BIO 211:
ANATOMY & PHYSIOLOGY I

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CHAPTER 01

INTRODUCTION
TO
ANATOMY and PHYSIOLOGY

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Some illustrations are courtesy of McGraw-Hill.

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I. The Scope of Anatomy and Physiology

A. **Anatomy** - The Study of **Form**

1. Anatomy is the study of **structure**, often done by dissection of cadavers.

   Different levels of anatomy include:
   gross anatomy (structures observed via the unaided eye)
   microscopic anatomy (**histology**- tissues; **cytology**- cells)
   ultrastructure (finer details; electron microscope)

2. Other ways to study anatomy include:
   palpation: feeling with hands; i.e.- swollen liver, pulse.
   auscultation listening to natural sounds of the body (i.e., lung/heart).
   percussion: tapping for echo sounds- reveals abnormal pockets of air/fluid.

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B. **Physiology** - The Study of **Function**

1. ***Physiology*** is the study of **function**, and is primarily an experimental science.

   Specialties: **neuro-**, **cellular-**, **patho-** etc.

2. **Comparative physiology** employs *other species* to enable us to learn more about human physiology/evolution/form-function relationships.

C. Unity of Form and Function

Anatomy is the result of physiology, and physiology is made possible by anatomic structure.

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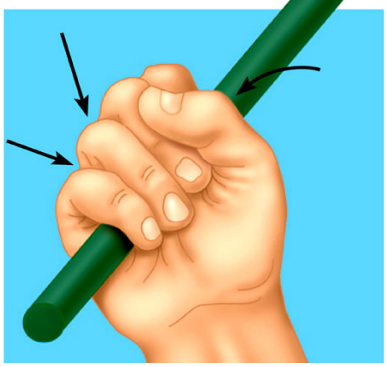
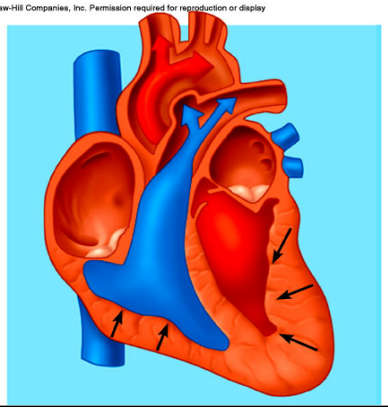
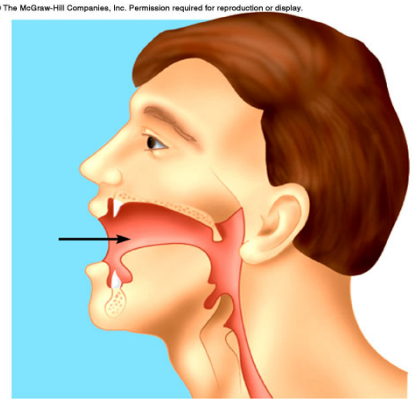
Structure and Function (1)



Structure and Function (2)



Structure and Function (3)



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II. The Nature of Life

A. What Is Life?

1. Life is a collection of *properties*:

cellular organization — microscopic units of structure
all functions of the body

biochemical unity — all contain similar components:
proteins, lipids, carbohydrates, DNA etc.
these are unique to *living materials*
or those of *biological origin.*

metabolism — all physical and chemical changes that occur within living cells.
either **catabolism** or **anabolism.**
assists in maintenance of **HOMEOSTASIS.**

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1. Life is a collection of *properties*: (cont.)

responsiveness — **excitability** via **detection of a change in conditions (stress);**
detection by cell (i.e. eye, taste)
reaction to stress via receptors may cause
an action by an **effector** **(i.e. muscle/gland).**

development — change in form and/or function over lifetime
growth: increase in size
differentiation: non-specialized to specialization

2. Clinical and legal definitions of life vary from those of the scientist.
A person is declared **legally dead** when he/she has not shown brain waves for 30 minutes, has no reflexes, and no heartbeat or respiration without assistance.

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table 1.1 Characteristics of Animal Life

Process	Examples	Process	Examples
Movement	Change in position of the body part; motion of an internal organ	Digestion	Breakdown of food substances into simpler forms that can be absorbed and used
Responsiveness	Reaction to a change taking place inside or outside the body	Absorption	Passage of substances through membranes and into body fluids
Growth	Increase in body size without change in shape	Circulation	Movement of substances from place to place in body fluids
Reproduction	Production of new organisms and new cells	Assimilation	Changing of absorbed substances into chemically different forms
Respiration	Obtaining oxygen, using oxygen in releasing energy from foods and removing carbon dioxide	Excretion	Removal of wastes produced by metabolic reactions

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table 1.2 Requirements of Organisms

Factor	Characteristic	Use	Factor	Characteristic	Use
Water	A chemical substance	For metabolic processes, as a medium for metabolic reactions to transport substances, and to regulate body temperature	Oxygen	A chemical substance	To help release energy from food substances
			Heat	A form of energy	To help regulate the rates of metabolic reactions
Food	Various chemical substances	To supply energy and raw materials for the production of necessary substances and for the regulation of vital reactions	Pressure	A force	Atmospheric pressure for breathing; hydrostatic pressure to help circulate blood

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B. Human Organization – A Hierarchy of Structural Complexity

1. Humans are organisms.

organism — ***single, complete individual***

organ system — ***group of organs; unique purpose***
i.e., circulatory, respiratory, digestive
reproductive, nervous etc.

Tissues — ***group of similar cells and non-living products serving a specific function.***
may form a discrete region of an organ.

Histology: the study of tissue:

Four primary classes:
muscular, nervous, epithelia and connective

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cells

- smallest unit of an organism capable of performing all basic functions of life.
- surrounded by a membrane (lipid/protein)

CYTOLOGY
The study of cells

eukaryotic has a membrane enclosed nucleus
at some point in life (i.e. RBCs)
few may be multi –nucleate:
i.e., liver, some bone marrow.

*prokaryotic has **no** nuclear membrane*
example: bacteria

Cytoplasm: the gelatinous fluid within all cells

organelles

- microscopic cellular structures that carry out individual functions.

Examples: mitochondria, lysosomes, Golgi complex, centrioles, etc.

molecules

- make up all cellular components;
- are comprised of **atoms**.

subatomic particles: protons, neutrons, electrons.

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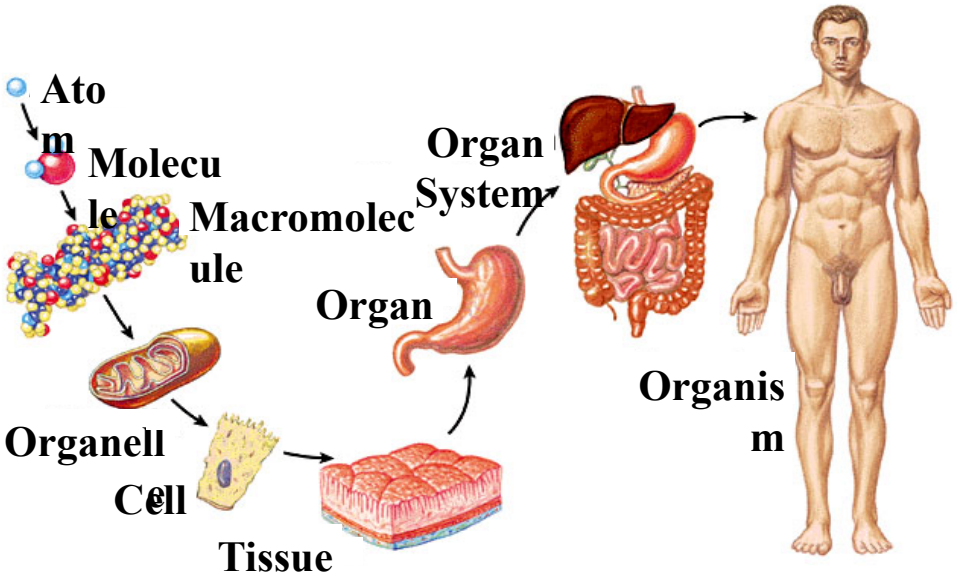
Organization of Human Body



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LEVELS of ORGANIZATION:

Level	Example
Atom	Hydrogen atom, lithium atom
Molecule	Water molecule, glucose molecule
Macro-molecule	Protein molecule, DNA molecule
Organelle	Mitochondrion, Golgi apparatus, nucleus
Cell	Muscle cell, nerve cell
Tissue	Simple squamous eptihelium, loose connective tissue
Organ	Skin, femur, heart, kidney
Organ system	Integumentary system, skeletal system, digestive system
Organism	Human

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2. **Reductionism** suggests that a human body can be understood by **studying its simpler components.**
(smaller and smaller discovery).

3. **Holism** suggests that there are properties possessed by the whole organism *that are not apparent (not obvious) from the study of its parts*, such as psychological factors.

Treating the **whole person** *not just individual symptoms.*

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III. Scientific Method

A. The **Inductive Method**

The inductive method involves **making numerous observations** *and then* **forming generalizations and predictions.**

B. The Hypothetico-**Deductive Method**

The hypothetico-**deductive** *method* begins with the formulation of a **hypothesis** (an educated guess) followed by a **deduction**.

An experiment will help the scientist decide whether to abandon the hypothesis. **Must be testable!**
Over time, assuming acceptance -→ **theory**.

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C. **Experimental Design**

1. Experimental design must employ a **large enough sample size**, and a **control** group. The control group receives the same conditions with the *exception* of the variable under observation.
2. **Placebos** are used to rule out ***psychosomatic*** effects seen with medication trials.
3. Experimenter bias can be minimized through the use of the **double-blind method** in which **NEITHER** the physician nor the patient know which treatment was received;
   only the scientist in charge knows.
4. Experiments must undergo rigorous **statistical testing** to help rule out chance events.

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D. Peer Review

1. Most scientific journals subject manuscripts to rigorous (sometimes!) **peer review** prior to publication.

E. Facts, Laws, and Theories

1. **Basic research** involves determining how nature works, while **applied science** seeks to study the application to human welfare.

2. A scientific "fact" is an **observation**; a law of *nature* is a **generalization** supported by much scientific evidence.

   A **theory** is a ***well-substantiated statement*** designed to explain a natural **phenomenon.**
   phenomenon = simply an *event.*

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IV. Homeostasis and Feedback

A. Homeostasis

1. **Homeostasis** is the body's ability to **maintain relatively constant internal conditions**, *and to return to those conditions if upset.* Failure to maintain: illness or death.

   Not static; not exact- regulation attempts ***to stabilize an acceptable range*** (average = set point, i.e. 37°C temp.)

   Dynamic (changing) equilibrium: balanced change.
   Feedback loops: general name for these mechanisms which alter the original changes that triggered them.

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Autoregulation: change is automatic

Extrinsic regulation: involves **nervous** or **endocrine** (hormones) systems.

Hormones: chemical *messengers produced in one part of the body* having an effect in *another* (target).

Both systems may adjust other systems simultaneously.

Examples:
- lack of digestion during exercise. effect of nervous system.
- reduced oxygen to stomach. increase heart rate to bring oxygen to muscles.

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IV. Homeostasis and Feedback

B. Negative Feedback and Stability

1. **Negative feedback** is the main way the body ***returns to stable conditions.***

   Example:
   How a thermostat works to control a room's temperature illustrates the idea of negative feedback.

2. Human "thermostats" involve:
   vasoconstriction or **vasodilation** of blood vessels to exchange heat with the outside environment.

   This thermoregulation is autoregulated.

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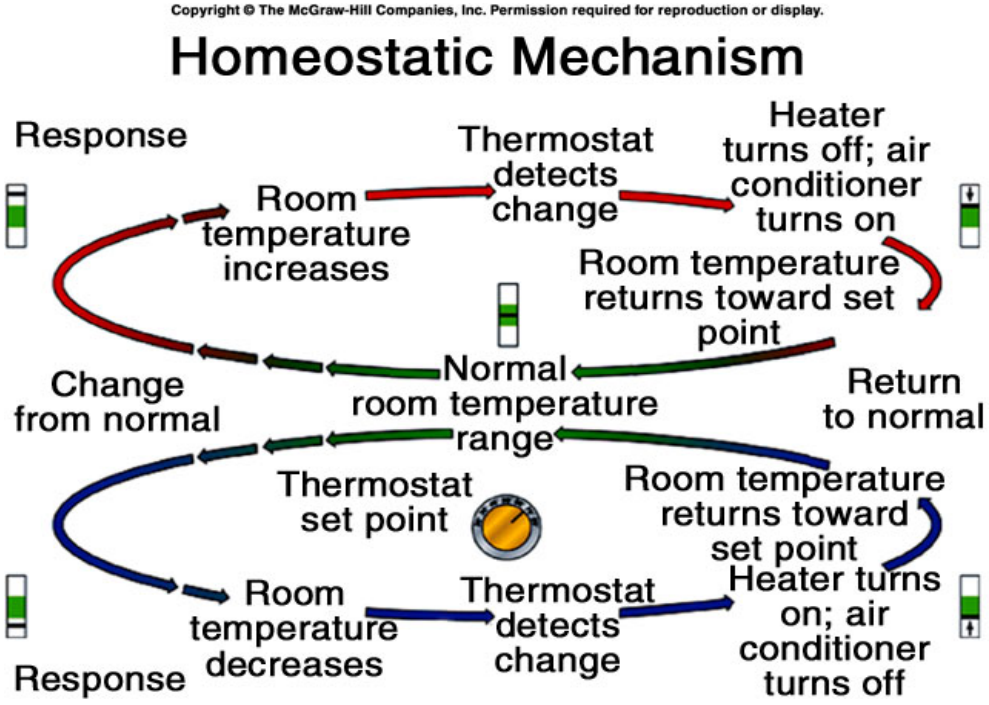

Just an example- will be covered during A&P II

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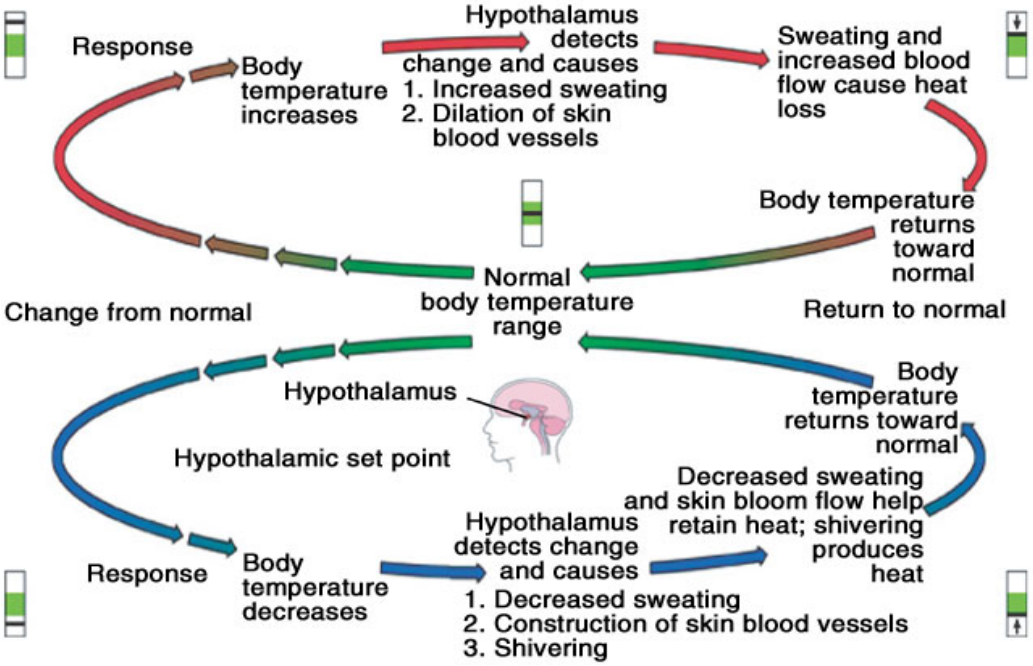

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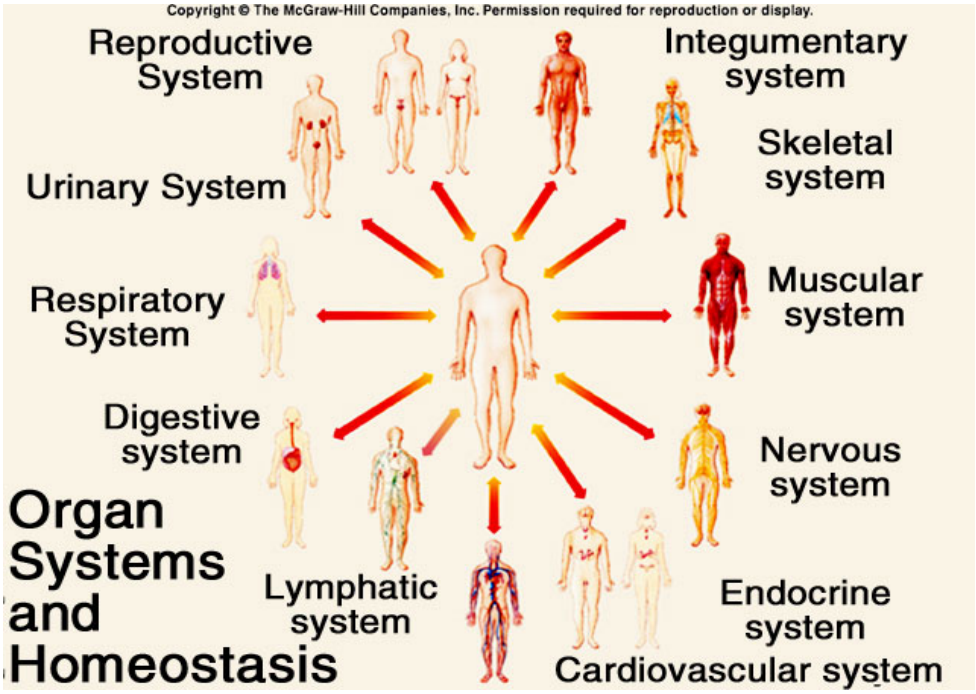

PREVIEW of COURSE: Learn whatever you do not already know. **23**

table 1.4 Organ Systems

Organ system	Major Organs	Major function
Integumentary	Skin, hair, nails, sweat glands, sebaceous glands	Protect tissues, regulate body temperature, support sensory receptors
Skeletal	Bones, ligaments, cartilages	Provide framework, protect soft tissue, provide attachments for muscles, produce blood cells, store inorganic salts
Muscular	Muscles	Cause movements, maintain posture, produce body heat
Nervous	Brain, spinal cord, nerves, sense organs	Detect changes, receive and interpret sensory information, stimulate muscles and glands
Endocrine	Glands that secrete hormones (pituitary gland, thyroid gland, parathyroid glands, adrenal glands, pancrease, ovaries, testes, pineal gland, and thymus gland)	Control metabolic activities
Cardiovascular	Heart, arteries, capillaries, veins	Move blood through blood vessels and transport substances throughout body
Lympathic	Lympathic vessels, lymph nodes, thymus, spleen	Return tissue fluid to the blood, carry certain absorbed food molecules, defend the body against infection
Digestive	Mouth, tongue, teeth, salivary glands, pharynx, esophagus, stomach, liver, gallbladder, pancreas, small and large instestine	Receive, break down, and absorb food; eliminate unabsorbed material
Respiratory	Nasal cavity, pharynx, larynx, trachea, bronchi, lungs	Intake and output of air, exchange of gases between air and blood
Urinary	Kidneys, ureters, urinary bladder, urethra	Remove wastes from blood, maintain water and electrolyte balance, store and transport urine
Reproductive	Male: scrotum, testes, epididymides, vasa deferentia, seminal vesicles, prostate gland, blubourethral glands, urethra, penis	Produce and maintain sperm cells, transfer sperm cells to female reproductive tract
	Female: ovaries, uterine tubes, uterus vagina, clitoris, vulva	Produce and maintain egg cells, receive sperm cells, support development of an embryo and function in birth process

IV. Homeostasis and Feedback

C. Positive Feedback and Rapid Change

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1. **Positive feedback** is a **self-amplifying cycle**, such as the increasing output of oxytocin and uterine contractions during labor and childbirth.

   Generally, positive feedback mechanisms produce **quick results.**

2. Some pathogens trigger high fevers that are regulated by positive feedback designed to rid the body of the pathogen.

   Such **positive feedback** can be life-threatening.

   Example: very high temperature ($108^{o}F$ may initiate **runaway**) great distance from the set point

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V. Language of Anatomy; 3 parts *on our website.*
(see Lab-book: Terminology)

Responsible for all! (except whole body transverse sections)

The following are simply a few *review examples*.

I. Anatomical Position

A. **Anatomical position** is a standing position in which the subject is erect, face forward, eyes ahead, arms down to the sides, with palms up.

B. The forearm is **supine** when palms face forward **(anterior)**, and **prone** when they face to the rear **(posterior)**.

V. Language of Anatomy; 3 parts *on our website.*
(see Lab-book: Terminology)

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Responsible for all! (except whole body transverse sections)

The following are simply a few *review examples*.

II. Anatomical Planes

A. A **sagittal** plane divides the person in anatomical position into right and left halves.
Midsagittal passes through the midline,
while **parasagittal** is off to one side.

B. A **frontal** or **coronal** plane divides the standing body into front and back.

C. A **transverse** **or** **cross-sectional plane** divides the body into top and body sections, perpendicular to the long axis.

The End

Anatomical terminology will be included on both Lecture and Lab tests.

This topic will be reviewed during the Lab.