

Introduction to the study of structure and function

MED 164

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Objectives

- Definition of anatomy, physiology, and morphology
- Characteristics of living organisms
- Organization of higher level living organisms
- Body systems in humans
- Homeostasis and equilibrium
- Negative feedback and positive feedback
- Anatomical position
- Directional terms

What is anatomy

- Ana = means apart
- Temnein = to cut
- Anatomy = to cut apart; The study of the structure of living things
 - we will study human anatomy
- Gross anatomy can be studied with the naked eye
- Microscopic anatomy requires aid of the microscope; thin sections

What is anatomy

- Primarily study of morphology;
- Morphology is the outward appearance
 - Shape and structure
- We will look at shape, structure and how that structure affects function

What is physiology?

- Began with Hippocrates in 420 B.C.
- Study of mechanical, biochemical, and physical functions of living systems
- Physiologists must be good at chemistry, physics, biology, biochemistry, and engineering
- We will learn how to use the best tools of all of these trades to understand human

What is physiology?

- Physiology is one of the most important courses a nurse will take
- Nurses must be physiologists!
- Must understand normal physiology before you can begin to understand abnormal physiology and disease processes

Relationship between Anatomy and Physiology

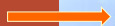
- Structure and function are interrelated!
 - Shape of a structure defines what functions it can perform
 - Function of a structure can be determined by looking at its shape

What is pathophysiology?

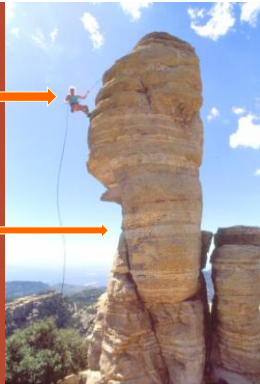
- Patho = disease
- -logy = study of
- Pathology is the study of disease
- Pathophysiology is the study of a disturbance in normal physiology
- All diseases are a pathology that are caused by some pathophysiology!
- Nurses treat patients with pathology!
- You need to understand physiology to understand pathophysiology

What is life?

Alive



Not Alive



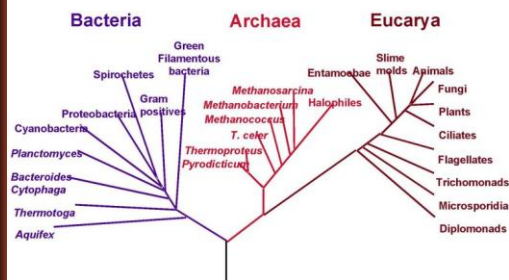
<http://www.fs.fed.us/r3/coronado/forest/local-resources/images/reppelling2.jpg>

What attributes define life?

- Ability to **m**ove
- Ability to **r**espirate
- Ability to **s**ense its environment
- Ability to **g**row
- Ability to **r**eproduce independently
- Ability to **e**xcrete
- Ability to acquire **n**utrition

• Mrs Gren !

Type of living organisms Phylogenetic Tree of Life



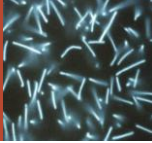
Bacteria/ Prokaryota

- Earliest living organisms
 - Appeared on Earth over 3 billion years ago
- Single celled organisms lacking cellular structures
- Found in nearly every habitat



Archaea

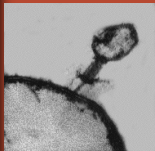
- Intermediate stage living organisms
- Best known for living in extreme environments
- Found in hot spring, sulfur vents, deep in ocean floor and the human intestine
- Utilize unique sources of energy



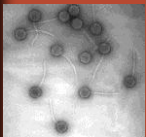
Eukaryota

- “Higher life form”
- Cells contain interiorly divided compartments called organelles
- Can be single celled or multicelled
 - Plants
 - Animals
 - Protists
- Ability to evolve by natural selection

Viruses

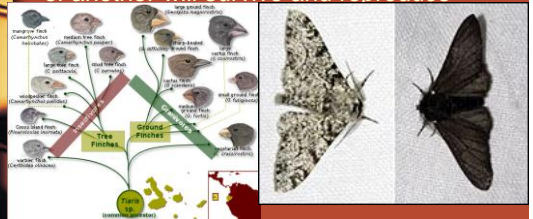


- Non-living entity
- Require a host for metabolic and reproductive properties
- Simple structures
 - Made of genetic material
 - Protein capsid (Coat)
- Very small in structure
 - Visible only with electron microscopes
- Ability to evolve by natural selection

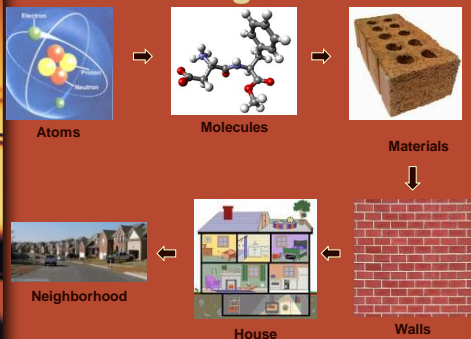


Darwin's Beautiful Theory

- Evolution by natural selection
 - Better known as survival of the fittest
- An organism with an adaptive advantage of another will survive and reproduce



Hierarchical Organization of a Neighborhood



What happens if there is a failure in the synthesis of an early step?

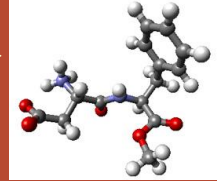


Six Levels of Organization in Living Systems

- Chemical
- Cellular
- Tissue
- Organs
- Organ System
- Organism
- Super Organism= 7th level of organization

Chemicals

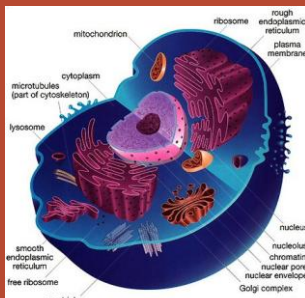
- Atoms come together to form small inorganic molecules
- Small inorganic molecules come together to form macro molecules
- Organic molecules come together to form macromolecules
- Macromolecules come together to form organelles
- Organelles come together to form cells



http://www.firstscience.com/STEMAGES/ARTICLES/aspartame/Chemical_Structure_aspartame.jpg

Cells

- Smallest unit of life
- Some organisms are only a single cell
- Cell must be able to live independently and cooperatively in higher life forms



<http://www.um.edu.inquiry/webquest/1806/mvogenbel/Animal-Cell.jpg>

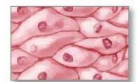
Tissues

- Cells working together to serve a common purpose form tissues
- Four basic types in animals
 - Many subtypes
- Connective, epithelial, muscle, and nervous

Four types of tissue



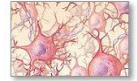
Connective tissue



Epithelial tissue



Muscle tissue

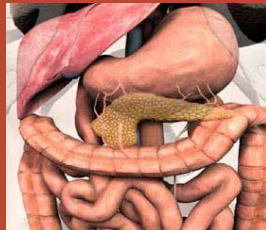


Nervous tissue

<http://static.howstuffworks.com/gif/adam/images/en/tissue-types-picture.jpg>

Organs

- Various tissues working together to accomplish a common goal
- Many organs in body
- Examples: heart, stomach, brain, pancreas, intestines



http://www.cdc.gov/tobacco/data_statistics/sgf/sgf_2004/sgf_animation/images/organs/pancreas_organ1.jpg

Organ Systems

- Organs work together in systems to accomplish a common goal
- Cardiovascular
- Respiratory
- Gastrointestinal
- Renal/ Urinary
- Nervous
- Lymphatic
- Muscular
- Skeletal
- Reproductive
- Integumentary
- Special senses
- Endocrine

Cardiovascular

- Includes heart, blood, and all blood vessels
- Transports nutrients to cells and removes waste products from cells

Respiratory

- Includes lungs, air passages and accessory organs
- Brings air in and out
- Exchanges gases of respiration
 - Oxygen
 - Carbon Dioxide

Gastrointestinal

- Includes alimentary canal (GI tract) and accessory organs (liver, gall bladder)
- Ingestion of food
- Digestion of food
- Absorption of nutrients

Renal/ Urinary

- Includes kidneys, bladder, and connecting tubes
- Removes metabolic waste products
- Regulates blood volume and composition
- Regulates acid/ base balance of body

Nervous System

- Brain, spinal cord and nerves
- Receives stimuli, process information and transmits response information

Lymphatic

- Includes lymph nodes, vessels and lymphoid organs (tonsils, thymus)
- Assists with interstitial fluid volume and aids in immunologic protection

Muscular

- All muscles in body
- Movement of person and substances through structures in body

Skeletal

- Bones, ligaments, and tendons
- Forms the framework of the body

Integumentary

- Includes the skin and its derivatives
- Covers and protects the body

Endocrine

- Includes many regulatory organs
- Process stimuli and secrete chemicals that direct actions of other cells

Reproductive

- Includes sexual organs, genitalia
- Responsible for reproducing a new human being

Special Senses

- Not really an organ system but an overlap of many systems and connected to nervous system
- Allows for identification of environmental stimuli

Homeostasis

- Homeostasis = to stay alike
 - Homeo = alike
 - stasis = always, staying
- Inherent ability to maintain balance or equilibrium.
 - Ability of the body to maintain a stable internal balance despite onslaught of environmental changes
- All systems play a role in maintaining homeostasis

Homeostasis

- Failure of one system will result in other systems trying to make up for the failure
 - Compensation

Homeostatic Control Mechanisms

- Three independent components create
- Variable = factor being controlled
 - Temperature
 - Blood sugar
 - Blood pressure
- Receptor = Sensor that is capable of detecting a change in environment
 - Change from normal is called a stimuli
 - Example: if blood sugar is lower than normal, it is a stimuli that causes changes in certain organs

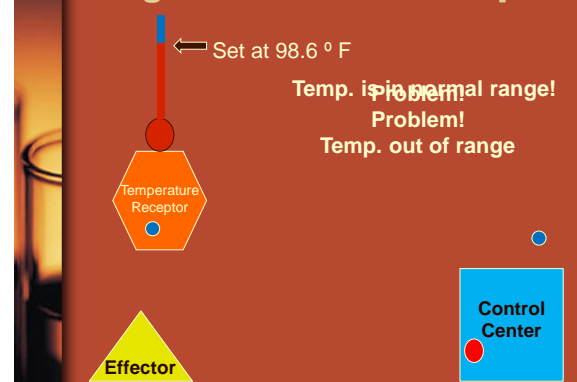
Homeostatic Control Mechanisms

- Control Center
 - Determines set point at which a variable should be maintained
 - Receives information from receptor, analyzes it and determines response
- Effector Organ
 - Receives and responds to commands from control center
 - Response of effector either opposes or enhances stimulus

Negative Feedback Loop

- If response opposes stimulus, it is a negative feedback
- Body responds in the opposite direction of the change
 - Example: Body temperature increases to 101 degrees F
 - Body will attempt to decrease the temperature to its set point
- Most control mechanisms in humans are negatively controlled!

Negative Feedback Loop



Positive Feedback Loop

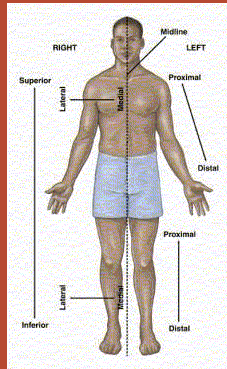
- If response enhances original stimulus, it is a positive feedback mechanism
- Body responds in the same direction of the change causing the variable to deviate even further from the set point
 - Example: Blood loss causes platelets to stick together; Platelets sticking together causes more platelets to stick together;
- Very few processes are controlled by a positive loop
 - Childbirth and blood clotting are!

Studying Anatomy

- Everyone must understand exactly what part of the body we are discussing
- A convention has been established that is universal in meaning

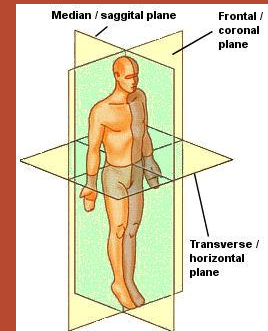
Anatomical Position

- All patient positions are described according to anatomical position
- Standing erect, palms forward
- Note: When talking about left and right, we use the patient's left and right!



Imaginary Planes

- Median Plane
 - Perpendicular to ground
 - Left and right
- Frontal Plane
 - Perpendicular to ground
 - Front and back
- Transverse Plane
 - Parallel to ground
 - Top and bottom



Terms to describe direction/ relationships

- **Superior** = upper or above
 - Shoulder is superior to elbow
- **Inferior** = lower or below
 - Elbow is inferior to shoulder
- **Posterior** = back side
 - Shoulder blade is posterior to the collar bone
- **Dorsal** = tail side
 - The anus is on the dorsal side of the body
- In bipeds posterior and dorsal mean the same thing; differ in quadrupeds

Terms to describe direction/ relationships

- **Anterior** = Front of
 - Breast bone is anterior to the lungs
- **Ventral** = Belly side
 - The umbilicus is on the ventral side of the body
- **Proximal** = closer to
 - The elbow is more proximal to the shoulder than the hand
- **Distal** = away from
 - The fingers are distal to the shoulder
- Default relationship is midline

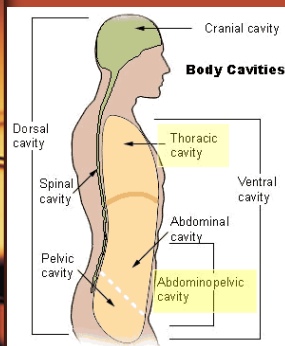
Terms to describe direction/ relationships

- **Cephalic** = towards the head
 - The shoulders are cephalic to the hips
- **Caudal** = towards the tail
 - The hips are caudal to the shoulders
- **Deep** = away from the surface
 - Arteries are often deep to the veins
- **Superficial** = near the surface
 - The dermis is superficial to the adipose tissue

Terms to describe direction/ relationships

- **Medial**- Towards the middle
- **Lateral**- Away from the middle, towards the side

Ventral Cavities

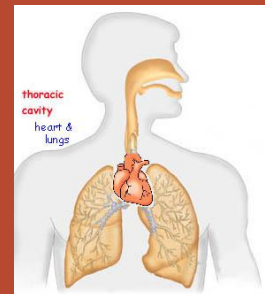


- Each cavity contains a group of organs that are collectively called viscera
- Two major ventral cavities
 - Thoracic
 - Abdominopelvic

<http://www.templejc.edu/dept/biology/RHicks/biol2404/Intcavities.gif>

Thoracic Cavity

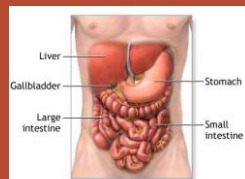
- Contains heart and lungs
- Region between lungs is called mediastinum



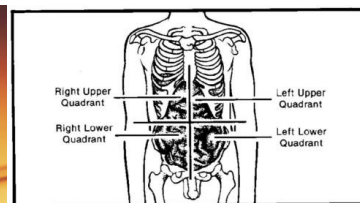
<http://porpax.bio.miami.edu/~cmallery/150/p/hysto/s41x8.jpg>

Abdominal Cavity

- Contains two regions
 - Peritoneal
 - Contains digestive organs
 - Retroperitoneal
 - Contains kidneys and aorta

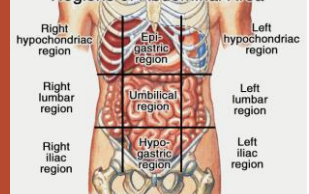


<http://www.nlm.nih.gov/MEDLINEPLUS/ency/images/ency/fulsize/8710.jpg>



<http://www.sweetshaven02.com/MedTechNurseFunc>

Regions of Abdominal Area



Pelvic Cavity



- Contains reproductive organs and urinary bladder