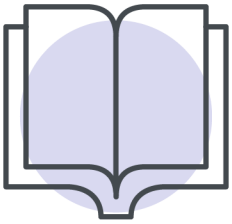
UW

BIOL 273

FINAL EXAM

STUDY GUIDE



Textbook Notes

BIOL 273 CHAPTER 1: Introduction to Physiology Notes

What is physiology?
- *Physiology:* the study of the normal functioning of a living organism and its component parts, including all its chemical and physical processes
- Literally means knowledge

What are emergent properties?
- *Emergent properties:* properties that cannot be predicted to exist based only on knowledge o the systems individual component of the system
- Result from complex, nonlinear interactions of the different components

What is a cell?
- *Cell:* the smallest unit of structure capable of carrying out all life processes

What is a cell membrane?
- *Cell membrane:* a lipid protein barrier
- AKA: plasma membrane
- Separates cells from their external environment

What are tissues?
- *Tissues:* form structural and functional units known as organs

What are organs?
- *Organs:* a group of tissues that carries out related functions

What is an organ system?
- *Organ system:* group of organs that work together to perform a certain task

What is an integumentary system?
- *Integumentary system:* composed of the skin, forms a protective boundary that separates the body's internal environment from the external environment

What does the musculoskeletal system do?
- *Musculoskeletal system:* provides support and body movement

What does the respiratory (pulmonary) system do?
- *Respiratory (pulmonary) system:* exchanges gases

What does the digestive (gastrointestinal) system do?
- *Digestive (gastrointestinal) system:* takes up nutrients and water and eliminates wastes

What does the urinary (renal) system do?
- *Urinary (renal) system:* removes excess water and waste material

What does the reproductive system do?
- *Reproductive system:* produces eggs or sperm

What does the circulatory (cardiovascular) system do?
- *Circulatory (cardiovascular) system:* distributes materials by pumping blood through the vessels

What does the nervous and endocrine systems do?
- *Nervous and endocrine system:* coordinate body functions

What does the immune system do?
- *Immune system:* defense against foreign invaders

What does function mean?
- *Function:* the "why" of the system/event: Why does a certain response help an animal survive in a particular situation?

What is teleological approach?
- *Teleological approach:* describing physiological processes by their purpose rather than their mechanism

What does mechanism mean?
- *Mechanism:* the "how" of a system

What is translational research?
- *Translational research:* an approach sometimes describes as "bench to bedside"
- Uses the insights and results gained from basic biomedical research on mechanisms to develop treatments and strategies for preventing human diseases

What are the 5 major themes?
1. Structure and function across all levels of organization
2. Energy transfer, storage and use
3. Information flow, storage, and use within single organisms and within a species of organism
4. Homeostasis and the control systems that maintain it
5. Evolution

What are molecular interactions?
- *Molecular interactions:* the ability of individual molecules to bind to or react with other molecules is essential for biological function
- *Compliance:* ability to stretch (strength)
- *Elastance:* stiffness or ability to return to the un-stretched state (flexibility)
- *Viscosity:* fluidity

What is compartmentation?

- *Compartmentation:* the division of space into separate compartments
- Allow a cell, a tissue, or an organ to specialize and isolate functions

What do cell-to-cell communication use?

- *Cell-to-cell communication:* chemical signals, electrical signals, or a combination of both
- Info. Can go from one cell to its neighbors (local communication)
- Info. Can go fro one part of the body to the other (long-distance communication)

What does homeostasis mean?

- *Homeostasis:* (homeo-, similar; -stais, condition) the ability of the body to maintain a relatively constant internal environment

What does pathological mean?

- *Pathological:* Of, or pertaining pathology, especially on the structural and functional changes in tissues and organs of the body caused by the disease

What is pathophysiology?

- *Pathophysiology:* the study of body functions in a disease state

What is diabetes mellitus?

- *Diabetes mellitus:* a metabolic disorder characterized by abnormally high blood glucose concentrations

What is extracellular fluid?

- *Extracellular fluid (ECF):* (extra-, outside of) the watery internal environment that surrounds the cells, a “sea within” the body
- Buffer zone between cells and the outside world

What is intracellular fluid?

- *Intracellular fluid (ICF):* (intra-, within) fluid within the cells

What is the law of mass balance?

- *Law of mass balance:* if the amount of a substance in the body is to remain constant, any grain must be offset by an equal loss

What does load mean?

- *Load:* the amount of substance in the body
- “Sodium load”

What does excretion mean?

- *Excretion:* the elimination of material from the body, usually through urine, feces, lungs or skin

What is metabolite?

- *Metabolite:* the general term for any product created in a metabolic pathway

What is mass flow?

$$\underset{(amount\ x/min)}{Mass\ flow} = \underset{(amount\ x/vol)}{concentration\ of\ x} \times \underset{(vol/min)}{x\ volume\ flow}$$

What is clearance?

- *Clearance:* a measurement of the disappearance of a substance from the blood
- Expressed as mL of plasma cleared of solute per unit time
- Kidney and Liver are the 2 primary organs that clear solutes from the body

What is plasma?

- *Plasma:* the fluid component, plus the heavier blood cells of centrifuge
- Part of ECF

What are the 3 parts to a control system/response loop?

1. Input signal
2. Controller/Integrating centre that integrates incoming information and initiates an appropriate response
3. Output signal that creates a response

What is local control?

- *Local control:* homeostatic control that takes place strictly at the tissue or cell by using paracrine/autocrine signals

What is a feedback loop?

- *Feedback loop:* the response "feeds back" to influence the input portion of the pathway

What is negative feedback loop?

- *Negative feedback loop:* stabilize the regulated variable and thus aid the system in maintaining homeostasis

What is positive feedback loop?

- *Positive feedback loop:* the response reinforces the stimulus rather than decreasing or removing it

What is feedforward control?

- *Feedforward:* anticipatory responses that start a response loop in anticipation of a change that is about to occur

What is circadian rhythm?

- *Circadian rhythm:* biological rhythm based on a 24-hour cycle

What is the placebo effect?

- *Placebo effect:* response to the placebo response
- Thinking something is there when it isn't

What is the nocebo effect?

- *Nocebo effect:* adverse effect that occurs because the patient expects it to

What is the blind study?

- *Blind study:* an experiment in which the subject does not know if he or she is receiving the experimental treatment

What is the double-blind study?

- *Double blind study:* experimental design in which neither the subject nor the researcher knows who is getting the experimental treatment and who is getting the placebo

What is the double-blind crossover study?

- *Double-blind crossover study:* double-blind experiment in which the subjects switch between experimental and placebo halfway through the study

What are longitudinal studies?

- *Longitudinal studies:* designed to be carried out for a long period of time

BIOL 273 CHAPTER 3: Compartmentation: Cells and Tissues Notes

What are the types of cavities?

1. Cranial cavity→AKA the skull
   - Contains the brain
2. Thoracic cavity→AKA thorax
   - Thoracic cavity is bounded by the spine and ribs, on top and sides, with muscular diaphragm forming the floor
   - Thorax contains the heart
3. Abdominal cavity
   - Abdominal cavity and pelvis form one continuous cavity
   - Kidney's lie outside the abdominal cavity
   - The pelvis contains reproductive organs, urinary bladder, and the terminal portion of large intestine

What is a lumen?

- *Lumen:* the interior of any hollow organ

What is a cell membrane?

- *Cell membrane:* a thin layer of lipids that separated the aqueous fluids of the interior and outside environments

What are the general functions of the cell membrane?

1. *Physical isolation*: physical barrier that separates the ICF inside the cell from surrounding the ECF
2. *Regulation of exchange within the environment*: cell membrane controls the entry of ions and nutrients into the cell, elimination of cellular wastes, release of products from cell
3. *Communication between the cell and its environment*: cell membrane contains proteins that enable the cell to recognize and respond to molecules or changes in external environment
   - Alterations in the cell membrane may affect cell's activities
4. Structural support: proteins hold the cytoskeleton in place maintaining its shape
   - Cell-cell and cell-matrix junctions stabilize the structure of tissues

What is the composition of selected membranes?

Membrane	Protein	Lipid	Carbohydrate
Red blood cell membrane	49%	43%	8%
Myelin membrane around nerve cells	18%	79%	3%
Inner mitochondrial membrane	76%	24%	0%

What are micelles?

- *Micelles:* small droplets with a single layer of phospholipids arranged so that the interior of the micelle is filled with hydrophobic fatty acid tails

What are liposomes?

- *Liposome:* larger than spheres with bilayer phospholipid walls

What are sphingolipids?

- *Sphingolipids:* have fatty acid tails, but their heads may be either phospholipids or glycolipids

What are integral proteins?

- *Integral proteins:* tightly bound to the membrane and the only way they can be removed is by disrupting the membrane structure with detergents or other harsh methods

What are peripheral proteins?

- *Peripheral proteins:* (peripheria, circumference) attach to other membrane proteins by non-covalent interactions can be separated by chemical methods that do not disrupt the integrity of the membrane
- Include some enzymes as well as structural binding proteins that anchor the cytoskeleton

What are transmembrane proteins?

- *Transmembrane proteins:* (trans-, across) AKA membrane-spanning proteins as the protein's chains extend to the cell membrane

What are lipid-anchored proteins?

- *Lipid-anchored proteins:* previously thought to be peripheral proteins
- Some of these proteins are covalently bound to lipid tails that insert themselves into the bilayer

What is a GPI anchor?

- *GIP anchor:* consists of a membrane lipid plus a sugar—phosphate chain
- GPI= glycosylphosphatidylinostitol

What are the components of the cytoplasm?

1. Cytosol (cyto-, cell + sol (uble)) or intracellular fluid
   - Cytosol is a semi-gelatinous fluid separate from the extracellular fluid by cell membrane
   - Contains dissolved nutrients and proteins, ions, and waste products
2. Inclusions
   - Particles of insoluble martials, some are stored as nutrients
   - Responsible for specific cell function
   - Sometimes called nonmembranous organelles
3. Insoluble protein fibres from cell's internal support system or cytoskeleton

4. Organelles
   - "Little organs"
   - Membrane-bound compartments that play specific roles in the overall function of the cell

What is a ribosome?
- *Ribosome:* small, dense granules of RNA and protein that manufacture proteins under the direction of the cell's DNA

What are fixed ribosomes?
- *Fixed ribosomes:* attach to the cytosolic surface of organelles

What are free ribosomes?
- *Free ribosomes:* suspended free in the cytosol

What is a polyribosome?
- *Polyribosome:* free ribosomes that form groups of 10-20

What are the 5 important functions of the cytoskeleton?
1. Cell shape
   - Protein scaffolding provides mechanical strength to the cell and in some cells plays an important role in determining the shape of the cell
   - Help support microvilli (micro-, small + villus, tuft of hair), finger-like
2. Internal organization
   - Cytoskeleton fibres stabilize the positions of organelles
   - Interior=dynamic, changing from one minute to the next in respond to the needs of the cell
3. Intracellular transport
   - Helps transport materials into the cell and within the cytoplasm by serving as an intracellular "railroad track" for moving organelles
   - IMPORTANT for cells in nervous system→ long distances
4. Assembly of cells into issues
   - Protein fibres of cytoskeleton connect with protein fibres in extracellular space linking cells to one another and supporting material
5. Movement
   - Helps cells move

What are motor proteins?
- *Motor proteins:* proteins that convert stored energy into directed movement
- 3 motor proteins: myosins, kinesis, and dyneins

What are myosins?
- *Myosins:* bind to actin fibres and are best known for their role in muscle contraction

What are secretory vesicles?

- *Secretory vesicles:* contain proteins that will be released from the cell

What are lysosomes?

- *Lysosome:* (lysis, dissolution + soma, body) are small storage vesicles appear as membrane-bound granules in the cytoplasm

What are peroxisomes?

- *Peroxisome:* are storage vesicles that are even smaller than lysosomes

What is extracellular matrix?

- *Extracellular matrix (matrix):* extracellular material that is synthesized and secreted by the cells of a tissue

What are proteoglycans?

- *Proteoglycans:* glycoproteins which are proteins covalently bound to polysaccharide chains

What are cell adhesion molecules (CAMs)?

- *CAMs:* membrane-spanning proteins responsible both for cell junctions and for transient cell adhesions

What are the major groups of junctions?

1. Gap junctions
   - Simplest cell-cell junctions
   - Cylindrical proteins called connexins interlock to create passageways
   - Allow both chemical and electrical signals to pass rapidly from one cell to another
2. Tight junctions
   - Occluding junctions that restrict the movement of material between cells they link
   - Have varying degrees of "leakiness"
   - Created the blood-brain barrier that prevents many potentially harmful substances in the blood from reaching the ECF of the brain
3. Anchoring junctions
   - Attach cells to each other (cell-cell anchoring junctions) or to the extracellular matrix (cell-matrix anchoring junctions)
   - *Cadherins:* connect with one another across the intracellular space
   - *Integrins:* are membrane proteins that can also bind to signal molecules in the cell's environment
   - *Desmosomes:* (desmos, band + soma, body) attach to intermediate filaments of the cytoskeleton

What are ciliated epithelia?

- *Ciliated epithelia:* non-transposing tissues that line the respiratory system and parts of the female reproductive tracts

What are protective epithelia?

- *Protective epithelia:* prevent exchange between the internal and external environments and protect areas subject to mechanical or chemical stresses

What are secretory epithelia?

- *Secretory epithelia:* composed of cells that produce a substance and then secrete it into the extracellular space

What are exocrine glands?

- *Exocrine glands:* release their secretions to the body's external environment

What are connective tissues?

- *Connective tissues:* the second major tissue type, provide structural support and sometimes a physical barrier that alone with specialized cells, helps defend the body from foreign invaders such as bacteria

What is fibronectin?

- *Fibronectin:* connects cells to extracellular matrix at focal adhesions

What are loose connective tissues?

- *Loose connective tissue:* elastic tissues that underlie skin and provide support for all glands

What are dense connective tissues?

- *Dense connective tissues:* (irregular and regular) provide strength/flexibility
- Ie. Tendons, ligaments, and the sheaths that surround muscles and nerves

What is adipose tissue?

- *Adipose tissue:* made up of adipocytes, or fat cells
- An anatomical term for loose connective tissue composed of adipocytes
- Its main role is to store energy in the form of fat, although it also cushions and insulates the body.
- *White fat:* single enormous lipid droplet that occupies most of the volume of the cell
- *Brown fat*: composed of adipose cells that contain multiple lipid droplets rather than a large single droplet

What is apoptosis?

- *Apoptosis:* (apo-, apart, away + ptosis, falling) do not disturb their neighbors when hey die

What is totipotent?

- *Totipotent:* (totus, entire) because they have the ability to develop into any and all types of specialized cells

What is pluripotent?

- *Pluripotent:* (plures, many) can develop into many different cell types but not all cell types
- Isolated cell cannot develop into an organism

What is multipotent?

- *Multipotent:* (multi, many) found in bone marrow and give rise to blood cells

BIOL 273 CHAPTER 6: Communication, Integration and Homeostasis Notes

What are electrical signals?
- *Electrical signals:* changes in a cell's membrane potential

What are chemical signals?
- *Chemical signals:* molecules secreted by cells into the extracellular fluid

What is local communication?
- *Local communication:*
  1. Gap junctions: which allow direct cytoplasmic transfer of electrical and chemical signals between adjacent cells
     - Forms from the union of membrane-spanning proteins
  2. Contact-dependent signals: which occur when surface molecules on one cell membrane bind to surface molecules on another cell's membrane
  3. Chemicals that diffuse through the extracellular fluid to act on cells close by
- *Long-distance communication:*
  1. Uses a combination of chemical and electrical signals carried by nerve cells and chemical signals transported in the blood

Where does contact-dependent signaling occur?
- Occurs in the immune system ad during growth and development

What are cell adhesion molecules (CAMs)?
- *CAMs:* act as receptors in cell-to-cell signaling
- Linked to the cytoskeleton or to intracellular enzymes

What is a paracrine signal?
- *Paracrine signal:* (para-, beside + krinen, to secrete) is a chemical that acts in cells in the immediate vicinity of the cell that secreted the signal

What is an autocrine signal?
- *Autocrine signal:* (auto-, self) acts on the cell that secreted the signal

What are hormones?
- *Hormones:* (hormone, to excite) chemical signals that are secreted into the blood and distributed all over the body by the circulation

What are receptor proteins?
- *Receptor proteins:* a cell can respond to a particular chemical signal only if the cell has the appropriate receptor protein to bind that signal

What do all signal pathways share the following features?

1. The signal molecule is a ligand that binds to a protein receptors
- Ligand is known as a first messenger because it brings information to the target cell
2. Ligand-receptor binding activates the receptor
3. The receptor in turn activates one or more intracellular signal molecules
4. The last signal molecule in the pathway creates a response by modifying existing proteins or initiating the synthesis of new proteins

What is signal transduction?

- *Signal transduction:* the process by which an extracellular signal molecule activates a membrane receptor that in turn alters intracellular molecules to create a response

What is a transducer?

- *Transducer:* a device that converts a signal from one form into a different form

What is protein kinases?

- *Protein kinases:* enzymes that are transfer a phosphate group from ATP to a protein

What is a cascade?

- *Cascade:* starts when a stimulus (signal molecules) converts inactive molecule A (receptor) to an active form

What is signal amplification?

- *Signal amplification:* turns one signal molecule into multiple second messenger molecules

What is amplifier enzyme?

- *Amplifier enzyme:* activates several molecules, which in turn each activated several more molecules as the cascade proceeds

What are receptor-channels?

- *Receptor-channels:* initiates the most rapid intracellular responses of all receptors

What are G protein-coupled receptors (GPCRs)?

- *GPCR:* are a large and complex family of membrane-spanning proteins that cross the phospholipid bilayer seven times
- G-protein: transducer molecule

What is G protein-coupled adenylyl cyclase- cAMP system?

- cAMP: was the first identified signal transduction pathway

What is phospholipase C (PLC)?

- *PLC:* converts a membrane phospholipid (phosphatidylinositolbisphosphate) into two lipid-derived second messenger molecules: diacylglycerol and inositol triphosphate

What is diacylglycerol (DAG)?

- *DAG:* a nonpolar diglyceride that remains in the lipid portion of the membrane and interacts with protein kinase C (PKC)

What is inositol triphosphate (IP_3)?

- *(IP_3):* a water-soluble messenger molecule that leaves the membrane and enters the cytoplasm

What are receptor-enzymes?

- *Receptor enzymes:* have 2 regions: a receptor region on the extracellular side of the cell membrane, and an enzyme region on the cytoplasmic side

What is calmodulin?

- *Calmodulin:* binding alters enzyme or transporter activity or the grating of ion channels

What are leukotrienes?

- *Leukotrienes:* molecules produced by the action of the enzyme lipoxygenase on arachidonic acid

What is an agonist?

- *Agonist:* molecules that combine with a receptor and mimic a response

What is an antagonist?

- *Antagonist:* one substance opposes the action of another

What is down-regulation?

- *Down-regulation:* a decrease receptor number

What is up-regulation?

- *Up-regulation:* the target cell inserts more receptors into its membrane

What is involved in a response loop?

- Input
    - Stimulus: the disturbance or change that sets the pathway in motion
        - May be a change in temperature, oxygen content, blood pressure, or any one of a myriad of other regulated variables
    - Sensor/sensory receptor: continuously monitors its environment for a particular variable
    - When activated by change, the sensor sends an input (afferent) signal to the intergrading centre for the reflex

- Integration
  - Integrating centre compares the input signal with the set point, or desired value of the variable
  - If the variable had moved out of the acceptable range, the integrating center initiates an output signal
- Output
  - The output (efferent) signal is an electrical and/or chemical signal that travels to the target
  - The target, effector is the cell or tissue that carries out the appropriate response to bring the variable back within normal limits

TABLE 6.2 Comparison of Neural and Endocrine Control

Property	Neural Reflex	Endocrine Reflex
Specificity	Each neuron terminates on a single target cell or on a limited number of adjacent target cells.	Most cells of the body are exposed to a hormone. The response depends on which cells have receptors for the hormone.
Nature of the signal	Electrical signal that passes through neuron, then chemical neurotransmitters that carry the signal from cell to cell. In a few cases, signals pass from cell to cell through gap junctions.	Chemical signals secreted in the blood for distribution throughout the body.
Speed	Very rapid.	Distribution of the signal and onset of action are much slower than in neural responses.
Duration of action	Usually very short. Responses of longer duration are mediated by neuromodulators.	Responses usually last longer than neural responses.
Coding for stimulus intensity	Each signal is identical in strength. Stimulus intensity is correlated with increased frequency of signaling.	Stimulus intensity is correlated with amount of hormone secreted.

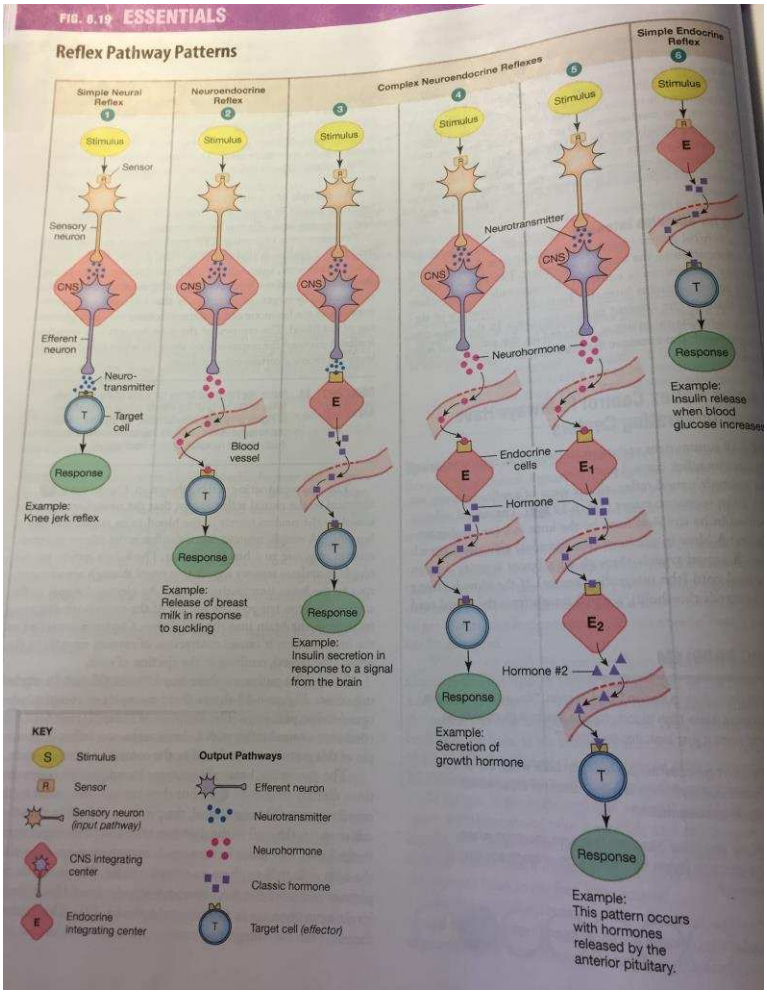


TABLE 6.3 Comparison of Neural, Neuroendocrine, and Endocrine Reflexes

	Neural	Neuroendocrine	Endocrine
Sensor	Special and somatic sensory receptors	Special and somatic sensory receptors	Endocrine cell
Input Signal	Sensory neuron	Sensory neuron	None
Integrating Center	Brain or spinal cord	Brain or spinal cord	Endocrine cell
Output Signal	Efferent neuron (electrical signal and neurotransmitter)	Efferent neuron (electrical signal and neurohormone)	Hormone
Target(s)	Muscles and glands, some adipose tissue	Most cells of the body	Most cells of the body
Response	Contraction and secretion primarily; may have some metabolic effects	Change in enzymatic reactions, membrane transport, or cell proteins	Change in enzymatic reactions, membrane transport, or cell proteins

BIOL 273-Chapter 8: Neurons: Cellular and Network Properties Notes

What is the nervous system?

- *Nervous system:* a network of billions of nerve cells linked together in a highly organized manner to form the rapid control system of the body

What are neurons?

- *Neurons:* carry electrical signals rapidly and in some cases over long distances

What are neurotransmitters?

- *Neurotransmitters:* chemical signals

What are emergent properties?

- *Emergent properties:* complex properties, such as consciousness, intelligence, and emotion that cannot be predicted from what we know about properties of individual nerve cells and their specific connections

What is the enteric nervous system?

- *Enteric nervous system:* a network of neurons in the walls of the digestive tract

What is multipolar?

- *Multipolar:* has many dendrites and branched axons

What is pseudounipolar?

- *Pseudounipolar:* neurons have the cell body located off one side of a single long process that is called the axon

What is bipolar?

- *Bipolar:* neurons have a single axon and single dendrite coming off the cell body

What is anaxonic?

- *Anaxonic:* neurons lack an identifiable axon but have numerous branched dendrites

What is varicosity?

- *Varicosity:* Swollen regions along autonomic axons that store and release neurotransmitters

What are growth cones?

- *Growth cones:* tips that extend through the extracellular compartment until they find their target

What are neural stem cells?

- *Neural stem cell:* immature cells that can differentiate into neurons and glial cells

What are the 2 factors that influence the membrane potential?

1. Uneven distribution of ions across the cell membrane
2. Differing membrane permeability to those ions

- The Nernst equation describes membrane potential that would result if the membrane were permeable to only one ion

$$E_{ion}(in\ mv) = \frac{61}{z} log \frac{[ion]_{out}}{[ion]_{in}}$$

Where,
61 is 2.303 RT/F at 37°C
z is the electrical charge on the ion (+1 for K^+)
$[ion]_{out}$ and $[ion]_{in}$ are the ion concentrations outside and inside the cell

What is the Goldman-Hodgkin-Katz (GHK) equation?

- *GHK equation:* calculates the membrane potential that results from the contribution of all ions that can cross the membrane

$$V_m = 61 log \frac{P_k[K^+]_{out} + P_{Na}[Na^+]_{out} + P_{Cl}[Cl^-]_{in}}{P_K[K^+]_{in} + P_{Na}[Na^+]_{in} + P_{Cl}[Cl^-]_{out}}$$

Where,
V_m is the resting membrane potential at 37°C
61 is 2.303 RT/F at 37°C
P is the relative permeability of the membrane to the ion shown in the subscript
$[ion]_{out}$ and $[ion]_{in}$ are the ion concentrations outside and inside the cell

What are the 3 types of gated ion channels?

1. Mechanically gated ion channels

- Found in sensory neurons and open in response to physical forces such as pressure/stretch

2. Chemically gated ion channels

- Most neurons respond to a variety of ligands, such as extracellular neurotransmitters and neuromodulators or intracellular signal molecules

3. Voltage-gated ion channels

- Respond to changes in the cell's membrane potential
- Voltage-gated Na^+ and K^+ channels play an important role in the initiation and conduction of electrical signals along the axon

What is Ohm's law?

- *Ohm's law:* states that current flow (I) is directly proportional to the electrical potential difference (in volts, V) between two points and inversely proportional to the resistance (R) of the system to current flow: I=V X 1/R or I=V/R

What is excitable tissue?

- *Excitable tissue:* neural and muscle tissue that is capable of generating and responding to electrical signals

What is an absolute refractory period?

- *Absolute refractory period:* represents the time required for the Na^+ channel gates to reset to their resting potential

What is a relative refractory period?

- *Relative refractory period:* follows the absolute refractory period

What is multiple sclerosis?

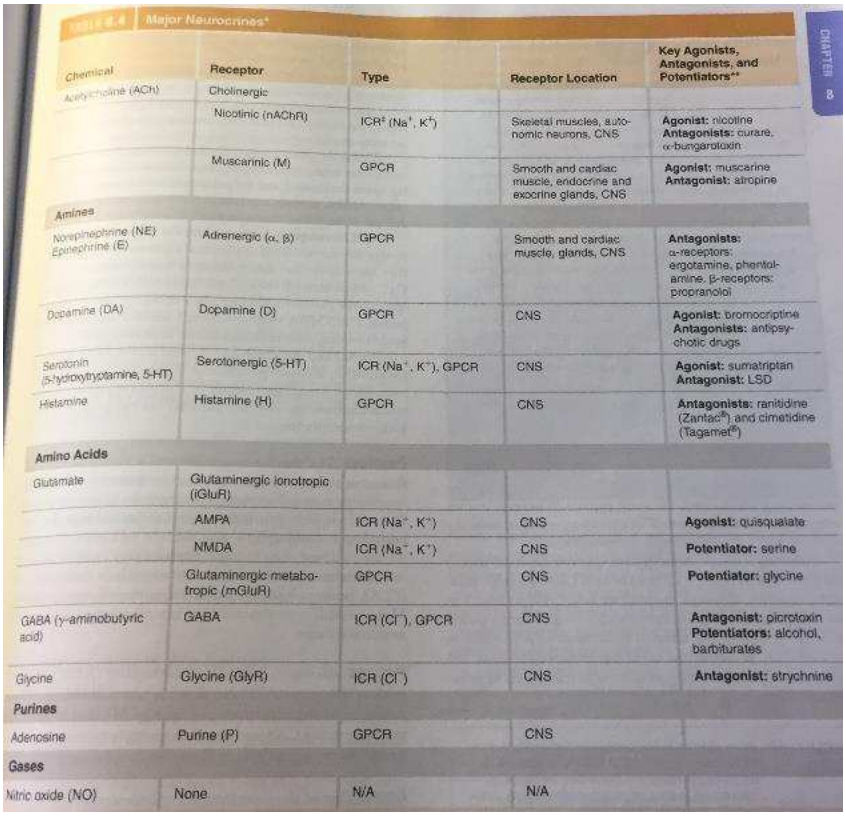
- *Multiple sclerosis:* the most common and best-known de-myelinating disease

What is hyperkalemia?

- *Hyperkalemia:* (in the blood), shifts the resting membrane potential of a neuron closer to threshold and causes the cells to fire action potentials in response to smaller graded potentials

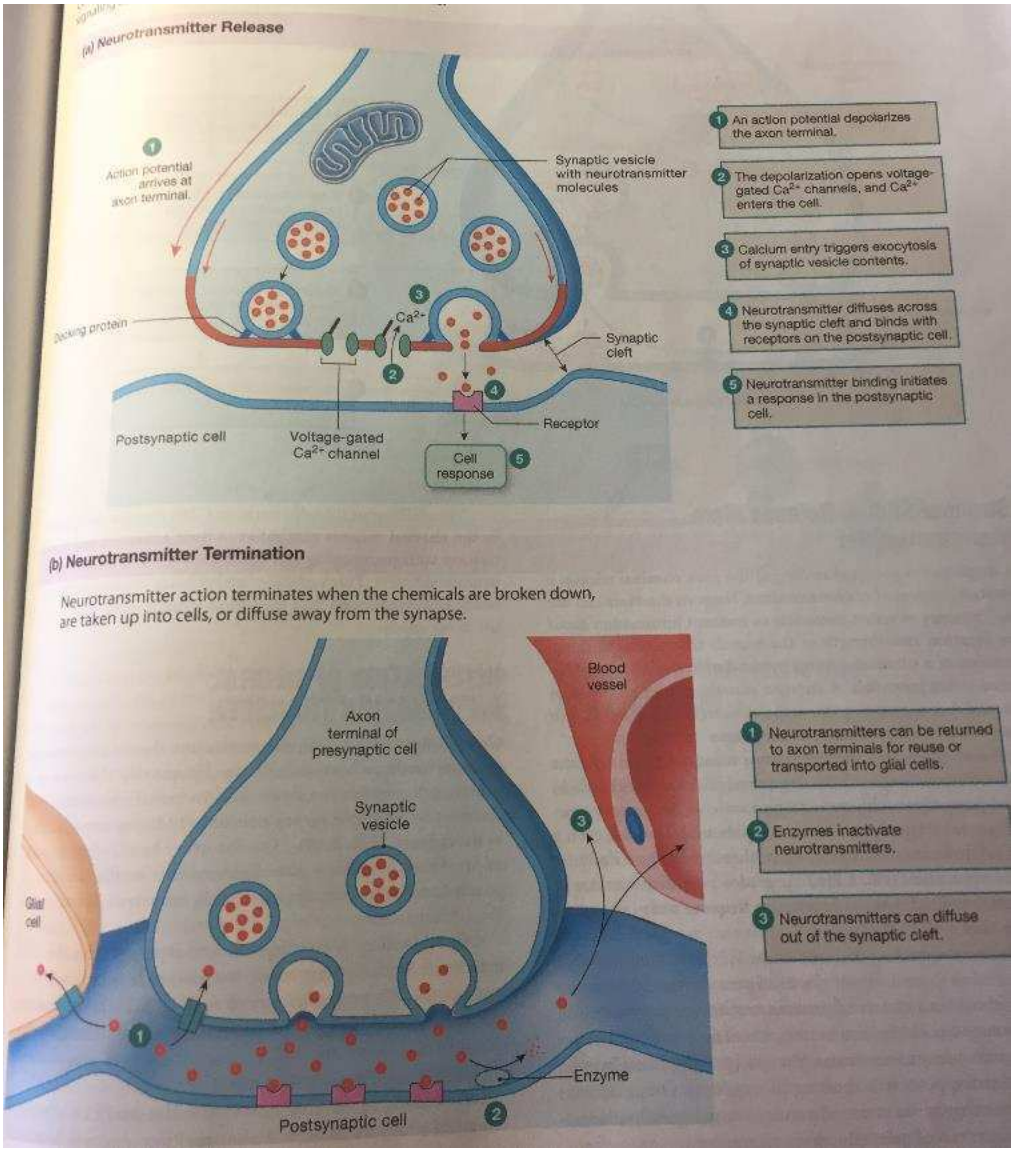
What are electrical synapses?

- *Electrical synapses:* pass an electrical signal, or current, directly from cytoplasm of one cell to another through the pores of the gap junction proteins



Major Neurocrines*

Chemical	Receptor	Type	Receptor Location	Key Agonists, Antagonists, and Potentiators**
Acetylcholine (ACh)	Cholinergic			
	Nicotinic (nAChR)	ICR‡ (Na^+, K^+)	Skeletal muscles, autonomic neurons, CNS	**Agonist:** nicotine **Antagonists:** curare, α-bungarotoxin
	Muscarinic (M)	GPCR	Smooth and cardiac muscle, endocrine and exocrine glands, CNS	**Agonist:** muscarine **Antagonist:** atropine
Amines				
Norepinephrine (NE) Epinephrine (E)	Adrenergic (α, β)	GPCR	Smooth and cardiac muscle, glands, CNS	**Antagonists:** α-receptors: ergotamine, phentolamine. β-receptors: propranolol
Dopamine (DA)	Dopamine (D)	GPCR	CNS	**Agonist:** bromocriptine **Antagonists:** antipsychotic drugs
Serotonin (5-hydroxytryptamine, 5-HT)	Serotonergic (5-HT)	ICR (Na^+, K^+), GPCR	CNS	**Agonist:** sumatriptan **Antagonist:** LSD
Histamine	Histamine (H)	GPCR	CNS	**Antagonists:** ranitidine (Zantac®) and cimetidine (Tagamet®)
Amino Acids				
Glutamate	Glutaminergic ionotropic (iGluR)			
	AMPA	ICR (Na^+, K^+)	CNS	**Agonist:** quisqualate
	NMDA	ICR (Na^+, K^+)	CNS	**Potentiator:** serine
	Glutaminergic metabotropic (mGluR)	GPCR	CNS	**Potentiator:** glycine
GABA (γ-aminobutyric acid)	GABA	ICR (Cl^-), GPCR	CNS	**Antagonist:** picrotoxin **Potentiators:** alcohol, barbiturates
Glycine	Glycine (GlyR)	ICR (Cl^-)	CNS	**Antagonist:** strychnine
Purines				
Adenosine	Purine (P)	GPCR	CNS	
Gases				
Nitric oxide (NO)	None	N/A	N/A	



BIOL 273-Chapter 12: Muscles Notes

What are most skeletal muscles attached to?
- *Skeletal muscle:* attached to the bones of the skeleton, enabling these muscles to control body movement

Where is cardiac muscle found?
- *Cardiac muscle:* found only in the heart and moves blood through the circulatory system

What are striated muscles?
- *Striated muscles:* muscles that appear to have alternating light and dark bands, includes skeletal and cardiac muscle

What is smooth muscle?
- *Smooth muscle:* the primary muscle of internal organs and tubes, such as the stomach, urinary bladder, and blood vessels

What are tendons?
- *Tendons:* connective tissue that attaches skeletal muscle to bone
- Made of collagen

What is the origin of a muscle?
- *Origin:* the end of the muscle attached closest to the truck or the more stationary bone

What is insertion?
- *Insertion:* is more the distal or more mobile attachment

What is flexor?
- *Flexor:* a muscle that bring connected bones closer together when it contracts

What is extensor?
- *Extensor:* a muscle that moves bones away from each other when the muscle contracts

What are antagonistic muscle groups?
- *Antagonist muscle groups:* flexor-extensor pairs of muscles attached to the same set of bones

What are muscle fibers?
- *Muscle fibers:* a muscle cell

What is a satellite cell?
- *Satellite cell:* committed stem cells

- Become active and and differentiate into muscle when needed for muscle growth and repair

What are fascicles?
- *Fascicles:* groups of adjacent muscle fibers bundled together into units

What is sarcolemma?
- *Sarcolemma:* the cell membrane of a muscle fiber

What is a sarcoplasm?
- *Sarcoplasm:* cytoplasm of a muscle fiber

What are myofibrils?
- *Myofibrils:* main intracellular structures in striated muscles
- Highly organized bundles of contractile and elastic proteins that carry out the work of a contraction

What is sarcoplasmic reticulum (SR)?
- *Sarcoplasmic reticulum:* a form of modified endoplasmic reticulum that wraps around each myofibril like a piece of lace

What is terminal cisternae?
- *Terminal cisternae:* longitudinal tubules with enlarged end regions

What are transverse tubules (t-tubules)?
- *T-tubules:* invaginations of the muscle fibers membrane, associated with the SR
- *Invaginations:* the action or process of being turned inside out or folded back on itself to form a cavity or pouch.

What is myosin?
- *Myosin:* a motor protein with the ability to create movement

What is myosin ATPase?
- *Myosin ATPase:* acts as an enzyme

What is a thick filament?
- *Thick filament:* an aggression of myosin in muscle

What is actin?
- *Actin:* a globular protein (G-actin) that polymerizes to form thin filaments (F-actin)

What is a thin filament?
- *Thin filament:* an actin-containing filament of the myofibril

What are the crossbridges?

- *Crossbridges:* span space between the filaments

What are sarcomeres?

- *Sarcomeres:* the contractile unit of the myofibril

What is a Z disk?

- *Z disk:* one sarcomere is composed of two Z disks and the filaments found between them
- Z disks are zigzag protein structures that serve as the attachment site for thin filaments
- From zwischen→German word for in-between

What is an I band?

- *I band:* are the lightest color bands of the sarcomere and represent a region occupied by only thin filaments
- From isotropic→ description from early microscopists meaning that this region reflects light uniformly under a polarizing microscope
- Z disk runs through the middle of every I band, so each half of an I band belongs to a different sarcomere

What is an A band?

- *A band:* the darkest of the sarcomere's bands and encompasses the entire length of a thick filament
- Outer edges of A band, the thick and thin filaments overlap
- Center of the A band is occupied by thick filaments ONLY
- From anisotropic → that the protein fibers in this region scatter light unevenly

What is the H zone?

- *H zone:* the central region of he A band is lighter than the outer edges of the A band because the H zone is occupied by thick filaments only
- From helles→German for clear

What is the M line?

- *M line:* band represents proteins that form the attachment site for thick filaments
- Equivalent to the Z disk for the thin filaments
- Each M line divides the A band in half
- From mittel→German for middle

What is muscle tension?

- *Muscle tension:* contracting muscle

What is relaxation?

- *Relaxation:* the release of tension created by a contraction

What are the major steps leading to skeletal muscle contraction?

1. Events at the neuromuscular junction
    - Convert an acetylcholine signal from a somatic motor neuron into an electrical signal in the muscle fiber
2. Excitation-contraction (E-C) coupling
    - The process which muscle action potentials initiate calcium signals that in turn activate a contraction-relaxation cycle
3. Contraction-relaxation cycle
    - Molecular level
    - Explained by the sliding filament theory of contraction
    - In intact muscles, one contraction-relaxation cycle is called a muscle TWITCH

What is the sliding filament theory?

- *Sliding filament theory:* the current model for muscle contraction in which muscle proteins slide past each other to generate force

What is a power stroke?

- *Power stroke:* movement of the myosin head that is the basis for muscle contraction

What is troponin (TN)?

- *Troponin:* calcium-binding complex of 3 proteins associated with tropomyosin

What is tropomyosin?

- *Tropomyosin:* a regulatory protein that blocks the myosin binding site on actin

What is troponin C?

- *Troponin C:* a protein that binds reversibly to Ca^{2+}

What is the rigor state?

- *Rigor state:* tight binding between actin and myosin in the absence of ATP

What is end plate potential (EPP)?

- *EPP:* depolarization at the motor plate due to acetylcholine

what is L-type calcium chain?

- *L-type calcium chain:* voltage-sensing protein

What is a dihydropyridine (DHP) receptor?

- *DHP receptor:* voltage-sensing receptors in the t-tubules, linked to Ca^{2+} channels

What is a ryanodine receptor (RyR)?

- *RyR receptor:* calcium-released channel of SR in striated muscles

What is Ca^{2+} ATPase?

- *Ca^{2+} ATPase:* membrane transporter than moves $Ca2^{+}$ against its concentration gradient

What is a latent period?

- *Latent period:* delay between the muscle action potential and beginning of muscle tension that represents the time required for the Ca^{2+} release and binding to troponin

What is a twitch?

- *Twitch:* a single concentration/relaxation cycle in a muscle fiber

What is phosphocreatine?

- *Phosphocreatine:* backup energy source of muscle
- A molecule whose high-energy phosphate bonds are created form creatine and ATP when muscles are at rest

What is creatine kinase (CK)?

- *CK AKA creatine phosphokinase (CPK):* enzyme that transfers the phosphate to ADP

What is central fatigue?

- *Central fatigue:* subjective feeling of fatigue during exercise

What is peripheral fatigue?

- *Peripheral fatigue:* mechanisms which arise anywhere between the neuromuscular junction and the contractile elements of the muscle

What are slow-twitch fibers?

- Slow-twitch fibers: good for endurance activities like long distance running or cycling. They can work for a long time without getting tired

What are fast-twitch oxidative-glycolytic fibers?

- *Fast-twitch oxidative-glycolytic fibers:* fast muscle fibers that use a combination of aerobic and anaerobic metabolism and therefore do not fatigue as fast as glycolytic fibers

What are fast-twitch glycolytic fibers?

- *Fast-twitch glycolytic fibers:* fast muscle fibers that rely on anaerobic metabolism and therefore fatigue rapidly

What is myoglobin?

- *Myoglobin:* oxygen-binding pigment in muscle that transfers oxygen between cell membrane and mitochondria

What is summation?

- *Summation:* the additive effect of several electrical impulses on a neuromuscular junction

What is tetanus?

- *Tetanus:* sustained muscle contraction

What is a motor unit?

- *Motor unit:* group of skeletal muscle fibers and the somatic motor neuron that controls them

What is recruitment?

- *Recruitment:* addition of motor units to increase the force of contraction in a muscle

What is asynchronous recruitment?

- *Asynchronous recruitment:* alternation of active motor units to prevent fatigue

What are isometric contractions?

- *Isometric contraction:* a contraction that creates force without movement

What isotonic contraction?

- *Isotonic contraction:* a contraction that creates force and moves a load

What are the series of elastic elements?

- *Series of elastic elements:* elastic fibers in the muscle that stretch during isometric contraction

What is a lever?

- *Lever:* a rigid bar that pivots around a point known as the fulcrum

What is a fulcrum?

- *Fulcrum:* the support, or point of rest, on which a lever turns in moving a body

What is Duchenne muscular dystrophy?

- *Duchenne muscular dystrophy:* genetic disorder characterized by progressive muscle degeneration and weakness

What is dystrophin?

- *Dystrophin:* Muslce protein that links actin to the cell membrane

What is McArdle's disease?

- *McArdle's disease:* rare inherited condition in which the body is not able to break down glycogen

What are the ways to categorize the different types of smooth muscle?

1. By location
    - Divided into 6 major groups:
        - Vascular (blood vessel walls)
        - Gastrointestinal (walls of digestive tract and associated organs, ie. Gallbladder)
        - Urinary (walls of bladder and ureters)
        - Respiratory (airway passages)
        - Reproductive (uterus in females and other reproductive structures in both males and females)
        - Ocular (eye)
2. By contraction patters
    - Whether it alternates between contraction and relaxation states
3. By their communication with neighboring cells
    - Some cells are electrically connected by gap junctions
    - Contract as a coordinate unit

What are tonic smooth muscles?

- *Tonic smooth muscles:* muscles that continuously contract

What are sphincters?

- *Sphincters:* circular muscle that normally maintains constriction of a natural body passage or orifice and which relaxes as required by normal physiological functioning

What are visceral smooth muscles?

- *Visceral smooth muscle:* forms the walls of internal organs (viscera), such as the intestinal tract

What are dense bodies?

- *Dense bodies:* intermediate filaments and proteins

What is calmodulin?

- *Calmodulin:* intracellular second messenger that bind Ca^{2+}

What is myosin light chain kinase (MLCK)?

- *MLCK:* enzyme that phosphorylates light protein chains of myosin in smooth muscles

What is myosin light chain?

- *Myosin light chain:* small protein chains that make up part of the smooth muscle myosin head

What is myosin light chain phophotase (MLCP)?

- *MLCP:* enzyme that dephosphorylates light protein chains of myosin in smooth muscles

What is latch state?

- *Latch state:* a state in which a low; myosin stays attached to actin and force continues to be generated

What is IP3-receptor channel?

- *IP_3-receptor channel:* Ca^{2+} channels in smooth muscle SR that open in response to IP_3

What is calcium-reduced calcium release (CICR)?

- *CICR:* process in which Ca^{2+} entry into a muscle fiber triggers release of additional Ca^{2+} from the SR

What is store-operated Ca^{2+} channels?

- *Store-operated Ca^{2+} channels:* stratified epithelium

What is a myogenic contraction?

- *Myogenic contraction:* common in blood vessels that maintain a certain amount of tone at all times

What are slow wave potentials?

- *Slow wave potentials:* cyclic depolarization and repolarization of membrane potential in smooth muscle

What are pacemaker potentials?

- *Pacemaker potentials:* create regular rhythms of contractions

What are intercalated discs?

- *Intercalated discs:* gap junctions that are contained in specialized cells

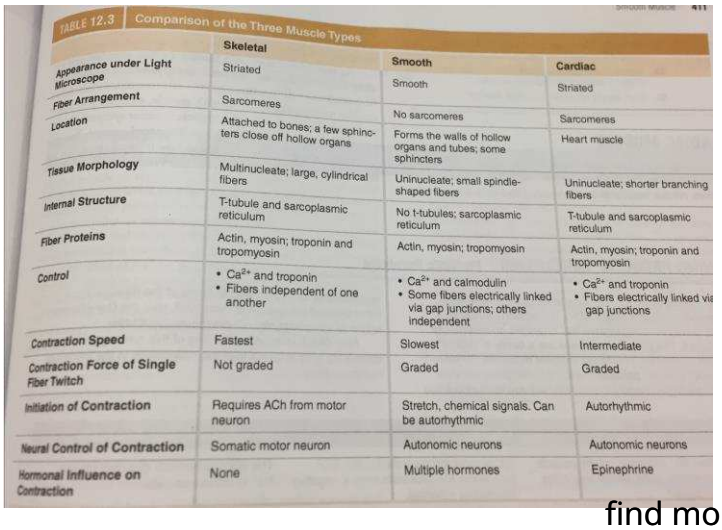


TABLE 12.3 Comparison of the Three Muscle Types

	Skeletal	Smooth	Cardiac
Appearance under Light Microscope	Striated	Smooth	Striated
Fiber Arrangement	Sarcomeres	No sarcomeres	Sarcomeres
Location	Attached to bones; a few sphincters close off hollow organs	Forms the walls of hollow organs and tubes; some sphincters	Heart muscle
Tissue Morphology	Multinucleate; large, cylindrical fibers	Uninucleate; small spindle-shaped fibers	Uninucleate; shorter branching fibers
Internal Structure	T-tubule and sarcoplasmic reticulum	No t-tubules; sarcoplasmic reticulum	T-tubule and sarcoplasmic reticulum
Fiber Proteins	Actin, myosin; troponin and tropomyosin	Actin, myosin; tropomyosin	Actin, myosin; troponin and tropomyosin
Control	• Ca^{2+} and troponin • Fibers independent of one another	• Ca^{2+} and calmodulin • Some fibers electrically linked via gap junctions; others independent	• Ca^{2+} and troponin • Fibers electrically linked via gap junctions
Contraction Speed	Fastest	Slowest	Intermediate
Contraction Force of Single Fiber Twitch	Not graded	Graded	Graded
Initiation of Contraction	Requires ACh from motor neuron	Stretch, chemical signals. Can be autorhythmic	Autorhythmic
Neural Control of Contraction	Somatic motor neuron	Autonomic neurons	Autonomic neurons
Hormonal Influence on Contraction	None	Multiple hormones	Epinephrine

BIOL 273-Chapter 14: Cardiovascular Physiology Notes

What is the cardiovascular system?

- *Cardiovascular system:* a circulatory system comprising a heart, blood vessels and blood

What are capillaries?

- *Capillaries:* the microscopic vessels where blood exchange material with the interstitial fluid

What are arteries?

- *Arteries:* blood vessels that carry blood away from the heart

What are veins?

- *Veins:* blood vessels that return blood to the heart

What is a septum?

- *Septum:* a divining wall, such as between the chambers of the heart

What is an atrium?

- *Atrium:* upper chamber of the heart that receives blood from the blood vessels

What is a ventricle?

- *Ventricle:* a hollow part or cavity in an organ

What is a pulmonary artery?

- *Pulmonary artery:* blood vessels that carries low oxygen blood from the right heart to left lung

What is pulmonary veins?

- *Pulmonary vein:* vessel that carries well-oxygenated blood from the lung to the left heart

What is pulmonary circulation?

- *Pulmonary circulation:* that portion of the circulation that carries blood to and from the lungs

What is aorta?

- *Aorta:* the main artery of the body, supplying oxygenated blood to the circulatory system

What is superior vena cava?

- *Superior vena cava:* the venous trunk draining blood from the head, neck, upper extremities, and chest; it empties into the right atrium of the heart

What is inferior vena cava?

- *Inferior vena cava:* venous trunk from the lower extremities and the pelvic and abdominal viscera; it empties into the right atrium of the heart

What is systemic circulation?

- *Systemic circulation:* the part of the cardiovascular system which carries oxygenated blood away from the heart to the body, and returns deoxygenated blood back to the heart

What is pressure gradients (ΔP)?

- *Pressure gradients:* difference in blood pressure across the vessel length (or across the valve), which is established by ventricular contraction & forces blood from high to low pressure

What is hydrostatic pressure?

- *Hydrostatic pressure:* the pressure exerted by a stationary column of the fluid in a tube

What is driving pressure?

- *Driving Pressure:* the difference between the arterial pressure at the source of blood flow, and the pressure at the target tissue

What is resistance?

- *Resistance:* the tendency of the cardiovascular system to oppose blood flow

What is viscosity?

- *Viscosity:* the thickness of the blood

What is Poiseuille's law?

- *Poiseuille's law:* the velocity of the steady flow of a fluid through a narrow tube (as a blood vessel or a catheter) varies directly as the pressure and the fourth power of the radius of the tube and inversely as the length of the tube and the coefficient of viscosity

$$Q = \frac{\pi a^4 P}{8 L \eta}$$

What is vasoconstriction?

- *Vasoconstriction:* a decrease in blood vessel diameter

What is vasodilation?

- *Vasodilation:* an increase in blood vessel diameter

What is pericardium?

- *Pericardium:* the connective tissue sac that encloses the heart

What is myocardium?
- *Myocardium:* cardiac muscle

What is coronary arteries?
- *Coronary arteries: artery supplying blood to the heart muscle*

What is coronary veins?
- *Coronary veins:* shallow grooves which supply blood to the heart

What is atrioventricular valve (AV valve)?
- *Atrioventricular valve:* heart valves that separate the atria from the ventricles

What is semilunar valve?
- *Semilunar valve:* heart valves between the ventricles and major arteries

What is chordae tendineae?
- *Chordae tendineae:* collagenous cords that prevent the atrioventricular valves from being pushed back into the atria during ventricular contraction

What is papillary muscles?
- *Papillary muscles:* small muscle in the interior of the ventricles to which the chordae tendineae attach

What is tricuspid valve?
- *Tricuspid valve:* the right AV valve of the heart

What is bicuspid valve?
- *Bicuspid valve:* the left AV valve of the heart
- Synonym is mitral valve

What is aortic valve?
- *Aortic valve:* the valve between the left ventricle and the aorta

What is pulmonary valve?
- *Pulmonary valve:* the semilunar valve between the right ventricle and the pulmonary trunk

What is autorhythmic cells?
- *Autorhythmic cells:* cardiac cells that spontaneously and rhythmically depolarize the fire action potentials

What is pacemakers?
- *Pacemakers:* the fastest depolarizing cell, usually the SA node

What is pacemaker potential?

- *Pacemaker potential:* cyclic depolarization of smooth and cardiac muscle that always reach threshold

What is sinoatrial node (SA node)?

- *SA node:* group of autorhythmic cells in the right atrium of the heart
- The main pacemaker of the heart

What is internodal pathway?

- *Internodal pathway:* conduction pathway from the SA node to the AV node

What is atrioventricular node (AV node)?

- *AV node:* the electrical gateway to the ventricles, located near the the floor of the right atrium

What is Purkinje fibers?

- *Purkinje fibers:* specialized myocardial cell that rapidly conducts electrical signals to the apex of the heart

What is atrioventricular bundle (AV bundle)?

- *AV bundle:* specialized electrical conducting cells of the heart that carry signals into the ventricles
- AKA bundle of His

What are bundle branches?

- *Bundle branches:* 2 branches of the bundle of His that carry electrical signals to each ventricle

What is AV node delay?

- *AV node delay:* slowing of electrical conduction through the AV node that allows atria to complete contraction before ventricles begin

What is electrocardiograms (ECGs)?

- *ECGs:* a recording of the summed electrical events of the cardiac cycle

What is the P wave?

- *P wave:* wave of the ECG that represents atrial depolarization

What is the PR segment?

- *PR segment:* from the end of the P wave to the beginning of the QRS complex

What is the QRS complex?

- *QRS complex:* wave complex that represents ventricular depolarization and atrial repolarization

What is the T wave?

- *T wave:* ECG wave that represents ventricular repolarization

What is the first heart sound?

- *First heart sound:* sounds created by vibrations from closure of AV nodes

What is isovolumic ventricular contraction?

- *Isovolumic ventricular contraction:* phase of the cardiac cycle when the ventricles are contracting but all valves are closed and the volume of blood in them is not changing

What is the second heart sound?

- *Second heart sound:* vibrations created by semilunar valve closure

What is isovolumic ventricular relaxation?

- *Isovolumic ventricular relaxation:* phase of the cardiac cycle when the ventricles are relaxing but the volume of the blood in them is not changing

What is end-diastolic volume (EDV)?

- *EDV:* the maximum volume of blood that the ventricles hold during the cardiac cycle

What is end-systolic volume (ESV)?

- *ESV:* the amount of blood left in the ventricle at the end of contraction

What is cardiac output (CO)?

- *Cardiac output:* the amount of blood pumped per ventricular per unit time

What is preload?

- *Preload:* the degree of myocardial stretch created by venous return

What is venous return?

- *Venous return:* the amount of blood that enters the heart from the venous circulation

What is skeletal muscle pump?

- *Skeletal muscle pump:* name given to skeletal muscle contractions that squeeze veins, compressing them and pushing blood towards the heart

What is respiratory pump?

- *Respiratory pump:* created by movement of the thorax during inspiration (breathing in)

What is inotropic agent?

- *Inotropic agent:* any chemical that affects cardiac contractility

What is inositol triphosphate (IP_3)?

- *IP_3:* a second messenger made from membrane

What is inotropic effect?

- *Inotropic effect:* influence on inotropic agents

What is phospholamban?

- *Phospholamban:* regulatory protein in contractile myocardium that alters Ca2+-ATPase activity in the SR

What is afterload?

- *Afterload:* arterial resistance during ventricular contraction

What is ejection fraction?

- *Ejection fraction:* common functional index derived from ventricular function

TABLE 14.2 The Heart and Major Blood Vessels

Blue type indicates structures containing blood with lower oxygen content; red type indicates well-oxygenated blood.

	Receives Blood from	Sends Blood to
Heart		
Right atrium	Venae cavae	Right ventricle
Right ventricle	Right atrium	Lungs
Left atrium	Pulmonary veins	Left ventricle
Left ventricle	Left atrium	Body except for lungs
Vessels		
Venae cavae	Systemic veins	Right atrium
Pulmonary trunk (artery)	Right ventricle	Lungs
Pulmonary vein	Veins of the lungs	Left atrium
Aorta	Left ventricle	Systemic arteries

TABLE 14.1 Transport in the Cardiovascular System

Substance Moved	From	To
Materials Entering the Body		
Oxygen	Lungs	All cells
Nutrients and water	Intestinal tract	All cells
Materials Moved from Cell to Cell		
Wastes	Some cells	Liver for processing
Immune cells, antibodies, clotting proteins	Present in blood continuously	Available to any cell that needs them
Hormones	Endocrine cells	Target cells
Stored nutrients	Liver and adipose tissue	All cells
Materials Leaving the Body		
Metabolic wastes	All cells	Kidneys
Heat	All cells	Skin
Carbon dioxide	All cells	Lungs

BIOL 273-Chapter 15: Blood Flow and the Control of Blood Pressure Notes

What are arterioles?

- *Arteriole:* the smallest arteries and site od variable resistance in the circulatory system

What is endothelium?

- *Endothelium:* layer of thin epithelial cells that line the lumen of the heart and blood vessels

What is vascular smooth muscle?

- *Vascular smooth muscle:* the smooth muscle of the blood vessel

What is metarterioles?

- *Metarterioles:* arterioles that are branched into vessels

What is precapillary sphincters?

- *Precapillary sphincters:* bands of smooth muscle that can alter blood flow through capillary beds

What are pericytes?

- *Pericytes:* cells that form a mesh-like outer layer between the capillary endothelium and the interstitial fluid

What are venules?

- *Venules:* blood flows from the capillaries into small vessels

What are angiogenesis?

- *Angiogenesis:* the process by which new blood vessels develop, especially after birth

What is coronary heart disease?

- *Coronary heart disease:* condition in which blood flow to the myocardium is decreased by fatty deposits that narrow the lumen of the coronary arties

What is systolic pressure?

- *Systolic pressure:* interaction of 2 or more hormones or drugs that yields a result that is more than additive

What is diastolic pressure?

- *Diastolic pressure:* lowest pressure in the circulatory system, associated with relaxation of the ventricles

What is pulse pressure?

- *Pulse pressure:* the strength of pulse wave, defined as the systolic pressure minus the diastolic pressure

What is mean arterial-pressure (MAP)?

- *MAP:* average blood pressure in the arteries, estimated as diastolic pressure plus one-third of the pulse pressure

What is Korotkoff sound?

- *Korotkoff sound:* a thumping noise that can be heard with each pressure wave

What influences arteriolar resistance?

1. Local control of arteriolar resistance
    - Matches tissue blood flow to the metabolic needs of the tissue
    - In the heart and skeletal muscle, these local controls often take precedence over reflex control by the CNS
2. Sympathetic reflexes
    - Mediated by the CNS maintain mean arterial pressure and govern blood distribution for certain homeostatic needs (ie. Temperature regulation)
3. Hormones
    - Particularly those that regulate salt and water excretion by the kidneys
    - Influence blood pressure by acting directly on the arterioles and by alternating autonomic reflex control

What is active hyperemia?

- *Hyperemia:* the process in which an increase in blood flow accompanies an increase in metabolic activity

What is reactive hyperemia?

- *Reactive hyperemia:* an increase in tissue blood flow following a period of low perfusion (blood flow)

What is adenosine?

- *Adenosine:* vasodilator paracrine signal nucleotide

What is cardiovascular control center (CVCC)?

- *CVCC:* neurons in the medulla oblongata that integrated sensory information and direct autonomic responses aimed at maintaining adequate blood pressure

What is baroreceptor reflex?

- *Baroreceptor reflex:* the primary reflex pathway for homeostatic control of blood pressure

What is baroreceptors?

- *Baroreceptors:* stretch-sensitive mechanoreceptors that response to change in pressure

What is Fenestrated capillaries?

- *Fenestrated capillaries:* have large pores that allow high volumes of fluid to pass rapidly between the plasma and interstitial fluid

What is bulk flow?

- *Bulk flow:* refers to the mass movement of fluid as the result of hydrostatic or osmotic pressure gradients

What is absorption?

- *absorption:* transfer of substances from the lumen of the kidney/gastrointestinal tract to the extracellular space

What is filtration?

- *Filtration:* (renal) Bulk flow of plasma-like fluid from the glomerular capillaries into Bowman's capsule

What is colloid osmotic pressure?

- *Colloid osmotic pressure:* Osmotic pressure that due to the presence of plasma proteins that cannot cross the capillary endothelium
- Synonym: oncotic pressure

What is lymph?

- *Lymph:* the fluid within the lymphatic system that moves from the tissues to the venous side of the systemic circulation

What are lymph nodes?

- *Lymph node:* collections of immune cells that monitor the lymph for pathogens

What is edema?

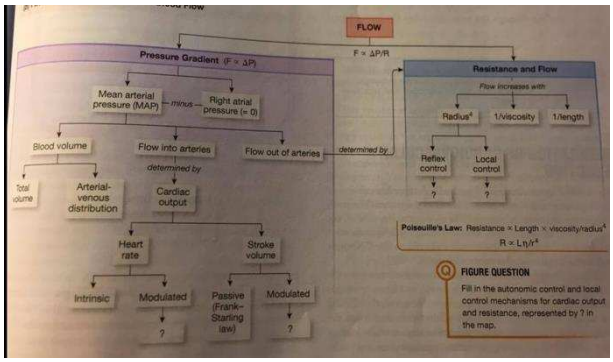
- *Edema:* an immobilized limb frequently swells from the accumulation of fluid in the interstitial space

What is high-density lipoprotein-cholesterol (HDL-C)?

- *HDL:* the "good" plasma carrier for cholesterol

What is low-density lipoprotein-cholesterol (LDL-C)?

- *LDL:* the "bad" protein carrier for plasma cholesterol



What is apoB?

- *apo*B: a protein

BIOL 273-Chapter 16: Blood Notes

What is plasma proteins?

- *Plasma proteins:* serve many different functions, including transport of lipids, hormones, vitamins and minerals in the circulatory system and the regulation of a cellular activity and functioning of the immune system
- AKA blood protein

What is Albumins?

- *Albumins:* plasma protein made in the liver

What is plasma?

- *Plasma:* the fluid matrix of the blood

What are red blood cells (RBCs)?

- *AKA erythrocytes:* red blood cells that transport oxygen and carbon dioxide between the lungs and the tissues

What are white blood cells (WBCs)?

- *AKA Leukocyte:* white blood cells that defend the body against foreign invaders

What are platelets?

- *Platelet:* cell fragments that participate in coagulation
- Synonym: thrombocyte

What are megakaryocytes?

- *Megakaryocyte:* parent cell of platelets, found in the bone marrow

What are the 5 types of mature white blood cells?

1. Lymphocytes
2. Monocytes
3. Neutrophils
4. Eosinophils
5. Macrophages

What are mast cells?

- *Mast cell:* a tissue that secretes histamine

What is a bone marrow?

- *Bone marrow:* a soft tissue that fills the hollow centers of bones; site of hematopoiesis

What are phagocytes?

- *Phagocyte:* immune cell that ingests material by phagocytosis

What are immunocytes?

- *Immunocyte:* general name given to any of the immune cells

What is Hematopoiesis?
- *Hematopoiesis:* blood cell production in the bone marrow

What is hemoglobin?
- *Hemoglobin:* the oxygen-binding protein of RBCs

What is interleukins?
- *Interleukins:* cytokines released by one type of WBC to act on another

What are colony-stimulating factors (CSFs)?
- *CSFs:* cytokines made by endothelial cells and WBCs that direct production and development of WBCs

What is leukopoiesis?
- *Leukopoiesis:* a form of hematopoiesis in which white blood cells (WBC, or leukocytes) are formed in bone marrow located in bones in adults and hematopoietic organs in the fetus

What is thrombopoietin (TPO)?
- *TPO:* cytokine that promotes platelet formation

What is erythropoiesis?
- *Erythropoiesis:* RBCs production

What is erythropoietin (EPO)?
- *EPO:* hormone made in the kidneys that regulates RBC production

What is hematocrit?
- *Hematocrit:* percentage of the total blood volume that is packed RBCs

What is morphology?
- *Morphology:* the study of the form and structure of organisms and their specific structural features

What is mean corpuscular volume (MCV)?
- *MCV:* a measure of the average volume of a red blood corpuscle (or red blood cell)

What is globin?
- *Globin:* a family of globular proteins

What are heme groups?
- *Heme group:* a carbon-hydrogen-nitrogen porphyrin ring with an iron atom in the center

What is transferrin?

- *Transferrin:* plasma protein that binds and transports iron

What is bilirubin?

- *Bilirubin:* breakdown product of the heme groups from hemoglobin

What is bile?

- *Bile:* a solution secreted by the lover and composed primarily of bile acids, bile pigments and cholesterol

What is jaundice?

- *Jaundice:* a yellow tint to the skin and sclera due to excessive levels of bilirubin

What is anemia?

- *Anemia:* pathological state with low hemoglobin

What is hemostasis?

- *Hemostasis: process of keeping blood within the blood vessels by repairing breaks without compromising the fluidity of the blood*

What is platelet plug formation?

- *Platelet plug formation:* platelets stick together to form a temporary seal to cover the break in the vessel wall

What is platelet adhesion?

- *Platelet adhesion:* platelets stick to exposed collagen in wall of damaged blood vessel

What is coagulation cascade?

- *Coagulation cascade:* the series of steps beginning with the activation of the intrinsic or extrinsic pathways of coagulation or of one of the related alternative pathways, and proceeding through the common pathway of coagulation to the formation of the fibrin clot

What is thrombus?

- *Thrombus:* a blood clot that adheres to the wall of a blood vessel

What is platelet-activating factor (PAF)?

- *PAF:* is a potent phospholipid activator and mediator of many leukocyte functions, platelet aggregation and degranulation, inflammation, and anaphylaxis

What is thromboxane A2?

- *Thromboxane A2:* is a type of thromboxane that is produced by activated platelets and has pro-thrombotic properties: it stimulates activation of new platelets as well as increases platelet aggregation

What is prostacyclin?

- *Prostacyclin:* eicosanoid in membrane of intact endothelial cells that prevents platelets from adhering

What is intrinsic pathway?

- *Intrinsic pathway:* coagulation reaction that begins with collagen exposure and uses proteins already present in plasma

What is extrinsic pathway?

- *Extrinsic pathway:* coagulation pathway that starts when damaged tissues expose tissue factor

What is common pathway?

- *Common pathway:* the pathway that results from the merging of the extrinsic and intrinsic pathways
- The common pathway includes the final steps before a clot is formed

What is thrombin?

- *Thrombin:* plasma protein that converts fibrinogen into fibrin

What is fibrinogen?

- *Fibrinogen:* plasma protein that becomes fibrin in blood clots

What is fibrin?

- *Fibrin:* plasma protein that forms polymer fibers that stabilize platelet plugs

What is plasmin?

- *Plasmin:* enzyme that breaks down fibrin
- Synonym: fibrinolysin

What plasminogen?

- *Plasminogen:* the blood substance that when activated forms plasmin.

What is tissue plasminogen activator (tPA)?

- *tPA:* is a protein involved in the breakdown of blood clots

What is fibrinolysis?

- *Fibrinolysis:* dissolution of fibrin by plasmin

What is anticoagulants?

- *Anticoagulant:* ant chemiclal that inhibits blood coagulation

What is heparin?

- *Heparin:* an anticoagulant molecule

What is antithrombin II?

- *Antithrombin II:* is a small protein molecule that inactivates several enzymes of the coagulation system

What is Protein C?

- *Protein C:* a vitamin K-dependent glycoprotein that is synthesized in the liver
- It circulates in an inactive form
- It is activated by the thrombin-thrombomodulin complex on endothelial cells

What is hemophilia?

- *Hemophilia:* a medical condition in which the ability of the blood to clot is severely reduced, causing the sufferer to bleed severely from even a slight injury

BIOL 273-Chapter 17: Mechanics of Breathing Notes

What are the 4 primary functions of the respiratory system?

1. Exchange of gases between the atmosphere and the blood
   - Body brings in oxygen for distribution to the tissues
   - Eliminates carbon dioxide waste product by metabolism
2. Homeostatic regulation of blood by pH
   - Lungs can alter pH by selectively retaining or excreting carbon dioxide
3. Protection from inhaled pathogens and irritating substances
   - The respiratory epithelium is well supplied with defense mechanisms to trap and destroy potentially harmful substances before they can enter the body
4. Vocalization
   - Air moving across vocal cords creates vibrations used for speech, singing, and other forms of communication

What are the principles that govern the bulk flow of blood through the cardiovascular system?

1. Flow takes place from regions of higher pressure to regions of lower pressure
2. A muscular pump creates pressure gradients
3. Resistance to air flow is influenced primarily by the DIAMETER of the tubes through which the air is flowing

What is cellular respiration?

- *Cellular respiration:* refers to the the intracellular reaction of oxygen with organic molecules to produce carbon dioxide, water and energy in the form of ATP

What is external respiration?

- *External respiration:* the interchange of gases between the environment and the body's cells

What is ventilation?

- *Ventilation:* the movement of air between the atmosphere and the lungs

What is inspiration?

- *Inspiration:* the movement of air into the lungs

What is expiration?

- *Expiration:* the movement of air out of the lungs

What is the respiratory system?

- *Respiratory system:* those structures involved in ventilation and gas exchange

What is the conducting system?

- *Conducting system:* a group of specialized cardiac muscle cells in the walls of the heart that send signals to the heart muscle causing it to contract

What are airways?

- *Airway:* anatomical structures from mouth to bronchioles that carry air to the alveoli

What is the alveoli?

- *Alveoli:* the exchange surface of the lungs, where oxygen and carbon dioxide transfer between air and the blood

What is the upper respiratory tract?

- *Upper respiratory tract:* is the part of the anatomy involved with the process of respiration
- Includes the nose and nasal passages, paranasal sinuses, the pharynx, and the portion of the larynx above the vocal cords.

What is the lower respiratory tract?

- *Lower respiratory tract:* is the part of the anatomy involved with the process of respiration
- Consists of the trachea, bronchi (primary, secondary and tertiary), bronchioles (including terminal and respiratory), and lungs (including alveoli
- It also sometimes includes the larynx

What is the diaphragm?

- *Diaphragm:* the skeletal muscle that forms the floor of the thoracic cage

What is intercoastal muscles?

- *Intercoastal muscle:* muscles associated with the rib cage, used for breathing

What is sternocleidomastoids?

- *Sternocleidomastoid:* inspiratory muscles that help elevate upper ribs

What is scalenes?

- *Scalenes:* respiratory muscle that lifts the upper rib cage

What is pleural sacs?

- *Pleural sacs:* separate layer of membrane

What is lungs?

- *Lungs:* organs where gases are exchanged with the blood

What is pleura?

- *Pleura:* the membranes that line the chest cavity and cover the outer surface of the lungs and form the pleural sacs

What is pleural fluid?

- *Pleural fluid:* the fluid that is found between the layers of the pleura

What is pharynx?

- *Pharynx:* the membrane-lined cavity behind the nose and mouth, connecting them to the esophagus

What is larynx?

- *Larynx:* the hollow muscular organ forming an air passage to the lungs and holding the vocal cords in humans and other mammals
- The voice box

What is trachea?

- *Trachea:* a large membranous tube reinforced by rings of cartilage,
- Extending from the larynx to the bronchial tubes and conveying air to and from the lungs
- The windpipe

What is vocal nodes?

- *Vocal nodes:* Small circumscribed beadlike enlargements on the vocal cords caused by overuse or abuse of the voice
- AKA singer's nodes

What is primary bronchi?

- *Primary bronchi:* is an airway in the respiratory tract that conducts air into the lungs
- There is a right bronchus and a left bronchus and these bronchi branch into smaller secondary and tertiary bronchi which branch into smaller tubes, known as bronchiole

What is bronchioles?

- *Bronchioles:* a small branch of a bronchus

What are the 3 components of conditioning air?

1. Warming
   - Air to body temp (37 degrees C)
   - Core body temp does not change ad alveoli are not damaged by cold air
2. Adding water vapor
   - Until air reaches 100% humidity
   - The moist exchange epithelium does not dry out
3. Filtering out foreign material
   - Viruses, bacteria and inorganic particles do not reach the alveoli

What is type I alveolar cells?

- *Type I alveolar cells:* very thin cells so that gases can diffuse rapidly through them

What is type II alveolar cells?

- *Type II alveolar cells:* smaller but thicker
- Synthesize and secrete a chemical known as surfactant

What is surfactant?

- *Surfactant:* chemical that decreases the surface tension of water

What is atmospheric pressure?

- *Atmospheric pressure:* is the pressure exerted by the weight of air in the atmosphere of Earth

What is Dalton's law?

- *Dalton's law:* the total pressure of a mixture of gases is determined by the sum of the pressures of the individual gases

What is partial pressure (P_{gas})?

- *Partial pressure:* the pressure of a single gas

What is Boyle's law?

- *Boyle's law:* if the volume of a gas increases, the pressure decreases, and vice versa
- $P_1V_1=P_2V_2$

What is the respiratory cycle?

- *Respiratory cycle:* an inspiration followed by an expiration

What is pulmonary function tests?

- *Pulmonary function tests:* measures the function of lung capacity and lung and chest wall mechanics to determine whether or not the patient has a lung problem

What is a spirometer?

- *Spirometer:* measuring lung function, specifically the amount (volume) and/or speed (flow) of air that can be inhaled and exhaled

What is tidal volume (V_T)?

- *Tidal volume:* the volume of air that moves in a single normal inspiration or expiration

What is inspiratory resolve volume (IRV)?

- *IRV:* the volume of air that can be inhaled in addition to a normal inspiration

What is expiratory resolve volume (ERV)?

- *ERV:* the amount of air that can be exhaled after the end of a normal expiration

What is residual volume (RV)?

- *Residual volume:* the volume of air left in the lungs following a maximal exhalation

What is vital capacity (VC)?

- *Vital capacity:* the maximum amount of air that can be voluntarily moved in and out of the respiratory system

What is forced expiratory volume (FEV)?

- *FEV:* measures how much air a person can exhale during a forced breath
- The amount of air exhaled may be measured during the *first (FEV1)*
- *second (FEV2),* and/or third seconds (FEV3) of the forced breath
- *Forced vital capacity (FVC)* is the total amount of air exhaled during the FEV test

What is total lung capacity (TLC)?

- *TLC:* vital capacity plus residual volume

What is inspiratory capacities?

- *Inspiration capacities:* the volume of gas that can be taken into the lungs in a full inhalation, starting from the resting inspiratory position; equal to the tidal volume plus the inspiratory reserve volume.

What is functional residual capacity?

- *Functional residual capacity:* the volume of gas remaining in the lungs at the end of expiration

What is compliance?

- *Compliance:* the ability of the lung or other tissue to stretch

What is elastance?

- *Elastance:* semen in the urethra is expelled to the exterior

What is restrictive lung disease?

- *Restrictive lung disease:* category of extra pulmonary, pleural, or parenchymal respiratory diseases that restrict lung expansion, resulting in a decreased lung volume, an increased work of breathing, and inadequate ventilation and/or oxygenation

What is fibrosis?

- *Fibrosis:* the formation of excess fibrous connective tissue in an organ or tissue in a reparative or reactive process

What is law of LaPlace?

- *Law of LaPlace:* pressure of a fluid sphere equals 2 times the surface tension of the fluid divided by the radius of the sphere

What is Bronchoconstriction?

- *Bronchoconstriction:* the constriction of the airways in the lungs due to the tightening of surrounding smooth muscle, with consequent coughing, wheezing, and shortness of breath

What is bronchodilation?

- *Bronchodilation:* a widening of the lumen of the bronchi, allowing increased airflow to and from the lungs

What is total pulmonary ventilation?

- *Total pulmonary ventilation:* the volume of air moved in and out of the lungs eat minute

What is anatomic dead space?

- *Anatomic dead space:* the portions of the airways that do not exchange gases with the blood

What is maximum voluntary ventilation?

- *Maximum voluntary ventilation:* the maximum speed and depth at which a person can voluntarily breathe

What is alveolar ventilation?

- *Alveolar ventilation:* the volume of fresh air that reaches the alveoli each minute

What is obstructive lung disease?

- *Obstructive lung disease:* inflamed and easily collapsible airways, obstruction to airflow, problems exhaling and frequent medical clinic visits and hospitalizations
- Types of obstructive lung disease include; asthma, bronchiectasis, bronchitis and chronic obstructive pulmonary disease (COPD)

What is asthma?

- *Asthma:* lung disease characterized by bronchoconstriction

What is intrapleural pressures?

- *Intrapleural pressures:* are subatomospheric because pleural cavity is sealed compartment

What is hyperventilation?

- *Hyperventilation:* increases alveolar PO_2 and decreases alveolar PCO_2

What is hypoventilation?

- *Hypoventilation:* has the opposite effect to hyperventilation

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BIOL 273-Chapter 18: Gas Exchange and Transport Notes

What is hypoxia?

- *Hypoxia:* a condition in which the body or a region of the body is deprived of adequate oxygen supply at the tissue level

What is hypercapnia?

- *Hypercapnia:* a condition of abnormally elevated carbon dioxide(CO2) levels in the blood
- AKA hypercarbia and CO2 retention

What is pulmonary edema?

- *Pulmonary edema:* excessive interstitial fluid volume in the lungs

What does solubility mean?

- *Solubility:* the ease with which a molecule or gas dissolves in a solution: The more easily a substance dissolves, the higher its solubility

What is the Fick equation?

- *Fick equation:* diffusion through a membrane is directly proportional to the surface area and concentration gradient

What is oxyhemoglobin?

- *Oxyhemoglobin:* hemoglobin bound to oxygen

What is the percent saturation of hemoglobin?

- *Percent saturation of hemoglobin:* the amount of oxygen combined with hemoglobin in proportion to the amount of oxygen the hemoglobin is capable of carrying. It is expressed as a percentage of a ratio: content/capacity

What are oxyhemoglobin saturation curves?

- *Oxyhemoglobin saturation curve:* a curve that plots the proportion of hemoglobin in its saturated (oxygen-laden) form on the vertical axis against the prevailing oxygen tension on the horizontal axis
- AKA the oxyhemoglobin dissociation curve or oxygen dissociation curve (ODC)

What is the Bohr effect?

- *Bohr effect:* the effect of a change in pH on hemoglobin binding of oxygen

What is 2,3-bisphosphoglycerate (2,3-DPG)?

- *2,3-DPG:* a substance made in the red blood cells. It controls the movement of oxygen from red blood cells to body tissues

What is chronic hypoxia?

- *Chronic hypoxia:* a usually slow, insidious reduction in tissue oxygenation resulting from gradually destructive or fibrotic lung diseases, congenital or acquired heart disorders, or chronic blood loss

What is carbonic anhydrase (CA)?

- *CA:* enzyme that catalyzes the conversion of carbon dioxide and water into carbonic acid

What is a chloride shift?

- *Chloride shift:* process in which RBCs exchange HCO_3^- for Cl^-

What is carbaminohemoglobin?

- *Carbaminohemoglobin:* Hemoglobin with bound carbon dioxide

What does the contemporary model for the control of ventilation state?

1. Respiratory neurons in the medulla control inspiratory and expiratory muscles
2. Neurons in the pons integrate sensory information and interact with medullary neurons to influence ventilation
3. The rhythmic pattern of breathing arises from a brainstem neural network with spontaneously discharging ventilation
4. Ventilation is subject to continuous modulation by various chemoreceptor-and mechanoreceptor-linked reflexes and by higher brain centers

What is nucleus tractus solitarius (NTS)?

- *NTS:* a series of purely sensory nuclei (clusters of nerve cell bodies) forming a vertical column of grey matter embedded in the medulla oblongata

What is dorsal respiratory group (DRG)?

- *DRG:* medullary neurons that control normal inspiration

What is phrenic nerves?

- *Phrenic nerves:* a nerve that originates in the neck and passes down between the lung and heart to reach the diaphragm
- It is important for breathing, as it passes motor information to the diaphragm and receives sensory information from it
- There are two phrenic nerves, a left and a right one

What is intercostal nerves?

- *Intercostal nerves:* part of the somatic nervous system and arise from anterior divisions (rami anteriores, ventral divisions) of the thoracic spinal nerves
- Distributed chiefly to the thoracic pleura and abdominal peritoneum

What are pontine respiratory groups (PRG)?

- *PRG:* a network of neurons in the rostral dorsal lateral pons
- AKA pneumotaxic

What is the ventral respiratory group (VRG)?

- *VRG:* medullary neurons for active expiration and greater-than-normal inspiration

What is pre-Bötzinger complex?

- *pre-Bötzinger complex:* a cluster of interneurons in the ventrolateral medulla of the brainstem

What is peripheral chemoreceptors?

- *Peripheral chemoreceptors:* chemoreceptors not found in the CNS

What is carotid bodies?

- *Carotid bodies:* a small cluster of chemoreceptors and supporting cells located near the fork (bifurcation) of the carotid artery (which runs along both sides of the throat)

What are central chemoreceptors?

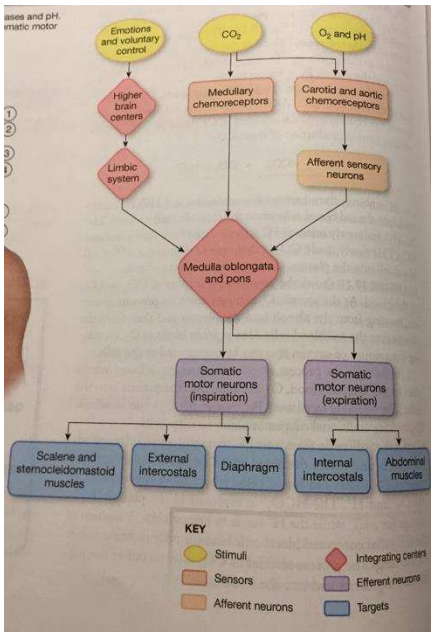
- *Central chemoreceptors:* chemoreceptors in the medulla oblongata that monitors plasma PCO_2

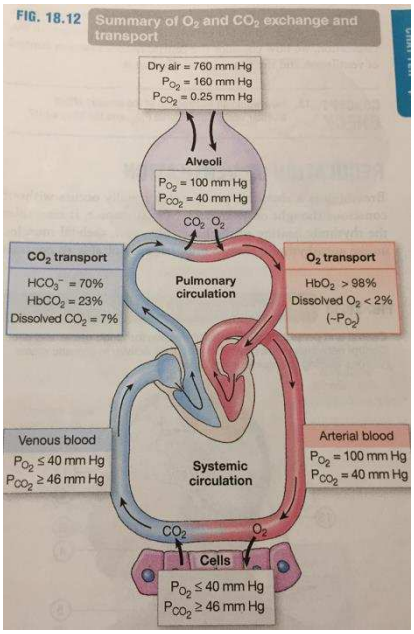
What are glomus cells?

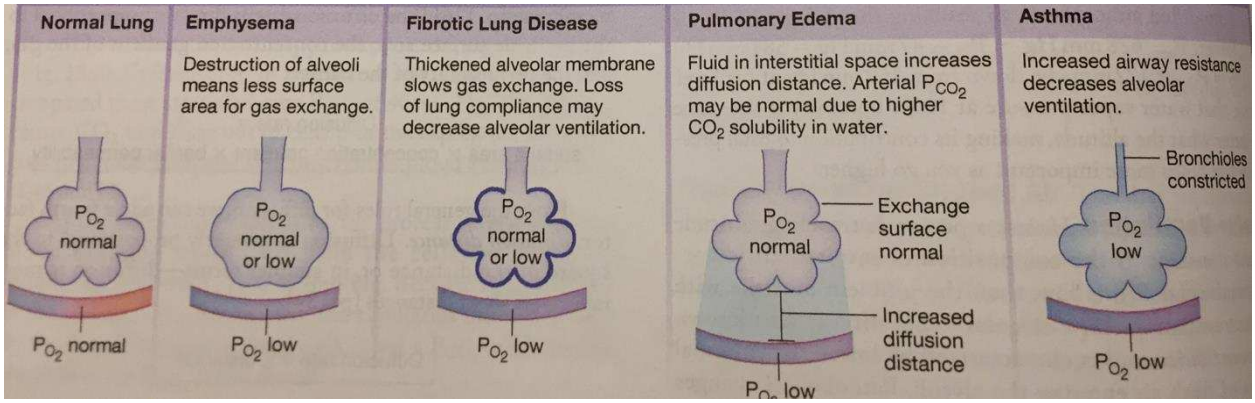
- *Glomus cell:* cells of the carotid and aortic body that respond to low oxygen

What irritant receptors?

- *Irritant receptors:* stimulated by inhaled particles or noxious gases in the airway mucosa







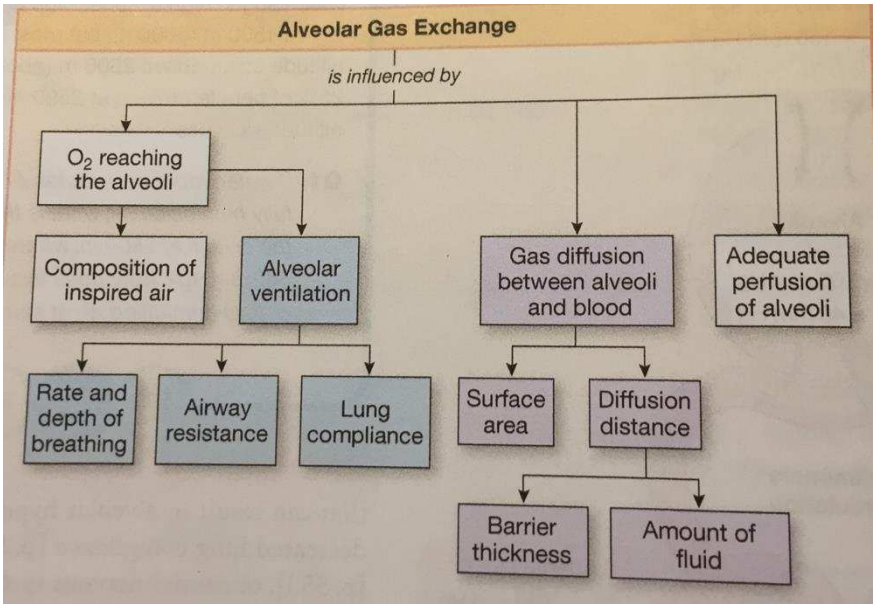
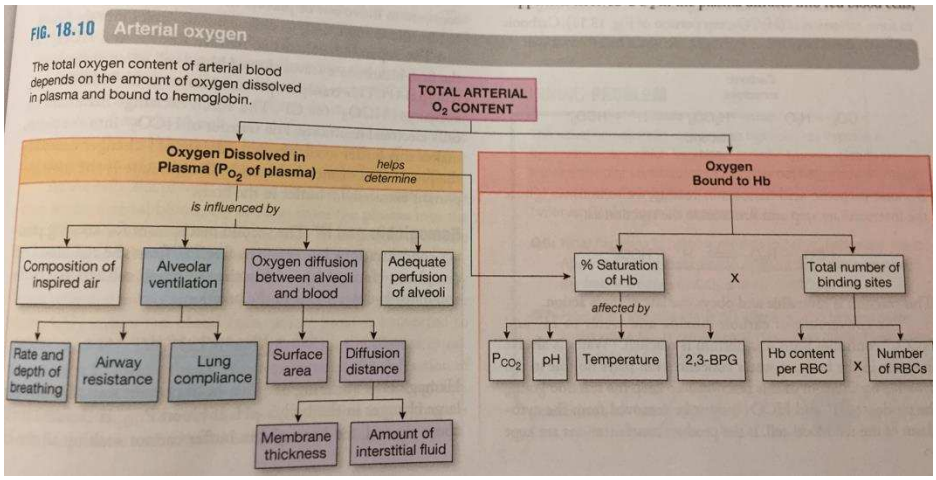
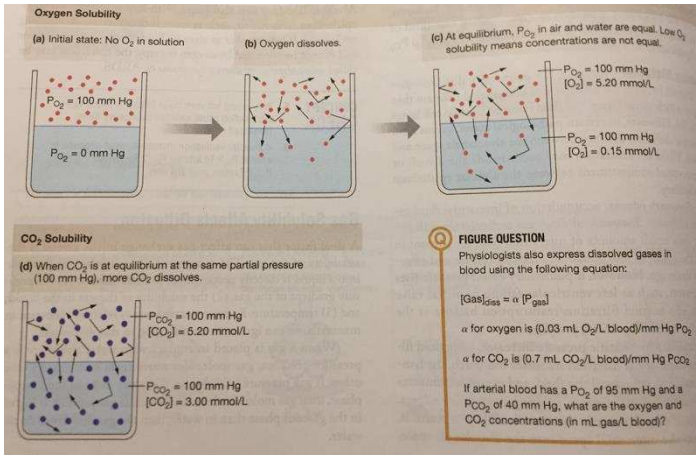
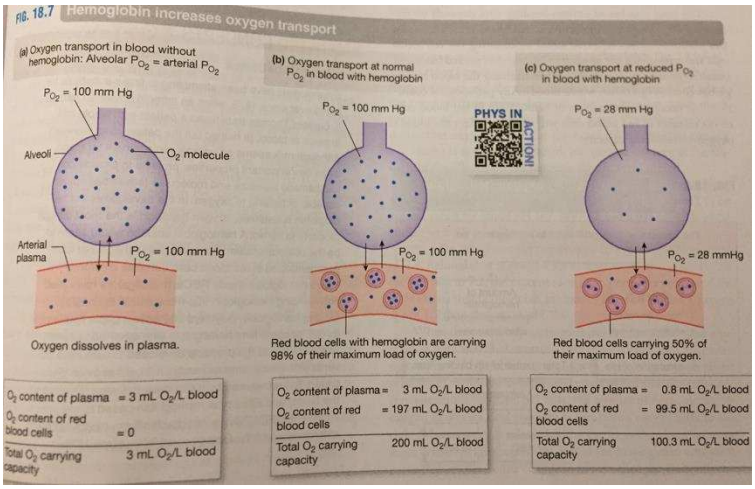


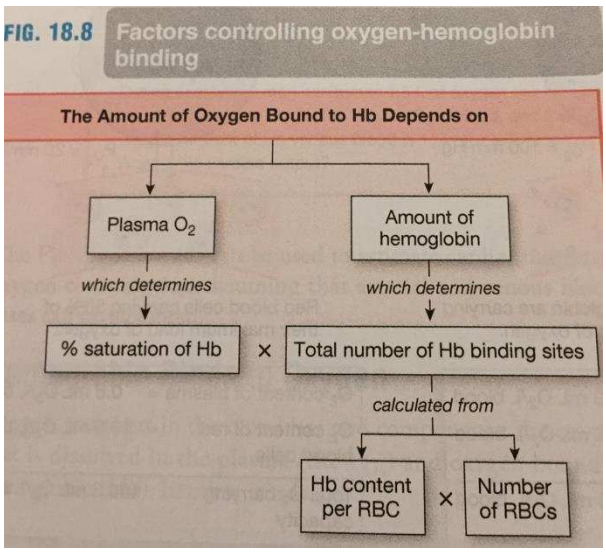
TABLE 18.1 Classification of Hypoxias

Type	Definition	Typical Causes
Hypoxic hypoxia	Low arterial P_{O_2}	High altitude; alveolar hypoventilation; decreased lung diffusion capacity; abnormal ventilation-perfusion ratio
Anemic hypoxia	Decreased total amount of O_2 bound to hemoglobin	Blood loss; anemia (low [Hb] or altered HbO_2 binding); carbon monoxide poisoning
Ischemic hypoxia	Reduced blood flow	Heart failure (whole-body hypoxia); shock (peripheral hypoxia); thrombosis (hypoxia in a single organ)
Histotoxic hypoxia	Failure of cells to use O_2 because cells have been poisoned	Cyanide and other metabolic poisons









BIOL 273-Chapter 24: The immune System Notes

What is immunity?

- *Immunity:* the ability to protect itself

What are the 3 major functions of the immune system?

1. It tries to recognize and remove abnormal "self" cells"
    - Created when normal cell growth and development go wrong
2. It removes dead or damaged cells
    - As well as RBCs
    - Scavenger cells of the immune systems, such as macrophages, patrol extracellular compartment, gobbling up and digesting dead or dying cells
3. It protects the body from disease-causing invaders known as pathogens
    - Microorganisms (Mivrobes) that act as pathogens include bacteria, viruses, fungi and one called protozoans
    - Larger pathogens include multicellular parasites, such as hookworm and tapeworms

What are parasites?

- *Parasite:* an organism that obtains nourishment and shelter on another organism

What are antigens?

- *Antigen:* substances that trigger an immune response from the body and that can react with products of that response

What are the 3 categories of pathologies of the immune system?

1. Incorrect responses
    - Mechanisms of distinguishing self from non-self fail and the immune system attacks the body's normal cells autoimmune disease results
2. Overactive responses
    - Allergies are conditions in which the immune system creates a response that is out of proportion to the threat posed by the antigen
3. Lack of response
    - Deficiency diseases arise when some component of the immune system ails to work properly

What is immunodeficiency?

- *Immunodeficiency:*
- PRIMARY: a family of genetically inherited disorders that range from mild to severe
- AQUIRED: may occur as a result of infection such as AIDS caused by HIV
    - May arise as a side effect of drug or radiation therapy, such as those used to treat cancer

What are the different immune responses to bacteria and viruses?

1. Structure
    - Bacteria are cells, with a cell membrane that is usually surrounded by a cell wall
    - VIRUSES are NOT cells
2. Living conditions and reproduction
    - Most bacteria can survive and reproduce outside a host if they have the required nutrients, temperature, pH and so on
    - VIRUSES must use the intracellular machinery of a host cell to replicate
3. Susceptibility to drugs
    - Most bacteria can be killed with antibiotics
    - VIRUSES cannot be killed with antibiotics

What are antibiotics?

- *Antibiotics:* drugs act directly on bacteria and destroy them or inhibit their growth

What is oncogenic viruses?

- *Oncogenic viruses:* any virus capable of inducing tumors

What is an immune response?

- *Immune response:* the reaction of the cells and fluids of the body to the presence of a substance that is not recognized as a constituent of the body itself

What are cytokines?

- *Cytokine:* regulatory peptides that control cell development, differentiation, and the immune response

What are antibodies?

- *Antibody:* a molecule keyed to a particular pathogen that helps target it for destruction
- Synonym: immunoglobin

What is innate immunity?

- *Innate immunity:* the nonspecific response of the body to invasion by foreign substances

What is non-specific immune response?

- *Non-specific immune response:* the defense system with which you were born
- It protects you against all antigens

What is inflammation?

- *Inflammation:* a nonspecific reaction of the immune system to a foreign invader

What is acquired immunity?

- *Acquired immunity:* immune response directed at specific invaders and mediated by antibodies

What is specific immune response?

- *Specific immune response:* Adaptive; every response is unique
- Second exposure to pathogen garners a much faster response by the immune system because it remembers the pathogen from previous encounters

What is thymus gland?

- *Thymus gland:* immune tissue that produces lymphocytes

What are encapsulated lymphoid tissues?

- *Encapsulated lymphoid tissue:* lymph nodes and the spleen

What is the spleen?

- *Spleen:* an abdominal organ involved in the production and removal of blood cells in most vertebrates and forming part of the immune system

What are lymph nodes?

- *Lymph nodes:* collections of immune cells that monitor the lymph for pathogens

What is diffuse lymphoid tissues?

- *Diffuse lymphoid tissues:* small concentrations of lymphoid tissue found in various sub-mucosa membrane sites of the body
- *S*uch as the gastrointestinal tract, thyroid, breast, lung, salivary glands, eye, and skin

What is gut-associated lymphoid tissue (GALT)?

- *GALT:* immune cells and tissues of the GI tract

What are granulocytes?

- *Granulocyte:* WBCs whose cytoplasmic inclusions give it a granular appearance
- Basophils, eosinophils and neutrophils

What are phagocytes?

- *Phagocytes:* cells that protect the body by ingesting (phagocytosing) harmful foreign particles, bacteria, and dead or dying cells

What are cytotoxic cells (T cells or T_C cytotoxic)?

- *Cytotoxic cells:* is a T lymphocyte (a type of white blood cell) that kills cancer cells, cells that are infected (particularly with viruses)
- *OR* cells that are damaged in other ways

What are antigen-presenting cells (APCs)?

- *APCs:* a cell that displays antigencomplexed with major histocompatibility complexes (MHCs) on their surfaces

What is the mononuclear phagocyte system?

- *Mononuclear phagocyte system:* a part of the immune system that consists of the phagocytic cells located in reticular connective tissue

What is heparin?

- *Heparin:* an injectable blood thinner (anticoagulant)

What are eosinophils?

- *Eosinophils:* a specific type of white blood cell that protects your body against certain kinds of germs, mainly bacteria and parasites
- They're also what causes you to have allergic reactions

What are neutrophils?

- *Neutrophils:* white blood cells that play some very important roles in our innate immune system
- They circulate around our body in the bloodstream, and when they sense signals that an infection is present, they are the first cells to migrate to the site of the infection to begin killing the invading microbes

What are monocytes?

- *Monocyte:* blood cell that is the parent cell of tissue macrophages

What are macrophages?

- *Macrophage:* tissue phagocytes that develop from monocytes

What are lymphocytes?

- *Lymphocyte:* a WBC responsible for primarily for the acquired immune response

What are dendrite cells?

- *Dendrite cell:* antigen-presenting immune cells with long, thin processes

What is a lysosome?

- *Lysosome:* an organelle in the cytoplasm of eukaryotic cells containing degradative enzymes enclosed in a membrane

What are chemotaxins?

- *Chemotaxin:* a molecule that attracts cells such as WBC

What are toll-like receptors (TLRs)?

- *TLR:* a class of proteins that play a key role in the innate immune system
- They are single, membrane-spanning, non-catalytic receptors usually expressed in sentinel cells such as macrophages and dendritic cells, that recognize structurally conserved molecules derived from microbes

What is phagosome?

- *Phagosome:* the vesicle formed around ingested material during phagocytosis
- Site of digestion

What are natural killer (NK) cells?

- *NK cell:* a type of lymphocyte that apparently attacks certain tumor and virus-infected cells

What are interferons?

- *Interferon:* cytokines excreted by lymphocytes

What is interferon-alpha (IFN- α)?

- *IFN-α:* is a pharmaceutical drug composed of natural interferon alpha obtained from the leukocyte fraction of human blood following induction with Sendai virus.

What is interferon-beta (IFN- β)?

- *IFN- β: a* cytokine in the interferon family used to treat multiple sclerosis (MS)

What is interferon-gamma (IFN-γ)?

- *IFN-γ:* a dimerized soluble cytokine that is the only member of the type II class of interferons

What is acute-phase proteins?

- *Acute-phase proteins:* a class of proteins whose plasma concentrations increase (positive acute-phase proteins) or decrease (negative acute-phase proteins) in response to inflammation

What is interleukin-1 (IL-1)?

- *Interleukin-1:* is a group of 11 cytokines, which plays a central role in the regulation of immune and inflammatory responses to infections or sterile insults

What is bradykinin?

- *Bradykinin:* an inflammatory mediator
- It is a peptide that causes blood vessels to dilate (enlarge), and therefore causes blood pressure to fall

What is complement?

- *Complement:* a group of plasma enzymes that are involved in immune function

What are plasma cells?

- *Plasma cell:* type of lymphocyte that secretes antibodies

What is T lymphocytes?

- *T lymphocytes:* A type of lymphocyte that functions in cell-mediated immunity
- Distinguished from other types of lymphocytes by the presence of special receptor (T cell receptor) on the cell surface

What is helper T or TH cells?

- *Helper T cell:* arguably the most important cells in adaptive immunity
- *T*hey are required for almost all adaptive immune responses
- *T*hey not only help activate B cells to secrete antibodies and macrophages to destroy ingested microbes
- Help activate cytotoxic T cells to kill infected target cells

What is a clone?

- *Clone:* a group of cells that are genetically identical

What is active immunity?

- *Active immunity:* A type of immunity or resistance developed in an organism by its own production of antibodies in response to an exposure to an antigen, a pathogen or to a vaccine

What is passive immunity?

- *Passive immunity:* a short-term immunization by the injection of antibodies, such as gamma globulin, that are not produced by the recipient's cells
- Naturally acquired passive immunity occurs during pregnancy, in which certain antibodies are passed from the maternal into the fetal bloodstream

What are naïve lymphocytes?

- *Naïve lymphocytes:* immune cells that are mature, but have not yet been exposed to an antigen
- *T*hese cells move freely through the immune system and play an important role in the development and maintenance of immunity

What ate clonal expansions?

- *Clonal expansions:* all progeny share the same antigen specificity

What are effector cells?

- *Effector cell:* the cell or tissue that carries out homeostatic response

What are memory cells?

- *Memory cells:* lymphocytes responsible for creating stronger and more rapid immune response following second exposure to an antigen

What are B lymphocytes (B cells)?

- *B lymphocytes:* are a type of white blood cell of the lymphocyte subtype
- They function in the humoral immunity component of the adaptive immune system by secreting antibodies
-

What is primary immune response?

- *Primary immune response:* adaptive immunity
- Body recognizes, remembers, and responds to specific antigens
- Frequently leaves the host with specific immunologic memory
- When foreign antigen is first introduced in the body, a primary antibody response occurs

1. Following the first exposure to a foreign antigen, a lag phase occurs in which no antibody is produced, but activated B cells are differentiating into plasma cells. The lag phase can be as short as 2-3 days, but often is longer, sometimes as long as weeks or months
2. The amount of antibody produced is usually relatively low
3. Over time, antibody level declines to the point where it may be undetectable
4. The first antibody produced is mainly IgM (although small amounts of IgG are usually also produced)

What is secondary immune response?

- *Secondary immune response:* the immune response to a previously encountered antigen

1. If a second dose of the same antigen is given days or even years later, an accelerated 2° or anamnestic immune response (IR) occurs. This lag phase is usually very short (e.g. 3 or 4 days) due to the presence of memory cells
2. The amount of antibody produced rises to a high level
3. Antibody level tends to remain high for longer
4. The main type of antibody produced is IgG (although small amounts of IgM are sometimes produced)

What is gamma globulins?

- *Gamma globulin:* what antibodies are collectively referred to

What are IgGs?

- *IgGs:* make up 75% of plasma antibody in adults because they are produced in secondary immune response
- Some maternal IgGs cross placental membrane and give infants immunity in the first few months of life
- Some IgGs activate complement

What is IgA?

- *IgA:* antibodies are found in external secretions such as saliva, tears, intestinal and bronchial mucus, and breast milk, where they bind to pathogens and flag them for phagocytosis if they reach the internal environment

What is IgE?

- Target gut parasites and are associated with allergic responses
- When mast cell receptors bind with IgEs and antigen, the mast cells de-granulate and release chemical mediators, such as histamine

What is IgM?

- *IgM:* antibodies are associated with primary immune responses and with antibodies that react to blood group antigens
- Strongly activate complement

What is IgD?

- *IgD:* antibody proteins appear on the surface of B lymphocytes along with IgM, but physiological role of IgDs is unclear

What is light chain?

- *Light chain:* The lighter of the two types of polypeptide chains that are found in immunoglobulin and antibody molecules
- Used as a non-specific term for the smaller subunits of several multimeric proteins such as immunoglobulin, myosin, dynein, clathrin

What is heavy chain?

- *Heavy chain:* a subunit of antibodies
- Heavy-chain antibody, an antibody composed of heavy chains only

What is Fab regions?

- Fab regions: a region on an antibody that binds to antigens
- AKA Fragment antigen-binding (Fab) fragment

What is Fc region?

- *Fc region:* the stem of the Y-shaped antibody molecule
- Determines the Ig class to which the antibody belongs

What are Fc receptors?

- *Fc receptors:* a protein found on the surface of certain cells
- Including, among others, B lymphocytes, follicular dendritic cells, natural killer cells, macrophages, neutrophils, eosinophils, basophils, human platelets, and mast cells
- Contribute to the protective functions of the immune system

What is antibody-dependent?

- *Antibody-dependent:* nonspecific response of cytotoxic cells to antibody-antigen

What is cell-mediated cytoxicity?

- *Cell-mediated cytoxicity:* a mechanism of cell-mediated immune defense whereby an effector cell of the immune system actively lyses a target cell, whose membrane-surface antigens have been bound by specific antibodies.
- In humans, ADCC is usually mediated by IgG

What is cell-mediated immunity?

- *Cell-mediated immunity:* an immune response that does not involve antibodies, but rather involves the activation of phagocytes, antigen-specific cytotoxic T-lymphocytes, and the release of various cytokines in response to an antigen

What are T-cell receptors?

- *T-cell receptors:* a molecule found on the surface of T cells, or Tlymphocytes, that is responsible for recognizing fragments of antigen as peptides bound tomajor histocompatibility complex (MHC) molecules

What are major histocompatibility complexes (MHC)?

- *MHC:* a family of membrane protein complexes encoded by a specific set of genes

What is MHC class I molecules?

- *MHC class I molecules:* found on all nucleated human cells

What is MHC class II molecules?

- *MHC class II molecules:* are found primarily on the antigen-presenting cells (APCs): macrophages, B lymphocytes, and dendritic cells

What is perforin?

- *Perforin:* pore-forming protein secreted by immune cells

What is granzymes?

- *Granzyme:* enzyme of cytotoxic T cells that triggers apoptosis in target cells
- *Apoptosis:* (cell suicide) programmed cell death

What is Fas?

- *Fas:* a “death receptor” protein on the target cell membrane that is linked to the enzyme cascade

What is an allergy?

- *Allergy:* A misguided reaction to foreign substances by the immune system, the body system of defense against foreign invaders, particularly pathogens(the agents of infection)

What is an allergen?

- *Allergen:* any substance capable of triggering an allergic reaction

What is sensitivity?

- *Sensitivity:* the state, condition, or quality of reacting or being sensitive to an external stimulus, drug, allergen, etc

What is hypersensitivity?

- *Hypersensitivity:* abnormal sensitivity, a condition in which there is an exaggerated response by the body to the stimulus of a foreign agent.

What are immediate hypersensitivity reactions?

- *Immediate hypersensitivity reactions:* an allergic reaction provoked by re-exposure to a specific type of antigen referred to as an allergen

What Is allergens?

- *Allergens:* a number of conditions caused by hypersensitivity of the immune system to something in the environment that usually causes little or no problem in most people

What are delayed hypersensitivity reactions?

- *Delayed hypersensitivity reactions:* the reaction takes two to three days to develop

What is anaphylaxis?

- *Anaphylaxis:* an acute, potentially fatal, multi-organ system reaction caused by the release of chemical mediators from mast cells and basophils

What are human leukocyte antigens (HLA)?

- *HLA:* name for classification of human MHC proteins

What is self-tolerance?

- *Self-tolerance:* the lack of immune response to cells of the body

What is autoimmune disease?

- *Autoimmune disease:* disease in which the immune system creates antibodies against the body's own tissues

What is immune surveillance?

- *Immune surveillance:* theory that cancer cells develop regularly but are usually detected and destroyed by the immune system

What is neuroimmunomodulation?

- *Neuroimmunomodulation:* the ability of the nervous system to influence immune function

What is stress?

- *Stress:* an organism's response to a stressor such as an environmental condition
- Stress is a body's method of reacting to a challenge

What are stressors?

- *Stressor:* an event that causes a stress reaction

What is the fight-or-flight reaction?

- *Fight-or-flight reaction:* a physiological reaction that occurs in response to a perceived harmful event, attack, or threat to survival

What are the several sets of interrelated reactions that bacteria set off?

1. Activity of the complicated system
    - Components of the bacterial cell wall are antigens that activate the complement system
    - Some products of the complement cascade are chemical signals (chemotaxins) that attract leukocytes from the circulation to help fight infection
    - Others act as opsonins to enhance phagocytosis
    - Complement causes degranulation of mast cells and basophils
    - Cytokines secreted by mast cells act as additional chemotaxins attacking more immune cells
    - Complement cascade ends with formation of membrane attack complex molecules that insert themselves into bacterial wall of un-encapsulated bacteria
    - Purely chemical process that does not involve immune cells
2. Activity of phagocytes
    - If bacteria are not encapsulated, macrophages can begin to ingest the bacteria immediately
    - IF bacteria are encapsulated, the capsule hides the bacteria from recognition by the macrophage receptors
3. Role of the acquired immune system
    - Some elements are called into play in bacterial infections
    - If antibodies against the bacteria are already present, they enhance the innate response by acting as opsonins and neutralizing bacterial toxins
4. Initiation of repair
    - If the initial wound damaged blood vessels underlying the skin, platelets and the proteins of the coagulation cascade are also recruited to minimize damage
    - Once bacteria are removed by immune response, the injured site is repaired under the control of growth factors and other cytokines