Anatomy, Physiology, and Pathology by Body Systems
Good work is not accomplished in haste. —Ancient Chinese Proverb

**HIGHLIGHTS**

Let’s begin with some basic definitions. **Anatomy** is the study of the structure of the body. **Physiology** is the study of the functions of the body.

Anatomy has many subdisciplines. **Cytology** is the microscopic study of the structure of cells. **Histology** is the study of tissue. **Developmental anatomy** is the study of the structure from egg to adult form. **Embryology** is the study of structures from the time of fertilization through the eighth week of gestation. **Gross anatomy** refers to structures that can be studied without the aid of a microscope. **Pathological anatomy** is the study of changes in structures caused by disease. **Regional anatomy** is the study of a specific region of the body, such as the head or lower extremities. **Radiographic anatomy** is the study of the body through x-rays. **Surface anatomy** is the study of the body through observation and palpation. **Systemic anatomy** is the study of specific body systems.

The logical order for learning anatomy is to get to know the chemistry of the body, the body’s cellular structure, and the major systems of the body—their components, their location, and their functions. Massage students left on their own to study may focus on the muscles and bones, ignoring other systems, such as the urinary system or the reproductive system. Don’t! Although it might be difficult to see why massage therapists would need to know how the urinary system or the reproductive system functions, it is on the test.

Physiology also has subdisciplines. These subdisciplines include **neuophysiology**, the study of nerves; **cell physiology**, the study of cell function; and **exercise physiology**, the study of the acute responses and long-term adaptations of the body to physical activity or exercise. In the study of any body system, whenever any structure
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is affected by a pathological condition, the physiology of the structure may be affected as well; therefore, cardiology, endocrinology, and study of other body systems may also cross over into the categories of physiology and pathology. As mentioned, this guide is not meant to be an anatomy text by anyone’s standards. To prepare adequately for your exam, you will want to review the anatomy and physiology textbook you had in school, and be sure you can answer the questions in it.

Another reason to know basic anatomy and physiology is for the benefit of your future clients. Although massage therapists are not allowed to prescribe or diagnose, part of your process is to take a thorough health history of clients before you begin the massage session. The more knowledge you have, the more competent you appear to the client. In my experience, clients often discuss their health problems while they are on the table; some will even ask you questions in the same way they would ask a doctor. Avoid giving unqualified advice. However, if a client asks where the spleen is located or what function it performs, you should be able to answer that question.

Part of your task as a massage therapist is to educate clients within the scope of practice and your own areas of expertise. By offering clients a holistic education that emphasizes the interconnections and integration of theory and practice, you are empowering them and furthering your own goals of creating a successful practice.

Because you have gotten this far in your quest to become a massage therapist, think back to the time before studying any anatomy, and see how much more body awareness you have now than you did before undertaking your massage studies. If you feel a sharp pain somewhere, can you identify its location? Do not diagnose yourself, either; if you are sick, seek help. The point is that it is useful to know where your own gallbladder or Achilles tendon is located. Your own body awareness is vital to your ability to function optimally as a massage therapist. Practicing good body mechanics and ergonomics can extend your career by years. Conversely, working in the wrong way can shorten your career by years! Many therapists have had their careers cut short by hyperextended thumbs, carpal tunnel syndrome, or back pain from working hard instead of working smart.

The examination includes kinesiology, the study of movement; this guide covers kinesiology in Chapter 20.

An Overview of the Human Body

The basic unit of life is the cell. Groups of similar cells combine to form tissue. Tissue types are defined in their respective sections of the body systems in which they occur. A collection of tissues having a specific function is an organ. Organs acting together to perform specific functions are called organ systems, which in turn make up the body, also called an organism. The organs of the body reside in cavities that are named for the organs or regions in which the organs are housed. The abdominal cavity holds the digestive organs and the liver and spleen. The abdominopelvic cavity describes both the abdominal cavity below the diaphragm and the pelvic cavity, which houses the urinary bladder, the rectum, and the internal reproductive organs. The thoracic cavity is protected by the rib cage and contains the vital organs, such as the heart and lungs. The pericardial cavity is the specific cavity within the thoracic cavity that protects the heart. The term ventral cavity describes the combined thoracic and abdominopelvic cavities. The interconnected cranial cavity, which houses the brain, and the spinal cavity, which houses the spinal cord, is described as the dorsal cavity.

The 11 body systems of the human organism are the integumentary system, the skeletal system, the muscular system, the nervous system, the cardiovascular system, the lymphatic system, the respiratory system, the digestive system, the endocrine system, the urinary system, and the reproductive system. In addition, the sensory system
An Overview of Anatomy, Physiology, and Pathology

is contained within several of the other systems. The sense of taste, for example, is part of the digestive system and the nervous system; the sense of touch is part of the integumentary system and the nervous system. The craniosacral system is often referred to as a separate system, but it is actually part of the nervous system. These systems, as well as the chemistry and cellular structure of the body, are discussed in the chapters that follow. For the examination, you will be expected to know the organs, the location, and the functions of all the systems, which are summarized in Table 3.1. For clarity and convenience when studying, at the end of each body system chapter, the pathology of that particular system is reviewed.

<table>
<thead>
<tr>
<th>Table 3.1</th>
<th>Body Systems</th>
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<tbody>
<tr>
<td><strong>System</strong></td>
<td><strong>Components</strong></td>
</tr>
<tr>
<td>Integumentary</td>
<td>Skin and associated structures such as hair, nails, sweat glands, and oil glands</td>
</tr>
<tr>
<td>Skeletal</td>
<td>Bones and joints and associated cartilages</td>
</tr>
<tr>
<td>Muscular</td>
<td>Skeletal muscle tissue, usually attached to bones</td>
</tr>
<tr>
<td>Nervous</td>
<td>Brain, spinal cord, nerves</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>Blood, heart, blood vessels</td>
</tr>
<tr>
<td>Lymphatic</td>
<td>Lymphatic fluid and vessels; also structures that contain lymphocytes (white blood cells), such as spleen, lymph nodes, thymus gland, and tonsils</td>
</tr>
<tr>
<td>Respiratory</td>
<td>Lungs and the airways going into and out of them</td>
</tr>
<tr>
<td>Digestive</td>
<td>GI tract, starting at mouth and includes esophagus, stomach, intestines, and ends at anus; also includes organs that aid digestion, such as salivary glands, liver, pancreas, and gallbladder</td>
</tr>
<tr>
<td>Endocrine</td>
<td>Cells and glands that produce hormones: pancreas, thyroid, pituitary, adrenal, and pineal glands</td>
</tr>
<tr>
<td>Urinary</td>
<td>Kidneys, ureters, urinary bladder, and urethra</td>
</tr>
<tr>
<td>Reproductive</td>
<td>Gonads (testes or ovaries) and associated organs; in females, uterine tubes, uterus, and vagina; in males, epididymis, ductus deferens, prostate gland, and penis</td>
</tr>
</tbody>
</table>
Directional Terminology

While studying the human body, it is vital to know directional terminology. The body can be described by planes of division (Fig. 3.1). The **frontal plane** divides the body into anterior and posterior positions. The frontal plane is also called the **coronal plane**. The **sagittal plane** divides the body into left and right sections; the **midsagittal plane** divides the body into equal left and right sections. The **transverse plane**, which divides the body into upper and lower sections, is also called the **horizontal plane**. The body is also described using anatomical directions as points of reference, as listed.

**Anatomical position**: standing erect, facing forward, arms at side, palms facing forward

- **Anterior (ventral)**: toward the front; in front of
- **Caudal (inferior)**: toward the tail; lower
- **Cephalad**: toward the head; upper
- **Cranial (superior)**: toward the head
- **Deep**: far from the surface
- **Distal**: away from a point of reference; farthest from the trunk
- **Dorsal (posterior)**: toward the back; in back of
- **Inferior (caudal)**: toward the tail; lower
- **Lateral**: away from the midline of the body
- **Medial**: toward the midline of the body
- **Posterior (dorsal)**: toward the back; in back of
- **Proximal**: toward or nearest the trunk or point of reference
- **Superficial**: near the surface
Superior (cranial): toward the head
Ventral (anterior): toward the front; in front of

PATHOLOGY: THE STUDY OF DISEASE

Disease can be defined as an impairment of health that interferes with the body's ability to function normally. Injuries, poisonings, the introduction of foreign substances, and environmental problems do not strictly fall into the category of disease but they cause their own pathologies nonetheless.

As mentioned, each body system chapter contains its own section on pathology. But here we will review some general terminology associated with disease and injury. Let us start by looking at the roots of the word pathology. The suffix –ology means the study of, and the prefix path– means feeling or suffering, from the Greek pathos, meaning disease. There are two main types of pathology. Anatomical pathology focuses on the study of tissues removed from a dead or living person to diagnose disease or cause of death. Clinical pathology is actually a number of subdisciplines that are often referred to as laboratory medicine: chemistry, histology, microbiology, and other specialties. To go even further, pathophysiology is the study of how disease and trauma alter the normal functioning of the body.

To know what is abnormal, you must first know what is normal—not just regarding disease but also regarding simple body function. You may encounter questions on the test pertaining to normal blood pressure, normal body temperature, normal blood pH, and so on.

WHAT YOU NEED TO KNOW

Acute: characterized by sudden onset
Aerobe: an organism that lives in an oxygen environment
Ambulatory: able to walk
Anaerobe: an organism that lives in an oxygen-free environment
Anaplasia: the irregular structural characteristics of a cell that identify it as a malignant cancer cell
Anomaly: an abnormal occurrence, especially in reference to birth defects
Antibiotic: a chemical substance derivable from a mold or bacterium that kills microorganisms and cures infections
Antibody: a protein produced by the body as part of its defense against foreign bacteria or blood cells
Antisepsis: the prevention of sepsis by excluding or destroying microorganisms
Antiseptic: a substance that kills or prohibits the growth of microorganisms
Asepsis: free from germs
Atrophy: a wasting away or decrease in size of a cell, tissue, organ, or part of the body caused by lack of nourishment, inactivity, or loss of nerve supply
Autoimmunity: a situation in which the body produces an immune response against its own organs or tissues, causing severe inflammation and chronic conditions
Bacteria: microorganisms capable of reproduction; some strains cause infection (and some are beneficial)
Benign: referring to a tumor, or abnormal growth, that is not cancerous and does not invade nearby tissues or spread to other parts of the body.

Chronic: slow developing, recurring.

Degenerative: characterized by diminishing capabilities.

Diagnosis: the identification of disease or trauma.

Disease: an impairment of health that interferes with the body's ability to function normally.

Disinfect: the prevention of sepsis by excluding or destroying microorganisms.

Endemic: characterizing a disease that exists in a location or group of people all the time.

Epidemic: a sudden outbreak of disease in numbers much higher than normal.

Etiology: the study of the cause and origin of disease.

Exacerbation: a marked increase in symptoms or severity of disease.

Fungus: a mold, yeast, or mushroom; some fungi are beneficial; some, such as ringworm and athlete's foot, are not.

Hereditary: genetically passed from parent to child.

Hyperplasia: an increase in the number of cells in an organ or tissue.

Idiopathic: of unknown origin.

Infection: the invasion and growth of microorganisms that may cause cellular injury in tissue.

Inflammation: a protective response from the body in response to infection or injury, characterized by swelling, heat, redness, and pain.

Local: affecting only one part.

Malignant: cancerous; a growth with a tendency to invade and destroy nearby tissue and spread to other parts of the body.

Morbid: diseased or sick.

Morbidity: any departure, subjective or objective, from a state of physiological or psychological well-being.

Neoplasm: an abnormal growth of tissue that may be benign or malignant.

Pandemic: an epidemic that affects an expanded demographic area.

Pathogenesis: the origin and development of disease.

Pathology: the study of disease.

Pathophysiology: the study of how disease and/or trauma alters the normal functioning of the body.

Signs: the evidence of disease as perceived by the doctor.

Sterilize: to destroy bacteria and other microorganisms.

Symptoms: the subjective evidence of disease as perceived by the patient.

Syndrome: a group of signs or symptoms characteristic of a particular disease or abnormal condition.

Systemic: affecting the whole body.

Trauma: a physical injury or wound caused by an external force of violence, which may cause death or permanent disability. Trauma is also used to describe severe emotional or psychological shock or distress.

Virulence: the ability of an organism to cause disease.

Virus: an intracellular parasite that causes disease.
Practice Questions

1. The basic unit of life is the ______ .
   a. Atom
   b. Cell
   c. Molecule
   d. Organelle

2. The study of the structure of the body is called _____.
   a. Kinesiology
   b. Neurobiology
   c. Pathology
   d. Anatomy

3. Cephalad means ______.
   a. Toward the feet
   b. In the middle of the torso
   c. Toward the head
   d. Toward the pelvis

4. Antibodies are molecules of ______ involved in the immune response of the body.
   a. Carbohydrates
   b. Lipids
   c. Antibiotics
   d. Proteins

5. Etiology is the study of _____.
   a. The cause of disease
   b. The sex organs
   c. Insects
   d. Emotions

6. The condition characterized by swelling, heat, redness, and pain is known as ______.
   a. Chicken pox
   b. Fibromyalgia
   c. Cushing syndrome
   d. Inflammation

7. In the Western anatomical position, the human body is: ______.
   a. Standing erect, facing forward, arms at side, palms facing forward
   b. Standing erect, facing forward, arms straight out, palms facing forward
   c. Standing erect, facing forward, arms at side, palms facing backward
   d. Standing erect, facing forward, arms bent at elbow, palms facing up

TIPS FOR PASSING

A full-length mirror is one of the most useful reference tools in studying for the examination. Stand in front of the mirror and draw the planes and directions in the air until you have them memorized. As you go through the next chapters, do the same for the bones and muscles. Touch them and say the names out loud several times.

AFFIRMATION

I persevere and finish any task that I undertake.
8. The pericardial cavity is located within the _____.
   a. Abdominopelvic cavity
   b. Cranial cavity
   c. Spinal cavity
   d. Thoracic cavity

9. The study of the tissues of the body is referred to as _____.
   a. Histology
   b. Phrenology
   c. Molecular biology
   d. Physiology

10. A short, severe episode is referred to as _____.
    a. Chronic
    b. Acute
    c. Terminal
    d. Minute

11. The ability of an organism to cause disease is referred to as _____.
    a. Hyperplasia
    b. Pandemic
    c. Virulence
    d. Asepsis

12. The human body is an _____.
    a. Anaerobe
    b. Organism
    c. Organ system
    d. Anomaly

13. The increase in symptoms or severity of a condition is a(n) _____.
    a. Endemic
    b. Inflammation
    c. Exacerbation
    d. Malignancy

14. The _____ plane divides the body into upper and lower sections.
    a. Transverse
    b. Frontal
    c. Coronal
    d. Sagittal

15. A disease of unknown origin is referred to as _____.
    a. Idiopathic
    b. Pandemic
    c. Ideologic
    d. Epidemic