# Muscular System

# Objectives

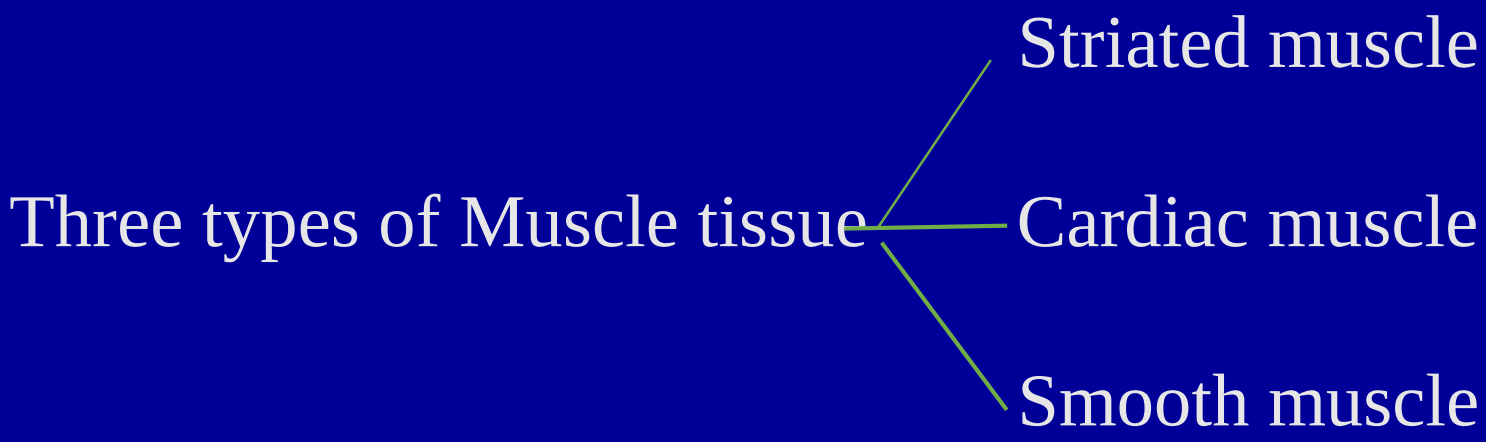
The student should be able to

1. Distinguish the type of muscles
2. Enumerate the functions of muscle
3. Describe how the muscles are attached to the bone firmly
4. State the antagonistic muscles and locomotion

# Muscle cells

- Muscles cells are specialized for contraction
- Found throughout the animal Kingdom
- Muscle cells → organize → differentiated into muscular tissue.

# Muscle types in mammals



1. Striated muscle moves the skeleton

   - called voluntary muscle (or) skeletal muscle

2. Cardiac muscle ➡ special type of striped muscle

   - Found wall of the heart

   - contraction is involuntary

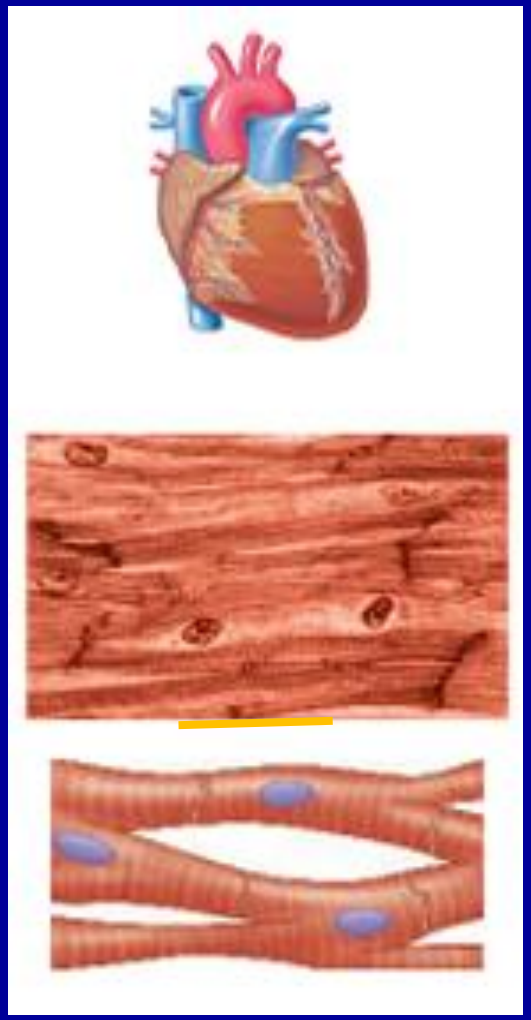
3. Smooth muscle ➡ Surrounds the walls of internal organs

   - contractions is involuntary



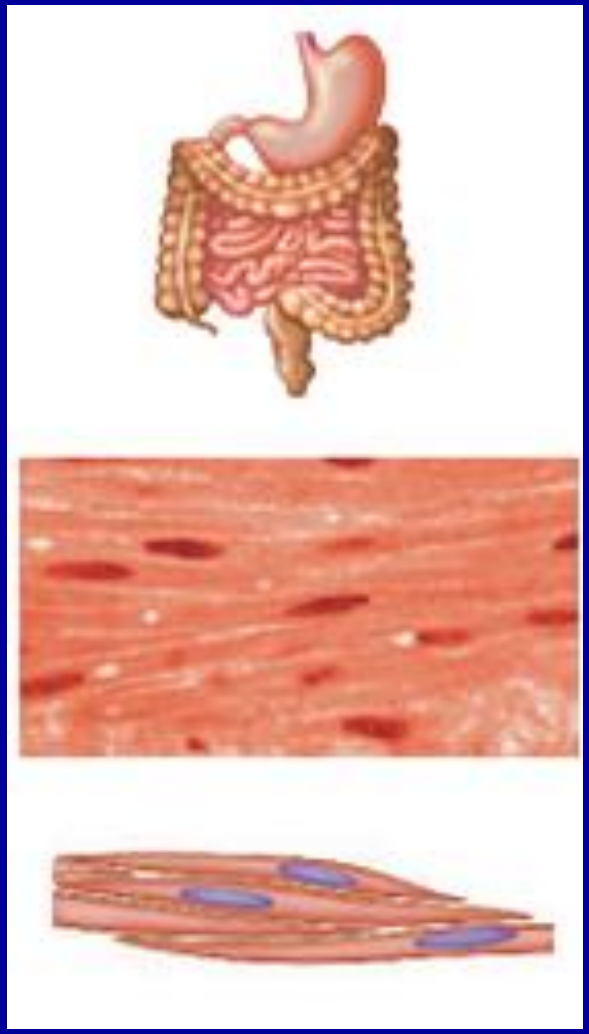
Striped voluntary muscle

e.g ,Skeletal muscle



Striped involuntary muscle

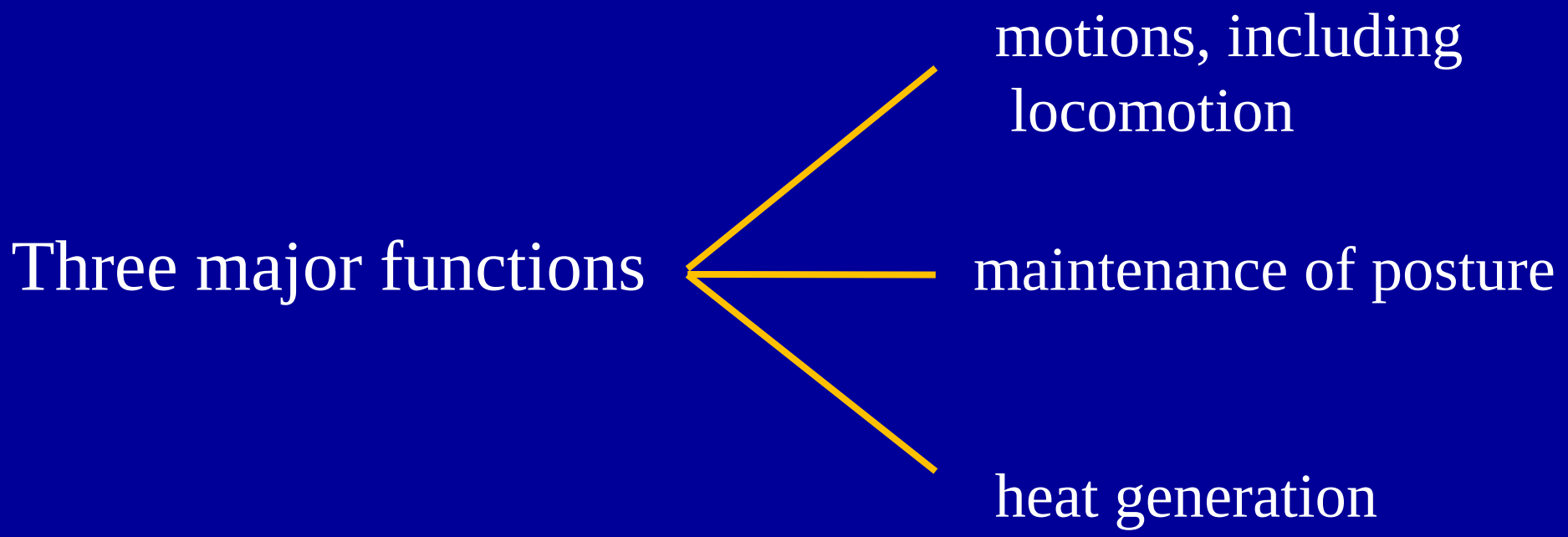
e.g ,Cardiac muscle



Smooth involuntary muscle

e.g ,Smoth muscle

# Functions of muscle



# Functions of Muscles

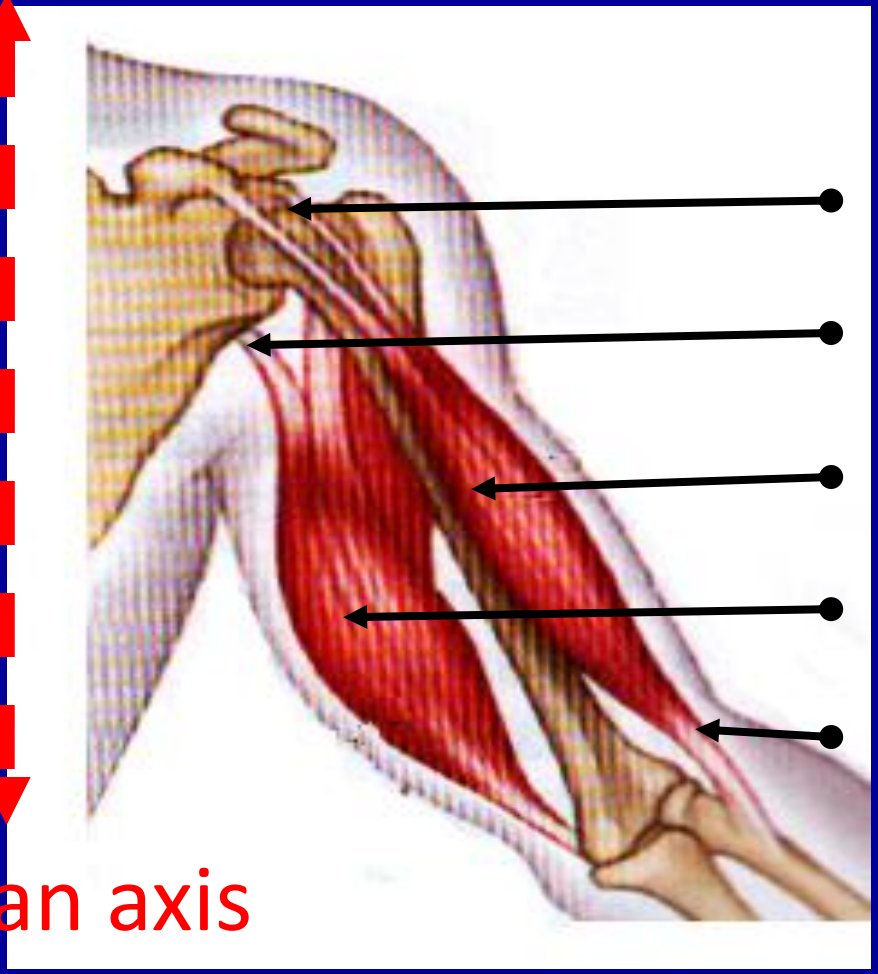
- **Motion including locomotion**
- **Maintenance of posture**
- **Heat generation**:
  - approximately 85% of human body heat is generated by muscle contraction;
  - brief involuntary muscle contracts (shivering) generate heat when the animal is cold

# Coordination of the skeleton, muscle and movement

- Muscle most often attached to skeletal elements at either end.
- The attached end is more stable and called origin and the other end the insertion.
- In the limb muscles the proximal end close to the median axis of the body is always considered to be origin.

- Muscles attach to the bones of the skeleton or of some other structures by tendons.
- Muscle fibres never attach directly to a bone or cartilage.
- The attachment is always mediated by connective tissue fibres.

Median axis



origin of muscle {proximal}

tendon

relaxed biceps

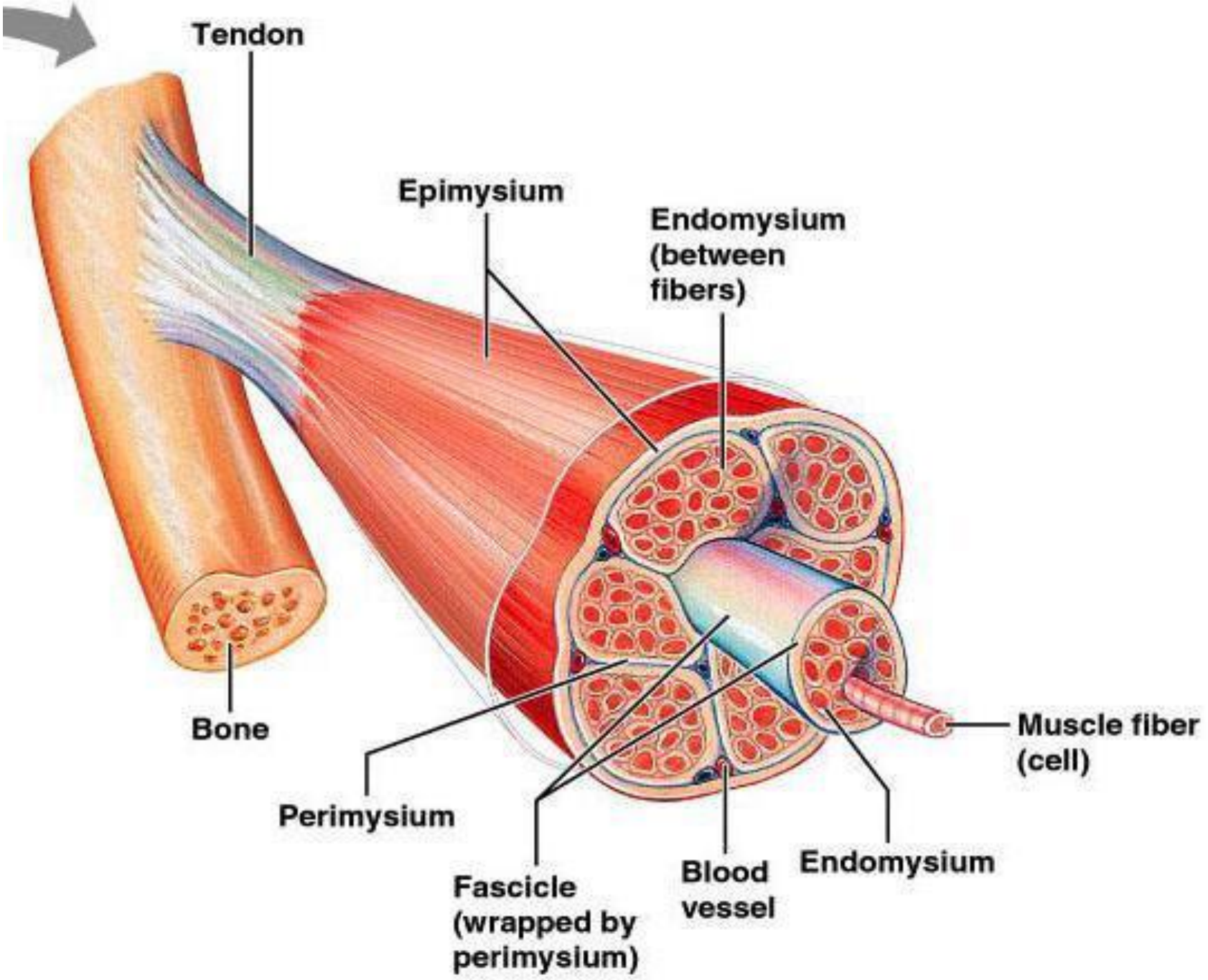
contracted triceps

insertion of muscle {distal}

Median axis

- **The muscle is surrounded by a thin sheet of connective tissue, the *epimysium*, within the muscle, further sheets, *perimysium* and *endomysium*, surrounded and separate bundles and other subdivisions.**
- **Fibres from these sheets are continuous with those around skeletal elements that are *periosteum* or *perichondrium* and form the actual attachment.**

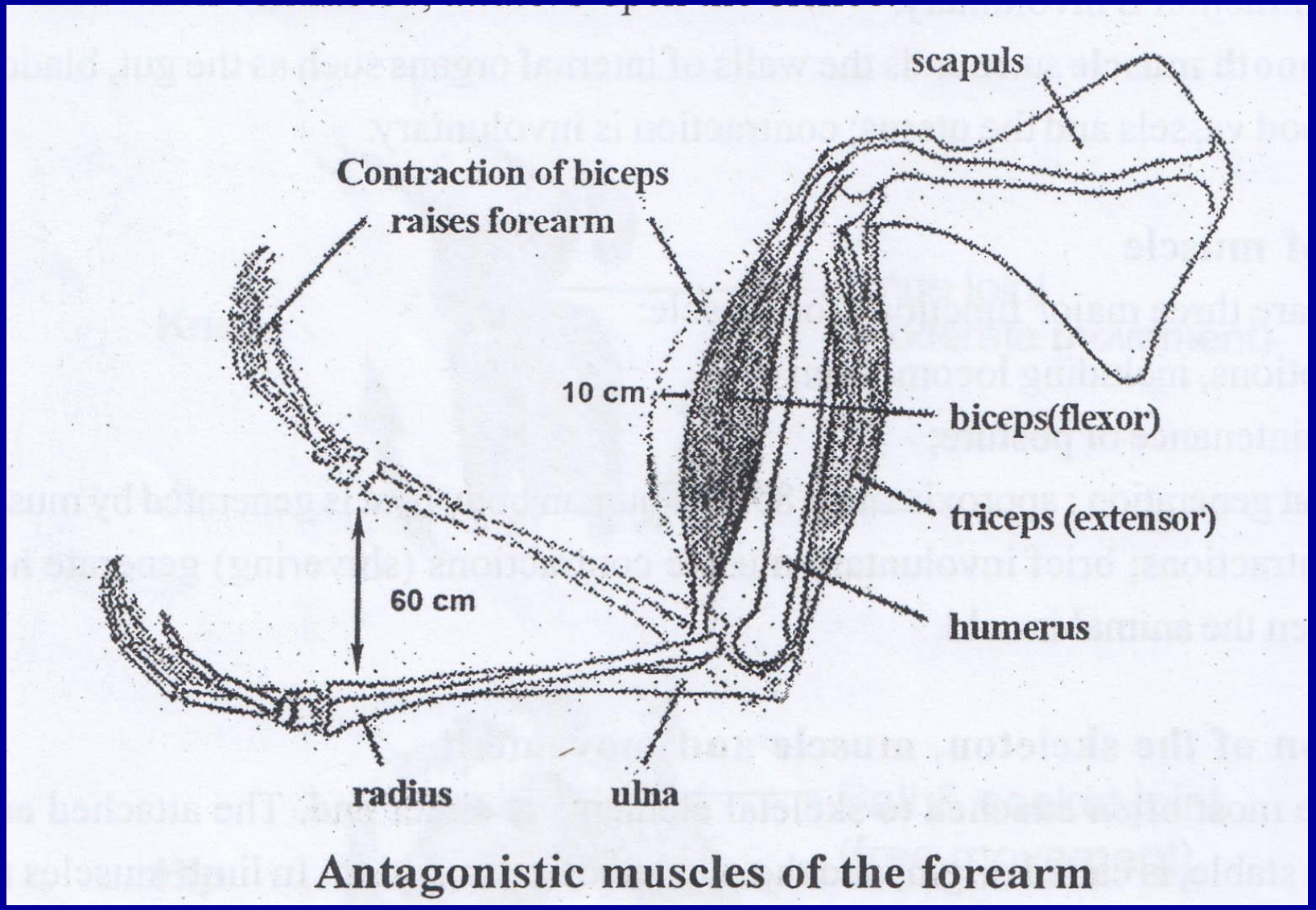
- Muscle terminates in a tendon, a ropelike structure formed almost entirely of connective tissue fibres.


Tendon
Epimysium
Endomysium
(between
fibers)
Bone
Muscle fiber
(cell)
Perimysium
Fascicle
(wrapped by
perimysium)
Blood
vessel
Endomysium

- The muscle can contract only a short distance but because they are attached near to the joint the movement at the end of the limb is greatly magnified..

- The biceps muscle of the arm may contract only about 10 cm, but the hand will move about 60 cm.

# Antagonistic muscles of the forearm



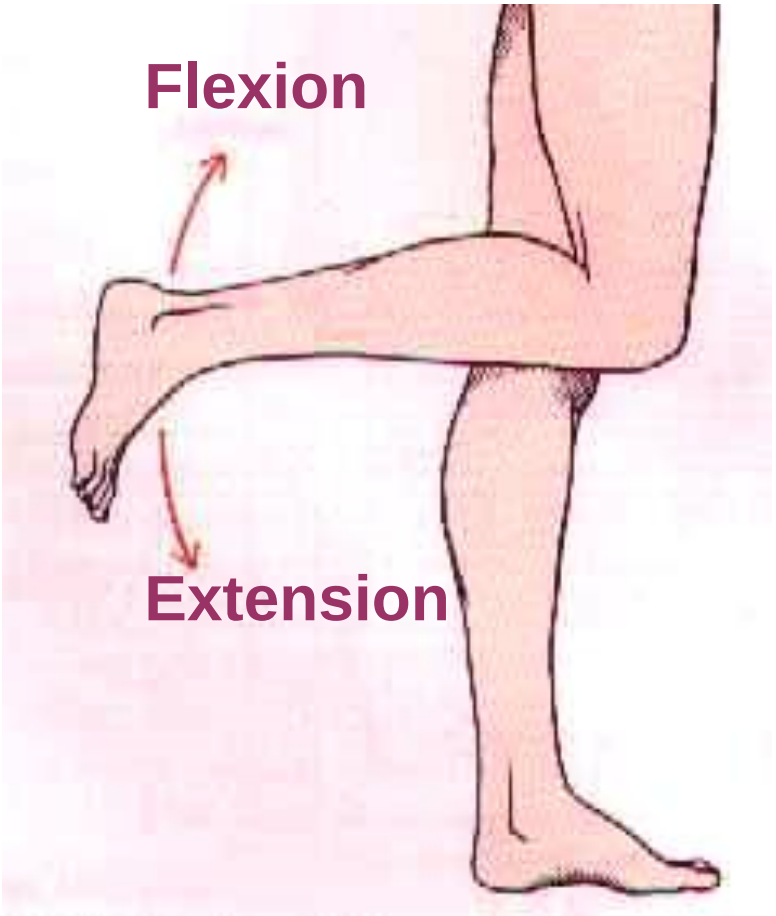

Antagonistic muscles of the forearm

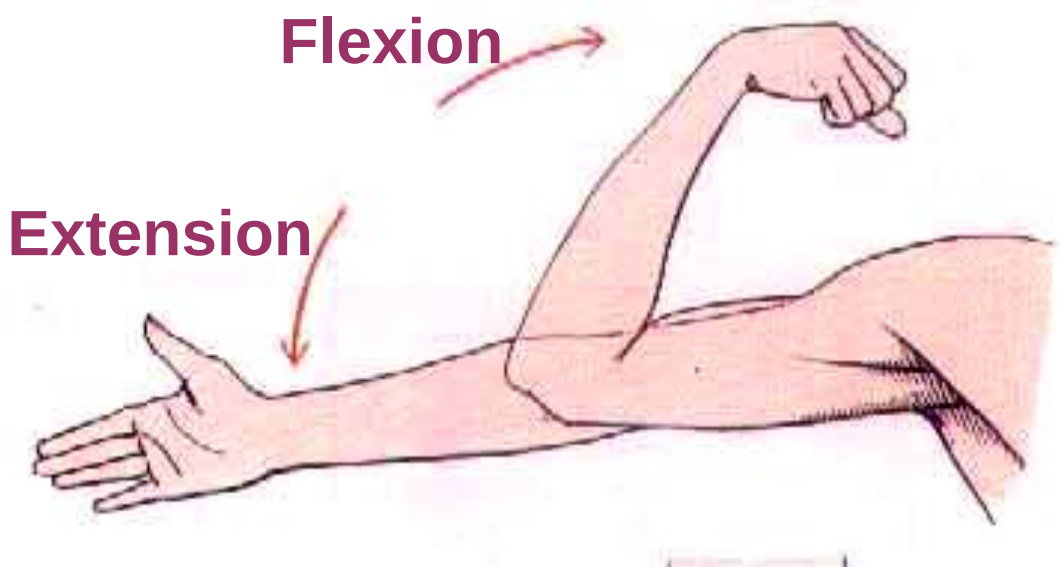
# ANTAGONISTIC MUSCLES AND LOCOMOTION

# Antagonistic pairs

**(1) Extensor - to extend or straighten the limb**

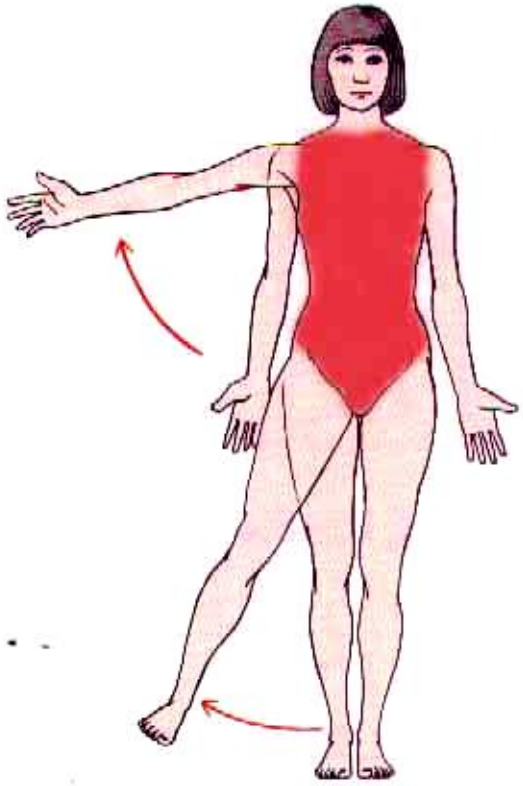
**Flexor - to bends or flexes the limb**



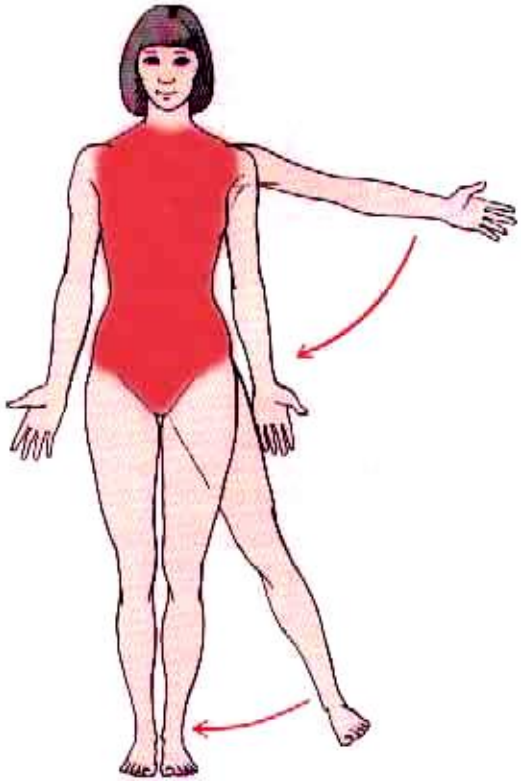



**(2) Abductor - draws a segment away from the body.**

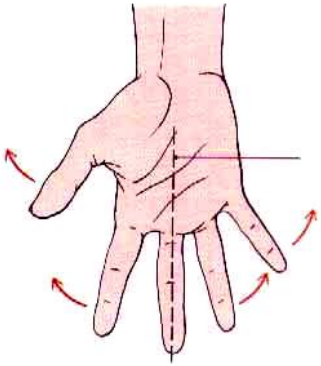
**Adductor - draws a segment toward the midline of the body.**

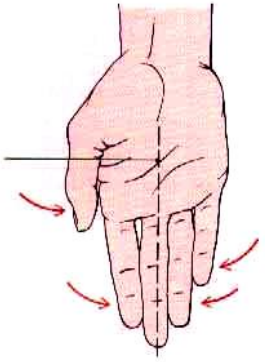


Abduction



Adduction



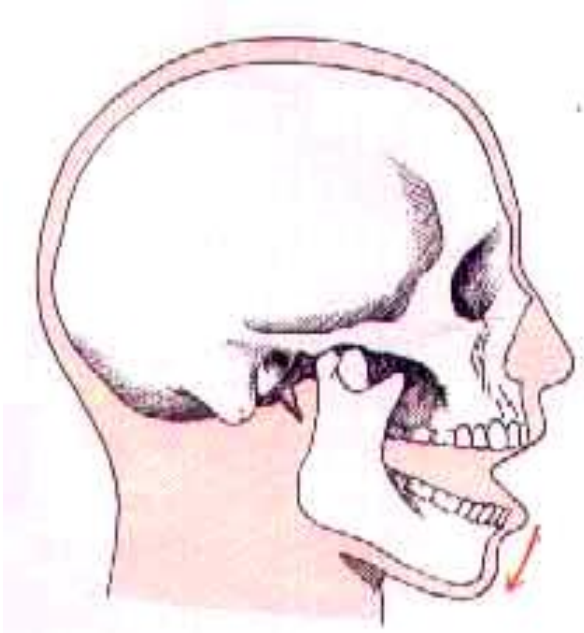


Axis

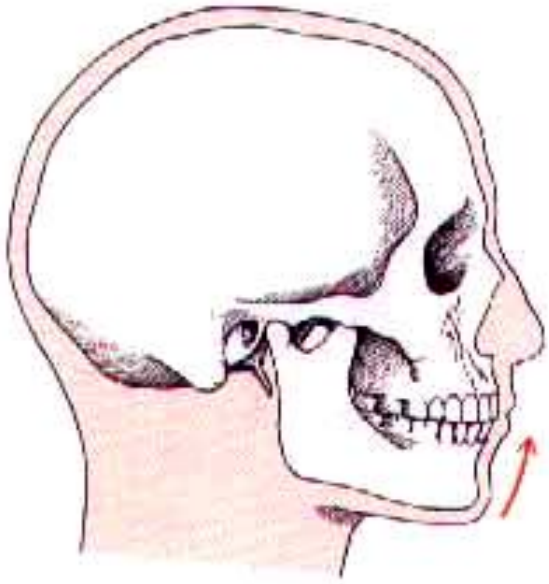
Abduction Adduction

**(3) Levator - raises a structure**

**Depressor - lowers a structure**



**Depression**

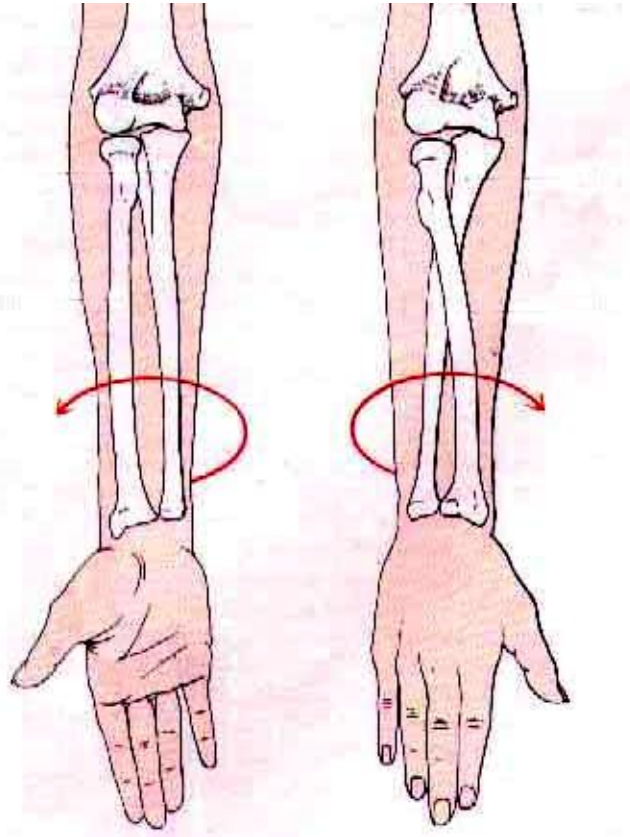


**Elevation**

## (4) Rotator - twists a limb segment

**Pronator - rotates the distal part of the limb toward a prone position of the foot (i.e., palm down)**

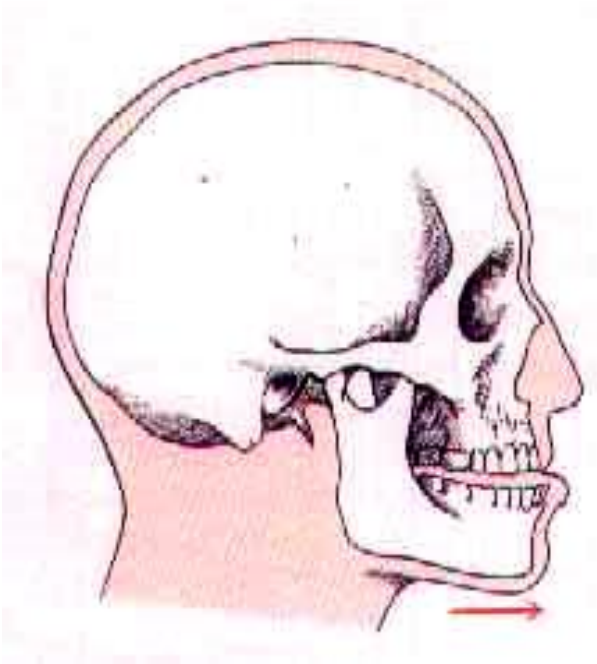
**Supinator - rotates the distal part of the limb toward a supine position of the foot (i.e., palm up)**



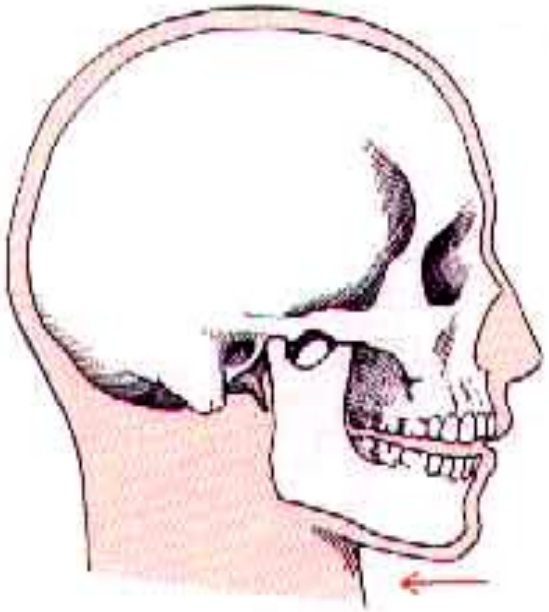
**Supination** **Pronation**

# (5) Protractors - draw parts forward or out

## Retractors - retract parts

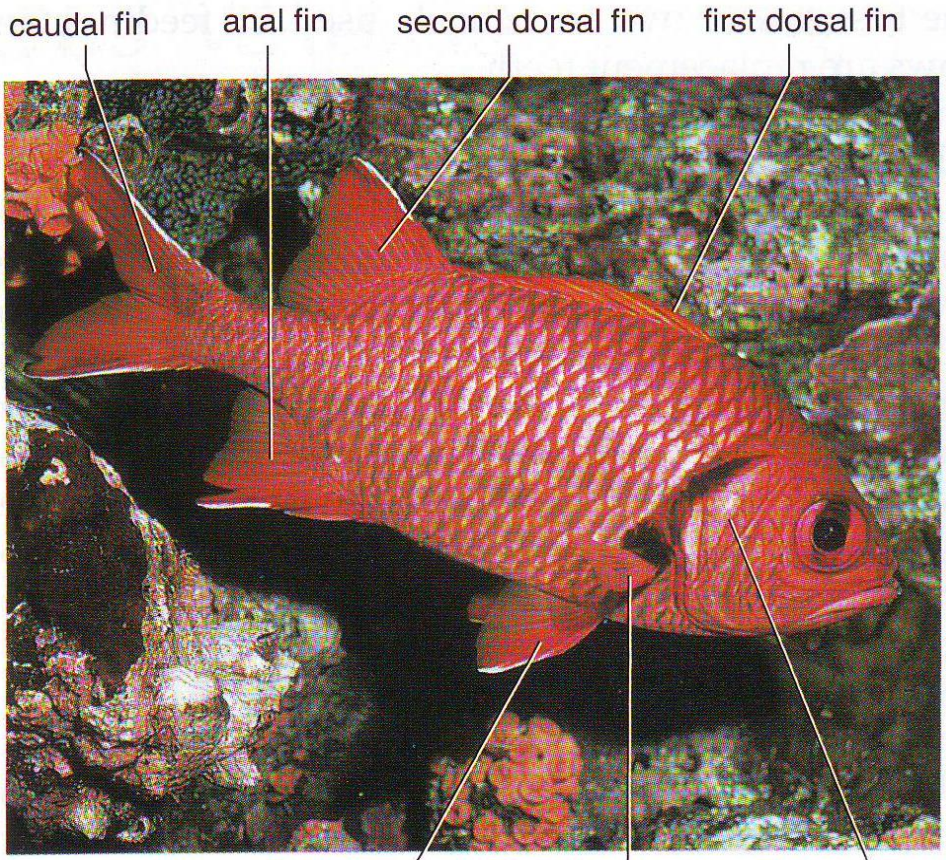


Protraction



Retraction

# (6) Contractors - close the orifices
# Dilators - open the orifices



a. Soldierfish, *Myripristis jacobus*



# COORDINATED LOCOMOTION

- Locomotion is brought about by the coordinated of limbs by sets of antagonistic muscles contracting and relaxing alternately.
- When the body is at rest, both antagonistic muscles remain in a state of tension or tone and so hold the body in position.

- The limbs are moved in a coordinated sequence, each one thrust in backwards on the ground and so propelling the animal forwards.
- While the limb is recovering its forward position, it must be removed from contact with the ground.