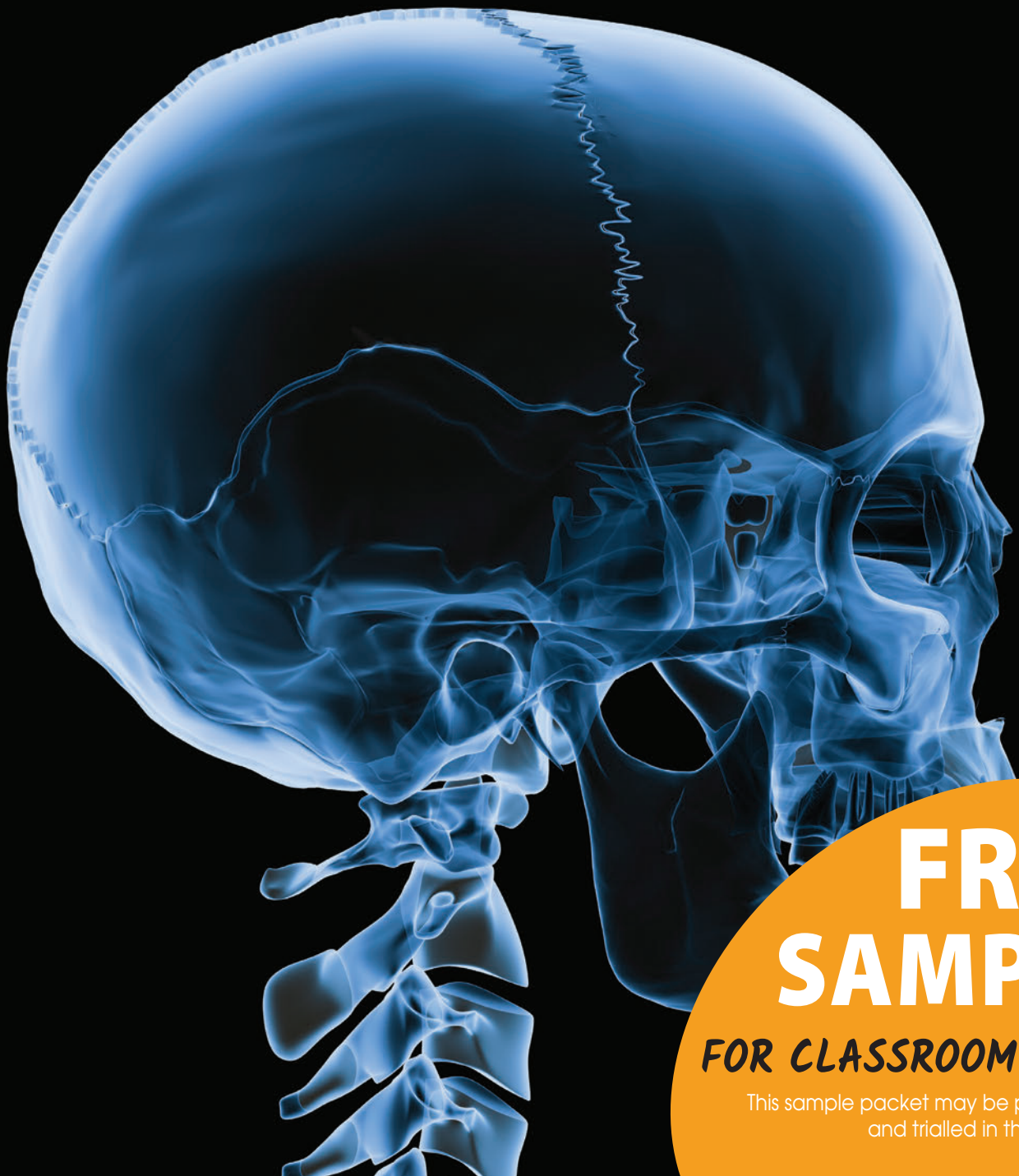
BIOZONE

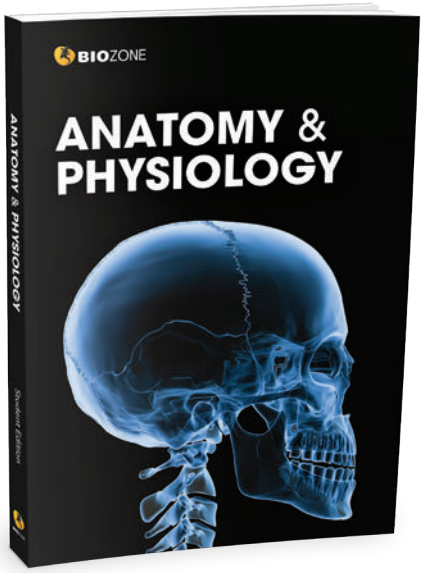
ANATOMY & PHYSIOLOGY



FREE SAMPLE

FOR CLASSROOM TRIAL

ANATOMY & PHYSIOLOGY



Now in **FULL COLOR** with **3D Model QR codes**

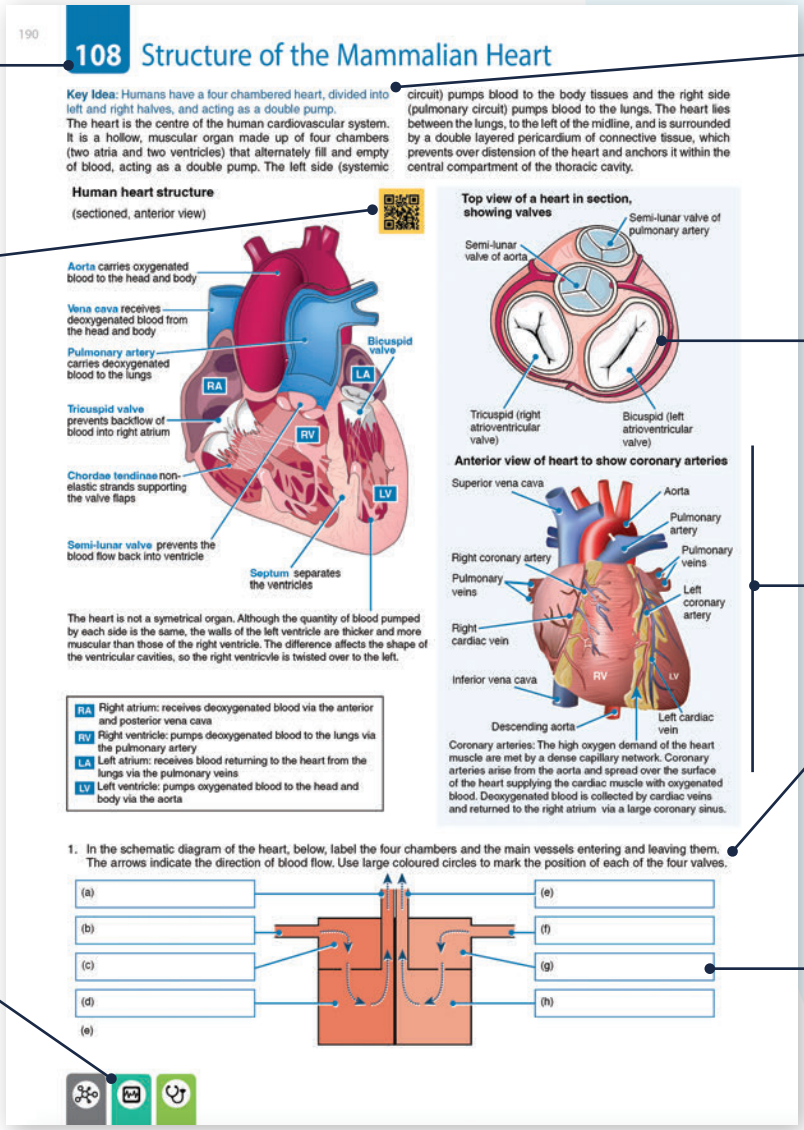
Anatomy and Physiology explores the essentials of human structure and function through engaging, generously illustrated, full color activities. Each body system is explored in detail. Homeostasis provides a unifying theme connecting the body systems and highlighting their interrelatedness. Students are encouraged to explore each body system within the contexts of four themes: disease, medicine and technology, aging, and exercise. The result is a rounded exploration of human anatomy and physiology.

BIOZONE's unique, interactive worktext approach encourages direct interaction with the content, allowing students to record their answers within the context of the stimulus material and form a record of work for quick and easy revision.

Activity number
Activities are numbered to make navigation through the book easier.

QR Codes
Scan the QR code to directly interact with 3D models.

Activity coding system
Tab codes indicate online support via BIOZONE's **Resource Hub** and identify any of the **four themes** covered in the activity: Aging, Exercise, Disease, and Medicine & Technology.



190

108 Structure of the Mammalian Heart

Key Idea: Humans have a four chambered heart, divided into left and right halves, and acting as a double pump.

The heart is the centre of the human cardiovascular system. It is a hollow, muscular organ made up of four chambers (two atria and two ventricles) that alternately fill and empty of blood, acting as a double pump. The left side (systemic circuit) pumps blood to the body tissues and the right side (pulmonary circuit) pumps blood to the lungs. The heart lies between the lungs, to the left of the midline, and is surrounded by a double layered pericardium of connective tissue, which prevents over distension of the heart and anchors it within the central compartment of the thoracic cavity.

Human heart structure
(sectioned, anterior view)

Aorta carries oxygenated blood to the head and body
Vena cava receives deoxygenated blood from the head and body
Pulmonary artery carries deoxygenated blood to the lungs
Tricuspid valve prevents backflow of blood into right atrium
Chordae tendinae non-elastic strands supporting the valve flaps
Semi-lunar valve prevents the blood flow back into ventricle
Bicuspid valve
Septum separates the ventricles
RA
LA
RV
LV

The heart is not a symetrical organ. Although the quantity of blood pumped by each side is the same, the walls of the left ventricle are thicker and more muscular than those of the right ventricle. The difference affects the shape of the ventricular cavities, so the right ventricvle is twisted over to the left.

RA Right atrium: receives deoxygenated blood via the anterior and posterior vena cava
RV Right ventricle: pumps deoxygenated blood to the lungs via the pulmonary artery
LA Left atrium: receives blood returning to the heart from the lungs via the pulmonary veins
LV Left ventricle: pumps oxygenated blood to the head and body via the aorta

Top view of a heart in section, showing valves
Semi-lunar valve of pulmonary artery
Semi-lunar valve of aorta
Tricuspid (right atrioventricular valve)
Bicuspid (left atrioventricular valve)

Anterior view of heart to show coronary arteries
Superior vena cava
Aorta
Pulmonary artery
Pulmonary veins
Right coronary artery
Pulmonary veins
Left coronary artery
Right cardiac vein
Inferior vena cava
RV
LV
Descending aorta
Left cardiac vein

Coronary arteries: The high oxygen demand of the heart muscle are met by a dense capillary network. Coronary arteries arise from the aorta and spread over the surface of the heart supplying the cardiac muscle with oxygenated blood. Deoxygenated blood is collected by cardiac veins and returned to the right atrium via a large coronary sinus.

1. In the schematic diagram of the heart, below, label the four chambers and the main vessels entering and leaving them. The arrows indicate the direction of blood flow. Use large coloured circles to mark the position of each of the four valves.

(a)
(b)
(c)
(d)
(e)
(e)
(f)
(g)
(h)

Key Idea
Each activity has a key idea summarizing its primary focus. It helps students to understand where the activity's emphasis lies.

Comprehensive, engaging diagrams
Engaging, high quality diagrams provide a visual focus whilst delivering important information in an accessible format.

Content organization
Logically organized content makes it easier for students to access and engage with the information.

Direct questioning
A direct questioning style helps students easily identify what is being asked.

Write-on answers
Students input their answers directly onto the page. This becomes their **record of work** and helps them when it is time to review for tests and exams.

www.BIOZONE.com/ANP3

CHAPTER
3 The Skeletal System

KEY IDEAS

- The skeleton is the internal supporting structure of the body, composed of mineralized connective tissue.
- The skeleton, together with body's system of muscles, enables movement of the body.
- Movement occurs through articulations in the skeleton called joints. The amount of movement permitted depends on the joint type.
- Bone is a dynamic tissue, undergoing growth, remodeling, and repair. Aging is associated with degenerative changes in the skeleton.

KEY TERMS

- Appendicular skeleton
- Axial skeleton
- Cartilaginous joint
- Fibrous joint
- Ossification
- Osteoblasts
- Osteocytes
- Pectoral girdle
- Pelvic girdle
- Synovial joint

RESOURCE HUB

Scan the QR code to access:

- **weblinks**
- **videos**
- **3D models**
- **Interactives**

LEARNING OBJECTIVES

		Activity number
☐ 1	Identify the two main divisions of the human skeleton as the axial and appendicular skeletons. Classify bones according to their size and shape. Recognize long bones, short bones, flat bones, and irregular bones. Identify the bones that make up the skull and understand the difference between paired and single bones.	31
☐ 2	Understand the structure of the spine, including the arrangement of vertebrae and the intervertebral disks. Describe ankylosing spondylitis as a disease that affects the spine.	32
☐ 3	Describe the main bones that make up the pectoral girdle and explain the difference between the male and female pelvic girdle.	33
☐ 4	Understand that bone is a living, dynamic substance that is continually remodelled and repaired. Use a diagram to describe the gross structure of a long bone, including the features that confer strength and shock absorption. Indicate the locations of the diaphysis, periosteum, and epiphysis, and associated cartilage.	34
☐ 5	Describe ossification, explaining the role of osteoblasts and the process by which hyaline cartilage is replaced with hard bone. Explain the roles of parathyroid hormone and calcitonin in hormonal regulation of blood calcium levels.	34
☐ 6	Describe the ultrastructure of compact bone. Identify the periosteum, osteoblasts, osteocytes, matrix, lacunae, and Haversian canals.	35
☐ 7	Explain the differences between cartilaginous, synovial and fibrous joints; name examples and locations of each of these joint types. Describe the structure of a synovial joint, explaining the role of synovial fluid. Explain why this type of joint is prone to injury. Explain the role of ligaments in the knee joint.	36
☐ 8	Describe the degenerative changes in the skeleton that occur with increasing age, including reduction in the rate of bone remodeling, accelerated areas of bone loss, and osteoporosis and osteoarthritis.	38

Interacting Systems

Muscular and Skeletal Systems

Endocrine system

- The skeleton protects the endocrine organs especially in the pelvis, chest, and brain.
- Bone growth, remodeling, and repair occurs in response to hormones.
- Androgens and growth hormone promote muscle strength and increase in mass..

Respiratory system

- Skeleton encloses and protects lungs
- Flexible ribcage enables ventilation of the lungs for exchange of gases (O_2/CO_2).
- Diaphragm and intercostals produce volume changes in breathing.

Cardiovascular system

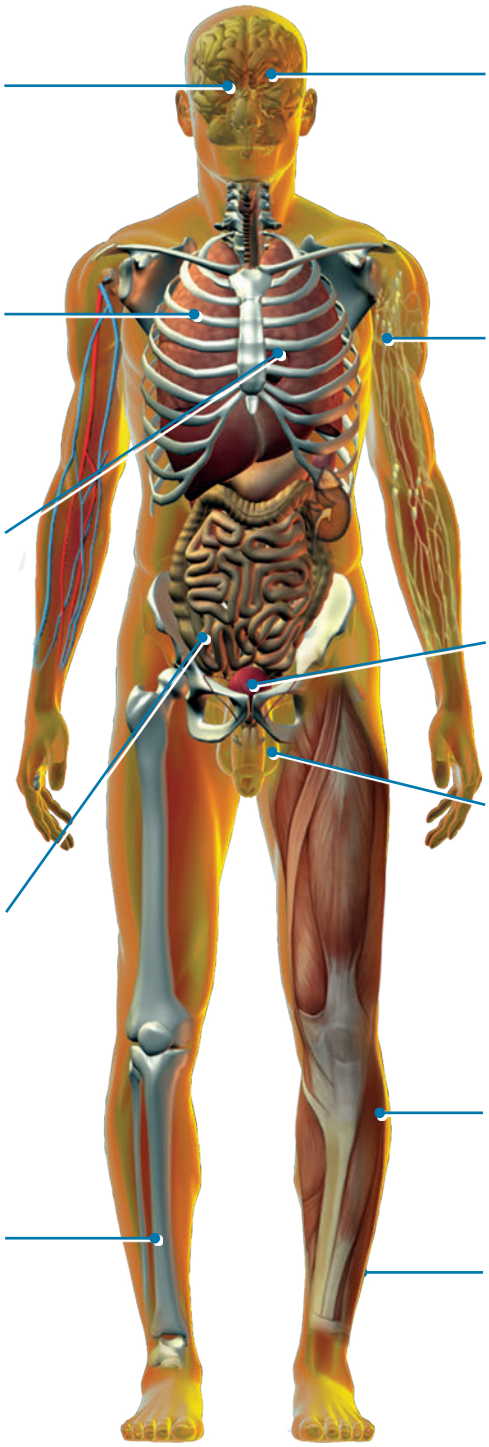
- Heart and blood vessels transport O_2, nutrients, and waste products to all the body.
- Bone marrow produces red blood cells
- Bone matrix stores calcium, which is required for contraction of muscle in the heart and blood vessels.

Digestive system

- Skeleton provides some protection and support for the abdominal organs.
- Digestive system provides nutrients for growth, repair, and maintenance of muscle and connective tissues.

Skeletal system

- Muscular activity maintains bone strength and helps determine bone shape.
- Muscles pull on bones to create movement.



Nervous system

- The skeleton protects the CNS.
- Bone acts as a store of calcium ions required for nerve function.
- Innervation of bone and joint capsules provides sensation and positional awareness.
- Muscular activity is dependent on innervation.

Lymphatic system and immunity

- Stem cells in the bone marrow give rise to the lymphocytes involved in the immune response.

Urinary system

- The skeleton protects the pelvic organs.
- Final activation of vitamin D, which is involved in calcium and phosphorus metabolism, occurs in the kidneys.
- Urination controlled by a voluntary sphincter in the urethra.

Reproductive system

- The skeleton protects the reproductive organs.
- Reproductive (sex) hormones influence skeletal development.

Muscular system

- Skeleton acts as a system of levers for muscular activity.
- Bone provides a store of calcium for muscle contraction.

Integumentary system

- Skin absorbs and produces precursor of vitamin D, which is involved in calcium and phosphorus metabolism.
- Skin covers and protects the muscle tissue.

General functions and effects on all systems

The skeletal system provides bony protection for the internal organs, especially the brain and spinal cord, and the lungs, heart, and pelvic organs. The muscular system acts with the skeletal system to generate voluntary movements. Smooth and cardiac muscle provide motility for involuntary activity.

Disease

Symptoms of disease

- Pain (moderate to severe)
- Inflammation
- Limitations in function

Disorders of the bones and joints

- Growth disorders
- Trauma (fractures and sprains)
- Infection
- Tumors
- Degenerative diseases

Diseases of the skeletal muscles

- Inherited diseases
- Fibrosis (scarring)
- Strains, tears, and cramps
- Denervation and atrophy

- Osteomalacia
- Osteoarthritis
- Osteoporosis
- Sarcomas
- Muscular dystrophy

Medicine and Technology

Diagnosis of disorders

- Blood tests
- Bone scans
- Medical imaging techniques
- Athroscopy

Treatment of injury

- Surgery
- Physical and drug therapies
- Prosthetics and orthotics

Treatment of inherited disorders

- Surgery
- Radiotherapy (for cancers)
- Physical and drug therapies
- Prosthetics and orthotics
- Gene therapy

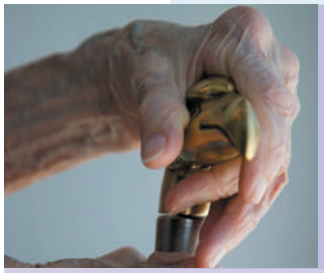
- Joint replacement
- Grafts
- Genetic counselling
- X-rays
- MRI

Support & Movement

The Musculoskeletal System

The musculoskeletal system can be affected by disease and undergoes changes associated with aging.

Medical technologies and exercise can be used to diagnose, treat, and delay the onset of musculoskeletal disorders.



- Osteoarthritis
- Osteoporosis
- Muscular atrophy

Aging and the bones, joints, and muscles

- Bone loss
- Loss of muscle mass
- Accumulated trauma
- Increased incidence of cancers

The Effects of Aging

- Muscle fatigue
- Fast vs slow twitch
- Aerobic training
- Anaerobic training

Effects of exercise on bones, joints, and muscles

- Increased bone density
- Increased lean muscle mass
- Changes in flexibility & joint mobility
- Changes in fiber type & recruitment
- Changes in oxidative capacity

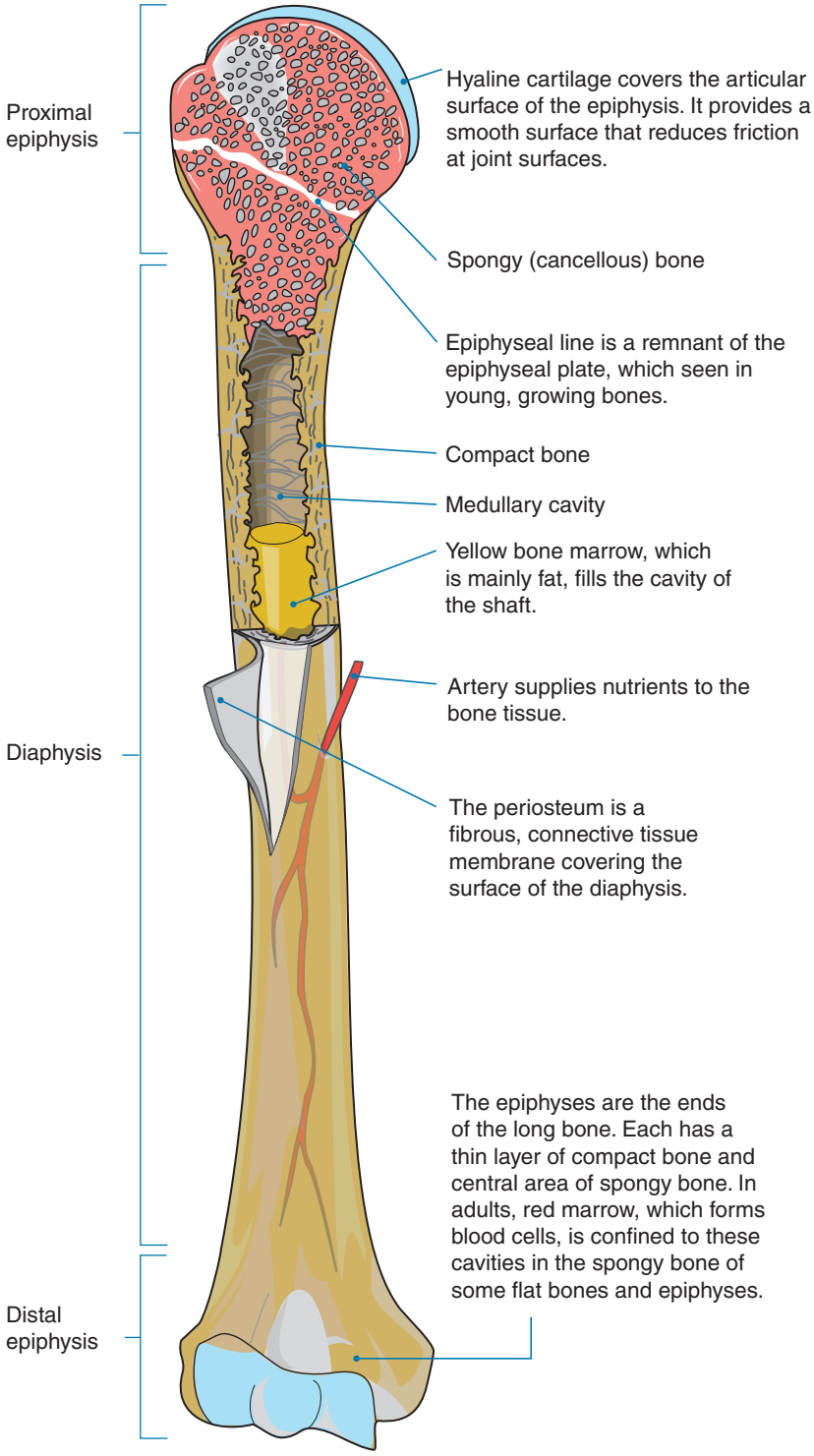
Exercise

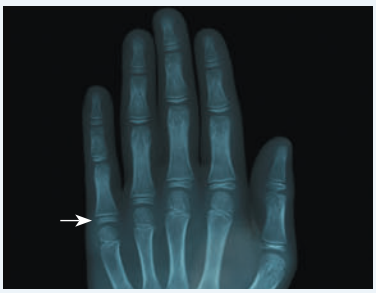
34 Bone

Key Idea: The skeleton is formed from two stiffened connective tissues: bone and cartilage.

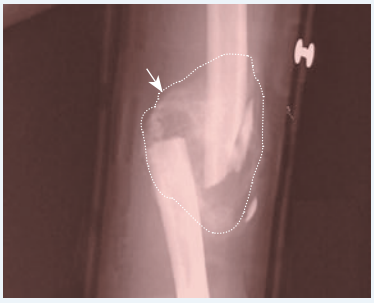
Although bone is hard, it is dynamic and is continually remodeled and repaired according to needs and in response to blood calcium levels and the pull of gravity and muscles. Hormones from the thyroid, parathyroids, and gonads, as well as growth hormone, are involved in this activity. Most bones of the skeleton are formed from hyaline cartilage by a process of ossification (bone formation) and they grow by bone remodeling. Bone remodeling is also important in bone repair. Bones have a simple gross structure, as illustrated by a long bone such as the humerus (below). The hard (dense) bone surrounds spongy (cancellous) bone filled with red bone marrow.

Mature long bone





An X-ray shows the epiphyseal plates (growth plates) of a child's hand, seen as separate from the longer bones.



A fibrocartilage callus or tissue mass (indicated) begins the repair process on a fractured humerus. Cigarette smoking slows bone healing markedly.

Red bone marrow is stored in the cavities of spongy bone. Here, it is being extracted for transplant. Bone marrow is a source of stem cells.

A section of a femur head shows the compact bone surrounding inner spongy bone and marrow. Blood cells are formed in the red marrow.

ISBN: 978-1-99-101408-5

51 Muscle Physiology and Performance

Key Idea: The overall effect of aerobic training on muscle is improved oxidative function and better endurance.

Regardless of the type of training, some of our ability to perform different types of activity depends on our genetic make-up. This is particularly true of aspects of muscle physiology, such as the relative proportions of different fiber types in the skeletal muscles. Muscle fibers are primarily of two types: **fast twitch** (FT) or **slow twitch** (ST). Fast twitch fibers predominate during anaerobic, explosive activity, whereas slow twitch fibers predominate during endurance activity. In the table below, note the difference in the degree to which the two fiber types show fatigue. Training can increase fiber size and, to some extent, the makeup of the fiber, but not the proportion of ST to FT, which is genetically determined.

The effects of aerobic training on muscle physiology

Improved oxidation of glycogen. Training increases the capacity of skeletal muscle to generate ATP aerobically.

An increased capacity of the muscle to oxidize fats. This allows muscle and liver glycogen to be used at a slower rate. The body also becomes more efficient at mobilizing free fatty acids from adipose tissue for use as fuel.

Increased myoglobin content. Myoglobin stores oxygen in the muscle cells and aids oxygen delivery to the mitochondria. Endurance training increases muscle myoglobin by 75%-80%.

Increase in lean muscle mass and decrease in body fat. Trained endurance athletes typically have body fat levels of 15-19% (women) or 6-18% (men), compared with 26% (women) and 15% (men) for non-athletes.

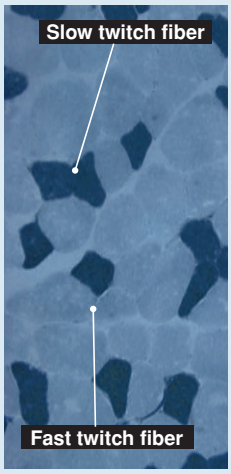
The size of **slow twitch fibers** increases. This change in size is associated with increased aerobic capacity.

An increase in the size and density of mitochondria in the skeletal muscles and an increase in the activity and concentration of Krebs cycle enzymes.

An increase in the number of capillaries surrounding each muscle fiber. Endurance trained men have 5%-10% more capillaries in their muscles than sedentary men.

Fast vs slow twitch muscle

Feature	Fast twitch	Slow twitch
Color	White	Red
Diameter	Large	Small
Contraction rate	Fast	Slow
ATP production	Fast	Slow
Metabolism	Anaerobic	Aerobic
Rate of fatigue	Fast	Slow
Power	High	Low



Slow twitch fibers appear dark colored when stained with a myofibrillar ATPase stain.

Type II fast twitch fibers are classified further according to their metabolism:

- Type IIa (intermediate) = some oxidative capacity
- Type IIb = fast glycolytic only

There are two basic types of muscle fibers: **slow twitch** (type I) and **fast twitch** (type II) fibers. Both fiber types generally produce the same force per contraction, but fast twitch fibres produce that force at a higher rate. Slow twitch fibers contain more mitochondria and myoglobin than fast twitch fibers, so they are more efficient at using oxygen to generate ATP without lactate build up. In this way, they can fuel repeated muscle contractions such as those required for endurance events.

1. Explain the following changes that occur due to aerobic training:

   (a) Slow twitch fibers increase in size: _____

   _____

   _____

   (b) Improved oxidation of glycogen: _____

   _____

   _____

   (c) Increase in lean muscle mass and decrease in body fat: _____

   _____

   _____

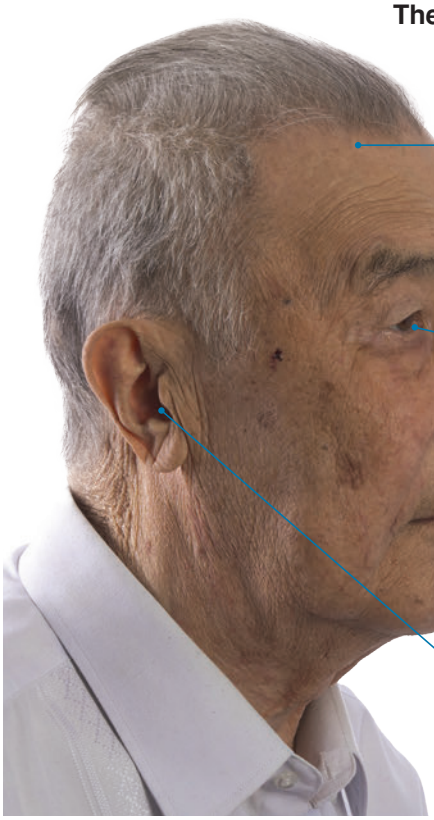
ISBN: 978-1-99-101408-5

77 Aging and the Nervous System

Key Idea: The aging process affects all body systems, including the nervous system.

Neuron loss begins around age 30, and accumulates over time, which is why the changes are often more obvious in the elderly. Common changes include impaired (diminished) hearing and vision, short term memory loss, slower reaction times, and loss of fine motor skills. Performing mental and physical exercise slows down the loss of **neurons** in the areas of the brain associated with memory, and helps the remaining neurons to function properly. Lack of mental and physical stimulation, a poor diet, and the consumption of two or more alcoholic drinks a day can increase the rate of neuron loss in the brain.

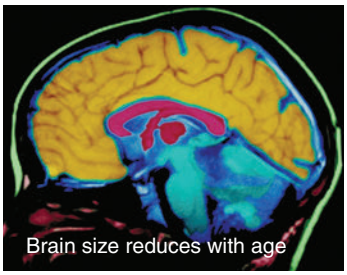
The effects of aging on the nervous system



Loss of neurons
Brain size reduces with age as neurons are lost, but this does not lead to dementia. Dementia disorders, such as Alzheimer's and vascular dementia, severely reduce the number of neurons in the brain and retard its functioning.

Changes in vision
Visual acuity diminishes with age. The lens becomes less flexible and cannot focus light on to the retina correctly. The lens also becomes more opaque, reducing the amount of light falling on the retina. Cataracts (clouding of the lens) obstruct the passage of light and are common in the elderly.

Sensory impairment
Neuron loss leads to a decrease in sensory perception. Hearing loss is often the most obvious sensory impairment in elderly people and usually begins with inability to hear high pitched sounds. Hearing aids are often worn to correct the problem.

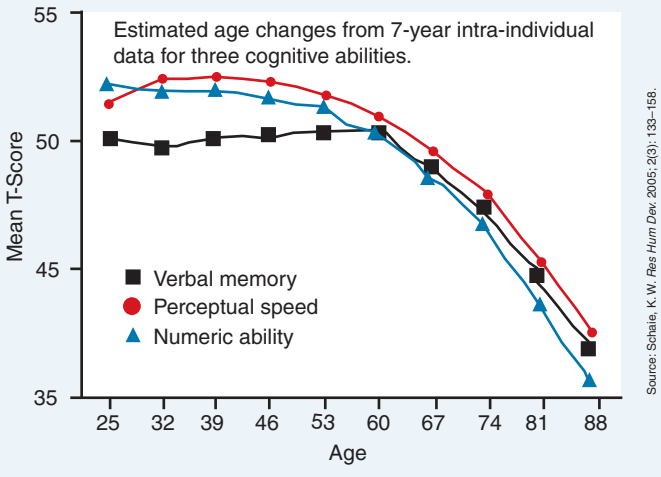

Brain size reduces with age


An elderly man with cataracts

The elderly often require hearing aids

How age affects cognitive ability

- The Seattle longitudinal study began in 1956 with the purpose of determining how cognitive (mental) ability and intelligence change with age. Every seven years, additional subjects were added to the study, and all participants undertook a series of cognitive tests and psychological questioning. Approximately 6,000 people have been tested.
- The graph (right) summarizes some of the results to date. Some cognitive abilities (perceptual speed and numeric ability), begin to decrease from early maturity, while others, such as verbal memory, do not begin to deteriorate until much later in life (60 years old). The study also showed that training (use of specific mental techniques) could slow the decline in cognitive ability.



1. (a) Why do many cognitive abilities diminish with age? _____

_____

_____

(b) What steps can be taken to reduce the rate of cognitive decline? _____

_____

_____

ISBN: 978-1-99-101408-5

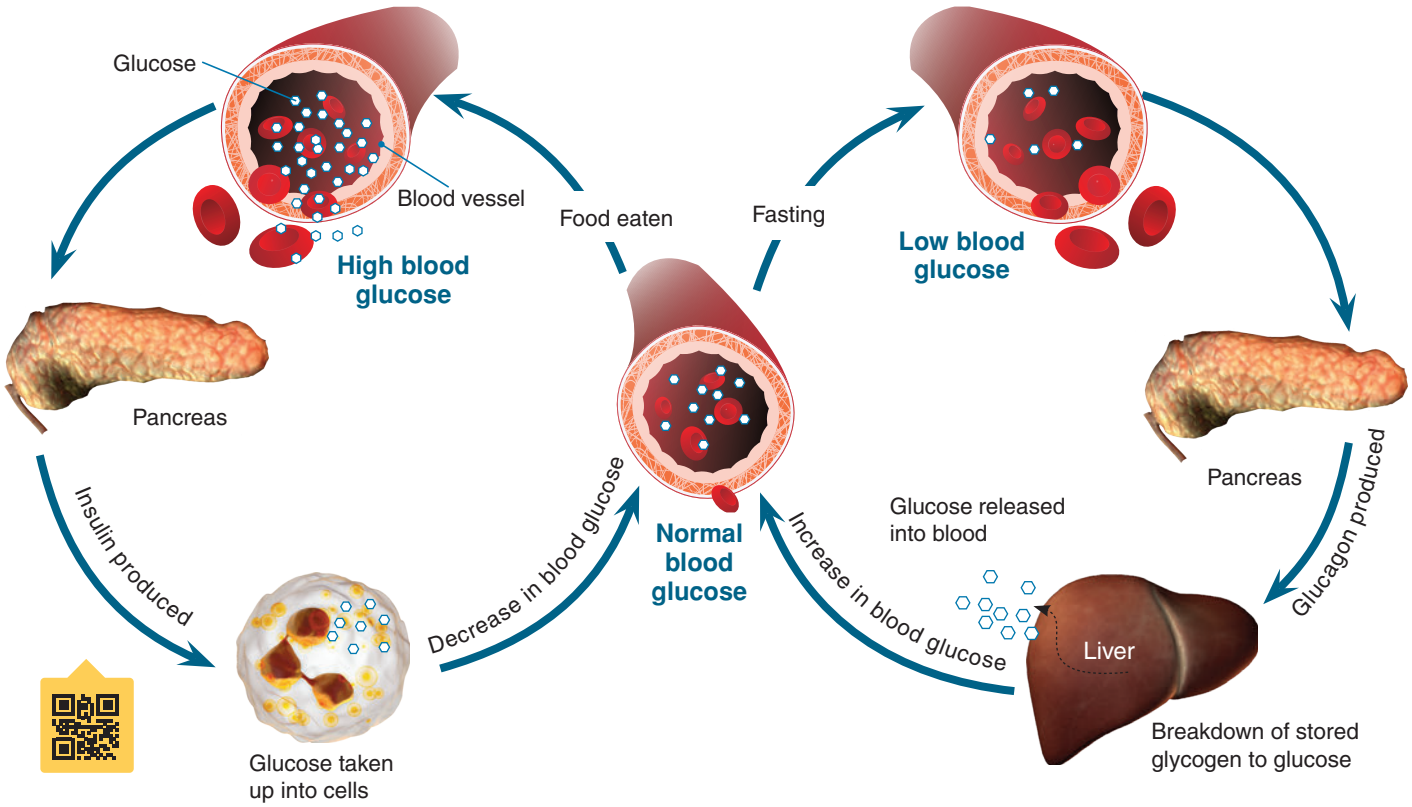
90 Control of Blood Glucose

Key Idea: The endocrine portion of the pancreas produces two hormones, insulin and glucagon, which maintain blood glucose at a steady state through negative feedback.

Blood glucose levels are controlled by negative feedback involving two hormones, insulin and glucagon. These hormones are produced by the islet cells of the pancreas, and act in opposition to control blood glucose levels. Insulin lowers blood glucose by promoting the uptake of glucose by the body's cells and the conversion of glucose into the storage molecule glycogen in the liver. Glucagon increases blood glucose by stimulating the breakdown of stored glycogen and the synthesis of glucose from amino acids. Negative feedback stops hormone secretion when normal blood glucose levels are restored. Blood glucose homeostasis allows energy to be available to cells as required. The liver has a central role in these carbohydrate conversions.

The importance of blood glucose

- Glucose is the body's main energy source. It is chemically broken down during cellular respiration to generate ATP, which is used to power metabolism. Glucose is the main sugar circulating in blood, so it is often called blood sugar. Blood glucose levels are regulated by negative feedback involving two hormones, insulin and glucagon.
- Blood glucose levels are tightly controlled because cells must receive an adequate and regular supply of fuel. Prolonged high or low blood glucose causes serious physiological problems and even death. Normal activities, such as eating and exercise, alter blood glucose levels, but the body's control mechanisms regulate levels so that fluctuations are minimized and generally occur within a physiologically acceptable range. For humans, this is 60-110 mg/dL, indicated by the shaded area in the graph (right).



1. For the following two scenarios, describe how normal blood glucose level is restored:

   (a) Low blood glucose: _____

   _____

   (b) High blood glucose: _____

   _____

2. What is the role of the liver in blood glucose homeostasis? _____

   _____

3. To recap, in what way are the actions of the hormones insulin and glucagon antagonistic? _____

   _____

   _____

ISBN: 978-1-99-101408-5

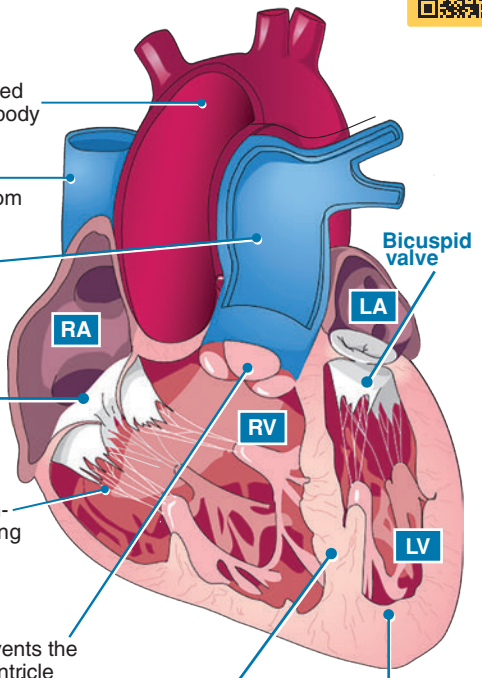
106 Structure of the Mammalian Heart

Key Idea: Humans have a four chambered heart, divided into left and right halves, acting as a double pump.

The heart is the centre of the human cardiovascular system. It is a hollow, muscular organ made up of four chambers (two atria and two ventricles) that alternately fill and empty with blood, acting as a double pump. The left side (systemic circuit) pumps blood to the body tissues and the right side (pulmonary circuit) pumps blood to the lungs. The heart lies between the lungs, to the left of the midline, and is surrounded by a double layered pericardium of connective tissue, which prevents over distension of the heart and anchors it within the central compartment of the thoracic cavity.

Human heart structure

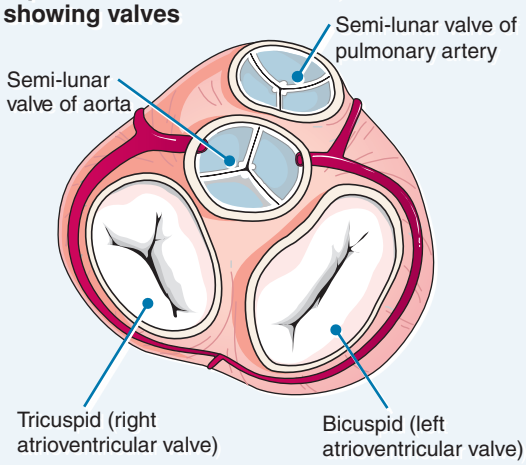
(sectioned, anterior view)



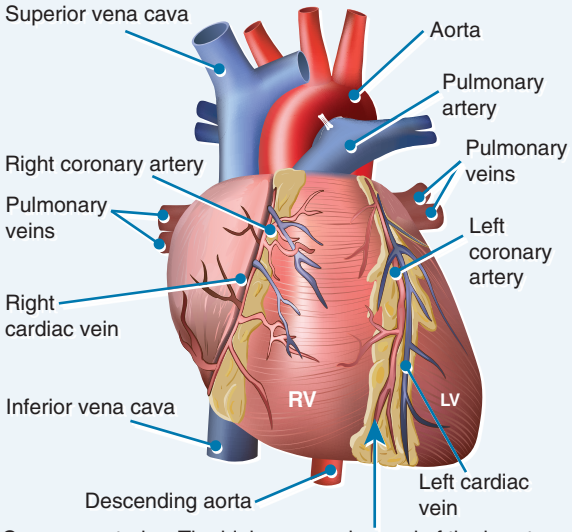
The heart is not a symmetrical organ. Although the quantity of blood pumped by each side is the same, the walls of the left ventricle are thicker and more muscular than those of the right ventricle. The difference affects the shape of the ventricular cavities, so the right ventricle is twisted over to the left.

RA	Right atrium: receives deoxygenated blood via the anterior and posterior vena cava
RV	Right ventricle: pumps deoxygenated blood to the lungs via the pulmonary artery
LA	Left atrium: receives blood returning to the heart from the lungs via the pulmonary veins
LV	Left ventricle: pumps oxygenated blood to the head and body via the aorta

Top view of a heart in section, showing valves

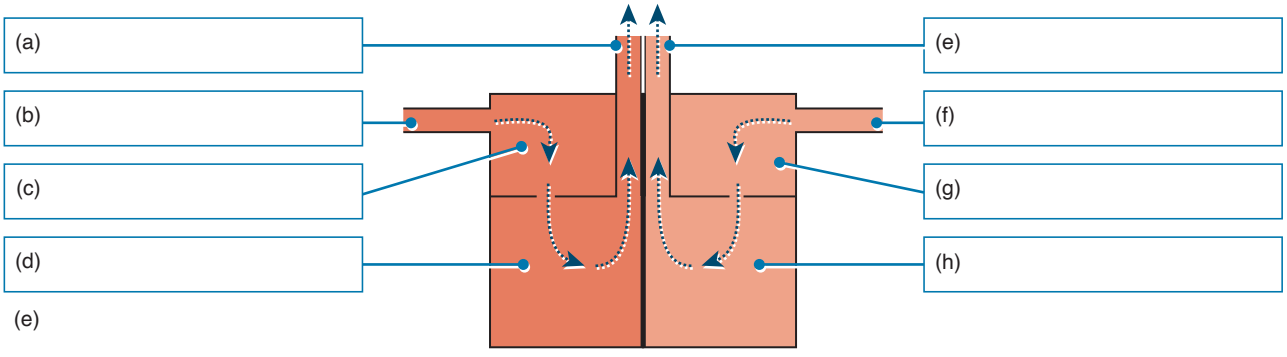


Anterior view of heart to show coronary arteries



Coronary arteries: The high oxygen demand of the heart muscle are met by a dense capillary network. Coronary arteries arise from the aorta and spread over the surface of the heart supplying the cardiac muscle with oxygenated blood. Deoxygenated blood is collected by cardiac veins and returned to the right atrium via a large coronary sinus.

1. In the schematic diagram of the heart below, label the four chambers, and the main vessels entering and leaving them. The arrows indicate the direction of blood flow. Use large colored circles to mark the position of each of the four valves.



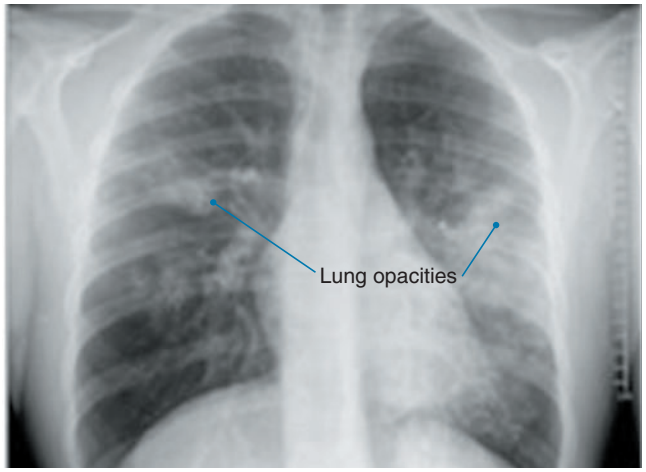
ISBN: 978-1-99-101408-5

160 Vaping and the Lungs

Key Idea: Vaping is a method of inhaling a vapor containing nicotine and other compounds, including some that may have an unknown negative impact on the respiratory system.

Nicotine 'vaping', through an electronic device, is a new phenomenon and research links its uptake to a decrease in tobacco smoking. Although 'vaping' is often promoted as a safe alternative to tobacco smoking, developing evidence is showing a multitude of possible negative health impacts, including cardiovascular and lung disease. Long-term health impacts are still unknown.

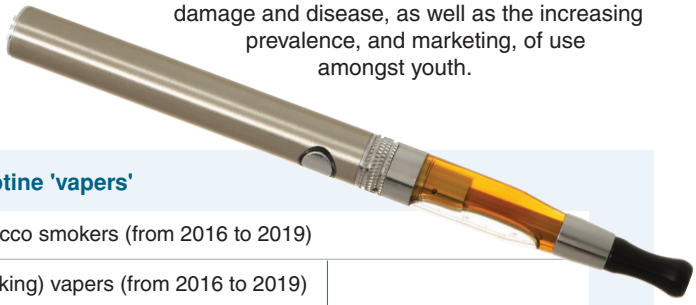
Vaping and lung damage



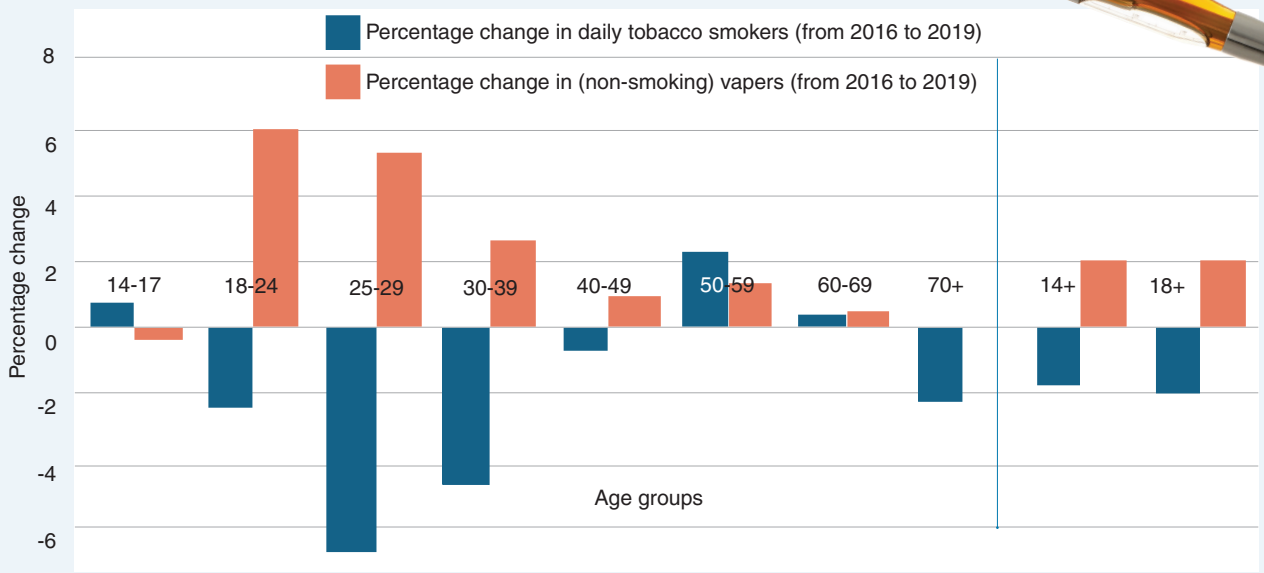
Schaffer , Strang , Saul, et al.

Chest radiograph showing lung damage in patient due to vaping, typical of EVALI.

Lung damage in some patients has been linked to vaping, and was defined by the CDC (Centres for Disease Control and prevention) in 2019 as e-cigarette or vaping product use-associated lung injury (EVALI). Symptoms including coughing, chest pain, and shortness of breath. Studies concluded that additives to the vaping liquid, such as Vitamin E acetate, were likely to a major contributor to the lung damage seen in over 2800 people, and over 68 deaths in the US, by early 2020. Although this additive was mainly linked to THC-containing vape liquids, other additives in nicotine-based vape liquids are thought to contribute to EVALI, and lung damage in general. Physicians and health specialists are concerned about the small amount of research around health impacts of vaping, possible poisons and carcinogens that may cause future lung damage and disease, as well as the increasing prevalence, and marketing, of use amongst youth.



Change in percentage of daily tobacco smokers vs nicotine 'vapers'



Source: https://www.athra.org.au/

1. From the graph above, describe the patterns you see in the data for tobacco smoking vs 'vaping': _____

2. 2022 research from the CDC shows around 9% of middle school and high school students in the US have vaped in the past 30 days, 3 times higher than the rate of adults. Why is promoting vaping as a healthy alternative to tobacco smoking in the 18-24 youth age scientifically and statistically incorrect?

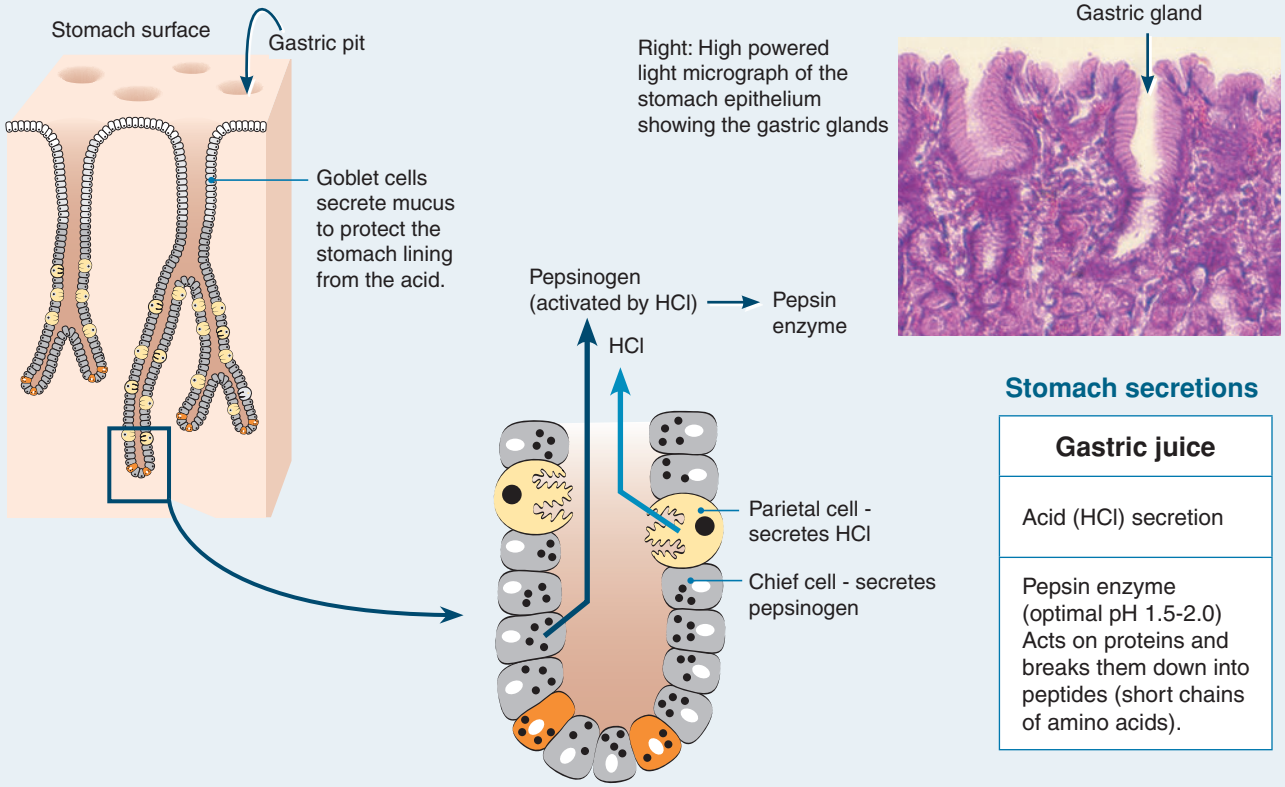
3. Summarize the impacts to lung health due to vaping: _____

ISBN: 978-1-99-101408-5

169 The Stomach and Small Intestine

Key Idea: The stomach produces acid and a protein-digesting enzyme, which breaks food down into a slurry, called chyme. The **stomach** is a hollow, muscular organ between the oesophagus and small intestine. In the stomach, food is mixed in an acidic environment to produce a semi-fluid mixture called chyme. The low pH of the stomach destroys microbes, denatures proteins, and activates a protein-digesting enzyme precursor. There is very little absorption in the stomach, although small molecules (glucose, alcohol) are absorbed across the stomach wall into the surrounding blood vessels.

Detail of a gastric gland (stomach wall)



Stomach secretions

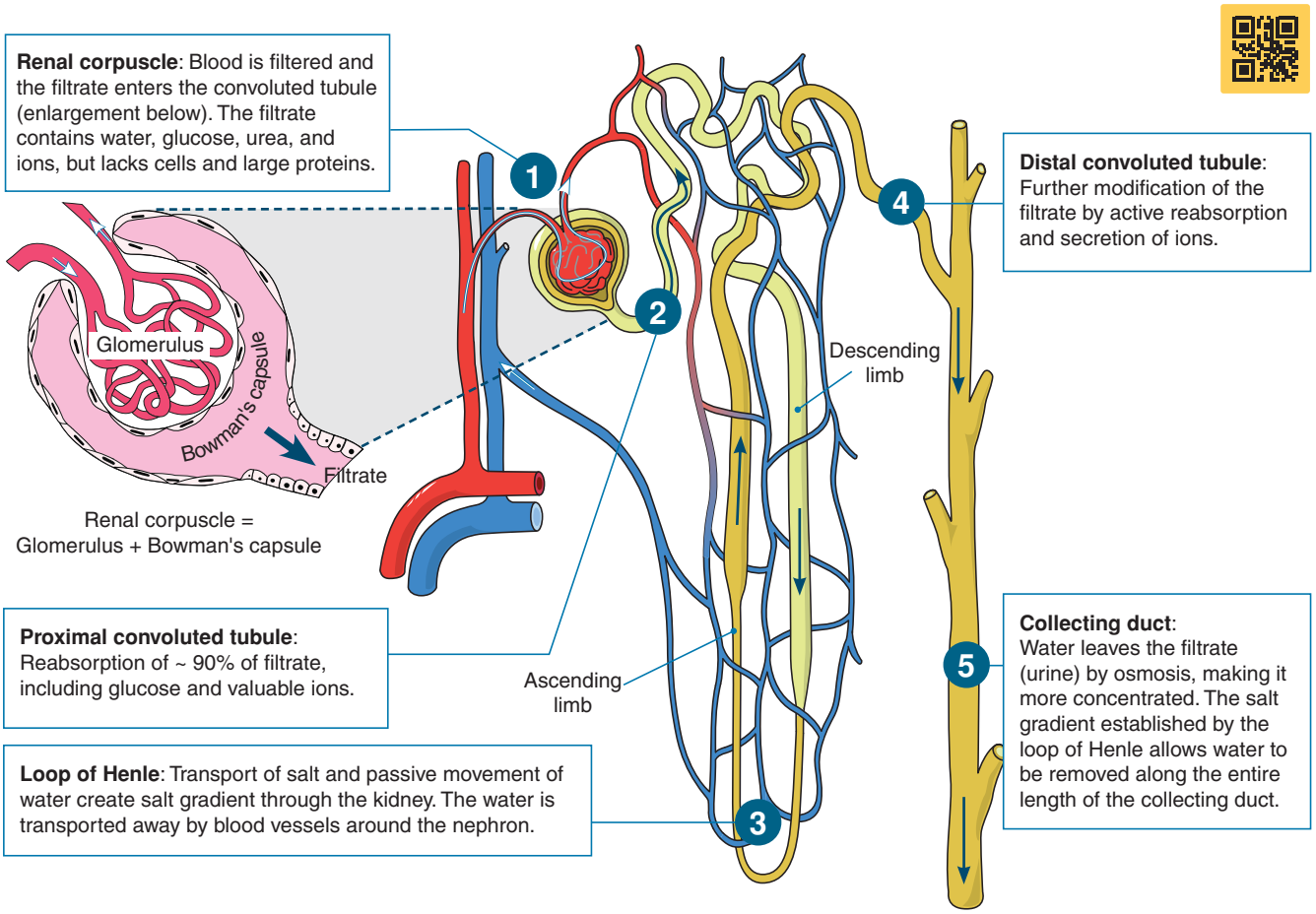
Gastric juice
Acid (HCl) secretion
Pepsin enzyme (optimal pH 1.5-2.0) Acts on proteins and breaks them down into peptides (short chains of amino acids).

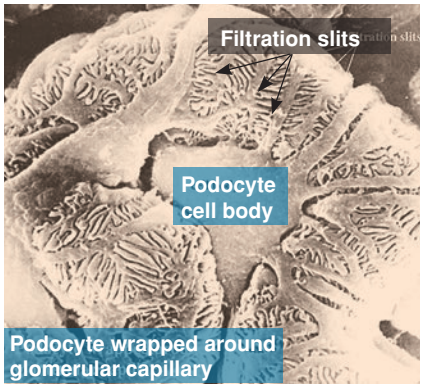
ISBN: 978-1-99-101408-5

186 The Physiology of the Kidney

Key Idea: The functional unit of the kidney is the nephron. It is a selective filter element, comprising a renal corpuscle and its associated tubules and ducts.

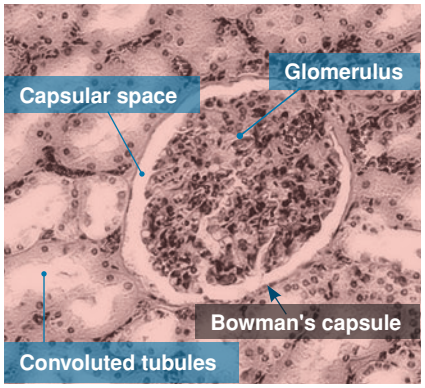
Ultrafiltration, i.e. forcing fluid and dissolved substances through a membrane by pressure, occurs in the first part of the nephron, across the membranes of the capillaries and the glomerular capsule. The formation of the glomerular filtrate depends on the pressure of the blood entering the nephron (below). If it increases, filtration rate increases; when it falls, glomerular filtration rate also falls. This process is precisely regulated so that glomerular filtration rate per day stays constant. The initial filtrate, now called urine is modified through secretion and tubular reabsorption according to the body's needs at the time.



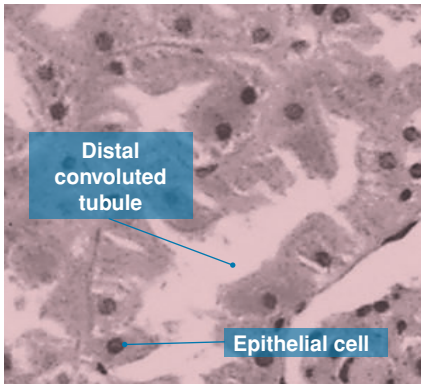


Dr D. Cooper: University of California San Francisco

The epithelium of Bowman's capsule is made up of specialized cells called podocytes. The finger-like cellular processes of the podocytes wrap around the capillaries of the glomerulus, and the plasma filtrate passes through the filtration slits between them.



Bowman's capsule is a double walled cup, lying in the cortex of the kidney. It encloses a dense capillary network called the glomerulus. The capsule and its enclosed glomerulus form a renal corpuscle. In this section, the convoluted tubules can be seen surrounding the renal corpuscle.



There are around 16 different types of epithelial cells in the kidney, lining the surface of tubules, each with different functions. The kidney tissue also contains endothelial cells lining blood vessels, interstitial cells in the space between functional cells, and immune cells.

1. Explain how water is reabsorbed in the kidneys? _____

ISBN: 978-1-99-101408-5

196 The Female Reproductive System

Key Idea: The female reproductive system maintains female characteristics, produces egg cells for reproduction, and provides the environment for the growth and development of the fertilized egg.

The female **reproductive system** consists of the ovaries, Fallopian tubes, uterus, the vagina and external genitalia, and the breasts. Although both male and females have breasts, the female breasts (mammary glands) are modified so that they produce milk after childbirth. The female reproductive system produces eggs, receives the penis and sperm during sexual intercourse, protects and houses the developing fetus, and produces milk to nourish the young after birth.

The female reproductive system

(a)

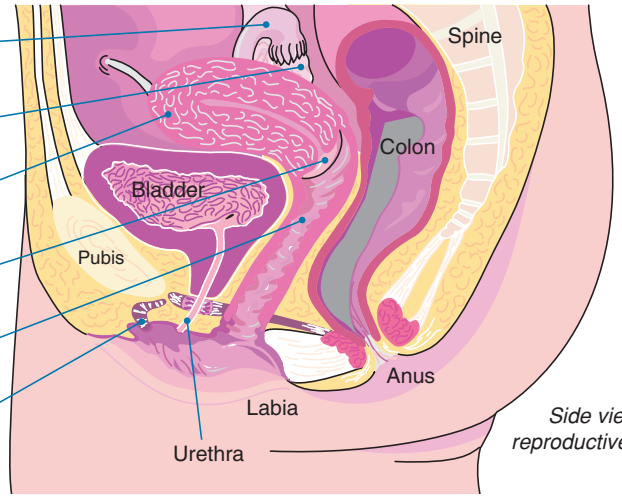
(b)

(c)

(d)

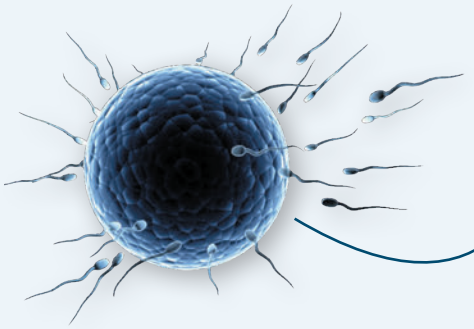
(e)

(f)



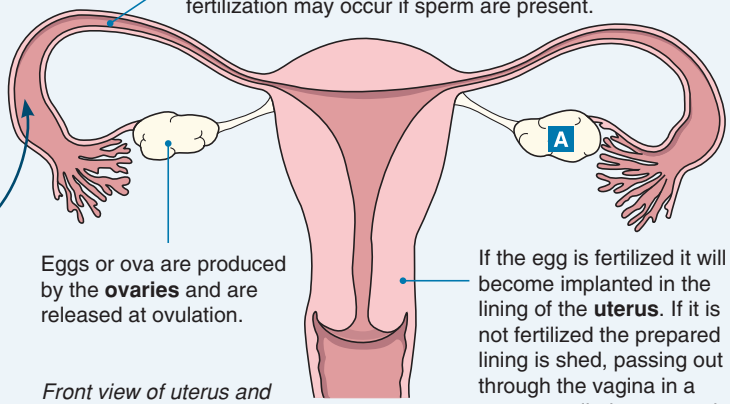
Side view of reproductive organs

Ovulation and implantation



Fertilization occurs in the Fallopian tube, after which the fertilized egg passes down to the uterus.

The unfertilized egg lives only for a day or so. It travels along the **Fallopian tube**, where fertilization may occur if sperm are present.



Eggs or ova are produced by the **ovaries** and are released at ovulation.

Front view of uterus and associated structures

If the egg is fertilized it will become implanted in the lining of the **uterus**. If it is not fertilized the prepared lining is shed, passing out through the vagina in a process called menstruation.

1. The female human reproductive system and associated structures are illustrated above. Label the structures using the following **word list** and the **BIOZONE Resource Hub**.
   Word list: *ovary, uterus (womb), vagina, Fallopian tube (oviduct), cervix, clitoris.*

2. (a) Name the organ labeled (**A**) in the diagram above: _____

   (b) Name the event associated with this organ that occurs every month: _____

   (c) Name the process by which mature ova are produced: _____

3. Where does fertilization occur? _____

4. In a few words or a short sentence, state the function of each of the structures labeled (a) - (c) in the above diagram:

   (a) _____

   (b) _____

   (c) _____

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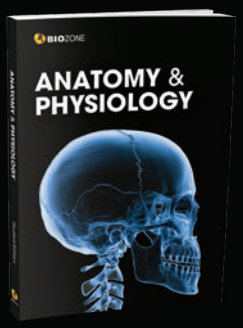

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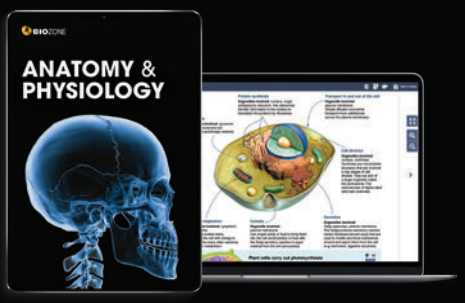

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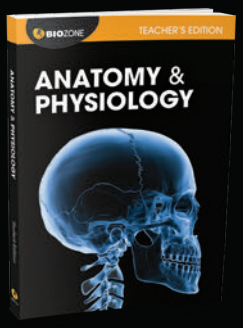

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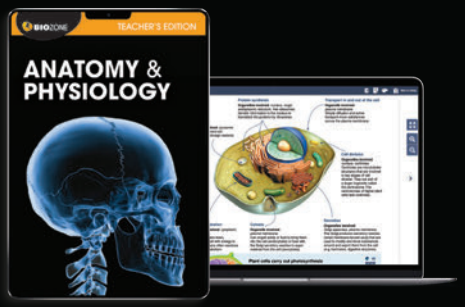

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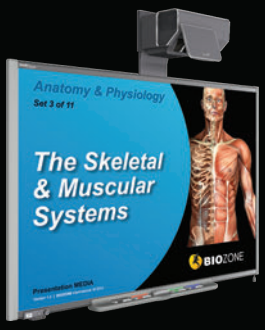

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