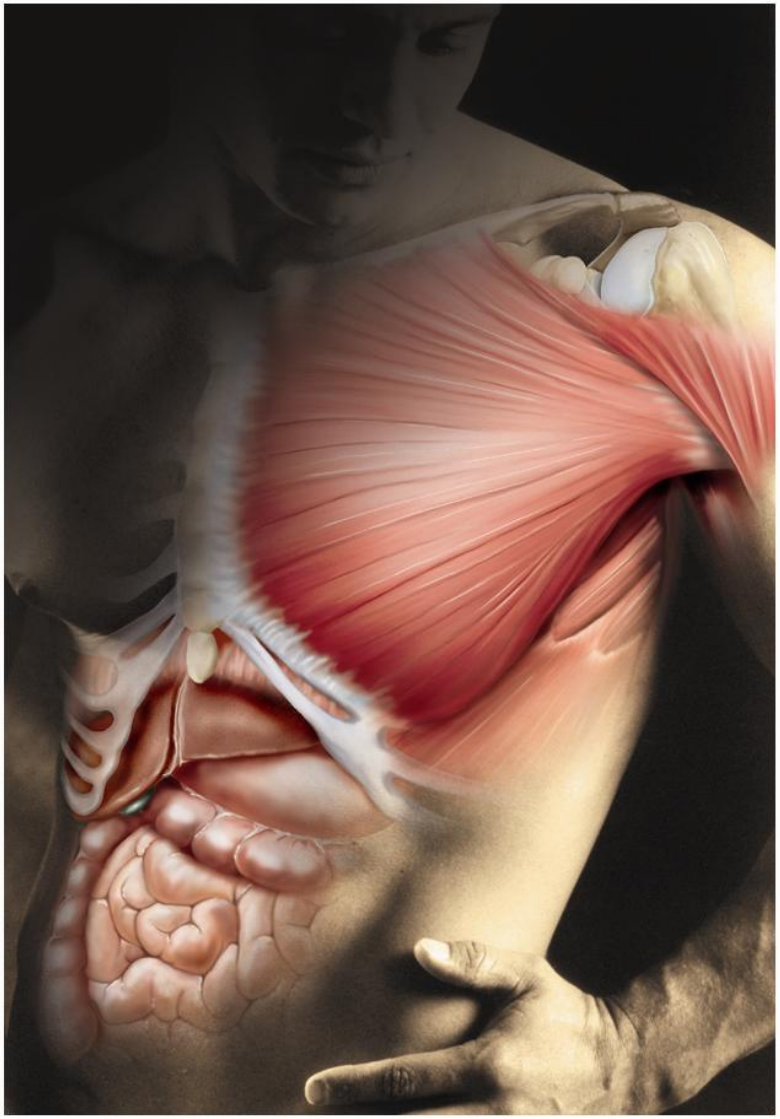
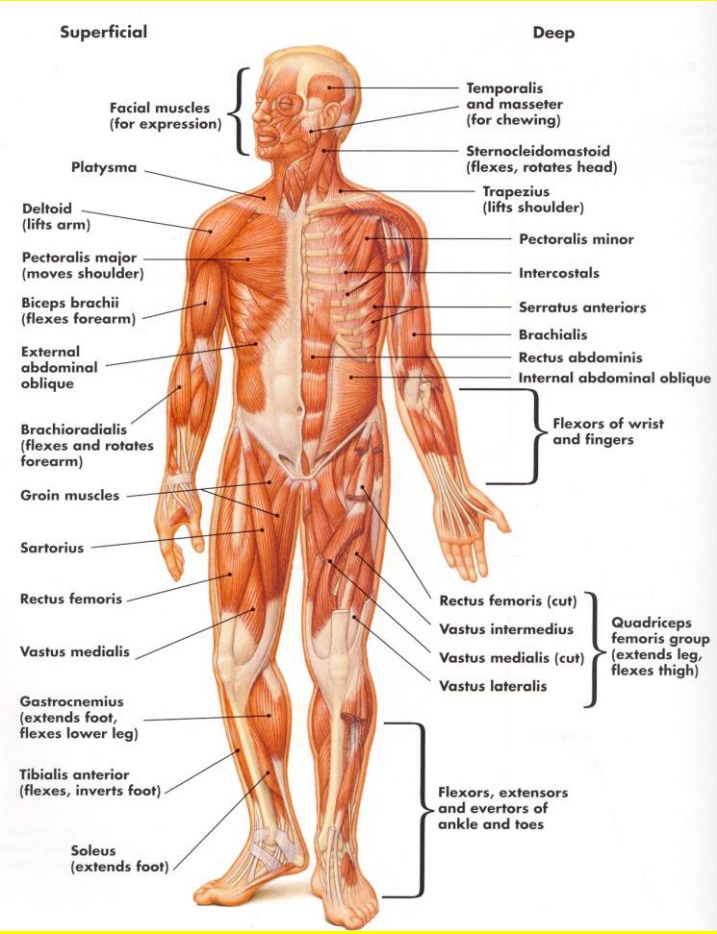
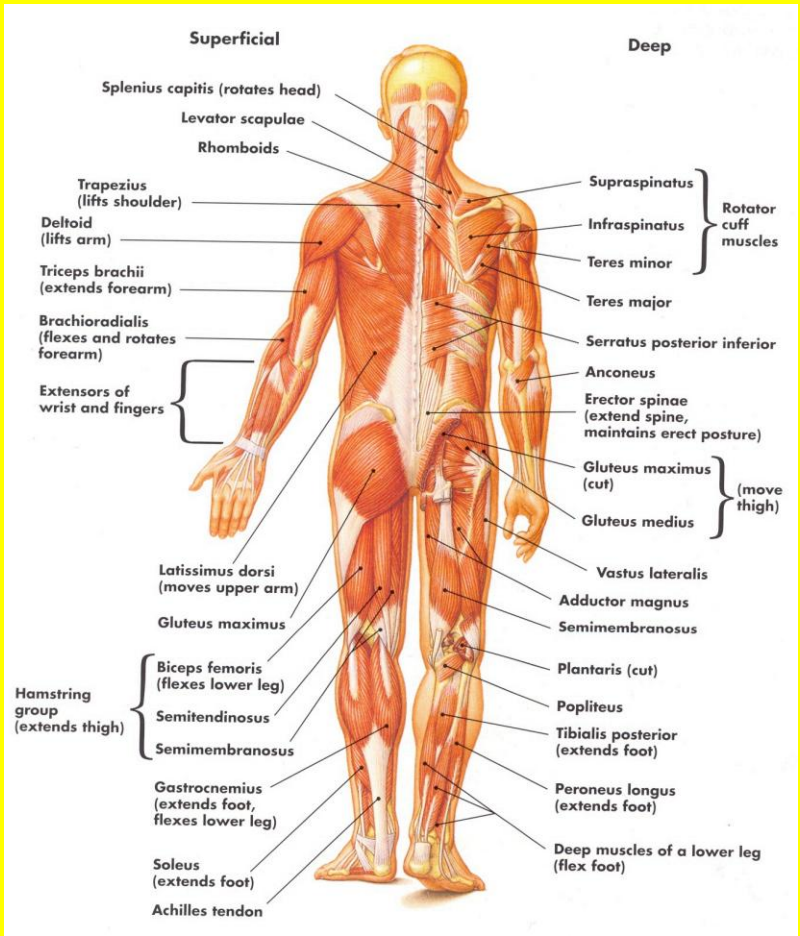
MUSCLES



Muscles: important- movement

40% your body weight





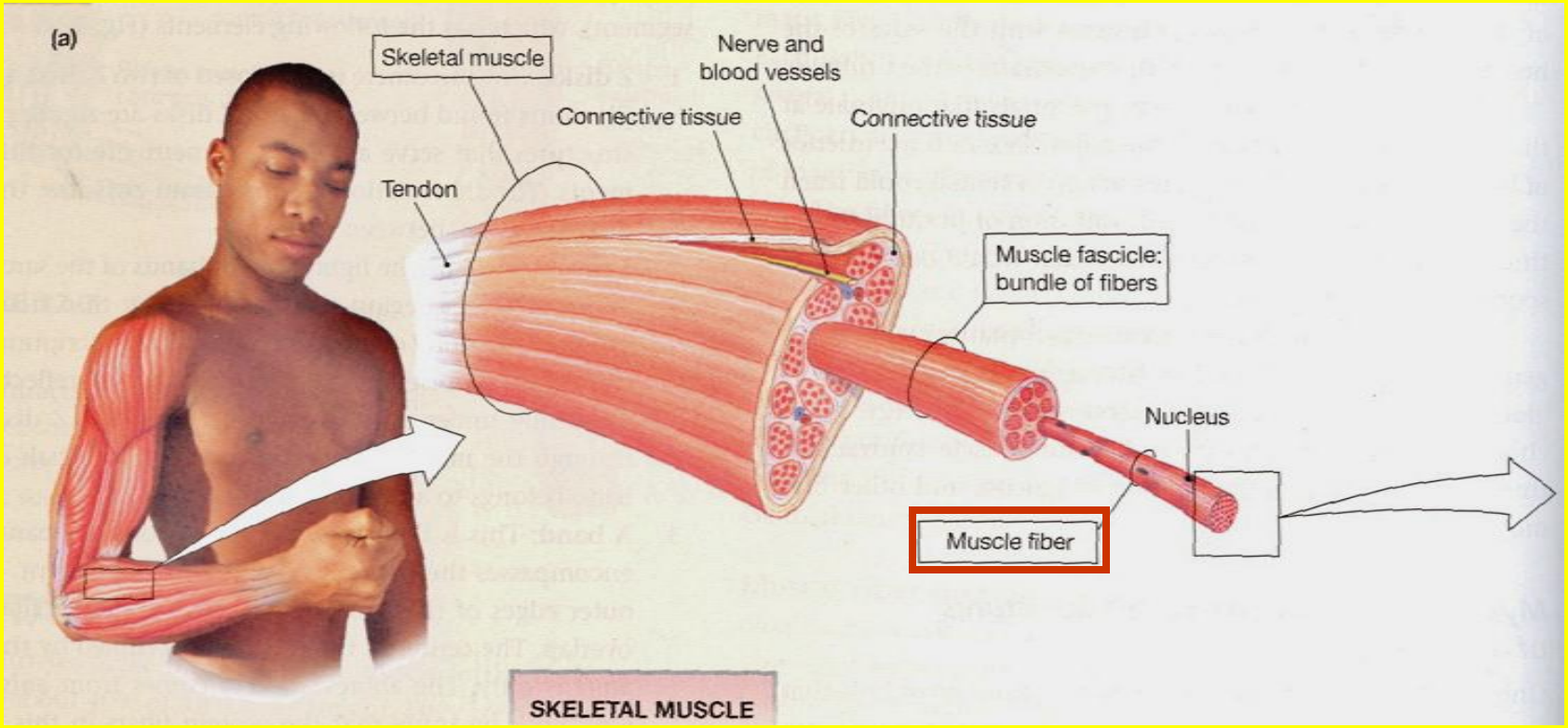
Muscle Structure: major body muscle = skeletal muscle

Myoglobin-(like hemoglobin) holds O_2 from blood during rest

Releases oxygen when muscle contracts

Gives some muscle: **red** color

Muscle cells = muscle fibers (long)



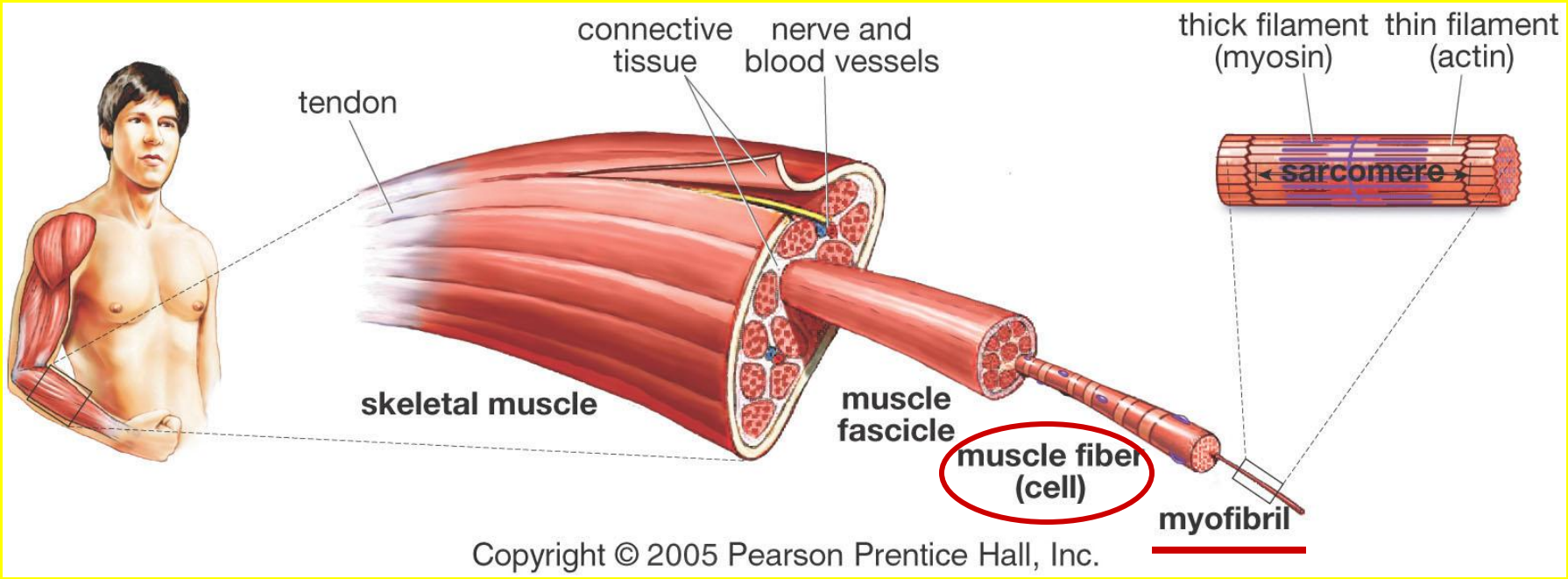
Muscle fiber

Smaller strands: **myofibrils**

Myofibrils: still smaller strands

Thick filaments (**Myosin** protein)

Thin filaments (**Actin** protein)


connective tissue
nerve and blood vessels
thick filament (myosin)
thin filament (actin)
tendon
sarcomere
skeletal muscle
muscle fascicle
muscle fiber (cell)
myofibril
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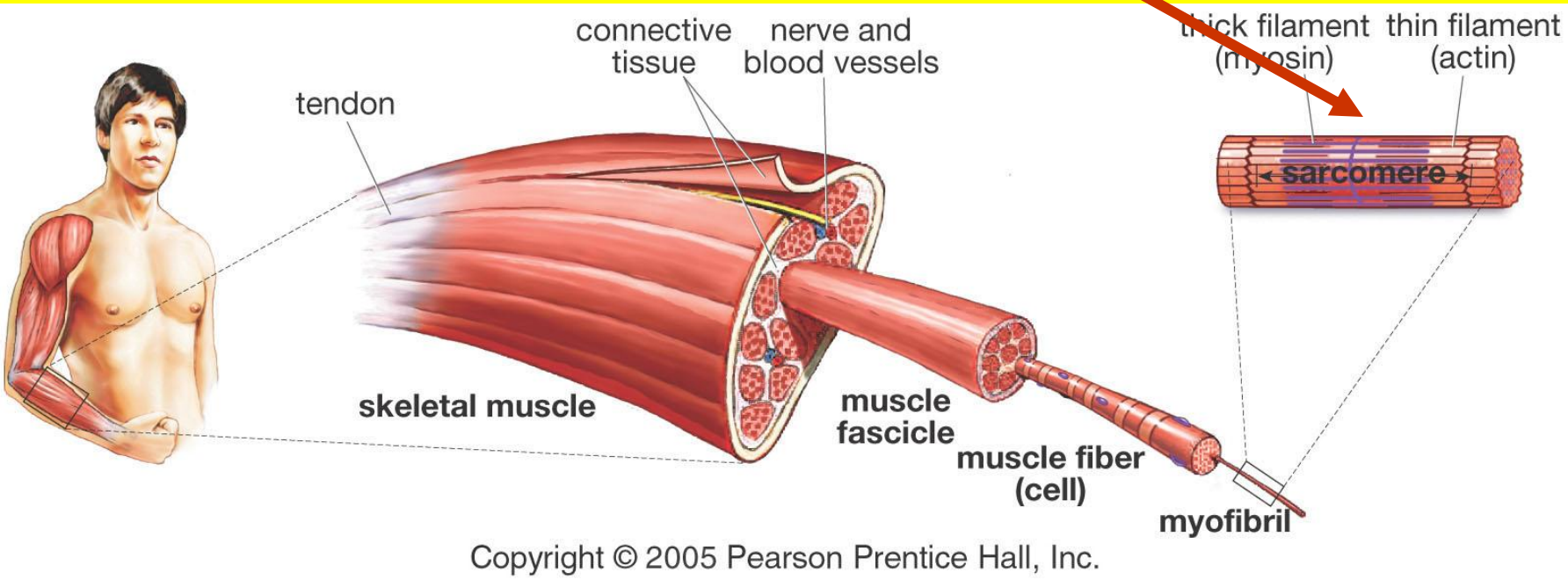
- **Sarcomere**: unit of muscle contraction
- **10,000** sarcomeres in each muscle cell

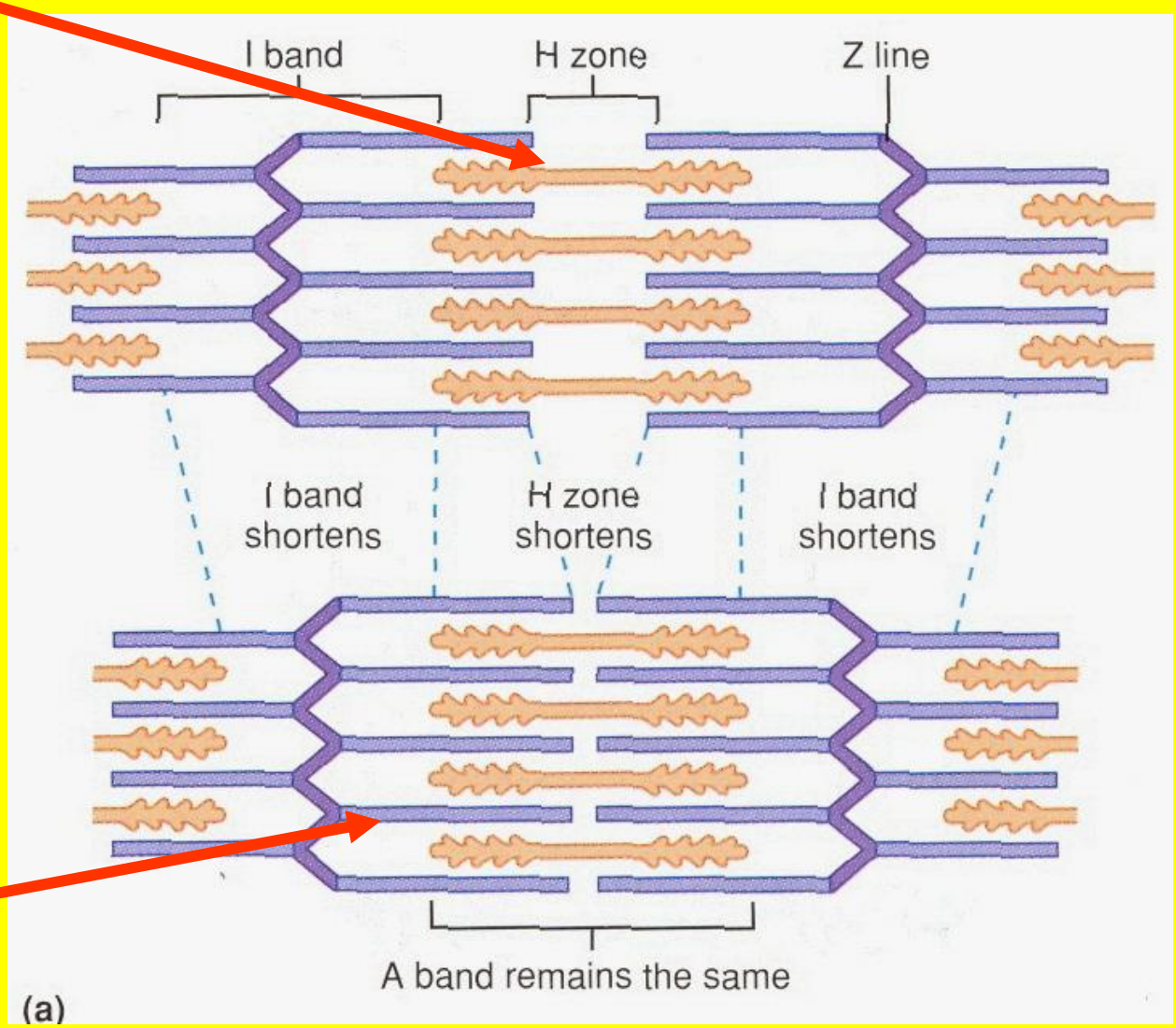


How your muscles work

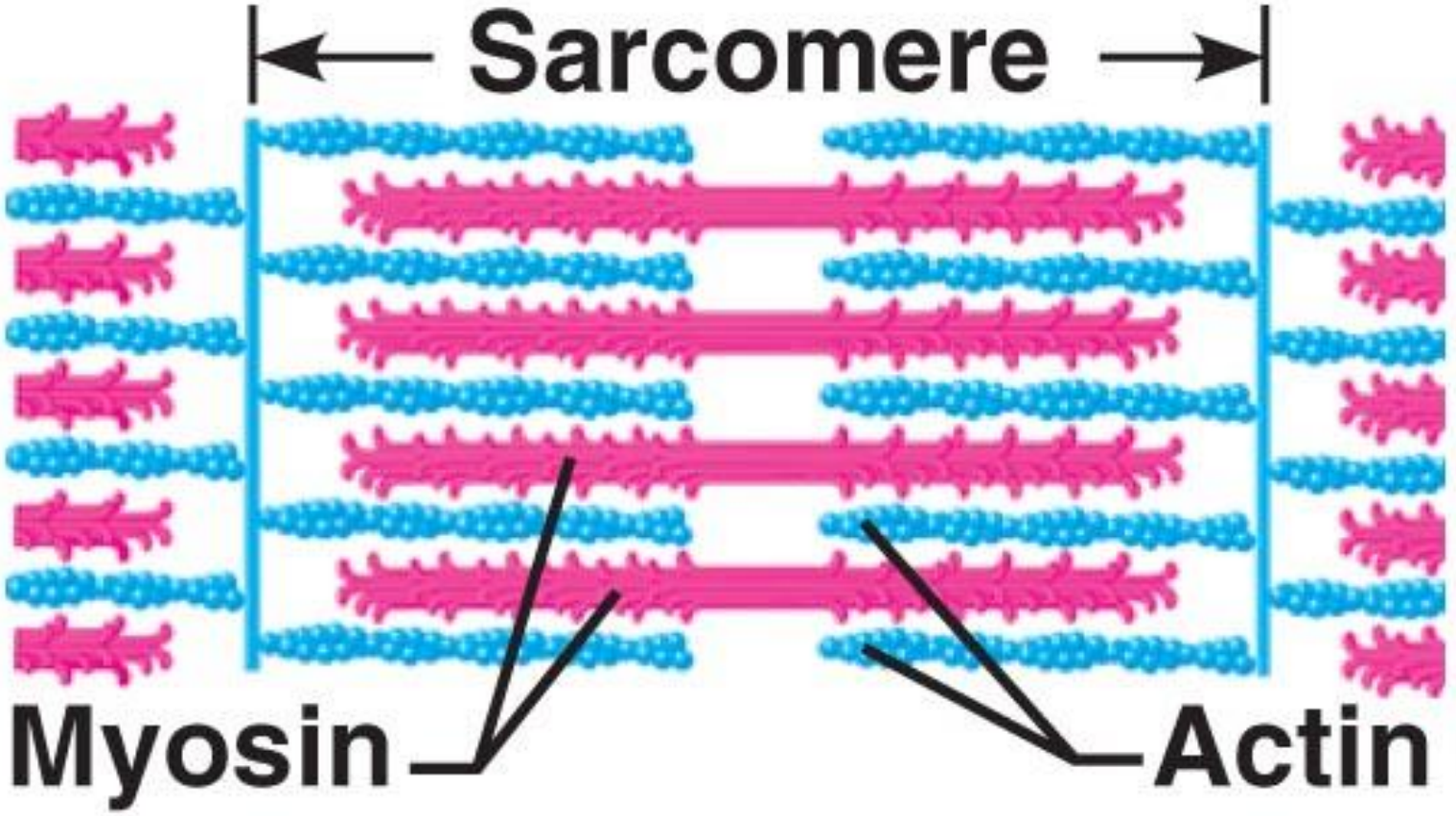
Myosin (thick) filaments: near **center** of sarcomere

Actin (thin) filaments: near **ends** of sarcomere- overlap myosin near center

Myosin



Actin



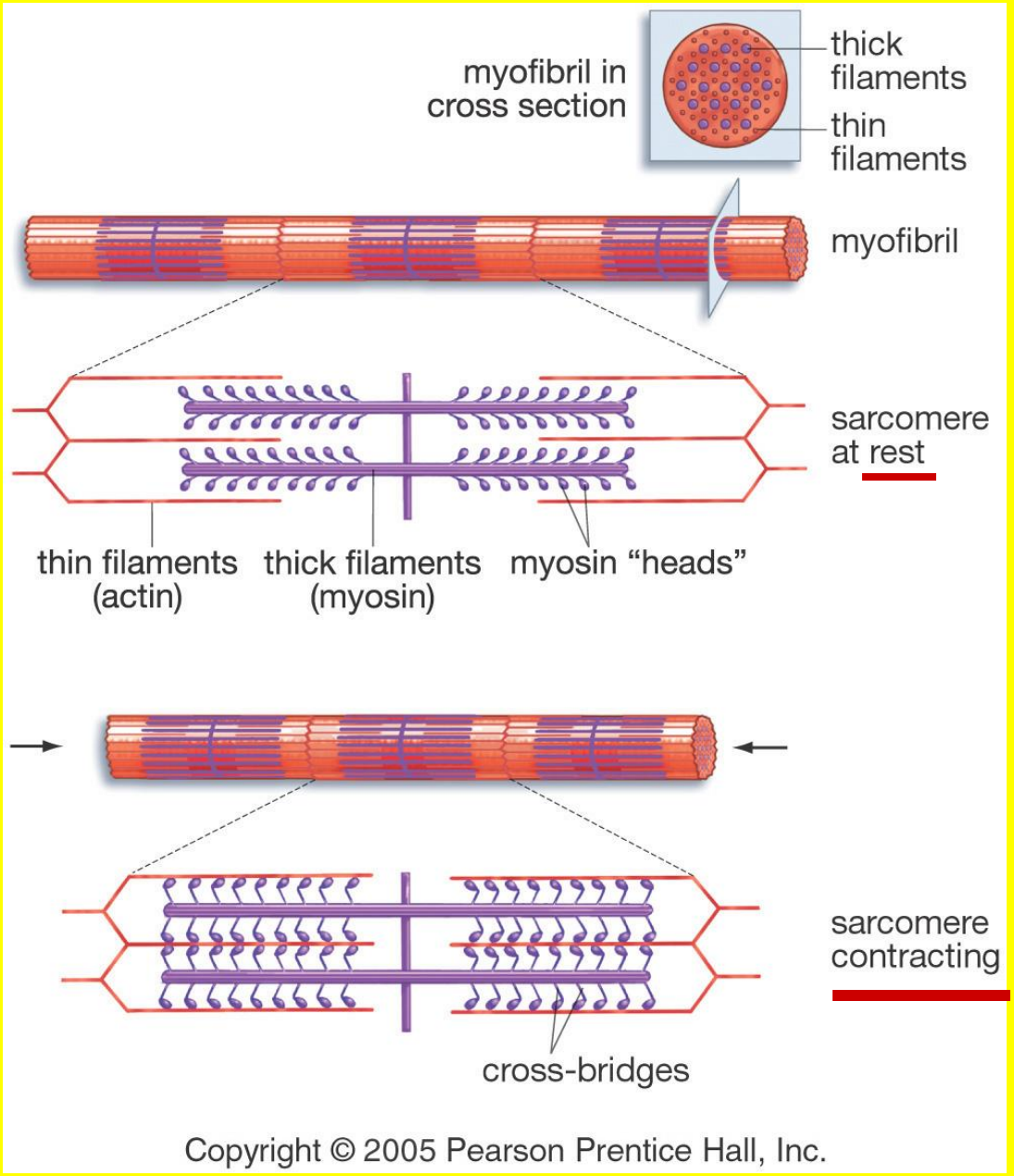
Muscle at **"Rest"-**

Sarcomere: **Longer**

Thin filaments slide to center

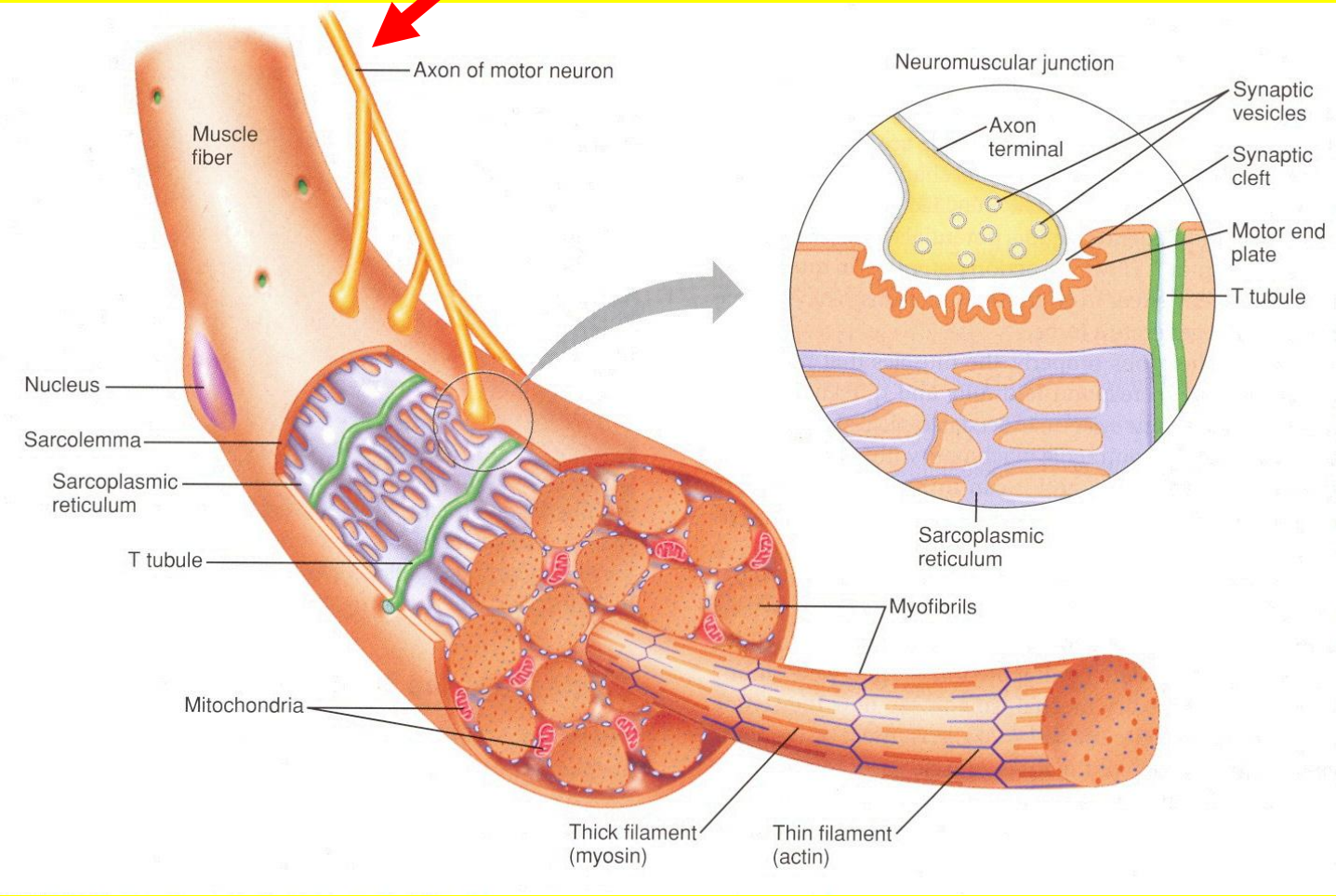
Sarcomere: **Shortens-**

"contraction"

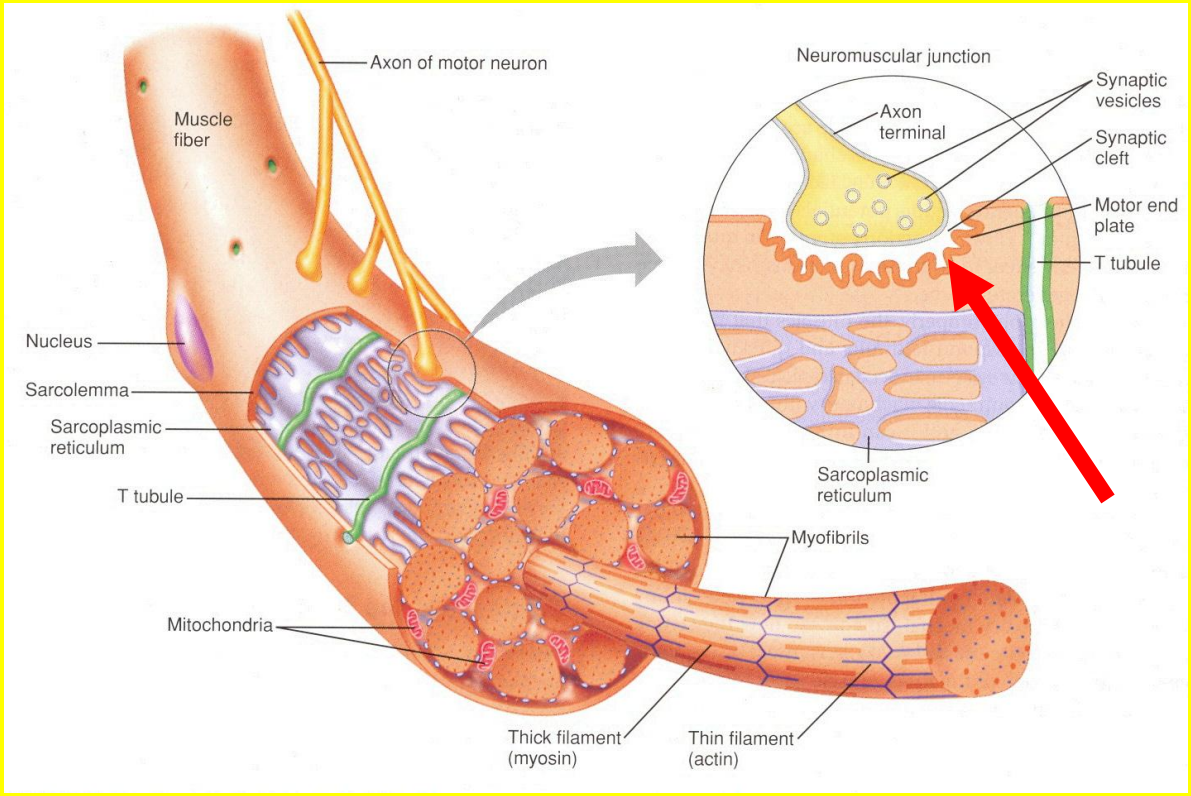


How muscle contraction happens

1) Nerve impulse arrives at muscle



- Gap between nerve & muscle
- Nerve endings release **neurotransmitter** (Acetylcholine)
- "Swims" across gap



2) Neurotransmitter "activates" muscle filaments

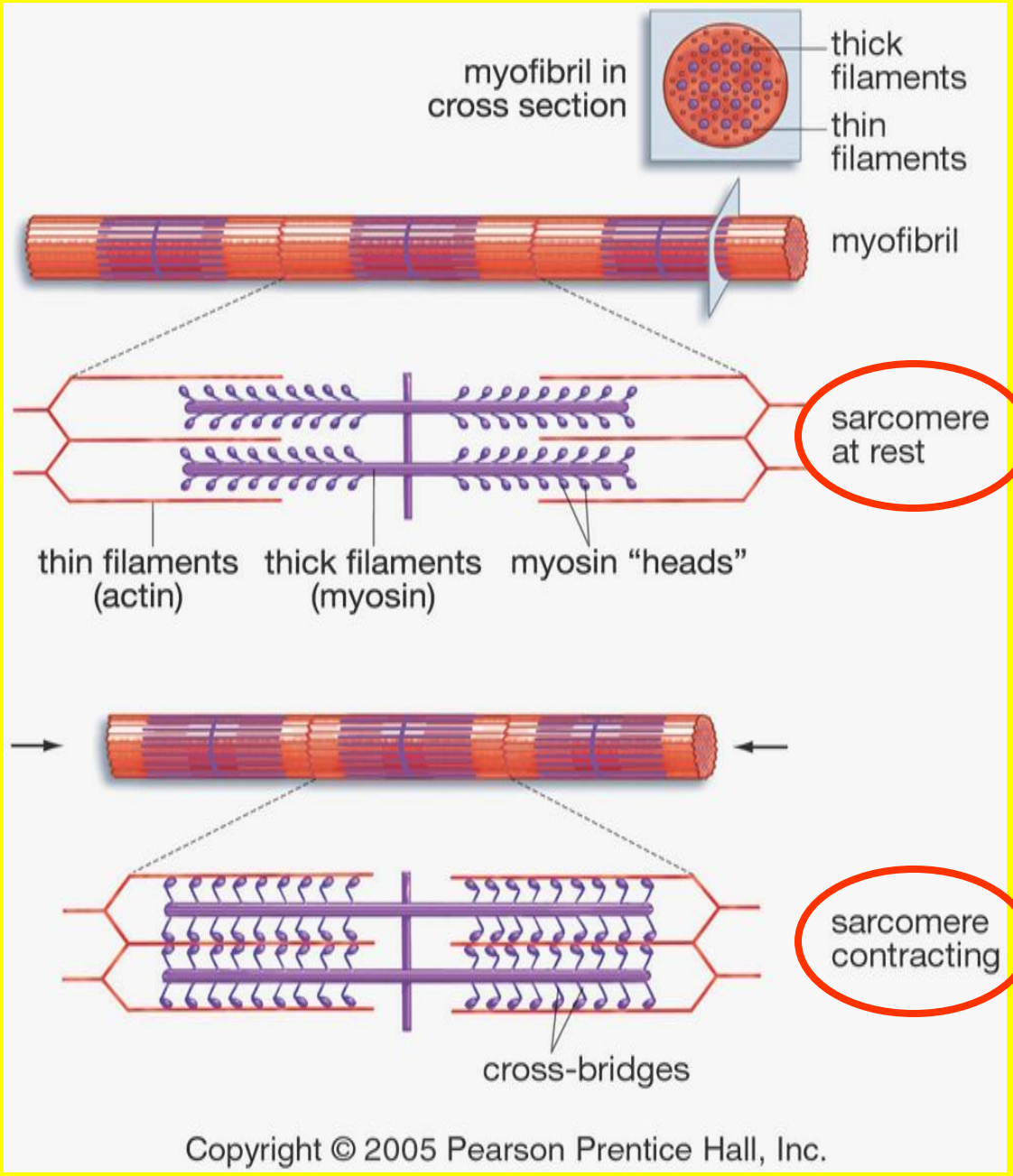
3) Thick **myosin** filaments have **"hooks"-** attach to actin **(cross-bridges)**

4) **Pull** actin toward sarcomere center **(sliding)**

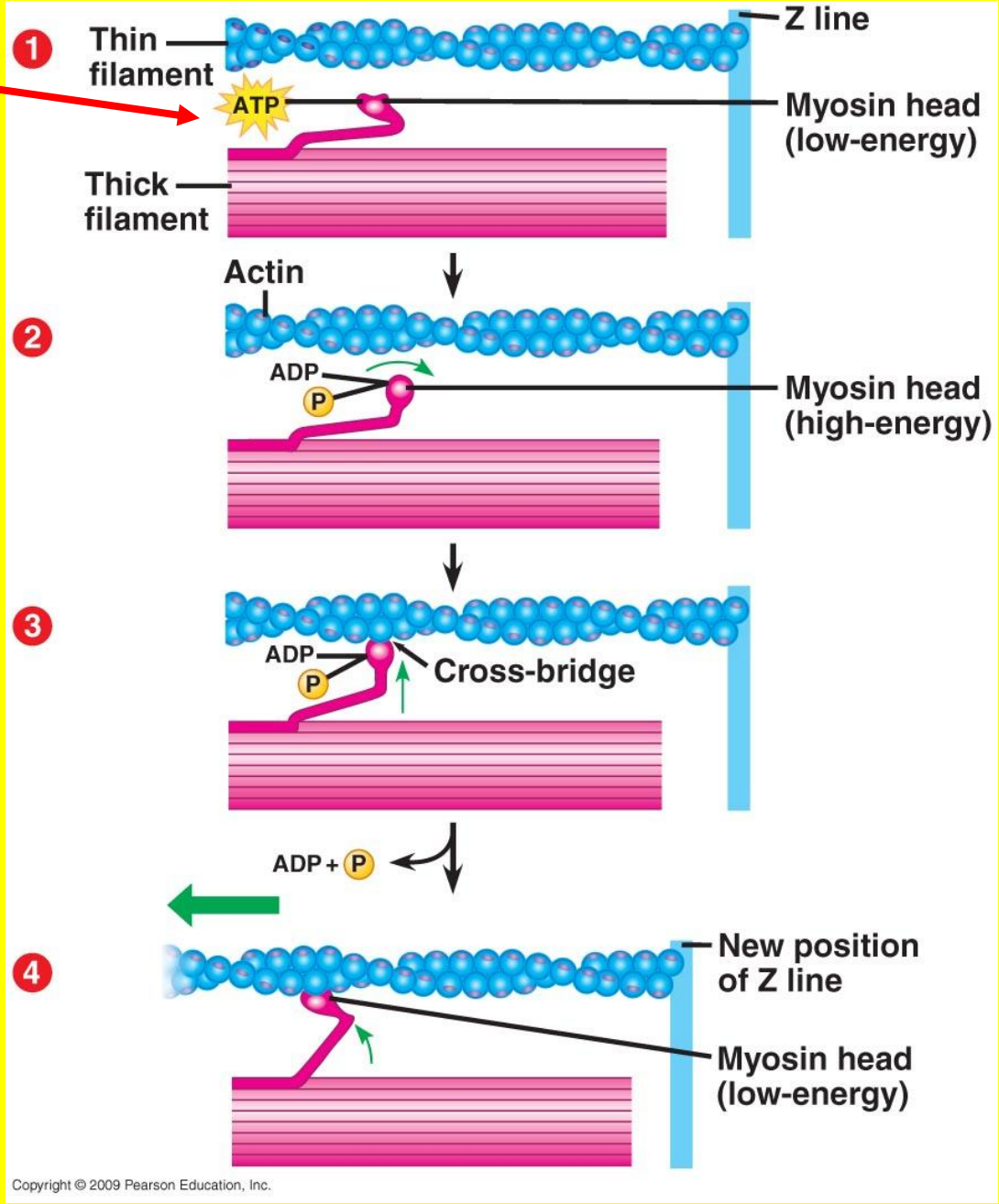
5) Myosin hooks **detach** from actin

6) Ready to pull again

7) Happens over & over during muscle contraction



Need **ATP**


1
Thin filament
ATP
Z line
Myosin head (low-energy)
Thick filament
Actin
2
ADP
P
Myosin head (high-energy)
3
ADP
P
Cross-bridge
ADP + P
4
New position of Z line
Myosin head (low-energy)
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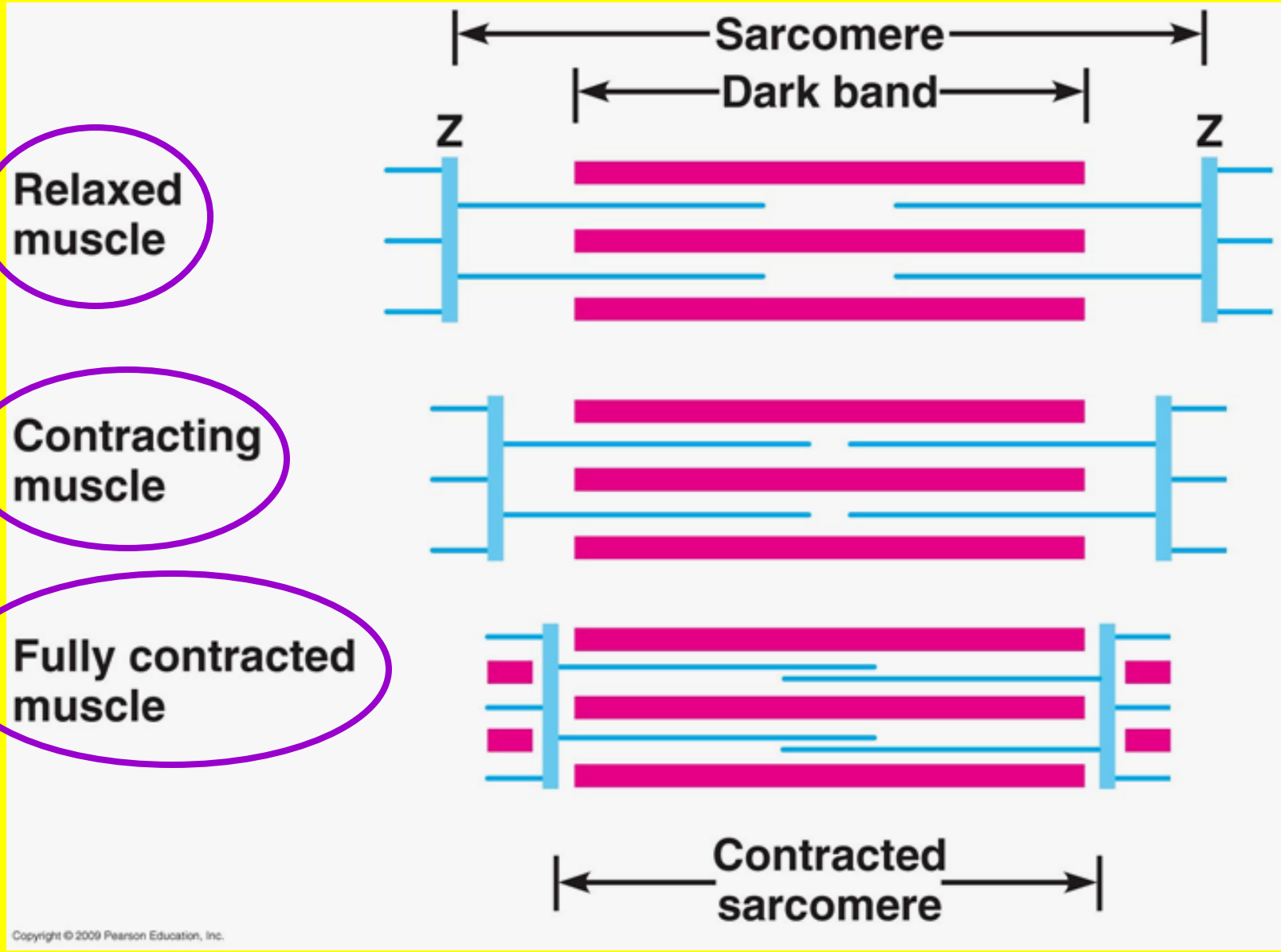
Sliding Filament Model



Antagonistic muscles: Muscles **pull** on a bone for movement

Muscles can't **push** a bone away

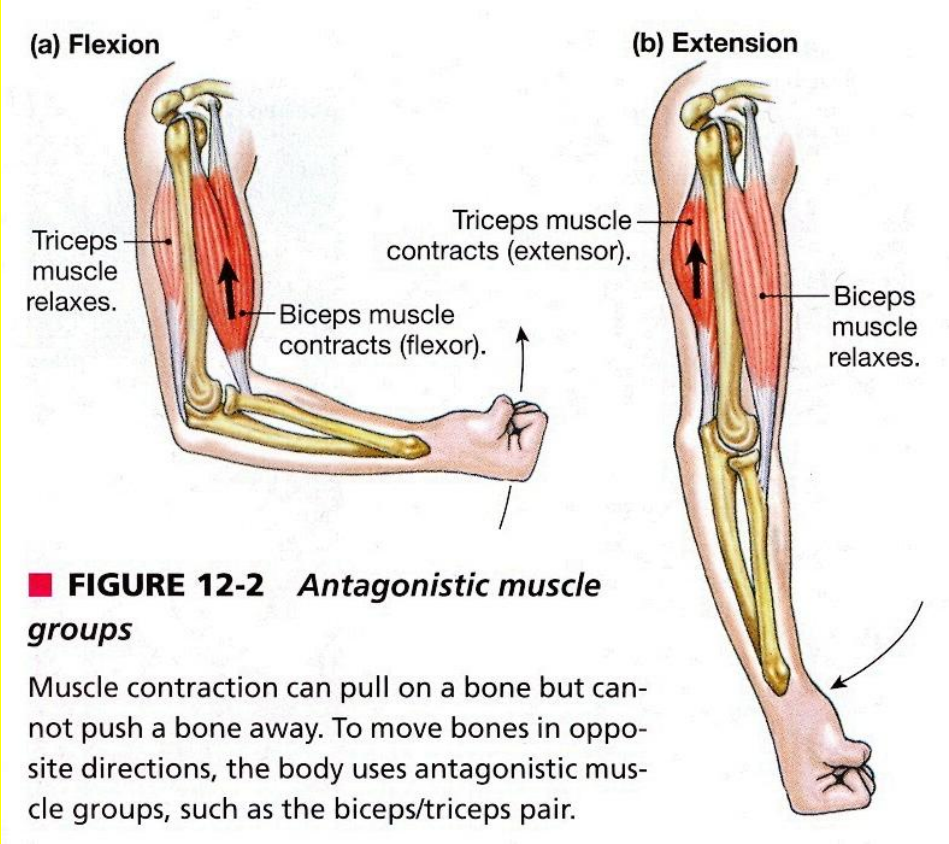


FIGURE 12-2 ***Antagonistic muscle groups***

Muscle contraction can pull on a bone but cannot push a bone away. To move bones in opposite directions, the body uses antagonistic muscle groups, such as the biceps/triceps pair.

To move in opposite direction: use different muscles

- Flex arm: **Biceps**
- Extend arm: **Triceps**

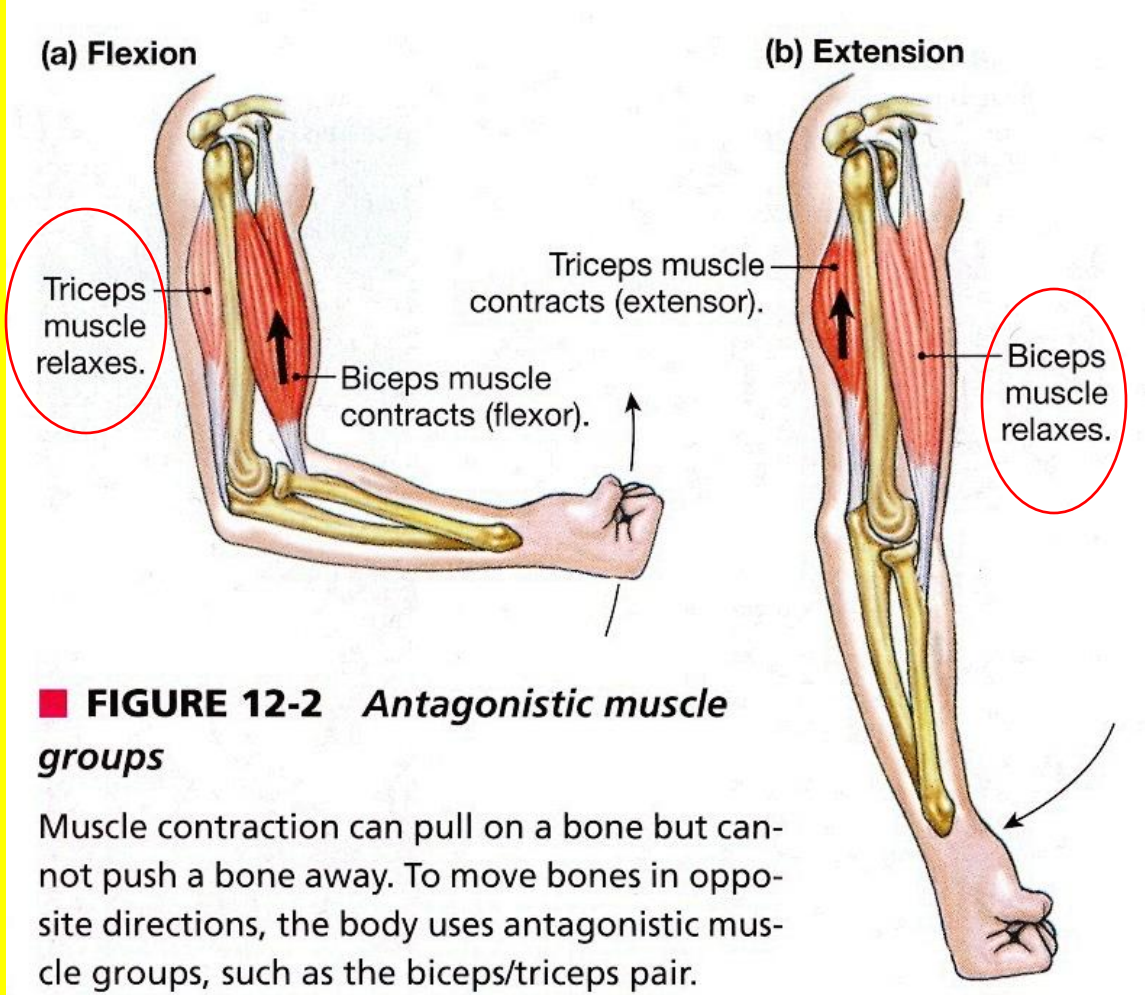


FIGURE 12-2 ***Antagonistic muscle groups***

Muscle contraction can pull on a bone but cannot push a bone away. To move bones in opposite directions, the body uses antagonistic muscle groups, such as the biceps/triceps pair.

Muscle Pathology

Muscular Dystrophy

- Usually inherited
- Missing important protein
- Muscles grow weak: wheel chair
- Weak respiratory muscles: ventilator

Muscle Pathology

Infections- bacteria **(Clostridium)**

Botulism

Food poisoning

Tetanus

Skin puncture

Bacteria toxins → ~~acetylcholine~~

Respiratory muscles- paralysis

death ← suffocation

Other muscle disorders

Disuse of muscles:

- Example: broken arm in cast
- ↓ Blood supply to muscles
- Muscle fibers **atrophy** (↓size)
- Atrophy > 1 year- usually **permanent**

Fast vs. Slow "Twitch" Muscle Fibers

- All muscles:
  mix of
  fast & slow twitch
- % varies:
  person to person
- Genetically
  determined

FAST TWITCH: SPRINTER

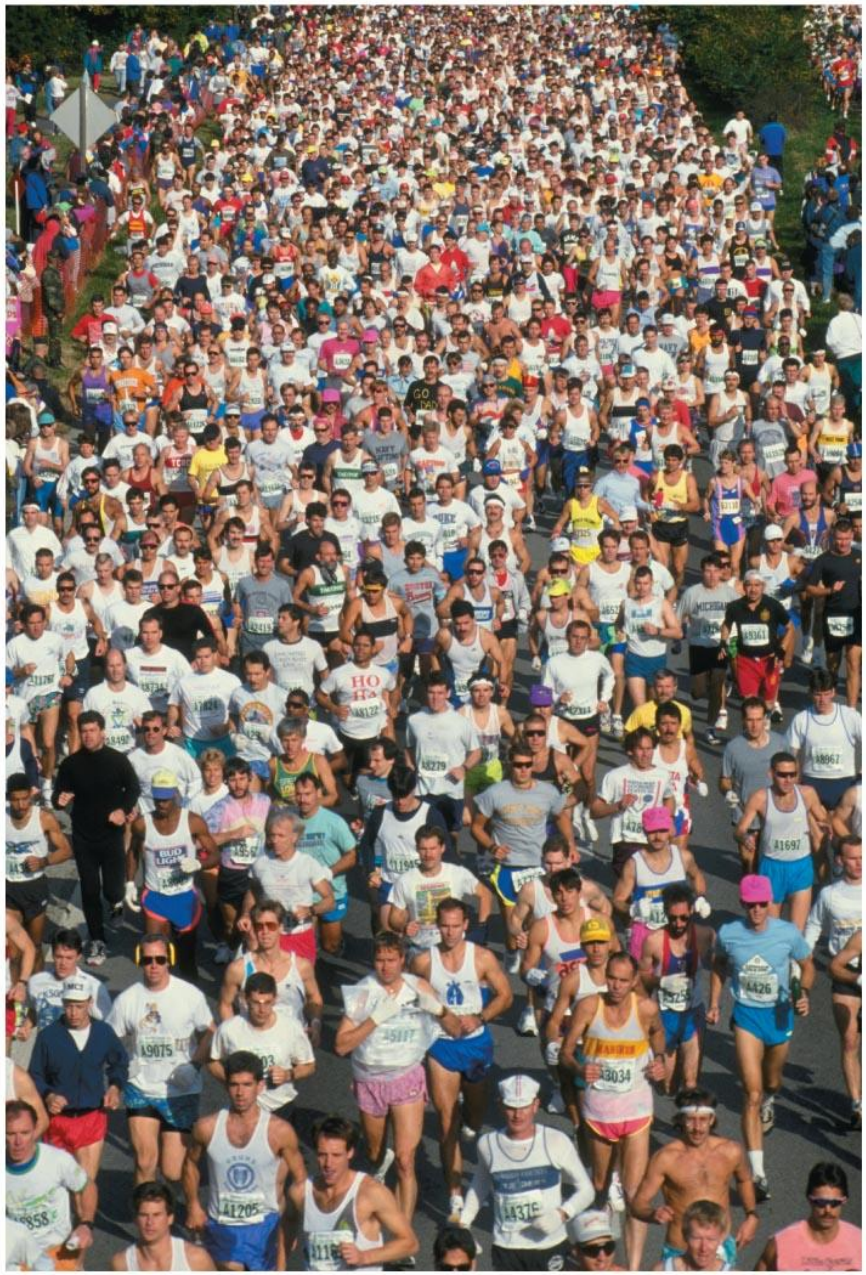
FAST TWITCH

- Good for: sprinting, weight lifting
- **Thicker fibers**, **more powerful**
- Contract: quickly, powerfully
- **Sprinters: ~60%** fast twitch in thigh muscles
- Good: short bursts, intense activity
- Fewer **mitochondria**
- Less **myoglobin** (to hold O_2)

FAST TWITCH

- **Fatigue** more easily
- Make fewer ATP per glucose molecule
- Partial breakdown of glucose by:
- Glycolysis (work anerobically- without oxygen)
- Glucose → Pyruvic acid → Lactic acid → **Muscle ache/fatigue**

SLOW TWITCH: MARATHONERS



SLOW TWITCH

- **Endurance**: long distance running
- Not much quick burst of power
- **Slow steady** muscle contractions, sustained over longer period
- **Slow to fatigue**
- More **myoglobin & mitochondria**

SLOW TWITCH

- Complete break down of glucose by **cell respiration**
- Glycolysis → Krebs Cycle → Electron transport
- **Aerobic**: use **oxygen**
- Produce more **ATP**
- **Marathoner**: ~ **80%** Slow Twitch