

Body & Self

Particulars in Movement

SANDRA CERNY MINTON
(univ. of Northern Colorado)

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The Skeletal System

The skeletal system provides a framework for the body. The bones of the skeleton connect, or articulate, at places known as joints to form the entire network.

Bones

The human skeleton is made up of many separate bones. The size and shape of these bones suits their function and placement in the body. Bones bearing greater weight are larger and more dense, whereas those bearing less stress are smaller and lighter. An example of a bone that supports more weight is the thigh bone or femur. In comparison to the bone of the upper arm, the humerus, the femur is much heavier and larger in size, although both bones make up the upper segment of an extremity. Increased bone size and density are also found in the vertebrae,

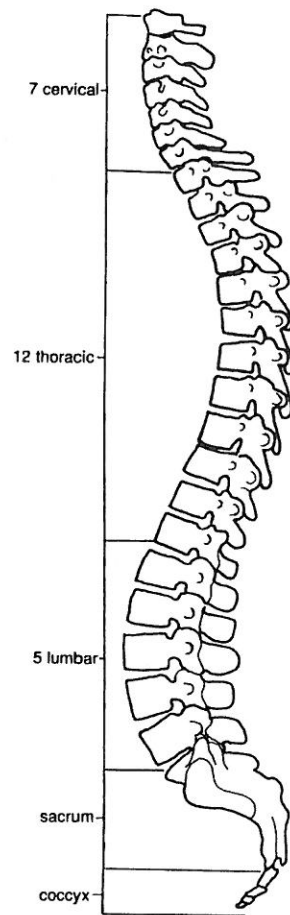


Figure 1.2. Bones of the spine, side view.

or separate bones of the spine. As one moves down the spine, the vertebrae become larger to support increased body mass from above (Figure 1.2).

The function of a bone determines not only its size, but its shape as well. The *vertebrae* can be compared to rounded building blocks that are stacked to form the spinal column enclosing the spinal cord. In contrast, the ribs are slender and gracefully curved to form a protective cage around the organs of the chest; the thin bones of the skull grow together in childhood to enclose the brain's mass in a spherical chamber. Bones used to move the body are long and slender to accommodate actions of various lever systems (Figures 1.3, 1.4, and 1.5).

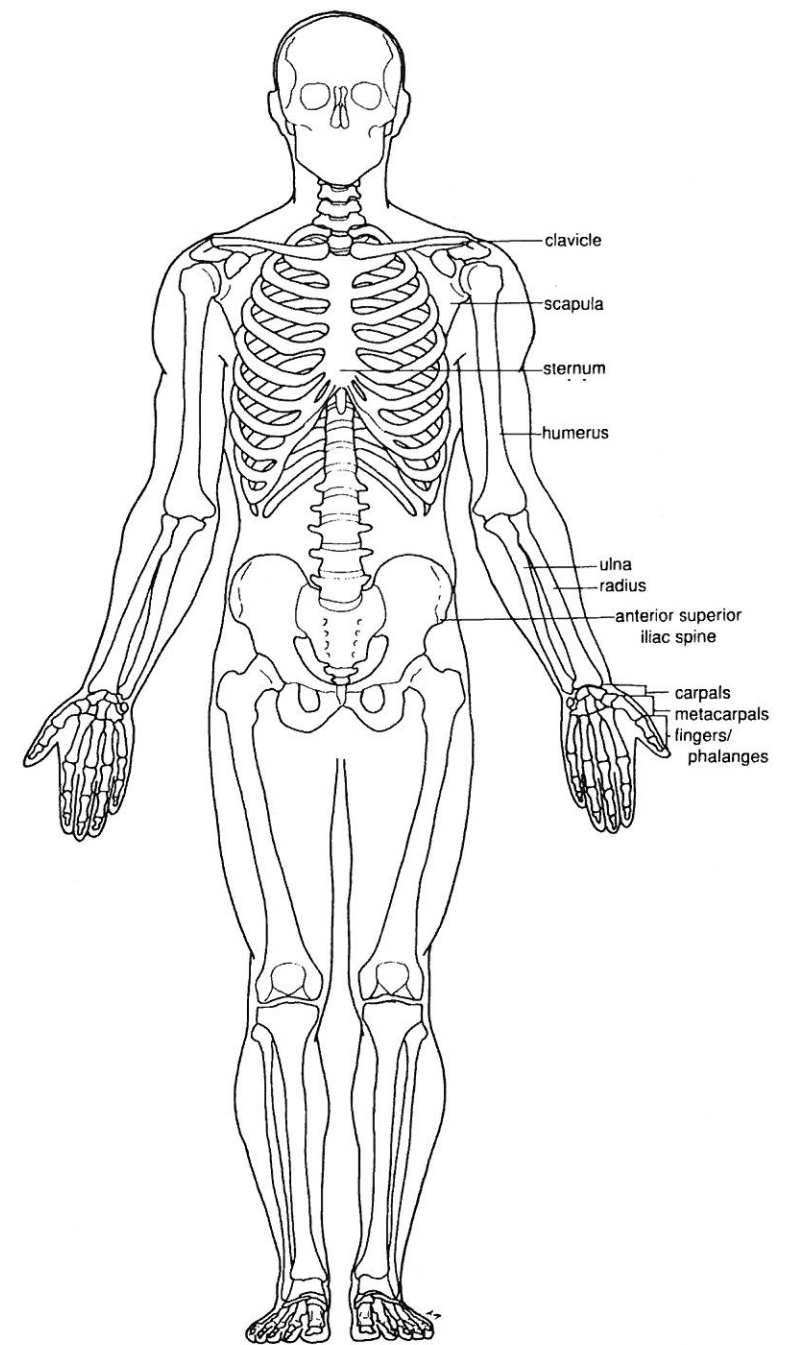


Figure 1.3. Skeleton, front view.

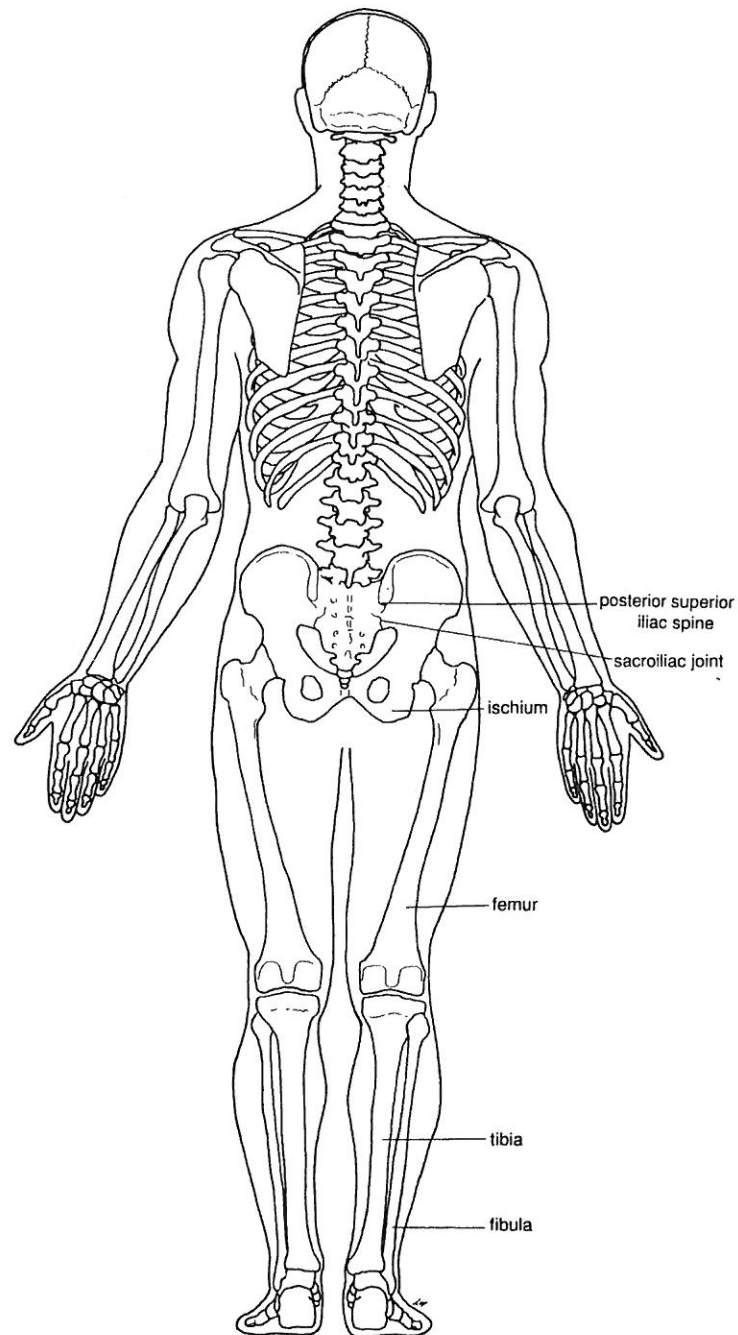


Figure 1.4. Skeleton, back view.

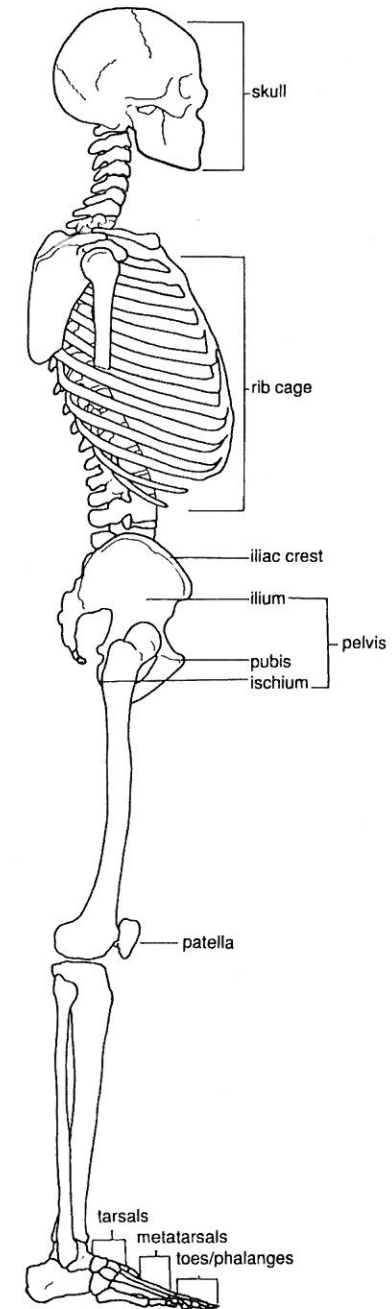


Figure 1.5. Skeleton, side view.

girdling. Those bones that form the core of the body—the head, chest, and pelvis—are known as the axial skeleton. The bones of the legs and arms are the appendicular part of the total framework.

Axial skeleton. The skull sits atop the entire skeletal framework. It is made of separate bones that are held in almost direct contact with each other by a thin layer of connective tissue. Those joints that are immovable and with which the bones are in almost direct contact are known as *sutures* (the differences in joint structure will be discussed in more detail later). The sutures of the skull are designed for structural strength, not movement. The *clavicle* is positioned at the front of the shoulders beneath the neck. It is a long narrow bone that extends horizontally from the body's midline outward to the tip of the shoulder. The *scapula* is a flat triangular bone located in the upper back; it can be easily felt or palpated. In some people the scapula protrudes outward from the body producing a winged effect. The clavicle and scapula together form a structure called the *shoulder girdle* (Barham, 1978; Figures 1.3, 1.4, and 1.5).

A flat and somewhat dagger-shaped bone is found on the front of the body along the midline. This bone is called the *sternum*. The *ribs* articulate at the front with the sternum and wrap around to the back to connect with the vertebrae of the spine to form a cagelike structure enclosing the organs in the thoracic area. There are 12 pairs of ribs in the body (Figures 1.3, 1.4, and 1.5).

The spinal column runs the full length of the upper and lower portions of the body. The separate vertebrae are positioned one on top of the other to produce its entire length. There are 7 separate vertebrae in the neck or cervical area, 12 in the thoracic or chest and rib cage area, and 5 in the lumbar region or lower back. The *sacrum* and *coccyx* lie below the lumbar spine and are formed from bones that are fused together. In each portion of the spine the vertebrae are arranged in a curve rather than being positioned in a straight line. When viewed in profile, the cervical curve reaches forward, the thoracic curve extends backward, the lumbar curve repeats the forward curved shape found in the cervical area, and there is another backward curve in the region of the sacrum and coccyx (Figure 1.2). The spinal curves help to alleviate some of the stress of weight bearing that would otherwise extend straight through the back. Compensatory curves have been developed in the spine to attain movement, because a straight back would not be suited to carry off-center or lateral loads like the head or thorax. A flexible support column

curves in a direction opposite to that which the load is actually bending the spine (Todd, 1975). Thus the thoracic curve reaches to the back so as to counterbalance the lateral weight of the thorax at the front of the body.

The lower portion of the spine connects with and forms part of the pelvis. Two separate hip bones form the sides and front of the pelvis, with the sacrum and coccyx completing the pelvic structure at the back of the hip area (Barham, 1978). The underside of the pelvis is formed from a third bone, the *ischium*. In adulthood the separate pelvic bones have ossified and grown together to form a shallow cuplike structure encasing the organs located in the lower part of the body (Figures 1.3, 1.4, and 1.5).

Appendicular skeleton. The bones of the arm consist of the *humerus* in the upper arm and the *radius* and *ulna* located in the lower arm or forearm. The wrist is composed of eight small bones known as *carpal bones*, whereas the *metacarpals* form the body of the hand, and the *phalanges* make up the fingers (Figures 1.3 and 1.10).

The thigh bone or *femur* is the longest and largest bone in the body (Barham, 1978). The bones of the lower leg segment, the *tibia* and smaller *fibula*, are located beneath the femur, and the *patella* or knee cap is found at the front of the knee joint (Figures 1.3, 1.4, and 1.5). The lower ends of the tibia and fibula plus some of the seven separate bones known as the *tarsals* make up different parts of the ankle. The tarsals also form the arch of the foot, whereas the five *metatarsals* are found in the ball of the foot. The five toes or digits are made up of the *phalanges* (Figure 1.6).

A good way to learn the placement and shape of the separate bones is to make a tracing of the skeleton. One tracing is made

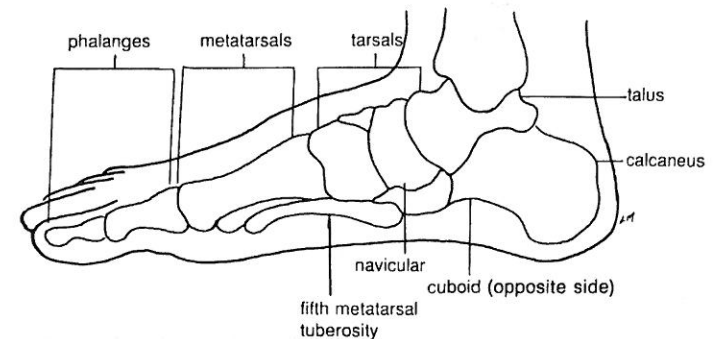


Figure 1.6. Bones of the foot.

of the front view of the skeleton, and another of the back view. These tracings can be done from the illustrations that appear in Figures 1.3 and 1.4. As you trace the separate bones, concentrate on their shape and placement and on how they connect or articulate with other bones.

Joints

The bones of the human skeleton are connected at many points known as *joints*. Some of these joints allow movement and some do not. Joints may be classified by structure and by the kinds of movement allowed. Structure will be discussed first, followed by an explanation of movement planes. Finally, the joints are classified in terms of movement potential.

Classification by structure. A *fibrous joint* is one in which the bones are connected by a thin layer of connective tissue, so that the bones are almost directly in contact with one another (Hinson, 1977). The bones of the skull are immovable, because they are sutured together by fibrous joints.

A second type of joint is formed from bones and intervening discs of fibrocartilage (Hinson, 1977). *Cartilaginous joints* permit only a light amount of movement, but provide great strength. They can be found between the pubic bones and between the vertebrae of the spine.

The type of joint that provides for the most movement potential has a more complex structure than the fibrous or cartilaginous joints already mentioned. It is known as a *synovial joint* (Hinson, 1977). Synovial joints have a space between the ends of the bones, which is filled with *synovial fluid*. The ends of the bones are usually flared outward and covered with *cartilage*, and the entire joint is surrounded by a *fibrous capsule* or membrane (Hinson, 1977; Figure 1.7). *Ligaments* or bands of connective tissue extend between the bones providing stability. They hold your bones together and, though pliable, are not as elastic as muscle fibers. Some people have very loose ligaments and other people's are much more tightly strung together (Alter, 1983). The *tendons* of various muscles also cross joints and attach to bone; they increase the strength of the capsulelike structure (Figure 1.8).

Movement. Kinesiologists classify human movement into two basic categories: *linear* and *angular*. If actions follow a straight line, they are linear (Barham, 1978). A human being is performing linear movement when he or she skates straight across ice.

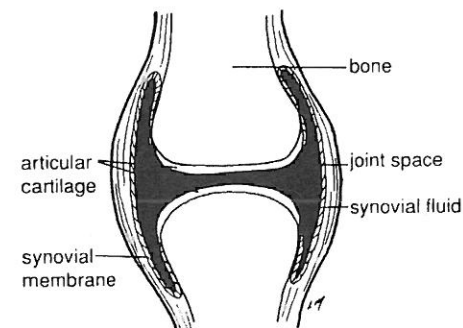


Figure 1.7. A synovial joint and capsule.

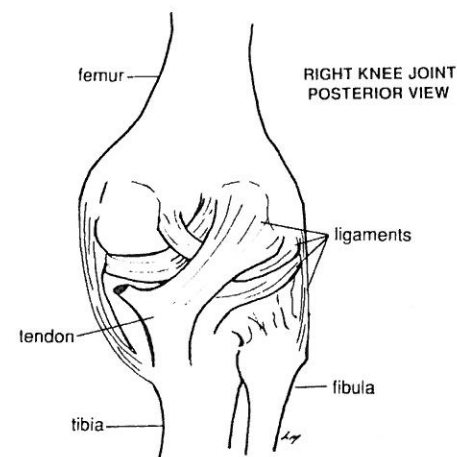


Figure 1.8. A joint and the surrounding ligaments and tendons.

Movement tracing a curved pathway in space is angular (Barham, 1978). A cartwheel is an example of angular motion because the performer's hands and feet go through an arc in space. Joint movement potential can be either linear or angular in nature. The difference between the two forms of activity is that linear movement occurs in a line in a plane, whereas angular movement takes place in a plane around a central point or axis (Hinson, 1977).

The human body is intersected by three planes. Division of the body front from back is by the *frontal plane*. The *sagittal plane* divides the right side of the body from the left, and the *horizontal plane* divides the top of the body from the bottom (Figure 1.9). Movement occurs in these three planes, or in planes parallel to these three.

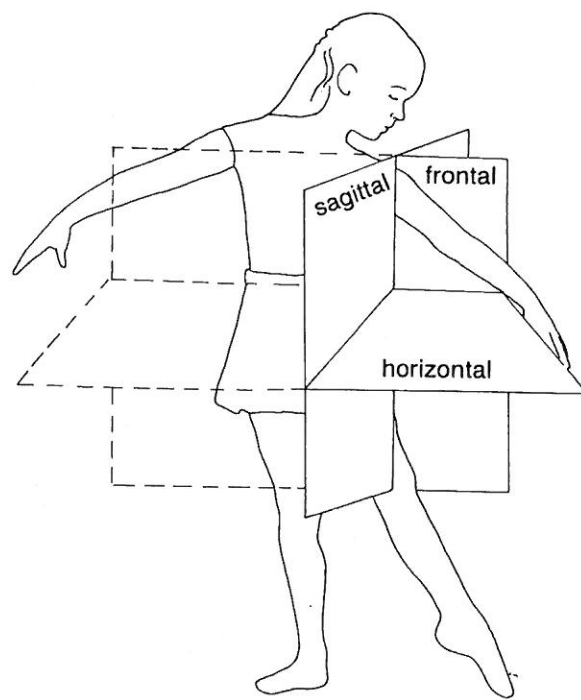


Figure 1.9. Three planes of motion: frontal, sagittal, and horizontal.

Classification by movement. Kinesiologists, or those who study the structure, function, and movements of the human body, classify the various joints by the kind of movement or movements each type allows. The possibilities for movement constitute the joint's potential for motion. The following discussions are derived mainly from Hinson's (1977) *Kinesiology*.

Joints that allow for linear movement only are called *nonaxial*. In nonaxial joints the articulating bones simply glide or slide over one another rather than moving around a central point or axis. Such gliding can, however, take place in all three planes. An example of a nonaxial joint would be the articulation between some of the bones in the foot. The connection between the talus, calcaneus, and navicular allows a linear or sliding action (Figure 1.6). Likewise, most of the carpal bones that form the palm of the hand glide or slide against each other (Figure 1.10).

An *uniaxial* joint permits angular movement in a single plane around a fixed point or axis. Uniaxial joints are sometimes known as *modified hinge* or *double condyloid* joints. The elbow and the knee are examples of a uniaxial joint (Figure 1.11).

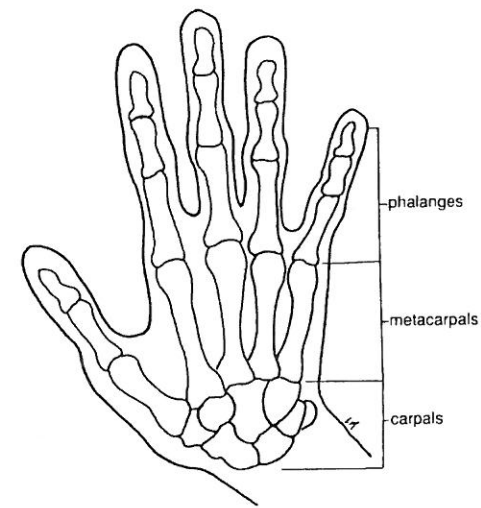


Figure 1.10. Bones of the hand and wrist.

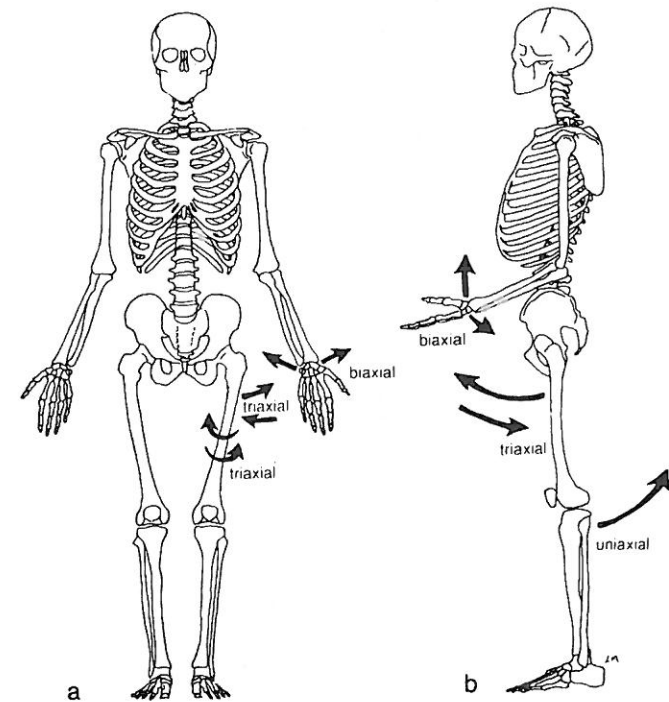


Figure 1.11. Planes of movement possible at the wrist, hip, and knee: (a) one plane for the wrist and two planes for the hip; (b) other plane of movement for wrist and hip, as well as the single plane of movement at the knee.

Biaxial joints are those that provide for motion in two planes around two perpendicular axes. The wrist is a biaxial joint (Figure 1.11).

Triaxial joints permit movement in all three planes (sagittal, frontal, and horizontal) and around three axes. Due to their shape, triaxial joints are sometimes called ball-and-socket joints. The hip and the shoulder joints both have a triaxial structure. In each of these, the ball-shaped end of one bone fits into a cup-shaped socket on the articulating surface (Figure 1.11).

The point here is that knowing the structure of the different joints provides for more enlightened movement participation. Movement can be learned and then performed within the framework of the body's potential for action. Forcing or twisting joints into directions for which they are not structured should be avoided to prevent injury.

