Neuromuscular system

Principles of anatomy, physiology and fitness

Muscle

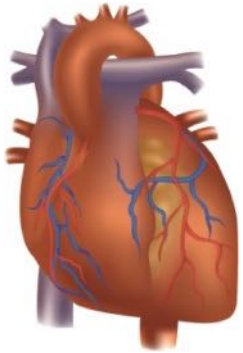
What are the three different types of muscle tissue?

What are the characteristics of each?

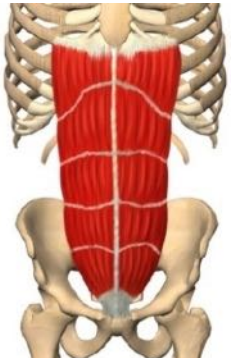
Muscle tissue

Smooth muscle, for example, the digestive system.

Cardiac muscle (myocardium), for example, the heart.



Skeletal muscle (striated), for example, the hamstrings or triceps.



Active iQ

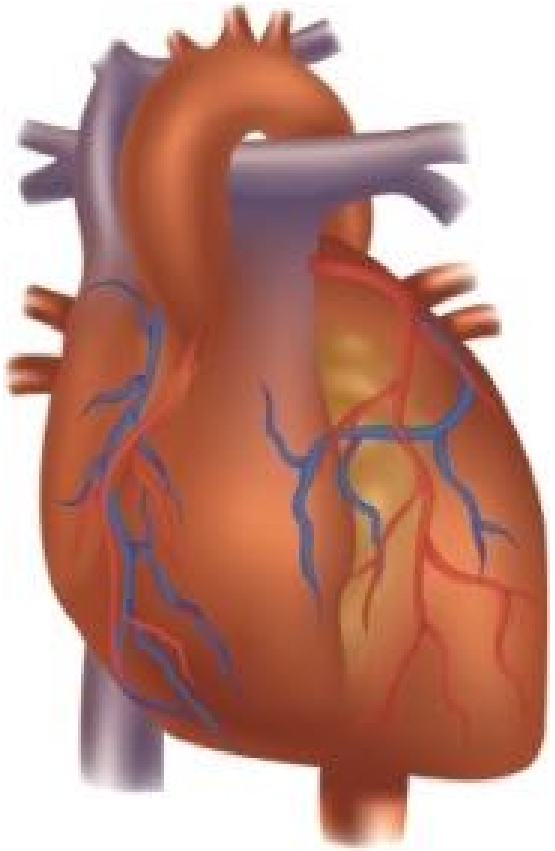
Smooth muscle tissue

- Controlled by the **autonomic** nervous system.
- Smooth, spindle-shaped.
- **Involuntary** – not under conscious control.
- Found in the digestive system, the blood vessels and urinary and reproductive systems.
- Used in all processes that maintain the body's **internal environment**.
- For example: the muscles of the digestive tract contract to move food through the body.

Active iQ

Cardiac muscle tissue

- Found in the **heart** (the chamber **walls**).
- Striated (striped or streaked).
- Main function is to pump blood around the body.
- Works continuously.
- **Involuntary** – not under conscious control.
- Contraction of the heart is controlled by the sinoatrial node (SAN).



Active iQ

Skeletal muscle tissue

- **Attaches to the bones** across joints via tendons.
- Controlled by the **somatic** nervous system.
- **Striated** (striped or streaked).
- Works under conscious or **voluntary** control.
- Contracts and pulls on the bones to produce locomotion and movement.
- Resists the force of gravity to hold the body upright.

Active iQ

Characteristics of muscle tissue

Contractility Ability to shorten.

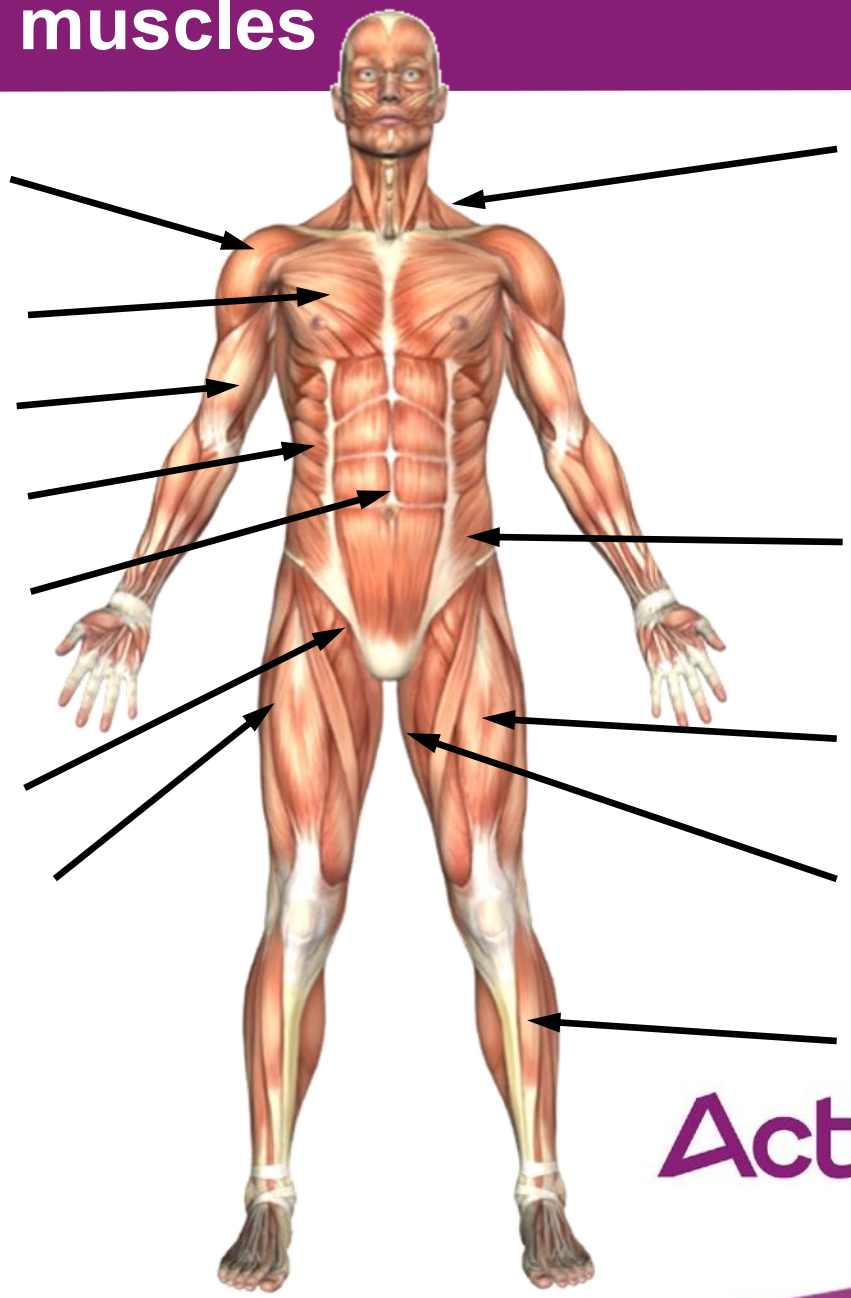
Extensibility Ability to stretch and lengthen.

Elasticity Ability to return to its original size and shape.

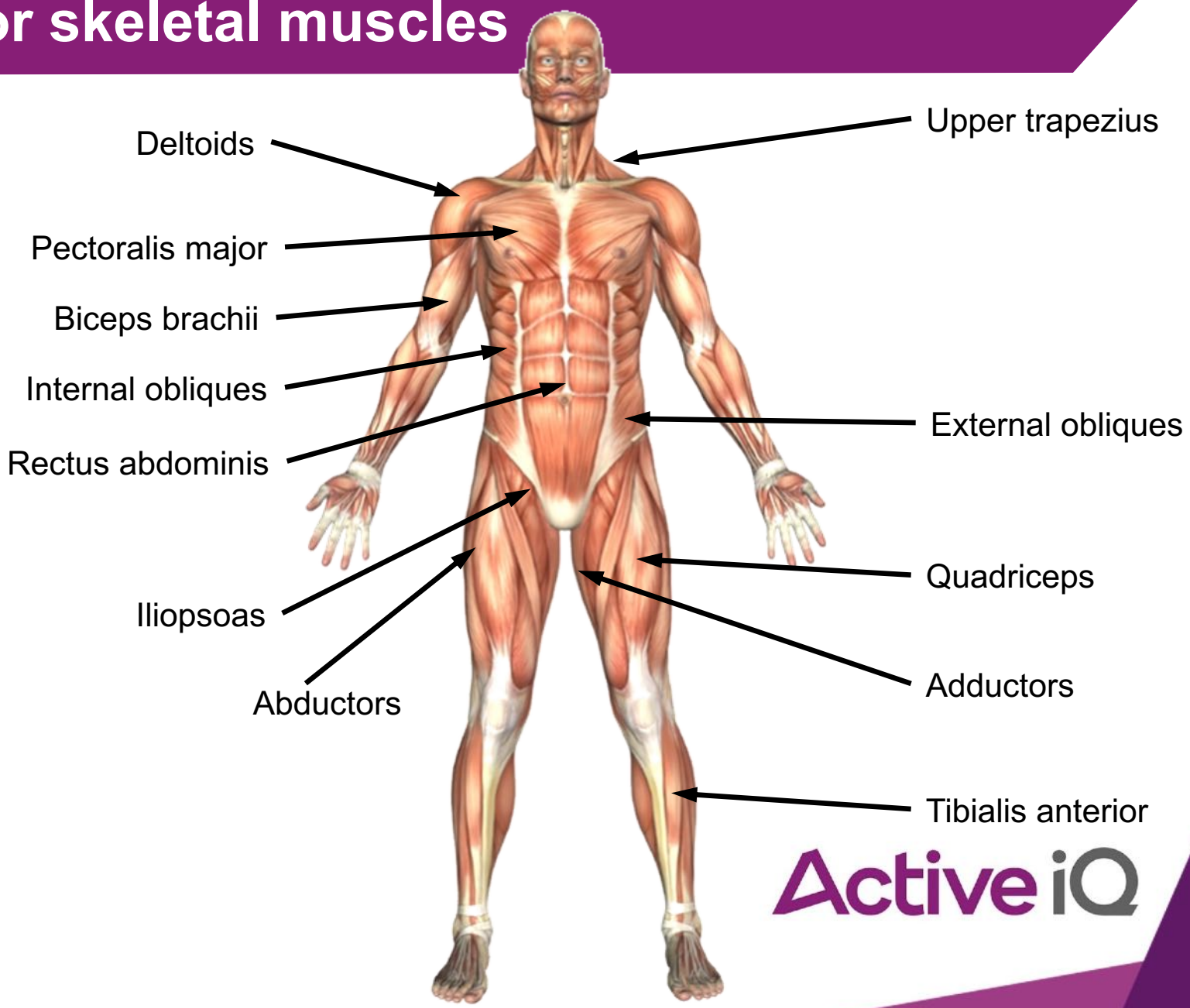
Excitability Ability to respond to stimuli from the nervous system.

Active iQ

Anterior skeletal muscles

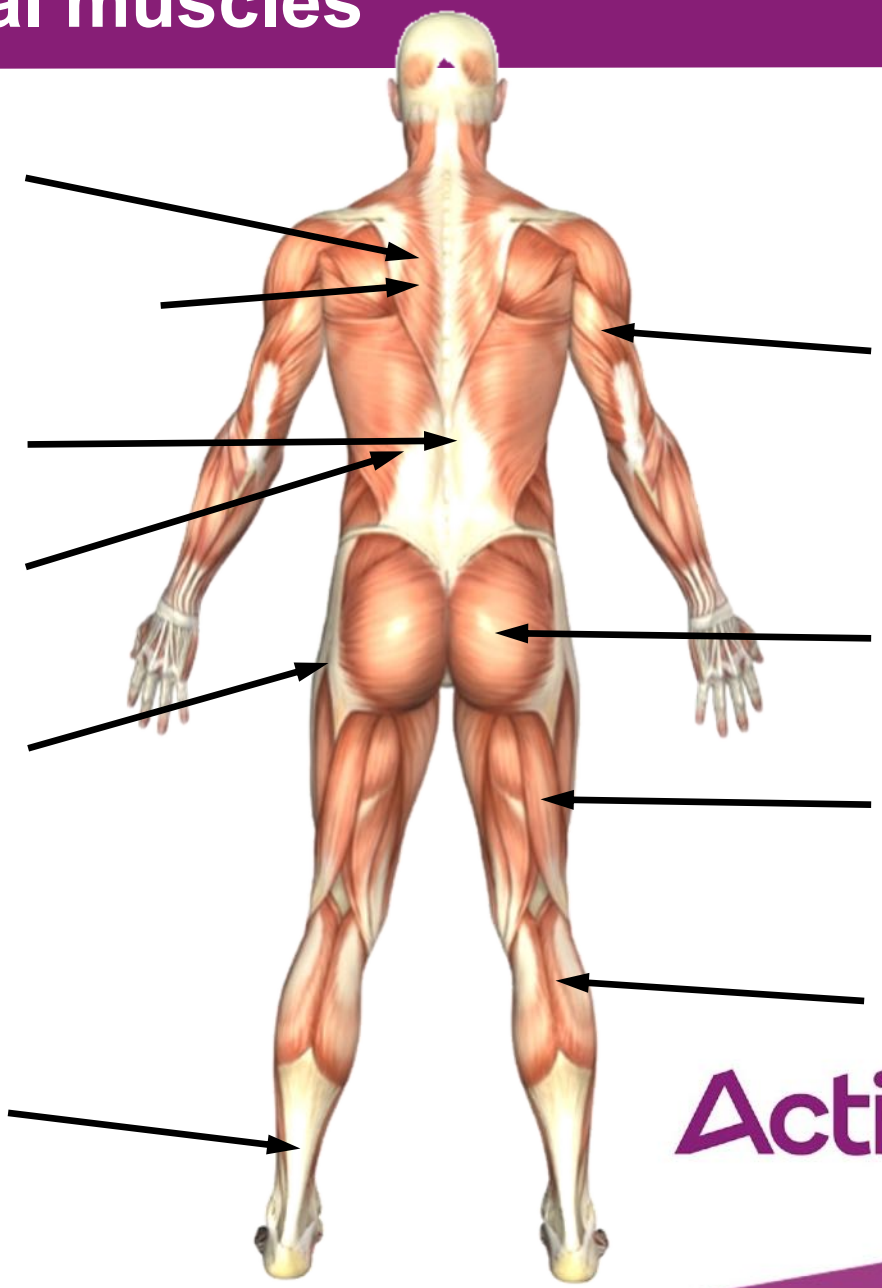


Anterior skeletal muscles



Active iQ

Posterior skeletal muscles



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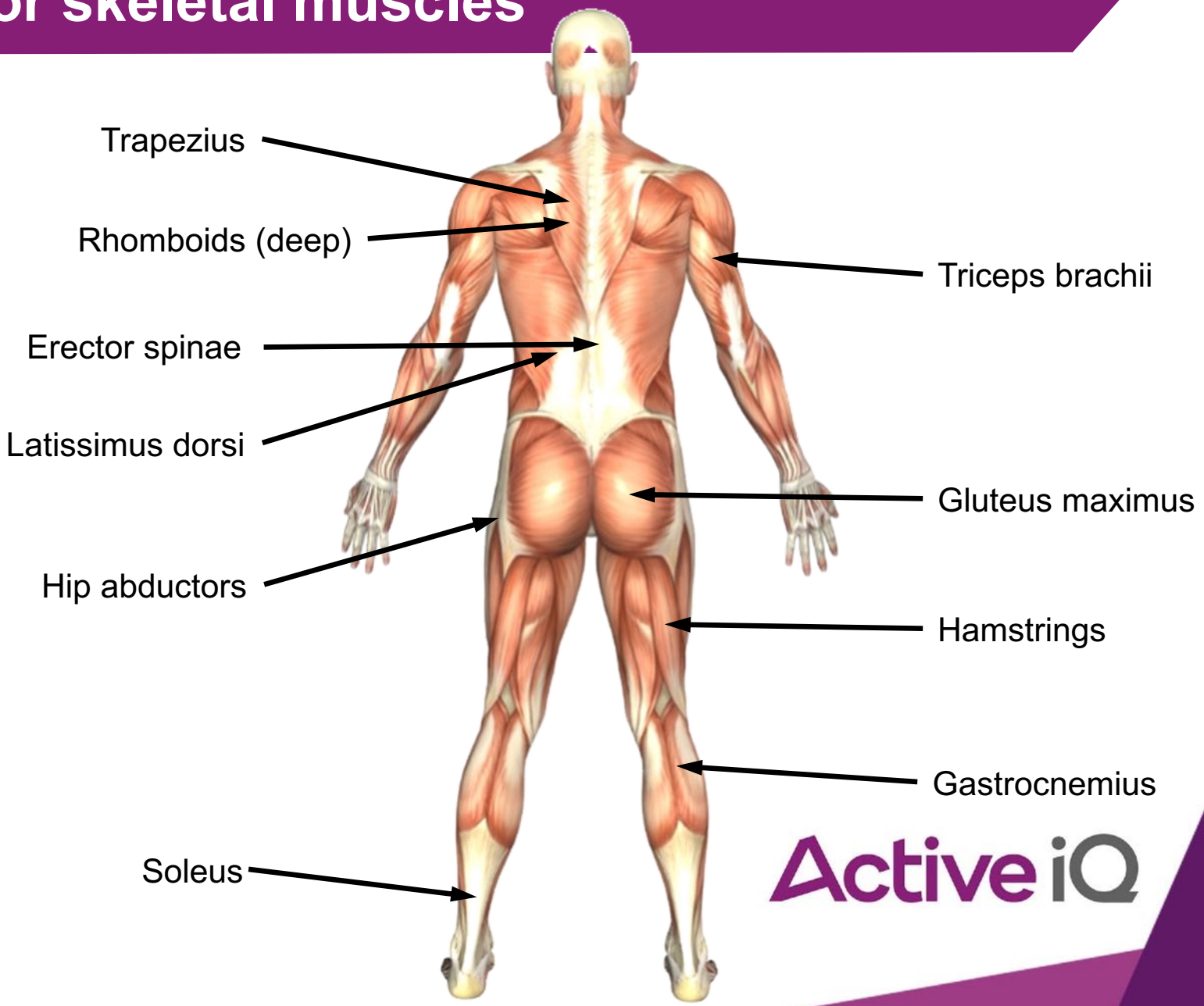
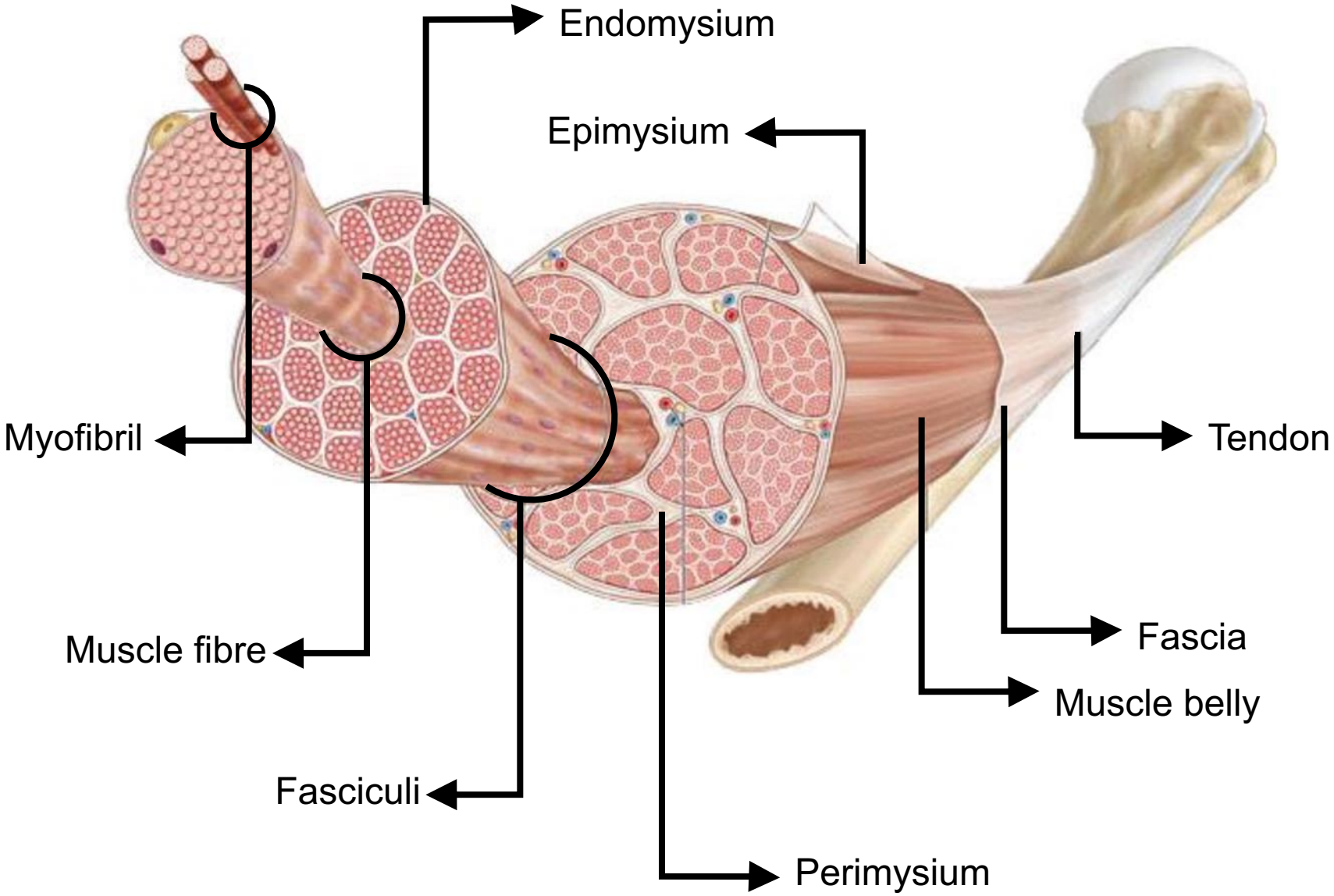
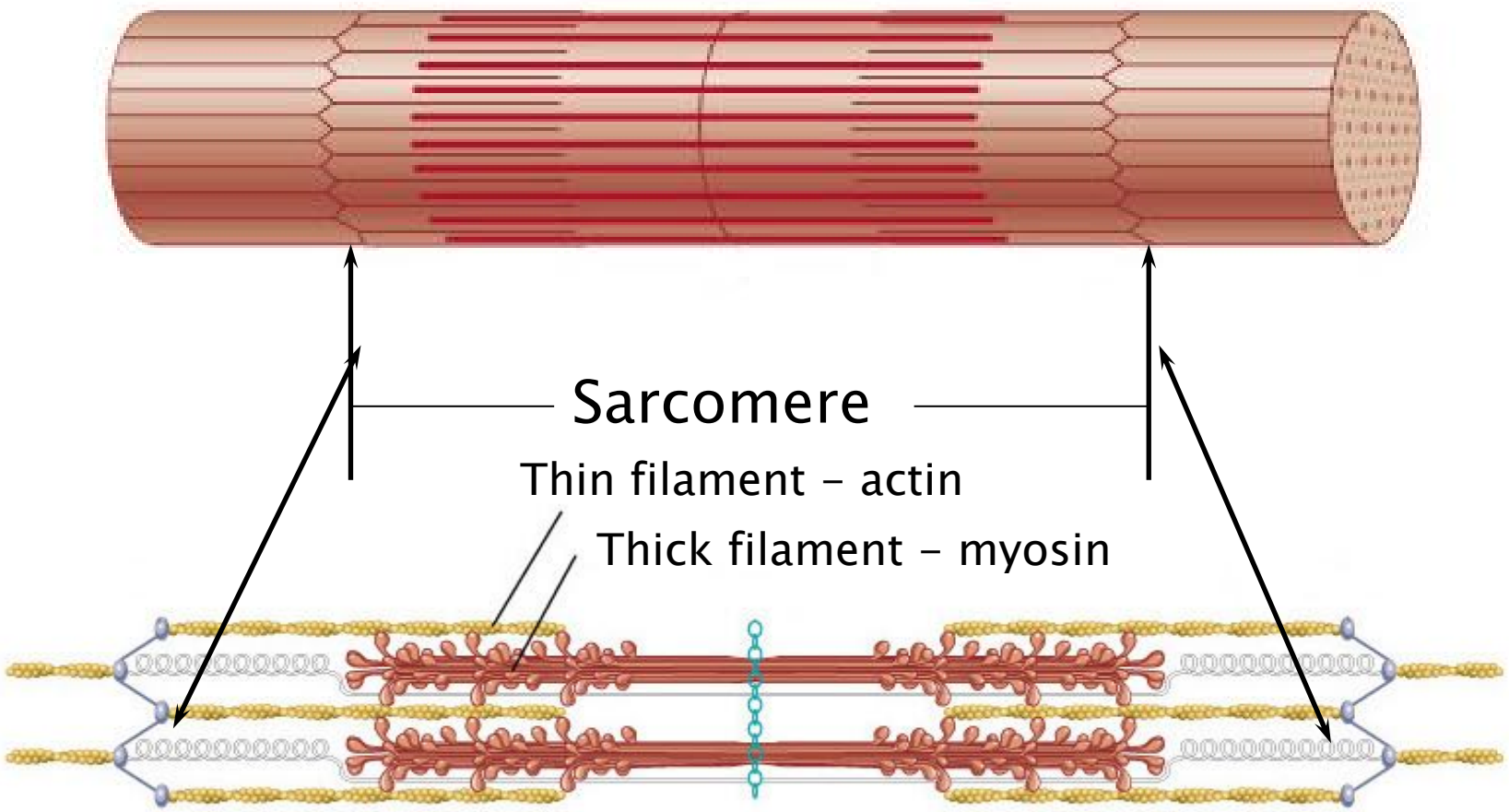
Posterior skeletal muscles




Endomysium
Epimysium
Myofibril
Tendon
Muscle fibre
Fascia
Muscle belly
Fasciculi
Perimysium

Structure of a myofibril



Sliding filament theory

Watch the video!

Muscle fibre types

Thought storm

- What are the different types of muscle fibre
- What are the differences between each one?

Type 1 fibres (Slow)	Type 2a fibres (Intermediate)	Type 2b (Fast)
• Red – rich blood supply		• White – poor blood supply
• Aerobic activity	←	• Anaerobic activity
• Rich in mitochondria	**TRAINING**	• Poor in mitochondria
• Lower force production	→	• Higher force production
• Slow to fatigue		• Quick to fatigue

What kind of athlete would have a higher proportion of each?

Roles of muscles

Prime mover or agonist

Antagonist:

Synergist

Fixator:

Roles of muscles

Prime mover or agonist: the working muscle, for example, bicep in a bicep curl.

Antagonist: the opposite muscle to the agonist; it relaxes to allow the prime mover to work, for example, triceps in a bicep curl.

Synergist: a muscle that aids or modifies agonist movement, for example, brachialis in a bicep curl.

Fixator: a muscle that stabilises the joint where movement is taking place, for example, the deltoids fix the shoulder in a bicep curl.

Active iQ

Muscle contraction types

Isometric

Isotonic

Concentric

Eccentric

Muscle contraction types

Isometric (static): the muscle contracts but remains the same length, for example, the plank.

Isotonic (dynamic): the muscle contracts and changes length by either shortening or lengthening.

Concentric (positive):
the muscle contracts and shortens, for example, upwards phase of a bicep curl.

Eccentric (negative):
the muscle contracts and lengthens, for example, downwards phase of a bicep curl.

Quiz

Name the muscles that contract concentrically to bring about the following joint actions:

- Elbow flexion.
- Knee extension.
- Hip flexion.
- Shoulder adduction.
- Spine lateral flexion.
- Spine flexion.
- Plantar flexion.
- Hip abduction.

Active iQ

Effects of exercise on the neuromuscular system

Immediate

- Increased muscle temperature.
- Increased muscle pliability (ability to stretch further).
- Increased power output from muscles.
- Increased nerve-to-muscle link.
- Increased recruitment of muscle fibres.

Long-term

- Increased muscular fitness.
- Increased glycogen and CP stores in muscle.
- Increase in actin and myosin.
- Increased basal metabolic rate.
- Improved posture.
- Increased neuromuscular connections.
- Increased recruitment of motor units.

Lifecycle of the neuromuscular system – early years

- Neural pathways increase rapidly in number to develop coordination, for example.
- Postural and stabilising muscles also develop quickly (think of a baby that can't hold its head up, to being able to walk within approximately 12 months).
- Genetics and environment strongly influence the potential for neuromuscular development during this stage.

Lifecycle of the skeletal system – pubescent period

- No significant gender difference until this stage.
- Influence of testosterone in boys, which stimulates muscle growth and oestrogen in girls, which stimulates, bone, muscle and fat tissue development.

Lifecycle of the skeletal system – adulthood and later years

- Neuromuscular development normally ends in our mid-20s.
- With training, this can continue beyond this stage.
- By the age of 30, the brain begins to lose thousands of neurons each day, which leads to the processing of information becoming slower.
- From the age of 60, muscular strength has an annual reduction of 1–2%, on average.
- Exercise and strength training can help combat the effects of ageing.

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