11.2 MUSCLES and MOVEMENT

The role of muscles in locomotion

Most animals can move from one place to another and this called locomotion. Animals show a great diversity of types of locomotion.

Muscles contract to provide the force needed for locomotion and pairs of muscles are needed to carry out opposite movements.

The role of nerves and bones in locomotion

Nerves stimulate each of the different muscles to contract at the correct time so that the movement is coordinated.

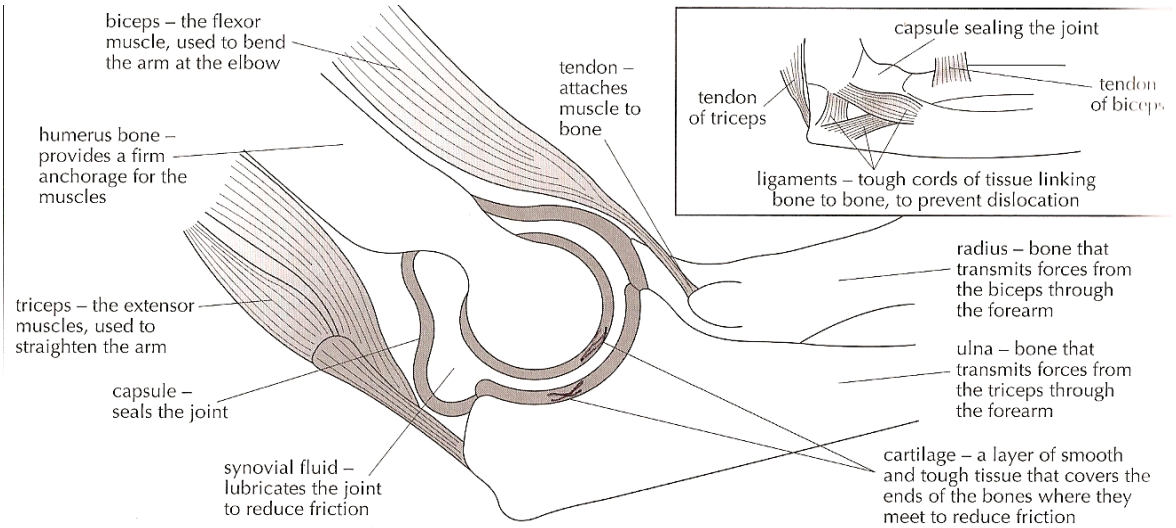
Bones provide a firm anchorage for muscles in many animals. They also act as levers, changing the size or direction of forces generated by muscles. The junctions between bones are called **joints**.

The role of ligaments and tendons in locomotion

Ligaments are tough elastic cords of tissue linking bone to bone, to prevent dislocation.

Tendons are responsible for attaching muscles to bones.

The human elbow joint and its functions



Movement / comparison of the hip joint and the knee joint

The knee joint belongs to the **Hinge joints** and it is a movable (synovial) joint. Therefore, there is considerable freedom of movement between bones. It permits movement in one plane about one axis and it is capable of heavy load.

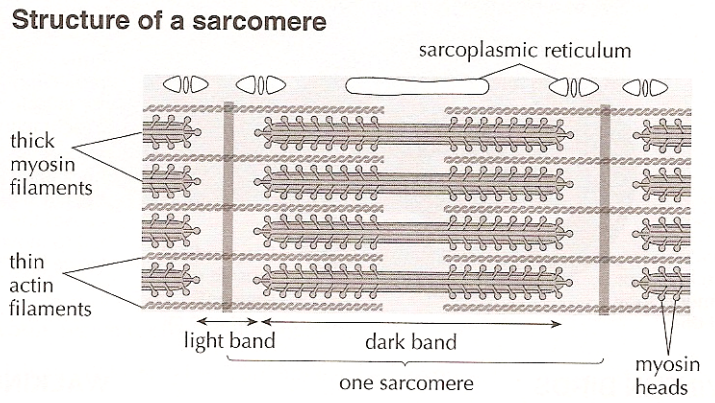
The hip joint belongs to the **Ball and Socket joints** and it permits movement in all planes and some rotation is possible. However, it is unable to bear very heavy loads.

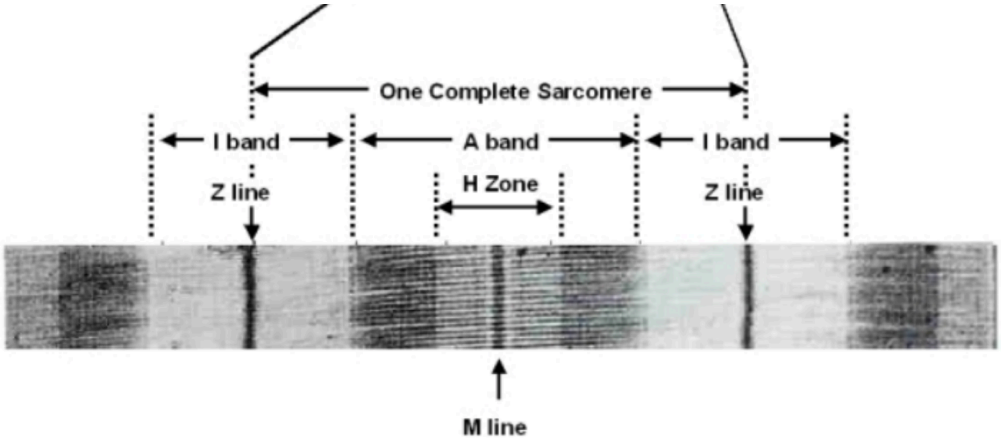
The structure of skeletal muscle fibres

When viewed under a light microscope, skeletal muscle is seen to consist of large multinucleate cells called **muscle fibres.** They have striated or stripped appearance. Muscle fibres contain cylindrical structures called **myofibrils** and these myofibrils consist of repeating units called **sarcomeres,** which have light and dark bands.

Around each myofibril there is a special type of ER called sarcoplasmic reticulum. There are also mitochondria between the myofibrils.

Figure: The structure of skeletal muscle and of a sarcomere





Contraction of skeletal muscle

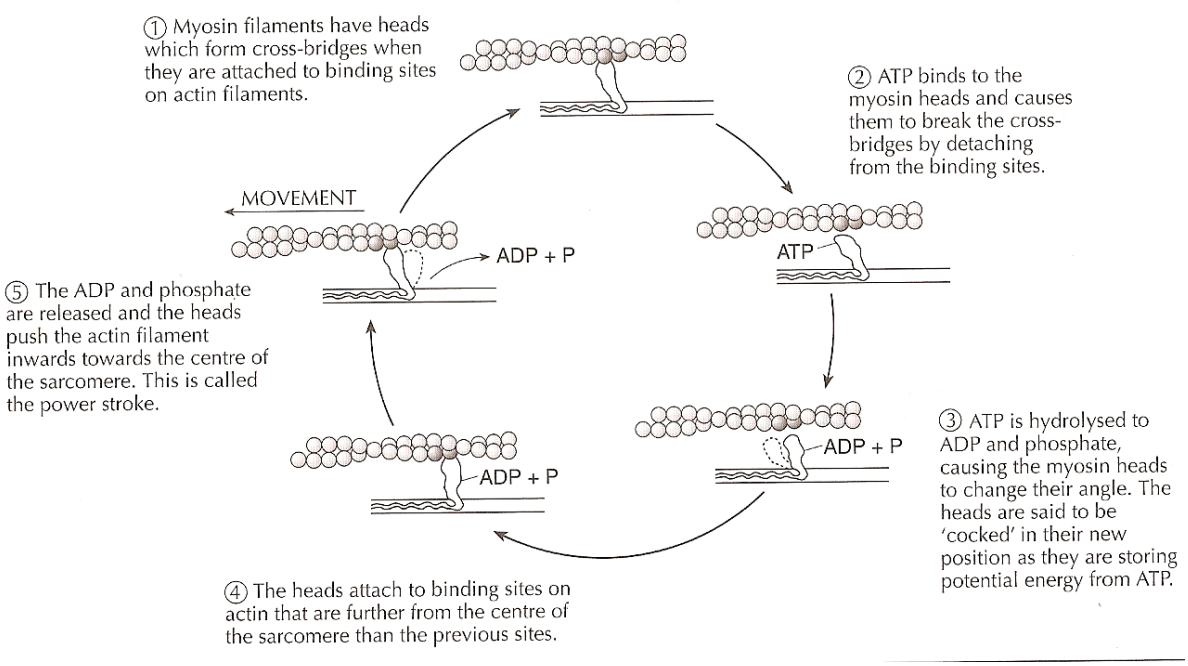
The contraction is due to the sarcomeres in the myofibrils becoming shorter. This is achieved by the sliding of actin and myosin filaments over each other, using ATP.

Controlling muscle contraction

When a skeletal muscle fibre is relaxed, a protein called **tropomyosin** blocks the myosin binding sites on actin. If a motor neurone stimulates the muscle fibre, **calcium ions** (Ca^{2+}) are released from the sarcoplasmic reticulum.

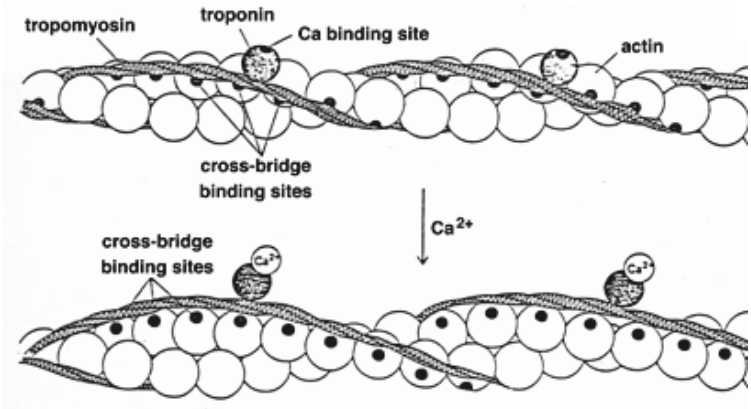
These calcium ions bind to another protein called **troponin.** Troponin then causes tropomyosin to move, which exposes the myosin binding sites and allows contraction to begin.

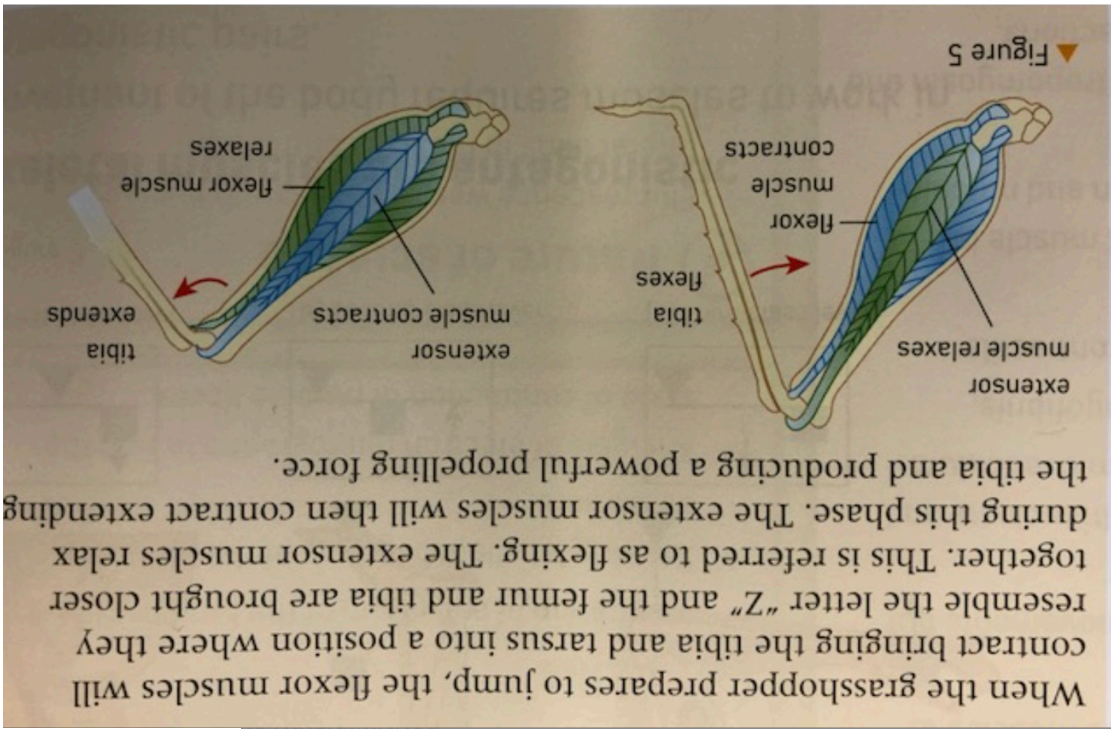
Stages in muscle contraction



Homework:

Please analyze electron micrographs to find the state of contraction of muscle fibres. Muscle fibres can be fully relaxed, slightly contracted, moderately contracted and fully contracted. You can search in your books or use the Internet!!!





When the grasshopper prepares to jump, the flexor muscles will contract bringing the tibia and tarsus into a position where they resemble the letter "Z" and the femur and tibia are brought closer together. This is referred to as flexing. The extensor muscles relax during this phase. The extensor muscles will then contract extending the tibia and producing a powerful propelling force.

Figure 5