WJEC (Wales) Biology A-level

Option B - Human Musculoskeletal Anatomy

Definitions and Concepts

This work by PMT Education is licensed under CC BY-NC-ND 4.0

Actin - A type of protein filament found in myofibrils. It forms thin filaments consisting of two long twisted chains.

Actin-myosin cross-bridge - The cross-bridge formed when a myosin head attaches to the myosin binding site on an actin filament.

Anaerobic respiration - A form of cellular respiration that takes place in the absence of oxygen. In animals, lactic acid is produced.

Anisotropic (A) bands - The darker bands in a myofibril, which consist of overlapping actin and myosin filaments.

Antagonistic muscles - Pairs of muscles that work in opposite directions e.g. biceps and triceps in the human arm.

Appendicular skeleton - The part of the skeleton made up of bones that support the appendages. This includes bones of the lower and upper limbs, the pectoral girdle and the pelvic girdle.

Axial skeleton - The part of the skeleton that forms the central axis of the body. It is made up of the skull, thoracic cage and vertebral column.

Ball and socket joint - A joint in which the rounded end of one bone moves within the 'socket' of another, e.g. hip, shoulder. Movement can occur in multiple planes.

Bisphosphonates - A class of drugs that are used to treat osteoporosis and brittle bone disease by increasing mineral density.

Brittle bone disease - A genetic disorder characterised by brittle bones that are prone to fracture. A gene mutation prevents collagen production, causing an imbalance between the components of the matrix in bone. Treatments include the insertion of metal rods, physiotherapy and the use of bisphosphonates.

Carbohydrate loading - A strategy used by athletes to increase glycogen storage in muscles.

Cartilage - Smooth, elastic connective tissue found in many areas of the body including joints, that provides structural support. It consists of chondrocytes, surrounded by an extracellular matrix. There are three types: hyaline cartilage, white fibrous cartilage and yellow elastic cartilage.

Cervical vertebrae - The small vertebrae of the neck which lie directly below the skull. The vertebral artery passes through a foramen in each transverse process.

Chondrocytes - Cells found in cartilage that secrete and maintain the cartilaginous matrix.

Comminuted fracture - The breakage of a bone into a number of pieces.

Compact bone - A matrix consisting of 30% organic material (primarily collagen) and 70% inorganic material (mainly hydroxyapatite). The organic material helps to resist fracture, whilst the inorganic material helps to stop compression.

Compound fracture - A type of fracture where the bone pierces the skin, creating an open wound or breakage.

Creatine phosphate - A compound stored in muscles that serves as a phosphate reserve, enabling ATP regeneration. It is made under aerobic conditions.

Displaced fracture - A type of fracture in which the bone breaks and moves so that the two parts no longer align.

Fast-twitch muscle fibres - A type of muscle fibre that contracts more rapidly, with more power, over a shorter period. They are adapted for anaerobic respiration and intense activity.

First order lever - A lever in which the fulcrum is between the effort and the load. This is found in the neck: the neck muscles provide the effort, the neck is the fulcrum and the weight of the skull is the load.

Flat foot - A postural deformity in which there is no or low arch in the foot. It is treated using specialised footwear.

Forelimb - Any anterior limb on an animal's body.

Fracture - A broken bone that can occur due to impact, stress or disease. There are five types of fracture: displaced, non-displaced, comminuted, simple and compound. Treatment depends on the type and may involve realignment and fixation with a splint or cast, or surgery.

Gliding joint - An articulation between bones that meet at flat surfaces. The bones can glide past each other along the plane of the joint in any direction e.g. ankle, wrist.

Glycogen - The main energy storage in animals.

Harversian system - The functional unit of compact bone. It consists of layers of bone tissue around a central canal which contains the blood supply.

Hind limb - Any posterior limb on an animal's body.

Hinge joint - An articulation between two bones in which movement can occur in one plane, e.g. knee, elbow.

Hyaline cartilage - Cartilage found at the ends of bone and in the nose and trachea. It contains a lot of collagen but no nerves or blood vessels.

H-zone - The lighter region in the centre of each A band that consists of myosin only.

Immovable joint - An articulation between two bones where no movement is possible, e.g. cranium. Also known as a fused joint.

CC BY NC ND

Isotropic (I) bands - The lighter bands in a myofibril which consist of actin filaments only.

Joint replacement surgery - The replacement of diseased or damaged joints. It has both advantages and disadvantages.

Knock knees - A postural deformity in which a large gap can be observed between the feet when an affected individual stands with their knees together. This may be due to calcium or vitamin D deficiency.

Lactic acid - The product of anaerobic respiration in mammals. Lactic acid build-up leads to muscle cramp and fatigue.

Ligaments - Fibrous bands of connective tissue that connect two bones to form a joint.

Lumbar vertebrae - The five largest vertebrae found between the rib cage and the pelvis that form the spine in the lower back. They support the upper body's weight, provide flexibility and enable movement.

Myofibrils - Tiny contractile muscle fibres which group together. Numerous myofibril bundles constitute muscles. Myofibrils consist of two protein filaments: actin and myosin.

Myosin - A type of protein filament found in myofibrils. It forms thick filaments, consisting of long tails with bulbous heads, positioned to the side.

Myosin binding site - A site on actin that is normally blocked by tropomyosin. During muscle contraction it becomes exposed, allowing a myosin head to attach.

Non-displaced fracture - A type of fracture in which the bone cracks but does not move, maintaining its alignment.

Osteoarthritis - A degenerative disease caused by the loss of articular cartilage in a joint due to changes in its constituent collagen and glycoprotein. Risk factors include joint damage, vigorous bending of a joint and being overweight. It is treated using non-steroidal anti-inflammatory drugs and in some cases, joint replacement.

Osteoblasts - Groups of connected cells embedded in the matrix of bone that lay down new bone during development of the skeleton and remodelling.

Osteoclasts - Bone cells that break down bone tissue. This is important in the repair and remodeling of bone.

Osteomalacia - A bone disorder, characterised by the softening of bones, that results from a calcium or vitamin D deficiency.

Osteoporosis - A condition characterised by weak bones that can easily break, resulting in chronic pain. It is caused by low peak bone mass or high bone loss. Treatments include endurance exercises, bisphosphonates and fall prevention.

Pectoral girdle - The bones (clavicle and scapula) of the appendicular skeleton that join the upper limb to the sternum of the axial skeleton.

CC BY NC ND

Pelvic girdle - The ring of bones at the base of the spine that connects the axial skeleton to the lower limbs.

Rheumatoid arthritis - An autoimmune disease, which, due to an inflammatory response, is characterised by stiff, swollen joints with restricted movement. Risk factors include smoking, a diet high in red meat or coffee, and cold and damp weather. It is treated using steroidal anti-inflammatory drugs, physiotherapy, and in some cases, surgery.

Rickets - A bone disorder resulting from a calcium or vitamin D deficiency. It is characterised by soft, weak bones in children, leading to bone deformities.

Sarcomere - Each repeating unit of striations between adjacent Z-lines.

Sarcoplasm - The cytoplasm shared by muscle fibres. It consists of a high concentration of mitochondria and endoplasmic reticulum.

Sarcoplasmic reticulum - A membrane-bound structure in muscle cells that stores calcium ions.

Scoliosis - A postural deformity characterised by a curvature of the spine, which often appears as an S or C shape. This may be due to gene mutations, tumours, muscle problems or cerebral palsy, and is treated using physiotherapy, back braces and/or surgery.

Second order lever - A leaver in which the load is between the effort and the fulcrum. This is found in the ankle: the calf muscles provide the effort, the weight of the body is the load and the toes act as the fulcrum.

Simple fracture - A fracture of the bone only. Surrounding tissues and organs are not damaged.

Skeletal muscle - A voluntary muscle responsible for movement. It makes up the majority of body muscle and is attached to the skeleton by tendons.

Skeleton - The internal framework of the body that has a variety of functions including support, protection, attachment of muscles, calcium storage and red blood cell production.

Sliding filament theory - The mechanism by which a muscle contracts. During contraction, myosin filaments pull actin filaments to the centre of the sarcomere. The actin filaments slide along the myosin filaments. The sarcomere is shortened and the muscle length is reduced.

Slow-twitch muscle fibres - A type of muscle fibre that contracts more slowly, with less power, over a greater period. They are adapted for aerobic respiration and enable endurance.

Striated muscle - Muscle tissue consisting of sarcomeres.

Synovial fluid - A viscous fluid secreted by the synovial membrane that reduces friction between the articular cartilage of joints during movement.

CC BY NC ND

Synovial joint - The most common joint in mammals characterised by the presence of a fluid-filled cavity enclosed in a fibrous capsule.

Synovial membrane - The connective tissue lining the synovial joint cavity that secretes synovial fluid.

Third order lever - A lever in which the effort is between the fulcrum and the load. This is found in the arm: the elbow joint is the fulcrum, contraction of the biceps provides the effort and the load is the weight of the forearm (and anything it is holding).

Thoracic vertebrae - The 12 vertebrae located in the middle of the vertebral column between the cervical and lumbar vertebrae. They have transverse processes and facets for attachment of the ribs.

Tropomyosin - A protein found in muscles that forms a fibrous strand wrapped around an actin filament.

Troponin - A protein complex which is attached to tropomyosin and binds Ca^{2+} ions. This causes it to pull on tropomyosin, allowing muscle contraction to take place.

Vertebrae - A series of small bones that constitute the backbone. Each vertebra has a vertebral body, transverse processes and spinal canal.

Vertebral column - The flexible column in the axial skeleton that provides support and protection to the spinal cord. It consists of individual vertebra.

Vitamin D - A fat-soluble vitamin present in a variety of foods (e.g. butter, eggs, fish liver oils) that is required for the absorption of calcium in the gut. It is also produced by the body in response to sunlight exposure.

White fibrous cartilage - Cartilage located in the discs between vertebrae that has a high tensile strength. It is made of up cartilaginous tissue with white fibrous tissue and collagen.

Yellow elastic cartilage - A type of cartilage found in the external ear and epiglottis that contains yellow elastic fibres.

Z-line - The line in the centre of each I band.

CC BY NC ND