

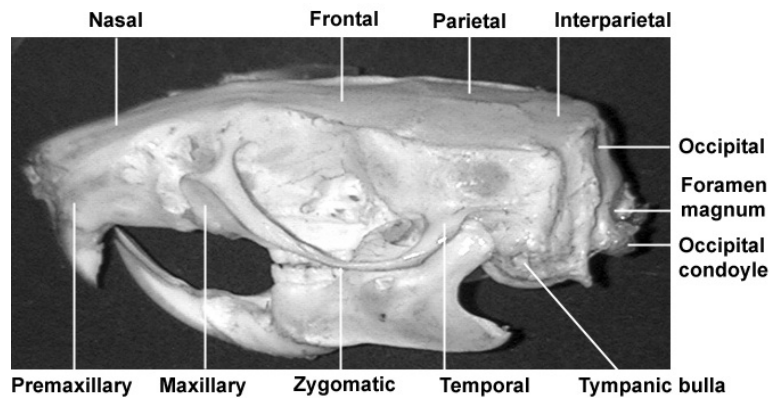
## SKELETAL SYSTEM

The skeletons of different species of vertebrates share many similarities. Since the rat skeleton is small you may find it easier to understand the basic organization if you compare the articulated skeleton of the rat to that of a cat. It may also be helpful to examine individual cat bones and note the many similarities and differences between the two species.

The skeleton of vertebrates is composed primarily of bone. Cartilage covers articular surfaces between bones and connects the ribs to the sternum. The skeleton is divided into two major parts:

- The **axial skeleton** includes the skull, mandible, hyoid, ribs, sternum, and vertebrae
- The **appendicular skeleton** includes the girdle, limb and feet bones

**Skull.** The skull which is part of the axial skeleton has two major regions (Fig 2.1). The facial region houses the nose, eyes, and provides support for the jaw. It is elongate in mammals that depend on their sense of smell. The more posterior cranial region of the skull houses the brain and ear. The size of this region depends on brain volume. At the back of the skull is the **foramen magnum** through which the spinal cord passes into the vertebral column. On either side of the foramen magnum are the **occipital condyles**, which articulate with the first cervical vertebra. *Examine the rat skull and trace the lines or sutures between the bones. Sutures make it possible to identify individual bones. Identify the following:*



**Figure 2.1.** Left, lateral view of a rat skull.

**Premaxillary and maxillary.** These bones are associated with the teeth. The large incisors are located in the premaxillary bones and the molars are in the maxillary bones.

**Nasal.** These bones form the dorsal wall of the nasal cavity.

**Frontal.** These bones form the roof of the anterior portion of the skull and the lateral wall of the eye socket.

**Zygomatic arch.** The arch encloses the ventrolateral side of the orbit. It is composed of three bones: the **maxillary** at the anterior end, the **zygomatic bone** in the middle and the **temporal bone** forming the posterior margin. An expanded **tympanic bulla** with an opening to the inner ear lies at the base of the temporal bone.

**Parietal & Interparietal.** These bones and the temporals form the dorsal and lateral wall of the cranium.

**Occipital.** This bone has the occipital condyles and foramen magnum on its caudal surface.

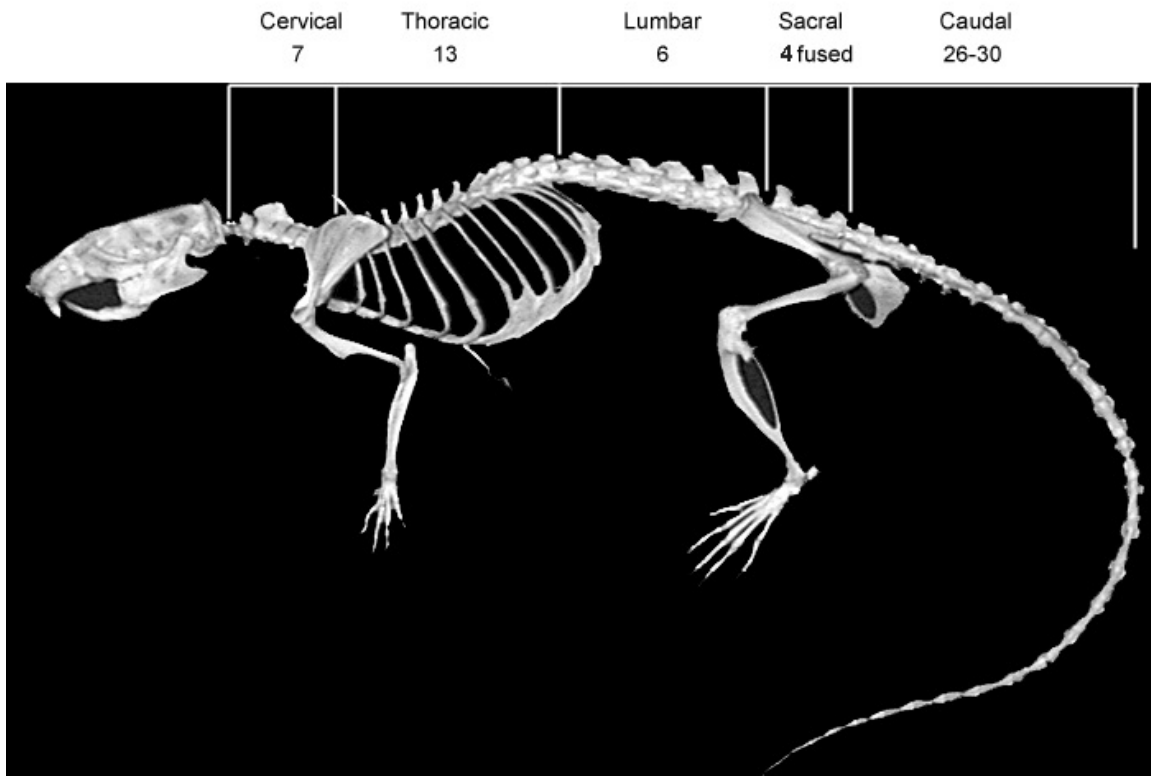
**Palatine.** These bones form the roof of the mouth and the ventral surface of the facial portion of the skull.

**Sphenoid.** These bones form the ventral wall of the cranial cavity, that houses the brain.

**Mandible.** Two **dentary** bones fuse anteriorly to form the lower jaw or mandible which provides support for two types of teeth: **incisors** for gnawing and **molars** for grinding.

The many openings in the skull bones provide for the passage of nerves and blood vessels. Flat spaces and ridges provide surfaces for attaching muscles that support the skull and jaw.

**Vertebral Column, Ribs and Sternum** are part of the axial skeleton. The vertebrae provide support for the head and body. All vertebrae have a similar basic design. A solid disc of bone forms the ventral body or **centrum**. Above this is a space enclosed by the **vertebral arch**. The spinal cord passes through this space. Associated with the arch are spines and processes of various sizes. These serve as points of attachment for the muscles and ligaments that control movement. The vertebrae at the anterior end overlap those at the posterior end and the **articular processes** arise from the vertebral arch. *Examine the vertebral column and identify the vertebrae shown in figure 2.2. Note how the shape of the vertebrae changes as you move from the anterior to the posterior end of the column. The disarticulated cat vertebrae will help you more easily see some of the major differences.*



**Figure 2.2.** Rat Skeleton - lateral view.

**Cervical vertebrae** have a small transverse processes containing a hole through which nerves and blood vessels pass. The first two vertebrae in this region, the **atlas** and **axis** are structurally modified to provide for head movements. *(Explore this with some of the skulls and vertebrae on the side bench).* What types of movement are possible at each point of articulation?

**Thoracic vertebrae** have articular surfaces where the ribs attach. The head of a rib fits between two adjacent vertebrae and the **tuberculum** articulates with the **transverse process**. The ribs are attached to the bones of the sternum by **costal cartilage**. The rib cage provides support of the body and protects the heart and lungs. Ribs also serve as a point of attachment for muscles that assist in respiration. The articulation of the ribs can be more easily seen by examining the cat skeleton.

**Lumbar vertebrae** have flattened, enlarged, anteriorly oriented transverse processes.

**Sacral vertebrae** are fused to provide additional support for the hindlimbs.

**Caudal vertebrae** are variable in number among different species depending on the length of the tail.

## Appendicular Skeleton

Compare the anterior and posterior limb and girdle bones (Fig. 2.3, 2.4). Note the similarities in the cranial and caudal long bones. The ridges on the long bones and girdles serve as points of attachment for the muscles that control the limbs. Why might these bones differ in size?

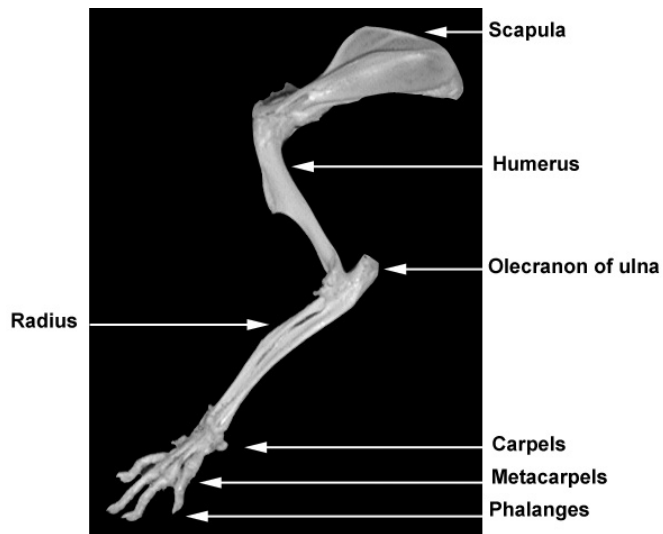


Figure 2.3. Rat left forelimb.

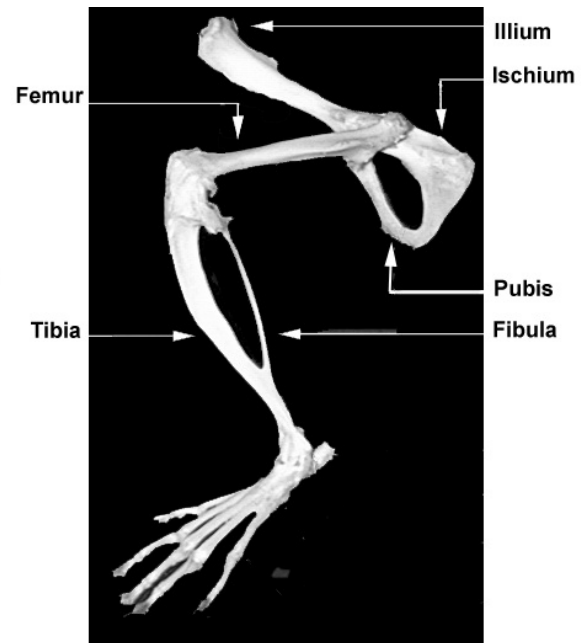


Figure 2.4. Rat left hindlimb.

Each side of the pelvic girdle is made of three fused bones that meet to form the hip socket. The elongate **ilium** extends cranially, the **ischium** is caudal, and the **pubis** extends ventrally from the ischium. The two pelvic girdle bones attach to the **sacrum** and meet ventrally along the **pubic symphysis**. The canal formed by the two sides of the pelvic girdle and sacrum houses the caudal regions of the digestive, urinary and reproductive systems.



Figure 2.5. Dorsal view of the rat forelimb and clavicle (arrow).

Note that the pectoral girdle bones are only attached to the axial skeleton by the **clavicles**, which extend between the scapula and the cranial end of the sternum (Fig. 2.5). The clavicles articulate with the finger-like **acromion**, which is the terminal portion of the scapular spine. The spine serves as a major point of attachment for the muscles that control the rotation of the scapula and forearm.

How do the differences in the two girdles relate to differences in the functions of the two limbs?