

TOPIC THREE: Homeostasis and the Human Body

I. Organization

A. **Cells** are specialized into **tissues**.

A. **Tissues** are groups of cells specialized to do certain jobs. Examples of tissues include muscle tissue and nerve tissue.

B. **Specialization** or **differentiation** is the process that changes a stem cell into a specialized tissue.

1. Almost every cell has a complete set of genes, but only those genes needed for the cell's particular job are *turned on*.

Example: A red blood cell has all the genetic information needed to make nerve cells, bone cells and skin cells, but all of those *extra* genes are turned off – only the red blood cell genes are turned on.

2. **Stem cells** are cells that have not yet been specialized.

B. **Tissues** work together to form **organs** (heart, lungs, kidney).

C. **Organs** work together in **organ systems** (digestive system, nervous system, etc.).

II. The Nervous System

A. The nervous system **regulates** your body with electrochemical **impulses**.

B. The **spinal cord** controls reflexes and relays impulses between the brain and body.

III. Endocrine System

A. Uses **hormones** to **regulate** the body.

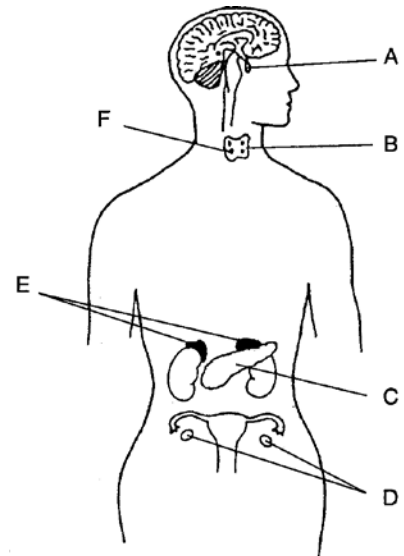
B. Slower than the nervous system, but with longer-lasting effects.

C. The **pancreas (C)** makes **insulin** and glucagon which control blood sugar.

Common mistake: *Insulin lowers blood pressure.*

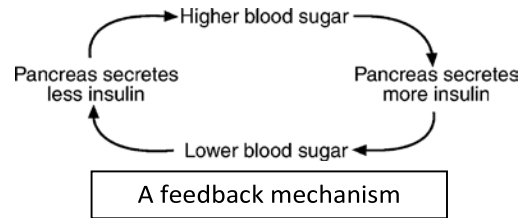
Insulin (and glucagon) directly control blood *sugar* (or glucose) levels, not blood pressure.

D. **Adrenal glands (E)** make **adrenaline** when the body is under stress.



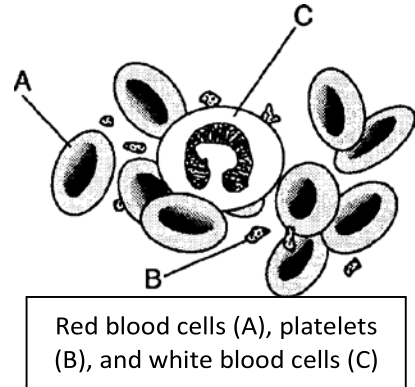
The brain (nervous system) and some endocrine glands.

- E. **Testosterone** (male), **estrogen** and **progesterone** (female) are the sex hormones. These are made in the gonads (testes for males, ovaries (D) for females).
- F. Hormone levels are controlled by **feedback mechanisms**.



IV. Transport/Circulatory System

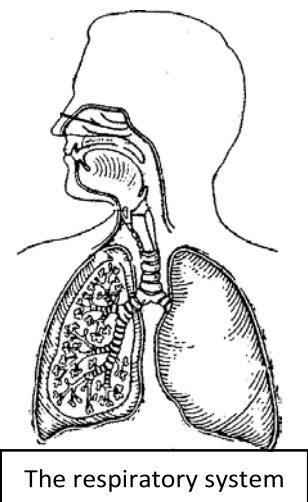
- A. Moves material (water, nutrients, hormones, wastes) through the body to the cells that need them.
- B. **The Heart is the pump that drives the circulatory system.**
- C. **Red blood cells** carry oxygen. **White blood cells** fight disease.
- D. **Plasma** is the fluid of the blood. It transports everything *except oxygen*.
- E. **Platelets** clot the blood.
- F. **Common mistakes**



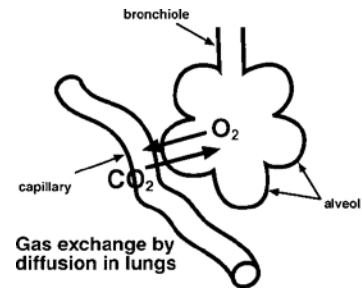
- A. *The heart controls the body.* It is the brain, nerves, and endocrine glands that control the body. The heart is only a pump. It does not control the body, and it is not part of the nervous or endocrine system.
- B. *The heart pumps oxygen to the brain.* Technically true, but the heart pumps blood (which carries the oxygen) everywhere in your body.
- C. *Oxygen diffuses into and out of the heart.* No materials diffuse in or out of the blood when it is in the heart. This only occurs in capillaries.

V. Respiratory System

- A. **Breathing provides oxygen needed for chemical respiration (which releases energy from sugar).** It also excretes the waste CO₂ which is produced from respiration.
- B. The **diaphragm** is the muscle that allows breathing to occur.
- C. You breathe faster when CO₂ builds up in the blood (not when you need oxygen).



- D. The **alveoli** are microscopic sacs where oxygen enters the blood and CO₂ leaves the blood. The alveoli are surrounded by **capillaries**.

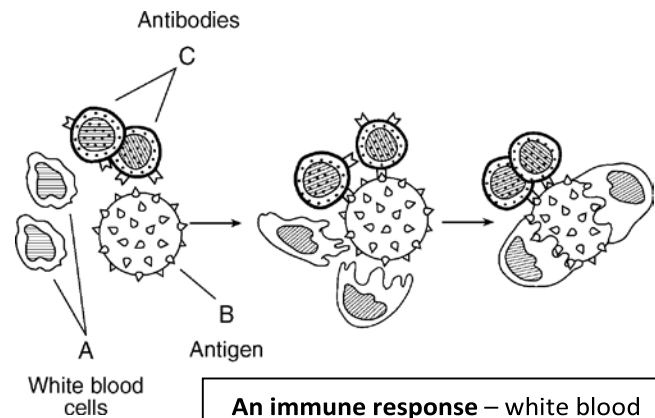


VI. Immune System

- A. The job of the immune system is to protect the body against **pathogens**.
- B. Types of pathogens include viruses, bacteria, and parasites.
- C. **White Blood Cells (wbc)** are the main components of the immune system. Different wbc's have different roles, including:
1. Identify pathogens.
 2. *Tag* pathogens for destruction by other wbc's.
 3. Destroy pathogens by eating them.
 4. Destroy pathogens using chemicals.
 5. Make antibodies

- D. **Antigens** are protein *tags* that can be used to identify a cell or virus. Cells and viruses which have antigens different than yours will cause an immune response.

- E. **Antibodies** are also proteins made by white blood cells to attack antigens. *Each antibody attacks a specific antigen as determined by its shape.*



An immune response – white blood cells and antibodies attack a virus.

- A. Be able to explain why your body's immune system rejects organ transplants.

- B. Blood type O is a universal donor; type AB is the universal acceptor.

C. **Common mistake**

Antibodies are cells that attack pathogens. Antibodies are proteins, not cells.

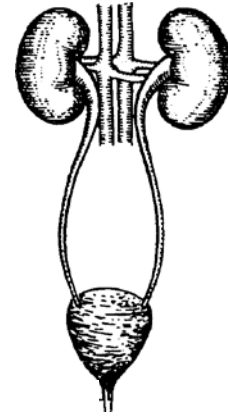
- F. **A vaccine is an injection of a dead or weakened pathogen.** This causes the body to make antibodies against that pathogen. It is effective against both viruses and bacteria.

Common mistake: *Vaccines are used to cure diseases.* Vaccines only prevent diseases you do not already have. They are not cures.

- G. **Antibiotics** are drugs used to stop infections by **bacteria**. Antibiotics will not work against viruses. Unlike vaccines, antibiotics can cure diseases.

VII. Excretory System

- A. **Removes metabolic cellular waste from your body.**
These wastes include **salt, water, urea and CO₂**.
- B. **Lungs** excrete CO₂ and water and the skin excretes sweat.
- C. The **kidneys** filter waste from blood and reabsorb nutrients.
- D. The **liver** filters toxins and dead red blood cells from the blood.

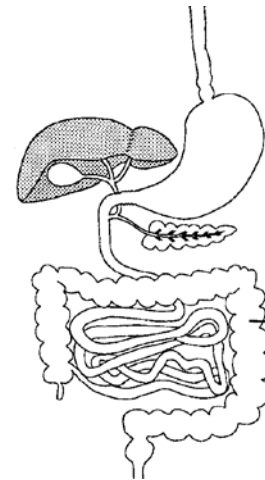


Kidneys and Urinary Tract - part of the human excretory system.

VIII. Digestive System

Food is broken down so that it is small enough to enter the body tissues/cells.

- A. The digestive system is a one-way passage through the body that includes the **mouth, stomach and intestines**.
- B. Food is moved through the digestive system by muscular contractions (peristalsis).
- C. Food is broken down mechanically and chemically.
- D. Undigested food is eliminated as solid waste (feces).
- E. **Common mistakes**
1. *Feces are excreted from your body.* Feces do not come from your cells, so it is technically not excreted.
 2. *The digestive system excretes waste.* The digestive system does *remove* waste (feces), but again *excrete* is not correct.
 3. *The digestive system gives you energy.* The digestive system gives you nutrients, not energy. Energy is gained only by chemical respiration.



The human digestive system

IX. Interaction between Systems

Be able to explain how different systems of the body work together to maintain homeostasis. For example:

- A. Nutrients from the digestive system are transported to cells by the circulatory system.

- B. Wastes from the respiratory system are removed by the excretory system.
- C. The nervous and endocrine systems work together to control the body.
- D. The immune system protects the nervous system from disease.
- E. The digestive system gives nutrients to the endocrine system.

X. Diseases and Disorders

Be familiar with different diseases and disorders, what causes them, and how they may affect the body. Don't fret about memorizing all of them. Typically, the exam asks you to name a disease and how it disrupts homeostasis. The most important diseases and disorders for you to know are:

A. AIDS

1. Caused by HIV virus (a pathogen).
2. Weakens human immune system, leaving body vulnerable to other diseases.
3. Spread through bodily fluids, usually sexual contact, intravenous (IV) drug use (sharing needles), or blood transfusions.
4. Can't be cured, but spread may be prevented by sexual abstinence, *safe sex* (using condoms), not sharing needles, or testing blood before using it for a transfusion.

B. Cancer

1. Caused when a cell reproduces (divides) at an uncontrolled rate, forming a **tumor**.
2. Cancer cells do not **specialize** and take resources from healthy tissue.
3. May be caused by radiation, chemicals (such as asbestos or cigarette smoke), and viruses.
4. Treatments include surgery, radiation therapy, and chemotherapy.

C. Diabetes

1. Affects body's ability to control blood sugar.
2. Some diabetics may be treated using injections of **insulin** made by genetically engineered bacteria.

D. Allergies

1. Occur when immune system reacts to a harmless substance (such as pollen) the same way it would a harmful pathogen (such as a cold virus).
2. **Asthma** is an allergic reaction to pollen, dust mites or mold particles in the air.

Adapted from *What You Absolutely Must Know to Pass
the NYS Living Environment/Biology Regents*
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