WELCOME TO A&P I

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The bookstore has a two volume edition specially for SCCC that can be purchased separately.
Vol. 1 for BIO-130 includes a Connect access code for one semester.
Vol. 2 for BIO-132 includes a Connect access code for one semester.
Laboratory manual can only be purchased in the bookstore.

INTRODUCTION

- Anatomy and physiology (A&P) is about human structure and function—the biology of the human body
- We want to know how our body works!
- A&P is a foundation for advanced study in health care, exercise physiology, pathophysiology, and other health-care-related fields
- Considers the historical development and a central concept of physiology—homeostasis

THE SCOPE OF ANATOMY AND PHYSIOLOGY

- Expected Learning Outcomes
  + Define anatomy and physiology and relate them to each other.
  + Describe several ways of studying human anatomy.
  + Define a few sub-disciplines of human physiology.

ANATOMY—THE STUDY OF FORM

- Examining structure of the human body
  + Inspection
  + Palpation
  + Auscultation
  + Percussion
- Cadaver dissection
  + Cutting and separation of tissues to reveal their relationships
- Comparative anatomy
  + Study of more than one species in order to examine structural similarities and differences, and analyze evolutionary trends

Cadaver Dissection
ANATOMY—THE STUDY OF FORM

- Exploratory surgery
  - Open body and take a look inside
- Medical imaging
  - Viewing the inside of the body without surgery
  - Radiology—branch of medicine concerned with imaging
- Gross anatomy
  - Study of structures that can be seen with the naked eye
- Cytology
  - Study of structure and function of cells
- Histology (microscopic anatomy)
  - Examination of cells with microscope
- Ultrastructure
  - View molecular detail under electron microscope
- Histopathology
  - Microscopic examination of tissues for signs of disease

PHYSIOLOGY—THE STUDY OF FUNCTION

- Subdisciplines
  - Neurophysiology (physiology of nervous system)
  - Endocrinology (physiology of hormones)
  - Pathophysiology (mechanisms of disease)
- Comparative physiology
  - Limitations on human experimentation
  - Study of different species to learn about bodily function
    - Animal surgery
    - Animal drug tests
  - Basis for the development of new drugs and medical procedures

LIVING IN A REVOLUTION

- Modern biomedical science
  - Technological enhancements
    - Advances in medical imaging have enhanced our diagnostic ability and life-support strategies
- Genetic Revolution
  - Human genome is finished
  - Gene therapy is being used to treat disease
- Early pioneers were important
  - Established scientific way of thinking
  - Replaced superstition with natural laws

HUMAN STRUCTURE

- Expected Learning Outcomes
  - List the levels of human structure from the most complex to the simplest.
  - Discuss the clinical significance of anatomical variation among humans.

HIERARCHY OF COMPLEXITY

- Organism — a single, complete individual
- Organ System — human body made of 11 organ systems
- Organ — structure composed of two or more tissue types that work together to carry out a particular function
- Tissue — a mass of similar cells and cell products that form discrete region of an organ and performs a specific function
- Cells — the smallest units of an organism that carry out all the basic functions of life
  - Cytology — the study of cells and organelles
- Organelles — microscopic structures in a cell that carry out its individual functions
- Molecules — make up organelles and other cellular components
  - macromolecules — proteins, carbohydrates, fats, DNA
- Atoms — the smallest particles with unique chemical identities
CHARACTERISTICS OF LIFE

- Organization
- Cellular composition
- Metabolism
  - anabolism, catabolism and excretion
- Responsiveness and movement
  - Stimuli
- Homeostasis
- Development
  - differentiation and growth
- Reproduction
- Evolution
  - mutations

ANATOMICAL VARIATION

- No two humans are exactly alike
  - 70% most common structure
  - 30% anatomically variant
  - Variable number of organs
    - Missing muscles, extra vertebrae, renal arteries
  - Variation in organ locations

PHYSIOLOGICAL VARIATION

- Sex, age, diet, weight, physical activity
- Typical physiological values
  + reference man
    - 22 years old, 154 lbs, 68.5 in, light physical activity
    - consumes 2800 kcal/day
  + reference woman
    - 22 years old, 128 lbs, 64.5 in and 2000 kcal/day

HOMEOSTASIS

- Homeostasis - the body’s ability to detect change, activate mechanisms that oppose it, and thereby maintain relatively stable internal conditions
  - state of the body fluctuates (dynamic equilibrium) within limited range around a set point
  - Negative feedback keeps variable close to the set point
  - Loss of homeostatic control causes illness or death

NEGATIVE FEEDBACK LOOP

- Body senses a change and activates mechanisms to reverse it—dynamic equilibrium
- Because feedback mechanisms alter the original changes that triggered them (temperature, for example), they are called feedback loops

NEGATIVE FEEDBACK

- Example: Room temperature does not stay at set point of 68°F— it only averages 68°F
NEGATIVE FEEDBACK

- Example: Brain senses change in blood temperature
  - If too warm, vessels dilate (vasodilation) in the skin and sweating begins (heat-losing mechanism)
  - If too cold, vessels in the skin constrict (vasoconstriction) and shivering begins (heat-gaining mechanism)

HOMEOSTASIS AND NEGATIVE FEEDBACK

- Receptor—senses change in the body (e.g., stretch receptors that monitor blood pressure)
- Integrating (control) center—control center that processes the sensory information, “makes a decision,” and directs the response (e.g., cardiac center of the brain)
- Effector—carries out the final corrective action to restore homeostasis (e.g., cell or organ)

POSITIVE FEEDBACK AND RAPID CHANGE

- During birth, the head of the fetus pushes against the cervix and stimulates its nerve endings
  - Hormone oxytocin is secreted from the pituitary gland
  - Oxytocin travels through the bloodstream to the uterus stimulating it to contract
  - This action pushes the fetus downward toward cervix, thus stimulating the cervix more, causing the positive feedback loop to be repeated

POSITIVE FEEDBACK AND RAPID CHANGE

- Self-amplifying cycle
  - Leads to greater change in the same direction
  - Feedback loop is repeated—change produces more change
- Normal way of producing rapid changes
  - Occurs with childbirth, blood clotting, protein digestion, fever, and generation of nerve signals

POSITIVE FEEDBACK AND RAPID CHANGE

- Fever > 104°F
  - Metabolic rate increases
  - Body produces heat even faster
  - Body temperature continues to rise
  - Further increasing metabolic rate
  - Cycle continues to reinforce itself
  - Becomes fatal at 113°F
REVIEW OF MAJOR THEMES

× Cell Theory
  + All structure and function result from the activity of cells

× Homeostasis
  + The purpose of most normal physiology is to maintain stable conditions within the body

× Evolution
  + The human body is a product of evolution

× Hierarchy of Structure
  + Human structure can be viewed as a series of levels of complexity

× Unity of Form and Function
  + Form and function complement each other; physiology cannot be divorced from anatomy

MEDICAL IMAGING

× Radiography (X-rays)
  + William Roentgen’s discovery in 1885
  + Penetrate tissues to darken photographic film beneath the body
  + Dense tissue appears white
  + Over half of all medical imaging
  + Until 1960s, it was the only method widely available

MEDICAL IMAGING

× Radiopaque substances
  + Injected or swallowed
  + Fills hollow structures
    × Blood vessels
    × Intestinal tract

MEDICAL IMAGING

× Computed tomography (CT scan)
  + Formerly called a CAT scan
  + Low-intensity X-rays and computer analysis
    × Slice-type image
    × Increased sharpness of image

MEDICAL IMAGING

× Positron emission tomography (PET) scan
  + Assesses metabolic state of tissue
  + Distinguished tissues most active at a given moment
  + Mechanics—inject radioactively labeled glucose
    × Positrons and electrons collide
    × Gamma rays given off
    × Detected by sensor
    × Analyzed by computer
    × Image color shows tissues using the most glucose at that moment
    × Damaged tissues appear dark

MEDICAL IMAGING

× Magnetic resonance imaging (MRI)
  + Slice-type image
  + Superior quality to CT scan
  + Best for soft tissue
  + Mechanics
    × Alignment and realignment of hydrogen atoms with magnetic field and radio waves
    × Varying levels of energy given off used by computer to produce an image

Figure 1.13b
MEDICAL IMAGING

× Sonography
  + Second oldest and second most widely used
  + Mechanics
    ✓ High-frequency sound waves echo back from internal organs
  + Avoids harmful X-rays
    ✓ Obstetrics
    ✓ Image not very sharp