Human Anatomy and Body Systems
Levels of Organization

Remember, the human body is organized in several levels, from the simplest to the most complex.

**Cells** – the basic unit of life

**Tissues** – clusters of cells performing a similar function

**Organs** – made of tissues that perform one specific function

**Organ Systems** – groups of organs that perform a specific purpose in the human body

***The purpose of the 11 organ systems is for the human body to maintain homeostasis.***
4- Cell types

**muscle tissue**
most abundant tissue
controls internal movement
digestion, blood through veins
external movement of body

**epithelial tissue**
covering for body & organs
linings of organs & vessels

**connective tissue**
holds organs in place
ligaments, tendons, some
keep organs in place

**nervous tissue**
receives messages from body’s
internal and external messages
analyze data & direct response
The 11 Human Body Systems

The 11 human body systems are as follows:

-- nervous system                      -- integumentary system
-- respiratory system                   -- digestive system
-- excretory system                     -- skeletal system
-- muscular system                      -- circulatory system
-- endocrine system                     -- reproductive system
-- lymphatic (immune) system
The Circulatory System

Purpose: to deliver oxygenated blood to the various cells and organ systems in your body so they can undergo cellular respiration

Cell type - Muscle

Major Organs and Their Functions

Heart – the major muscle of the circulatory system

-- pumps deoxygenated blood into the lungs, where it gets oxygenated, returned to the heart, and then pumped out through the aorta to the rest of the body

-- valve regulate the flow of blood between the chambers
Organ system Interactions

• With lungs – exchange O₂ & CO₂
• With digestive system - pick up nutrients for transport throughout the body
• With excretory – blood is filtered to remove toxins and some water
• Nervous system – heart-beat regulation & blood pressure
Image of the Circulatory System

- anterior vena cava
- posterior vena cava
- heart
- lung
- stomach
- aorta
- spleen
- portal vein
- liver
- kidney
- capillary bed
- intestine
The Nervous System

**Purpose**: to coordinate the body’s response to changes in its internal and external environment

**Cell type - Nerve**

**Major Organs and Their Functions**

**Brain** – control center of the body, where all processes are relayed through
- consists of cerebrum (controls though and senses) and cerebellum (controls motor functions)

**Spinal Cord** – sends instructions from the brain to the rest of the body and vice versa
- any organism with a major nerve cord is classified as a **chordate**

**Nerves** – conduct impulses to muscle cells throughout the body
Nerves – neurons clustered into bundles of fibers (axons)

- 3 types:
  1. Sensory – carry impulses from sense organs to brain and spinal cord.
  2. Motor – from brain or spinal to other organs.
  3. Interneuron – connects sensory and motor neurons.

Synapse – point at which a neuron can transfer an impulse to another cell.
Human Nervous System

1. Central Nervous System (CNS) – the control center.
   A. Brain – 100 billion cells neurons
      b. Cerebellum – coordinates and balances actions of muscles. (Posture, movement, and balance.)
      c. Brainstem – regulates blood pressure, heart rate, breathing, and swallowing. (Thalamus, hypothalamus, midbrain, pons, and medulla oblongata.)
Nerves – conduct impulses to muscle cells throughout the body
Organ system Interactions

- Nervous system is interactive with all other systems in the body – you name it it’s involved
The Respiratory System

**Purpose:** to provide the body with a fresh supply of oxygen for cellular respiration and remove the waste product carbon dioxide

**Cell type:** Epithelial

**Major Organs and Their Functions**

**Nose** – internal entry and exit point for air

**Pharynx** – serves as a passage way for both air and food at the back of the throat

**Larynx** – your “voicebox”, as air passes over your vocal chords, you speak

**Trachea** – the “windpipe”, or what connects your pharynx to your lungs -- a piece of skin, called the **epiglottis**, covers the trachea when you swallow, preventing food from entering.
**Bronchi** – the two large passageways that lead from the trachea to your lungs (one for each lung)

-- the bronchi are further subdivided into bronchioles

-- eventually, the further subdivisions lead to tiny air sacs called **alveoli**

-- alveoli are in clusters, like grapes

-- capillaries surrounding each alveolus is where the exchange of gases with the blood occurs

**Lungs** – contain the alveoli, bronchi and connective tissue

The **diaphragm** is the muscle that causes you to breath

-- hiccups are involuntary contractions of the diaphragm
WHY ARE ALVEOLI SO IMPORTANT?

• Alveoli are the air sacs of the lungs.
• They have thin walls made of simple cells and are surrounded by blood capillaries.
• Gas exchange occurs in the alveoli.
  – Oxygen gas is in higher concentration in the alveoli than in the blood and so it diffuses into the blood through a layer of cells.
  – Carbon dioxide is in higher concentration in the blood than the alveoli and so it diffuses into the alveoli through a layer of cells.
• The surface of alveoli are covered in a thin lipoprotein layer and it prevents them from collapsing during exhalation.
Organ system Interactions

- The respiratory system directly interacts with the circulatory system
- Indirectly interacts with the immune system (lining of the nasal and bronchiol cavities/tubes)
- Nervous system (smell & taste) – regulation of breathing
Image of the Respiratory System

- Nasal passages
- Mouth
- Epiglottis
- Trachea
- Larynx
- Pharynx (Throat)
- Right upper lobe
- Right bronchus
- Right middle lobe
- Right lower lobe
- Left upper lobe
- Pulmonary vein
- pulmonary arteries
- Bronchioles
- Pleura
- Alveoli
- Oxygen-rich blood
- Oxygen-poor blood

RIGHT LUNG  LEFT LUNG
The Digestive System

**Purpose:** to convert food particles into simpler micromolecules that can be absorbed into the bloodstream and used by the body

**Cell Type:** epithelial and muscle

**Major Organs and their Functions:**

**Mouth** – to chew and grind up food

-- saliva also begins the chemical breakdown

**Esophagus** – pipe connecting mouth to stomach

**Stomach** – secretes an extraordinarily strong acid (pH = 2) that leads to breakdown of food

-- once the food is broken down in the stomach and mixed with digestive juices, it is called **chyme**
Pancreas – secretes digestive enzymes, produces the hormone insulin that regulates blood sugar levels

-- also help neutralize stomach acid

Liver – produces bile, which breaks down fats in foods

Gallbladder – pouch-like organ that stores bile for future use

Small Intestine – after digestion is complete, the chyme enters the small intestine where it is absorbed into the bloodstream

-- the chyme is propelled along by folded surfaces called villi, on the intestine

Large Intestine – removes water from the chyme and gets the waste ready for excretion
Organ system Interactions

- Circulatory system – move nutrients to other parts of body
- Nervous system – regulation of peristaltic activity
- Endocrine system – hormones that regulate apatite and digestive enzyme release
- Excretory – removal of solid waste
The Lymphatic/Immune System

**Purpose:** to remove infectious diseases and other pathogens from the human body.

**Cell type - Epithelial**

**Major Organs and Their Functions**

**Skin** – also called the integumentary system, the skin is the body’s first line of defense.

**White Blood Cells** – recognize disease agents (antigens) and create antibodies to tag and remove these antigens.

-- phagocytes are the white blood cell type that actually eats and destroys these antigens.

**Lymph Nodes** – help restore fluid lost by the blood and return it to the circulatory system.

**Spleen** – produces and stores white blood cells.

**Thymus** – site of white blood cell maturation.
Organ system Interactions

- Integumentary – first line of defense
- Respiratory – mucus membranes
- Circulatory – transport of antibodies & white blood cells
- Endocrine – chemical stimulus response
- Excretory & digestive – elimination of pathogens
White blood cells - travel in both the lymph system and the blood stream
Integumentary System

• Purpose: temperature regulation, waste removal, sensory info, and protection

• Largest organ of the body = skin which has two layers.

• Skin, Hair, Nails

• Cell type – epithelial
Hair Functions

- Absorbs radiation from the sun that maybe harmful
- Reduces loss of heat
- Filters out dust and dirt
- Shows gender
- Sensitive to movement
Nail Functions

• Protects tips of fingers or toes
• Helps pick up small objects
• Enhances sensation of the finger by acting as a counterforce
• Scratching
The Epidermis

- Outermost layer of skin.
- Made of layers of epithelial cells.
- Outermost layer of cells are flattened, dead, and keratin filled.
- Keratin makes skin tough and waterproof.
- Skin is continually damaged, but replaces cells instead of repairing them.
- Layer of actively dividing cells at base of epidermis make new cells that move up to replace old ones on surface, producing keratin as they go.
- Epidermal cells contain melanin, a pigment that absorbs UV radiation.
- Melanin ranges from reddish brown to black
Epidermis

Outermost Layer:
- **keratin** - tough, flexible protein; found in hair and fingernails
- **melanocytes** - cells that produce melanin

Image from:  
[www.avreskincare.com/.../about_skin.html](http://www.avreskincare.com/.../about_skin.html)
Dermis

- Dermis - supports epidermis. Contains nerve endings, blood vessel, and smooth muscles.
- 2 types of glands
  A) sweat glands - controlled by nervous system
  B) sebaceous glands - produce oily secretions that helps keep the epidermis flexible and waterproof.

Image from: www.avreskincare.com/.../about_skin.html
Subcutaneous Tissue

• Located beneath the Dermis.
• It’s a layer of connective tissue made of fat.
• It’s a shock absorber, insulator, and energy storage.
• Anchors skin to underlying organs.
• Thickness varies throughout the body.
Organ system Interactions

• Immune system - first line of defense
• Circulatory system - brings nutrients and water
• Excretory system – sweat
• Nervous system – touch
• Endocrine – thermoregulation
The Endocrine System

**Purpose:** to control growth, development, metabolism and reproduction through the production and secretion of hormones

**Major Organs**

-- hypothalamus
-- pituitary gland
-- thyroid
-- parathyroid
-- adrenal glands
-- pancreas
-- testes
-- ovaries

**Cell type - epithelial**
Endocrine System

• Controls all the metabolic activities of the body.
• Made up of a series of glands – organs which produce and release chemical messengers, generally into the bloodstream.
• The chemical messengers are called hormones and they affect the behavior of cells.
  – Only cells with receptors respond to hormones
Glands of the Endocrine System

• The major gland is the **pituitary gland** – produces many of the hormones that regulate the endocrine glands.

• The **hypothalamus** controls the pituitary gland.

• Thyroid, parathyroid, adrenal, pancreas, ovaries and testes.
# Examples of Hormones

<table>
<thead>
<tr>
<th>Endocrine Gland</th>
<th>Hormone</th>
<th>Effect on Target Cells</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thyroid</td>
<td>Thyroxine</td>
<td>Regulates metabolic rate of cells</td>
</tr>
<tr>
<td>Adrenal medulla</td>
<td>Adrenaline and noradrenaline</td>
<td>Prepare the body for “fight or flight” by increasing body activities</td>
</tr>
<tr>
<td>Pancreas – Islets of Langerhans</td>
<td>Insulin</td>
<td>Regulates the amount of sugar in bloodstream</td>
</tr>
<tr>
<td>Posterior pituitary</td>
<td>Oxytocin</td>
<td>Stimulates contractions of uterus during childbirth</td>
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Organ system Interactions

• You name it – it interacts with it for regulation especially in conjunction with the nervous system and circulatory system
The Excretory System

**Purpose:** to rid the body of wastes, including excess water and salts

**Cell Type:** epithelial

**Major Organs and Their Functions**

**Kidneys** – the main organs of the excretory system

-- waste-laden blood enters the kidney and the kidney **filters** out urea, excess water and other waste products, which eventually travel out of the kidney as urine

-- eventually they travel through the **ureter** to the **urinary bladder**

**Rectum** – solid (food) waste travels out of the body through the rectum
Organ system Interaction

- Circulatory system – filters blood
- Digestive system – removes undigested food
- Nervous system – response & regulation
- Endocrine system – response regulation
Skin – sweat glands remove excess water and salts from the body

Lungs – expel the waste gas carbon dioxide

The Excretory System
The Skeletal System

**Purpose:** to provide structure and support to the human body

Bones are where new blood cells are generated (in the marrow), and require the mineral **calcium** for strength

**Major Bones of the Human Body**

- -- femur (thigh bone)
- -- radius and ulna (lower arm)
- -- sternum (breastbone)
- -- fibula and tibia (calf)
- -- scalpula (shoulder)
- -- coccyx (tail bone)
- -- humerus (upper arm)
- -- cranium (skull)
- -- clavicle (shoulder blade)
- -- vertebrae (back)
- -- pelvic bone
- -- phalanges (fingers/toes)
Skeletal System

- Types of cells:
  - osteocytes - cells that build and maintain bones
  - bone marrow - produce white and red blood cells
What are joints, ligaments, tendons, and cartilage?

- **Joints** are where two bones meet and can withstand pressure.
- **Ligaments** are strong bands of connective tissue that hold joints together and prevent them from moving too far.
- **Tendons** are strips of dense connective tissue attached to bone.
- **Cartilage** is lightweight, strong, flexible tissue.
Organ system Interaction

- Nervous system – movement
- Muscle system – movement
- Circulatory system – oxygen & nutrients
- Digestive system – digestion (stomach & peristaltic activity)
- Excretory - sweat
The Reproductive System

• Produces, matures, nourishes, and stores gametes.
  – For the first 6 weeks of development, male and female embryos are identical.
  – At the 7th week, if a Y chromosome is present, the testes develop and begin to produce androgens (hormones) that cause male physical characteristics and reproductive structures to develop.

• Cell type – epithelial
Female Reproductive System

www.sw.org/.../piid/331/ciid/764

- Ovary
- Uterus
- Cervix
- Fallopian tube
- Endometrium
- Vagina
Organ system Interaction

- Endocrine – hormones for gamete production & reproductive cycle
- Nervous system
- Circulatory system
The Muscular System

**Purpose:** works with the skeletal and nervous system to produce movement, also helps to circulate blood through the human body

-- muscle cells are fibrous

-- muscle contractions can be voluntary or involuntary

makes up to 40 – 50% of the body mass

**Cells:**

![Muscle tissue image]

**Major Muscles in the Human Body**

-- biceps

-- triceps

-- deltoids

-- glutes

-- hamstrings
Muscular System

• Three types of muscles:
  – 1. skeletal - attached to bones, voluntary control, multinucleated, striated
  – 2. smooth - internal organs (except heart), one nucleus, nonstriated, involuntary control
  – 3. cardiac - heart, one nucleus, striated, involuntary control
structure

- **tendons** - dense strips of connective tissue.
- **flexor** - muscles that cause a joint to bend.
- **Extensor** - muscles that cause the joint to straighten.
- **actin & myosin** - enable muscles to contract.
- **myofibrils** - a fiber found in straighten muscle cells and that is responsible of muscle contractions.
- **Sarcomere** - basic unit of contraction in skeletal and cardiac muscles.
- **Origin** - muscle pulls against origin.
- **Insertion** - bone that moves when muscle contracts.
Muscular System

- Muscles work in antagonistic pairs (opposite each other) and are always in a state of slight contraction.
- Muscles always pull, bones do not push them.
  * flexor - decreases the angle of the joint (bends), examples are biceps and hamstrings
  * extensor - opens a joint to normal position (extends), examples triceps and quadriceps
  * abductor - moves bone away from midline of the body, like the deltoids
  * adductor - moves bone towards the midline of the body, like the latisimus dorsi
skeletal muscle cells

biceps muscle (contracted)

triceps muscle (relaxed)

biceps muscle (relaxed)

tendon

insertion

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Organ system Interaction

- Circulatory – heart
- Skeletal – movement
- Nervous – movement & vision (focus)
- Digestive – stomach & peristaltic activity
- Endocrine – release of some hormones & enzymes