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#### • Graphics package (PowerPoint slides)

• Student workbook (answer key) Pages 31-54 13 activities

#### • Online resources

Anatomy study cards Flash cards Crosswords Quiz questions Lesson websites • Teacher's guide supplement TGS 4.1 to TGS 4.18

# THE PIECES OF THE BODY PUZZLE A Regional Approach



#### After completing this chapter you should be able to:

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



By the end of the course, students will:

- Use correct anatomical terminology when describing human movement (e.g., anatomical position, planes, axes, basic movement terms such as flexion and extension, and terms pertaining to body position such as anterior and superior).
- Identify the major parts of the musculoskeletal system (e.g., muscles and bones) and describe the ways in which they relate to human movement (e.g., according to their location, structure, function, and characteristics).
- Describe the articular system (e.g., classification of joints, structure of joints, and joint mechanics) as it relates to human movements (e.g., elbow as a hinge joint allows for flexion and extension, shoulder as a ball and socket joint allows for various movement such as abduction and adduction, flexion and extension, medial and lateral rotation).

# **Chapter Learning Objectives**

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• Student workbook Pages 31-50

#### Online resources

Anatomy study cards Flash cards Crosswords Quiz questions



#### O Student workbook

Check Your Understanding quiz (pp. 51-52) Chapter Culminating Assignment (pp. 53-54)

#### • Online quiz

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 Develop an understanding of the bones, muscles, and joints that make up the axial skeleton, and apply knowledge of the axial skeleton to injuries of the head, neck, back, and abdominal regions.



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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.

# Teaching Materials

- Graphics package: PowerPoint slides
- O Student workbook (3)
- Online resources

Anatomy study cards Flash cards

• Teacher's guide supplement TGS 4.1 to TGS 4.4



For a summary of key terms, see TGS 4.1.



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.

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Watch the episode of *The Magic Schoolbus* called "Flexes Its Muscles" to introduce how remarkable the human body is.



# **Soft Spot for Babies**

Have students research how long it typically takes the bones of a baby's skull to fuse (18 months) and why the skull isn't solid at birth. The skull is not fused together at birth, which allows the baby to fit through the birth canal and also allows for brain growth.





# EN **G(**) HINGS

#### 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 highprofile athletes, such as hockey star Sidney Crosby, have sustained careerthreatening 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.

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Figure 4.1 Anterior and lateral views

of the human skull.



What are the curved flat bones of the skull called? Name the five bones, and identify the most fragile of these bones.

> The calvaria is formed by the **frontal**, parietal, temporal, occipital, and sphenoid bones. The temporal bone is the most fragile.



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#### **Keep Your Head in the Game**

In groups of four, debate whether or not the increasing violence in hockey that has led to a greater number of concussions is a necessary part of the game. Two students will support the belief that violence is part of the game, and two students will support the belief that violence isn't necessary to the game of hockey.



#### **Use Your Head**

To help students remember some of the bones of the skull, help them make word associations: the temporal bone is located where the temple is; the frontal bone is located at the front of the head, and so on.



What facial muscles allow you to open and close your eyes and mouth?

> The **orbicularis oculi** and **orbicularis oris** allow you to open and close your eyes and mouth, respectively.



Ask students to recall the various types of bone shape classifications. They should be able to differentiate between the flat and irregular bones of the skull and face.

#### Facial Muscles



The Pieces of the Body Puzzle

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.





#### **Turn That Frown Upside Down**

Have students research which and how many muscles it takes to smile, frown, or make other facial expressions.





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.

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#### **Building the Backbone**

Have students construct a vertebral column using paper vertebrae labeled as C1, T10, L5, S3, and so on. Challenge students to put the vertebrae in the correct order and to display the correct curvature of the spine (see TGS 4.2).



 List the five regions of the vertebral column from the most superior to the most inferior.

> The five regions of the vertebral column from superior to inferior are the cervical vertebrae (C1-C7), thoracic vertebrae (T1-T12), lumbar vertebrae (L1-L5), sacrum, and coccyx.



How many pairs of ribs make up the chest cage? Name the three types of ribs from most superior to inferior.

There are usually 12 pairs of ribs. The upper 7 pairs are the **true** ribs; the next 3 pairs are the **false** ribs; and pairs 11 and 12 are the **floating** ribs.



 The breastbone is actually made up of three parts. Name them.

The breastbone is made up of the manubrium, sternal body, and xiphoid process.



# THINGS GO BRENES

#### 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 electriclike 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

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).

False ribs

True ribs

(1-7)

 Floating ribs (11 and 12)

(8-10)

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#### **Chest Compressions**

Use CPR mannequins (Actars) to perform chest compressions as a way to introduce students to the anatomy of the rib cage and sternum. This is a good way to help students learn the importance of CPR and how to "landmark" (using the xiphoid process) before starting compressions. Although ribs can be broken while performing chest compressions, it's a far better outcome than dying.





# **Do Floating Ribs Really Float?**

A common misconception is that floating ribs actually float. Challenge students to clear up the confusion and discuss how and where floating ribs are connected to the body.