



In This Chapter:

The Axial Skeleton 56

Head and Neck Region 56

Back Region 58

The Appendicular Skeleton 64

Pectoral Girdle 64

Scapulohumeral Region 68

Upper Limb 69

Pelvic Girdle 76

Lower Limb 79

Putting It All Together 90

THE PIECES OF THE BODY PUZZLE

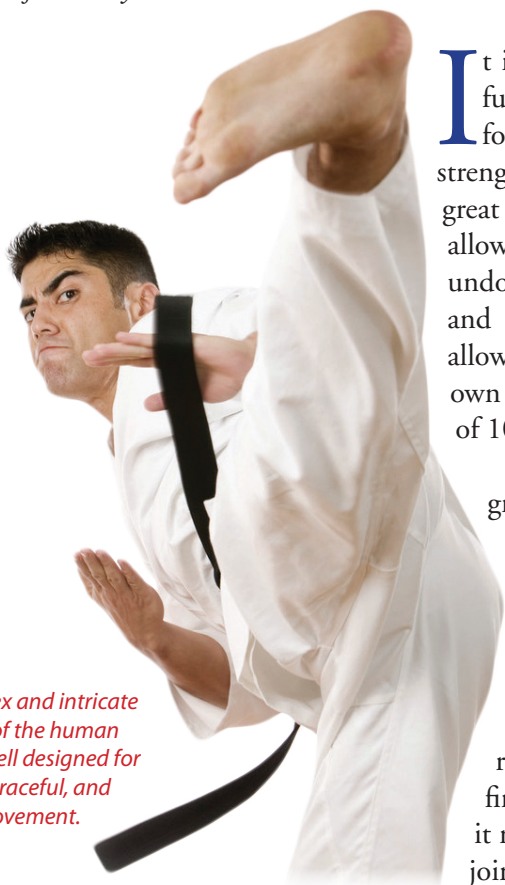
A Regional Approach



After completing this chapter you should be able to:

- use correct anatomical terminology when describing the human body;
- give a detailed description of the parts of the skeletal and muscular systems and how they relate to human performance;
- identify the bones and major ligaments that form the various joints of the body;
- appreciate the organization and complexity of human anatomy.

The complex and intricate structures of the human body are well designed for powerful, graceful, and efficient movement.



It is important to understand that structure often determines function; the structures of the human body are well designed for efficient movement. You have probably marveled at the strength of the human skeleton, which is able to withstand great impact and stress, not to mention its light weight that allows movements to be swift and active. The human body is undoubtedly a strong, flexible, well-oiled machine, able to move and perform with astonishing efficiency. But what structures allow some power lifters to lift weights two or three times their own body weight? How do the world's top sprinters run a distance of 100 meters under 10 seconds?

In fact, how are we able to stand upright and move against gravity and other forces? The science of anatomy attempts to shed light on these and other questions, as well as to provide answers based on the complex and intricate structure of the human body.

A regional approach to anatomy will be used to study the components and functions of the human body. The axial skeleton, in particular the head and neck, pectoral region, vertebral/back region, and abdomen, will be examined first, and then the appendicular skeleton will be discussed as it relates to the axial skeleton. The bones, the muscles, and the joints that make up each region will be discussed together.

The Axial Skeleton

Head and Neck Region

The skull and cervical vertebrae comprise the bones of the head and neck region.

DID YOU KNOW?

The most fragile of the calvaria bones is the temporal bone, and it overlies one of the major blood vessels supplying the membranes protecting the brain. If the temporal bone is fractured and displaced internally, it can cut the middle meningeal artery, resulting in an **epidural hemorrhage** (bleeding between the skull and the meninges, or protective covering of the brain). This is a clinical emergency, and bleeding must be stopped as quickly as possible.

Skull

The skull is divided into two major parts. The curved flat bones form the **calvaria**, or vault that protects the brain and brain stem. The irregular bones of the face give it its individuality, provide protection for the eyes and air passages, and allow chewing and entry of food into the body (Figure 4.1).

Calvaria The calvaria is formed by the **frontal**, **parietal**, **temporal**, **occipital**, and **sphenoid bones**. These may be fractured by blows to the skull (e.g., as a result of hitting the skull on the ice when playing hockey – see the box *Did You Know?* in the margin).

Facial Bones The facial bones (Figure 4.1) include the **nasal** (nose), **lacrimal** (for drainage of tears), **zygomatic** (cheek), **maxilla** (upper jaw), and **mandible** (lower jaw) bones. Facial bones are often broken in contact sports due to rough impact. Some fractures across the maxilla (upper jaw) can leave the lower face separated from the upper face.

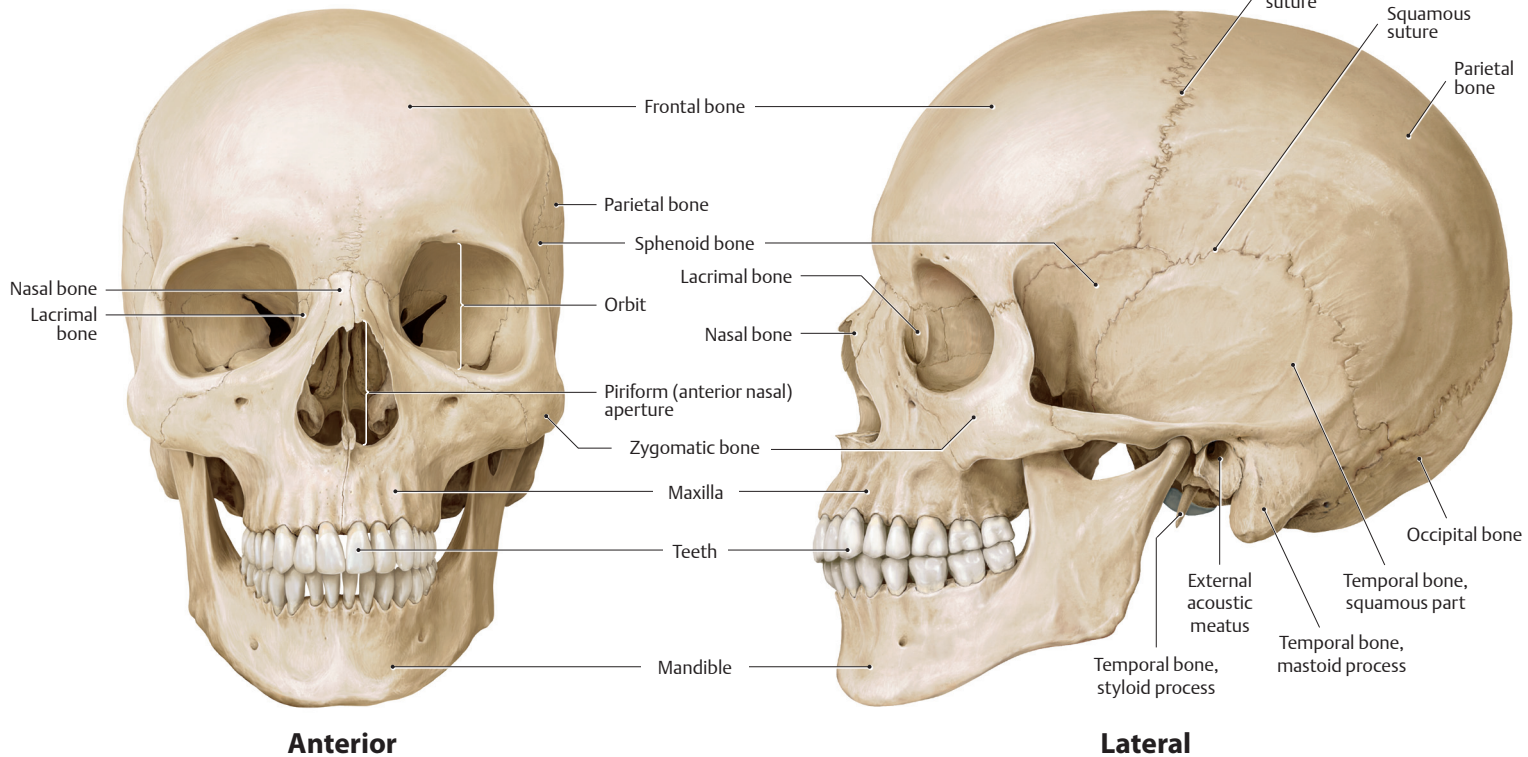


Figure 4.1 Anterior and lateral views of the human skull.



WHEN GO RACING

Concussions

A **concussion** is an injury to the brain that usually develops from a violent shaking or jarring action of the head. The force of impact causes the brain to bounce against the inside of the skull, which results in confusion and a temporary loss of normal brain function (memory, judgment, reflexes, speech, muscle coordination, and balance).

Approximately 20 percent of reported concussions occur in organized sports. They are common in hockey, football, boxing, and many other contact sports. Athletes with a previous concussion are three to six times more likely to suffer another one.

For years, coaches would urge an injured player to “shake it off” and return after a brief rest. This casual attitude has changed in recent years as many high-profile athletes, such as hockey star Sidney Crosby, have sustained career-threatening or -ending concussions. Brain injury experts emphasize that although some concussions are less serious than others, there is no such thing as a “minor concussion.”

Why Wear a Helmet?

Helmets are a good idea for activities such as bicycling, in-line skating, and skateboarding. Skateboarders need special helmets that provide more coverage for the back of the head (especially for beginners who tend to fall backward more often).

Research has shown that a properly fitted bicycle helmet offers up to 88 percent protection from brain injury.



Always replace helmets that have sustained a significant impact. Helmets are effective for one fall – one time use only! Also, avoid buying “used” helmets to ensure maximum protection.





Facial Muscles

Facial muscles enable you to change expression and display your emotions outwardly; but most important, they allow you to close your eyes (**orbicularis oculi**) and your mouth (**orbicularis oris**). Closing the eyelids, as in blinking, acts to move tears across the cornea of the eye, keeping it moistened. When the eyeball is not kept moist, it will dry out and ulcerate, leading to discomfort and irritation, even blindness. People with paralysis of facial muscles will put artificial tears in their eyes to prevent this.

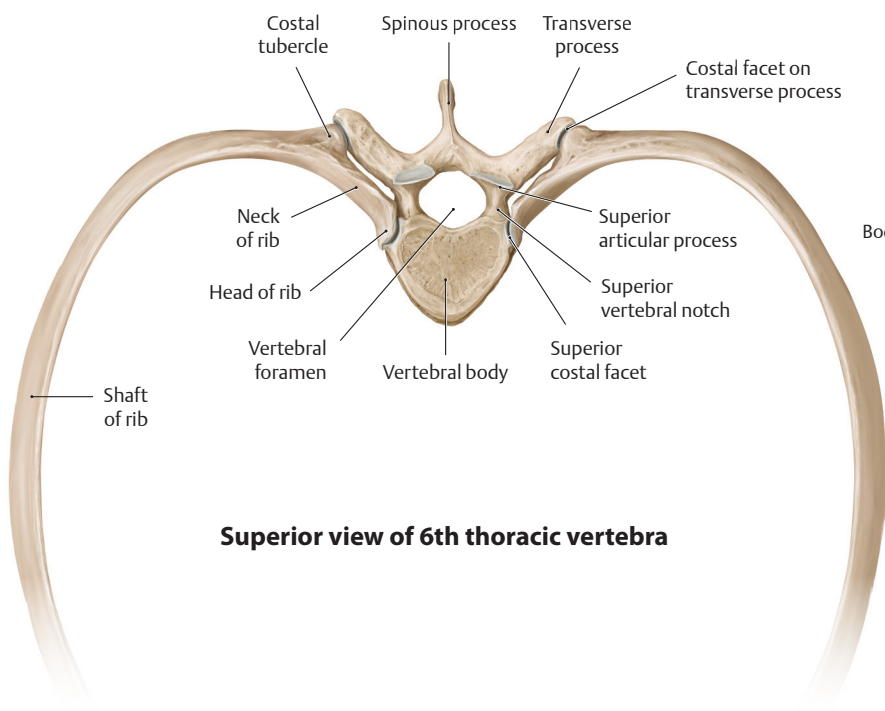
Also, facial muscles are essential for opening and closing the mouth, thereby keeping food in the mouth and allowing you to move it between the teeth during chewing, to say nothing of forming words in speaking.



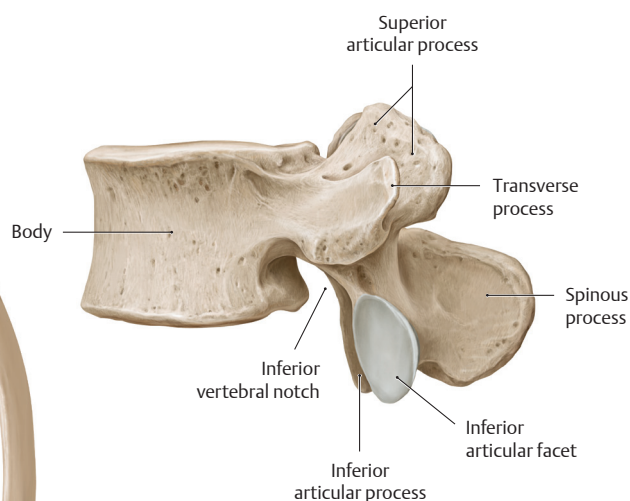
Back Region

Vertebral Column (Back Bone)

The vertebral column is normally made up of 33 bones (see Figures 4.2 and 4.3): 7 **cervical** (neck) vertebrae, of which the first 2 are named the **atlas** (C1) and the **axis** (C2), 12 **thoracic** (chest) vertebrae, 5 **lumbar** (lower back) vertebrae, 1 **sacrum** (midline region of buttocks) made up of 5 fused vertebrae, and 1 **coccyx** (tailbone) made up of 3 to 5 fused vertebrae.



Superior view of 6th thoracic vertebra



Lateral view of 4th lumbar vertebra



Terminology Alert

A **foramen** (plural = *foramina*) is an opening, usually in bone, through which an anatomical structure can pass.

Figure 4.2 Superior and lateral views of a thoracic and lumbar vertebra, respectively.

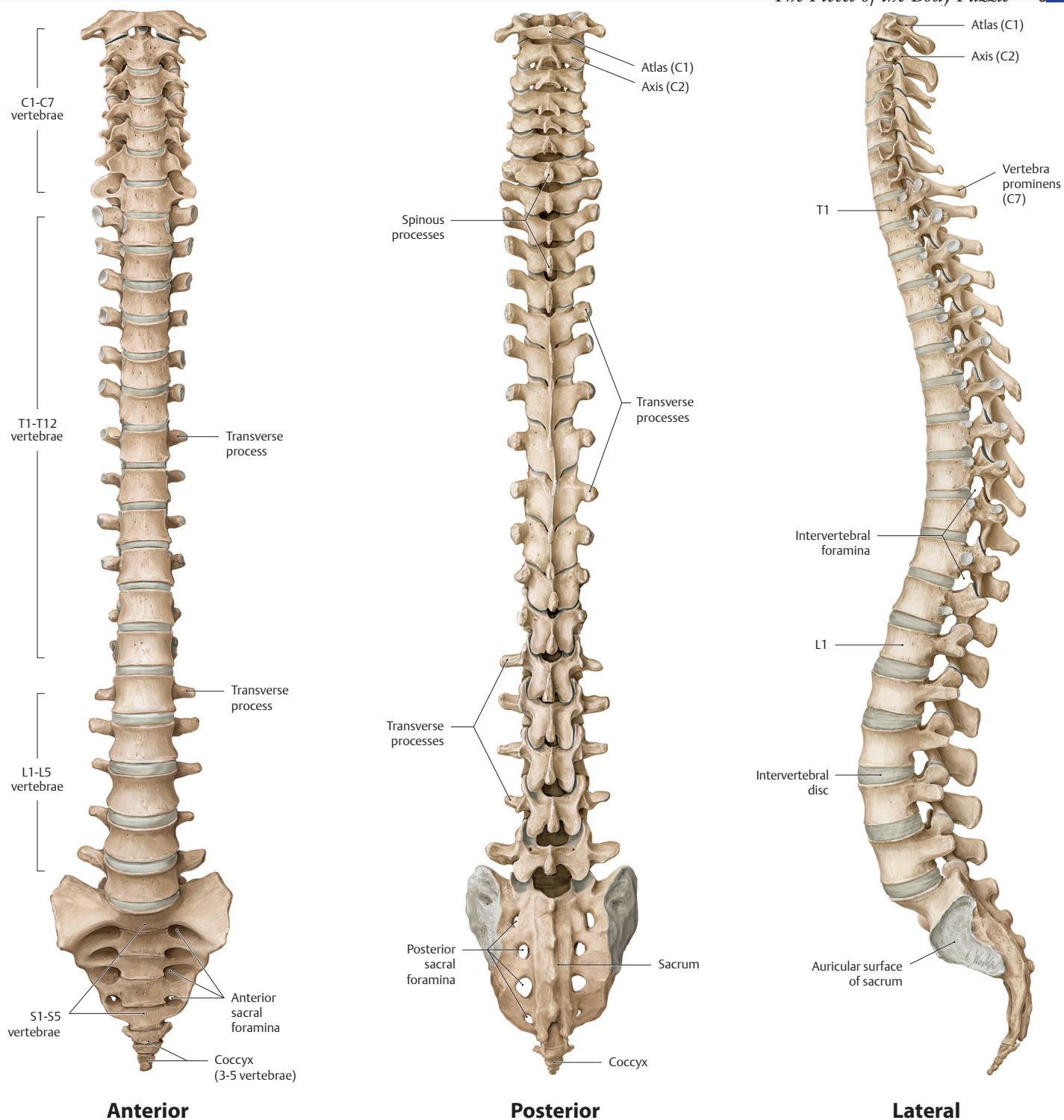
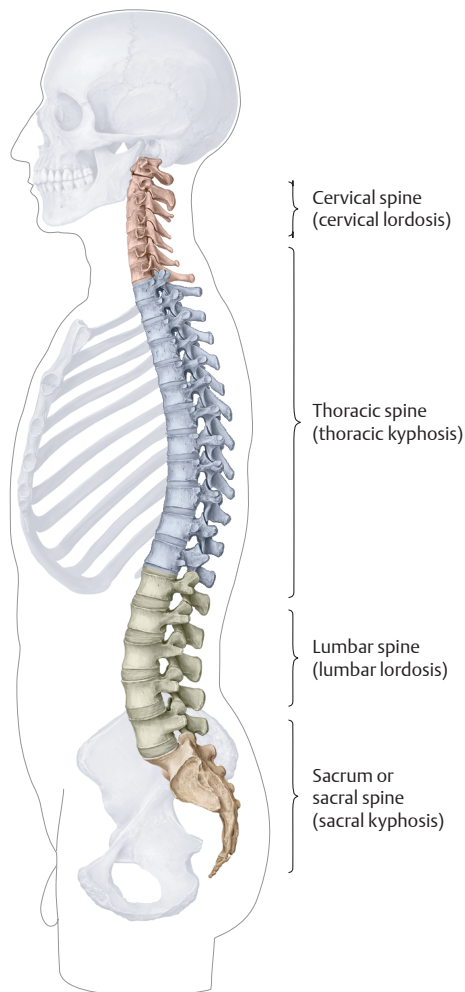


Figure 4.3 Regions of the vertebral column: anterior, posterior, and lateral views.

Vertebrae are arranged in a cylindrical column interspersed with fibrocartilaginous **intervertebral discs**, forming a strong and flexible support for the neck and trunk (Figure 4.3). The vertebral column is also the point of attachment for the muscles of the back. The column has a snakelike form when viewed from the side, with cervical, thoracic, lumbar, and sacral curves extending from the base of the skull through the entire length of the trunk. Not only does the column protect the spinal cord and nerves, it also provides essential support for the body and the ability to keep the body erect. The intervertebral discs absorb shock effectively when the load on the column increases and allow the vertebrae to move without causing damage to other vertebrae or to the spinal cord.

Curvature is convex anteriorly with **lordosis** and convex posteriorly with **kyphosis**.



WHEN THINGS GO WRONG

Herniated Disc

A **herniated disc** results from a disruption of the outer fibrous ring (annulus fibrosus) of an intervertebral disc, allowing the jelly-like central portion (nucleus pulposus) to bulge out between the annular fibers, which may result in nerve irritation causing reflex, sensory, and motor dysfunctions. A common symptom that occurs with disc herniations at L4-L5 or L5-S1 is electric-like pain that shoots down the leg all the way to the foot, with associated leg weakness. Although disc herniations can occur anywhere in the spine, they occur most commonly in the low back. Symptoms are directly related to the nerve root level where the herniation occurs. The most common type of disc herniation is a posterolateral disc herniation, which will affect the nerve root at that particular side and level.

The primary mechanism of disc herniation is repetitive spine flexion. Common sources of repetitive spine flexion include poor sitting posture, poor lifting technique, and crunches that flex the spine. Research has shown that discs appear to have a flexion lifespan of somewhere around 20,000 flexion cycles for most individuals. This means that when we exceed this

amount the likelihood of a disc problem increases. Constant poor posture where the spine is flexed is a sure way to disrupt the annular fibers of the disc.

Recognizing the negative impact of spine flexion has resulted in a new approach to strengthening the spine in a neutral position – planks, side bridges, and bird dog exercises are good examples of exercises that help build the neutral spine. During these exercises, bracing is very important – an active contraction of the abdominal wall that causes the sides of the body to become firm and extend outward. Try standing with your hands above your iliac crest. Now, with your hands, feel the sides of your trunk while you try to blow out a candle. Notice the sides of your trunk tense and extend outward. That's a brace.

Developing endurance of the muscles that become active during the brace is very important for protecting the spine. Likewise, during all lifting tasks you should keep your spine in a neutral position with your brace on.

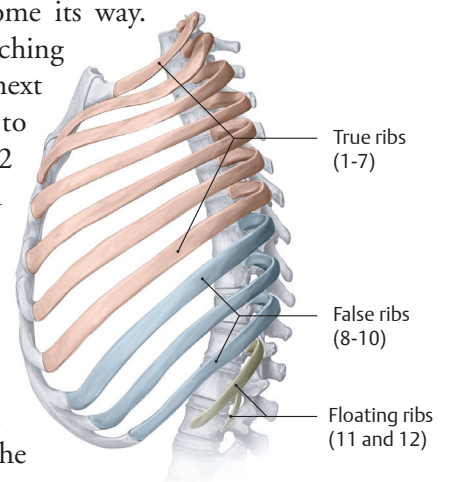


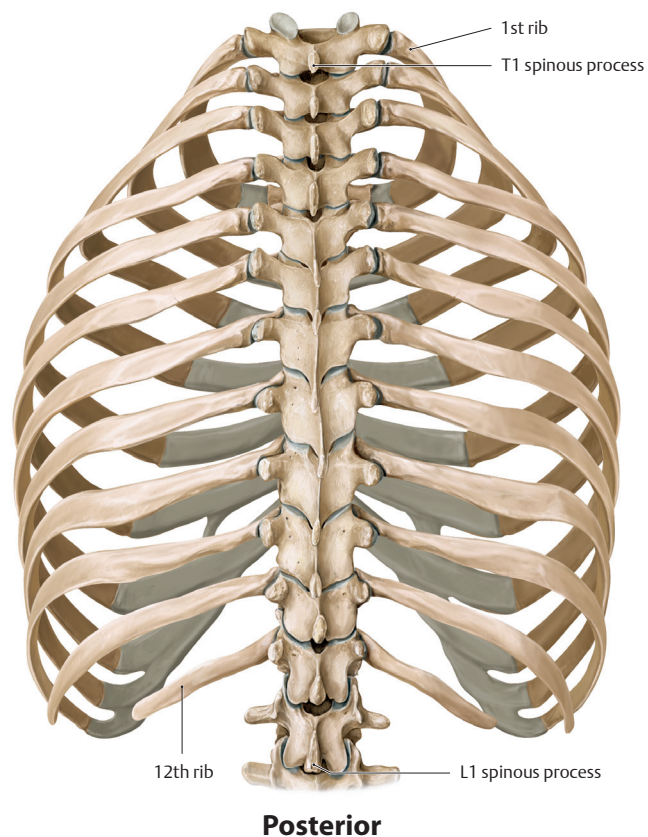
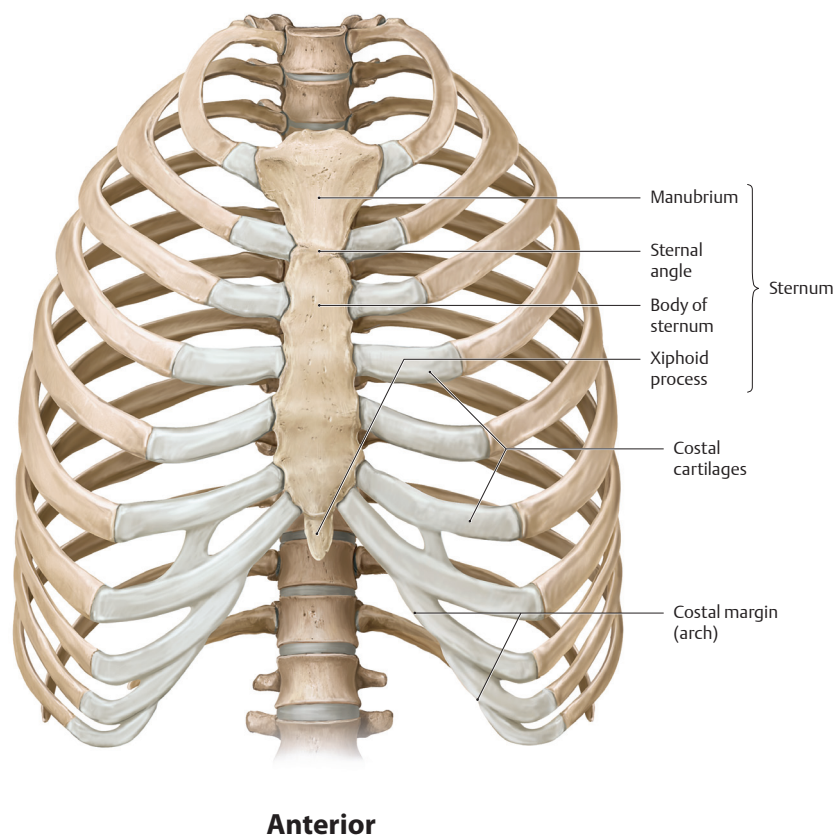
Ribs and Sternum

There are usually 12 pairs of **ribs**, made up of bone and **costal cartilage**, that give strength to the chest cage and permit it to expand (Figure 4.4). The ribs are curved and slightly twisted, making them ideal to protect the chest area, effectively deflecting most blows that come its way.

The upper 7 pairs (1 to 7) are the **true ribs** (attaching to both the vertebrae and the sternum), the next 3 pairs (8 to 10) are the **false ribs** (attaching to the sternum indirectly), and pairs 11 and 12 are **floating ribs**, so called because they attach only to the vertebral column. All 12 pairs of ribs articulate with the 12 thoracic vertebrae posteriorly.

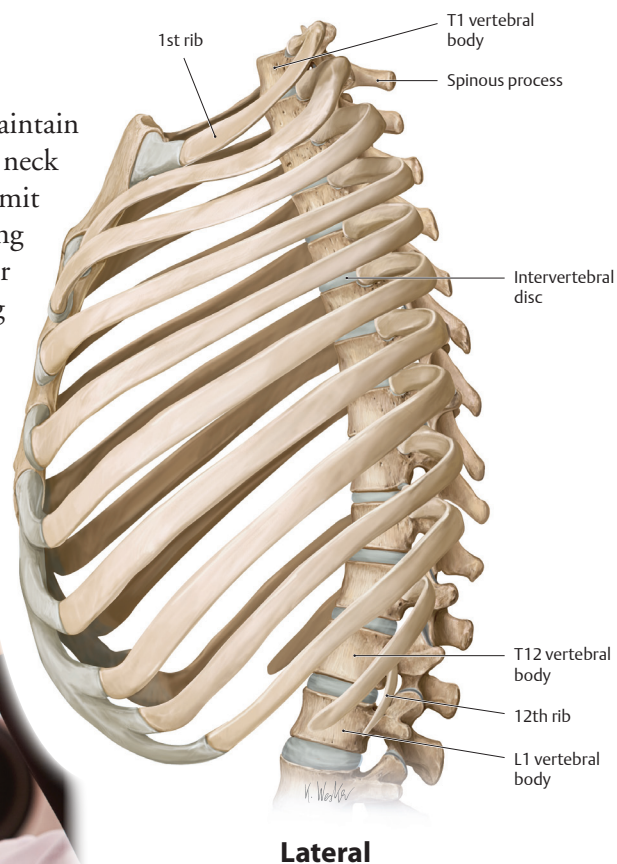
The midline breastbone is called the **sternum** and is made up of three parts – the **manubrium**, **sternal body**, and **xiphoid process**. The clavicles and ribs 1 to 7 articulate with the sternum (Figure 4.4).





Muscles of the Neck and Back

The head sits on the first cervical vertebra (C1), called the atlas. To maintain this position there are muscles posterior, lateral, and anterior to the neck or cervical region that allow you to hold up your head and also permit a wide range of movement. Try turning your own head while keeping your shoulders in a fixed position. The most important anterior pair of neck muscles is the **sternocleidomastoids** (Figure 4.5). Acting together, they are the muscles that allow you to flex your head toward your chest. Without them you cannot get up from a supine position (lying down). Individually, each sternocleidomastoid muscle tilts the face up and toward the opposite side.



The sternocleidomastoids are the muscles that allow you to flex your head toward your chest.

Figure 4.4 Anterior, posterior, and lateral views of the rib cage.