Bio 1 General Biology – Final Exam Outline

Circulation & Respiration (Ch. 21)

Every cell in the body needs oxygen for energy transfer. How is oxygen transported after entering through the lungs and then delivered to every cell in the body?

I. The Cardiovascular System

A. Blood

Components of Blood:

Read about “The Components of the Blood” and answer the following questions about each blood component:

1. Formed Elements – red blood cells, white blood cells, and platelets
   a. Red Blood Cells (RBCs) (erythrocytes; erythros=red)
      What two gases do red blood cells transport?
      What protein do red blood cells contain, which gives them their red color?
      Do red blood cells have a nucleus and organelles?

      Anemia:

   b. White Blood Cells (WBCs) (leukocytes; leukos=white)
      What do white blood cells do for us?
      Do white blood cells have a nucleus?

      Leukemia:

   c. Platelets (thrombocytes; thrombo=clot)
      Are platelets cells or fragments of cells?
      What do platelets do for us?

      Hemophilia:
2. Plasma:
What is the major component of plasma?

What makes up the other components of plasma?

B. Blood Vessels
Read “Arteries, Veins, and Capillaries” and state the function of these vessels:
1. Arteries
2. Veins
3. Capillaries

C. The Heart & Circulation of Blood
1. Basic Circulation
   a. Left side of the heart pumps ____________________ blood to ____________________.
   b. Right side of heart pumps ____________________ blood to ____________________
   c. Which side of the heart has to pump harder? Why?
2. Heart Structure
   4 chambers:
   a. Right atrium and right ventricle pump _________________ blood to ________________.
   b. Left atrium and left ventricle pump _________________ blood to ________________.
   c. Which chamber has to pump the hardest? Why?

3. Path of Circulation
   a. Deoxygenated blood enters right atrium from veins that carry deoxygenated blood from body.
   b. Blood then pumped to right ventricle and then pumped thru pulmonary arteries out to the lungs to become oxygenated.
   c. Oxygenated blood returns from lungs and into left atrium.
   d. Blood then pumped to left ventricle pumped thru aorta (large artery) out to rest of body.

4. Challenges that heart has to deal with:
   a. Why doesn’t blood flow backward in the heart?
   b. How do individual heart muscle cells create smooth, coordinated contractions?
   c. How do the 4 heart chambers coordinate contractions?

D. Chemicals Affect Heart Rate
   1. Caffeine
   2. Alcohol
   3. Nicotine
   4. Epinephrine/Adrenaline
E. What is Blood Pressure?
Blood pressure is the force of the blood pushing against the walls of the arteries. Each time the heart beats (about 60-70 times a minute at rest), it pumps out blood into the arteries.

1. Systolic Pressure

Blood pressure is always given as these two numbers, the systolic and diastolic pressures. Usually they are written one above or before the other, such as 120/80 mmHg. The top number is the systolic and the bottom the diastolic. Blood pressure is measured using an inflatable blood pressure cuff, a stethoscope and a sphygmomanometer (SFIG'mo-mah-NOM'eh-ter). The cuff is inflated until its pressure closes off the arm’s main artery, blood flow stops and no pulse can be detected below the cuff. Then the pressure is gradually reduced. When the pulse is first heard in the artery, the pressure pulses created by the contracting left ventricle are just overcoming the pressure in the cuff and blood is flowing. This is the upper reading: the systolic pressure. Cuff pressure is further reduced until no pulse is heard, indicating that blood is flowing continuously through the artery and that the pressure between the ventricular contractions is overcoming the cuff pressure. This is the lower reading: the diastolic pressure. The numbers are in millimeters of mercury (mmHg).

Blood pressure changes during the day. It is lowest as you sleep and rises when you get up. It also can rise when you are excited, nervous, or active.

3. Why is understanding blood pressure important?
   a. What does high blood pressure mean?

   b. Is this healthy for your vessels?

   c. Does this increase or decrease the chances of a stroke, heart attack & kidney problems?

4. What is high blood pressure (Hypertension)?
   a. A blood pressure of 140/90 or higher is considered high blood pressure. Both numbers are important. If one or both numbers are usually high, you may have high blood pressure.

5. What causes high blood pressure (Hypertension)?
There are two levels of high blood pressure: Stage 1 and Stage 2 (see the chart below).

**Categories for Blood Pressure Levels in Adults** *(American Heart Association recommended blood pressure levels)*  
(In mmHg, millimeters of mercury)

<table>
<thead>
<tr>
<th>Category</th>
<th>Systolic (mm Hg) (Top number)</th>
<th>Diastolic (mm Hg) (Bottom number)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>Less than 120</td>
<td>Less than 80</td>
</tr>
<tr>
<td>Prehypertension</td>
<td>120-139</td>
<td>80-89</td>
</tr>
<tr>
<td><strong>High Blood Pressure</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stage 1</td>
<td>140-159</td>
<td>90-99</td>
</tr>
<tr>
<td>Stage 2</td>
<td>160 or higher</td>
<td>100 or higher</td>
</tr>
</tbody>
</table>

F. The Heart’s Own Blood Supply & Heart Attack
1. The heart is a large muscle that also needs its own blood (oxygen) supply. Blood to the heart muscle is supplied by the __________________________.

2. Complete blockage of one these arteries results in a ____________. As a result of blockage, the blood supply can be cut off and heart muscle cells die. When too many heart muscle cells die, the heart is no longer able to function properly.

3. Death may come when heart muscle is no longer able to contract with enough force to pump blood through body; or when a irregular heart rhythm (ventricular fibrillation) is set off.

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**Watch “How Many Heartbeats Do We Get?”** if you want to learn more.

II. Respiratory System

A. Structure of Respiratory System
1. Starts with nose, nasal cavity and sinuses; pharynx (throat), the larynx (voice box), and trachea (windpipe); conducting passageways called bronchi and bronchioles, that lead to lungs; at end of bronchioles are tiny air sacs called ________________________.

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2. Alveoli are like capillaries because they are thin enough to allow diffusion of materials in and out of themselves.

B. Steps in Respiration
1. Breathing
   a. What does the diaphragm do as you inhale?
   b. What does the diaphragm do as you exhale?

2. Oxygen breathed into lungs diffuses into capillaries while CO₂ diffuses from capillaries into lungs.

3. What two gases do red blood cells that contain hemoglobin transport?

4. What happens to the pH of your blood as CO₂ builds up?

5. The brain controls your breathing
   a. How does your brain react to this change in pH?
The Nervous System & Senses (Ch. 23)

Your brain and nervous system allows you to respond to your environment. In order to live, we must monitor what’s around us, pursue what we need, and adapt to change.

I. The Nervous System
   Basic functions: monitor internal and external environment, integrate sensory info animal receives and coordinate voluntary and involuntary responses of body systems

   A. How is Nervous System Organized?
      Read “The Central Nervous System” and (“The Peripheral Nervous System” define the following divisions of the nervous system:

      2 main divisions:
      1. Central Nervous System (CNS)
      2. Peripheral Nervous System (PNS)

   B. Cells of the Nervous System = Neurons
      Anatomy of a Neuron

      1. Dendrites
      2. Axon
      3. Synaptic Terminals

      Watch “The Chemical Mind” to review what a neuron is and how nerve impulses travel.

   C. How Are Signals Transmitted Along a Neuron (Nerve Impulses)?
      By using concentration gradients of charged particles!
This process happens really fast, a few thousandths of a second (milliseconds)!
Watch “Action Potential” if you want to learn more about how neurons work.

D. How does the signal from one neuron pass to the next neuron or another cell?

1. Signal reaches synaptic terminal but then how does it get to next cell?
   a. A neuron does not touch the next cell (there is a gap between them)
   b. Upon arrival of action potential at synaptic terminal, the sending neuron releases a chemical called a neurotransmitter
   c. Neurotransmitter diffuses to receiving cell or receiving neuron and sets in motion an action potential in that cell
   d. Area where cell to cell signal transmission occurs = synapse

Watch “Synapses” if you want to learn more.
2. Nervous System Uses Many Different Neurotransmitters -

### Table 33-1 Some Important Neurotransmitters

<table>
<thead>
<tr>
<th>Neurotransmitter</th>
<th>Location in Nervous System</th>
<th>Some Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetylcholine</td>
<td>Motor neuron-to-muscle synapse; autonomic nervous system, brain</td>
<td>Activates skeletal muscles; activates target organs of parasympathetic nervous system</td>
</tr>
<tr>
<td>Dopamine</td>
<td>Midbrain</td>
<td>Important in control of movement</td>
</tr>
<tr>
<td>Epinephrine (adrenaline)</td>
<td>Sympathetic nervous system</td>
<td>Activates target organs of sympathetic nervous system</td>
</tr>
<tr>
<td>Serotonin</td>
<td>Midbrain, pons, and medulla</td>
<td>Influences mood, sleep</td>
</tr>
<tr>
<td>Glutamate</td>
<td>Brain and spinal cord</td>
<td>Major excitatory neurotransmitter in CNS</td>
</tr>
<tr>
<td>Glycine</td>
<td>Spinal cord</td>
<td>Major inhibitory neurotransmitter in spinal cord</td>
</tr>
<tr>
<td>GABA (gamma amino butyric acid)</td>
<td>Throughout brain</td>
<td>Major inhibitory neurotransmitter in brain</td>
</tr>
<tr>
<td>Endorphins</td>
<td>Brain and spinal cord</td>
<td>Influence mood, reduce pain sensations</td>
</tr>
<tr>
<td>Nitric oxide</td>
<td>Brain</td>
<td>Important in forming memories</td>
</tr>
</tbody>
</table>

**Neurotransmitters and Drugs:**
1. Synapses in brain use neurotransmitters dopamine, serotonin or norepinephrine that contribute to energy level and over all sense of well being
2. Normally, after the sending neuron releases neurotransmitter, it immediately starts to pump it back in thus limiting its effects
3. Drugs that affect neurotransmitters such as cocaine work by blocking this pump. When person takes cocaine, neurotransmitters remain in synapses much longer and reach higher levels than normal, so effects are enhanced. The user feels euphoric and energetic.
4. Brain compensates and in order to reduce impact of cocaine, receiving neuron decreases its number of receptors for these neurotransmitters and the body begins to naturally make less neurotransmitter. When fewer receptors and less neurotransmitter are present, higher levels of cocaine are now required for the user to feel normal.
5. When cocaine is withdrawn, receiving neurons are inadequately stimulated and user experiences emotional crash that can be relieved only by more cocaine. Increasing amounts of drug are required to produce euphoric effects; the user has become addicted.

**Neurotransmitters and Alcohol:**
1. Alcohol stimulates receptors for neurotransmitter GABA, enhancing inhibitory signals and blocks receptors for glutamate, reducing excitatory signals.
2. When person drinks frequently, brain compensates by decreasing GABA receptors and increasing glutamate receptors.
3. Alcoholic feels jittery and overstimulated without alcohol

**Neurotransmitters and Depression:**
1. Too little serotonin can cause depression. Antidepressants such as Prozac, Zoloft and Paxil block the reuptake of serotonin in the presynaptic neuron, enhancing serotonin’s effects

**Neurotransmitters and Diseases:**
1. Parkinson’s and Alzheimer’s are caused by the death of specific neurons in the brain and loss of their neurotransmitters which normally communicate with other neurons.
2. Parkinson’s is associated with lack of dopamine. Dopamine releasing neurons in brain die which interferes with the control system that causes smooth movements. As a result, patients experience tremors.
3. In Alzheimer’s, neurons in the brain that produce acetylcholine die in large numbers.
4. Schizophrenia has been linked to excess dopamine.
E. The Brain

Read about the "Brain" and be able to locate each of the following parts and describe its function:

1. The Old Brain:
   a. Brainstem

   b. Cerebellum

2. The Limbic System
   a. Amygdala

   b. Hypothalamus

   c. Hippocampus

3. Cerebrum & cerebral cortex

Now watch “Getting to Know Your Brain”
Watch the online video “Sleep” and answer the following questions:

1. What is your brain doing while you are asleep?

2. What are the following brain parts doing when you sleep?
   a. Hippocampus:
   b. Visual cortex:
   c. Neocortex (cerebral) cortex:

3. What is the sleeping brain doing for long term memory?

Watch “Why Do We Have to Sleep” to learn more about the science of sleep.

F. The Spinal Cord
1. Functions:
   a. A major pathway for sensory impulses going to and from the brain.
   b. A communication center of its own, receiving input from sensory neurons and directing motor activities with no input from the brain

2. Reflexes
   a. How is the response so fast and automatic?
II. The Nervous System and the Senses
   A. How do our senses work?
      Sensory receptors receive stimuli from environ. & produce electrical responses that brain can understand.

      | Type of Receptor | Sensory Cell Type       | Stimulus                      | Location          |
      |------------------|-------------------------|------------------------------|-------------------|
      | Thermoreceptor   | Free nerve ending       | Heat, cold                   | Skin              |
      | Mechanoreceptor  | Hair cell               | Vibration, motion, gravity   | Inner ear         |
      |                  | Specialized nerve endings| Vibration, pressure, touch   | Skin              |
      |                  | and free nerve endings in|                              |                   |
      |                  | skin (Pacinian corpuscle,|                              |                   |
      |                  | Merkel’s disc)          |                              |                   |
      |                  | Specialized nerve endings| Stretch                      | Muscles, tendons  |
      |                  | in muscles or joints (muscle spindle,|                    |                   |
      |                  | Golgi tendon organ)     |                              |                   |
      | Photoreceptor    | Rod, cone               | Light                        | Retina of eye     |
      | Chemoreceptor    | Olfactory receptor      | Odor (airborne molecules)    | Nasal cavity      |
      | Taste receptor   |                         | Taste (waterborne molecules) | Tongue            |
      | Pain receptor    | Free nerve ending       | Chemicals released by tissue injury | Widespread in body |

   B. How do we detect temperature, pain, and pressure?

   C. How do we detect chemicals?
      1. Smell (olfaction)
         a. Olfactory receptors located in upper part of nasal cavity.
2. Taste
   a. Taste receptors located in clusters on the tongue.
   b. Does your ability to taste depend on your ability to smell? Why?

Watch “Taste and Smell” if you want to learn more.

D. How do we detect sound?
   1. What do sounds produce?
   2. What type of cells detect this?

Watch “Hearing and Balance” if you want to learn more.
E. How is light detected?

1. Eye structure:
   a. Cornea – transparent covering over front of eyeball; lets in light and helps focus light
   b. Aqueous humor – provides nourishment for lens and cornea
   c. Iris – adjusts amount of light entering eye
   d. Pupil – opening in the center of iris; controlled by iris
   e. Lens – composed of transparent protein fibers; suspended behind pupil by muscles that regulate its shape; focuses images onto the retina
   f. Vitreous humor – clear jelly-like substance that maintains shape of eye
   g. Retina – multi-layered sheet of photoreceptors; light is converted into electrical nerve impulses that is transmitted to the brain
   h. Choroid – darkly pigmented tissue nourishes retina; also absorbs stray light whose reflection inside eyeball would interfere with clear vision
   i. Fovea - visual image is focused most sharply on this small area of the retina; contains many receptors
   j. Sclera – tissue that is visible as the white of the eye
Read “Vision” and state where rods and cones are found in our eyes and what their specific functions are:

1. Rods:

2. Cones:

2. How the lens focuses light
   a. How does the shape of your lens change when you are viewing a nearby object?

   b. How does the shape of your lens change when you are viewing an object that is far away?

3. Vision Problems
   a. Nearsighted

      If you are nearsighted, how is your eye shaped?

   b. Farsighted

      If you are farsighted, how is your eye shaped?

   c. Astigmatism

4. Why is the human eye not perfect?

5. Why do the eyes of certain animals seem to glow at night?
   a. Tapetum lucidum

Watch “Vision” if you want to learn more.
The Immune System (Ch. 26)

Your body is under constant attack from all kinds of microbes (viruses, bacteria, fungi, protists) trying to invade and make a living in your body. For the most part, we are able to fight off these invaders. But how?

I. Ways That Your Body Defends Against Invaders: Nonspecific Defenses & Specific Defenses
   A. Nonspecific Defenses – do not discriminate between one invader to the next
      1. External Defenses (1st Line of Defense) - keep microbes out of body
         Examples?

If invader does penetrate external barrier then next step of defense kicks in:

2. Internal Defenses (2nd Line of Defense) – targets a wide variety of microbes
   a. White Blood Cells (Lymphocytes)
      Ex. Phagocytes (microphages & macrophages) and natural killer cells

Table 27.1a Selected Immune-System Cells

| Phagocytes (cells that can ingest other cells) |
| Neutrophils |
| Microphages (“small eaters”) |
| Eosinophils |
| Macrophages (“large eaters”), which can become antigen-presenting cells (APCs) |
| Most cells (release histamine) |
| Dendritic cells (antigen-presenting cells) |
| Lymphocytes |
| Natural killer cells |
| B cells, which differentiate into: |
| Plasma cells |
| Memory cells |
| T cells, which differentiate into: |
| Helper T (CD4) cells |
| Cytotoxic (killer) T cells |
| Regulatory T cells |

Table 27.1b Selected Immune-System Proteins

- Lysozymes (protective enzymes found in tears and saliva)
- Complement proteins (kill some invaders, bind with others to aid phagocytes)
- Antibodies (receptors on surface of B cells; later released by plasma cells derived from B cells)
- Interleukins (diverse group of signaling molecules)
b. Inflammatory Response - occurs during tissue damage & invasion of microbes
What chemical do mast cells release at the sight of injury?

What does this chemical do?

c. Fever – an increase in body temp. that occurs when microbes succeed in establishing a major infection

What are other effects of a fever?

Is taking aspirin to reduce fever always a good thing?
When nonspecific defenses fail to do the job, the body’s immune system starts a highly specific immune response directed against the particular organism that has successfully invaded the body.

B. Specific Defenses (Immune System) (3rd Line of Defense) - recognizes and attacks specific kinds of invading microbes and cancer cells.

1. Specific defenses consist of an army of highly coordinated cells. This coordination requires complex communications involving hormones, receptors, cells, antigens and antibodies.
   a. Functions of specific defenses:

   b. Lymphocytes:
      - Specific defenses include about 2 trillion lymphocytes.
      - Different lymphocytes have a different job.
      - Where are lymphocytes produced?

2. The Lymphatic System
   a. Lymphocytes distributed in blood & lymphatic system.
   b. Where are many lymphocytes stored?

3. How do immune cells recognize invaders?
   a. Invaders have antigens on their surfaces.
      - Antigens
   b. Proteins produced by lymphocytes recognize and bind to antigens.
      - Antibodies

4. How does immune system attack invaders? (2 ways)
   a. Antibody Mediated Immunity

   Goal of this type of immunity?
- Plasma cells

- Memory cells

What will memory cells do if invaders re-enters the body?

Antibody Mediated Immunity only defends against invaders that are in bloodstream. It cannot kill invaders that have already entered into body cells.

b. Cell Mediated Immunity

Goal of this type of immunity?

T cells come in several varieties:
- Helper T cells (CD4 cells)
- Cytotoxic (killer) T cells (CD8 cells)
- Memory T Cells
II. Why do we still keep getting the flu?

III. Medical care can assist the immune response
   A. Antibiotics

   1. Problem with antibiotics?
B. Vaccinations

Watch “Why Vaccines Work” and read “Fact or Fiction?: Vaccines Are Dangerous” and answer the following:
1. State what vaccines made up of and briefly explain how they protect us.

2. Why have some parents chosen to not have their children vaccinated for diseases?

3. What are the chances that a dangerous side effect will occur from a vaccine?

4. Are so many shots dangerous for young children?

5. Do vaccines cause autism?

6. How does immunizing ourselves and our children protect others?

IV. Sometimes the immune system malfunctions
A. Autoimmune Disorders

Ex. Rheumatoid arthritis – immune system attacks joints and cartilage
Insulin dependent diabetes – immune system attacks insulin producing cells in pancreas
Multiple sclerosis – immune system attacks nerves
Certain types of anemia – antibodies destroy red blood cells
B. Allergies

Examples of allergens: pollen, dust mites, mold spores, food, latex, animal dander, insect stings

1. 2 stages of building an allergy:
   1st stage = Sensitization – when person is first exposed to allergen
   - After allergen enters bloodstream, it binds to B cells
   - B cells replicate and produce antibodies to that allergen
   - Some of these antibodies bind to mast cells which produce histamine that can trigger inflammatory response

   2nd stage = Later exposure to same allergen (when symptoms occur)
   - Same allergen reenters body and binds to antibodies on mast cells
   - Mast cells release histamine, which causes sneezing, coughing, itching, inflammation, etc.

   Watch “%$?# Allergies” to learn more

2. Anaphylactic shock
C. Immune Deficiencies

1. Severe Combined Immune Deficiency (SCID)

2. Acquired Immune Deficiency Syndrome (AIDS)
   Go to this website and answer the following:
   a. What virus causes AIDS?
   b. What type of immune cell does this virus attack?
   c. Why is it important for someone to have healthy numbers of this type of immune cell?
   d. Does an effective cure exist?
   e. Can someone with HIV live a long, healthy life? How so?
   f. What is AIDS and what are the immune systems like of those who have AIDS?

Go to this website and answer the following:
   a. Is there a vaccine for HIV?
   b. Watch the “Progress Toward an HIV Vaccine” video and state why it has been difficult to produce a successful vaccine.