Movement and locomotion:

Background:

Two parts are needed:

- skeleton - provide support, protection, and movement.

    - exoskeleton/endoskeleton

    - also, hydrostatic skeleton

- muscles - muscles move the skeleton, and therefore the animal.

    - bones are moved against each other by using joints. See fig. 30.3C on p. 607 for some examples.

    - muscles only contract, so they are usually arranged in opposing groups.

    - **[Fig. 30.7, p. 611]**

Muscle function (skeletal) **[Fig. 30.8, p. 612]**:

- muscles are composed of bundles of muscle fibers.

- these bundles are in turn composed of individual muscle fibers, which are actually individual muscle cells.

- in turn, these are composed of:

- myofibrils. And yet again, Myofibrils in turn are composed of two types of molecules:

    - actin - makes up thin filaments

    - myosin - makes up thick filaments

- actin and myosin are arranged in a very regular pattern that allows these filaments to slide past each other as the muscle contracts.

    - each unit of actin/myosin is called an sarcomere.

- don't worry about the names of the different bands (i.e., I band, Z band, etc.).

- actin and myosin fibers lie next to each other. Under certain circumstances, the "head" of the myosin fiber will make contact with the actin fiber and cause the actin fiber to slide past the myosin:

    - suppose the action potential arrives from a nerve.

- acetylcholine is then released, and this transfers the action potential to the muscle cell.

- this causes the sarcoplasmic reticulum to release Ca+ ions (sarcoplasmic reticulum actively stores Ca+ ions, and releases them in response to an action potential **[Fig. 30.10A, p. 614]**.

- these Ca+ ions the modify tropomyosin (they bind to a "troponin" site on the tropomyosin)**[Fig. 30.10B, p. 614]**.

  - tropomyosin normally covers up the sites on the actin that the myosin heads can attach to.

  - by modifying the tropomyosin (Ca+ binding to troponin), the myosin heads can now bind to actin.

- when the myosin heads can bind to the actin, they do so; the head then rotates and this results in the actin fibers sliding past the myosin fibers.

- Myosin is then done. To reset the myosin fibers (and heads), ATP is needed. ATP restores the myosin head to its original configuration.

- [NOTE: the description in the text is confusing. Pay attention to these notes and the **[Fig., not in book, but see fig. 30.9B, p. 613]**.

  - analogy: ATP "cocks" the hammer (myosin head).

  - the arrival of the Ca+ ions triggers the hammer, and causes muscle movement.

  - rigor mortis is due to the fact that the myosin heads are never released from the actin fibers.

- this cycle can repeat up to 10/sec(?), each myosin fiber can have up to 500(?) heads.

- muscles are controlled by:

  - the number of muscle fibers that are triggered **[Fig. 30.10C, p. 614]**.

  - the number of impulses triggered can also control the strength/duration of muscle contractions (muscle twitcher in lab).

    - For smooth sustained muscle contraction (as opposed to muscle "twitches), a series of impulses is needed. This is termed "tetanus". A single impulse would just cause "twitches".

      (tetanus - the reason for giving this name to the disease is because the disease causes some muscles to contract (and stay that way)).

Finally, a few miscellaneous things about muscles:

- fast fibers - allow for a rapid, powerful contractions, but are often not of long endurance.

- slow fibers - are slower, but allow for sustained contractions.

fast fibers --> flight muscles of pheasants and other birds that need to get away quickly (light meat).

slow fibers --> leg muscles, posture muscles (constantly active); (dark meat).

- smooth muscles - are not arranged as regularly, so contractions are not as powerful; but on the other hand, they can contract over a much greater length.

- cardiac muscles - are highly structured and organized. Intercalated disks allow for rapid dissemination of electrical signal, causing these muscles to contract almost simultaneously.