As Per PCI Regulations
First Year B. Pharm. • Semester-II

A PRACTICAL BOOK OF

HUMAN ANATOMY AND PHYSIOLOGY-II

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Dr. ANTESH KUMAR JHA
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NIRALI PRAKASHAN
ADVANCEMENT OF KNOWLEDGE

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Semester II

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Preface

Welcome to Practical Book **Human Anatomy and Physiology - II**. We created this Practical Book with several goals in mind: accessibility, customization, and student engagement—helping students reach high levels of academic in a simplest way. We observed that students of pharmacy had a difficult time to understanding the complex language and reading big bulky books of pharmacy for their limited syllabus. They require a book that was simple and easy to follow. It's encouraging us to write this practical book for pharmacy students as per new PCI syllabus.

This book deals with the basic systems of the body with reference to anatomy & physiology, and we have attempted to achieve maximum coverage in the simplest way.

Some important features of the book given below:

- Exactly as per syllabus prescribed by Pharmacy Council of India.
- Easy to follow, step wise, self explanatory and student's friendly approach.
- Well labeled diagram.

We have written all Practicals of Human Anatomy and Physiology with the major intention: To help students learn basic anatomy and physiology. We chose to present the major concepts that provide a current understanding of the subject. We present the information in a readable form that seeks to explain in such a way that concepts may be truly understood rather than simply memorized. Written explanations of structures and functions are coupled with illustrations that reinforce the concepts and explanations.

We would like to thanks all our colleagues for their valuable suggestion to write this book in a simplest way for Pharmacy students in a respective prescribed syllabus.

We are thankful to Shri. Dineshbhai Furia and Shri. Jignesh Furia of Nirali Prakashan, Pune and Staff of Nirali Prakashan for bringing out nicely printed book.

Dr. Mahesh Prasad
Dr. Antesh Kumar Jha
Mr. Ritesh Kumar Srivastav

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Syllabus & Contents

Practical Physiology is complimentary to the theoretical discussions in Physiology. Practicals allow the verification of physiological processes discussed in theory classes through experiments on living tissue, intact animals or normal human beings. This is helpful for developing an insight on the subject.

Object 1

Study of the Integumentary and Special Senses using Specimen and Models

Theory:

The integumentary system consists of the skin, hair, nails, glands, and nerves. Its main function is to act as a barrier to protect the body from the outside world. It also retains body fluids, protect against disease, eliminate waste products and regulate body temperature. In order to do these things, the integumentary system works with all the other systems of our body, each of which has a role to play in maintaining the internal conditions that a human body needs to function properly.

Functions of the Integumentary System:

The integumentary system has many functions, most of which are involved in protecting and regulating our body's internal functions in a variety of ways:

- Protects the body's internal living tissues and organs.
- Protects against invasion by infectious organisms.
- Protects the body from dehydration.
- Protects the body against abrupt changes in temperature.
- Helps dispose of waste materials.
- Acts as a receptor for touch, pressure, pain, heat, and cold.
- Stores water and fat.

1. SKIN

Epidermis:

The epidermis is the most superficial layer of the skin that covers almost the entire body surface. The epidermis rests upon and protects the deeper and thicker dermis layer of the skin. Structurally, the epidermis is only about a tenth of a millimeter thick but is made of 40 to 50 rows of stacked squamous epithelial cells. The epidermis is an avascular region of the body, meaning that it does not contain any blood or blood vessels. The cells of the epidermis receive all of their nutrients via diffusion of fluids from the dermis.

Dermis:

The dermis is the deep layer of the skin found under the epidermis. The dermis is mostly made of dense irregular connective tissue along with nervous tissue, blood and blood vessels. The dermis is much thicker than the epidermis and gives the skin its strength and elasticity. Within the dermis there are two distinct regions: the papillary layer and the reticular layer.

Hypodermis:

Deep to the dermis is a layer of loose connective tissues known as the hypodermis, subcutis or subcutaneous tissue. The hypodermis serves as the flexible connection between the skin and the underlying muscles and bones as well as a fat storage area.

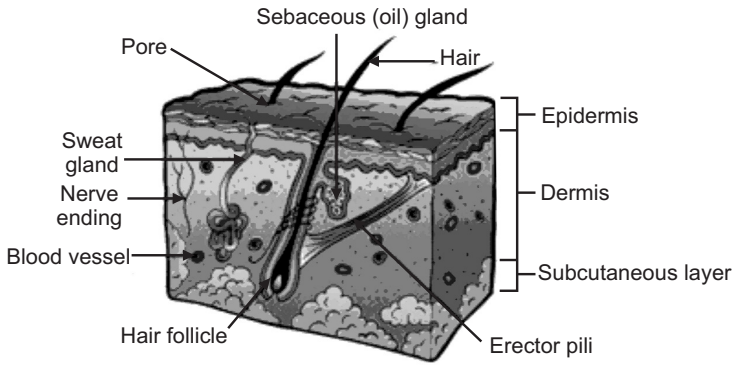

Fig. 1.1

Hair:

Hair is an accessory organ of the skin made of columns of tightly packed dead keratinocytes found in most regions of the body. The few hairless parts of the body include the palmar surface of the hands, plantar surface of the feet, lips, labia minora and glans penis. Hair helps to protect the body from UV radiation by preventing sunlight from striking the skin. Hair also insulates the body by trapping warm air around the skin.

The structure of hair can be broken down into 3 major parts: the follicle, root and shaft. The hair follicle is a depression of epidermal cells deep into the dermis.

Nails:

Nails are accessory organs of the skin made of sheets of hardened keratinocytes and found on the distal ends of the fingers and toes. Fingernails and toenails reinforce and protect the end of the digits and are used for scraping and manipulating small objects. There are 3 main parts of a nail: the root, body and free edge. The nail root is the portion of the nail found under the surface of the skin. The nail body is the visible external portion of the nail. The free edge is the distal end portion of the nail that has grown beyond the end of the finger or toe.

Sudoriferous Glands:

It is exocrine glands found in the dermis of the skin and commonly known as sweat glands. There are two major types of sudoriferous glands: eccrine sweat glands and apocrine

sweat glands. **Eccrine sweat glands** are found in almost every region of the skin and produce a secretion of water and sodium chloride. Eccrine sweat is delivered via a duct to the surface of the skin and is used to lower the body's temperature through evaporative cooling.

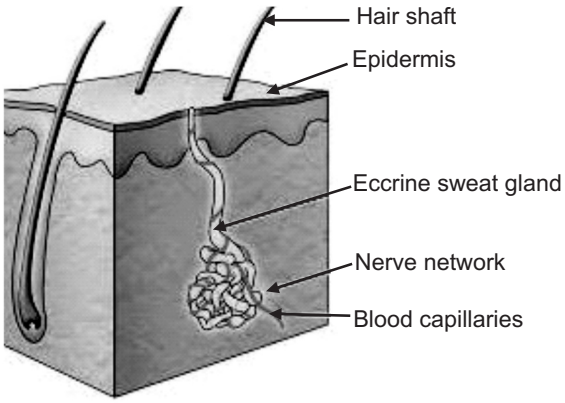

Fig. 1.2

Sebaceous Glands:

It is exocrine glands found in the dermis of the skin that produce an oily secretion known as sebum. Sebaceous glands are found in every part of the skin except for the thick skin of the palms of the hands and soles of the feet. Sebum is produced in the sebaceous glands and carried through ducts to the surface of the skin or to hair follicles. Sebum acts to waterproof and increase the elasticity of the skin. Sebum also lubricates and protects the cuticles of hairs as they pass through the follicles to the exterior of the body.

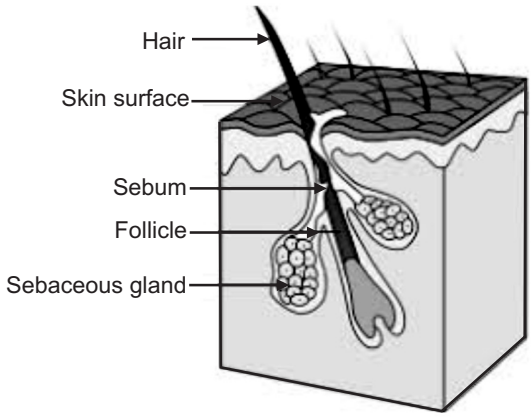

Fig. 1.3

Ceruminous Glands:

It is special exocrine glands found only in the dermis of the ear canals. Ceruminous glands produce a waxy secretion known as cerumen to protect the ear canals and lubricate the **eardrum**. Cerumen protects the ears by trapping foreign material such as dust and

airborne pathogens that enter the **ear canal**. Cerumen is made continuously and slowly pushes older cerumen outward toward the exterior of the ear canal where it falls out of the ear or is manually removed.

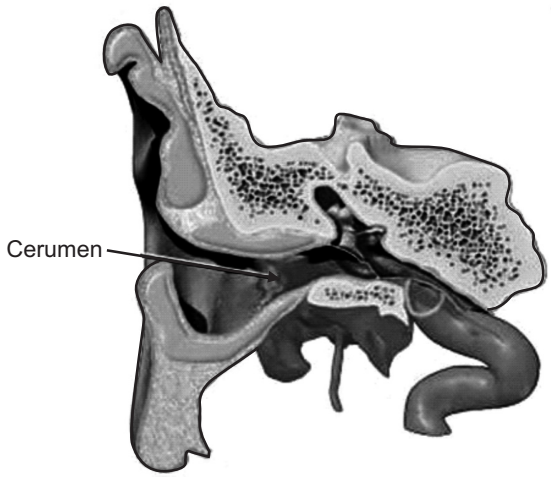

Fig. 1.4

Special Senses:

The special senses (smell, taste, eye, ear and balance) play a significant role serving as exteroreceptors or antennas, which collect and transmit external sensations from the environment to the brain. The following discussions about the special senses are presented.

Sensation:

General sense of Awareness to changes:

1. Detect changes in the external environment.
2. Respond to the changes.
3. Maintain homeostasis.

Characteristics of Sensation:

1. Projection (area of origin of sensation).
2. Intensity: debt of sensation (light, medium, heavy).
3. Contrast (comparison between intensities).
4. Adaptation (voluntary suppression of sensation).
5. Memory of sensation: Memory of sensation stored even after sensation.

Types of Sensations:

1. **Cutaneous Sensation:**
   - Contains free nerve endings for pain, touch and pressure.

- Protects the skin and provide info about temperature (heat and cold), pain, touch and pressure (covered nerved endings).
- Sensory areas in parietal lobes.
- Receptors for touch and pressure are encapsulated (i.e. they are covered).

2. Muscle Sensation:

- Provide awareness of our muscles.
- Stretch receptors in muscles; sensory nerves located in the parietal lobes.
- Cerebellum coordinate voluntary motion.

3. Taste Sensation:

- Chemoreceptors located in the taste buds of the tongue.
- They detect chemicals present in food and in saliva.
- Sweet, sour, bitter and salty are four basic tastes.
- Pathways; Facial and Glossopharyngeal nerves in temporal and parietal lobes.

4. Smell Sensation:

- Chemoreceptors in the upper nasal cavities detect volatile (vaporized) chemicals.
- Pathways: Olfactory nerves to olfactory bulbs connected to olfactory areas in the temporal lobe.
- Smell and taste sensations are synergistic.

5. Hunger and Thirst

- Receptors in the hypothalamus.
- Detect changes in nutrient levels and project to the stomach.
- Osmoreceptors detect changes in body water concentration (water-salt ratios). Thirst projected to the mouth/pharynx.

Sensory Areas in the Brain:

The lobes of the brain participate in recognizing and interpretation of sensations. These areas are:

- **Parietal lobe:** Generalized sensations (cutaneous sensations) muscular sensations are received and interpreted in this area. It also functions in speech comprehension and verbal articulation of thought and emotions.
- **Temporal lobe:** Contains auditory centers that receive sensory neurons from the cochlea of the ear. It also interprets some sensory experiences and stores information of both auditory and visual sensations.

- **Occipital lobe:** Concerned mainly with interpreting visual sensations. It integrates eye movements by directing and focusing the eye. It is also responsible for visual association that is, relating visual images with past experiences.
- **Frontal lobe:** The frontal lobe initiates voluntary motor sensations for the movement of skeletal muscles. It analyzes sensory experiences and provide information pertaining to the individual. In addition it is also involved in sensation related to emotions, reasoning, memory, judgment, planning and speaking.

2. SMELL SENSATION (OLFACTION)

- Olfaction involves chemical receptors which detect and transmit sensations of vaporizing chemicals emitted into the nasal passages.
- Olfaction or the sense of smell involves chemicals. The receptors for smell are the olfactory hair cells located on the roof of each nasal cavity in a path of cells called the **olfactory epithelium** or membrane.
- Odours or scents chemical vapors. **Chemoreceptor cells** (neurons) perceive the chemicals as they vaporize.
- Air-bone chemical molecules bind to the olfactory hairs or cilia which extend from dendrites of these neurons on the watery membrane surface.
- Impulses are sent to the **olfactory bulb** (a structure whose neurons synapse with the dendrites of the receptor cells.
- Axons of the neurons of the olfactory bulb travel to the brain by way of the olfactory nerve (Olfactory nerve 1) to olfactory areas of the temporal lobes.
- Humans can distinguish tens of thousands of odors however, the receptors for smell are more sensitive in animals than in humans.
- Receptors for smell are sensitive, act quickly within a short period (about a minute) and adapt very quickly.
- Smell influences our sense of taste and vice versa.

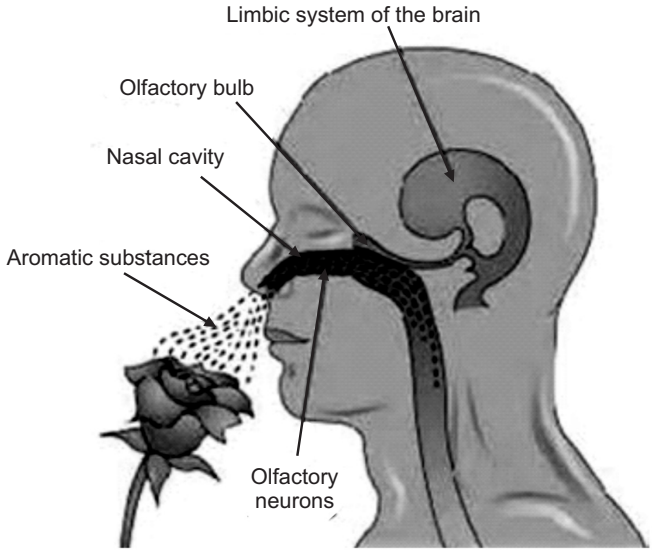

Fig. 1.5

3. TASTE SENSATION (GUSTATION)

- Taste buds are the receptors for taste and respond to chemicals dissolved in food.
- Taste sensation work with smell sensation or they enhance each other.
- The receptors for taste are located in specialized organs called **taste buds** which are numerous on the surface of the epithelium covering the tongue in humans and mamals. The taste buds are also located on the **papillae** on the upper surface of the tongue and also on the **roof** of the **oral cavity**, the **pharynx** and **larynx**.
- There are three kinds of papillae: **vallate** (back of tongue), **fungiform** (middle) and **filiform** (front or apex of tongue).
  - Vallate: largest but least abundant, and "V-shaped".
  - Fungiform: knob-like appearance; present on top and sides of tongue.
  - Filiform: short, threadlike; most numerous.
- Vallate and fungiform are involved in the perception of all four primary taste: sweet, sour, bitter and salty. Filiform the most abundant is not involved in perception of taste.
- Sweet taste is perceived on the tip of the tongue; salty taste occurs especially on the sides and most of the tongue; sour taste occurs on the sides and bitter taste on the back.
- Sourness is related to concentration of hydrogen ions in food (acids). Organic molecules taste sweet.

- Taste buds (contain receptor cells) are **chemoreceptors** stimulated by chemicals present in foods we eat. The chemicals dissolve in the saliva and enter the taste pores of the taste buds.
- The taste pores contain **taste hairs**, part of the receptors of the taste buds. Chemicals dissolved in water bind to the receptor hairs and stimulate the receptor cells. The cells in turn stimulate the dendrites of the sensory nerve (7 and 9). Impulses are then transmitted to the **taste centers** (parietal-temporal lobes) in the **cerebral cortex**.
- Taste buds respond to all four primary flavors but are generally preferentially responsive to one

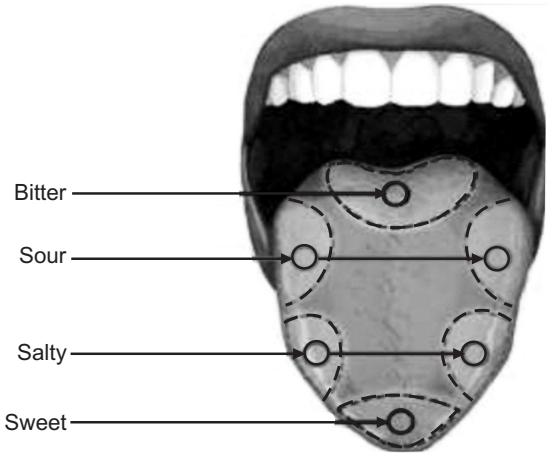

Fig. 1.6

4. VISUAL SENSATION

- The eye transmits visual sensations of light (photosensations) and color sensations of all images. Transmission of these sensations occurs through photoreceptors in the eye.
- Eyelids and eyelashes; keep dust out.
- Lacrimal glands produce tears, cleans the eyes.
- Eyeballs: protected by the bony socket.
- Six extrinsic muscles move the eyeballs; Nerves #s 3, 4 and 6 cranial nerves stimulate the eyes. All six muscles originate from the back of the eye orbit and insert on the surface of the eye.

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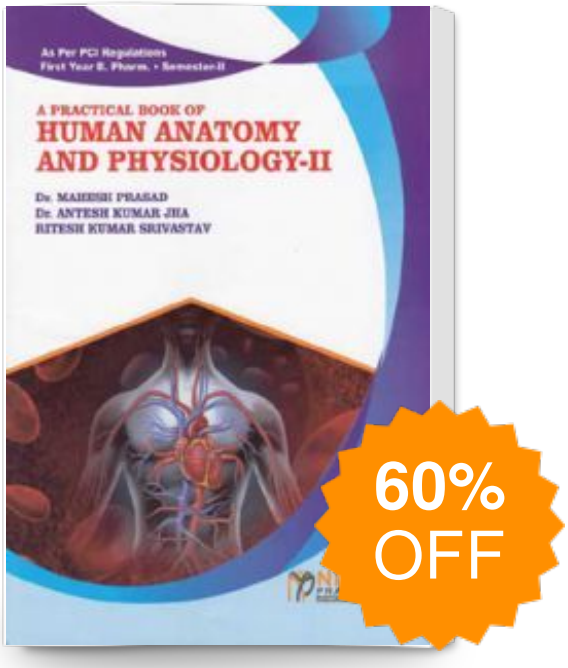

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