

Anatomy/Physiology Introduction Notes

Science Olympiad Anatomy and Physiology

Name _____

What is Anatomy and Physiology?

Anatomy is the study of the structure and relationship between body parts. Physiology is the study of the function of body parts and the body as a whole. Some specializations within each of these sciences follow:

- Gross (macroscopic) anatomy is the study of body parts visible to the naked eye, such as the heart or bones.
- Histology is the study of tissues at the microscopic level.
- Cytology is the study of cells at the microscopic level.
- Neurophysiology is the study of how the nervous system functions.

Organization of Living Systems

Living systems can be defined from various perspectives, from the broad (looking at the entire earth) to the minute (individual atoms). Each perspective provides information about how or why a living system functions:

- At the chemical level, atoms, molecules (combinations of atoms), and the chemical bonds between atoms provide the framework upon which all living activity is based.
- The cell is the smallest unit of life. Organelles within the cell are specialized bodies performing specific cellular functions. Cells themselves may be specialized. Thus, there are nerve cells, bone cells, and muscle cells.
- A tissue is a group of similar cells performing a common function. Muscle tissue, for example, consists of muscle cells.
- An organ is a group of different kinds of tissues working together to perform a particular activity. The heart is an organ composed of muscle, nervous, connective, and epithelial tissues.
- An organ system is two or more organs working together to accomplish a particular task. The digestive system, for example, involves the coordinated activities of many organs, including the mouth, stomach, small and large intestines, pancreas, and liver.
- An organism is a system possessing the characteristics of living things—the ability to obtain and process energy, the ability to respond to environmental changes, and the ability to reproduce.

Homeostasis

A characteristic of all living systems is homeostasis, or the maintenance of stable, internal conditions within specific limits. In many cases, stable conditions are maintained by negative feedback.

In negative feedback, a sensing mechanism (a receptor) detects a change in conditions beyond specific limits. A control center, or integrator (often the brain), evaluates the change and activates a second mechanism (an effector) to correct the condition; for example, cells that either remove or add glucose to the blood in an effort to maintain homeostasis are effectors. Conditions are constantly monitored by receptors and evaluated by the control center. When the control center determines that conditions have returned to normal, corrective action is discontinued. Thus, in negative feedback, the variant condition is canceled, or negated, so that conditions are returned to normal.

The regulation of glucose concentration in the blood illustrates how homeostasis is maintained by negative feedback. After a meal, the absorption of glucose (a sugar) from the digestive tract increases the amount of glucose in the blood. In response, specialized cells in the pancreas (alpha cells) secrete the hormone insulin, which circulates through the blood and stimulates liver and muscle cells to absorb the glucose. Once blood glucose levels return to normal, insulin secretion stops. Later, perhaps after heavy exercise,

blood glucose levels may drop because muscle cells absorb glucose from the blood and use it as a source of energy for muscle contraction. In response to falling blood glucose levels, another group of specialized pancreatic cells (beta cells) secretes a second hormone, glucagon. Glucagon stimulates the liver to release its stored glucose into the blood. When blood glucose levels return to normal, glucagon secretion stops.

Compare this with positive feedback, in which an action intensifies a condition so that it is driven farther beyond normal limits. Such positive feedback is uncommon but does occur during blood clotting, childbirth (labor contractions), lactation (where milk production increases in response to an increase in nursing), and sexual orgasm.

Anatomic Terminology

In order to accurately identify areas of the body, clearly defined anatomical terms are used. These terms refer to the body in the anatomical position—standing erect, facing forward, arms down at the side, with the palms turned forward. In this position, the following apply:

Directional terms are used to describe the relative position of one body part to another:

- Superior: above another structure (ex. The heart is superior to the stomach.)
- Inferior: below another structure (ex. The stomach is inferior to the heart.)
- Anterior/ventral: toward the front of the body (ex. The navel is anterior to the spine.)
- Posterior/dorsal: toward the back of the body (ex. The spine is posterior to the navel.)
- Medial: toward the midline of the body – the midline divides the body into equal right and left sides (ex. The nose is medial to the eyes.)
- Lateral: away from the midline of the body or toward the side of the body (ex. The ears are lateral to the nose.)
- Ipsilateral: on the same side of the body (ex. The spleen and descending colon are ipsilateral.)
- Contralateral: on opposite sides of the body (ex. The left and right lungs are contralateral.)
- Intermediate: between two structures (ex. The nose is intermediate between the eyes.)
- Proximal: closer to the point of attachment of a limb (ex. The elbow is proximal to the wrist.)
- Distal: farther from the point of attachment of a limb (ex. The foot is distal to the knee.)
- Superficial: toward the surface of the body (ex. The skin is superficial to the muscle.)
- Deep: away from the surface of the body (ex. The skeleton is deep to the skin.)
- Cranial/cephalic: towards the head – similar to superior (ex. The neck is caudal to the waist.)
- Caudal: towards the feet – similar to inferior (ex. The ankles are caudal to the knees.)

Body planes and sections are used to describe how the body or an organ is divided into two parts:

- Sagittal (lateral) planes divide a body or organ vertically into right and left parts. If the right and left parts are equal, the plane is a midsagittal (median) plane; if they're unequal, the plane is a parasagittal plane.
- A frontal (coronal) plane divides the body or organ vertically into front (anterior) and rear (posterior) parts.
- A horizontal (transverse or axial) plane divides the body or organ horizontally into top (superior) and bottom (inferior) parts. This is also known as a cross-section.

Body cavities are enclosed areas that house organs. These cavities are organized into two groups:

- The posterior/dorsal body cavity includes the cranial cavity (which contains the brain) and the vertebral cavity (which contains the spinal cord).
- The anterior/ventral body cavity includes the thoracic cavity (which contains the lungs, each in its own pleural cavity, and the heart, in the pericardial cavity) and the abdominopelvic cavity (which contains the digestive organs in the abdominal cavity and the bladder and reproductive organs in the pelvic cavity).

Serous membranes found throughout the body are of two layers (between them is a very thin, fluid-filled serous space, or cavity):

- The parietal layers of the membranes line the walls of the body cavity.
- The visceral layer of the membrane covers the organ (the viscera).

Regional terms identify specific areas of the body. In some cases, a descriptive word is used to identify the location. For example, the axial region refers to the main axis of the body—the head, neck, and trunk. The appendicular region refers to the appendages—the arms and legs. Other regional terms use a body part to identify a particular region of the body. For example, the nasal region refers to the nose.

- Nasal: nose
- Oral: mouth
- Frontal: forehead
- Orbital: eye
- Buccal: cheek
- Mental: chin
- Otic: ear
- Cephalic: head
- Cervical: neck
- Occipital: base of Skull
- Acromial: point of shoulder
- Axillary: armpit
- Abdominal: abdomen
- Umbilical: navel
- Vertebral: spinal column
- Scapular: shoulder blade
- Dorsal: back
- Lumbar: loin
- Brachial: arm
- Antebrachial: forearm
- Carpal: wrist
- Pollex: thumb
- Palmar: palm
- Manus: hand
- Digital: fingers/toes
- Olecranal: back of elbow
- Pelvic: pelvis
- Coxal: hip
- Sacral: between hips
- Gluteal: buttock
- Perineal: between anus and genitals
- Pubic: genital region
- Inguinal: groin
- Femoral: thigh
- Patellar: front of knee
- Popliteal: back of knee
- Crural: leg
- Sural: calf
- Peroneal: side of leg
- Tarsal: ankle
- Calcaneal: heel
- Hallux: great toe
- Plantar: sole
- Pedal: foot

List of Body Systems

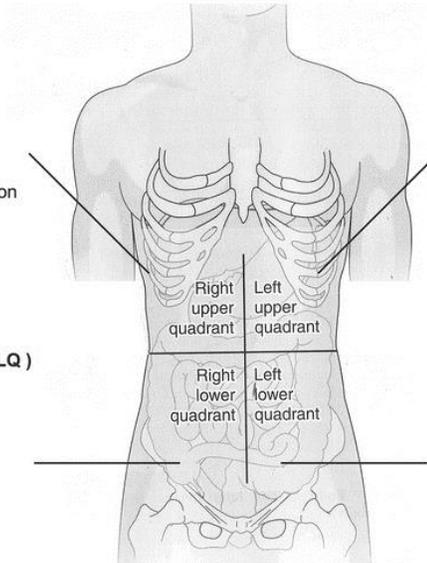
Taken from the other resource sheet provided:

- Integumentary System
- Skeletal System
- Muscular System
- Nervous System
- Sensory System
- Endocrine System
- Circulatory (Cardiovascular) System
- Lymphatic System
- Immune System
- Respiratory System
- Digestive System
- Urinary (Renal) System
- Reproductive System

Body Quadrants and Abdominal Regions

Right upper quadrant (RUQ)

- right lobe of liver
- gallbladder
- duodenum
- head of pancreas
- right adrenal gland
- right kidney
- superior part of ascending colon
- right of transverse colon



Right lower quadrant (RLQ)

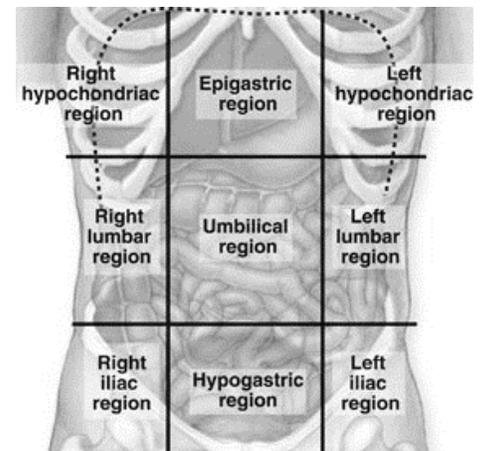
- cecum
- appendix
- most of ileum
- inferior part of right uterine tube
- right ovary
- ascending colon
- right ureter
- right spermatic cord

Left upper quadrant (LUQ)

- left lobe of liver
- spleen
- most of stomach
- jejunum and proximal ileum
- body and tail of pancreas
- left adrenal gland
- left kidney
- superior part of descending colon
- left half transverse colon

Left lower quadrant (LLQ)

- sigmoid colon
- inferior part of descending colon
- left ovary
- left uterine tube
- left ureter
- left spermatic cord



Sources:

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