DETAILED LECTURE OUTLINE

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Please note:
- References to textbook headings, figures and tables appear in italics.
- “100 Keys” are designated by an asterisk (*).
- Important vocabulary terms are underlined.
Chapter 1: An Introduction to Anatomy and Physiology

I. An Introduction to Studying the Human Body, p. 4

• *The Fundamentals of Anatomy and Physiology* will familiarize you with the structures and functions of the human body, and the special vocabulary used by health professionals to discuss problems of health and disease.

• Understanding the principles of anatomy and physiology will also help you make important health decisions for yourself and your family.

• Most terms used in anatomy and physiology stem from Greek words because the Greeks were among the first to study this subject 1500 years ago. Learning the roots of these words will help you understand many scientific terms without having to look them up.

• Anatomy describes the structures of the body -- their scientific names, composition, location, and associated structures. Anatomy ("a cutting open") is a plan or map of the body.

• Physiology studies the function of each structure, individually and in combination with other structures (-ology = "the study of").

The Relationship between Anatomy and Physiology, p. 4

• (* All physiological functions are performed by specific anatomical structures. These functions follow the same physical and mechanical principles you see in the world around you.

• For example, an anatomist would look at the structure of a car and describe all of its parts (their measurements, what materials they are made of) and how they are put together to make the whole car. But the physiologist would look at the car’s function (how it moves, turns, stops, and starts) and study the way the car performs (what forces are involved, how it gets it energy; how fast it can go and how much it can carry).

• Anatomy and physiology always work together. As we examine each part of the body, always consider both its structure and its function.
Anatomy, p. 5

- The study of anatomy is divided into 2 major fields:
  1. **Gross anatomy** is the study of large visible structures
  2. **Microscopic anatomy** is the study of structures that are too small to see, such as cells and molecules.

- Gross anatomy, also called **macroscopic anatomy**, is separated into 5 major divisions:
  1. **Surface anatomy** describes surface forms and marks
  2. **Regional anatomy** describes the organization of specific areas of the body such as the head or hand.
  3. **Systemic anatomy** describes groups of organs that function together for a single purpose.
  4. **Developmental anatomy** describes the structural changes in an organism from fertilized egg to maturity. **Embryology** is the anatomical study of early development.
  5. **Clinical anatomy** describes various medical specialties, including medical anatomy (changes that occur during illness), and radiographic anatomy (structures that appear in scans and x-rays).

- Microscopic anatomy is divided into two major divisions:
  1. **Cytology**, the study of cells and their structures.
  2. **Histology**, the study of tissues and their structures.

Physiology, p. 5

- Physiology has many specialties. The 4 basic divisions are:
  1. **Cell physiology**, including chemical and molecular processes within and between cells.
  2. **Special physiology**, the study of specific organs such as the heart.
  3. **Systemic physiology**, the cooperative functions of all the organs in an organ system.
  4. **Pathological physiology**, the effects of diseases on organs and organ systems.

- How do anatomy and physiology work together? When a patient visits his physician, the doctor examines his gross anatomy, his microscopic anatomy (blood tests) and observes the way he functions -- his physiology. These observations are part of the **scientific method**, the basis of all science.
II. Levels of Organization, p. 6

• Our bodies are organized at many different levels.

• The levels of organization of living things, from smallest to largest, are:
  1. **Atoms**, the smallest functional units of matter.
  2. **Molecules**, active chemicals.
  3. **Organelles**, specialized structures within a cell.
  4. **Cells**, the smallest living units.
  5. **Tissues**, a group of similar cells that work together.
  6. **Organs**, two or more tissue types working together.
  7. **Organ systems**, two or more organs working together.
  8. **Organism**, a single individual, including all of the above.

*Figure 1-1*

• Each organizational level depends on all the levels below it. For example:
  1. Specific atoms join together to form protein molecules.
  2. Specific protein molecules come together to form contraction-filament organelles.
  3. Contraction filaments join with other organelles to form a muscle cell.
  4. Many muscle cells group together to form a muscle tissue.
  5. Muscle tissues join with other tissues to become a muscle, a functional organ such as the heart.
  6. The heart works with other organs such as the lungs to supply oxygen to the body, forming an organ system.
  7. All organ systems together make up a single organism such as a human being.

• Any change that occurs at one level -- such as a disease at the cellular level or an injury at the organ or tissue level, affects the whole body at all levels.

• (*) The human body is divided into 11 interdependent, interconnected organ systems. All organ systems work together, and many organs function in more than 1 organ system.

*Figure 1-2*

• These are the 11 organ systems of the human body.
• *Figure 1-2* shows 12 systems because the **reproductive system** is divided into male and female systems.
• Sexual differences in the reproductive system also affect our hormones, which are part of the **endocrine system**.
III. Homeostasis p. 11

• The foundation of all physiology is homeostasis (“staying the same”). When the body does not function within its normal range, organ systems malfunction, resulting in disease.

• (*) As the environment around or within us changes, physiological systems work together to maintain a stable internal environment, the condition of homeostasis. Systems monitor and adjust the volume and composition of body fluids, and keep body temperature within normal limits.

• Two general mechanisms regulate homeostasis:
  1. Autoregulation or intrinsic regulation, an automatic response by a cell, tissue, organ or organ system to a change in its environment.
  2. Extrinsic regulation, changes regulated by the nervous system or endocrine system.
     (a) The nervous system responds to external stimuli (e.g. a hot stove) with short-term nerve responses.
     (b) The endocrine system responds to internal conditions with long-term chemical controls -- hormones.

• A homeostatic regulatory mechanism consists of 3 parts:
  1. Receptors, sensors that respond to a stimulus.
  2. The control center, receives information from sensors and sends out commands.
  3. Effectors, the cell or organ that responds to the control center.

• When the response of an effector opposes the original stimulus, that is called negative feedback because it negates the stimulus.

The Role of Negative Feedback in Homeostasis p. 12

Figure 1-3

• An example of negative feedback is the temperature thermostat in your home.
• Temperature sensors turn the air conditioner off and on to maintain air temperature within a specific, limited range.
**Figure 1-4**

- In the same way, the brain controls normal body-temperature homeostasis by negative feedback.
- When body temperature is too high or too low, the control center instructs an effector to oppose the effects of the stimulus by increasing or decreasing blood flow and sweat production.

**Figure 1-5**

- In the opposite response, *positive feedback*, the effector adds to the initial stimulus instead of negating it, speeding up the process.
- Positive feedback is useful in emergencies, such as speeding up blood clotting.

_Systems Integration, Equilibrium and Homeostasis, p. 14_

- (*) A **state of equilibrium** exists when opposing forces are in balance. When homeostasis is threatened, physiological systems attempt to restore balance. **Failure to maintain internal conditions in a state of equilibrium within normal limits results in disease or death.**

_Table 1-1_

- The body is constantly working, changing and responding to stimuli, a state of **dynamic equilibrium**.
- All body systems must work together (**systems integration**) to maintain homeostasis.
- Body temperature, body fluid composition, body fluid volume, waste product concentration and blood pressure are among the most important internal characteristics which must be maintained in homeostasis.

**IV. Frames of Reference for Anatomical Studies p. 15**

- Standard anatomical terms, based on Greek and Latin words, are used to describe body sections, regions, and relative positions. It is important to learn root words, prefixes and suffixes, as they combine in different forms to create many other words.

_Superficial Anatomy p. 15_

- We begin by creating a mental map of external anatomical landmarks, anatomical regions, and terms for anatomical directions.
(*) Anatomical descriptions refer to standard anatomical position: standing with the hands at the sides, palms facing forward, feet together. (Standard anatomical position lying down -- face up is supine, face down is prone.)
**Figure 1-6**

- Here we see the anatomical terms for some of the superficial or surface characteristics of the body.
- Note that each body part has both an anatomical name and (in parentheses) an adjective used when describing that part.
- Understanding the roots, suffixes, and prefixes of each word will help you memorize each term precisely and use it correctly when referring to body parts.

**Table 1-2**

- The body is divided into 19 major anatomical regions.
- Again, note name of the structure and the corresponding adjective identifying the region.

**Figure 1-7**

- To locate a specific area of interest on the body, such as a growth or injury, requires even more specific descriptions.
- For example, the abdominopelvic area is divided into 4 quadrants, intersecting at the umbilicus, and 9 abdominopelvic regions.
- Clinically, the quadrants are abbreviated to indicate left and right, upper and lower (e.g. RUQ for right, upper quadrant).
- Each quadrant or region is associated with corresponding internal organs.

**Figure 1-8**

- Anatomical directions refer to the patient’s left or right.
- Each direction is paired with an opposite; caudal is the opposite of cranial, anterior is the opposite of posterior.
- A lateral view is from the side.
- An anterior view is from the front.

**Table 1-3**

- Relative directional terms are used to describe the relationship between two locations on the body.
- An area may be nearer to (proximal) or farther away from (distal) the medial or central region of the body.

*Sectional Anatomy, p 18*

**Figure 1-9**

- Moving from exterior references to the internal organs requires a 3-dimensional description, imagined as an axis or plane cut through the body.
- A specific slice along these planes is called a section.
Table 1-4

- The 3 sectional planes are:
  1. **Sagittal plane** (the length of the body, front to back), including the midsagittal or median section and left or right parasagittal sections.
  2. **Frontal plane** (the length of the body, side to side), also called coronal plane, resulting in anterior and posterior portions.
  3. **Transverse plane** (at right angles to the sagittal and frontal planes), also called a transverse section or cross section, resulting in inferior and superior portions.

Body Cavities, p. 19

- Internal compartments called body cavities protect internal organs, hold them in place, and allow them to change size and shape. All the internal organs found within these cavities are called **viscera**.

- Moist layers of connective tissue called **serous membrane** cover both the walls of internal cavities (parietal layer) and the visceral organs themselves (visceral layer), providing a double layer of membrane between an organ and its surroundings. Serous membrane contains a watery lubricant that reduces friction, allowing organs to expand and contract freely.

Figure 1-10

- The ventral body cavity (coelom) is divided by the diaphragm muscle into 2 parts:
  1. A superior thoracic cavity, containing the
     (a) **pleural cavity** (left and right, divided by the mediastinum)
     organs: lungs
     membranes: visceral and parietal pleura
     (b) **pericardial cavity**
     organs: heart
     membranes: visceral and parietal pericardium
  2. and an inferior abdominopelvic cavity, containing the
     (a) **peritoneal cavity**
     membranes: visceral and parietal peritoneum
     (b) **abdominal cavity** (superior peritoneal)
     organs: liver, stomach, spleen, intestine
     (c) **pelvic cavity** (inferior peritoneal)
     organs: intestine, bladder, reproductive organs.
LECTURE SUMMARY

In Chapter 1 we discussed:

• The relationship between structure and function in anatomy and physiology.
• The importance of understanding vocabulary and anatomical terms.
• The roles of different levels of physical organization from molecular to the individual organism.
• The importance of maintaining a stable internal environment through various regulatory mechanisms (homeostasis and feedback).
• The importance of balance and cooperation between organ systems (systems integration and equilibrium).
• How the body is divided and described by physicians.
• An overview of locations and functions of the major components of organ systems.