

AFCOE-Europe March 2017

PER ARILD STRUKSNES

ANATOMY AND PHYSIOLOGY

1



MY FAMILY

2



And as they that bare the ark were come unto Jordan, and the feet of the priests that bare the ark were dipped in the brim of the water, (for Jordan overfloweth all his banks all the time of harvest.) That the waters which came down from above stood and rose up upon an heap. . . . (Jos 3:15-16)

QURE FYSIOTERAPI

quire
FYSIOTERAPI

3

THE STORY OF QURE FYSIOTERAPI

THEN HE CALLED HIS TWELVE DISCIPLES TOGETHER, AND GAVE THEM POWER AND AUTHORITY OVER ALL DEVILS, AND TO CURE DISEASES. (LUKE 9:1)

quire
FYSIOTERAPI

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THE STORY OF QURE FYSIOTERAPI

**CURE: GREEK – THERAPEUŌ
TO SERVE, DO SERVICE, TO HEAL, CURE,
RESTORE TO HEALTH**

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FYSIOTERAPI

5

THE STORY OF QURE FYSIOTERAPI

AND HE SENT THEM TO PREACH THE KINGDOM OF GOD, AND TO HEAL THE SICK. (LUKE 9:2)

quire
FYSIOTERAPI

6

THE STORY OF QURE FYSIOTERAPI

HEAL: GREEK - IAOMAI=TO CURE, HEAL, TO MAKE HOLE. TO FREE FROM ERRORS AND SINS, TO BRING ABOUT (ONE'S) SALVATION

quire
FYSIOTERAPI

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ANATOMY AND PHYSIOLOGY

I will praise thee, for I am fearfully and wonderfully made: marvellous are thy works; and that my soul knoweth right well.

My substance was not hid from thee, when I was made in secret, and curiously wrought in the lowest parts of the earth.
Ps 139:14-15

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ANATOMY AND PHYSIOLOGY

So closely is health related to our happiness, that we cannot have the latter without the former. A practical knowledge of the science of human life is necessary in order to glorify God in our bodies. It is therefore of the highest importance that among the studies selected for childhood, physiology should occupy the first place. How few know anything about the structure and functions of their own bodies and of nature's laws! Many are drifting about without knowledge, like a ship at sea without compass or anchor; and what is more, they are not interested to learn how to keep their bodies in a healthy condition and prevent disease. — (CH 38.1

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ANATOMY AND PHYSIOLOGY

Anatomy – the study of the structure of body parts and their relationships to one another

Physiology – the study of the function of the body's structural machinery

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Characteristics of Life

And the LORD God formed man of the dust of the ground, and breathed into his nostrils the breath of life; and man became a living soul. (Gen 2,7)

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Characteristics of Life

- **Movement** – change in position; motion
- **Responsiveness** – reaction to a change
- **Growth** – increase in body size; no change in shape
- **Reproduction** – production of new organisms and new cells
- **Respiration** – obtaining oxygen; removing carbon dioxide; releasing energy from foods

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Characteristics of Life

- Digestion – breakdown of food substances into simpler forms
- Absorption – passage of substances through membranes and into body fluids
- Circulation – movement of substances in body fluids
- Assimilation – changing of absorbed substances into chemically different forms
- Excretion – removal of wastes produced by metabolic reactions

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Maintenance of Life

Life depends on 5 environmental factors:

- Water
- Food
- Oxygen
- Heat
- Pressure

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Maintenance of Life

- Water
 - most abundant substance in body
 - required for metabolic processes
 - required for transport of substances
 - regulates body temperature
- Food
 - provides necessary nutrients
 - supplies energy
 - supplies raw materials

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Maintenance of Life

- Oxygen (gas)
 - one-fifth of air
 - used to release energy from nutrients
- Heat
 - form of energy
 - partly controls rate of metabolic reactions
- Pressure
 - application of force on an object
 - atmospheric pressure – important for breathing
 - hydrostatic pressure – keeps blood flowing

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Homeostasis

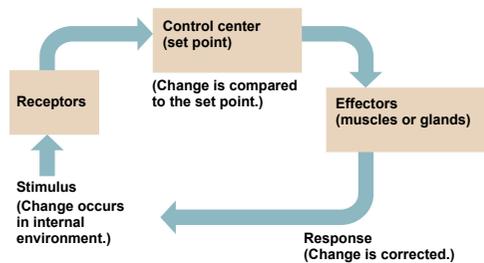
* Maintaining of a stable internal environment

- Body tries to maintain balance
- If we are warm - we sweat
- If we are cold - we shake

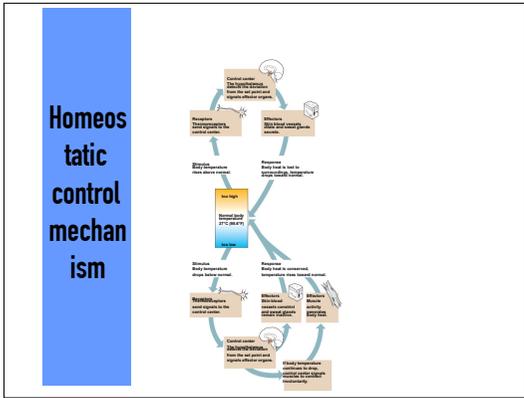
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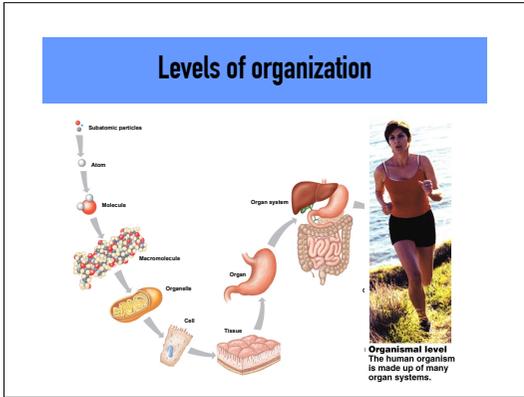
Homeostatic control mechanism



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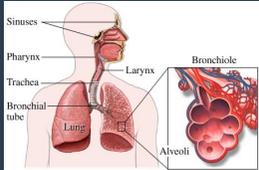
- Blood vessels transport blood
- Carries oxygen and carbon dioxide
- Also carries nutrients and wastes
- Heart pumps blood through blood vessels

THE CARDIOVASCULAR SYSTEM

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FOOTLEARN

21

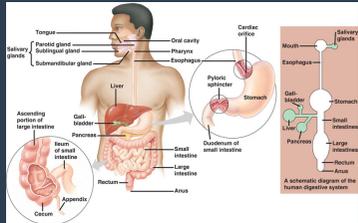
- Keeps blood supplied with oxygen
- Removes carbon dioxide
- Gas exchange occurs through walls of air sacs in the lungs



THE RESPIRATORY SYSTEM

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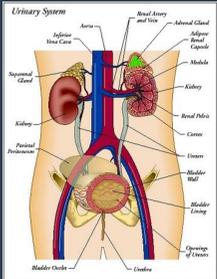


- Breaks down food into absorbable units
- Indigestible foodstuffs eliminated as feces

THE DIGESTIVE SYSTEM

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- Eliminates nitrogenous wastes
- Regulates water, electrolyte, and acid-base balance

THE URINARY SYSTEM

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- Protects and supports body organs
- Provides a framework for muscles
- Blood cells formed within bones
- Stores minerals

THE SKELETAL SYSTEM

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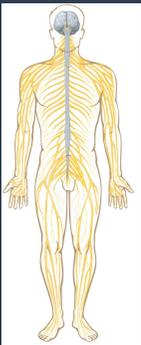


- Allows manipulation of environment
- Locomotion
- Facial expression
- Maintains posture
- Produces heat

THE MUSCULAR SYSTEM

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- Fast-acting control system
- Responds to internal and external changes

THE NERVOUS SYSTEM

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Endocrine System

- Glands secrete hormones that regulate
- Growth
- Reproduction
- Nutrient use

THE ENDOCRINE SYSTEM

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Lymph nodes

- Picks up fluid leaked from blood vessels
- Disposes of debris in the lymphatic system
- Houses white blood cells (lymphocytes)
- Mounts attack against foreign substances in the body

THE LYMPHATIC SYSTEM

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• Anatomical position – a common visual reference point

• Person stands erect with feet together and eyes forward

• Palms face forward with the thumbs pointed away from the body

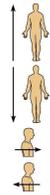
GROSS ANATOMY

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PHYSIOTHERAPY

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ORIENTATION AND DIRECTIONAL TERMS

Term	Definition	Example
Superior (cranial)	Toward the head end or upper part of a structure or the body; above	The head is superior to the abdomen.
Inferior (caudal)	Away from the head end or toward the lower part of a structure or the body; below	The navel is inferior to the chin.
Anterior (ventral)*	Toward or at the front of the body; in front of	The breastbone is anterior to the spine.
Posterior (dorsal)*	Toward or at the back of the body; behind	The heart is posterior to the breastbone.



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ORIENTATION AND DIRECTIONAL TERMS

Term	Definition	Example
Medial	Toward or at the midline of the body; on the inner side of	The heart is medial to the arm.
Lateral	Away from the midline of the body; on the outer side of	The arms are lateral to the chest.
Proximal	Closer to the origin of the body part or the point of attachment of a limb to the body trunk	The elbow is proximal to the wrist.
Distal	Farther from the origin of a body part or the point of attachment of a limb to the body trunk	The knee is distal to the thigh.



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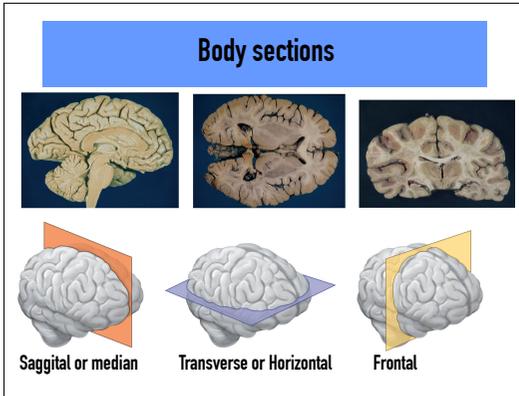
ORIENTATION AND DIRECTIONAL TERMS

Term	Definition	Example
Superficial (external)	Toward or at the body surface	The skin is superficial to the skeletal muscles.
Deep (internal)	Away from the body surface; more internal	The lungs are deep to the skin.
Ipsilateral	On the same side	The right hand and right foot are ipsilateral.
Contralateral	On opposite sides	The right hand and left foot are contralateral.

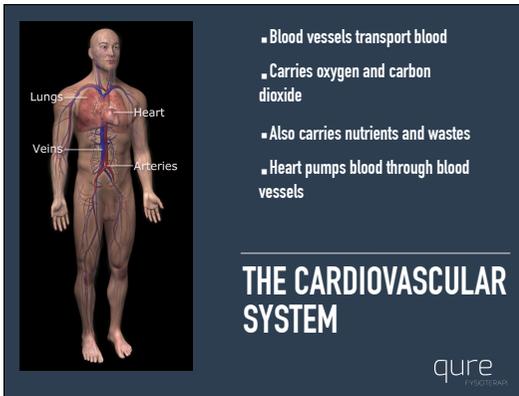


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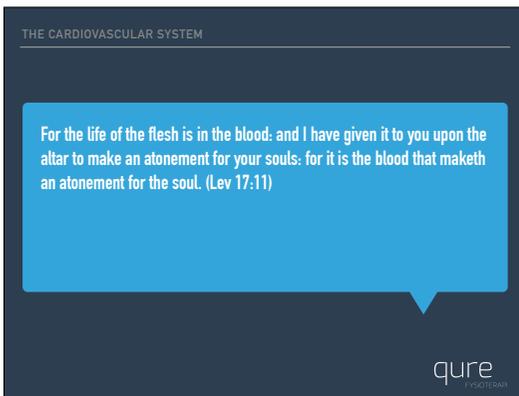
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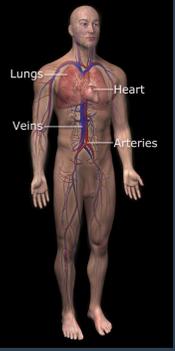
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THE CARDIOVASCULAR SYSTEM

Only be sure that thou eat not the blood: for the blood is the life; and thou mayest not eat the life with the flesh. (Deut 12:23)

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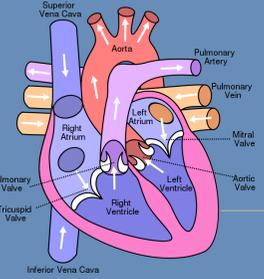


- Three parts:
- Heart
- Blood vessels
- Blood

THE CARDIOVASCULAR SYSTEM

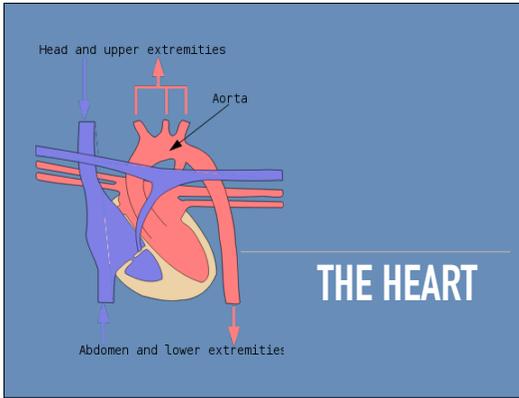
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PHYSICIAN

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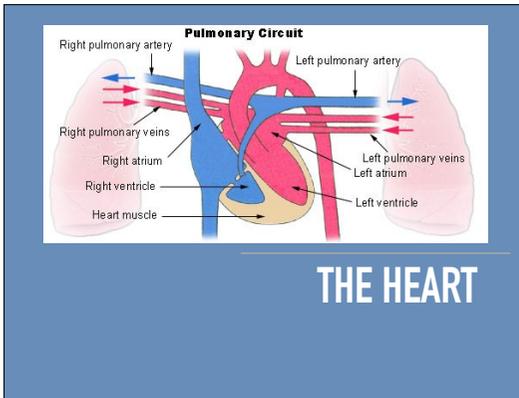


THE HEART

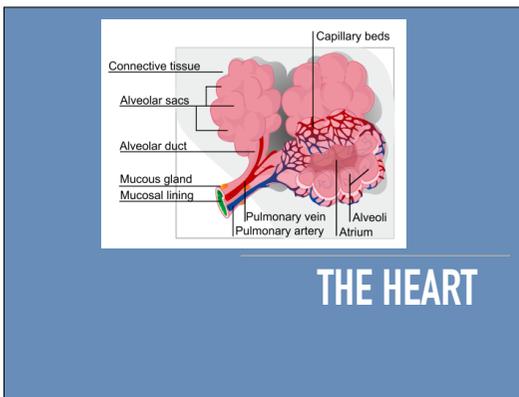
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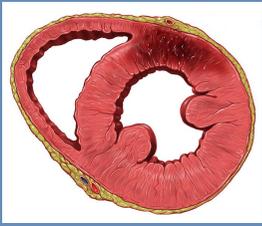
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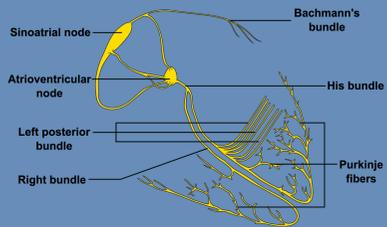


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THE HEART

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THE HEART

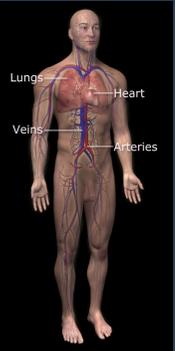
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Heart rate
Pulse

THE HEART

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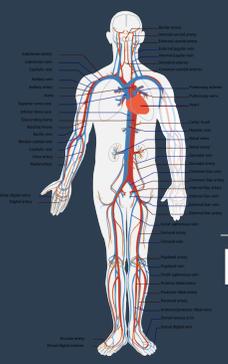
Lungs
 Heart
 Veins
 Arteries

- Three parts:
- Heart
- **Blood vessels**
- Blood

THE CARDIOVASCULAR SYSTEM

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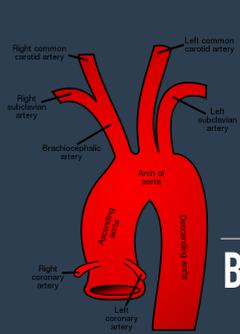
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BLOOD VESSELS

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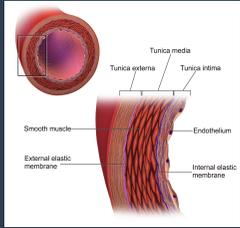


Right common carotid artery
 Left common carotid artery
 Right subclavian artery
 Left subclavian artery
 Brachiocephalic artery
 Arch of aorta
 Ascending aorta
 Descending aorta
 Right coronary artery
 Left coronary artery

BLOOD VESSELS

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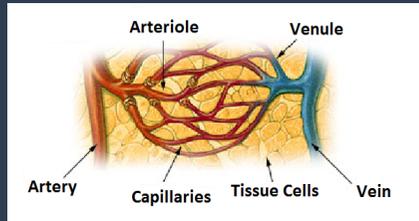
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BLOOD VESSELS

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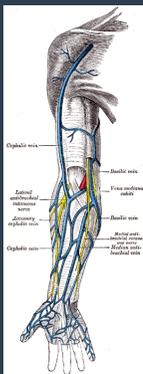
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BLOOD VESSELS

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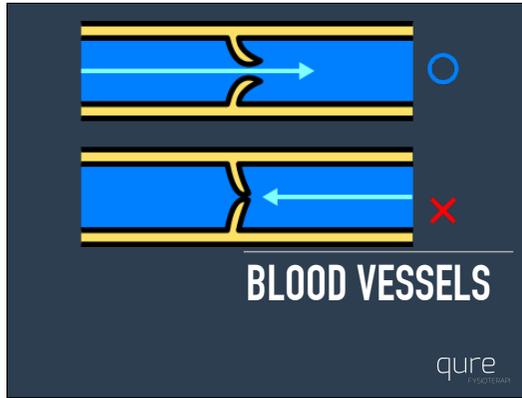
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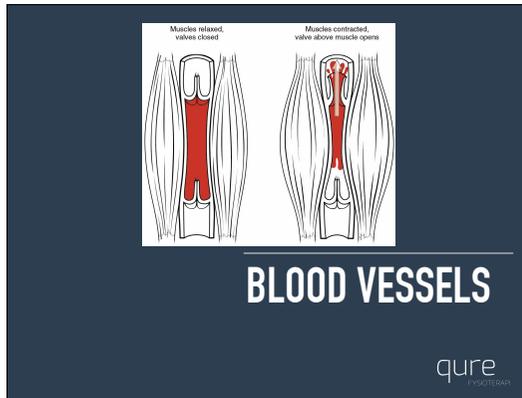
BLOOD VESSELS

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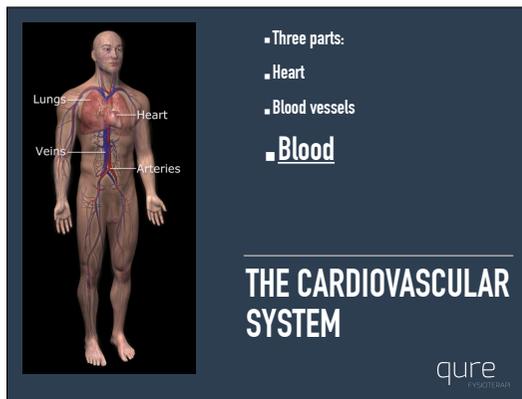
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- 4-5 liters in our body
- about 5-7% of our body weight
- about 38° C is ideal

THE BLOOD

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- Consists of:
- 55% plasma
- 45% blood cells

THE BLOOD

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- Consists of:
- 55% plasma (90% water, 10% difference substances, waste products, oxygen etc)

DRINK WATER!!

THE BLOOD

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57



- Consists of:
- 55% plasma
- 45% blood cells

THE BLOOD

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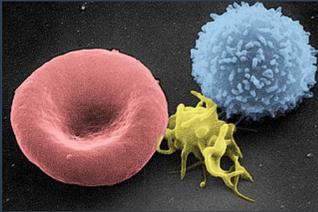


- Consists of:
- 55% plasma
- 45% blood cells (99% erythrocytes
- red blood cells - 0.5% leucocytes
- white blood cells - 0.5%
thrombocytes - platelets)

THE BLOOD

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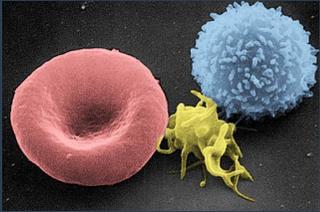
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THE BLOOD

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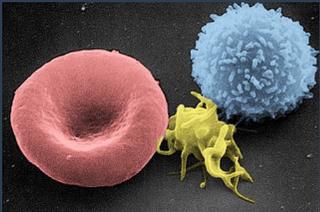
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THE BLOOD

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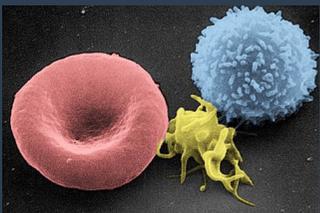
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THE BLOOD

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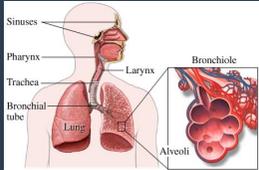


THE BLOOD

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- Keeps blood supplied with oxygen
- Removes carbon dioxide
- Gas exchange occurs through walls of air sacs in the lungs



THE RESPIRATORY SYSTEM

qure
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ANATOMY AND PHYSIOLOGY

Prayer is the breath of the soul. It is the secret of spiritual power. No other means of grace can be substituted, and the health of the soul be preserved. Prayer brings the heart into immediate contact with the Well-spring of life, and strengthens the sinew and muscle of the religious experience. — (HP 83.5)

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ANATOMY AND PHYSIOLOGY

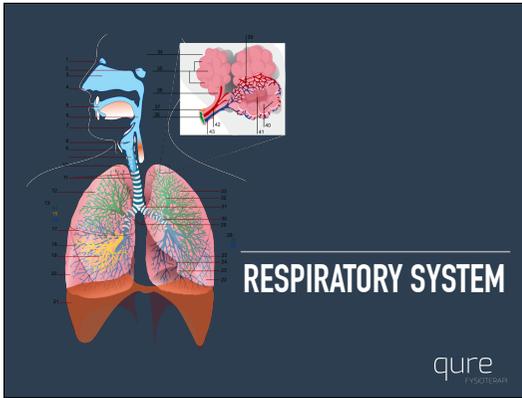
Two zones:

Conducting zone - where air travels

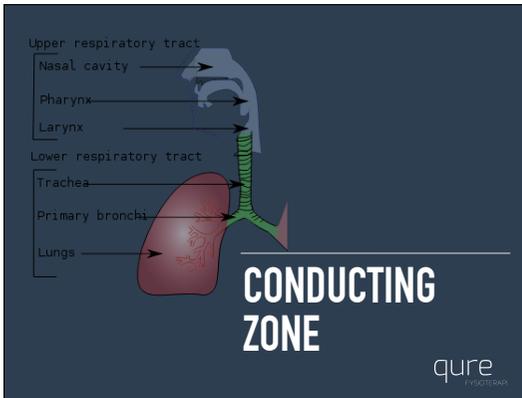
Respiratory zone - where the exchange of O₂ and CO₂ takes place.

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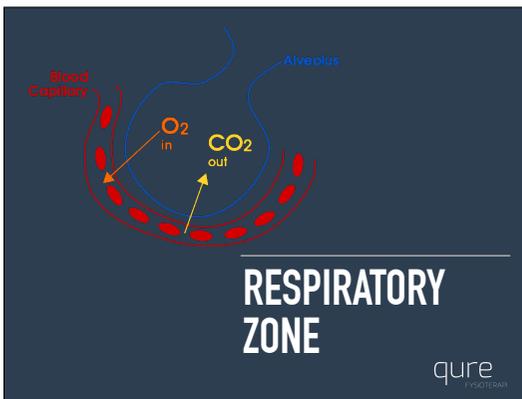
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RESPIRATORY SYSTEM

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RESPIRATORY SYSTEM

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THE DIGESTIVE SYSTEM

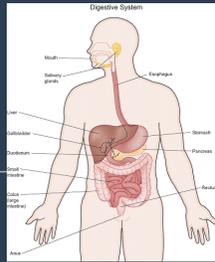
- Breaks down food into absorbable units
- Indigestible foodstuffs eliminated as feces

qure
FYSIOTHERAPY

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Introduction

THE DIGESTIVE SYSTEM IS USED FOR BREAKING DOWN FOOD INTO NUTRIENTS WHICH THEN PASS INTO THE CIRCULATORY SYSTEM AND ARE TAKEN TO WHERE THEY ARE NEEDED IN THE BODY.

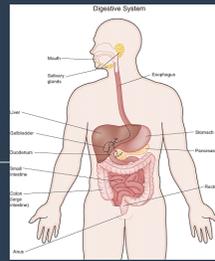


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Introduction

- There are four stages to food processing:
 1. Ingestion: taking in food
 2. Digestion: breaking down food into nutrients
 3. Absorption: taking in nutrients by cells
 4. Egestion: removing any leftover wastes

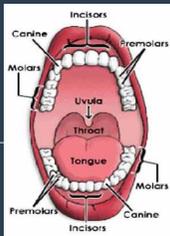


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THE HUMAN DIGESTIVE SYSTEM

- Begins when food enters the mouth.
- It is physically broken down by the teeth.
- It is begun to be chemically broken down by amylase, an enzyme in saliva that breaks down carbohydrates.

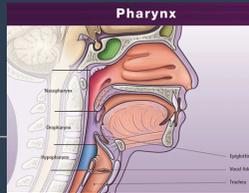


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THE HUMAN DIGESTIVE SYSTEM

- The tongue moves the food around until it forms a ball called a bolus.
- The bolus is passed to the pharynx (throat) and the epiglottis makes sure the bolus passes into the esophagus and not down the windpipe!

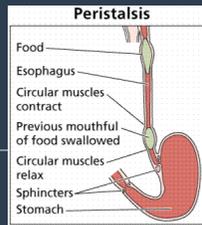


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THE HUMAN DIGESTIVE SYSTEM

- The bolus passes down the esophagus by peristalsis.
- Peristalsis is a wave of muscular contractions that push the bolus down towards the stomach.

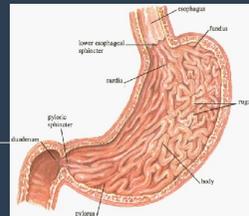


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THE HUMAN DIGESTIVE SYSTEM

- To enter the stomach, the bolus must pass through the lower esophageal sphincter, a tight muscle that keeps stomach acid out of the esophagus.

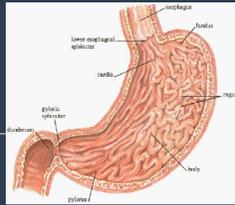


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THE HUMAN DIGESTIVE SYSTEM

- The stomach has folds called rugae and is a big muscular pouch which churns the bolus (Physical Digestion) and mixes it with gastric juice, a mixture of stomach acid, mucus and enzymes.

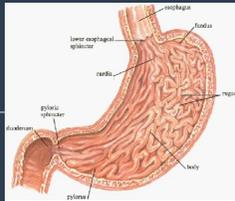


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THE HUMAN DIGESTIVE SYSTEM

- The acid kills off any invading bacteria or viruses.
- The enzymes help break down proteins and lipids. Chemical Digestion.
- The mucus protects the lining of the stomach from being eaten away by the acid.

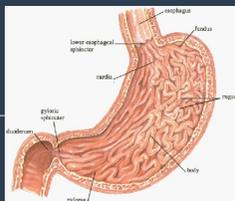


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THE HUMAN DIGESTIVE SYSTEM

- The stomach does do some absorption too.
- Some medicines (i.e. aspirin), water and alcohol are all absorbed through the stomach.
- The digested bolus is now called chyme and it leaves the stomach by passing through the pyloric sphincter.

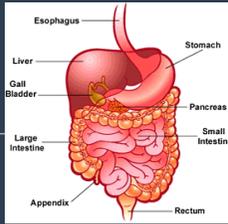


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THE HUMAN DIGESTIVE SYSTEM

- Chyme is now in the small intestine.
- The majority of absorption occurs here.
- The liver and pancreas help the small intestine to maximize absorption.
- The small intestine is broken down into three parts:



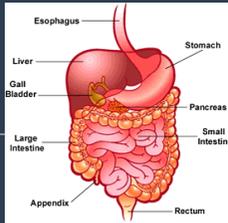
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THE HUMAN DIGESTIVE SYSTEM

1. Duodenum

- Bile, produced in the liver but stored in the gall bladder, enters through the bile duct. It breaks down fats.
- The pancreas secretes pancreatic juice to reduce the acidity of the chyme.



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THE HUMAN DIGESTIVE SYSTEM

1. Jejunum

- The jejunum is where the majority of absorption takes place.
- It has tiny fingerlike projections called villi lining it, which increase the surface area for absorbing nutrients.



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THE HUMAN DIGESTIVE SYSTEM

1. Each villi itself has tiny fingerlike projections called microvilli, which further increase the surface area for absorption.

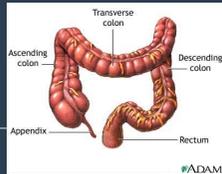


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FYSIOLOGIE

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THE HUMAN DIGESTIVE SYSTEM

1. The large intestine (or colon) is used to absorb water from the waste material leftover and to produce vitamin K and some B vitamins using the helpful bacteria that live here.

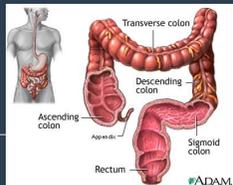


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86

THE HUMAN DIGESTIVE SYSTEM

- All leftover waste is compacted and stored at the end of the large intestine called the rectum.
- When full, the anal sphincter loosens and the waste, called feces, passes out of the body through the anus.

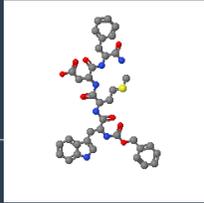


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THE HUMAN DIGESTIVE SYSTEM

- The endocrine, nervous, digestive and circulatory systems all work together to control digestion.
- Before we eat, smelling food releases saliva in our mouths and gastrin in our stomachs which prepares the body for a snack.



The Hormone Gastrin

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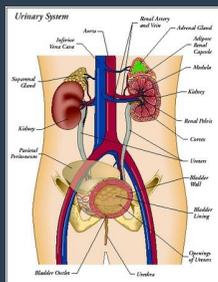
THE HUMAN DIGESTIVE SYSTEM

- A large meal activates receptors that churn the stomach and empty it faster.
- If the meal was high in fat, digestion is slowed, allowing time for the fat to be broken down.
- Hence why we feel fuller after eating a high fat meal.



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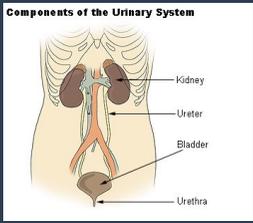
- Eliminates nitrogenous wastes
- Regulates water, electrolyte, and acid-base balance

THE URINARY SYSTEM

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90

Components of the Urinary System

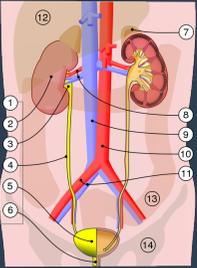


Kidney
Ureter
Bladder
Urethra

THE URINARY SYSTEM

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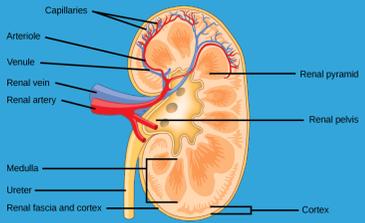
91



THE URINARY SYSTEM

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Capillaries
Arteriole
Venule
Renal vein
Renal artery
Medulla
Ureter
Renal fascia and cortex
Renal pyramid
Renal pelvis
Cortex

THE URINARY SYSTEM

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93

The basic physiology of a nephron within a kidney

The labels are: 1. Glomerulus, 2. Efferent arteriole, 3. Bowman's capsule, 4. Proximal tube, 5. Cortical collecting tube, 6. Distal tube, 7. Loop of Henle, 8. Collecting duct, 9. Peritubular capillaries, 10. Arcuate vein, 11. Arcuate artery, 12. Afferent arteriole, and 13. Juxtaglomerular apparatus.

THE URINARY SYSTEM

quire
PHYSIOLOGY

94

THE URINARY SYSTEM

quire
PHYSIOLOGY

95

THE URINARY SYSTEM

quire
PHYSIOLOGY

96

Urinary Bladder

THE URINARY SYSTEM

quire
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97

Disorders:
Infection in urinary tract
High blood pressure

THE URINARY SYSTEM

quire
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98

- Protects and supports body organs
- Provides a framework for muscles
- Blood cells formed within bones
- Stores minerals

THE SKELETAL SYSTEM

quire
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99

ANATOMY AND PHYSIOLOGY

A merry heart doeth good like a medicine: but a broken spirit drieth the bones. (Proverbs 17:22)

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PHYSIOTHERAPY

100

ANATOMY AND PHYSIOLOGY

- **SUPPORT:** Hard framework that supports and anchors the soft organs of the body.
- **PROTECTION:** Surrounds organs such as the brain and spinal cord.
- **MOVEMENT:** Allows for muscle attachment therefore the bones are used as levers.

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PHYSIOTHERAPY

101

ANATOMY AND PHYSIOLOGY

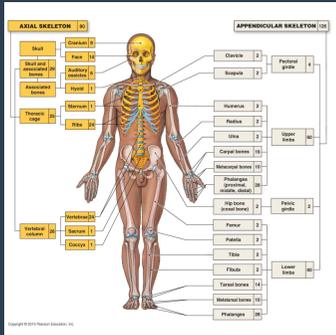
- **STORAGE:** Minerals and lipids are stored within bone material.
- **BLOOD CELL FORMATION:** The bone marrow is responsible for blood cell production.

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PHYSIOTHERAPY

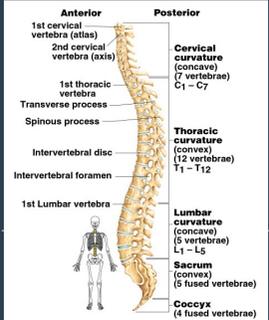
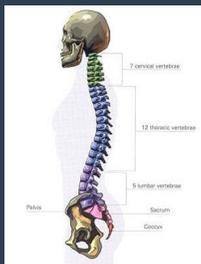
102

- Axial skeleton
- Appendicular skeleton

103

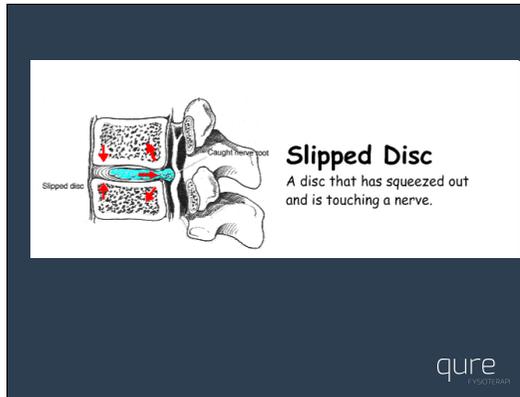


104

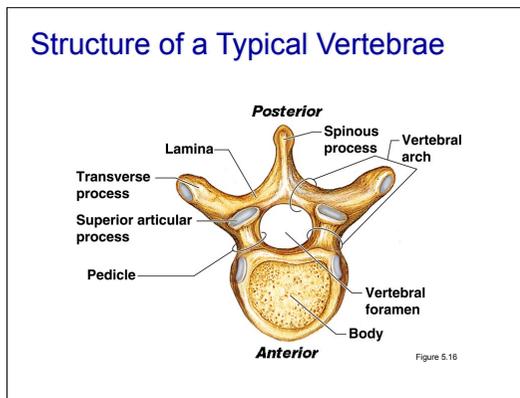


105

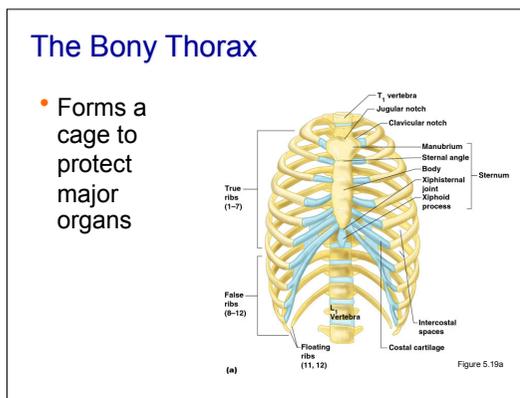
106



107

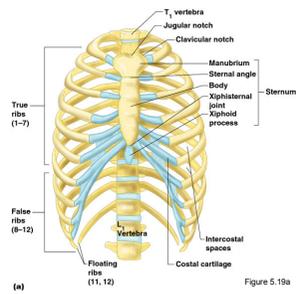


108



The Bony Thorax

- Made-up of three parts
- Sternum
- Ribs
- Thoracic vertebrae



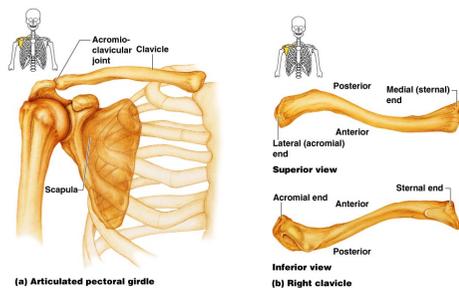
109

The Pectoral (Shoulder) Girdle

- Composed of two bones
 - Clavicle – collarbone
 - Scapula – shoulder blade
- These bones allow the upper limb to have exceptionally free movement

110

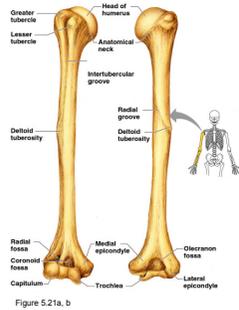
Bones of the Shoulder Girdle



111

Bones of the Upper Limb

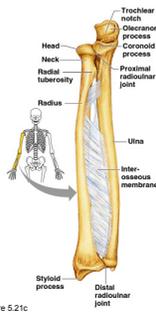
- The arm is formed by a single bone
- Humerus



112

Bones of the Upper Limb

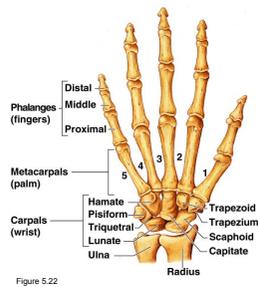
- The forearm has two bones
- Ulna
- Radius



113

Bones of the Upper Limb

- The hand
- Carpals – wrist
- Metacarpals – palm
- Phalanges – fingers



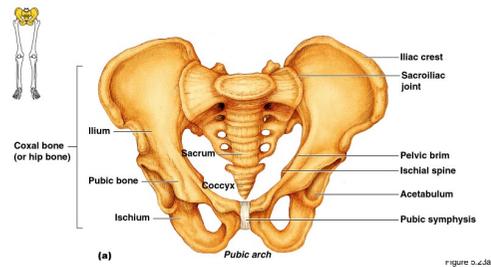
114

Bones of the Pelvic Girdle

- Hip bones
- Composed of three pair of fused bones
 - Ilium
 - Ischium
 - Pubic bone
- The total weight of the upper body rests on the pelvis
- Protects several organs
 - Reproductive organs
 - Urinary bladder
 - Part of the large intestine

115

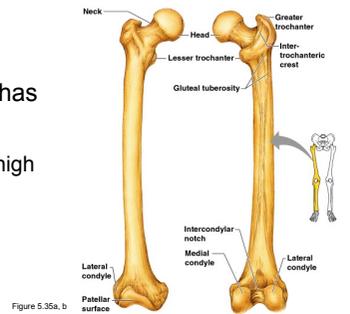
The Pelvis



116

Bones of the Lower Limbs

- The thigh has one bone
- Femur – thigh bone



117

Bones of the Lower Limbs

- The leg has two bones
- Tibia
- Fibula



Figure 5.35c

118

Bones of the Lower Limbs

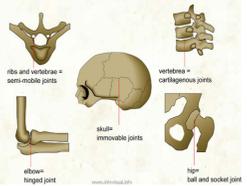
- The foot
- Tarsus – ankle
- Metatarsals – sole
- Phalanges – toes



Figure 5.25

119

TYPES OF JOINTS FOUND IN THE HUMAN BODY



**JOINTS AND
ARTICULATIONS**
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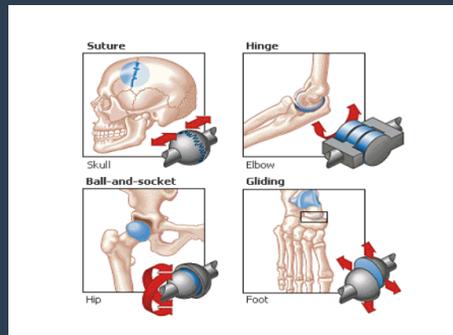
120

Types of joints:

- (1) Immovable.
- (2) Ball-and-socket joints
- (3) Hinge joints
- (4) Pivot joints: such as the neck joints, allow limited rotating movements.
- (5) Sliding Joint
- (6) Ellipsoidal Joint

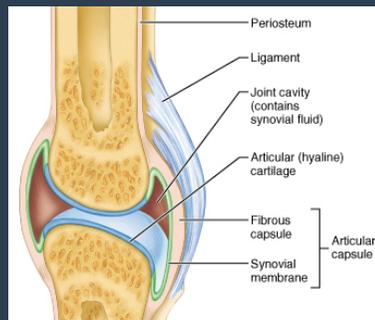
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121



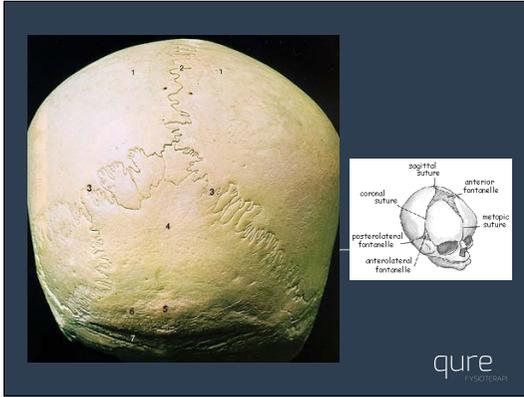
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PHYSIOTHERAPIE

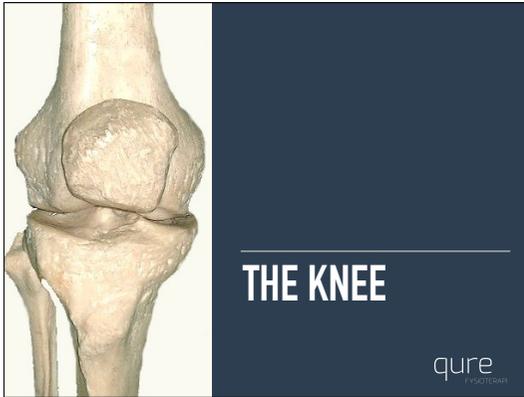
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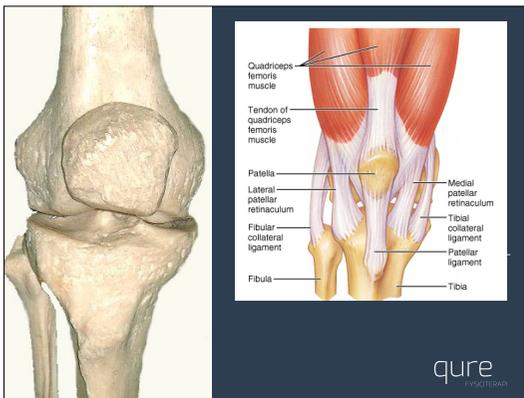


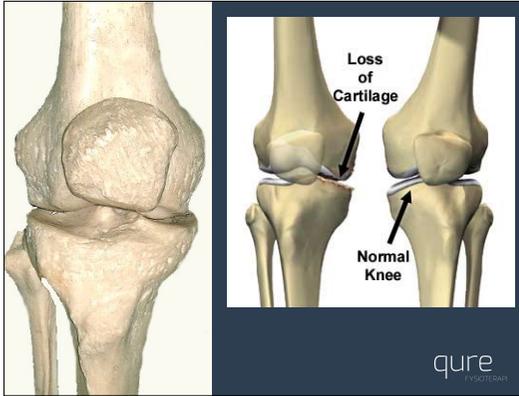
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123









127

General Motion (Articulations) of Joints: Terminology

Joints generally have motion opposite of one another

- (1) **Flexion:** bending movement that decreases the angle between two parts (bending the elbow or making a fist)
Extension: opposite of flexion, movement increases angle (standing up- knees extended)
- (2) **Abduction:** motion that pulls away from the body (spreading fingers or toes)
Adduction: opposite of abduction, motion that pulls towards the body (closing fingers or toes)
- (3) **Elevation:** upward movement (hold arm up)
Depression: downward movement (bring arm back down)
- (4) **Pronation:** rotation of the forearm so palm faces down
Supination: rotation of the forearm so that the palm faces up

- **Rotation** - A motion that occurs when a part turns on its axis. The head rotates on the neck, as in shaking the head 'no'.

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Flexion and Extension of the Vertebral Column

When extension proceeds beyond anatomical position it is called **hyperextension**.

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129

Flexion and Extension of the Head

Hyperextension Extension

Flexion

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130

- Allows manipulation of environment
- Locomotion
- Facial expression
- Maintains posture
- Produces heat

THE MUSCULAR SYSTEM

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PHYSIOTHERAPY

131

- Allows manipulation of environment
- Locomotion
- Facial expression
- Maintains posture
- Produces heat

THE MUSCULAR SYSTEM

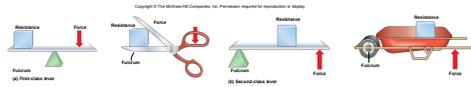
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132

Body Movement

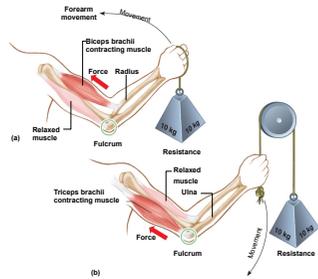
Four Basic Components of Levers:

1. Rigid bar – bones
2. Fulcrum – point on which bar moves; joint
3. Object – moved against resistance; weight
4. Force – supplies energy for movement; muscles



133

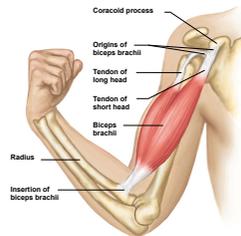
Levers and Movement



134

Origin and Insertion

- **Origin** – immovable end
- **Insertion** – movable end

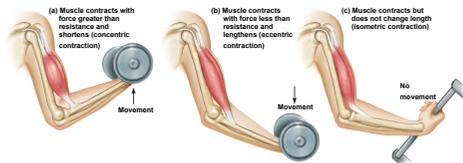


135

Types of Contractions

• **Isotonic** – muscle contracts and changes length

• **Isometric** – muscle contracts but does not change length



136

Fast Twitch and Slow Twitch Muscle Fibers

• **Slow-twitch fibers (Type I)**

- Always oxidative
- Resistant to fatigue
- Red fibers
- Most myoglobin
- Good blood supply

• **Fast-twitch glycolytic fibers (Type IIa)**

- White fibers (less myoglobin)
- Poorer blood supply
- Susceptible to fatigue

• **Fast-twitch fatigue-resistant fibers (Type IIb)**

- Intermediate fibers
- Oxidative
- Intermediate amount of myoglobin
- Pink to red in color
- Resistant to fatigue

137

Introduction

Three (3) Types of Muscle Tissues

• **Skeletal Muscle**

- Usually attached to bones
- Under conscious control
- Somatic

• **Cardiac Muscle**

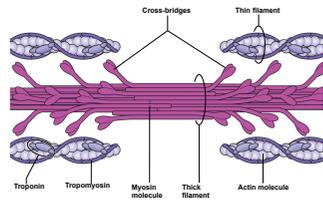
- Wall of heart
- Not under conscious control
- Autonomic

• **Smooth Muscle**

- Walls of most viscera, blood vessels and skin
- Not under conscious control
- Autonomic

138

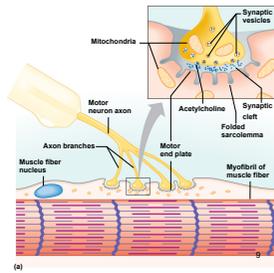
Myofilaments



142

142

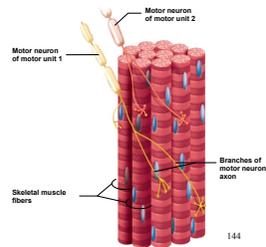
Neuromuscular Junction



(a)

143

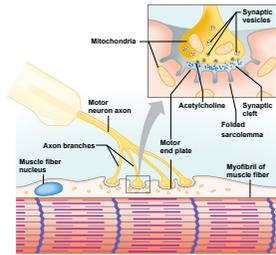
Motor Unit



144

144

Stimulus for Contraction

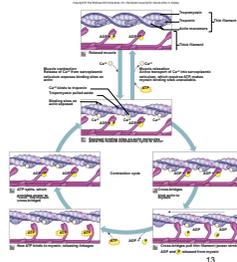


(e)

11

145

Excitation-Contraction Coupling



13

146



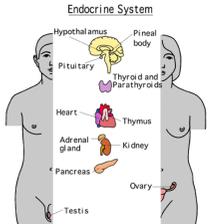
Examples of muscles (on the iPad)

THE MUSCULAR SYSTEM

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FOOTCARE

147

Endocrine System



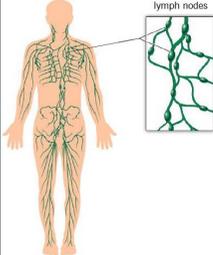
- Glands secrete hormones that regulate
- Growth
- Reproduction
- Nutrient use

THE ENDOCRINE SYSTEM

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EYK02E0001

148

lymph nodes

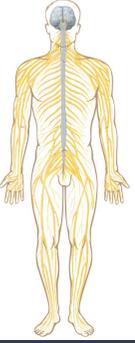


- Picks up fluid leaked from blood vessels
- Disposes of debris in the lymphatic system
- Houses white blood cells (lymphocytes)
- Mounts attack against foreign substances in the body

THE LYMPHATIC SYSTEM

quire
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149

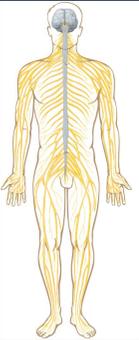


- Fast-acting control system
- Responds to internal and external changes

THE NERVOUS SYSTEM

quire
EYK02E0001

150



Central vs. Peripheral

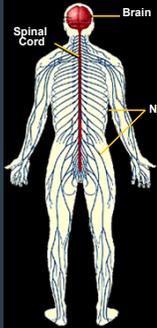
Central or CNS- brain and spinal cord

Peripheral- nerves connecting CNS to muscles and organs

THE NERVOUS SYSTEM

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151



3 kinds of neurons connect CNS to the body

- sensory
- motor
- interneurons

Motor - CNS to muscles and organs
Sensory - sensory receptors to CNS
Interneurons: Connections Within CNS

PERIPHERAL NERVOUS SYSTEM

quire
FYSIOTHERAPIE

152

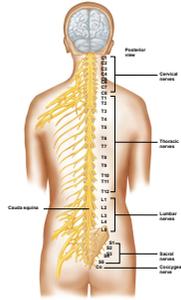
Nerve and Nerve Fiber Classification

- **Sensory nerves**
 - Conduct impulses into brain or spinal cord
- **Motor nerves**
 - Conduct impulses to muscles or glands
- **Mixed (both sensory and motor) nerves**
 - Contain both sensory nerve fibers and motor nerve fibers
 - Most nerves are mixed nerves
 - ALL spinal nerves are mixed nerves (except the first pair)

153

Spinal Nerves

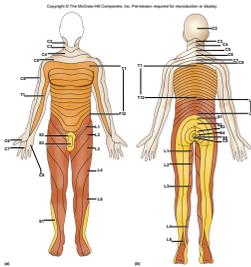
- ALL are mixed nerves (except the first pair)
- 31 pairs of spinal nerves:
 - 8 cervical nerves
 - (C1 to C8)
 - 12 thoracic nerves
 - (T1 to T12)
 - 5 lumbar nerves
 - (L1 to L5)
 - 5 sacral nerves
 - (S1 to S5)
 - 1 coccygeal nerve
 - (Co or Cc)



154

Dermatome

- An area of skin that the sensory nerve fibers of a particular spinal nerve innervate



155

Peripheral Nervous System

Skeletal
(Somatic)

Autonomic

Sympathetic

Parasympathetic

PERIPHERAL
NERVOUS SYSTEM
cure
FOOTCURE

156

SOMATIC SYSTEM

Nerves to/from spinal cord control muscle movements somatosensory inputs

Both Voluntary and reflex movements

Skeletal Reflexes simplest is spinal reflex arc

Brain
Sensory Neuron
Motor Neuron
Interneuron
Skin receptors
Muscle

PERIPHERAL NERVOUS SYSTEM

quire
INSISTENT

157

Reflex Arcs

- Reflexes are automatic, subconscious responses to stimuli within or outside the body
- Simple reflex arc (sensory – motor)
- Most common reflex arc (sensory – association – motor)

Sensory or afferent neuron
Receptor
Central Nervous System
Motor or efferent neuron
Effector (muscle or gland)

(a)

158

General Components of a Spinal Reflex

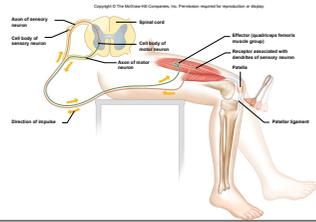
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Receptor
Sensory neuron
Cell body of sensory neuron
Interneuron
Motor neuron
Effector (muscle or gland)
Spinal cord
Dorsal
White matter
Gray matter
Ventral
Central canal

159

Reflex Behavior

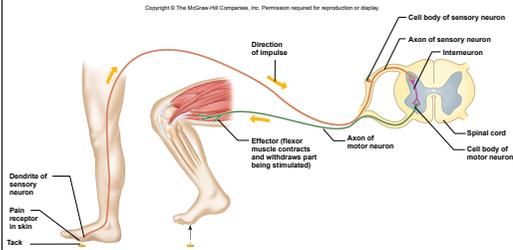
- Example is the *knee-jerk reflex*
- Simple monosynaptic reflex
- Helps maintain an upright posture



160

Reflex Behavior

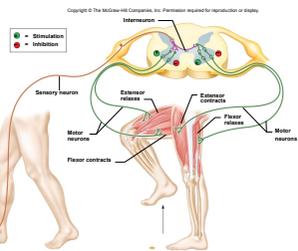
- Example is a *withdrawal reflex*
- Prevents or limits tissue damage



161

Reflex Arc

- Example *crossed extensor reflex*
- Crossing of sensory impulses within the reflex center to produce an opposite effect



162

AUTONOMIC SYSTEM

Two divisions:

Sympathetic
Parasympathetic

Control involuntary functions

heartbeat
blood pressure
respiration
perspiration
digestion

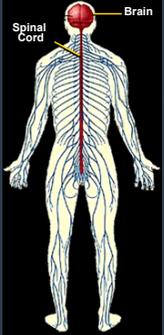
Can be influenced by thought and emotion

- ☑ "Fight or flight" response
- ☑ Release adrenaline and noradrenaline
- ☑ Increases heart rate and blood pressure
- ☑ Increases blood flow to skeletal muscles
- ☑ Inhibits digestive functions
- ☑ "Rest and digest" system
- ☑ Calms body to conserve and maintain energy
- ☑ Lowers heartbeat, breathing rate, blood pressure

PERIPHERAL NERVOUS SYSTEM

quire

163



Brain
Spinal Cord

3 kinds of neurons connect CNS to the body

- sensory
- motor
- interneurons

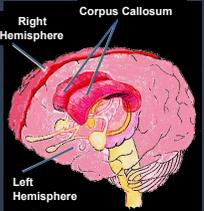
Motor - CNS to muscles and organs
Sensory - sensory receptors to CNS
Interneurons: Connections Within CNS

BRAIN AND SPINAL CORD

quire

164

BRAIN HAS TWO HEMISPHERES



Right Hemisphere
Left Hemisphere
Corpus Callosum

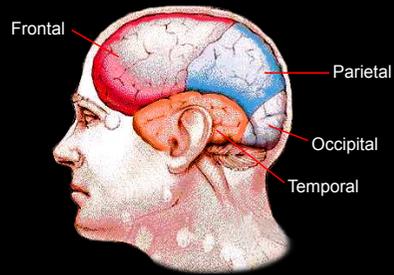
- ☑ Left & Right sides are separate
- ☑ Corpus Callosum : major pathway between hemispheres
- ☑ Some functions are 'lateralized'
- ☑ language on left
- ☑ math, music on right
- ☑ Lateralization is never 100%

BRAIN AND SPINAL CORD

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165

Each hemisphere is divided into 4 lobes



166

Sensory Information sent to opposite hemisphere

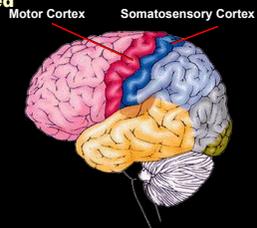
- Principle is Contralateral Organization
- Sensory data crosses over in pathways leading to the cortex
- Visual Crossover
 - left visual field to right hemisphere
 - right field to left
- Other senses similar



167

Contralateral Motor Control

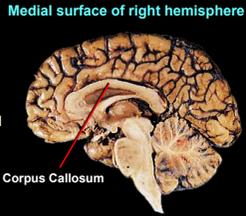
- Movements controlled by motor area
- Right hemisphere controls left side of body
- Left hemisphere controls right side
- Motor nerves cross sides in spinal cord



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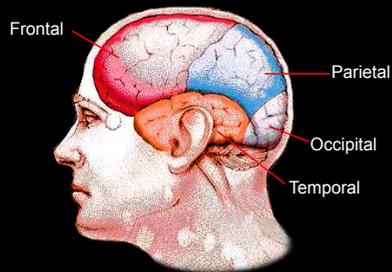
Corpus Callosum

- Major (but not only) pathway between sides
- Connects comparable structures on each side
- Permits data received on one side to be processed in both hemispheres
- Aids motor coordination of left and right side



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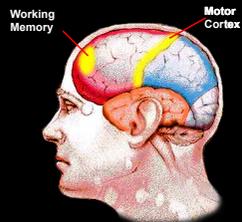
Localization of function



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Frontal Lobe

- Contains primary motor cortex
- No direct sensory input
- Important planning and sequencing areas
- Broca's area for speech
- Prefrontal area for working memory



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Functions of the Cerebral Lobes

TABLE 11.5 | Functions of the Cerebral Lobes

Lobe	Functions
Frontal lobes	Association areas carry on higher intellectual processes for concentrating, planning, complex problem solving, and judging the consequences of behavior. Motor areas control movements of voluntary skeletal muscles.
Parietal lobes	Sensory areas provide sensations of temperature, touch, pressure, and pain involving the skin. Association areas function in understanding speech and in using words to express thoughts and feelings.
Temporal lobes	Sensory areas are responsible for hearing. Association areas interpret sensory experiences and remember visual scenes, music, and other complex sensory patterns.
Occipital lobes	Sensory areas are responsible for vision. Association areas combine visual images with other sensory experiences.

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Hemisphere Dominance

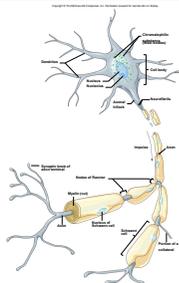
• The left hemisphere is dominant in most individuals

- Dominant hemisphere controls:
 - Speech
 - Writing
 - Reading
 - Verbal skills
 - Analytical skills
 - Computational skills
- Nondominant hemisphere controls:
 - Nonverbal tasks
 - Motor tasks
 - Understanding and interpreting musical and visual patterns
 - Provides emotional and intuitive thought processes

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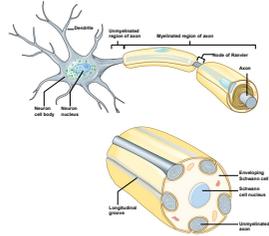
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Neuron Structure



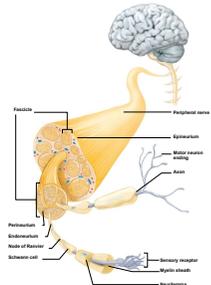
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Myelination of Axons



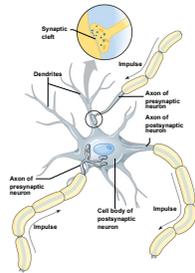
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Structure of a Peripheral Nerve



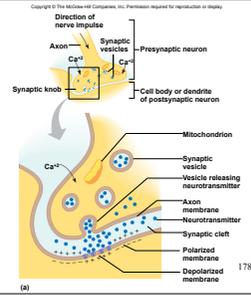
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The Synapse



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Synaptic Transmission



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