

The Language of Anatomy and Physiology

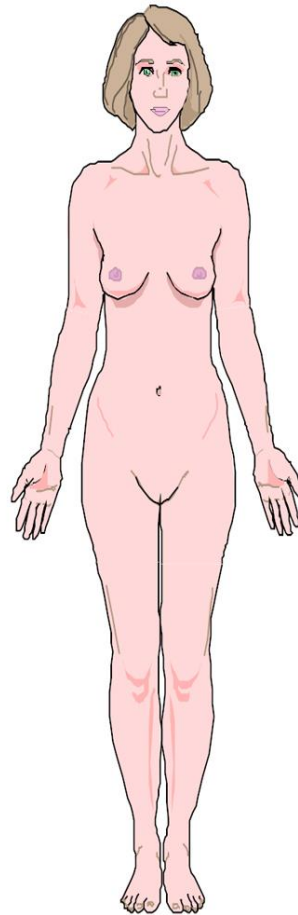
An Introduction

Anatomy

- Anatomy is the study of the structure [of the human body, in this case].
- Surface anatomy is the study of the forms and markings of the surface of the body.

Anatomical Position

- The position that is referred to whenever the body is described.
- There are 3 criteria required to meet the anatomical position of the human body:
 - 1) the subject must be standing erect,
 - 2) the subject has his/her hands facing forward and
 - 3) the subject's feet are flat and face the front at 45°
- 4) Humans are a tube within a tube
- 5) Humans are bilaterally symmetrical.

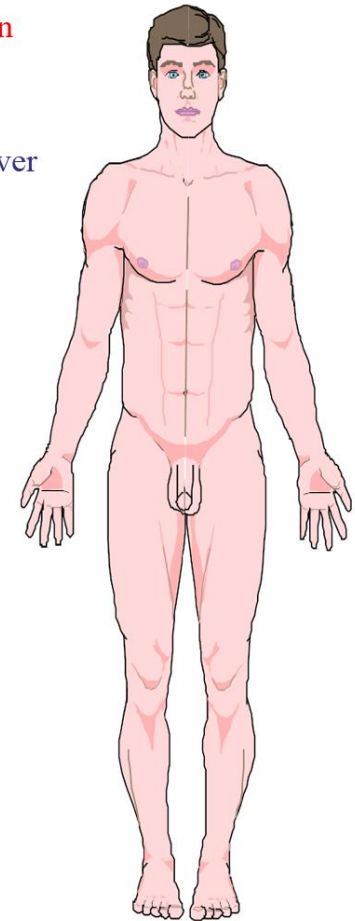


Standard Anatomic Position

Standing erect, facing observer

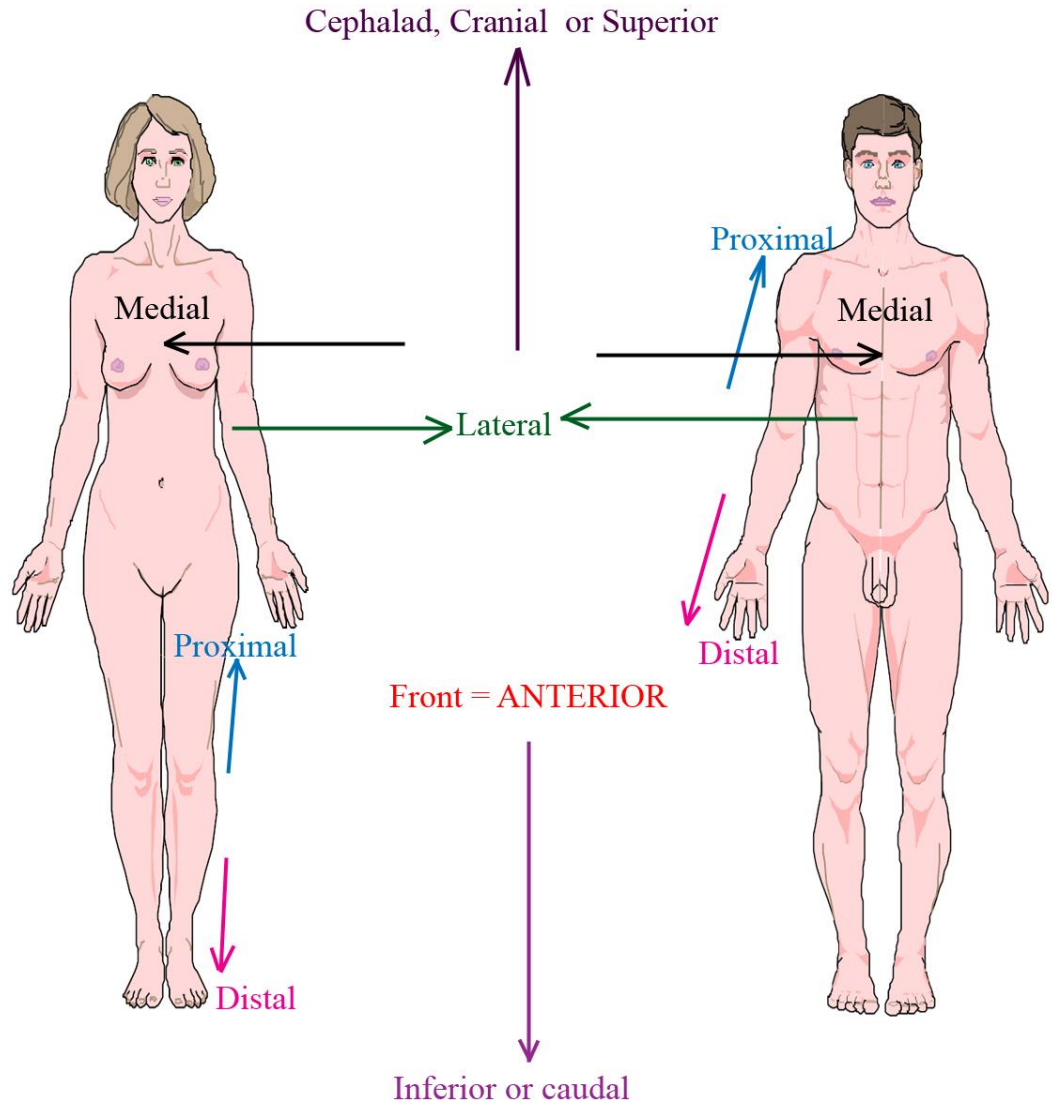
Palms facing forward

Standing flat on feet



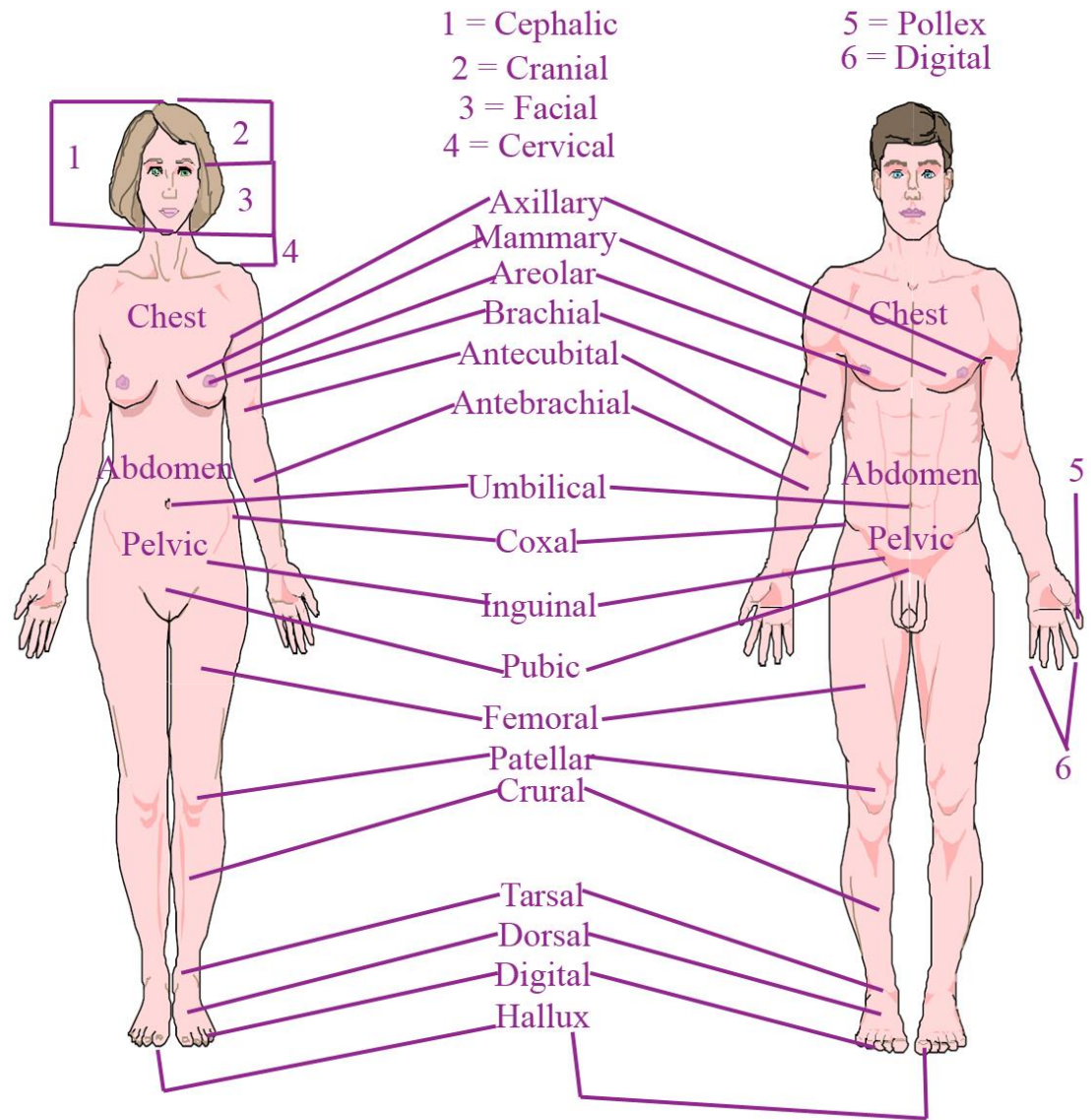
Anatomical Position

- The position that is referred to whenever the body is described.
- There are 3 criteria required to meet the anatomical position of the human body:
 - 1) the subject must be standing erect,
 - 2) the subject has his/her hands facing forward and
 - 3) the subject's feet are flat and face the front at 45°
- 4) Humans are a tube within a tube
- 5) Humans are bilaterally symmetrical.



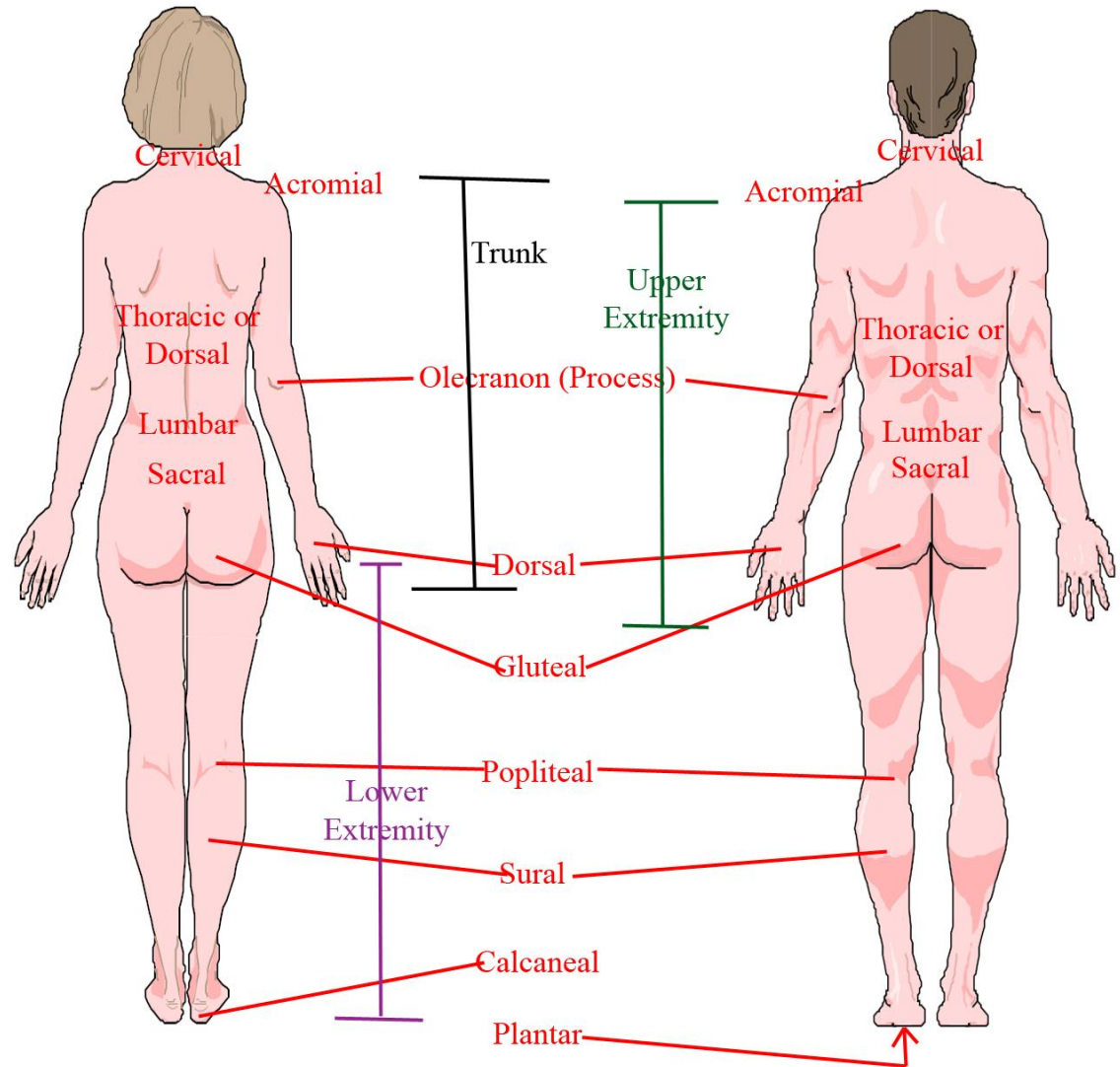
Anatomical Position

- The position that is referred to whenever the body is described.
- There are 3 criteria required to meet the anatomical position of the human body:
 - 1) the subject must be standing erect,
 - 2) the subject has his/her hands facing forward and
 - 3) the subject's feet are flat and face the front at 45°
- 4) Humans are a tube within a tube
- 5) Humans are bilaterally symmetrical.

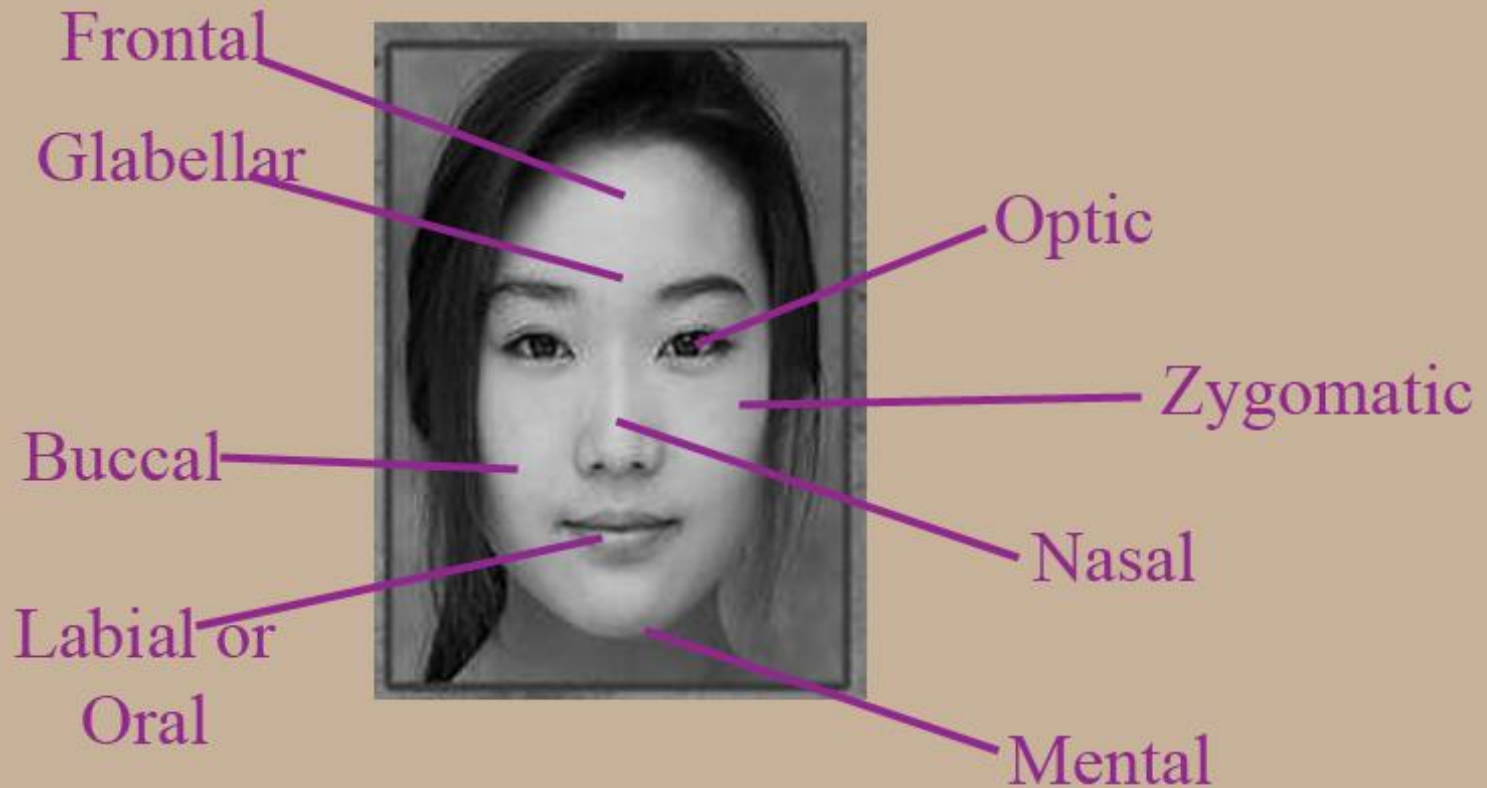


Anatomical Position

- The position that is referred to whenever the body is described.
- There are 3 criteria required to meet the anatomical position of the human body:
 - 1) the subject must be standing erect,
 - 2) the subject has his/her hands facing forward and
 - 3) the subject's feet are flat and face the front at 45°
- 4) Humans are a tube within a tube
- 5) Humans are bilaterally symmetrical.



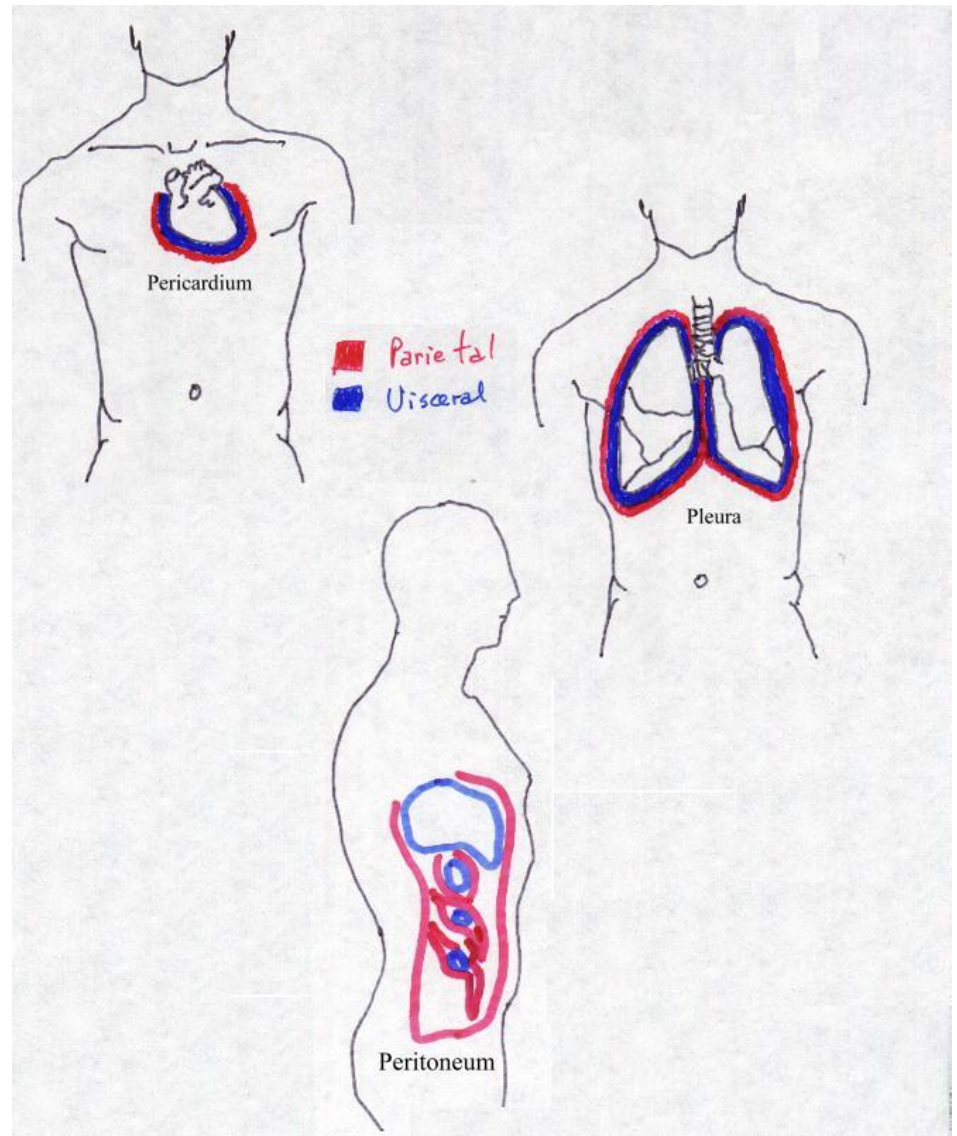
Further Surface Anatomical Terminology



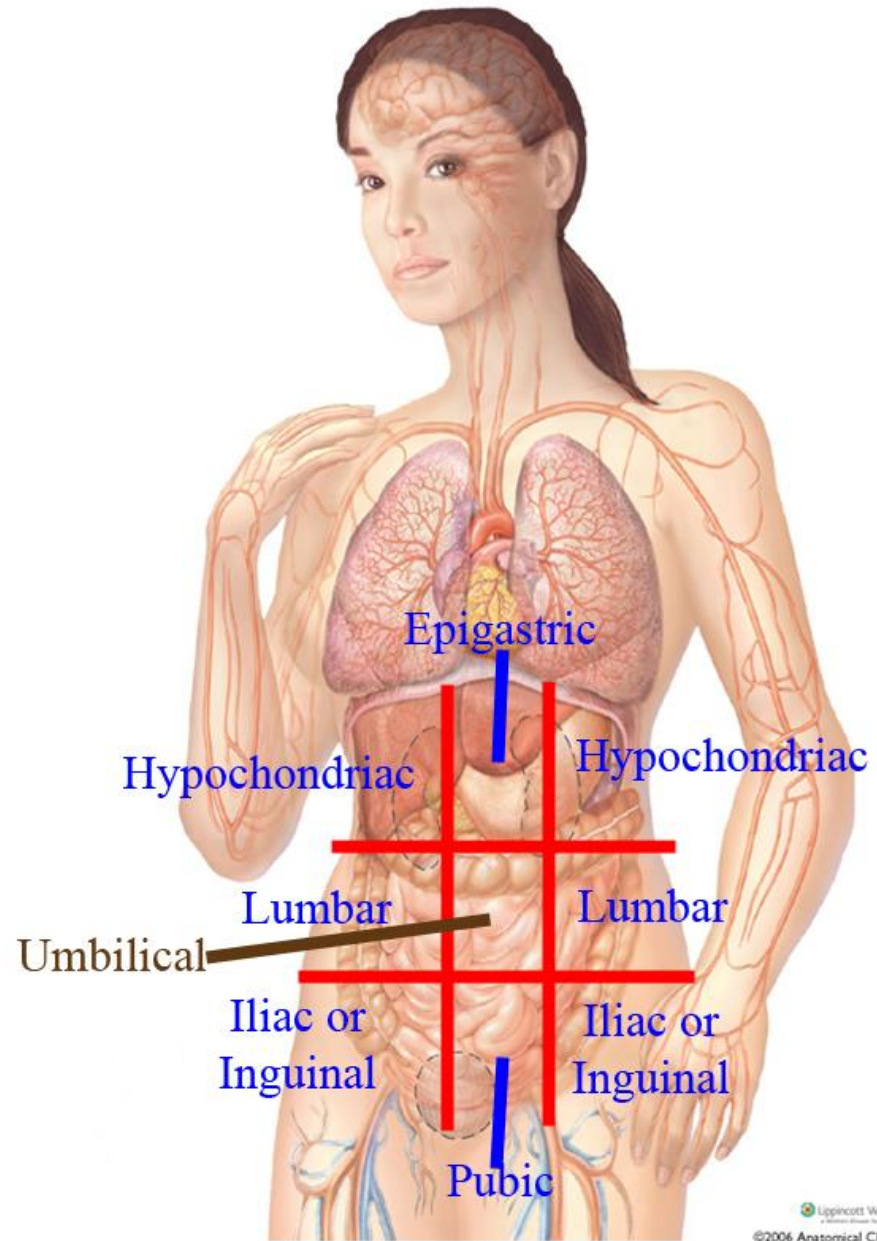
Term	Definition	Term	Definition
Superior (or cephalad or cranial)	Towards the top or head	Posterior (or dorsal)	Back of the body
Proximal	Closer to the body	Ipsilateral	On the same side as
Distal	Farther away from the body	Contralateral	On the opposite side as
Lateral	Away from the midline of the body	Superficial	Closer to the surface of the body
Medial	Towards the midline of the body	Deep	Closer to the internal organs and body structure
Inferior (or caudal)	Towards the bottom, feet or tail	Parietal	Outer wall covering of a body cavity
Anterior (or ventral)	Front of the body	Visceral	Covers an organ within the ventral body cavity - - these are the pleura, the pericardium and the peritoneum,

Serous Mesothelium

- There are two "wrappings" around the lungs (pleura; PLOO ruh), heart (pericardium; para CAR dee umm) and digestive/abdominal organs (peritoneum; para toe NEE umm).
- The purpose for this is that these organs all move.
- At the interface of the parietal (puh RI uh tull) and visceral (VISS er ull) membranes, a fluid is scantily secreted, lubricating the two faces so that the membranes glide over each other.
- This permits these organs to move fluously.
- If the pleura, for example, do not secrete this fluid, pleurisy develops.



- Although those working in emergency medical services utilize a "quadrant system" of isolating abdominal pain, i.e., right upper quadrant, right lower quadrant, left lower quadrant and left upper quadrant, from a line drawn through the umbilicus, vertically AND horizontally from top to bottom over the abdominal cavity, an older, more anatomically correct format is used by numerous physicians, physician assistants and nurse practitioners.
- On the upper left and right of the abdomen are the hypochondriac regions.
- On the mid right and left are the lumbar regions.
- On the lower right and left are the iliac OR inguinal regions.
- Between these regions, running vertically down the abdomen from top to bottom are the epigastric, umbilical and pubic regions, in order.
- Note the organs from the illustration that are in each region and how some organs take up more than one region.



Term	Definition	Term	Definition
Cephalic (se FALL ick)	Toward the head	Inguinal (IN gwin ull)	In groin
Cranial (CRAE neal)	The part of the skull with the brain	Pubic (PYOO bick)	Over symphysis pubis
Facial (FA shull)	The part you look out of	Patellar (puh TELL urr)	Knee cap
Cervical (SURR vi cull)	Neck	Crural (CREW rull)	Shin
Mammary (MAMM err ee)	Breast region	Tarsal (TARR sull)	Ankle
Axillary (AX ull aree)	Arm pit	Dorsal (DOR sull)	Top of foot -- bad use, but it's been around for centuries
Brachial (BRAY keal)	Upper anterior arm	Hallux (HAL ucks)	Great toe
Antebrachial (ANN tee bray keal)	Anterior forearm	Frontal (FRUN tal)	Forehead
Antecubital (ANN te KYOO bi tull)	Anterior depression of elbow	Nasal (NA sull)	Nose

Term	Definition	Term	Definition
Carpal (KARR pull)	Wrist	Ocular (OCK you larr)	Eye
Palmar (PALL mer)	Palm of hand	Otic (OH tick)	Ear
Pollex (PALL ecks)	Thumb	Buccal (BYOO kull or BUCK al)	Cheek
Digital (DI ji tull)	Fingers or toes	Oral (O rull)	Mouth
Umbilical (um BIL i kull)	Belly button	Mental (MEN tull)	Tip of chin
Coxal (COCKS ull)	Top part of pelvis ("hips")	Acromial (uh CROME ee ull)	Posterolateral shoulder
Olecranal (o LEC ruh null)	Posterior elbow point	Sural (SEWER ull)	Calf of leg
Gluteal (GLUE te al)	Buttocks over gluteal muscles	Calcaneal (cal can EE ull)	Heel
Dorsal (DOR sull)	Back or posterior	Plantar (PLAN tarr)	Sole of foot
Popliteal (POP li TEE ull)	Posterior knee		

More Anatomy Definitions

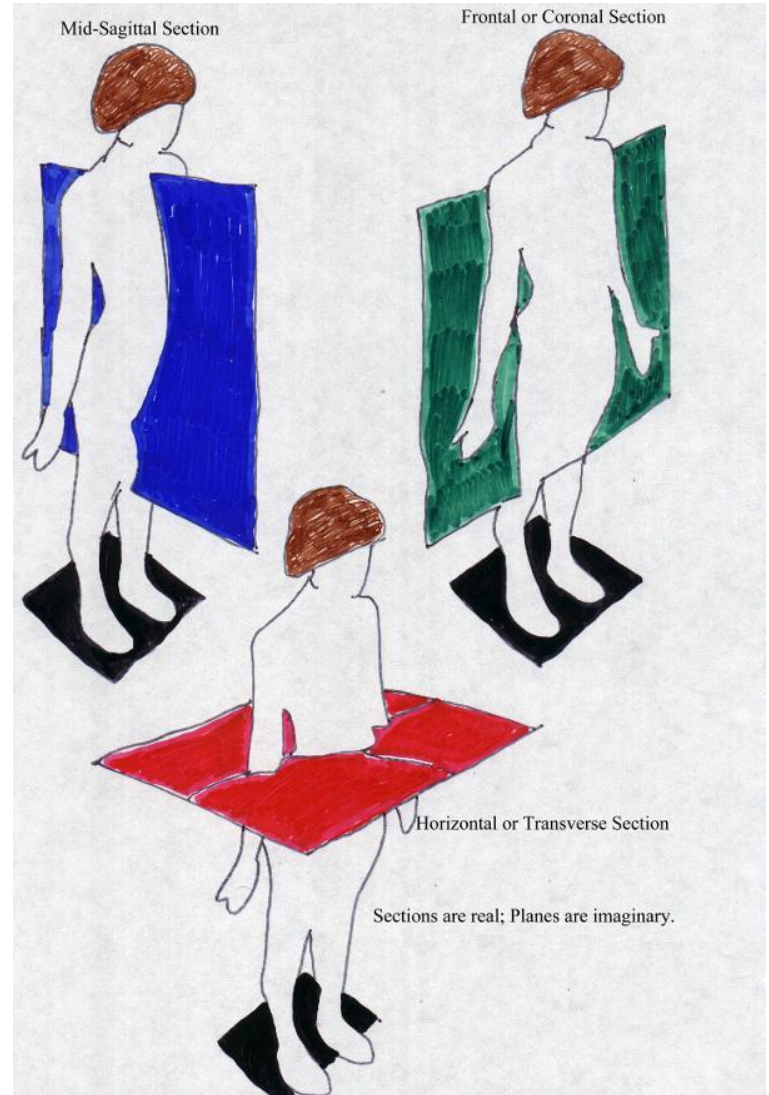
- Gross anatomy is the study of structures that can be examined without the use of a microscope.
- Systemic anatomy is the study of specific systems of the body, e.g., nervous, reproductive, circulatory, etc.

Principle Systems of The Human Body

- Integumentary (in tegg you MEN turry; skin and derivatives, e.g., hair, nails, glands; largest organ of the body),
- Skeletal (SKELL a tull; bones, cartilage and joints of the body),
- Muscular (MUSS kyu lerr; skeletal, cardiac and visceral muscle),
- Nervous (brain, spinal cord, nerves, sense organs, e.g., eyes, ears),
- Endocrine (ENN doe crun; all glands that produce hormones),
- Cardiovascular (karr de o VAS kyu lurr; blood, heart and blood vessels),
- Lymphatic/immune (lymph, lymph vessels, spleen, thymus, appendix, tonsils, lymph nodes),
- Respiratory (RESS purr uh tor ee; lungs and airways),
- Digestive (die GESS tive; GI tract and associated organs, e.g., liver, salivary glands, pancreas; remember, the human body is a tube within a tube),
- Urinary (YOOR i nar ee; organs that produce, collect and eliminate urine, e.g., kidneys, bladder) and
- Reproductive (ree pro DUCK tivv; testes and ovaries that produce sperm/ova, respectively, and the accessory organs, e.g., vas deferens, vagina).

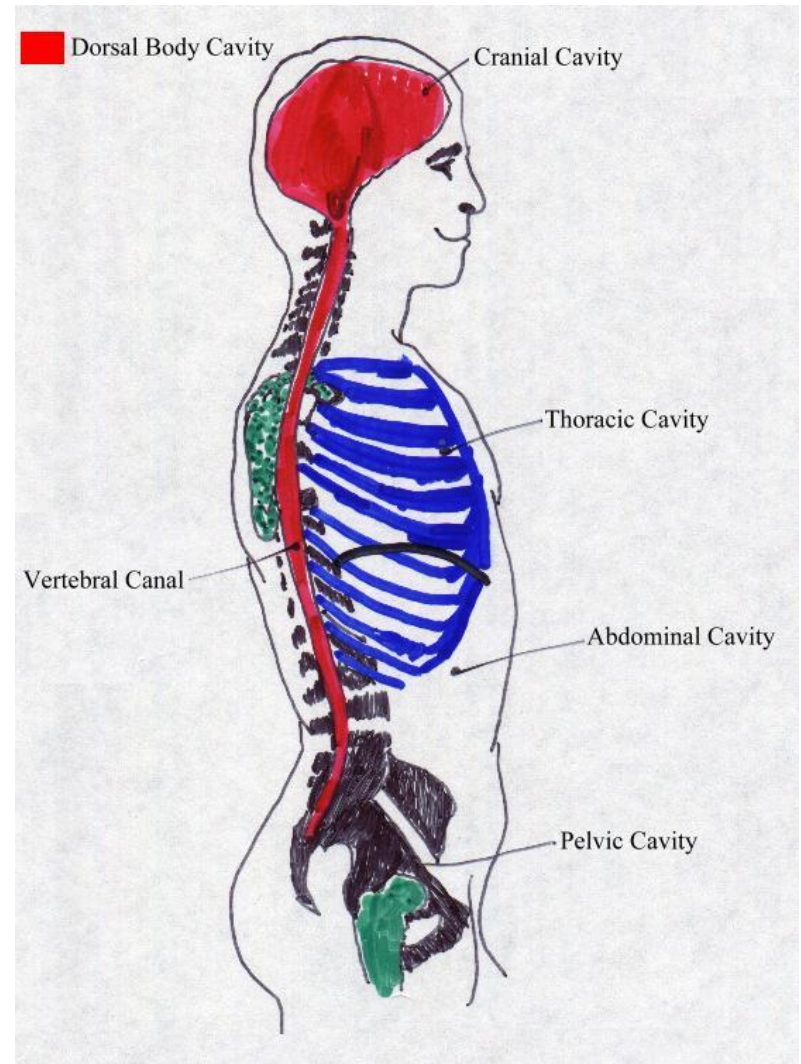
- Regional anatomy is the study of a specific region of the body, e.g., head, chest
- A sagittal section is a section that splits the body into right and left parts.
 - A mid-sagittal section leaves equal right and left halves;
 - a para-sagittal section leaves unequal right and left parts.
 - The human body is bilaterally symmetrical (has the same stuff on each side of the body -- with the exception of the heart, of course).
- A frontal, or coronal, section divides the body into front and back parts.
- A horizontal, or transverse, section divides the body into superior and inferior parts.
- Sections are real, i.e., we can see them and cut them.
- Planes are imaginary and we visualize them in our heads and on CT and MRI screens/films.

Regional Anatomy, Sections and Planes

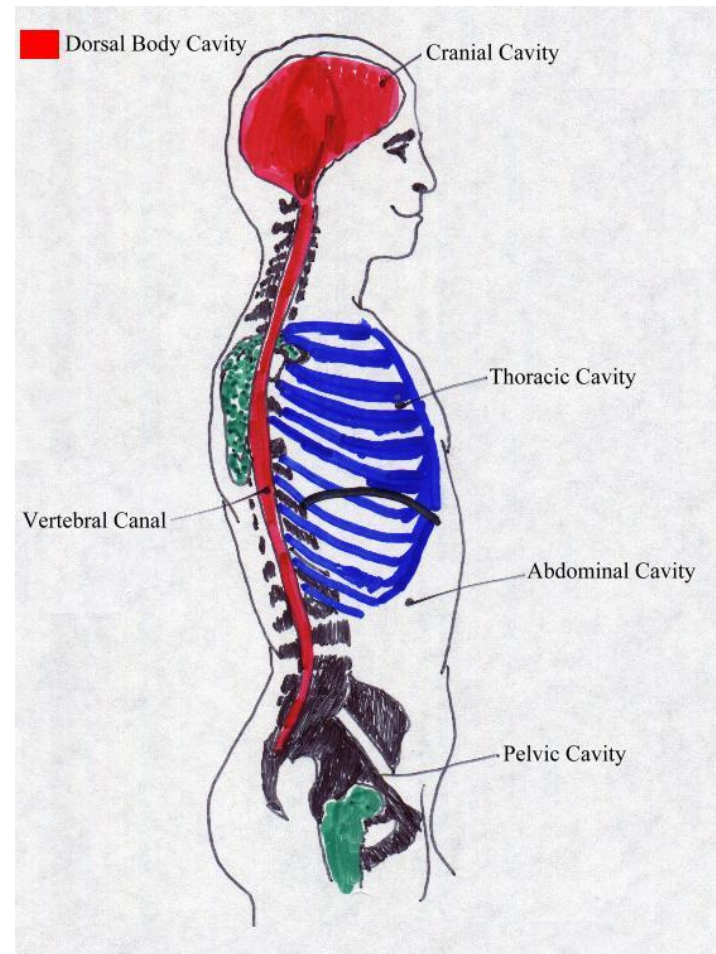


Body Cavities

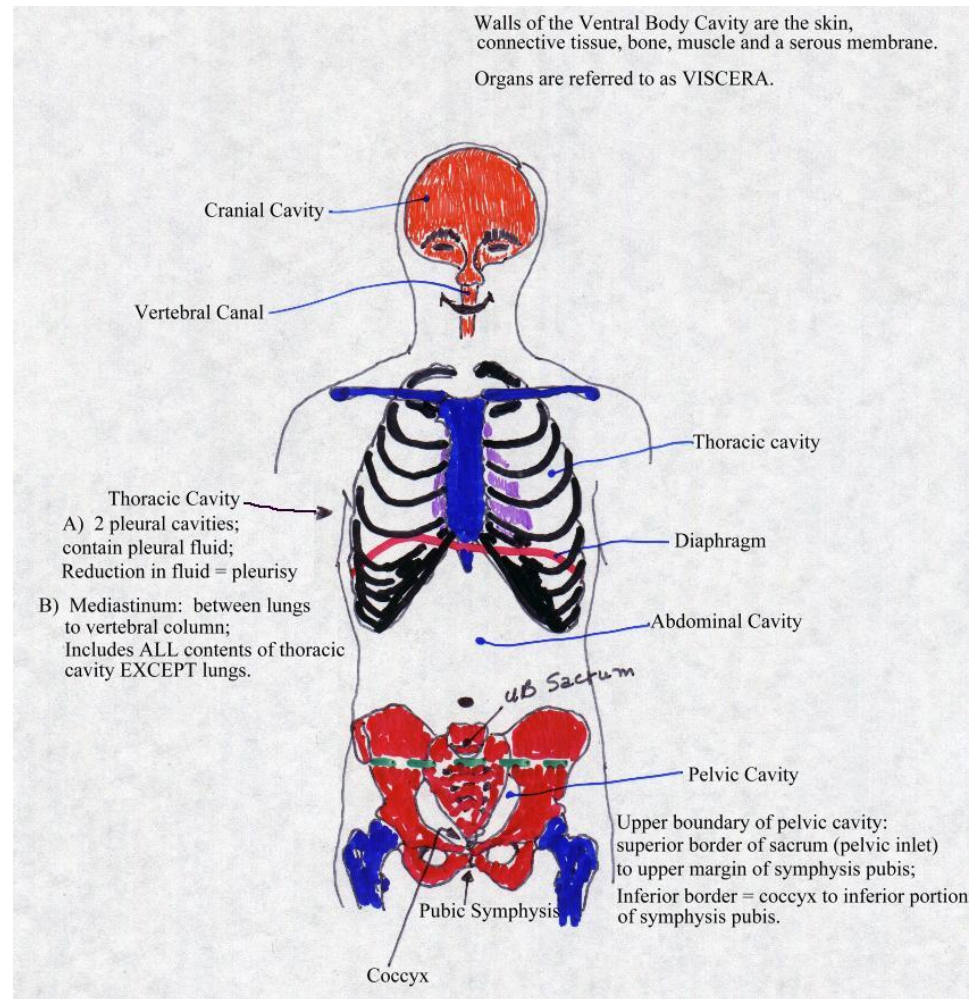
- The walls of the ventral body cavity include the skin, connective tissue, bone, muscle and a serous membrane (pleura, pericardium or peritoneum).
- The organs enveloped by the membrane are called viscera (VISS err uh).
- The thoracic cavity consists of 2 sub-cavities:
 - 1) 2 pleural cavities that contain a miniscule amount of pleural fluid (a reduction of this fluid leads to pleurisy) and
 - 2) the mediastinum (mee dee uh STIE numm or mee dee ASS tin umm, depending on the part of the country you're from) that is between the lungs from the sternum (STURR numm; breast bone) to the vertebral (vurr TE brull) column and includes all contents of the thoracic cavity EXCEPT the lungs.



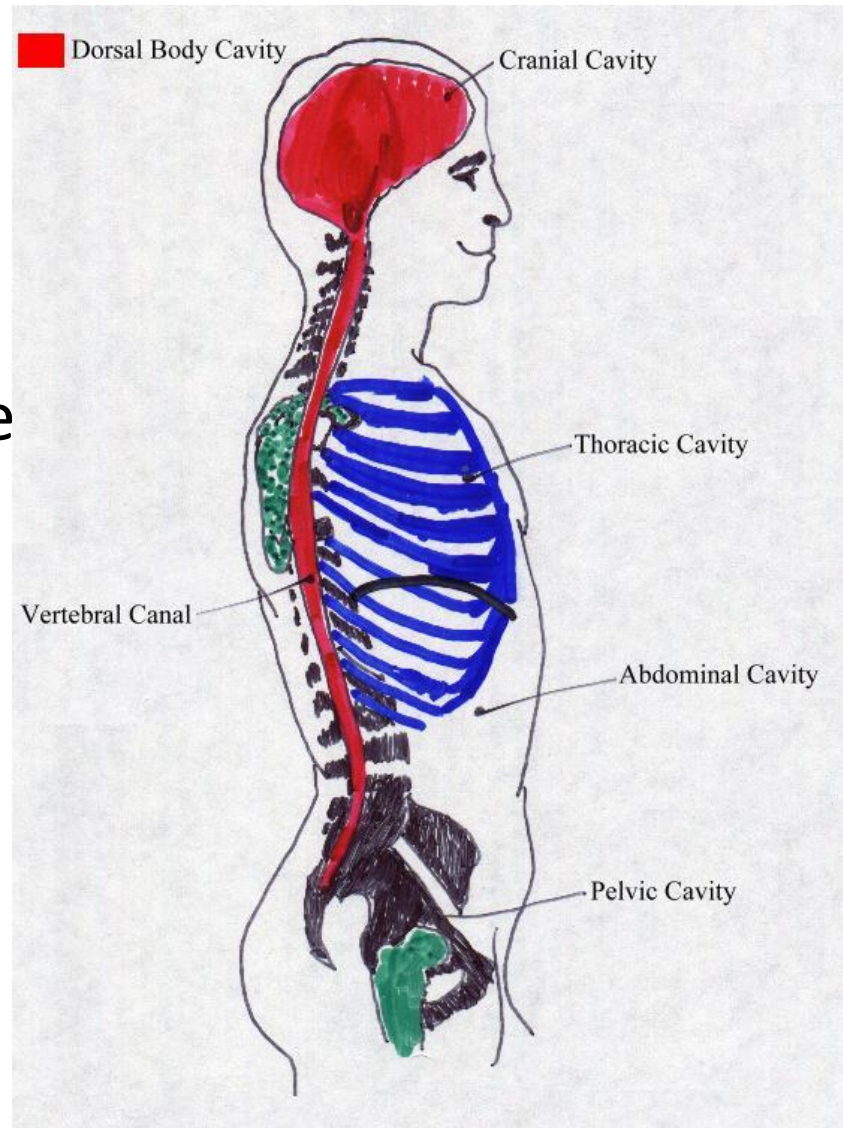
- The diaphragm separates the thoracic and abdominal cavities. The abdominal cavity lies between the thoracic and pelvic cavities.



- The upper boundary of the pelvic cavity is the superior border of the sacrum (SACK rumm), the pelvic inlet, to the upper margin of the symphysis pubis (SIMM fi siss PYOO biss).
- The inferior border of the pelvic cavity is from the coccyx (COX icks) to the inferior portion of the symphysis pubis.
- One landmark to keep in mind is McBurney's point.
- This is a point half way between the top of your pelvis and your belly button (umbilicus: umm BILL i cuss) on the right side of your abdomen (ABB doe men).
- This point is useful to determine if you are having an attack of appendicitis: there is usually no pain on pressing, here, but is incredible pain upon release of the pressure.
- This is called positive rebound tenderness.



- The dorsal body cavity is protected pretty completely by bone: the skull and the vertebral column. This cavity houses the brain and spinal cord.



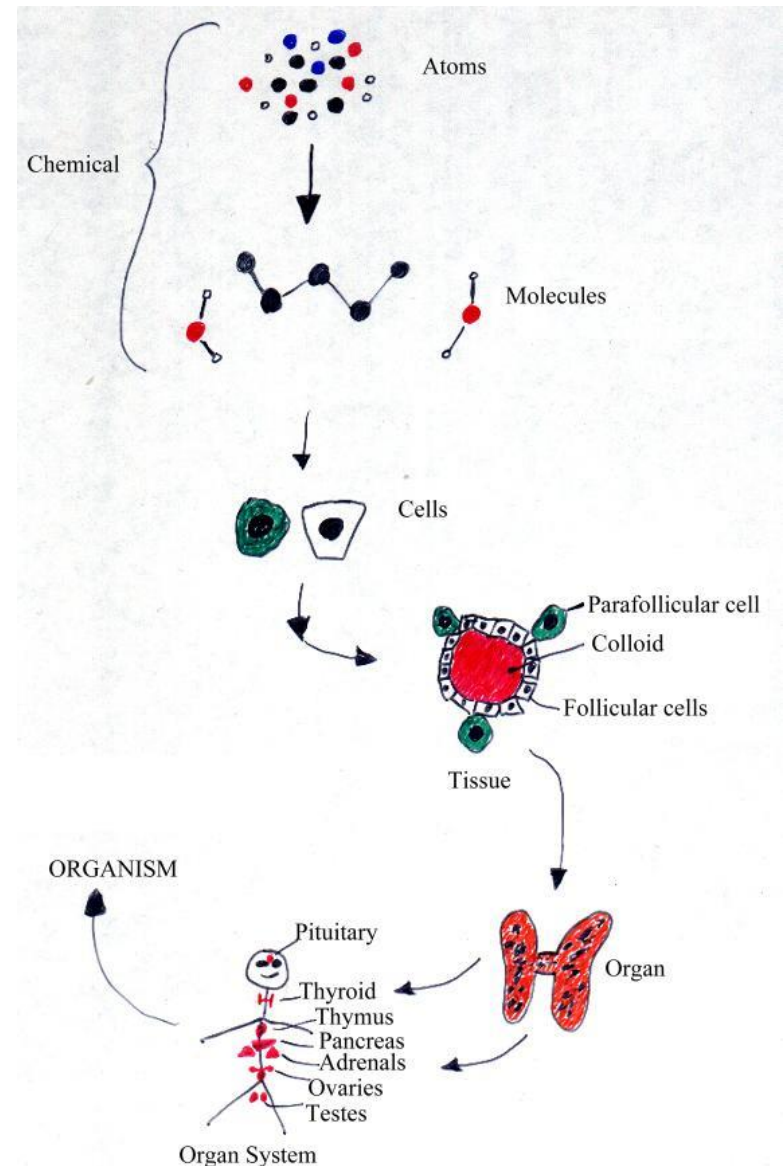
- Developmental anatomy is the study of the development of a human from the zygote (fertilized egg) to the adult form.
- Embryology is the study of development from the fertilized egg to the 9th week in utero.
- Pathological anatomy is the study of structural changes associated with disease.
- Histology is the microscopic study of tissue structure.
- Cytology is the microscopic study of cell structure.
- Radiographic anatomy is the study of the structure of the human body utilizing x-rays.

Physiology

- Physiology is the study of the function [of the human body, in this case].
- Anatomy and Physiology, hence, is the study of the structure and the function of the human body.
- One note to keep in mind is that structure ALWAYS gives function, i.e., change the structure of something and you change the function of that "something".

Organization

- The human body is organized in a most meticulous manner.
- Atoms combine in appropriate manners to form molecules in the chemical organization of the body.
- Molecules combine appropriately to form cells.
- Cells organize into collectively functioning masses called tissues (e.g., thyroid tissue).
- When enough tissue is present, the mass is called an organ (e.g., thyroid gland).
- When organs operating in similar ways combine, they form organ systems (e.g., endocrine system).
- When enough organ systems accumulate, an organism is formed.
- Basis for Biological Chemistry and Biophysics' lectures, as well.



Life Processes

- To differentiate living organisms from dead "stuff", we examine life processes.
- These processes allow us to tell the difference between living (human beings, bacteria) and dead entities (viruses).

Life Processes – Cont'd

- Metabolism occurs in living processes.
- Metabolism, for our purposes, consists of 3 subtypes: catabolism, anabolism and amphibolism.
 - Catabolic processes are those processes that "break down" nutrient stores for energy.
 - Anabolic processes are those processes that allow us to "bulk-up", to store, nutrients for future use.
 - Amphibolic processes are those process that can be either catabolic OR anabolic.
- Ingestion contributes to metabolism in that one must first get the goodies into their body.
- Digestion contributes to metabolism by allowing us to take larger particles and make them smaller.
 - The smaller particles are absorbed (taken up) across the bowel and put into the blood.
 - Once the particles are in the blood, they must be assimilated (stored or utilized) so that their nutritional value may be realized by the cells in our bodies.

Life Processes – Cont'd

- Respiration plays 2 roles in metabolism:
 - 1) we breathe in air that contains oxygen (this is respiration at the lungs) and
 - 2) the oxygen we breathe in must get to and be used in/by the cells, themselves (this is cellular respiration).
- When we take substances from one part of the body and "dump" them into the blood for useful purposes, this is called secretion.
- The removal of wastes from the cells and body for disposal, that is through the process of excretion.

Life Processes – Cont'd

- Another life process is that of excitability.
 - We can sense changes through the environment, i.e., light, pressure, heat, noise, chemicals, and pain, to name a few.
- Conductivity is the third life process.
 - This means that we can carry the effect of a stimulus from one part of a cell to another, e.g., nerves and muscles.
- Contractility, the fourth process, permits cells or parts of cells to actively generate a force to undergo shortening and change form for purposeful movement.

Life Processes – Cont'd

- The last life process we'll discuss is reproduction. This is the formation of new cells for any of the following:
 - 1) growth,
 - 2) repair,
 - 3) replacement,
 - 4) production of a new individual, i.e., any way you look at it, life is transmitted from one generation to the next.
- Growth suggests an increase in size due to one of the following:
 - 1) an increased number of cells,
 - 2) an increased size of existing cells or
 - 3) an increased amount of substance surrounding cells following growth (inside or outside the cell).
- Differentiation occurs when unspecialized cells change to specialized cells,
e.g., **zygote → embryo → fetus → infant → child → adult**

Homeostasis and Its Regulation

- Homeostasis (HOE mee oh STAY suss) is defined as a condition in which the body's internal environment is maintained within certain physiological limits.
- Two fluids are involved: extracellular fluid (ECF) and intracellular fluid (ICF).

ECF

- ECF is fluid outside of the body cells:
 - 1) the fluid between the cells in tissues (aka interstitial, intercellular OR tissue fluid) and
 - 2) the ECF in blood vessels
- (PLASMA -- keep in mind that plasma is the liquid part of blood that still has the clotting proteins in it and SERUM is the liquid part of blood from clotted blood -- they are NOT the same fluids).
- The ECF circulates through blood/lymph vessels and from there to spaces between the cells in tissues.
- Nutrients and wastes are transported one way or another between the two fluids.
- Therefore, there is constant motion in the body and the environment is constantly the same for cells in the body.
- Because of this, the ECF is often called the body's internal environment.

ICF

- The ICF is within the cells.
- It contains gases, nutrients, ions (electrically charged particles necessary for fluid balance, muscle contraction, brain functioning, to name a few) to maintain life.

- Homeostasis may be effected by stress, which is any stimulus that creates an imbalance in the internal environment.
- External sources of stress include heat, cold, loud noises, lack of oxygen.
- Internal sources include hypertension (high blood pressure), pain, tumors, and unpleasant thoughts.
- Input is the same as stimulus: information picked up by nerve cells.
- Output is the response, i.e., the return to normal.

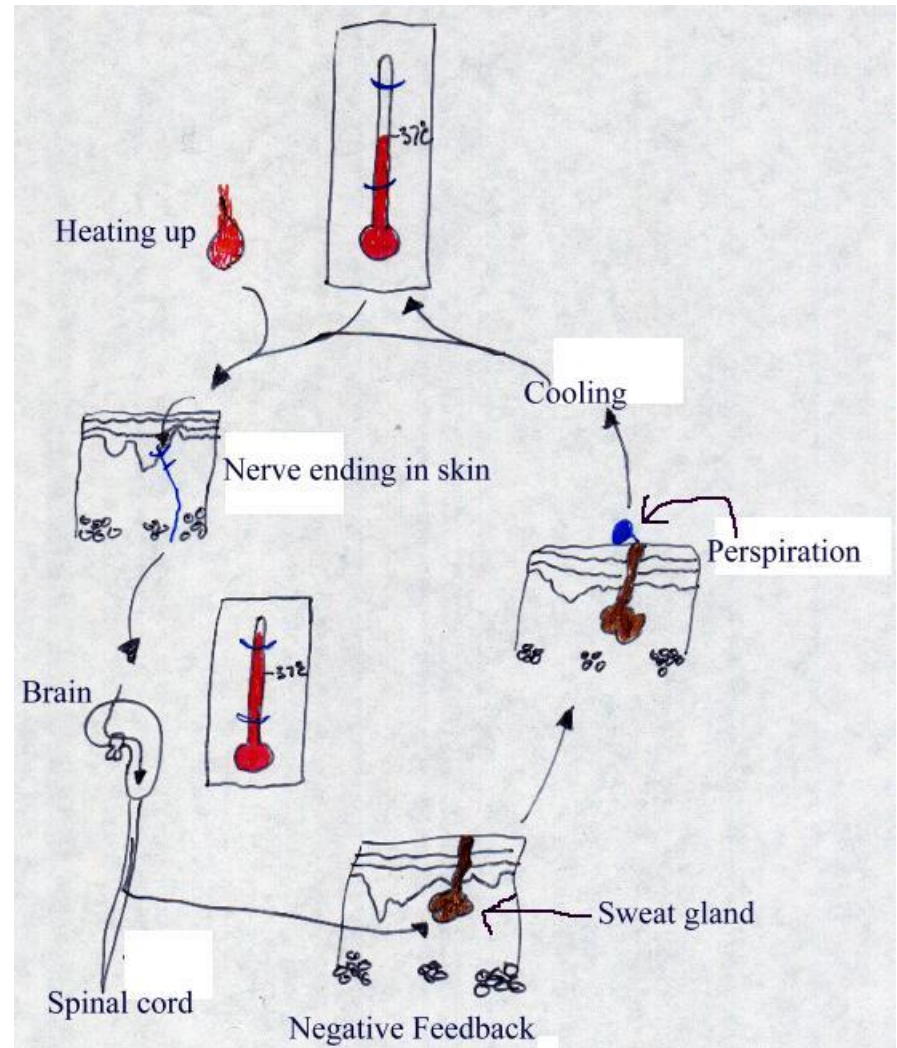
- The regulation of homeostasis comes about through feedback systems.
- These are any circular system in which information is constantly reported (FED BACK) to a central control region.
- Nerves send messages to and from organs responding to the stress when deviations in homeostasis are detected.
- Nerves work rapidly, i.e., in seconds.
- Chemical regulators (hormones) may be secreted into the blood by the endocrine system to regulate homeostasis.
- Hormones work slowly, i.e., they take minutes.

There are fundamentally two kinds of feedback systems: positive and negative.

- Positive Feedback perpetuates an action in the body (e.g., uterine contractions during delivery caused by/due to estradiol and oxytocin).
- Negative Feedback returns the body to normal (body temperature and blood pressure regulation).

An Example of Negative Feedback

- The body prefers to be kept around 37°C , more or less.
- When the body begins to heat up, signals are sent via nerve endings in the skin to the brain.
- The brain sends the signals to the cooling portion of the brain and signals are sent back to the skin.
- These signals stimulate sweat glands to secrete sweat, which causes the body to cool back down to normal.



Positive Feedback: Drug Addiction

- A less commonly thought of form of positive feedback.
- The characteristics of drug addiction are three-fold:
 - 1) tolerance (the requirement for larger doses for the same effect),
 - 2) physiological dependence (the need for a drug to prevent withdrawal symptoms) and
 - 3) habit-forming nature (the quality that causes addicts to spend their time and resources seeking more of the drug).
- The word "drug" includes street drugs, prescription drugs, over the counter drugs, alcohol and tobacco.

Alcoholism – Drug Addiction by Another Name

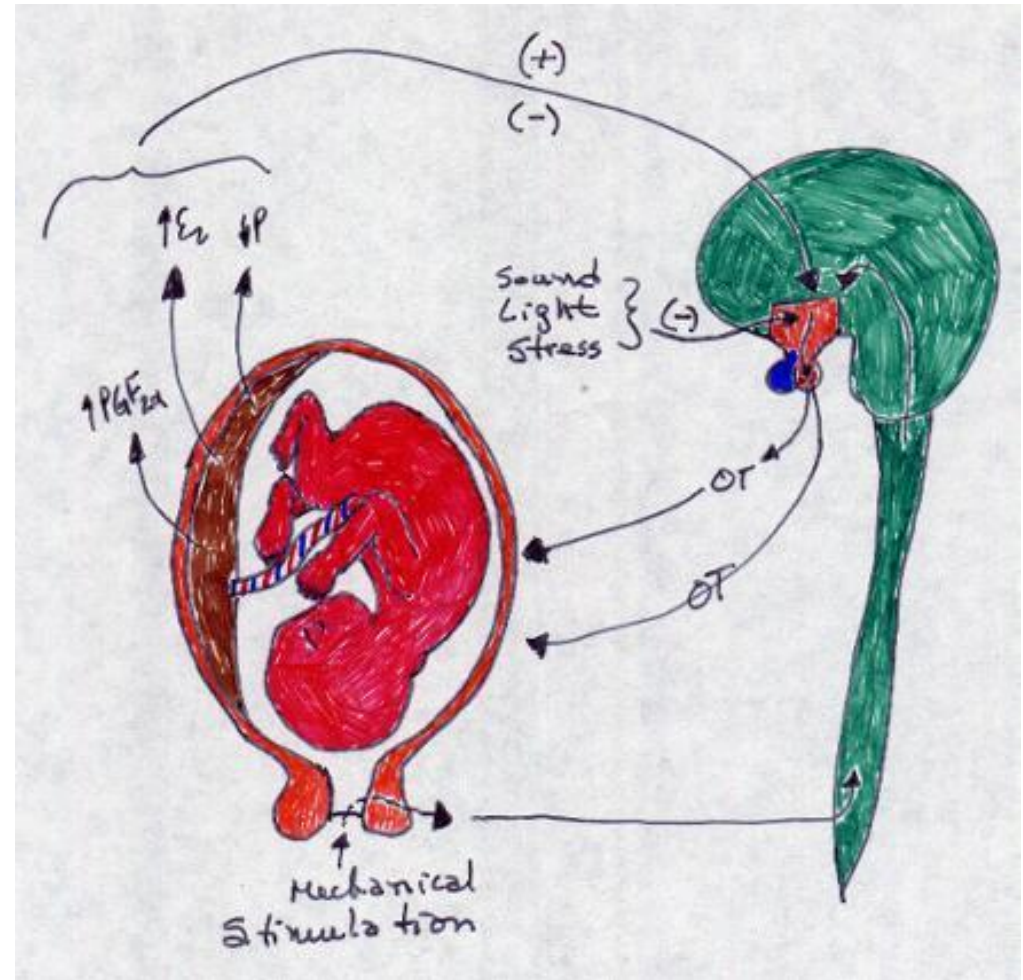
- It seems that alcoholism involves positive feedback, as well, i.e., each drink creates a desire for another drink.
- Biologically, alcoholics have multiple drinks to feel better although the next drink makes the hangover worse.
- The cycle continues.
- Behaviorally, alcoholics drink to numb their real feelings of inadequacy, fear, and nausea.
- The cycle continues.
- In general, there are 10,000,000 severe alcoholics in the U.S.
- There are 7,000,000 alcohol abusers.
- Alcoholism is the third leading cause of death of people between 25 and 65 years of age (YOA).

Two Types of Alcoholics, Biologically

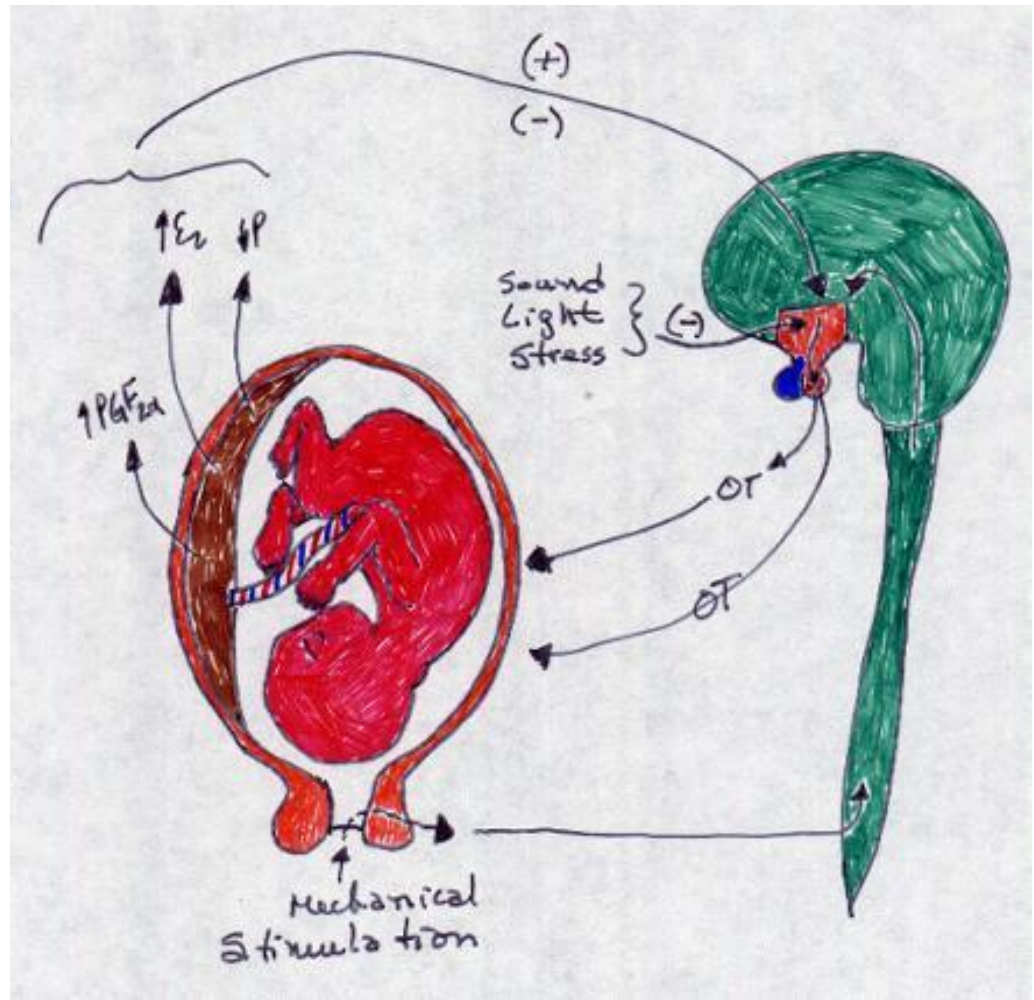
- Type I: the major group of alcoholics.
- Tends to develop after the patient ages beyond 25 YOA.
- The excuse for it is that the person is in a stressful environment.
- Type II alcoholics seem to occur in the sons of men who became alcoholics prior to the age of 25.
- These individuals display aggressive behavior.
- There may be a genetic factor present, although the only marker thus far is an abnormal dopamine type 2 receptor in the brain.
- These men have a unique, characteristic brain wave that is present even if they've never drunk alcoholic beverages.

- As the fetus is preparing to be expelled, the placenta and uterus release more prostaglandin $F_{2\alpha}$ (prostaglandin $F_{2\alpha}$) and estradiol while lowering progesterone levels.
- This sets up an excitatory environment for the uterus and it contracts.
- The release of the $PGF_{2\alpha}$ and estradiol (E_2 in the illustration) stimulate the release of oxytocin (OT) from the posterior pituitary to synchronize the uterine contractions.
- This continues until the fetus and placenta have been expelled, at which time a negative feedback cycle is set up to stop the release of OT.

Positive AND Negative Feedback



- Sound, light and stress inhibit the release of OT -- hence, first time mothers who wish to breast feed are taught how to breast feed in a quiet room with low lights and taught quietly and patiently.
- Mechanical stimulation of the cervix, whether by surgical instrument, the fetus wanting out or sexual intercourse, likewise, causes an increased output of OT.



Exercises

- Using the human torso models and the cadavers, complete the following sentences:
 -
 - 1. The head is _____ to the feet.
 - 2. The shoulder is _____ to the trunk.
 - 3. The wrist is more _____ to the shoulder than is the elbow.
 - 4. The right hand is _____ to the left foot.
 - 5. The right hand is _____ to the right foot.
 - 6. The waist is _____ to the chest.
 - 7. The chest is _____ to the back.
 - 8. The shoulder is _____ to the breast bone.
 - 9. The elbow is more _____ to the shoulder than is the wrist.
 - 10. The knee is more _____ to the hip than is the ankle.
 - 11. The spinal column is _____ to either shoulder blade.
 - 12. The arm pit is _____ to the groin.