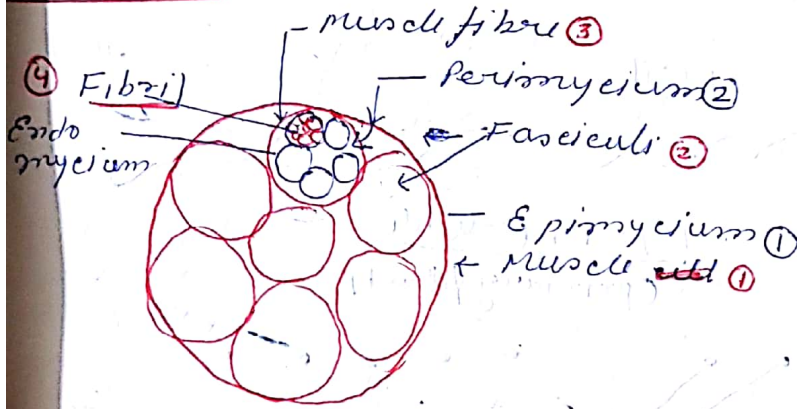


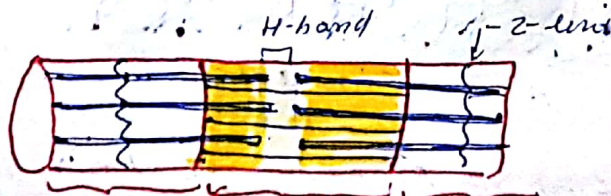
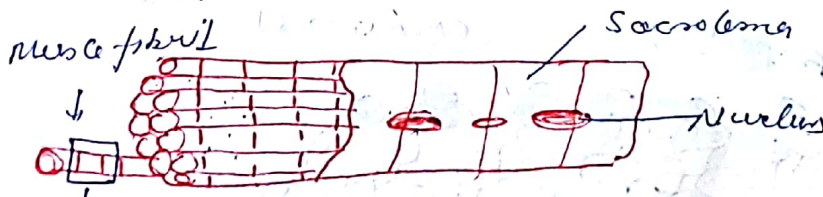
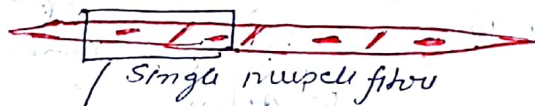
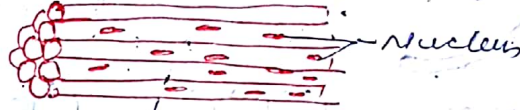
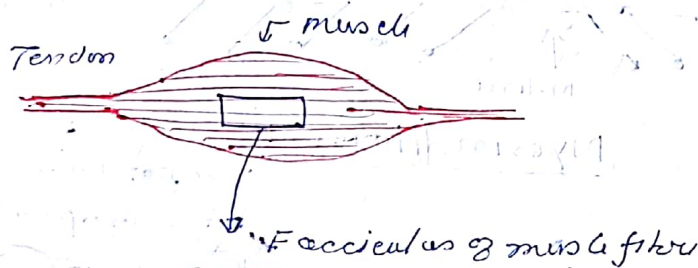
Muscles Type's

1) Striped / Skeletal / Voluntary / Somatic / Phasic type muscle.

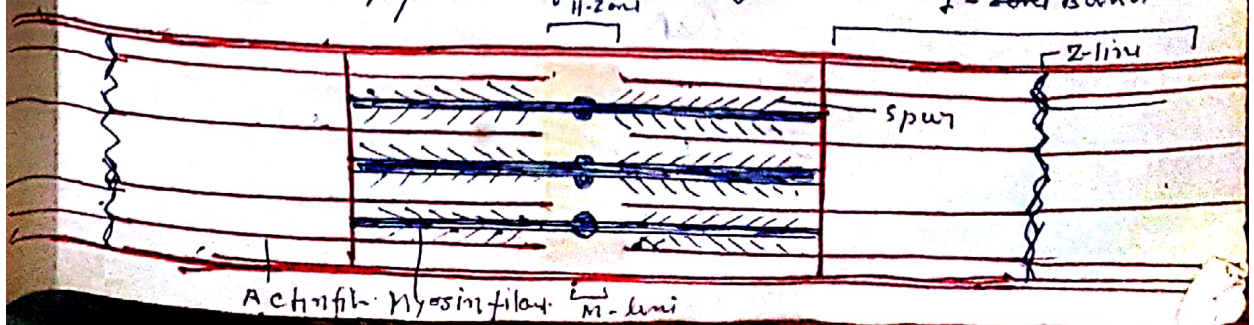
Structure

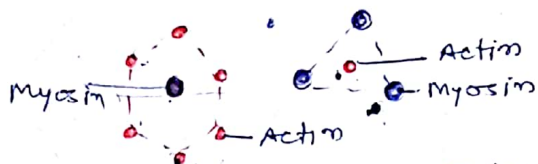


Each muscle fibre is made up of many fibrils, the light & dark bands are present on fibril.



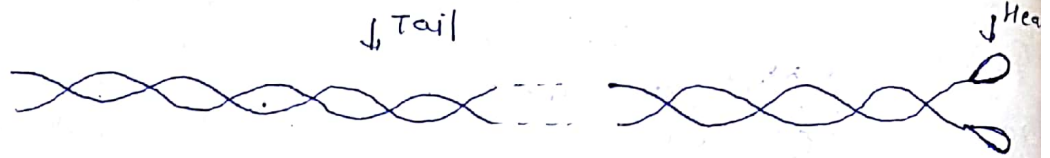
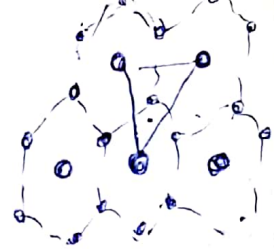
A band A Band I Band
A portion of muscle fibril.



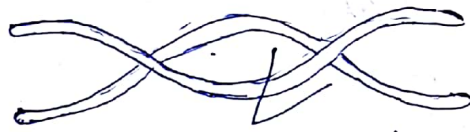
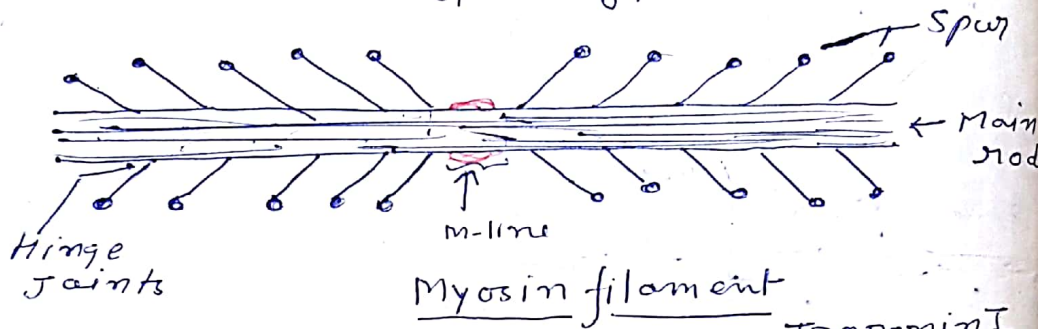


Hexagone
(A Myosin covered
by 6 Actin)

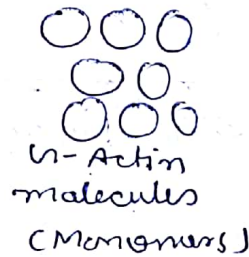
Triangle
(An Actin covered
by 3 Myosin)



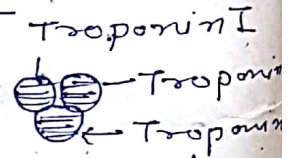
Myosin Molecule
(Primary filament)



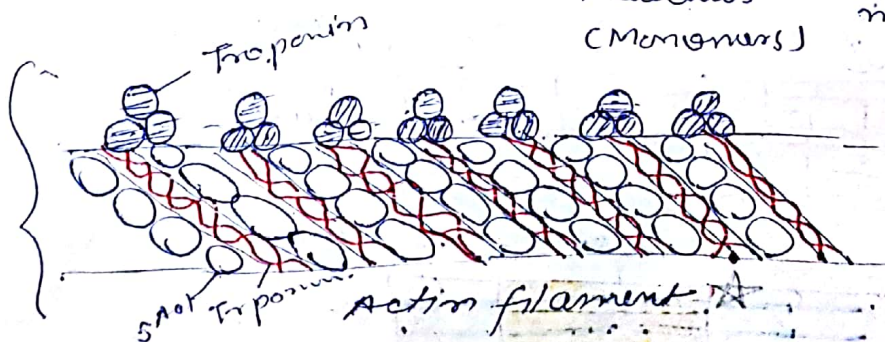
Tropomyosin
molecules



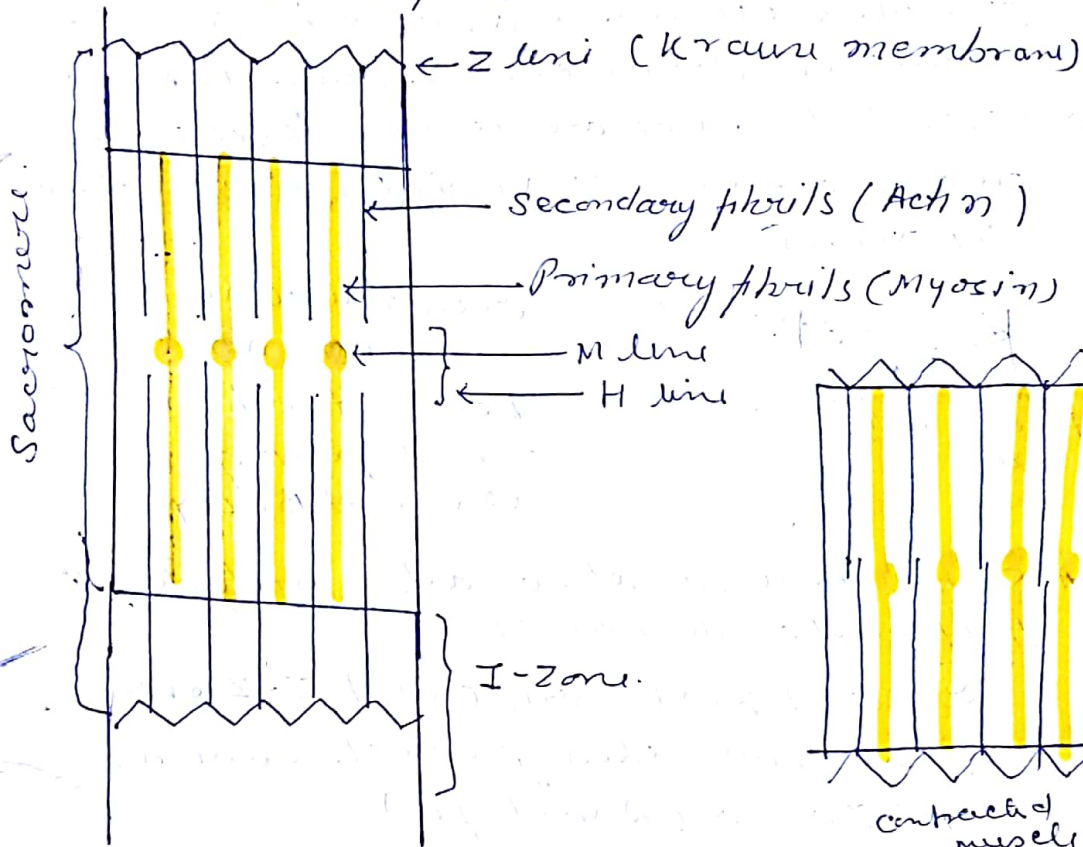
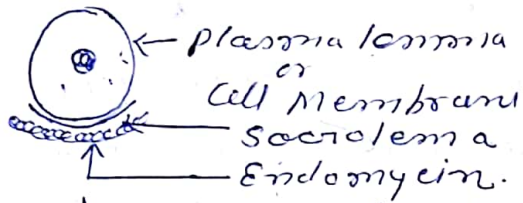
n-Actin
molecules
(Monomers)



Group of
Tropomyosin
molecules



Ultrastructure of Myosin and actin filament.



H-Zone (H = heller - German for light)
Z-line (Z = Zwischenscheibe German for intercardiac disc)

* In the middle of the "H" zone is the "m" line which is locus of enzymes important in energy metabolism ex - creatine kinase.

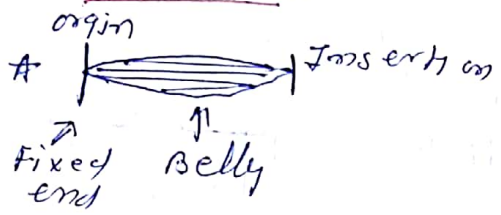
Ultrastructure of myofilaments: →

- * Each myosin filament is composed of numerous myosin molecules.
- * Each myosin molecule has two distinct parts a long, coiled double helical tail part and small, globular knob like 'head' with double helical shaft.
- * These head forms 'spur' or 'arrow heads'. They are directed away from 'm' line and arranged in six parallel rows facing the six surrounding actin filament. **Hexamer**
- * Each actin filament is formed of 3 different

Kinds of proteins -

- (1) Actin Actin protein filament, two filaments made of (1) actin monomers
- (2) Troponin protein forms another thin double helical strand

- * Several fibrils combined to form FIBRE
- * Each muscle cell or fibre is enclosed by a connective tissue coat called ENDOMYCIUM
- * A bundle of several such fibres constitute fasciculus which is enveloped by another connective tissue sheath called PERIMYCIUM
- * Several fasciculi are united together by outermost connective tissue sheath called EPIMYCIUM.



Each muscle has an origin and an insertion between two bones. The middle part of muscle is called BELLY.

- * Striped muscles show alternately placed light and dark bands

L-B
D-B
L-B
D-B

The light zones are called "I"-Zones (Isotropic) while the dark zones are "A" Zones (Anisotropic)

- * The light & dark zones of all the muscles fibrils in a muscle are placed at same level.
- * The outermost membrane of a muscle cell is called SARCOLEMMMA (absent in smooth muscle), the cytoplasm inside is called SARCOPLASM. The E.R of muscle cell is called SARCOPLASMIC RETICULUM & mitochondria are called SARCOSOMES.
- * Skeletal muscle cells are multinucleated.
- * The "A" zone possesses thick myofibrils made up of MYOSIN which are thickest in the middle to form a "M" line.
- * The I-zone in the middle is divided by a zig-zag membrane called KRAUSE membrane or "Z" membrane.

The secondary myofibrils of actin arise from "Z" and ~~partly~~ partly extend into A zone from both sides. Thus primary fibrils are found in "A" zones only while secondary in both A & I zones

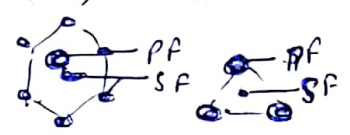
SARCOMERE is the unit of muscle contraction, this is that part of a muscle cell which lies between two "Z" membranes.

- * The "A" zone constitutes about 65% of Sarcomere, while I-zone. 35%
- * The muscle never expand, they contract and relax, to perform work.

The transverse strip of A zone in which secondary myofibrils (ACTIN) are absent (during relaxed state) is called "H" zone. This appear lighter.

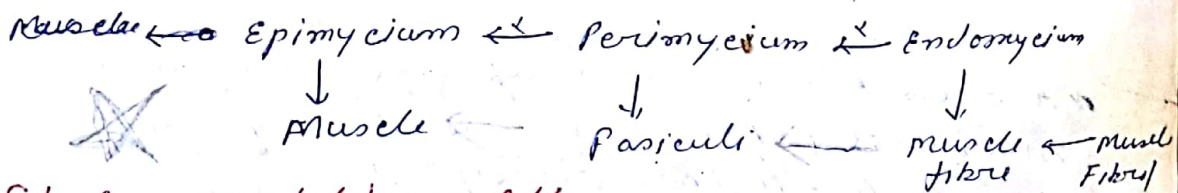
* There are 2 secondary myofibrils lying between two primary ones.

* In cross section Hexagon and trigons are seen. In each hexagon one primary is surrounded by six secondary ones, while in a Trigon one secondary by 3 primary one.



* In general the no of secondary fibrils is double of primary ones

St of muscle →



St. of a muscle fibre or cell.

- Long slender, cylindrical
- Unbranched (Except tongue & facial muscles)
- multinucleated.

* Outer membrane - Sarcolemma - composed of 3-layers

- 1) Inner P.m
- 2) middle fibrous layer (basement memb.)
- 3) External glycoproteinous layer.

* Cytoplasm :- called sarcoplasm → composed of

- (1) Myoalbumin
 - (2) Myoglobin (comb. O_2)
 - (3) Myogen
 - (4) Enzymes, glycogen granules & lipid droplets.
- } Proteins

Two types of fibre —

① Red fibre - short

- slow fibre
- more numerous nuclei
- deeply situated "
- more myoglobin
- more mitochondria (sarcosomes) hence more ATP
- Adapted for prolonged continuous muscle activity
- Used for work against grav. long athletic event
- Ex - Marathon race etc.
- So called slow fibre.

② White fibre - Longer

- few nuclei
- nuclei are peripherally situated
- few mitochondria
- Release energy ^{rapidly} from glucose by glycolytic process
- Adapted for very rapid and powerful muscle contraction
- Situated for jumping, fast running

* A Each fibre is made up of fusion of many myoblasts (stem cells) hence regarded as multicellular syncytial body.

Str of Smooth muscle:- DI (in) / non-striated / unstriated muscle (7)

- * Absence of striations
- * These muscles are found in the walls of tubular internal organs Ex - alimentary canal, gall bladder etc. Arrector pili,
- * ~~Arrector~~ Fibres of smooth muscles are short thin & spindle shaped
 - uninucleated
 - unbranched
- * Sarcolemma absent
- * Elongated nucleus is located in middle region of fibre
- * Actin & Myosin filaments are short, chemical composition different
- * These filaments are scattered in sarcoplasm and does not form sarcomeres
- * more thin actin and less thick myosin filaments
- * Dense bodies are found attached with actin filament
- * Myosin heads large number of spur
- * Two type on the basis of arrangement of muscle fibres

① Multicunit smooth muscle

② Unit smooth muscle

① Multicunit smooth muscle - muscle fibres are separated by a basement membrane, which surrounds each fibre. Each unit function independently. * separate nerve supply to each
Ex - ciliary muscle, iris of eye, arrector pili, muscle of wall of larger blood vessels etc.

② Unit muscle

- * Fibres occur in sheath or bundles
- * ~~Here~~ The fibres are bound with each other by gap junction. Hence when a coordination begins in any part of such muscle, it automatically repeats to the whole muscle.

②
* Muscle fibres operate together as a single unit in the form of a functional syncytium hence also called syncytium smooth muscle.

* Found in the walls of most viscera of the body

Contracton of smooth muscle

* contraction is not under conscious control of body

* occurs slowly, accordance with the internal environment

* Involuntary muscle of body

* These muscles are innervated only by the A.N.S.

* multicent muscles are myogenic
Single unit " " myogenic

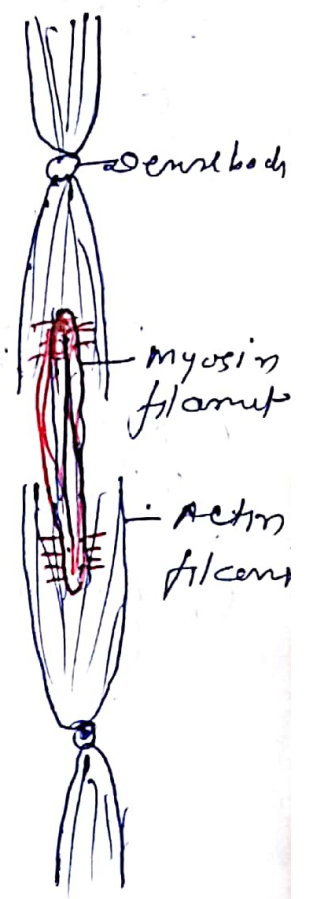
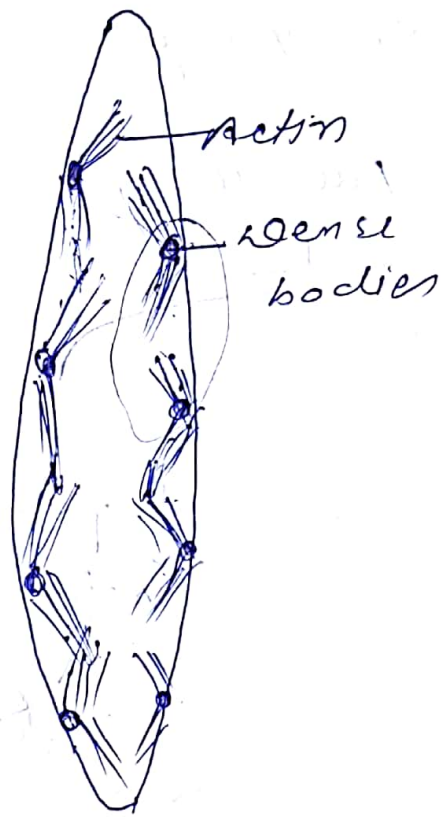
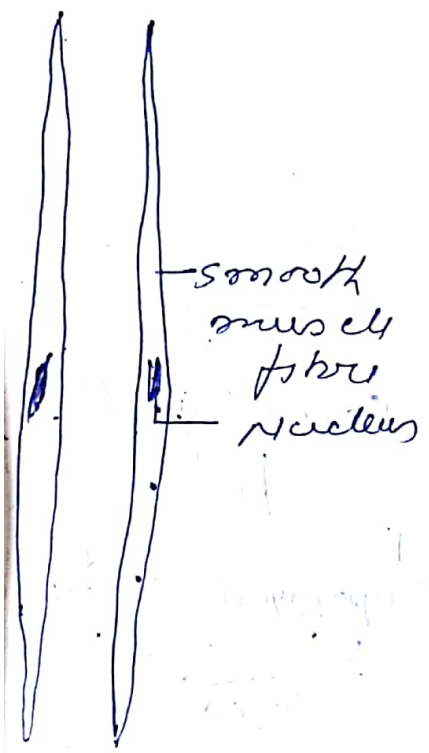
Cardiac Muscles

* Heart wall is made up of cardiac muscle hence called myocardium

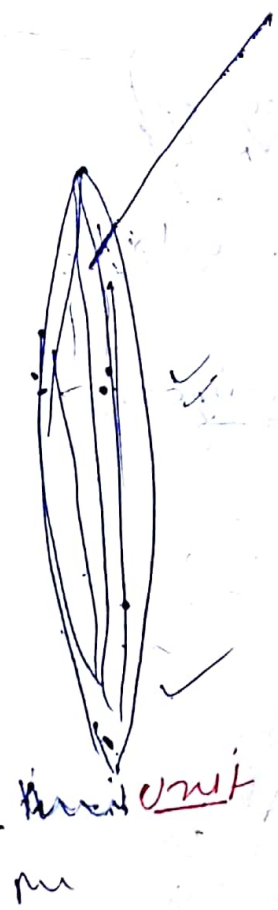
* Resemble striated muscle in structure but differ in functioning as work independently of the conscious control of body, hence these are involuntary muscles (smooth)

* Shorter, branched mostly uninucleate

* Sarcotem are present



Str. of smooth muscle fibres



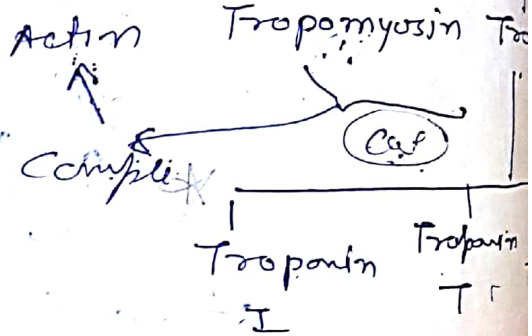
Chemistry of muscle contraction:- Skeletal

Given by S. Gyorgyi

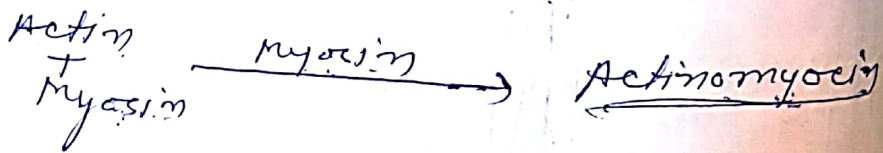
muscle

Primary fibril (myosin)

Secondary fibril



Actin & myosin show a tendency of uniting if not inhibited.
Myosin is structural as well as enzymatic protein



Skeletal/striped M or voluntary muscle	Visceral/unstriped or smooth muscle	Cardiac M
- multinucleated (sync)	uni	cent
- Sarcolemma + int	absent	present
- light & dark band + int	"	"
- Unbranched	Unbranched	branched
- IC absent	IC absent	present
- Tapering (fusiform) end	not	not
- connected by somatic motor neuron	- by visceral motor N	by vi. motor N
- Voluntary	Involuntary	Involuntary
- Under control of CNS	CNS	CNS
- 1° fatigue occurs	Never fatigue	Never fatigue

