

**FIGURE 5.19 The bony thorax. (a)** Skeleton of the bony thorax, anterior view (costal cartilages are shown in blue). **(b)** Left lateral view of the thorax, showing the relationship of the surface landmarks of the thorax to the vertebral column (thoracic portion).

articulate with the vertebral column posteriorly and then curve downward and toward the anterior body surface. The **true ribs**, the first seven pairs, attach directly to the sternum by costal cartilages. **False ribs**, the next five pairs, either attach indirectly to the sternum or are not attached to the sternum at all. The last two pairs of false ribs lack the sternal attachments, and so they are also called **floating ribs**.

The intercostal spaces (spaces between the ribs) are filled with the intercostal muscles that aid in breathing.

## Appendicular Skeleton

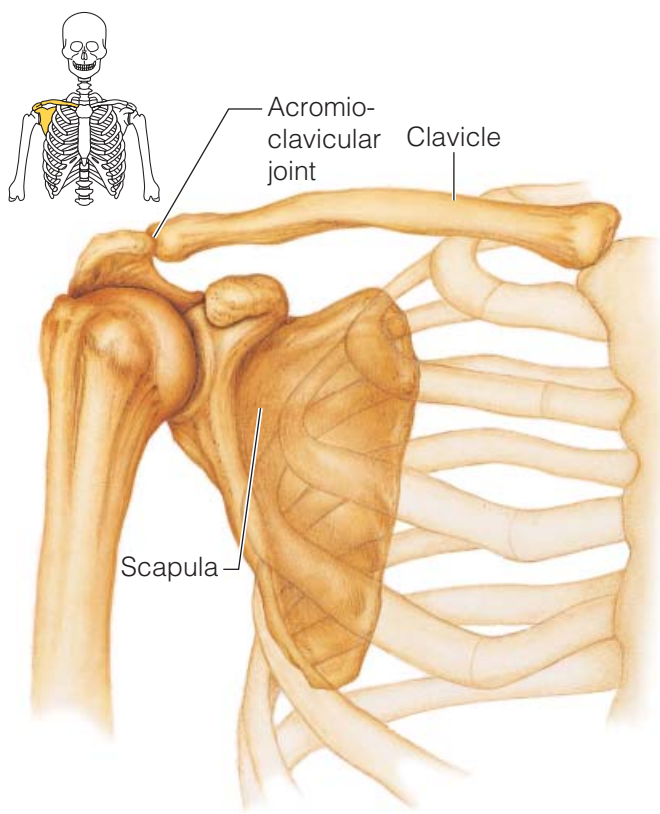
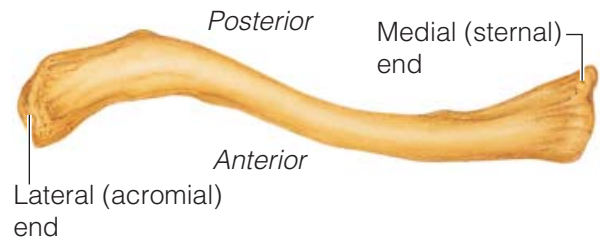
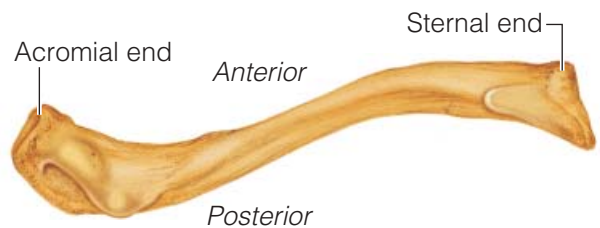
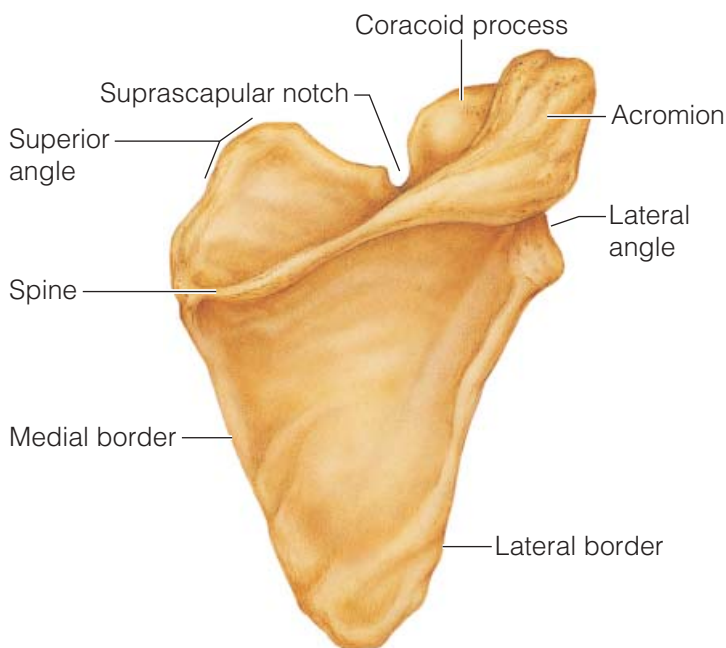
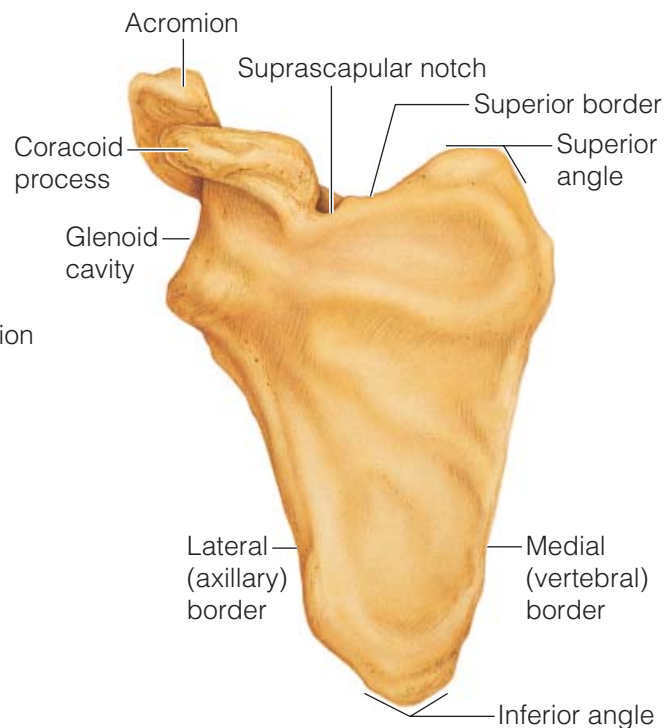
The *appendicular skeleton* is shaded gold in Figure 5.6. It is composed of 126 bones of the limbs (ap-

pendages) and the pectoral and pelvic girdles, which attach the limbs to the axial skeleton.

### Bones of the Shoulder Girdle

Each **shoulder girdle**, or **pectoral girdle**, consists of two bones—a clavicle and a scapula (Figure 5.20).

The **clavicle** (klav'ī-kl), or *collarbone*, is a slender, doubly curved bone. It attaches to the manubrium of the sternum medially (at its sternal end) and to the scapula laterally, where it helps to form the shoulder joint (at its acromial end). The clavicle acts as a brace to hold the arm away from the top of the thorax and helps prevent shoulder dislocation. When the clavicle is broken, the whole shoulder region caves in medially, which shows how important its bracing function is.

**(a) Articulated shoulder (pectoral) girdle****Superior view****Inferior view****(b) Right clavicle****(c) Right scapula, posterior aspect****(d) Right scapula, anterior aspect**

**FIGURE 5.20 Bones of the shoulder girdle.** (a) Relationship of the right shoulder girdle to the bones of the thorax and arm. (b) Right clavicle, superior and inferior views. (c) Right scapula, posterior view. (d) Right scapula, anterior view.

The **scapulae** (skap'u-le), or *shoulder blades*, are triangular and are commonly called “wings” because they flare when we move our arms posteriorly. Each scapula has a flattened body and two important processes—the **acromion** (ah-kro'me-on), which is the enlarged end of the spine of the scapula, and the beaklike **coracoid** (kor'ah-koid) **process**. The acromion connects with the clavicle laterally at the **acromioclavicular joint**. The coracoid process points over the top of the shoulder and anchors some of the muscles of the arm. Just medial to the coracoid process is the large **suprascapular notch**, which serves as a nerve passageway. The scapula is not directly attached to the axial skeleton; it is loosely held in place by trunk muscles. The scapula has three borders—superior, medial (vertebral), and lateral (axillary). It also has three angles—superior, inferior, and lateral. The **glenoid cavity**, a shallow socket that receives the head of the arm bone, is in the lateral angle.

The shoulder girdle is very light and allows the upper limb to have exceptionally free movement. This is due to the following factors:

1. Each shoulder girdle attaches to the axial skeleton at only one point—the *sternoclavicular joint*.
2. The loose attachment of the scapula allows it to slide back and forth against the thorax as muscles act.
3. The glenoid cavity is shallow, and the shoulder joint is poorly reinforced by ligaments.

However, this exceptional flexibility also has a drawback; the shoulder girdle is very easily dislocated.

## Bones of the Upper Limbs

Thirty separate bones form the skeletal framework of each upper limb (Figures 5.21 and 5.22). They form the foundations of the arm, forearm, and hand.

### Arm

The arm is formed by a single bone, the **humerus** (hu'mer-us), which is a typical long bone (see Figure 5.21a and b). At its proximal end is a rounded head that fits into the shallow glenoid cavity of the scapula. Opposite the head are two bony projections—the **greater** and **lesser tubercles**, which are sites of muscle attachment. In the midpoint of the shaft is a roughened area called the **deltoid tuberosity**, where the large,

fleshy deltoid muscle of the shoulder attaches. Nearby, the **radial groove** runs obliquely down the posterior aspect of the shaft. This groove marks the course of the radial nerve, an important nerve of the upper limb. At the distal end of the humerus is the medial **trochlea** (trok'le-ah), which looks somewhat like a spool, and the lateral ball-like **capitulum** (kah-pit'u-lum). Both of these processes articulate with bones of the forearm. Above the trochlea anteriorly is a depression, the **coronoid fossa**; on the posterior surface is the **olecranon** (o-lek'rah-non) **fossa**. These two depressions, which are flanked by **medial** and **lateral epicondyles**, allow the corresponding processes of the ulna to move freely when the elbow is bent and extended.

### Forearm

Two bones, the radius and the ulna, form the skeleton of the forearm (see Figure 5.21c). When the body is in the anatomical position, the **radius** is the lateral bone; that is, it is on the thumb side of the forearm. When the hand is rotated so that the palm faces backward, the distal end of the radius crosses over and ends up medial to the ulna. Both proximally and distally the radius and ulna articulate at small **radioulnar joints**, and the two bones are connected along their entire length by the flexible **interosseous membrane**. Both the ulna and the radius have a **styloid process** at their distal end.

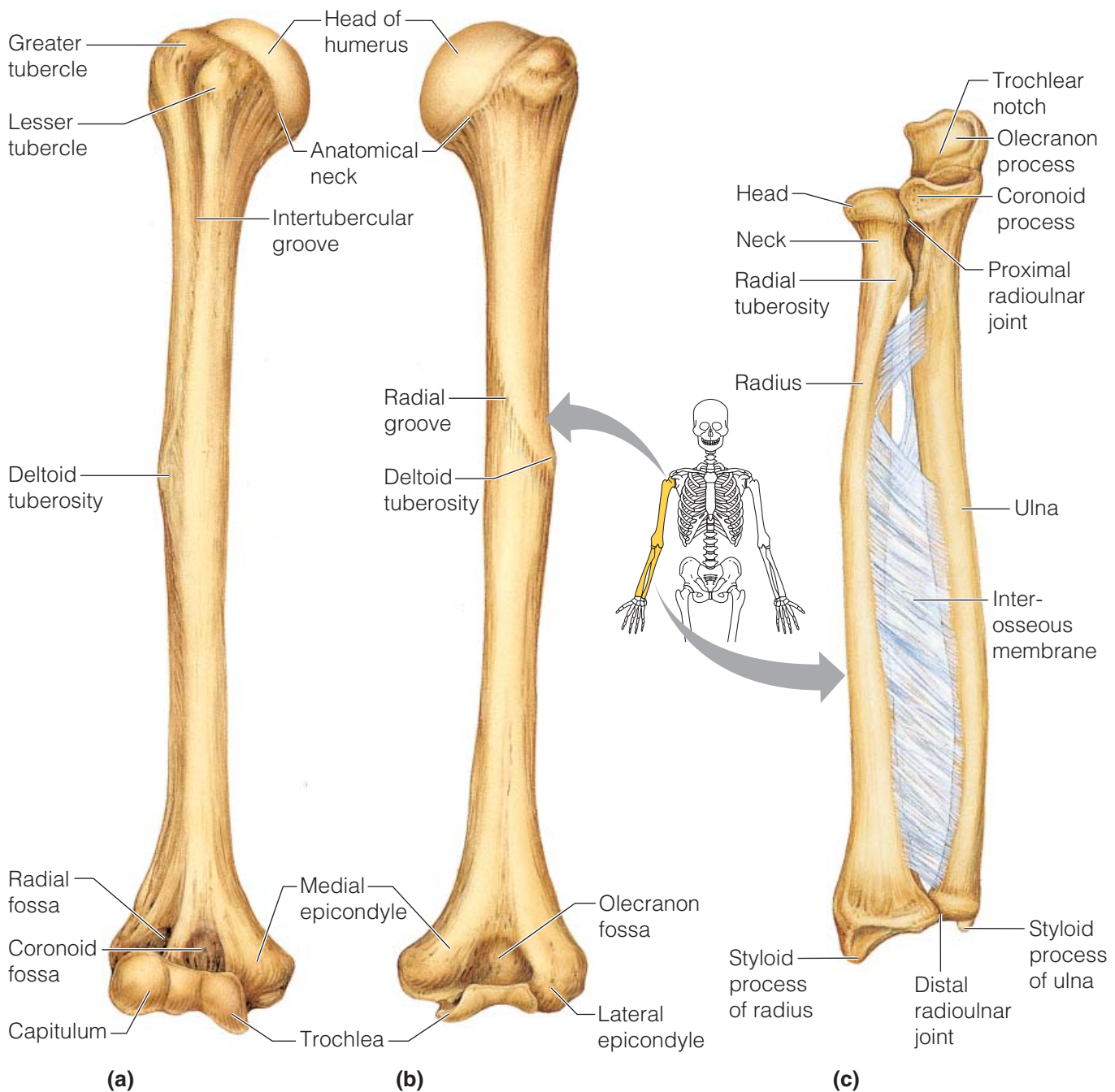
The disc-shaped head of the radius also forms a joint with the capitulum of the humerus. Just below the head is the **radial tuberosity**, where the tendon of the biceps muscle attaches.

When the upper limb is in the anatomical position, the **ulna** is the medial bone (on the little-finger side) of the forearm. On its proximal end are the anterior **coronoid process** and the posterior **olecranon process**, which are separated by the **trochlear notch**. Together these two processes grip the trochlea of the humerus in a pliers-like joint.

### Hand

The skeleton of the hand consists of the carpals, the metacarpals, and the phalanges (Figure 5.22). The eight **carpal bones**, arranged in two irregular rows of four bones each, form the part of the hand called the **carpus** or, more commonly, the *wrist*. The carpals are bound together by ligaments that restrict movements between them. (In case you





**FIGURE 5.21** Bones of the right arm and forearm. (a) Humerus, anterior view. (b) Humerus, posterior view. (c) Anterior view of the bones of the forearm: the radius and the ulna.

need to learn their names, the individual carpal bones are identified in Figure 5.22.)

The palm of the hand consists of the **metacarpals**. The **phalanges** (fah-lan'jēz) are the bones of the fingers. The metacarpals are numbered 1 to 5 from the thumb side of the hand

toward the little finger. When the fist is clenched, the heads of the metacarpals become obvious as the "knuckles." Each hand contains 14 phalanges. There are three in each finger (proximal, middle, and distal), except in the thumb, which has only two (proximal and distal).