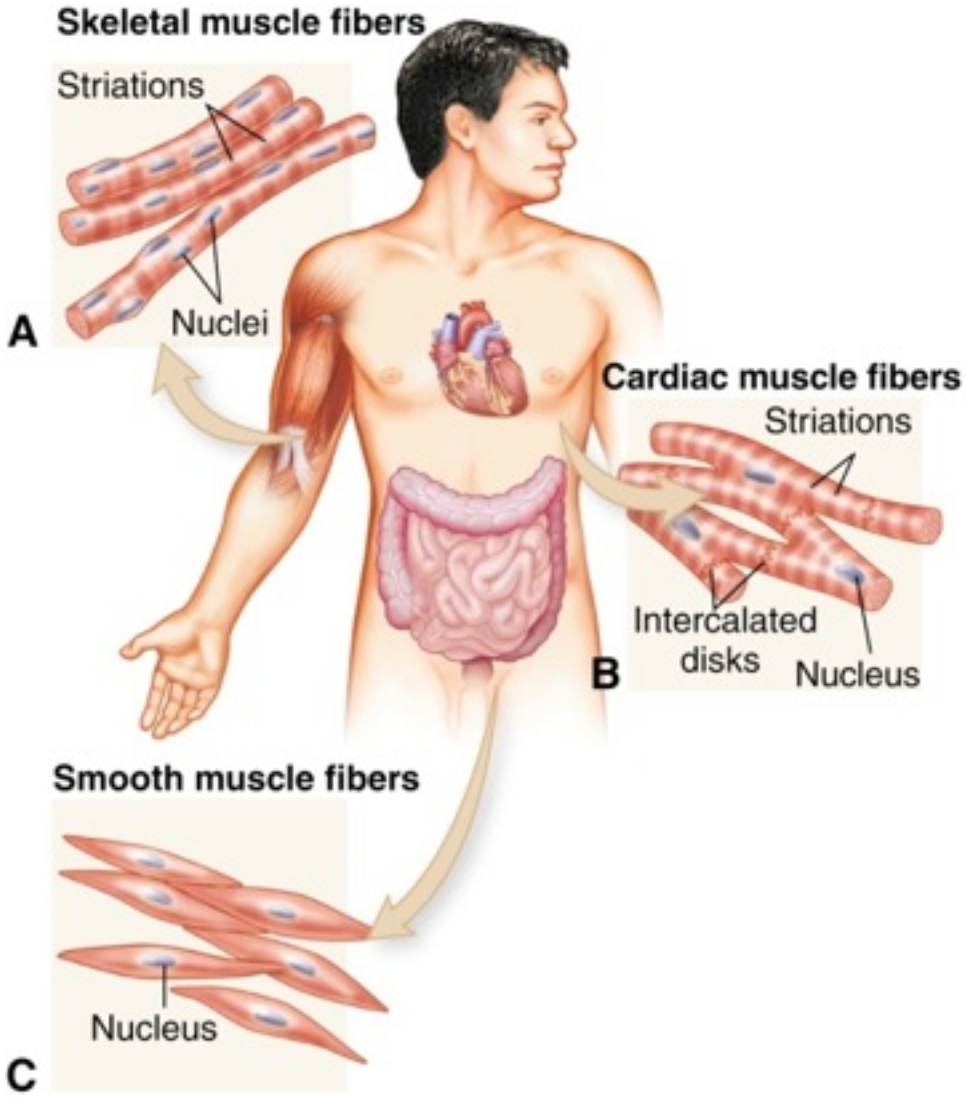
Chapter 7
The Muscular System

INTRODUCTION

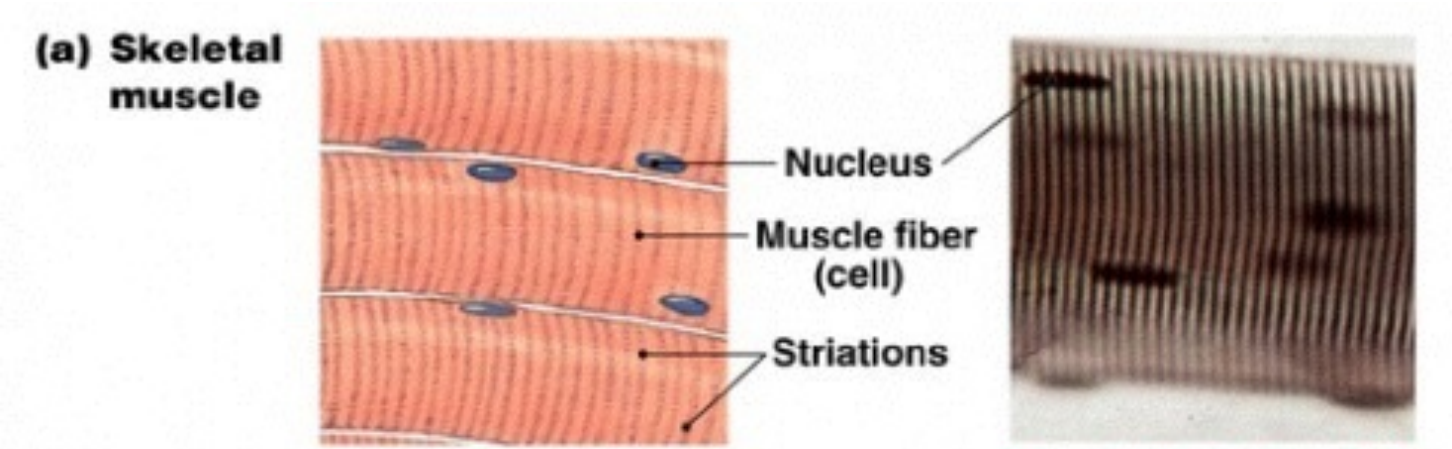
A. Muscular tissue enables the body and its parts to move
   1. Three types of muscle tissue exist in body
   2. Movement caused by muscle cells (called *fibers*): shortening or contracting
   3. Muscle movement occurs when chemical energy (obtained from food) is converted into mechanical energy

MUSCLE TISSUE



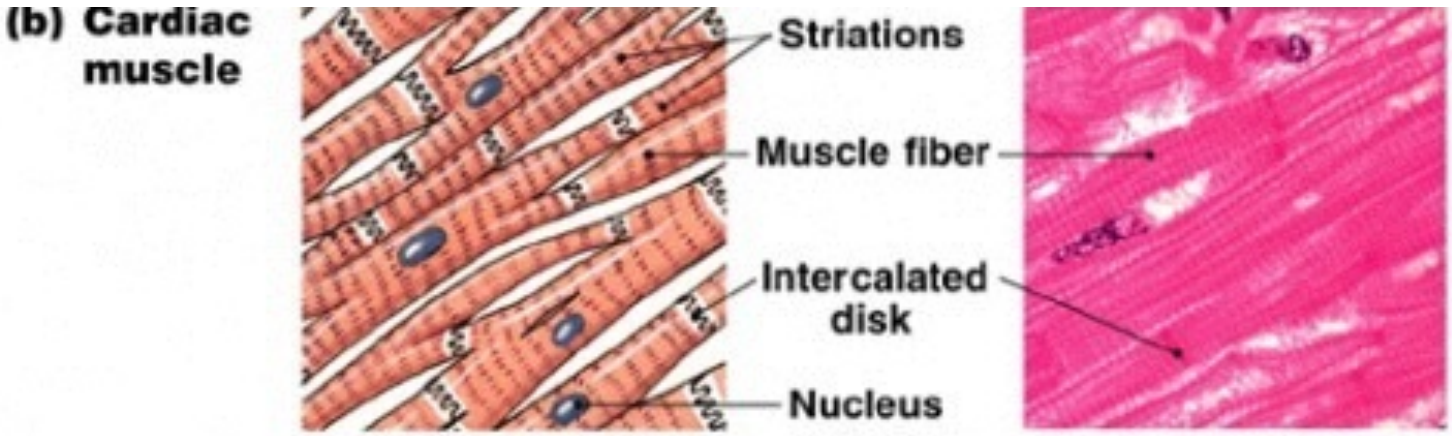
MUSCLE TISSUE

A. Types of muscle tissue (Figure 7-1)
   1. Skeletal muscle—also called *striated* or *voluntary muscle*
      - Microscope reveals crosswise stripes or striations
      - Contractions can be voluntarily controlled



MUSCLE TISSUE

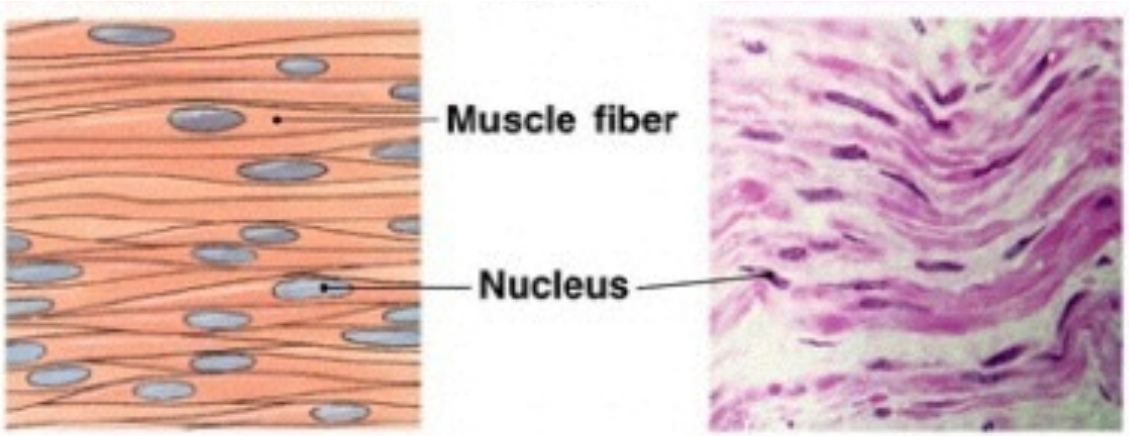
A. Types of muscle tissue (cont.)
   2. Cardiac muscle—composes bulk of heart
      - Cardiac muscle fibers are branched
      - Has dark bands called *intercalated disks*
      - Cardiac muscle fiber interconnections allow heart to contract efficiently as a unit



MUSCLE TISSUE (cont.)

A. Types of muscle tissue (cont.)
   3. Nonstriated muscle, or involuntary muscle—also called *smooth* or *visceral muscle*
      - Lacks cross stripes or striations when seen under a microscope; appears smooth
      - Found in walls of hollow structures, such as digestive tract, blood vessels, etc.
      - Contractions not under voluntary control

(c) Smooth muscle



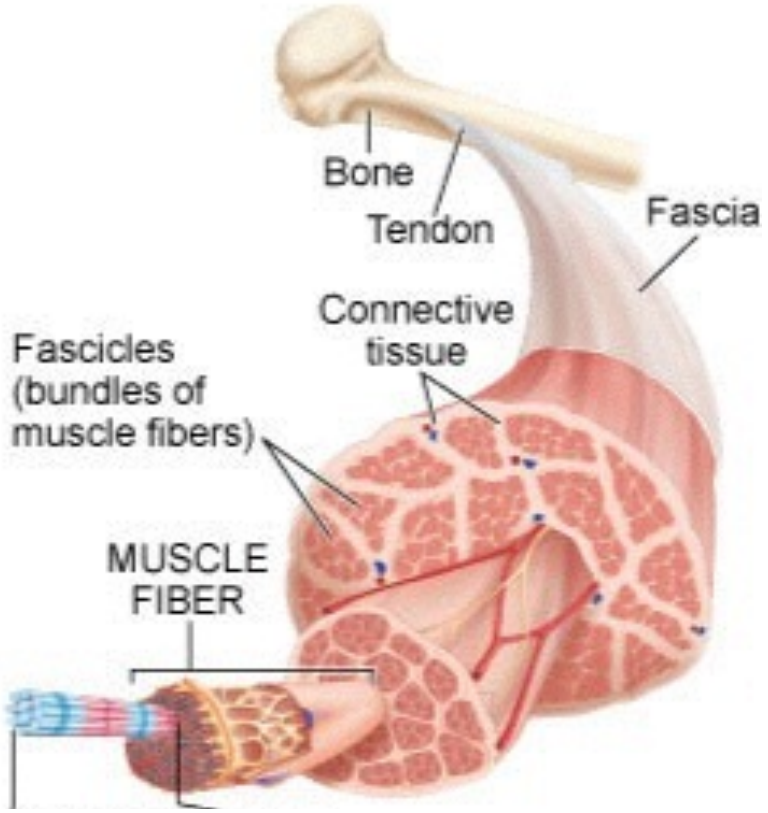
MUSCLE TISSUE (cont.)

B. Function—all muscle fibers specialize in contraction (shortening)

STRUCTURE OF SKELETAL MUSCLE

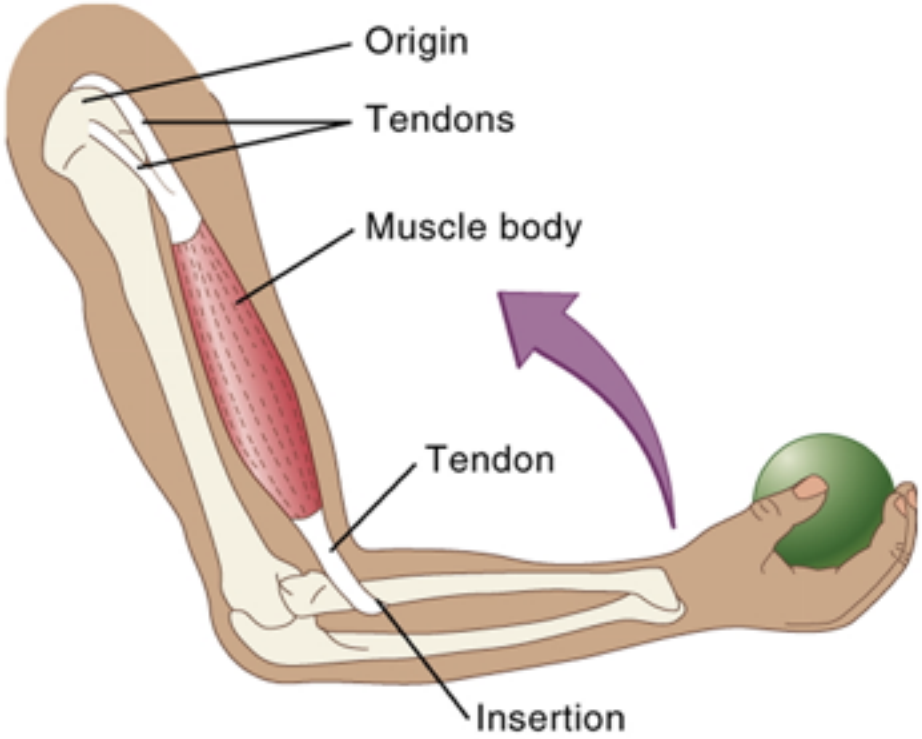
A. Muscle organs—mainly striated muscle fibers and connective tissue

1. Connective tissue forms “wrappers” around each muscle fiber, around **fascicles** (groups) of muscle fibers, and around the entire muscle; **fascia** surrounds muscle organs and nearby structures



STRUCTURE OF SKELETAL MUSCLE

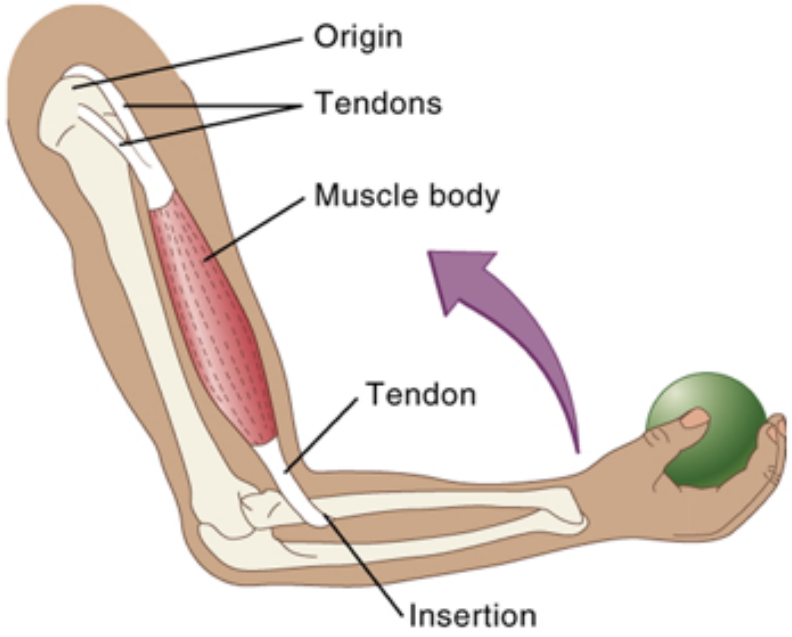
A. Muscle organs— (Con't)
   2. Most skeletal muscles extend from one bone across a joint to another bone.



STRUCTURE OF SKELETAL MUSCLE

A. Muscle organs— (Con't)

3. Regions of a skeletal muscle (Figure 7-2)
   a. Origin—attachment to the bone that remains relatively stationary or fixed when movement at the joint occurs
   b. Insertion—point of attachment to the bone that moves when a muscle contracts
   c. Body—main part of the muscle



STRUCTURE OF SKELETAL MUSCLE

A. Muscle organs— (Con't)

4. Muscles attach to bone by tendons—
   - strong cords or sheets of fibrous connective tissue that extend from the muscle organ
   - some tendons enclosed in synovial-lined tubes (tendon sheaths) and are lubricated by synovial fluid

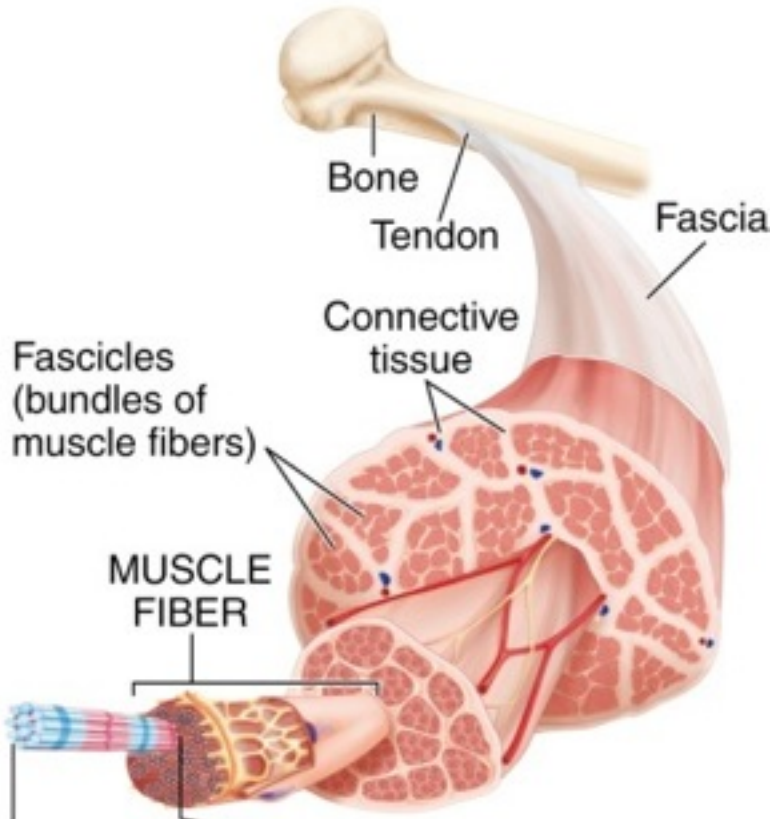
STRUCTURE OF SKELETAL MUSCLE

A. Muscle organs— (Con't)

5. Bursae—
   - small synovial-lined sacs containing a small amount of synovial fluid
   - located between some tendons and underlying bones

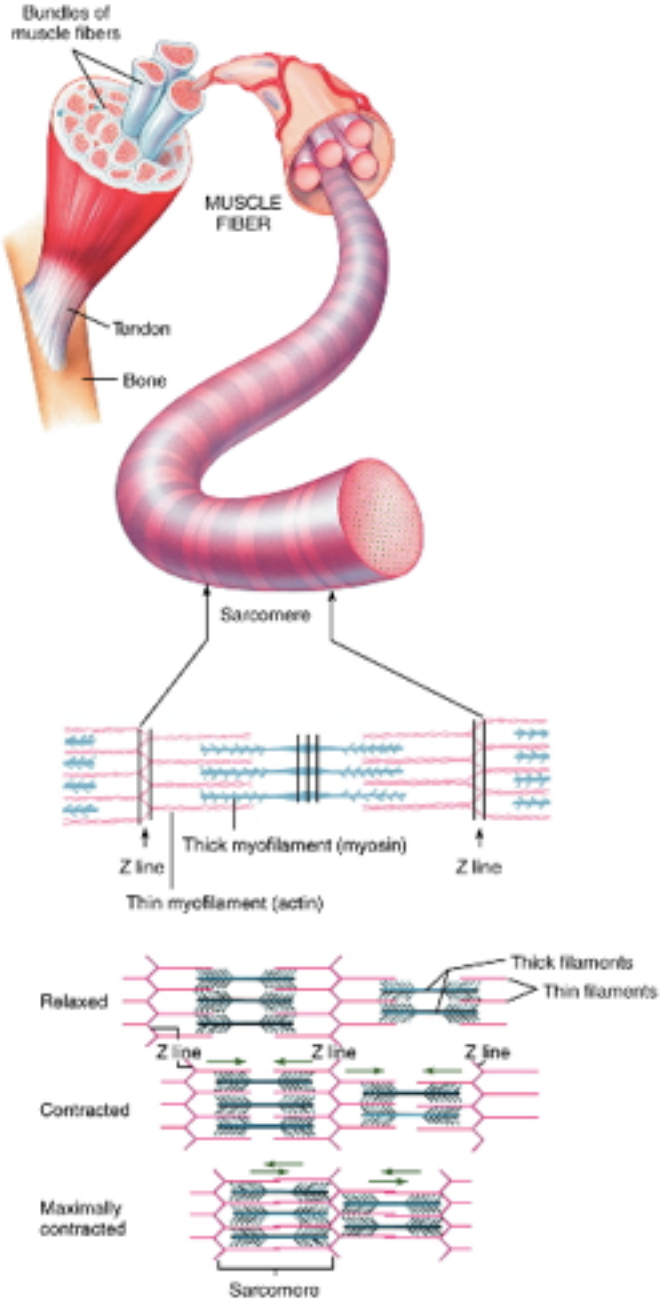
STRUCTURE OF SKELETAL MUSCLE

B. Microscopic structure and function (Figure 7-3)
- Consist of elongated **<u>contractile cells</u>**, or *muscle fibers;*
- Connective tissue holds muscle fibers in **<u>parallel groupings</u>**



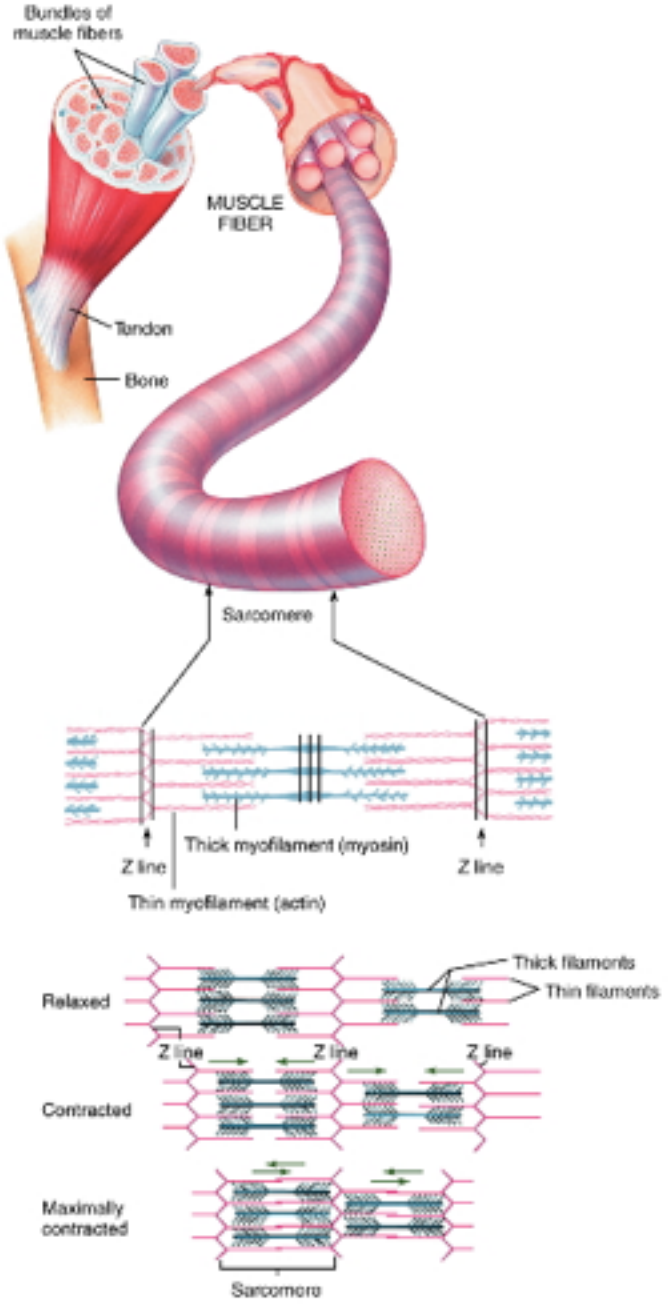
STRUCTURE OF SKELETAL MUSCLE

B. Microscopic structure and function (Figure 7-3)
   1. Fibers contain thick myofilaments (containing myosin) and thin myofilaments (containing mainly actin)



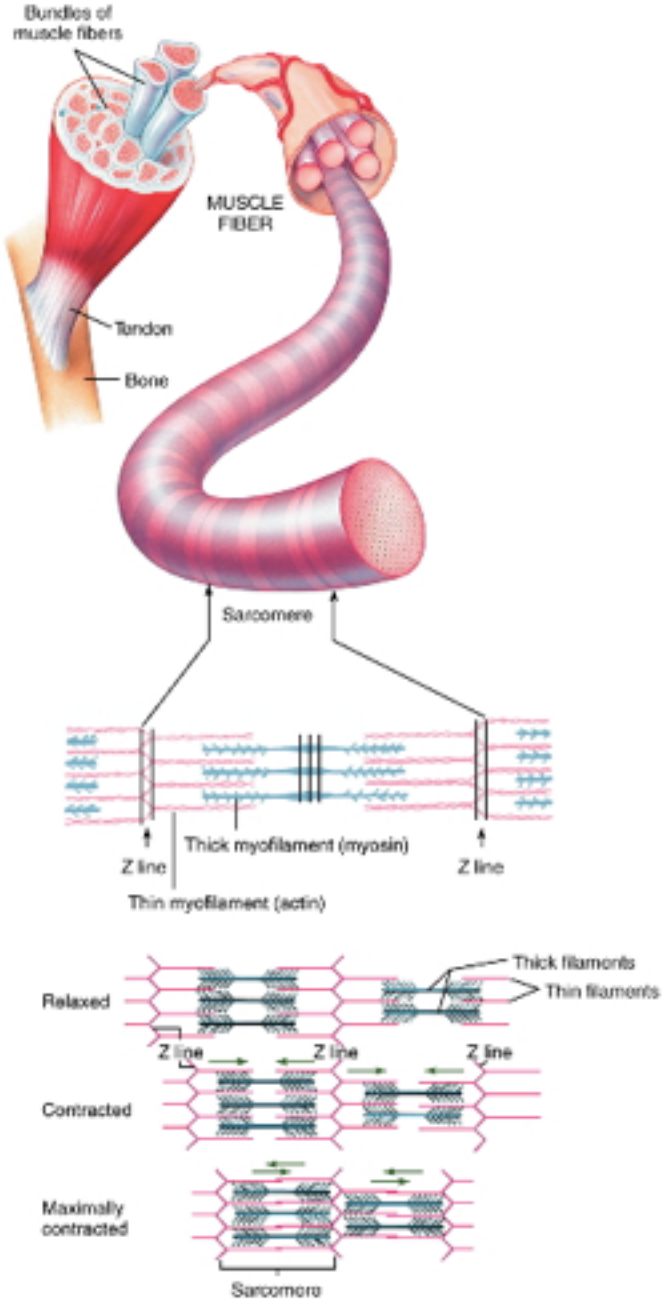
STRUCTURE OF SKELETAL MUSCLE

B. Microscopic structure and function (Figure 7-3)
   1. Fibers contain thick myofilaments (containing myosin) and thin myofilaments (containing mainly actin)
   2. Myosin + actin = Sarcomere - basic contractile unit



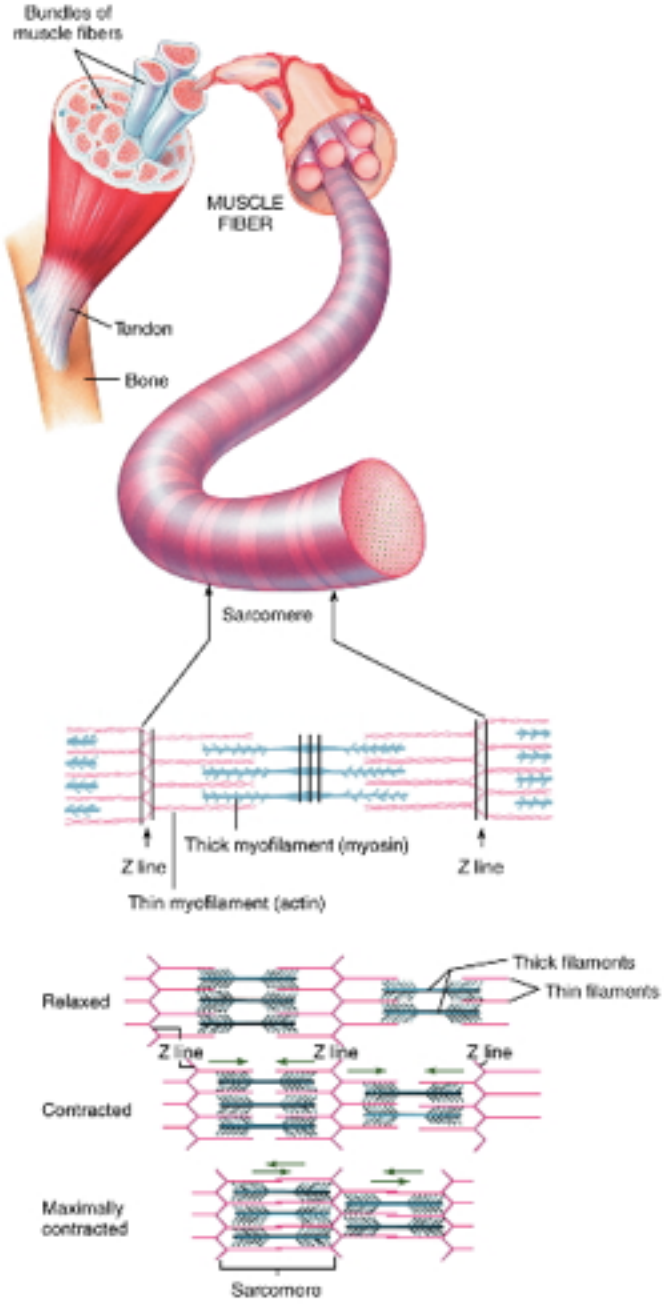
STRUCTURE OF SKELETAL MUSCLE

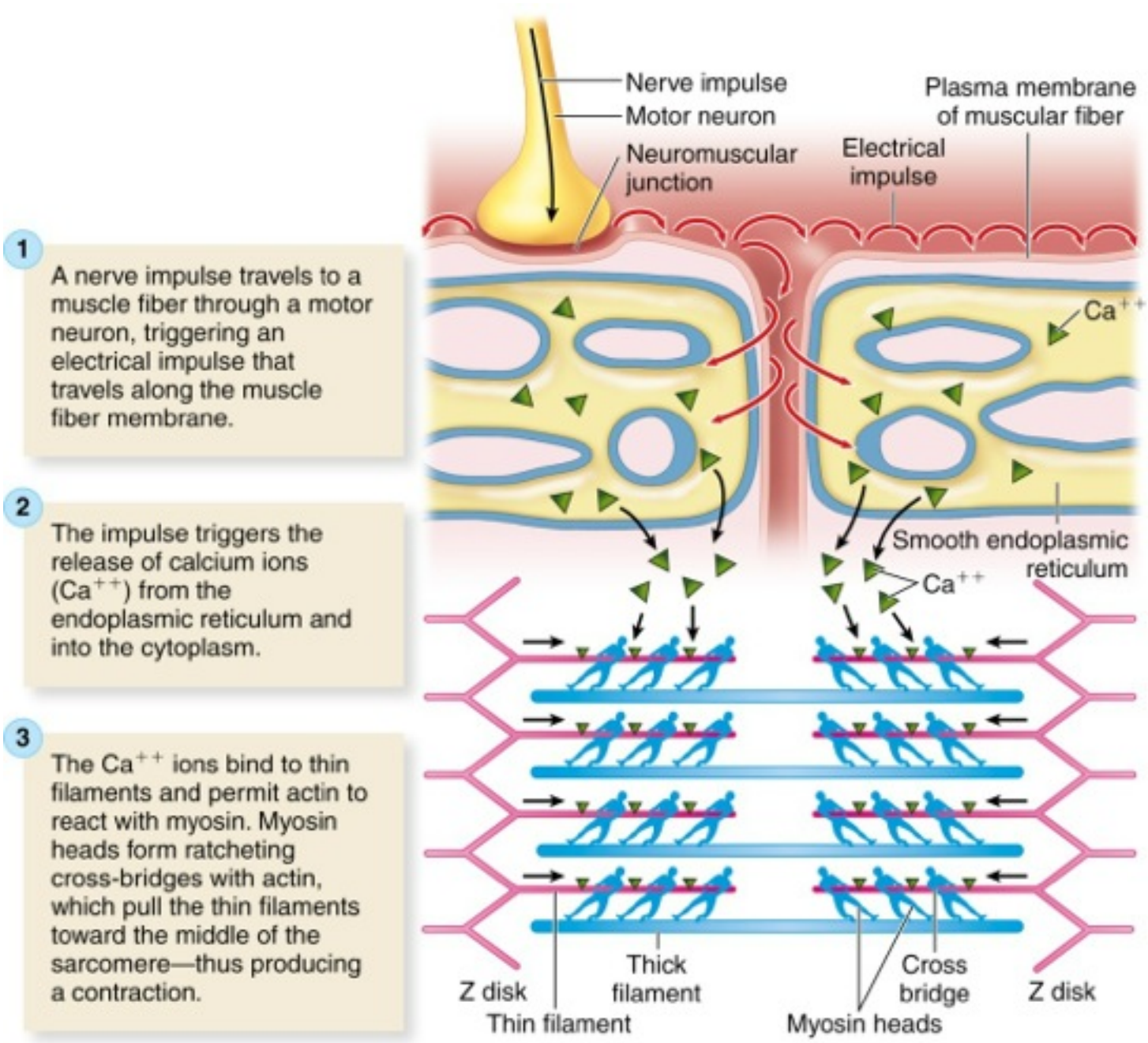
B. Microscopic structure and function (Figure 7-3)
   1. Fibers contain thick myofilaments (containing myosin) and thin myofilaments (containing mainly actin)
   2. Myosin + actin = Sarcomere - basic contractile unit
      a. Sarcomeres separated from each other by dark bands called *Z lines*

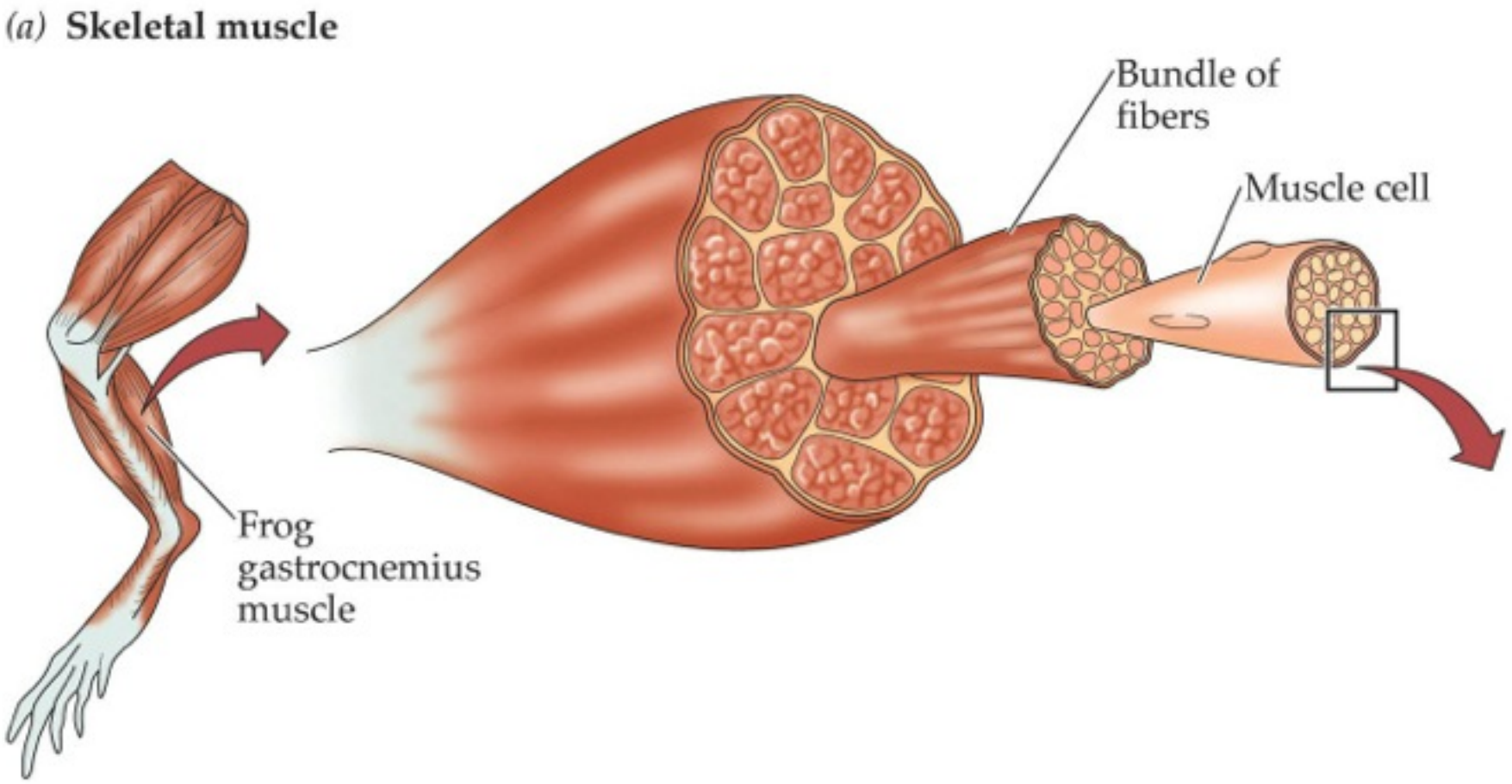


STRUCTURE OF SKELETAL MUSCLE

B. Microscopic structure and function (Figure 7-3)
   1. Fibers contain thick myofilaments (containing myosin) and thin myofilaments (containing mainly actin)
   2. Myosin + actin = Sarcomere - basic contractile unit
      a. Sarcomeres separated from each other by dark bands called *Z lines*
      b. Sliding filament model explains mechanism of contraction
         – Thick and thin myofilaments slide past each other to contract
         – Contraction requires calcium and energy-rich ATP molecules (Figure 7-4)







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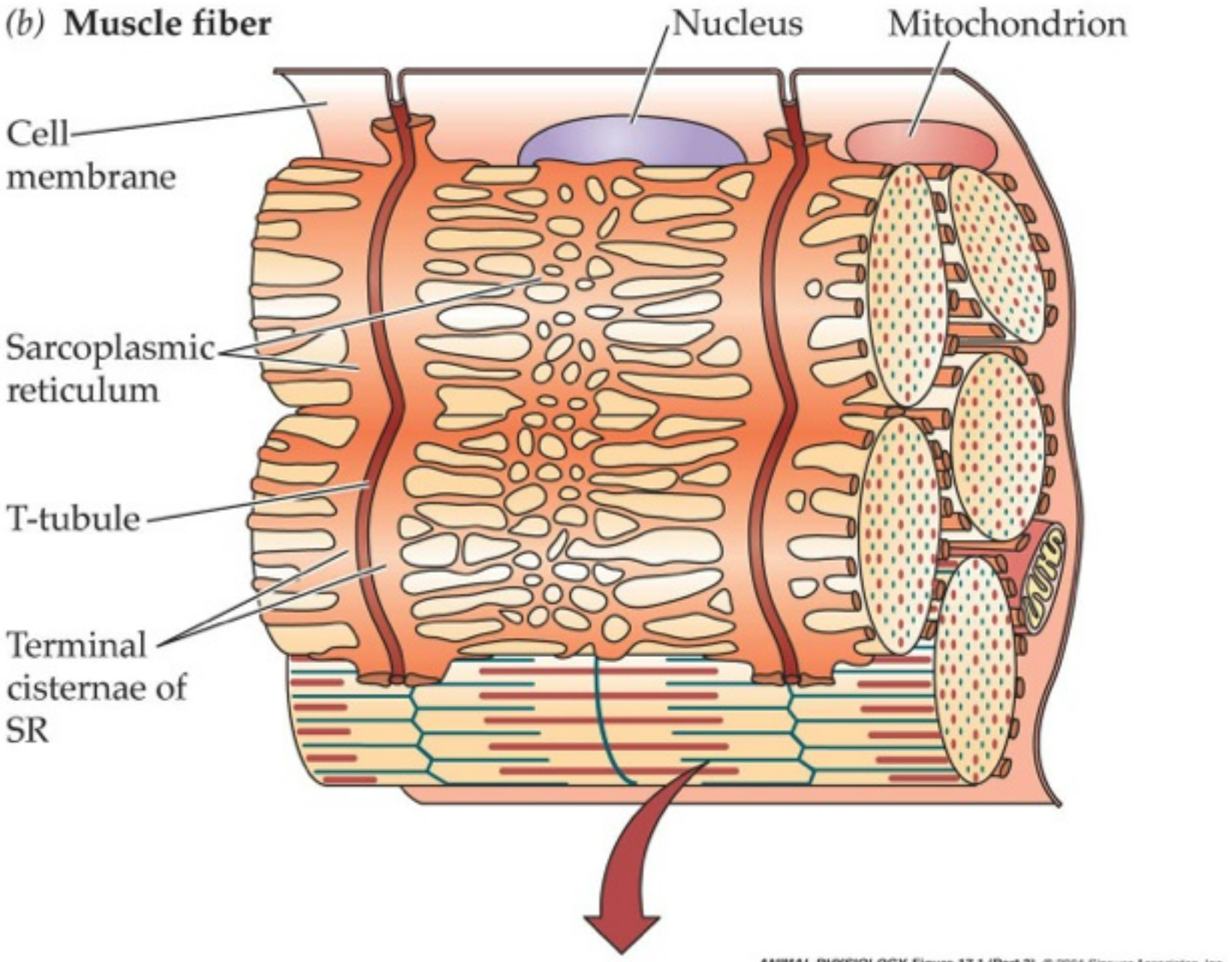

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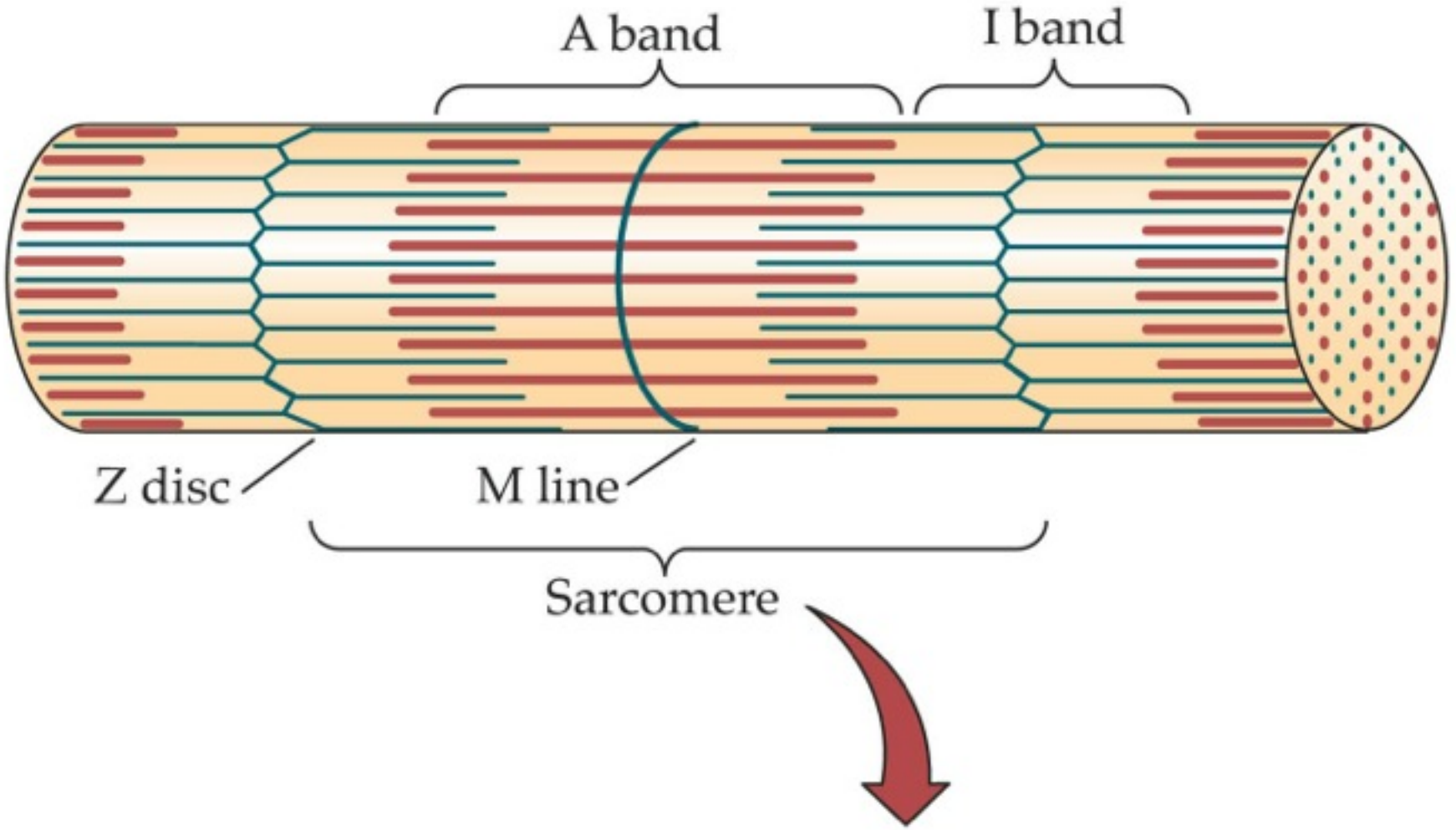

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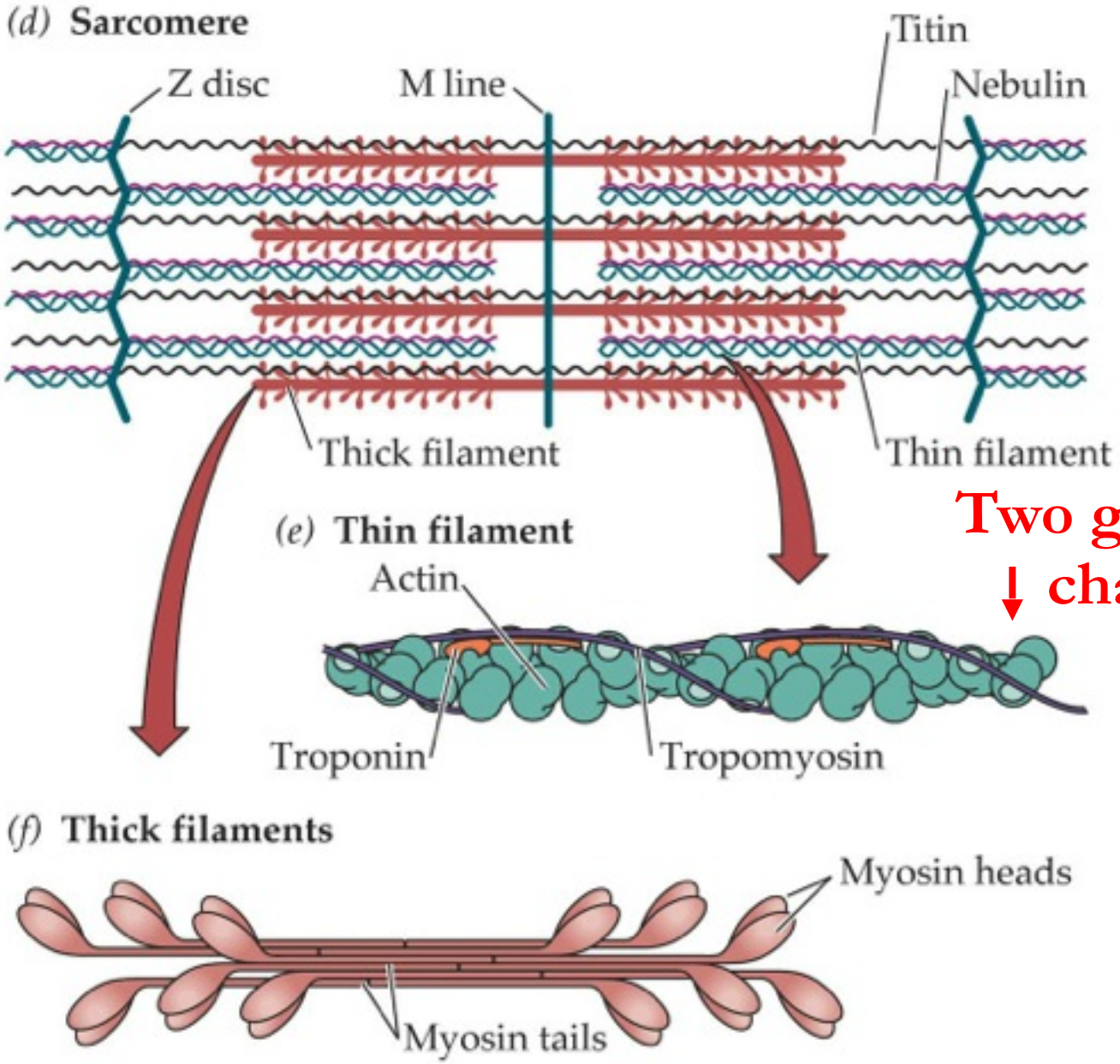


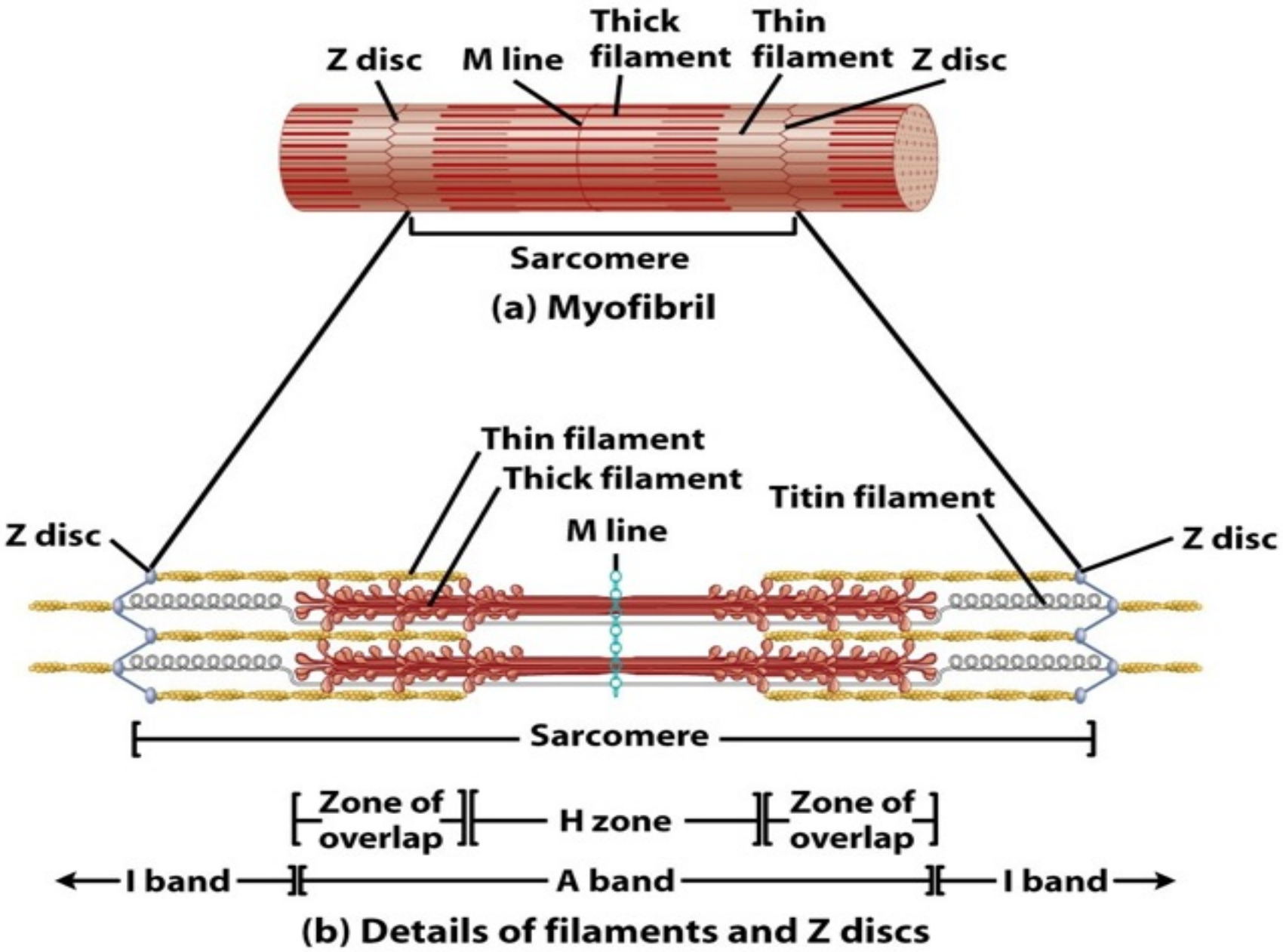
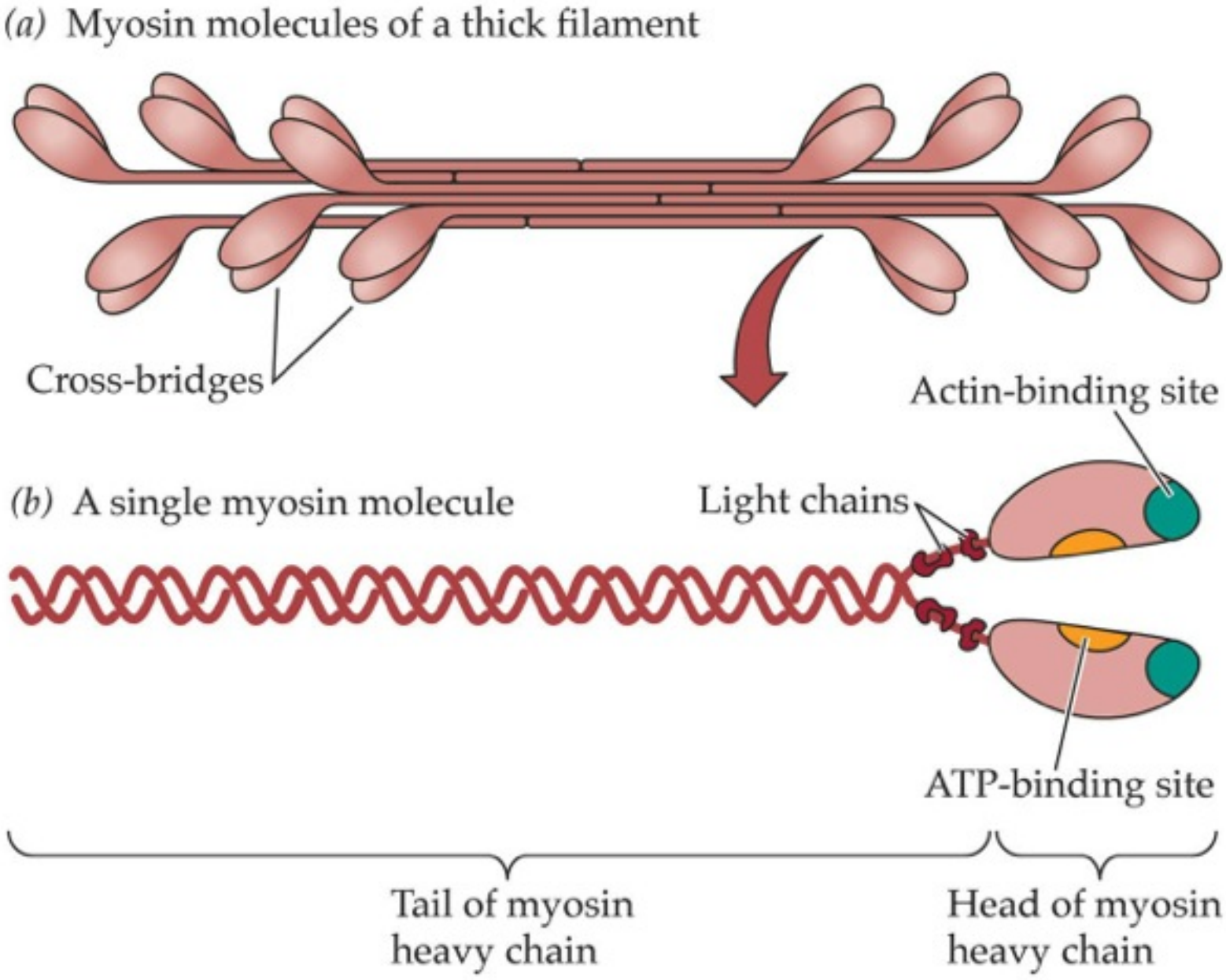


Figure 10-3 Principles of Anatomy and Physiology, 11/e



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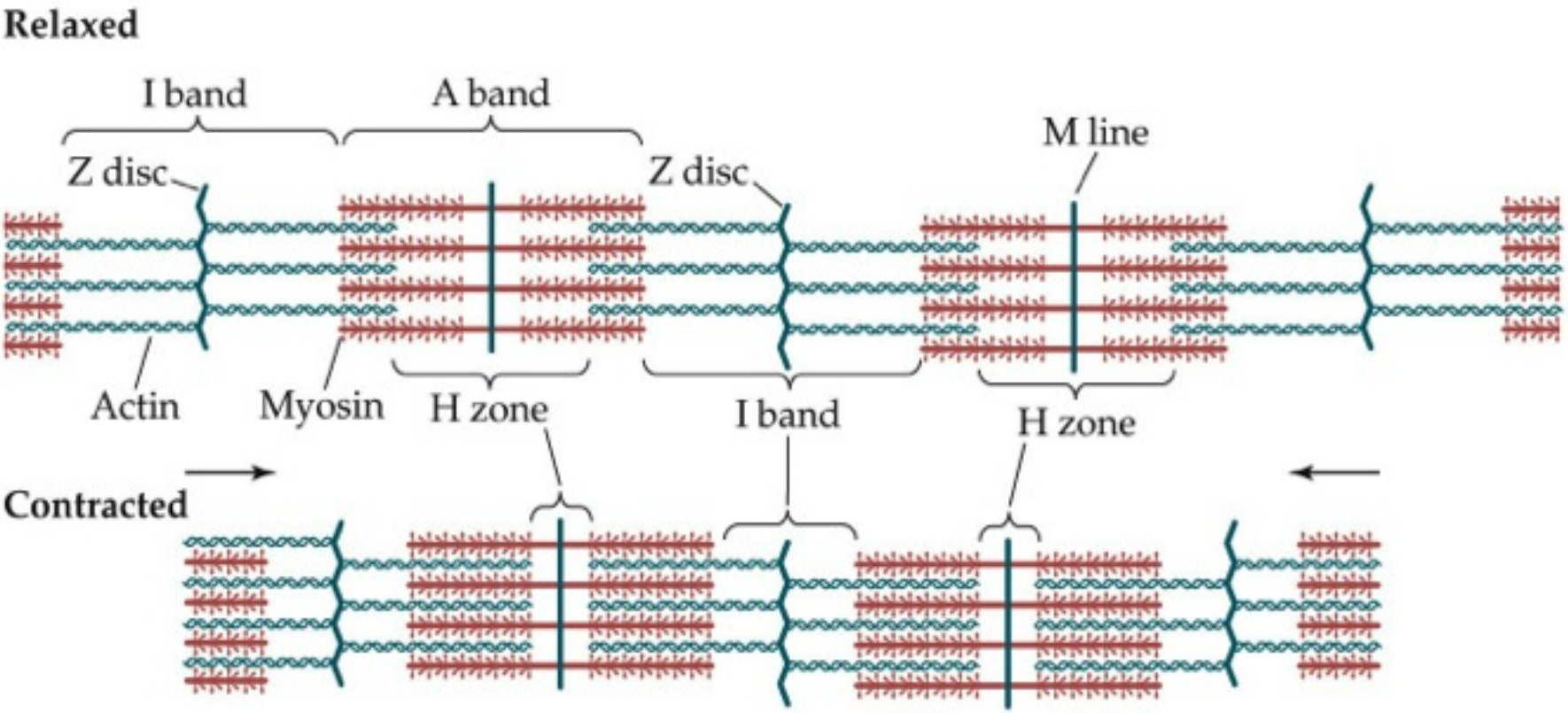
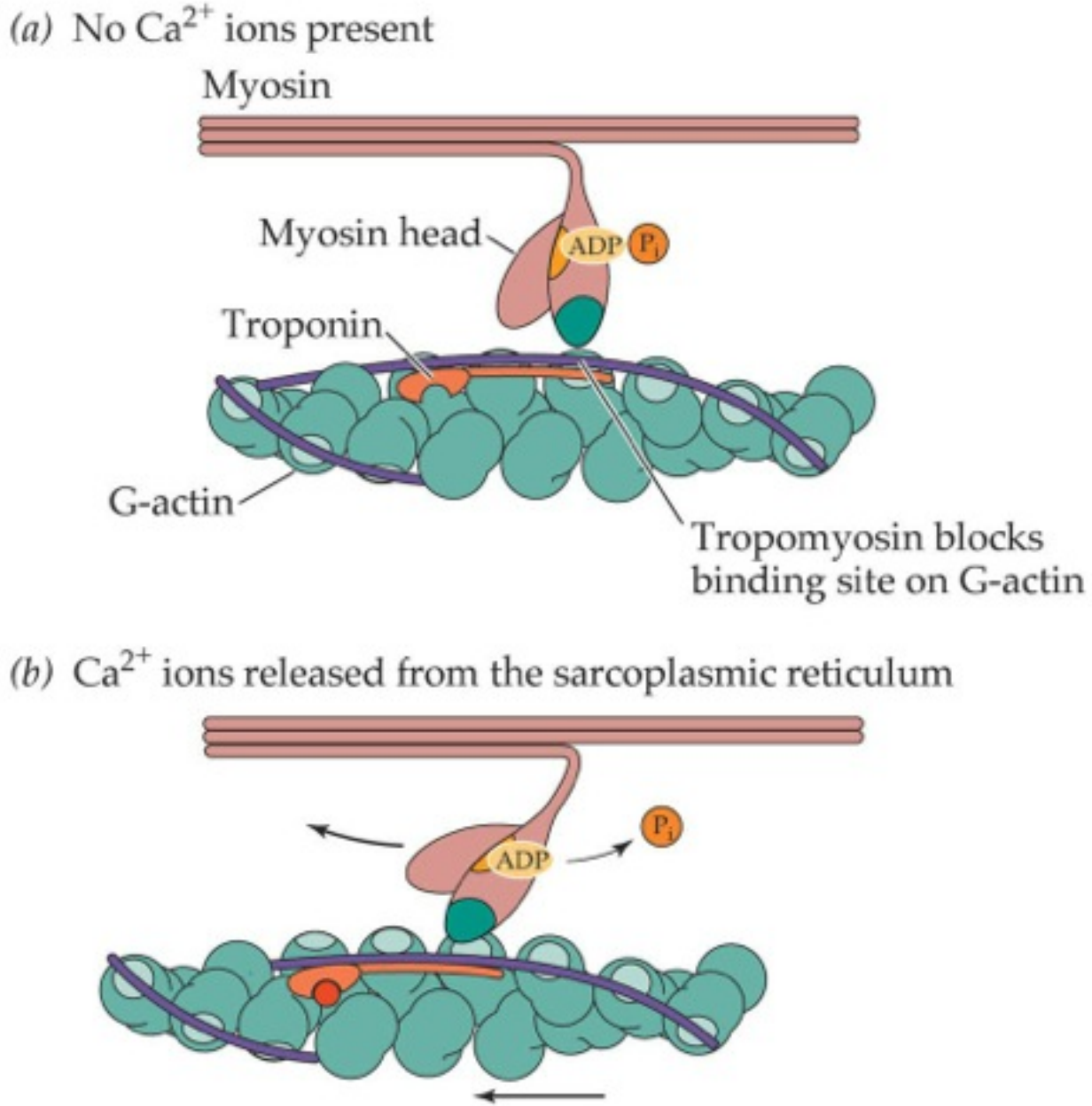
Mechanism of Contraction



Animal Physiology 2e, Figure 19.3



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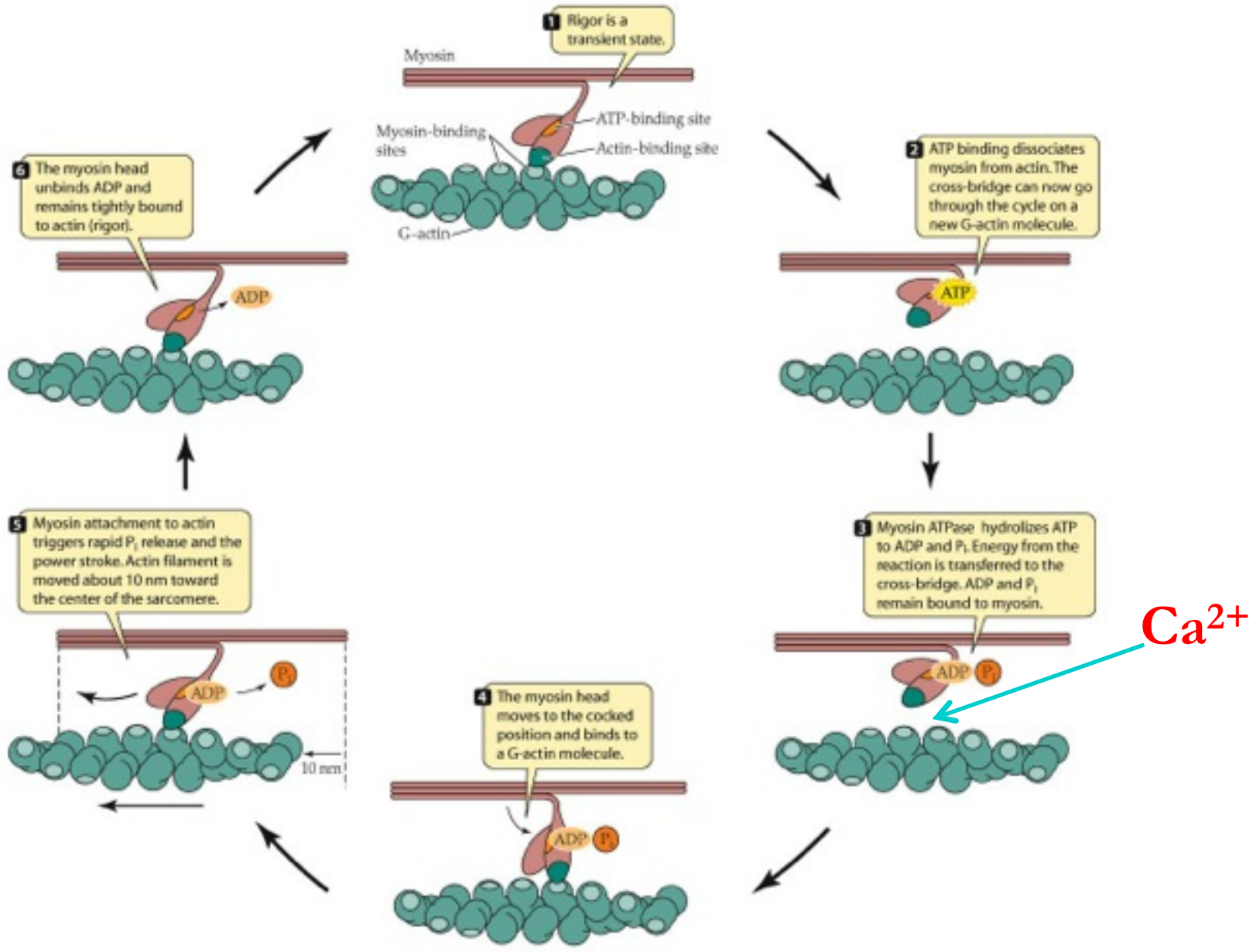
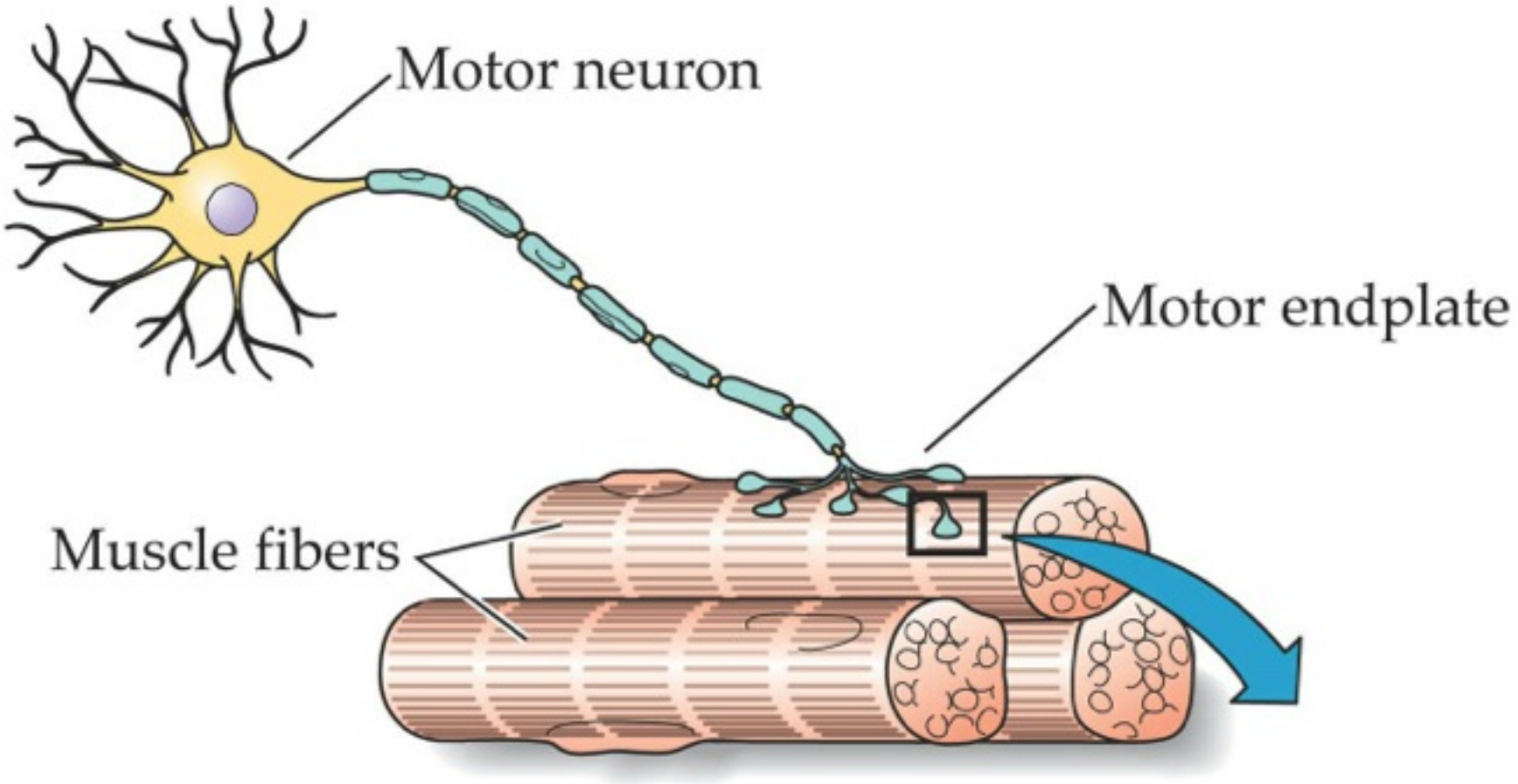


***Animal Physiology 2e*, Figure 19.5**

Excitation/Contraction Coupling



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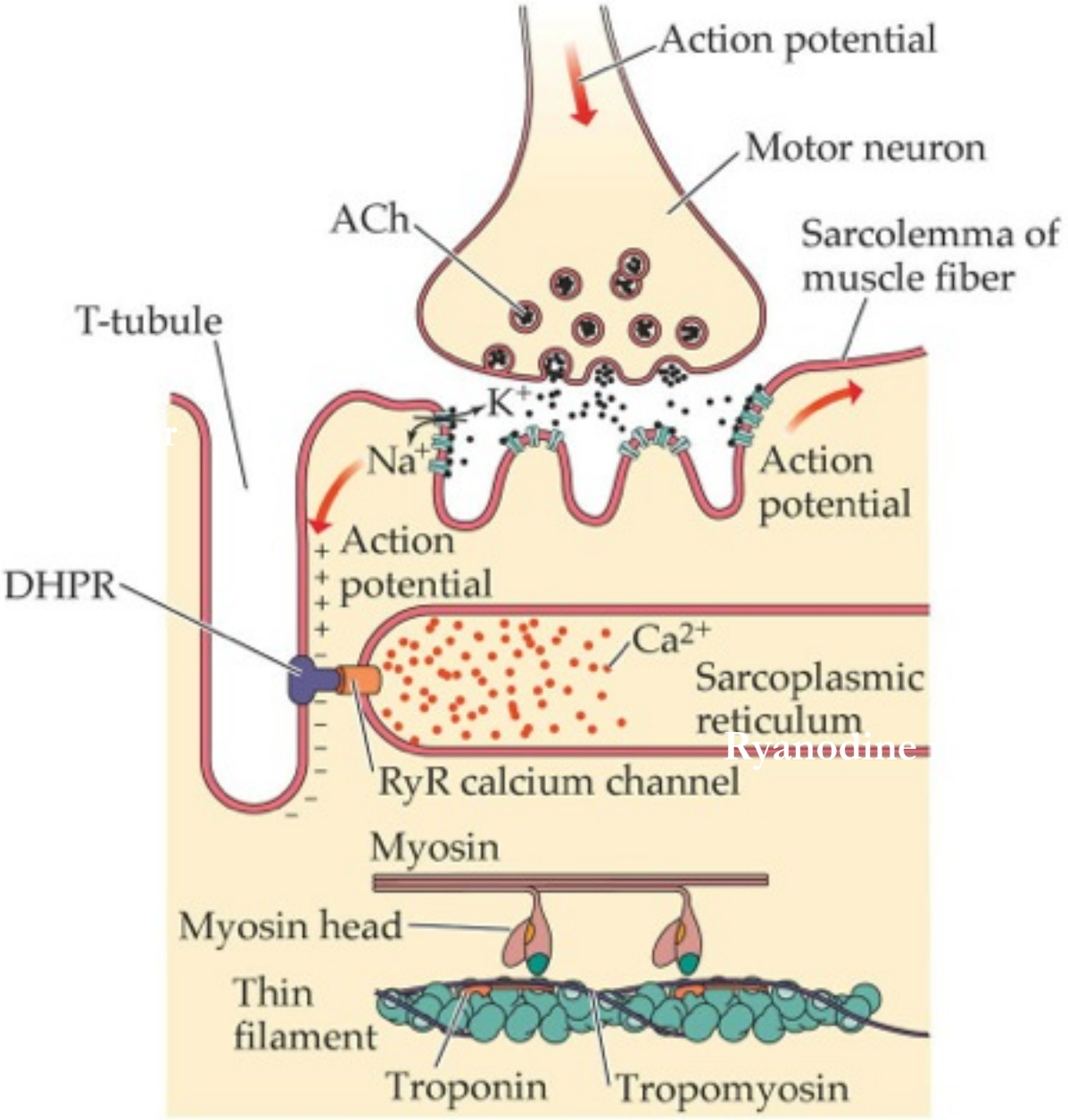
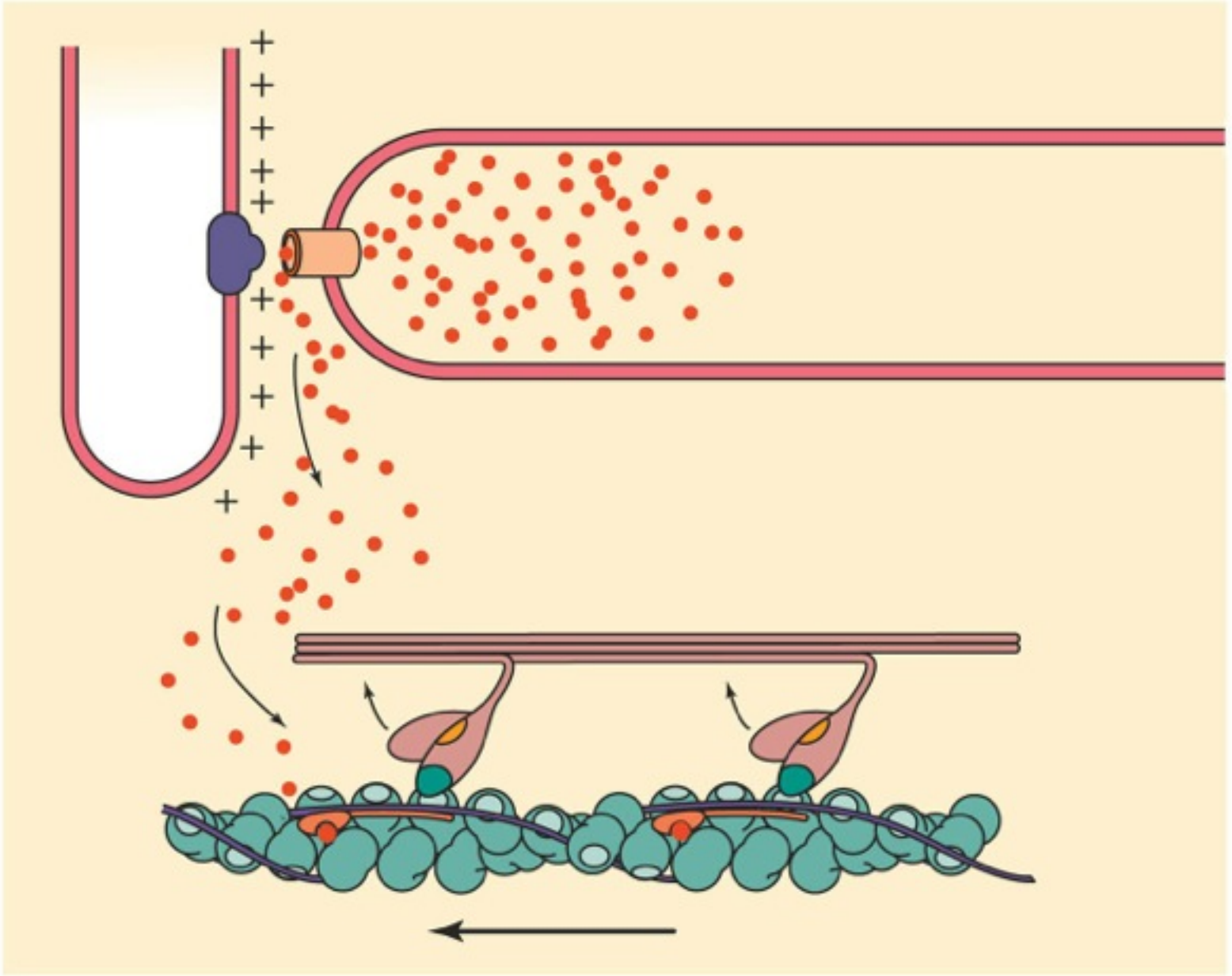

Action potential
Motor neuron
ACh
Sarcolemma of muscle fiber
T-tubule
K+
Na+
Action potential
Action potential
DHPR
Ca2+
Sarcoplasmic reticulum
Ryanodine
RyR calcium channel
Myosin
Myosin head
Thin filament
Troponin
Tropomyosin



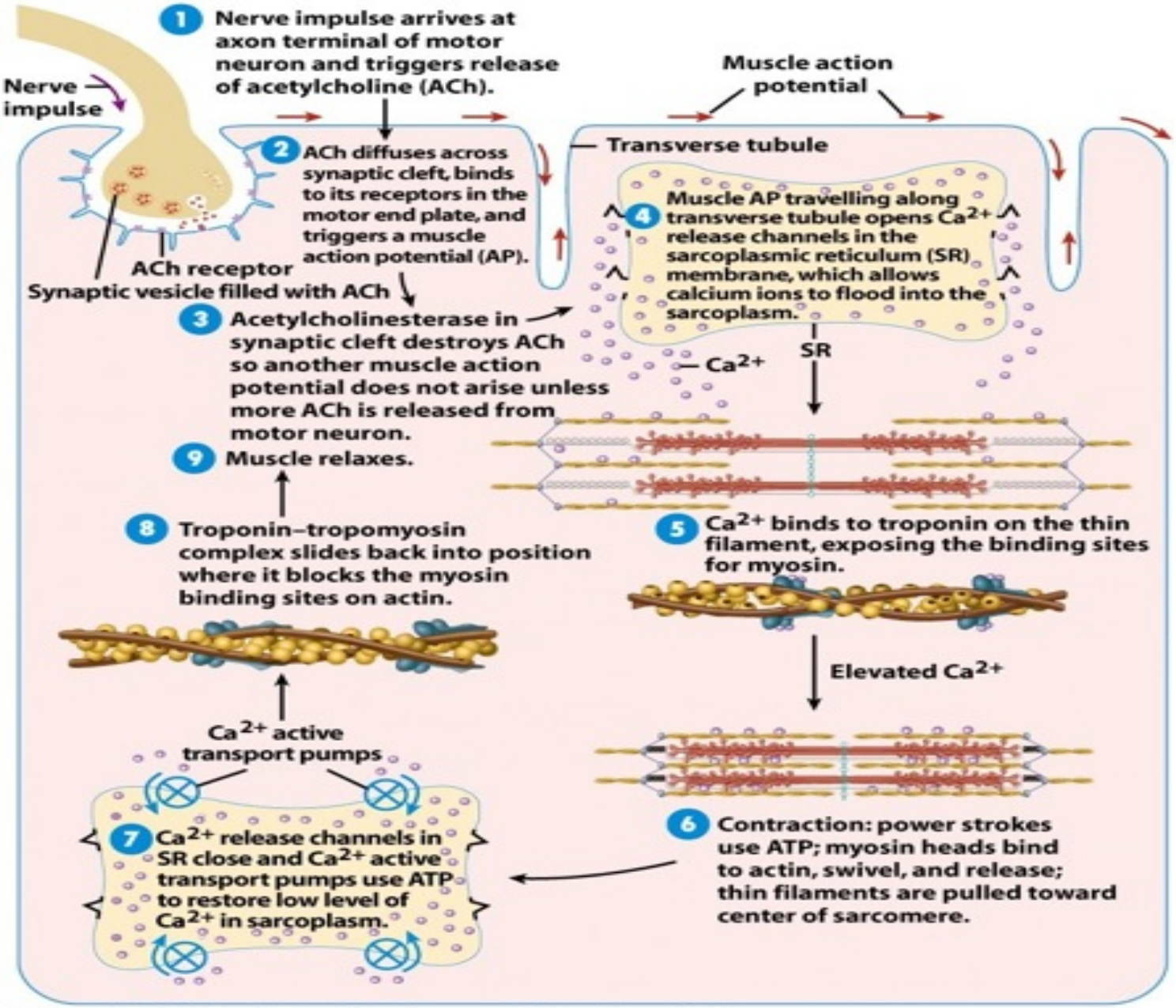


Figure 10-11 Principles of Anatomy and Physiology, 11/e

Place the following in the correct order:

____ **Acetylcholine** is released

____ **ATP** used to allow for release and reattachment

____ Ca+ binds to **troponin** on actin, allowing myosin to attach

____ Calcium channels in sarcoplasmic reticulum opens, **releasing Ca+ ions**

____ **Muscle potential** runs along sarcomere

____ **Nerve impulse** arrives

____ **Power strokes** result in contraction

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____ **Muscle potential** runs along sarcomere

__1__ **Nerve impulse** arrives

____ **Power strokes** result in contraction

Place the following in the correct order:

__2__ **Acetylcholine** is released

____ **ATP** used to allow for release and reattachment

____ Ca+ binds to **troponin** on actin, allowing myosin to attach

____ Calcium channels in sarcoplasmic reticulum opens, **releasing Ca+ ions**

____ **Muscle potential** runs along sarcomere

__1__ **Nerve impulse** arrives

____ **Power strokes** result in contraction

Place the following in the correct order:

__2__ **Acetylcholine** is released

____ **ATP** used to allow for release and reattachment

____ Ca+ binds to **troponin** on actin, allowing myosin to attach

____ Calcium channels in sarcoplasmic reticulum opens, **releasing Ca+ ions**

__3__ **Muscle potential** runs along sarcomere

__1__ **Nerve impulse** arrives

____ **Power strokes** result in contraction

Place the following in the correct order:

__2__ **Acetylcholine** is released

____ **ATP** used to allow for release and reattachment

____ Ca+ binds to **troponin** on actin, allowing myosin to attach

__4__ Calcium channels in sarcoplasmic reticulum opens, **releasing Ca+ ions**

__3__ **Muscle potential** runs along sarcomere

__1__ **Nerve impulse** arrives

____ **Power strokes** result in contraction

Place the following in the correct order:

__2__ **Acetylcholine** is released

___ **ATP** used to allow for release and reattachment

__5__ Ca+ binds to **troponin** on actin, allowing myosin to attach

__4__ Calcium channels in sarcoplasmic reticulum opens, **releasing Ca+ ions**

__3__ **Muscle potential** runs along sarcomere

__1__ **Nerve impulse** arrives

____ **Power strokes** result in contraction

Place the following in the correct order:

__2__ **Acetylcholine** is released

__6__ **ATP** used to allow for release and reattachment

__5__ Ca+ binds to **troponin** on actin, allowing myosin to attach

__4__ Calcium channels in sarcoplasmic reticulum opens, **releasing Ca+ ions**

__3__ **Muscle potential** runs along sarcomere

__1__ **Nerve impulse** arrives

____ **Power strokes** result in contraction

Place the following in the correct order:

__2__ **Acetylcholine** is released

__6__ **ATP** used to allow for release and reattachment

__5__ Ca+ binds to **troponin** on actin, allowing myosin to attach

__4__ Calcium channels in sarcoplasmic reticulum opens, **releasing Ca+ ions**

__3__ **Muscle potential** runs along sarcomere

__1__ **Nerve impulse** arrives

__7__ **Power strokes** result in contraction