Kinesiology: Bio-mechanistic processes involved in movement, Muscle Contraction-relaxation

Part 1

Kinesiology

- Kinesiology is the study of the principles of mechanics and anatomy in relation to human movement.
- Brings together anatomy, physiology, physics, and geometry as they relate to the human bodies movement.

Kinesiology

- A sound understanding of kinesiology allows for the development of a rational evaluation, a precise diagnosis, and an effective treatment of musculoskeletal disorders, and allows for safe, appropriate exercise prescription

Kinesiology

- Kinesiology enables the detection and correction of various imbalances that may relate to stress, nutrition, learning problems, minor injuries and other issues encountered in daily life.

Kinesiology

- The study of Kinesiology borrows heavily from the sciences of anatomy, biomechanics, and physiology.
- Anatomy – the science of the shape and structure of the human body and its parts.
- Biomechanics – a discipline that uses principles of physics to quantitatively study how forces interact with the living body.
- Physiology – the biologic study of living organism.

Biomechanics

"**Biomechanics** is the study of the structure and function of biological systems".

Bio= Living

Mechanics= Forces and effects

This includes studies of the tissues including bone, cartilage, ligament, tendon, muscle, and nerve, at multiple scales ranging from the single cell to whole body.

The study of mechanics in the human body divided into 2 areas:

Kinematics – study of the variables that describe or quantify motion

- Displacement
- Velocity
- Acceleration

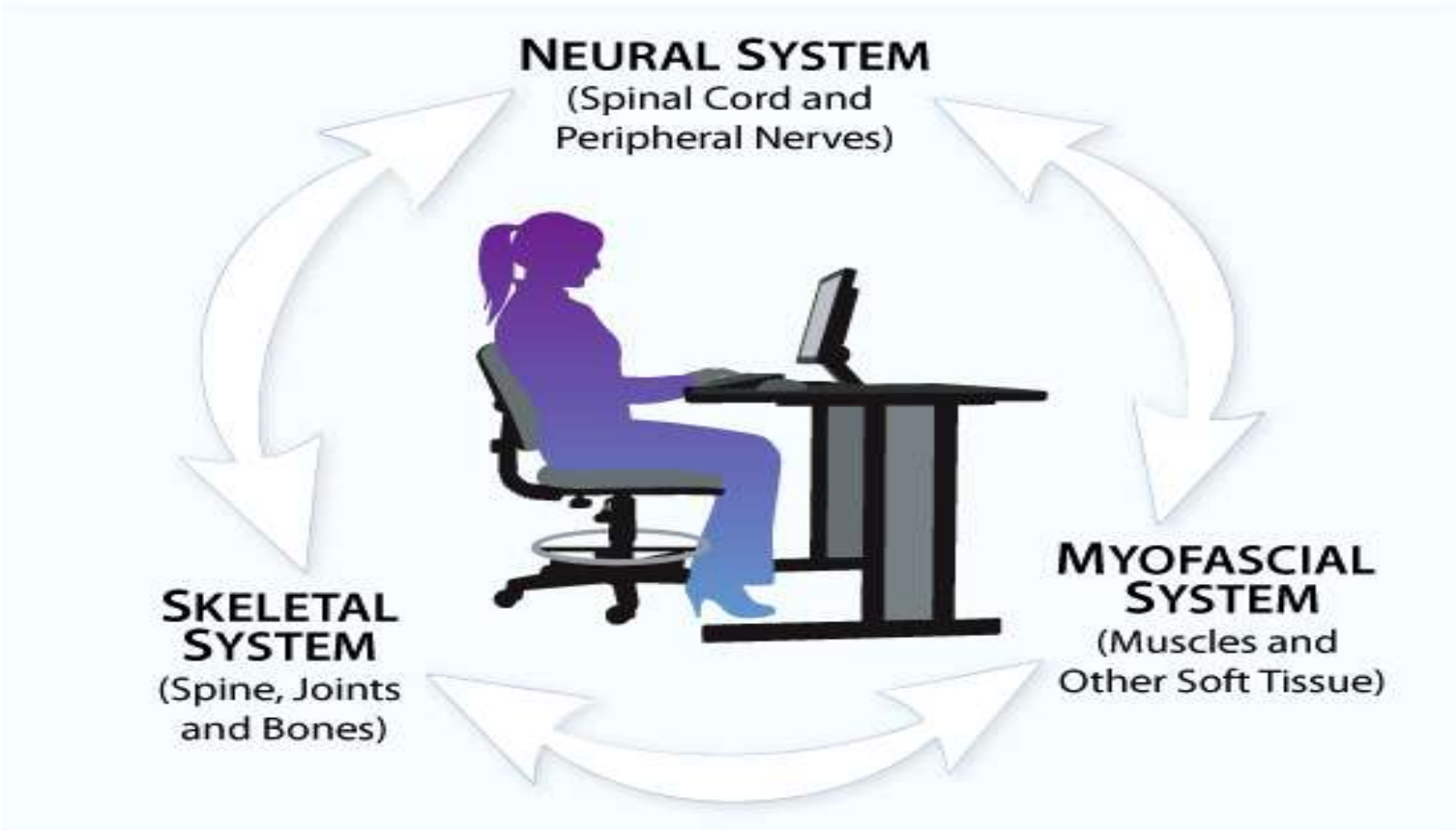
Kinetics – study of the variables that cause or influence motion

- Forces
- Torques
- Mass

Biomechanists use the principles of mechanics in the analysis of human movement to answer questions such as:

1. How can human performance be enhanced?
2. How can injuries be prevented?
3. How can rehabilitation from injury be expedited?

Neuromuscular Skeletal Biomechanics



Muscular System

- Muscles provide the forces needed to make movement possible; they transmit their forces to tendons, whose forces in turn cause rotation of the bones about the joints.

Muscular System

- Muscles, however, are not simple force generators: the force developed by a muscle depends not only on the level of neural excitation provided by the central nervous system (CNS), but also on the length and speed at which the muscle is contracting.

Muscular System

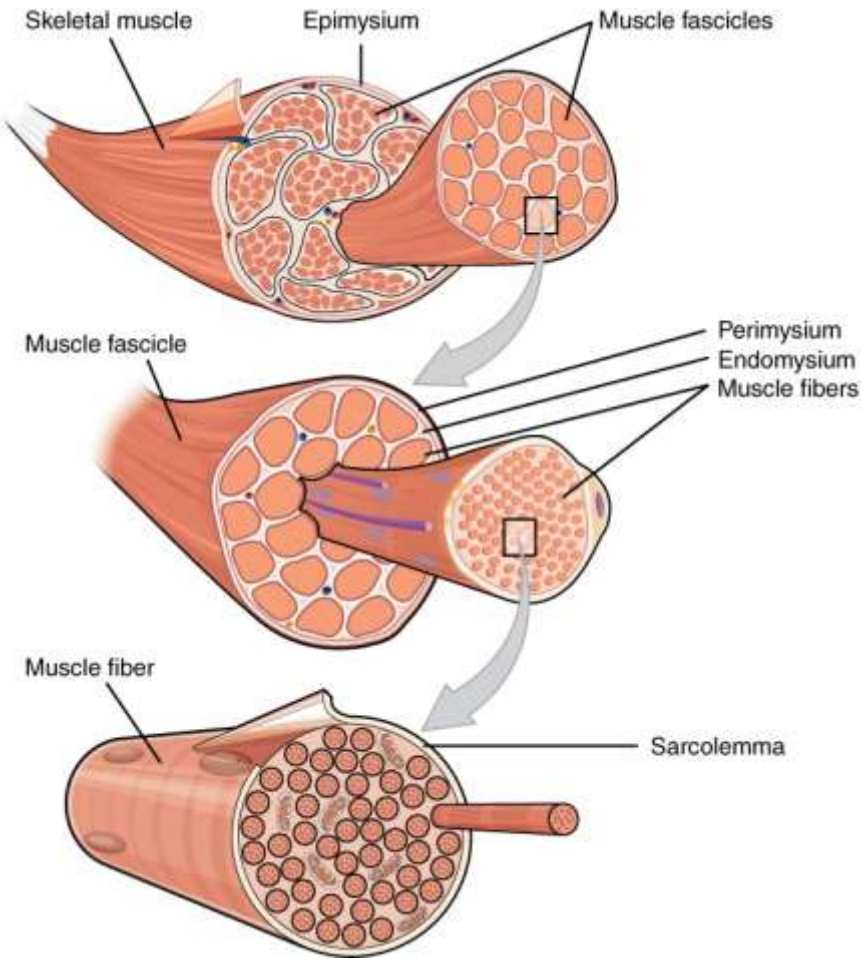
- Muscles can shorten and pull but not push
- Most muscles are arranged in opposing teams e.g. agonistic/antagonistic - as each team pulls, the other team relaxes and gets stretched
- There are more than 640 muscles (320 in pairs). Nevertheless, exact number is difficult to define.
- The muscles make up about 40% of the body mass.

- The longest muscle in the body is ***Sartorius.***
- The smallest muscle in the body is ***Stapedius.*** It is located deep in the ear. It is only 5mm long and thinner than cotton thread. It is involved in hearing.
- The biggest muscle in the body is ***Gluteus Maximus*****.** It is located in the buttock. It pulls the leg backwards powerfully for walking and running.

Muscle

Gross Structure. Muscles are molecular machines that convert chemical energy into force. Individual muscle fibers are connected together by three levels of collagenous tissue endomysium, which surrounds individual muscle fibers; perimysium, which collects bundles of fibers into fascicles; and epimysium, which encloses the entire muscle belly.

Structure of Muscle



Functions of Muscles

- Movement
- Maintenance of posture and muscle tone
- Heat production
- Protects the bones and internal organs.

Classification of Muscles

Functionally

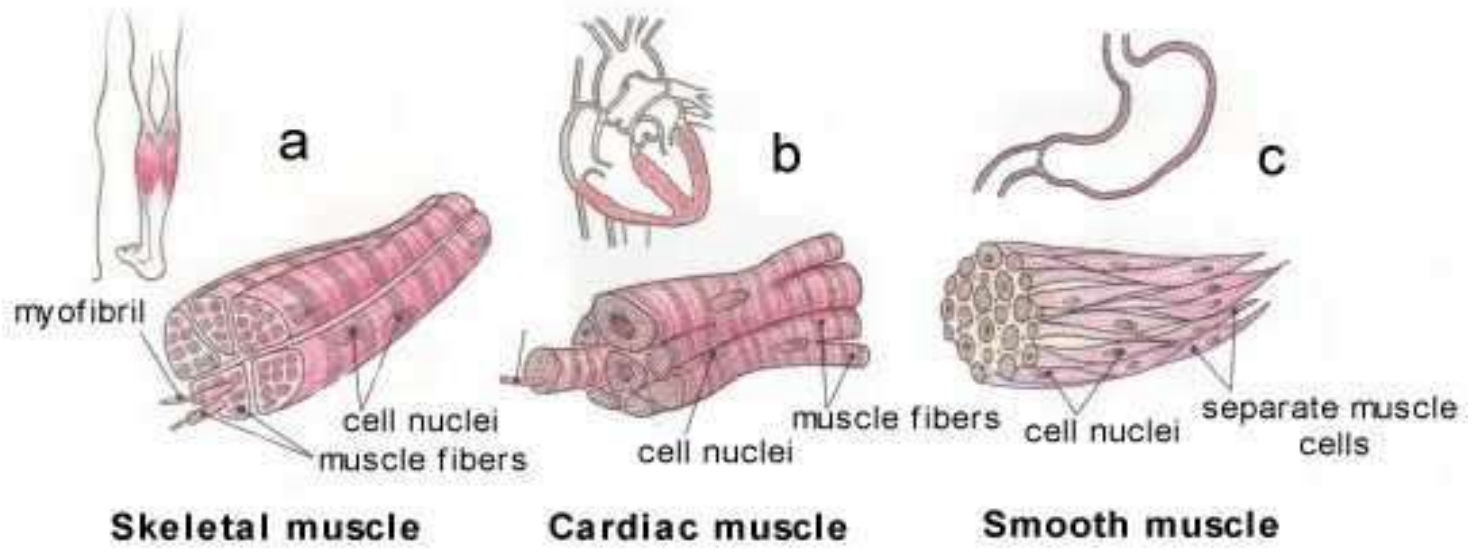
- Voluntarily – can be moved at will
- Involuntarily – can't be moved intentionally

Structurally

- Striated – have stripes across the fiber
- Smooth – no striations

Types of Muscles

A. Skeletal Muscles
B. Cardiac Muscles
C. Smooth Muscles



A. Skeletal Muscle

- Fibers are long and cylindrical.
- Has many nuclei, striations and voluntary
- Attached to skeleton by tendons and cause movements of bones at the joints
- They do fatigue

Functions of Skeletal muscles

A. **Movements** – muscles move bones by pulling not pushing

1. Synergists – any movement is generally accomplished by more than one muscle.
2. Agonist- most responsible for the movement.
3. Antagonist- muscles and muscle groups usually work in pairs. Biceps flex arm and its partner triceps extend arm. Two muscles are antagonists.
4. Levators - muscle that raise a body part.

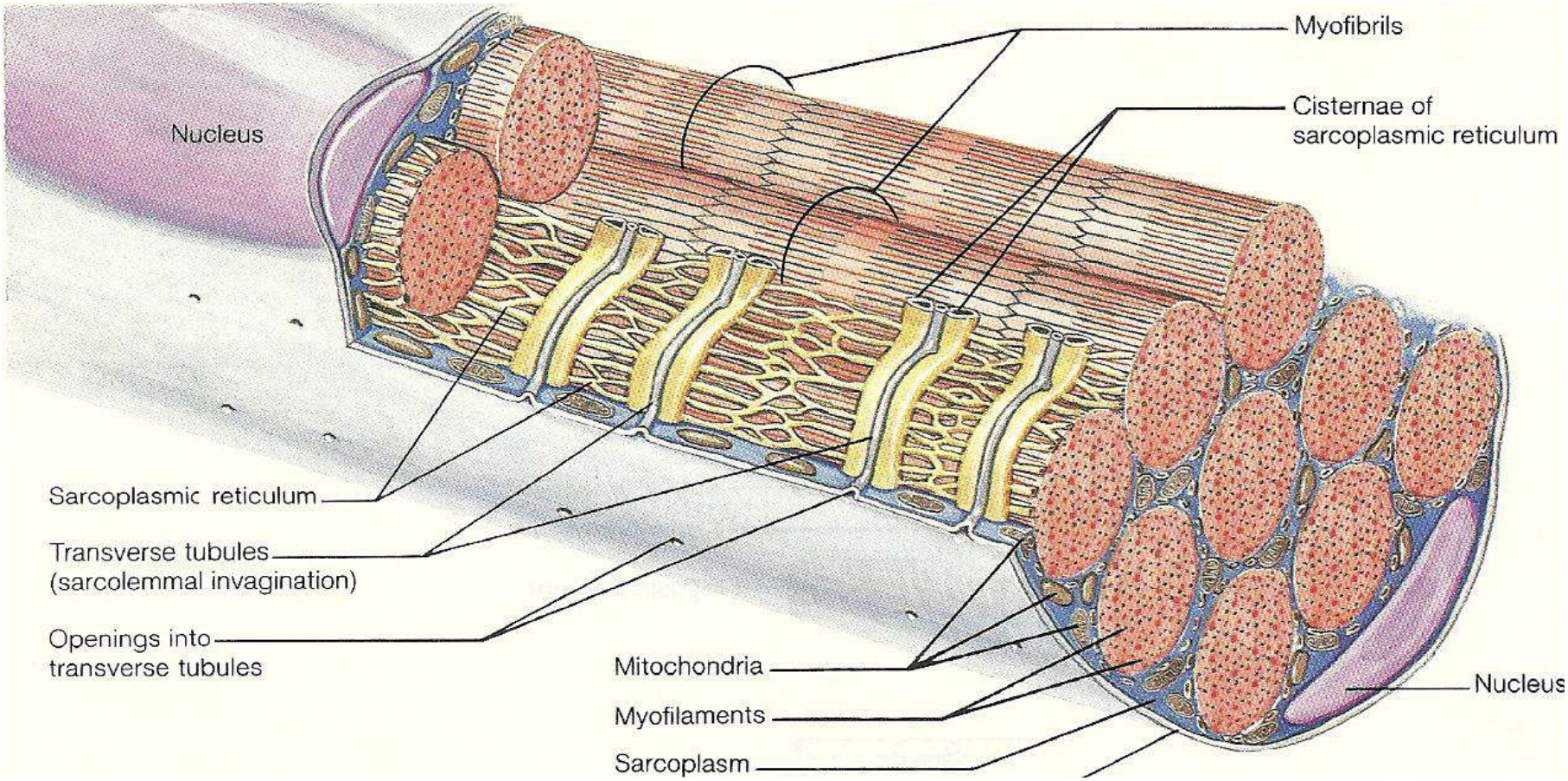
Functions of Skeletal muscles

B. **Maintenance of posture or muscle tone** –

We are able to maintain our body position because of tonic contractions in our skeletal muscles.

C. **Heat Production** – Contractions of muscles produce most of the heat required to maintain body temperature.

Structural Organization of Skeletal Muscle



B. Cardiac Muscles

- Cells are branched and appear fused with one another , has striations, each cell has a central nucleus and involuntary.
- Found only in the heart.
- Healthy cardiac muscle never fatigue.

C. Smooth Muscle

- Fibers are thin and spindle shaped. No striations, single nuclei, involuntary and contracts slowly. They fatigue but slowly.
- Found in circulatory (lining of blood vessels), in digestive, respiratory and urinary system.