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A Textbook of Applied Psychology for Nurses

As per the Revised INC Syllabus for BSc Nursing

Sheela Upendra



Semester I

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2

CHAPTER

Biological Basis of Behavior—Introduction

Learning Outcome(s)

- Recall definitions of behavior, brain, genetics, and other standard terms
- Relate the body mind relationship
- Describe the inheritance of behavior
- Elaborate psychology and sensation—sensory process
- Learn brain and behavior
- Develop an understanding of the biological and psychological basis of human behavior

Key Terms: Behavior, Mind, Genetics, Inheritance, Sensory Process

The chapter will delve into the following topics:

- Body-mind relationship
- Genetics and behavior
- Inheritance of behavior
- Brain and behavior
- Psychology and sensation—sensory process: normal and abnormal

BODY-MIND RELATIONSHIP

Psychology studies human behavior, which involves both the body and the mind. Mind and body are interrelated and interact with each other. Because the body and mind are interdependent, they cannot function alone, and this is known as the integrated response or body-mind relationship **(Fig. 2.1)**.

The body and mind act on or influence each other. Therefore, the mind is believed to be a bodily function and not separate from the body.

Our body's capabilities and health problems impact our mind and mental health, just as our mind—which consists of our perception, ideas, emotions, and motivation—affects our body's functioning and physical health. Thus, there is a relationship between physical health and mental health, both affect each other.

Mind is regarded as a body function; it does not exist apart from the body. It is the sum total of various mental processes such as observing, knowing, thinking, reasoning, feeling, imagining, remembering, judging and others.

The mind-body relationship is an essential component of holistic medicine, a healthcare philosophy that seeks to treat the whole person, not just their symptoms.



Fig. 2.1: A healthy mind exists in a healthy body and vice versa.

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Body and its Function

The head, trunk, hands, and feet make up the body. It has five sensory organs: eye, skin, ears, nose, and tongue. It includes functionary systems like the Respiratory, blood-circulatory, skeletal, digestive, endocrine, and excretory systems.

Mind and its Function

Mind is not reality—a fictitious construction. The mind should not be mistaken for the brain or the central nervous system because it is not located anywhere in our body. The mind is a collective name given to our mental processes and activities. It culminates various cognitive activities, including reasoning, thinking, observing, analyzing, learning, and more **(Fig. 2.3)**. The functioning of our mind improves or develops with growing age. The mind develops at different ages, such as throughout childhood, adolescence, and old age **(Fig. 2.2)**.

Level of Functioning of Mind

Refer **Figure 2.2**.

The Regular Operation of Our Minds

Typically, our mind's regular operation occurs at the conscious level. Three mental processes are involved **(Fig. 2.3)**.

Mind's Influence on Body

- Cortical or brain processes are closely related to mental activities.
- Peptic ulcers, coronary heart disease, high blood pressure, ulcerative colitis, and neurosis are all caused by emotional problems.
- Physical tiredness can result from intense focus and deep thought (reasoning).
- The motivation in the mind is the starting point for all physical and motor activity. Unconscious desires and conflicts cause numerous bodily symptoms and neurological diseases (conversion disorders).
- Emotions like fear, jealousy, anger and worry causes irritability, depression, insomnia, headaches, and more.

Body's Influence on the Mind

- Severe pain impairs one's ability to concentrate
- Depression is caused by chronic sickness
- Malfunctioning of endocrine organs has an impact on mental health like hypothyroidism causes lethargy, and hyperthyroidism leads to excitement.
- Septic tonsils and a sore throat might impair concentration

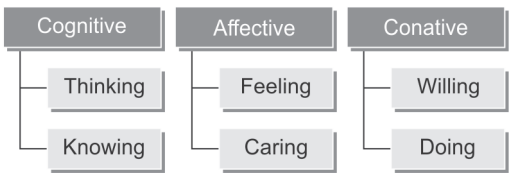

Fig. 2.3: Regular operation of the mind at the conscious level.

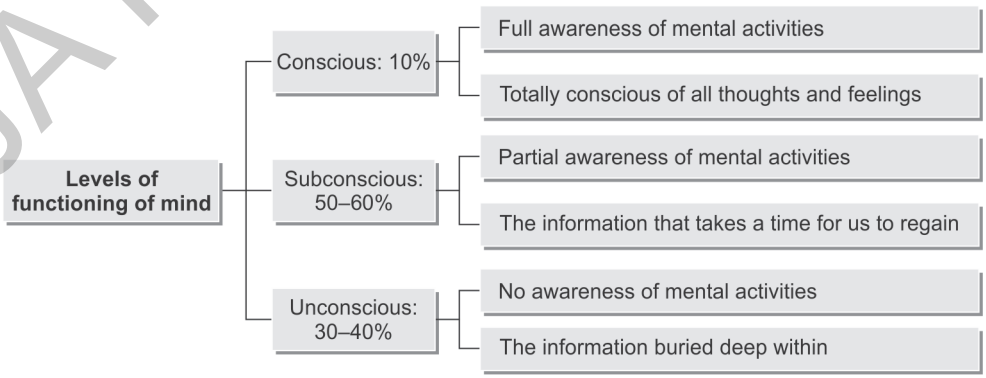

Fig. 2.2: Level of functioning of mind.

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- Endocrine gland dysfunction may substantially influence one's personality, resulting in lethargy, nervous tension, etc.
- Physical exhaustion lowers motivation, interest, and focus and impacts mood.
- Learning and perception are impaired when sensory organs are not working correctly.
- Fatigue impairs mental function
- Excitation of the mind is caused by elevated blood pressure.
- Sudden emotions upset the mind
- Digestive system problems like constipation and indigestion make individuals moody, irritable, unpleasant, etc.
- Brain injuries impact many psychological processes.
- A properly developed brain results in better development of intellectual functioning.

GENETICS AND BEHAVIOR (FIG. 2.4)

Genetics is the study of the genetic makeup of organisms and how this influences physical and behavioral characteristics. It refers to how living things pass on traits from generation to generation.

Genotype: Our unique genetic makeup. The genetic makeup, as distinguished from the physical appearance, of an organism or a group of organisms.

Phenotype: Outward expression of a trait. Genetic makeup and environmental influences determine an organism's observable physical or biochemical characteristics.

Behavior is the series of actions or events that show how things usually happen or are done via an organism.

Heredity: Heredity is "the total of inborn individual traits."

- There are 23(46) pairs of chromosomes in the fertilized ovum, with half coming from the father and the other half from the mother. There are several genes on each chromosome, and it appears that these genes determine characteristics. One gene (DNA, RNA) may affect several traits or attributes, or multiple genes may work together to decide one trait.
- Twins who are dizygotic or fraternal differ from one another due to separate pairs of germ cells. Since identical or monozygotic twins have the same set of genes, they are entirely similar. The dominant or recessive character of genes and their combination has a role in determining phenotypes.

Chromosomes: Pairs of thread-like bodies that contain genes.

Deoxyribonucleic acid (DNA): Organic molecule arranged in a double helix. It contains the "code of life."

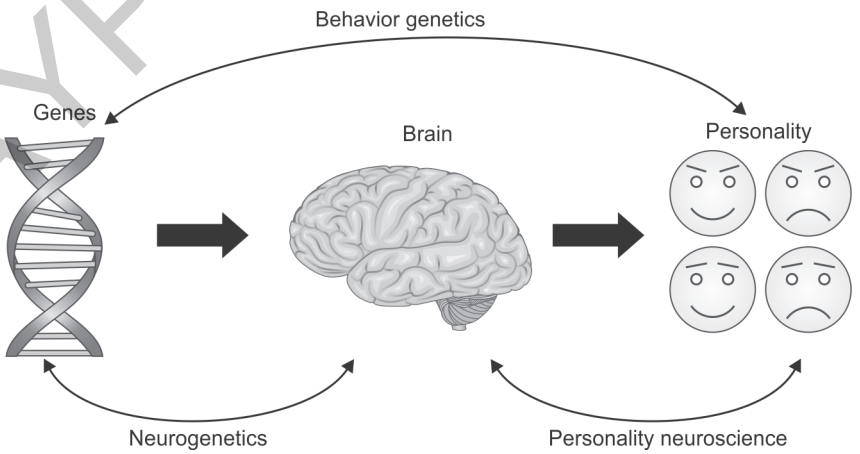

Fig. 2.4: Genetic and behavior.

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Environment: Covers the social, moral, economic, political, physical, and intellectual factors that influence the development of the individual from time to time.

Boring, Langfield, and Weld: The environment is everything that affects the individual except his genes.

Woodworth: Environment covers all the outside factors that have acted on the individual since he began life.

- The child inherits the traits and characteristics of his parents and ancestors through genes at the time of conception, so whatever he possesses at conception is a result of heredity. After conception, his development results from the interaction between his hereditary characteristics and environment. During fertilization, when sperm attaches to an egg, environmental factors exert their effect on and shape the developing human being. Consequently, not only is the event immediately after delivery crucial, but so is the process that begins in the mother's womb after conception. There are essentially two main categories of environmental factors.
- Environmental forces can be divided into two significant heads:
  1. **Internal environment:** From conception to his birth in the womb of the mother. The embryo receives nutrition through the bloodstream of its mother. The mother's physical and mental health, as well as her behaviors, attitudes, and interests, all make up the inner environment that influences an individual's growth and development.
  2. **External environment:** The environment the infant is exposed to after birth is entirely external.

     It can be further divided into three subparts:

     A. **Physical environment:** The environment comprises non-living elements, including water, air, buildings, soil, climate, heat, light, radiation, noise, etc. These have an impact on a child's developing body and mind. So, providing a decent home and neighborhood for the child's good physical and mental health is necessary.

     B. **Biological environment:** It relates to the living elements that make up the outside environment of a person, including plants, animals, insects, germs, and viruses. The kid must be allowed to develop in a decent, healthy biological environment. The child should avoid the disease-carrying germs, bacteria, and viruses.

     C. **Psychosocial (socio-cultural) environment:** It comprises cultural norms, values, practices, attitudes, and morals as well as religion, education, occupation, and social and political structures, among other things. This environment includes parents, family members, friends, classmates, neighbors, instructors, mass communication and recreation centers, and libraries.

Therefore, it is always advisable to consider sources like one's heredity and environmental factors to determine the behavior or development of specific personality traits.

Behavioral genetics is concerned with the genetic transmission of traits that give rise to behavior patterns, or it's the study of the relative influence of genetics and environment on behavior.

Studying genes and behavior in psychology helps us understand what genes are and how they relate to human behavior. Behavioral genetics studies an organism's genes' impact on its behavior **(Fig. 2.7)**.

Behavior genetics is a branch of study that evaluates the role of genetics in the behavior of living organisms, which often includes the Nature vs. Nurture debate.

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Gene-Environment Correlations: Nature or Nurture?

Nature versus Nurture

"Nature versus nurture" is a psychological term related to whether heredity or the environment most impacts human psychological development (behavior, habits, intelligence, personality, sexuality, aggressive tendencies, and so on) **(Table 2.1)**.

Understanding differences in human behavior has traditionally been made from two perspectives**. The nature approach** emphasizes genes and inborn characteristics.

The nurture approach emphasizes learning, experience, and the environment.

Nurture Requires Nature

Refer **Figure 2.5**.

"Nature" Interacts with "Nurture"

Refer **Figure 2.6**.

Inheritance of Behavior

Inheritance is the process by which genetic information is passed on from parent to child. This is why members of the same family tend to have similar characteristics.

The term inheritance refers to causal transmission processes between parents and offspring that account for heredity and the mechanisms responsible for them. Hereditary

Table 2.1: Nature versus nurture.

Nature	*Nurture*
Nature refers to an individual's innate qualities (nativism)	Nurture refers to personal experiences (i.e., empiricism or behaviorism)
Example: Genes will always influence physical appearance and personality	**Example:** Nurture refers to childhood or how you were brought up
Factors: Genetic and biological influences	**Factors:** Social, economic, and environmental influences
Our genetics determine our behavior. Our personality traits and skill sets are hardwired into us from birth (nature)	When we grow up, the things we encounter, and the places we live in all have an impact on how we act. We are "nurtured" to behave in specific ways
People inherit personality traits, intellect, and preferences from their parents in addition to physical characteristics	The home and town we grew up in and how we were raised by our parents, teachers, and friends are environmental variables that shape who we are
"Studies show that we inherit genes related to certain personality traits"	"Often identical twins grow up to have very different personalities and preferences"
Nature and Nurture BOTH help shape our behavior	

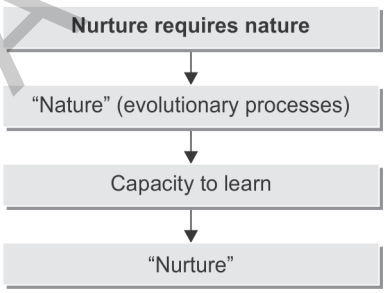

Fig. 2.5: Nurture requires nature.

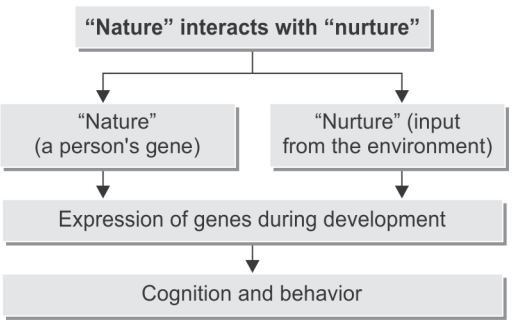

Fig. 2.6: "Nature" interacts with "nurture".

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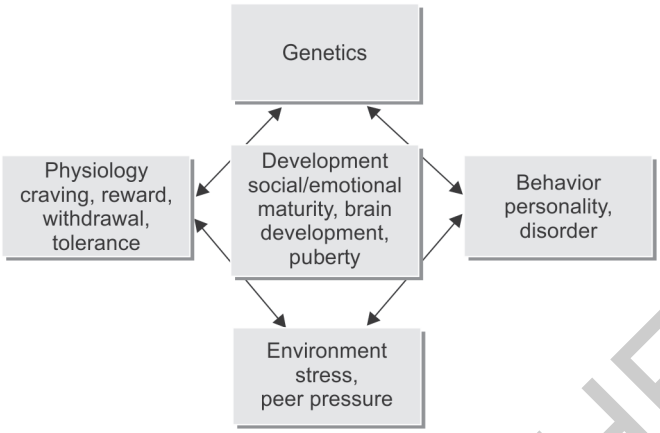

Fig. 2.7: Genetic and environmental effect on a person's behavior.

traits may be traced back to genes, as Gregory Mendel proved. Transmitted structurally unchanged from generation to generation, genes are the fundamental building blocks of heredity. Genes often exist in pairs and are arranged in a certain way along chromosomes. Part of a chromosome that contains deoxyribonucleic acid (DNA) is called a gene. Ribonucleic acid (RNA) synthesis is modeled after DNA synthesis.

A person's inherited behaviors are those that they get from their parents or grandparents. People often don't consider their genes to influence their behavior, even if they govern physical traits like hair texture, eye color, and height. The reason is, unlike innate traits, most behaviors are picked up via experience.

How does one's genetic inheritance work?

- The majority of human cells are diploid, meaning they have two sets of 23 chromosomes.
- As an exception to this rule, gametes, which are sex cells (eggs and sperm), only contain one pair of chromosomes apiece.
- Fertilization is the process by which sperm and egg cells join to create the initial cell of a new organism.
- This cell, the fertilized egg, has two sets of 23 chromosomes (diploid) and all the necessary instructions to make more cells and, eventually, a full person.
- Every cell in the new person contains genetic material from both parents.
- The shared traits of family members, such as average height, eye and hair color, nose and ear shape, and hair and eye color, make it clear that genetic material is passed down.
- If there is a mutation in the genetic material, this can also be passed on from parent to child. Due to this, illnesses might run in families.

Pattern of Inheritance

Trait: A variation of a particular character.

Genotype

- Genetic constitution
- A person's genotype is a summary of their specific genetic composition. The whole genome or just a single gene with all its variant forms may be described.
- An individual's phenotype is affected by their genetics.
- The combination of two or more alleles for a specific trait.

Phenotype

- Physical appearance
- The phenotype is a description of the physical characteristics of an organism
- The trait which is expresses

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- An individual's genotype influences most phenotypes, although environment can also play a role (nature versus nurture).

Single locus inheritance: A continuous distribution of a genetic character can sometimes be due to two alleles at one locus.

Polygenic inheritance: When two or more genes affect a single character. In humans, height and skin color have a polygenic inheritance.

BRAIN AND BEHAVIOR

The relationship between the brain and behavior seems to be the successor of the famous Cartesian mind-body dualism, where the brain is the physical/biological component and behavior is the mental/psychological aspect **(Fig. 2.8)**.

Central nervous system: Brain and spinal cord, command central for the rest of the nervous system.

Peripheral nervous system: The peripheral nervous system is the part that runs through the rest of the body (everything except the brain and spinal cord). It is divided into the somatic nervous system and the autonomic nervous system.

The **somatic nervous system** is the part of the peripheral nervous system that controls the skeletal muscles.; it consists primarily of sensory neurons and motor neurons.

Sensory neurons: Input from the environment is received by sensory neurons, which then transmit this information to the brain.

Motor neurons: Neurons that are responsible for generating movement are known as motor neurons.

Autonomic nervous system: The internal organs and glands are controlled by the autonomic nervous system, which is further split into the sympathetic and parasympathetic branches **(Fig. 2.9)**.

A number of physiological reactions are triggered by the **sympathetic nervous system**, which heightens awareness and prepares the body for action. As soon as the body detects danger, it goes into what is known as the **"fight or flight"** response, a series of reactions designed to either confront the threat head-on or flee from it.

The **parasympathetic nervous system** is the division of the autonomic nervous system that calms the body down.

Nerves: A network of neurons connected by axons and other connective tissues is called a nerve. Activated when a nerve impulse travels

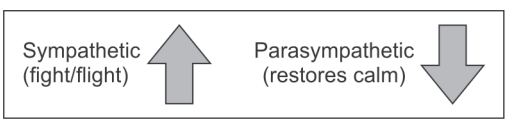

Fig. 2.9: Sympathetic and parasympathetic divisions.

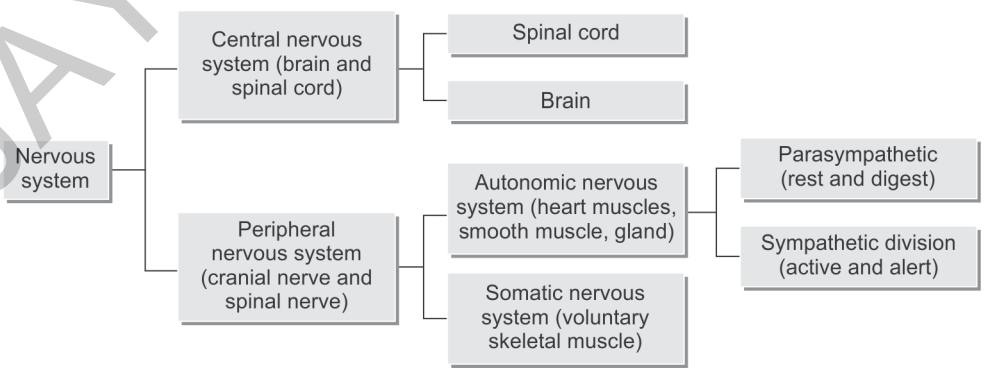

Fig. 2.8: The nervous system.

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from a receptor to the central nervous system and then back to an effector, such as a muscle or gland.

Neuron

A neuron is the fundamental building block of all neurons in the nervous system. Neurons are specialized cells that use electrochemical signaling for processing and transmission of information **(Fig. 2.10)**.

Dendrites are branchlike extensions that arise from the cell body; they receive signals from other neurons, muscles, or sense organs and pass these signals to the cell body.

Cell body/soma: This is a relatively large, egg-shaped structure that provides fuel, manufactures chemicals, and is the control center of the neuron, containing the nucleus.

Axon is a single threadlike structure that extends from and carries signals away from the cell body to neighboring neurons, organs, or muscles. Axons can be several feet long.

Myelin sheath: An insulating layer around an axon prevents inference from electrical signals generated in adjacent axons.

Synapse: is an infinitely small space (20–30 billionths of a meter) that exists between an end bulb and its adjacent body organ (heart), muscles (head), or cell body.

End bulbs, situated at the ends of the axon's branches, and which resemble tiny bubbles. The neurotransmitters stored in each end bulb serve as a means of communication between nearby cells.

Types of Neurons

Sensory neurons: Neurons located in receptor organs (skin, eyes, ears). Its function is to receive incoming stimuli from the environment.

Motor neurons: Neurons located near effectors (muscles and glands). Its function is to carry impulses to initiate a response.

Interneurons: Neurons that relay messages between other neurons, e.g., between sensory and motor neurons (found most often in the brain and spinal cord).

Communication within neurons is electrical: The axon carries an electrical signal throughout its length. This kind of electrical impulse is known as an **"action potential."**

Communication between neurons is chemical: The terminal buttons release chemicals called neurotransmitters into the synaptic gap when an electrical impulse reaches them **(Table 2.2 and Fig. 2.11)**. These neurotransmitters attach to neurons in the area via their receptor sites. Neurotransmitters are like keys: they "fit in" to specific receptor locations. These neurotransmitters are "taken back up" into the terminal buttons of neurons through reuptake.

Depending on the neurotransmitter released into the synapse, it either excites or inhibits the next neuron from firing. Some neurotransmitters do both!

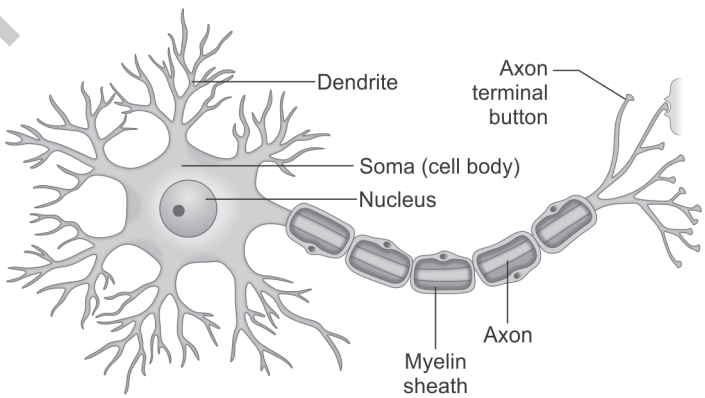

Fig. 2.10: Basic neuron structure.

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Table 2.2: Neurotransmitters.

Neurotransmitter	*Action*	*Excitatory/↑ ↓/Inhibitory*
Acetylcholine	Activates the parasympathetic nervous system and causes movement	↑ ↓
Dopamine	Promotes happiness and improves memory function	↑
GABA (gamma-aminobutyric acid)	Reduces anxiety, integrates sensory input	↓
Serotonin	Mood, aggressiveness, and sexual response are among the several behaviors it influences	↓
Glutamate	Increases arousal and learning	↑
Glycine	It participates in a variety of motor and sensory functions. Function as a co-agonist	↓
Aspartate	increases the likelihood of depolarization in the postsynaptic membrane	↑
Nor epinephrine	It affects mood and sympathetic nervous system activity	↑ ↓

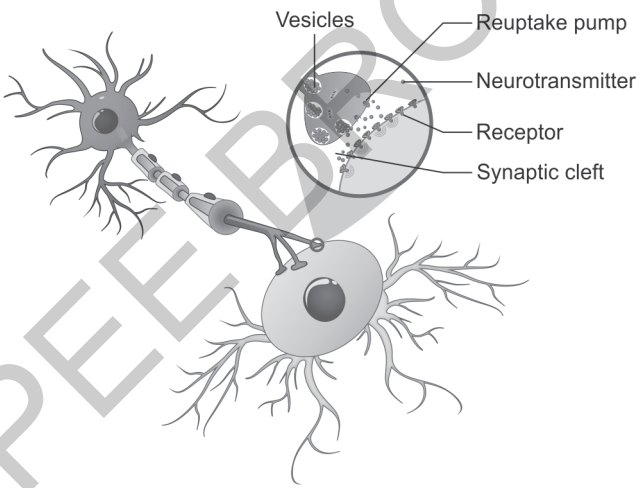

Fig. 2.11: Neurotransmitter.

Brain Areas

Our ideas, emotions, and actions are the result of a complex interplay between the many regions of the human brain **(Fig. 2.12)**. Blood carries oxygen and nutrition to the brain, which is further protected by the skull's bones and three layers of membranes. The fluid surrounding the brain acts as a shock absorber. The brain is divided into three sections:

1. The hindbrain
2. The midbrain
3. The forebrain

The hindbrain is the brain structure most closely related to basic survival functions. It is located at the base of the skull. As the spinal cord reaches into the skull, it begins to widen **(Fig. 2.13)**.

Medulla: It is the broader area at the very base of the brain; it is essentially the first brain part distinct from the spinal cord. The medulla transmits signals between the spinal cord and higher brain levels. It controls vital functions such as heart rate, blood pressure, and breathing.

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Fig. 2.12: Brain areas.

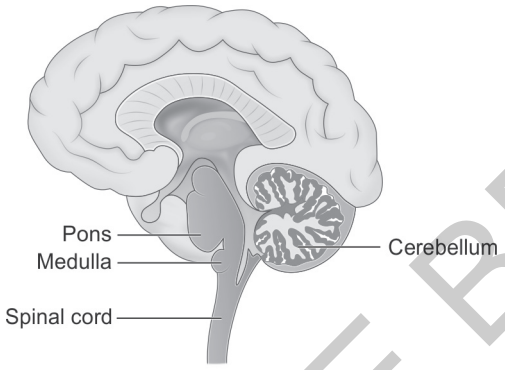

Fig. 2.13: Hindbrain structures.

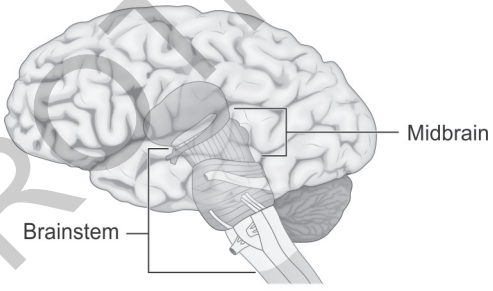

Fig. 2.14: Midbrain.

Pons: An additional, more prominently bulging region lies just above the medulla; it acts as a connector, relaying signals from the brain to the spinal cord. Regulates bodily movement, attention, sleep, and alertness.

Cerebellum is the part that looks like a miniature brain (cerebellum means "little brain"). Nestled between the medulla and pons lies the cerebellum. Although it only accounts for 10% of the brain's volume, the cerebellum is home to over 50% of the neurons. The cerebellum aids in learning and motor coordination, as well as in maintaining proper posture and balance. Because it normalizes complicated thought processes, the cerebellum seems to play a significant role in the acquisition of higher-order cognitive abilities like reasoning.

Midbrain: Brain structures closely related to processing sensory information and movements **(Fig. 2.14)**. The midbrain is the second region of the brain, and it is located above the brainstem. Visual and auditory processing both engage the midbrain. Eye movement is also controlled by it. Its position between the forebrain and hindbrain is defined.

Reticular activating system (RAS): It controls vision and hearing, and keeps people alert.

Cerebral cortex: The cerebral cortex is the brain's outermost layer and is responsible for thought and individuality. Including vision, language, emotions, and complicated motor function.

Corpus callosum: This is the corpus callosum, which joins the two cerebral hemispheres. Facilitates communication between the left and right sides of the brain.

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Tegmentum: It is involved in movement coordination and alertness.

Reticular formation: This brain region is essential for attention and arousal; it is stretched between the medulla and the pons.

Forebrain: Brain structures responsible for higher-level cognitive processes, emotion regulation, and sensory data processing make up what is known as the forebrain **(Fig. 2.15)**. Its position is at the crown of the head. Therefore, the forebrain generates the activities that set humans apart from other animals.

Thalamus: Sensory input is relayed via the thalamus. It lies above the midbrain, reticular formation, and pons, and has an oval shape. The thalamus actually has two lobes, one on each side of the brain, yet many people mistakenly believe that because the brain is shown in a side view.

"Hypothalamus" literally means "below thalamus" and refers to the area just below the thalamus. Proximity to the pituitary gland allows the hypothalamus to collaborate closely with it. The pituitary gland secretes hormones into the circulation in response to neural impulses sent by the brain. The hormones make their way to various organs and glands throughout the body, where they trigger the production of other hormones. The hypothalamus is an essential organ for motivation in addition to regulating core body temperature, nutritional storage, hunger, thirst, and activity.

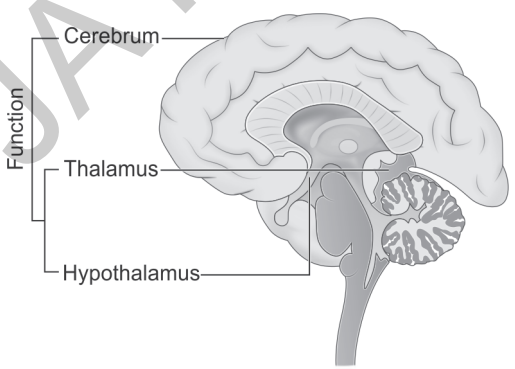

Fig. 2.15: Forebrain.

Amygdala: The amygdala is a small almond-shaped structure (amygdala is Latin for almond) located outside and just below the thalamus (one on each side). The amygdala is probably the most critical brain part of emotions. The amygdala is also vital for distinguishing different emotions and enhancing our memory of emotional episodes.

Hippocampus: Outside and slightly below the thalamus is where lies the hippocampus. Each side of the brain has a hippocampus. It seems that the hippocampus helps us remember things by rearranging previously stored memories so they may be remembered for longer periods and also lets us store fresh explicit memories.

Limbic system: The hypothalamus, amygdala, hippocampus, and a few other structures create the limbic system, which encircles the thalamus on both sides. Emotion, memory, and the regulation of appetite, libido, and aggressiveness are the primary tasks of the intricate limbic system, which also contributes to many others. The limbic system is involved in feeling, expressing, and identifying emotions. Some are critical for information acquisition, storage, and retrieval; others.

Cerebrum is the brain's most significant part, about 70% of weight. The surface is wrinkled with ridges and valleys. The cortex plays a crucial role in many behaviors, including perception, movement, and our higher intellectual functions such as memory and reasoning. It is also better developed in humans than in other animals. Thus, it deserves a bit more attention.

Lobes of the Cerebral Cortex

The cortex is subdivided into four main lobes: Frontal lobe, parietal lobe, occipital lobe, and temporal lobe **(Fig. 2.16)**. The lobes are separated by some of the most prominent wrinkles in the cortex.

- **The frontal lobe:** Language, speaking, logic, impulse control, and voluntary movement are all functions of the frontal lobe. A key component of the brain responsible

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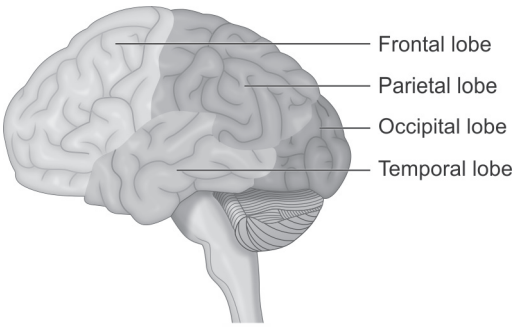

Fig. 2.16: Lobes of the cerebral cortex.

for movement control, the primary motor cortex, is located in the posterior region of the frontal lobe. Both the left and right sides of the body are controlled by the motor cortex located in the left frontal lobe. A region of the brain responsible for making sounds is located in the left frontal lobe; this is **Broca's area**. The **prefrontal cortex** is located in the front region of the frontal lobe. Involved with working memory, it is the hub of several thinking and judgment operations.

- **The parietal lobe:** Sensation of touch, knowledge of one's limbs' whereabouts, and overall spatial awareness are primarily processed by the parietal lobe. Its location is one level below the frontal lobe. Primary sensory cortex describes the area immediately anterior to the parietal lobe. This region of the brain is responsible for our pervasive feeling of touch. For the processing of sensory data and the formulation of motor plans, the region immediately below the sensory cortex—the parietal lobe—is crucial.
- **The occipital lobe:** The occipital lobe is located at the rear end of the cerebral cortex. It is located directly behind the parietal lobe, which contains the **primary visual cortex**. Out of all the cerebral cortex lobes, the occipital lobe is the only one engaged in a single function. In the occipital lobe, visual processing takes place exclusively.
- The temporal lobe is located on the side of the cerebral cortex, opposite the occipital lobe and below the parietal lobe. The area near the top of the temporal lobe is the **primary auditory cortex**, which processes sounds. **Wernicke's area** is for speech production, together with Broca's area. Wernicke's area is connected to Broca's by a large group of nerve fibers called the **arcuate fasciculus**.

SPINAL CORD

Starting at the base of the brain stem and extending almost all the way to the base of the spine, the spinal cord is a delicate, lengthy tube-like tissue. Connecting the brain to the rest of the body, the spinal cord is made up of bundles of nerve axons that create pathways **(Fig. 2.17)**.

Column of nerves about as thick as a thumb. Protected by the bones of the spine. Transmits messages between the brain and the muscles and the glands throughout the body. Spinal reflex is a simple, automatic response to something.

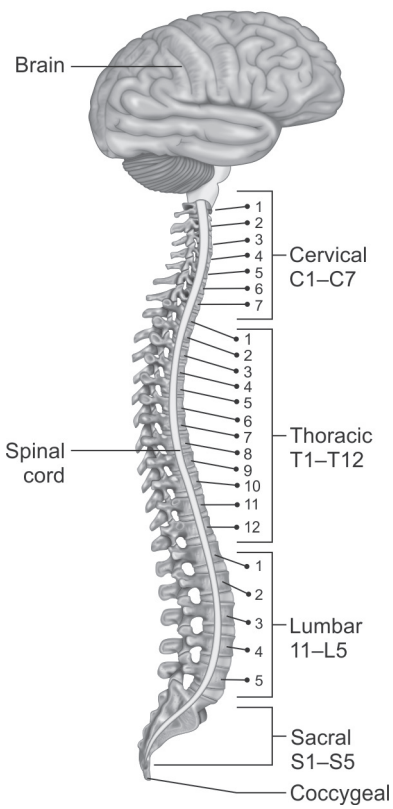

Fig. 2.17: Spinal cord.

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The spinal cord contains nerve cell circuits within itself that control coordinated movements such as walking, swimming, and urinating.

PSYCHOLOGY AND SENSATION

In response to external cues, sensory receptors in the skin, nose, ears, and eyes generate a neural impulse in the brain, a phenomenon known as sensation. The five senses—sight, smell, taste, hearing and touch—are responsible for translating mechanical energy into electrical impulses that the brain processes as feeling.

This process is known as transduction, or the conversion of one form of energy into another.

When we experience feeling, it's because our bodies have extraordinary sensors that allow us to take in data about our surroundings. The psychological process of making sense of data collected by the senses is known as perception. The two processes are combined.

The minimum amount of physical energy needed to produce a sensory experience is called the "absolute threshold."

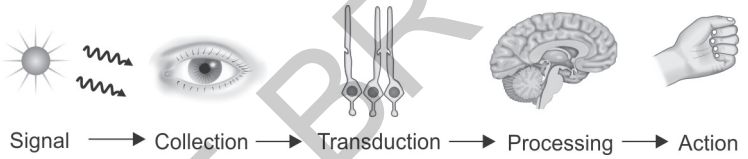
Fundamental Human Senses

See **Table 2.3**.

Sensory Process—Normal and Abnormal

Sensory processing, sometimes called 'sensory integration,' is a term that refers to the way the brain receives messages from the sensory receptors and turns them into appropriate motor and behavioral responses **(Fig. 2.18)**.

Humans can perceive various types of sensations, and this information determines our motor movement. We become aware of the world through sensation. Sensations can also protect the body by registering, e.g., when the environment is cold or warm. All the daily activities carry associations with sensations.



Broadly, these sensations can be classified into two categories:

1. **General sensations** include touch, pain, temperature, proprioception, and pressure.
2. **Special senses** include vision, hearing, taste, and smell, which convey sensations to the brain through cranial nerves.

The sensory receptors that extend out from the CNS and establish communication with various sections of the body make up the peripheral nervous system. When exposed to environmental changes or stimuli, these receptors release a signal. Sense organs, which consist of several cells and sensory receptors, are responsible for the functioning of the senses of sight, sound, balance, odor, and taste.

For each of the five senses, there are specialized neural pathways and an associated brain area dedicated to processing information gathered by that sense.

Vision: Vision is extremely important for all of us.

Structures of the Eye

The sclera is the "white part" of the eye that provides protection and structure. The cornea is a specialized, transparent portion of the sclera through which light enters. The iris is

Table 2.3: Fundamental human senses.

Sense	*Sense organs*	*Stimulus*	*Receptors*	*Sensation*
Sight	Eyes	Light waves	Photoreceptor	Colors, patterns, textures
Hearing	Ear	Sound waves	Auditory receptors	Noise, tones, music
Touch	Skin	External touch	Taste receptors	Touch, cold, warmth, pain
Smell	Nose	Volatile materials	Olfactory receptors	Odors
Taste	Tongue	Soluble materials	Various receptors	Sweet, salty, bitter

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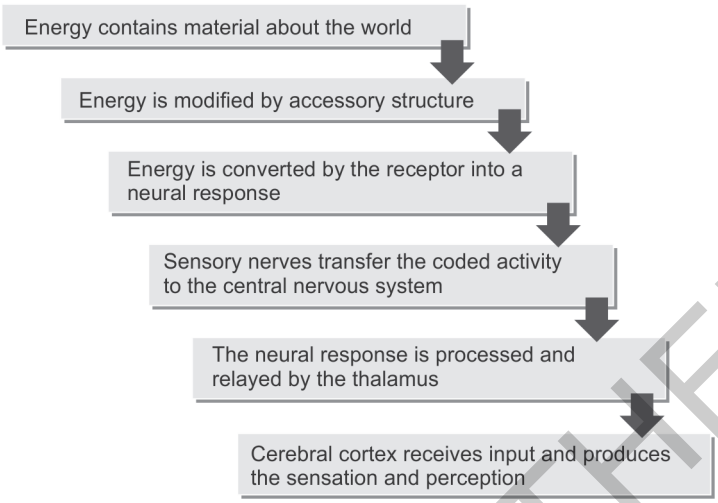

Fig. 2.18: Sensation process.

the pigmented muscle that gives the eye its color and regulates pupil size. The muscles of the iris control the amount of light entering the eye. Opening in the iris is a pupil. The lens is a transparent, shape-changing convex structure focusing images on the retina. The lens must accommodate to focus on a specific object. The ciliary muscles relax for objects in the distance and constrict, which thickens the lens, for close items. Retina contains two types of photoreceptors—rods and cones—that transduce light energy to electrochemical energy **(Fig. 2.19)**.

- Rods are located primarily in the retina's periphery. Capable of receiving light energy in low light. Not involved with color perception.
- Cones are concentrated in the middle of the retina in the fovea and involved with color perception in bright light.
- Both rods and cones synapse with bipolar cells, which synapse with ganglion cells, which form the optic nerve.
- The blind spot is where the optic nerve connects to the eye and contains neither rods nor cones.

Color blindness: Color perception varies from person to person. A color deficit may be inherited by certain individuals. A person who is colorblind cannot see differences between colors, either partially or completely.

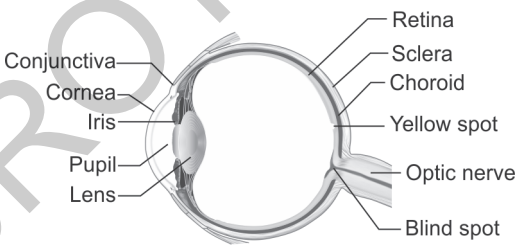

Fig. 2.19: Structure of eye.

Differentiating between green and red is a challenge for most colorblind persons.

What we perceive as sight is really the result of the visual system's processing of environmental light. Color and brightness are imparted by the light's wavelengths. Our night vision isn't up to par with what we have during the day, but it does allow us to see something.

The visual system begins with the eyes. The visual receptors in the retina, called rods and cones, are located at the rear of the eye. The eyes guide light, regulate its amount of entry, and focus it. Daytime and brightly lit environments are ideal for cones, which give color vision and excellent visual acuity. We can see in low light, but in grayscale, thanks to the many more rods in our eyes.

After being transformed into a nerve impulse by the eye's optic nerve, the primary visual cortex is responsible for processing the information that the human eye perceives

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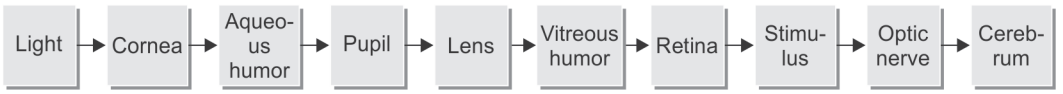

Fig. 2.20: Sense of light.

as light **(Fig. 2.20)**. Hue (color), brightness, and saturation are the three characteristics of light that human senses can identify. A greater saturation level indicates that there is less white light mixed with the color, which may be seen as purity of color.

Vision plays an important role in balance and movement. Consequently, functional activities may be significantly affected by any deficiencies.

Hypermetropia (long sight): Due to shortened eyeball image form behind the retina. Cannot see nearby objects clearly.

Myopia (short sight): Due to an elongated eyeball, images form in front of the retina. Cannot see distant objects clearly.

Night blindness: Due to deficiency of Vitamin A, no clear vision in dim light.

Color blindness: Due to the defect of cone cells, which detect colors, a person with this defect cannot distinguish green and red colors.

Hearing: Hearing is equally important in our daily lives. For humans, it's the primary means of seeing and conveying information **(Fig. 2.21)**.

External ear: Ear pinna, ear canal, eardrum/tympanum.

Middle ear: Malleus, incus, stapes, Eustachian tube.

Internal ear: Cochlea, vestibule (saccule, utricle), semicircular canal, auditory nerve.

Pinna: External (visible) flap of skin and cartilage.

Auditory canal: Part of the outer ear, along with the pinna, leads to the tympanic membrane.

The tympanic membrane, also called the eardrum, is a structure that divides the middle ear from the outer ear and vibrates in response to sound.

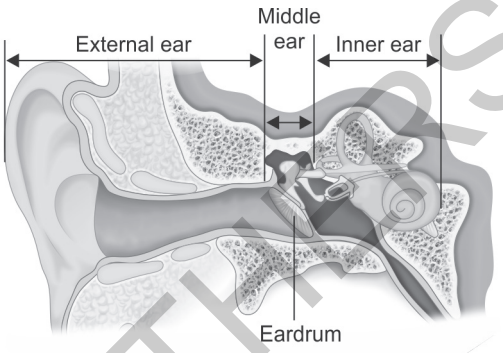

Fig. 2.21: Structure of ear.

Pitch: The frequency of a sound determines its pitch, which may be either high or low. The difference between high and low pitch is the frequency range of the audible sound.

Loudness: A sound's amplitude is a measure of its loudness or physical intensity. A larger amplitude of a sound wave is perceived as louder than a smaller one. Decibels (dB) are units used to measure the loudness of sound.

Timbre: The term "timbre" refers to the intricate character of a sound wave. The noise we hear is really a combination of several different frequencies that aren't necessarily connected to one another.

The **auditory system** also deals with waves, but in this case, these **waves** are transmitted through the air and detected as frequency, amplitude, and timbre (pitch, loudness, purity of tone). Ear organs engage in **mechanoreception**, which involves the transformation of mechanical vibration into neurological signals that the brain assembles into our perception of sound. An exposed ear canal is known as the **pinna**. This organ directs acoustic waves toward the eardrum and auditory canal. The sound then travels from this point to the inner ear's snail-shaped **cochlea** via the bones of the middle ear. It is at this point that the vibration is converted into

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what we perceive as sound via the receptors on our hair cells **(Fig. 2.22)**.

- The inability to hear is called deafness or hearing impairment.
- The sense of hearing is of paramount importance in spoken communication, and hearing loss can lead to problems with communication, decreased awareness of environmental clues, and even social isolation.

Smell (olfaction): The sense of smell involves a sequence of bio-chemical activities that trigger neural impulses. The ability to detect odors is a function of the olfactory system. The nasal cavity contains specific sensory cells that mediate this sensation. Odoration happens in humans when molecules of odorant attach to certain locations on the nasal cavity's olfactory receptors. The presence of odor is detected by these receptors. The glomerulus is where they converge, and it is from there that messages are sent to the brain's olfactory cortex **(Figs. 2.23 and 2.24)**.

The inability to smell is called **anosmia**.

Taste (Gustation)

Refers to the ability to detect substances such as food, certain minerals, poisons, etc. A person's sense of flavor, which includes both taste and smell, is sometimes mistaken

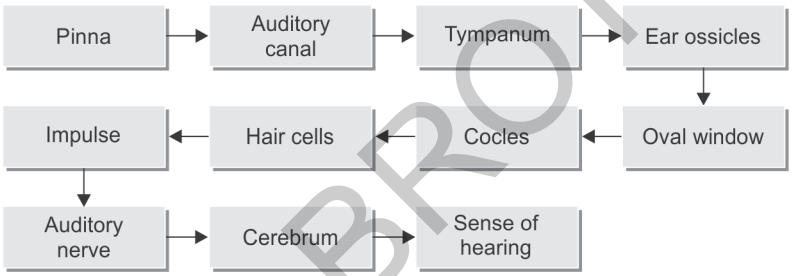

Fig. 2.22: Process sense of hearing.

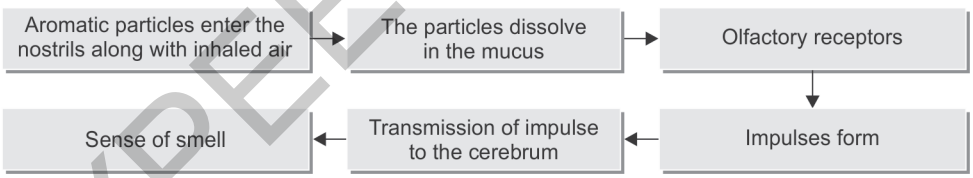

Fig. 2.23: Process of sense of smell.

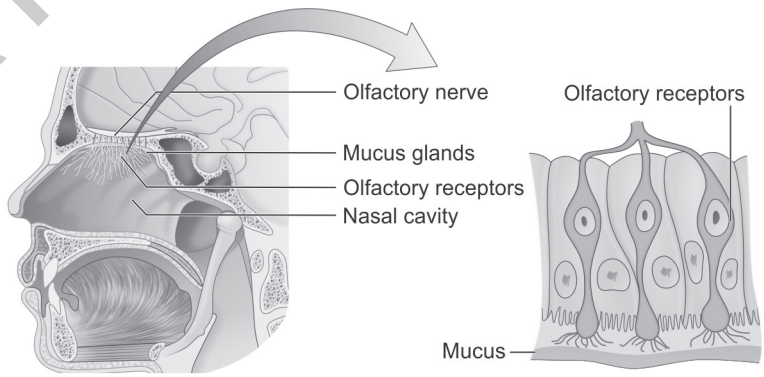

Fig. 2.24: Structure of nose.

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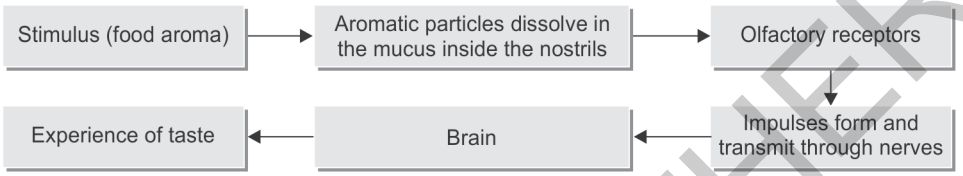
for their sense of taste. Olfactory, textural, thermal, and gustatory factors all influence flavor **(Figs. 2.25 and 2.26)**.

The taste receptor cells are gathered in the taste buds on the upper side of the tongue. It is via these taste receptors that we perceive salty and sweetness. Sweet, sour, bitter, and salty are the only four main flavors. Damage to taste receptors may occur from things like smoking, acidity, or heavy alcohol use; nevertheless, new taste receptors are produced every few days, and it is very unusual to have a permanent loss of flavor.

- The inability to taste is called **ageusia.**
- Taste sensitivity develops in infancy but decreases in old age.



Touch

Our skin contains nerve endings that are stimulated by contact with external objects, and they produce sensations of cold, warmth, or pressure. The sensitivity to pressure is maximum on the face, tongue and hands, and less on our backs. Touch plays a vital role in human relations and emotions. Touch is a perception resulting from the activation of neural receptors in the skin, including hair follicles, tongue, throat, and mucosa **(Fig. 2.27)**.

Heat, cold, touch, pressure and pain are felt by our skin. When these receptors are stimulated, impulses reach in the cerebrum for perception.

- **Tactile anesthesia** is the inability or partial inability to feel any object or surface that is touched.
- Nerve injury may cause paraesthesia, which is a tingling, prickling, or numbing feeling on the skin. It can be either transient or permanent.

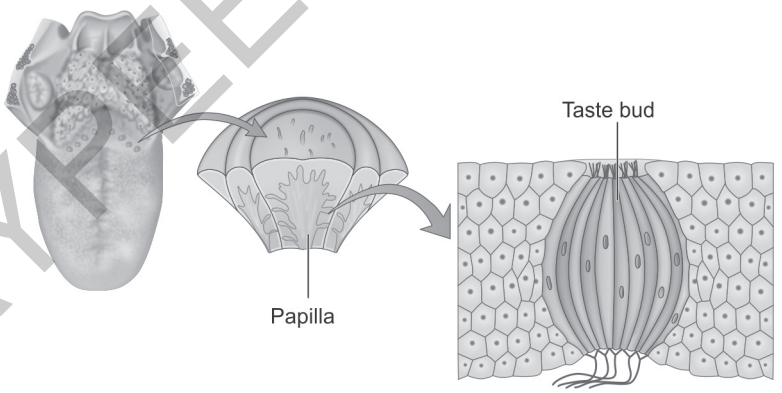


Fig. 2.25: Structure of tongue.

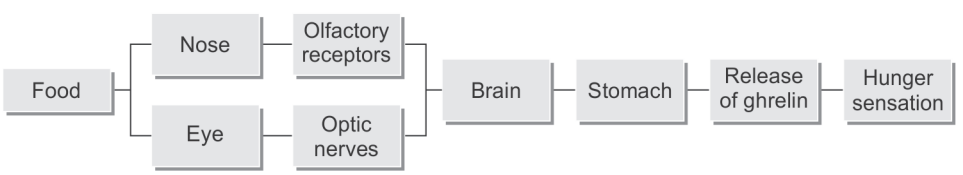


Fig. 2.26: Process of sense of taste.

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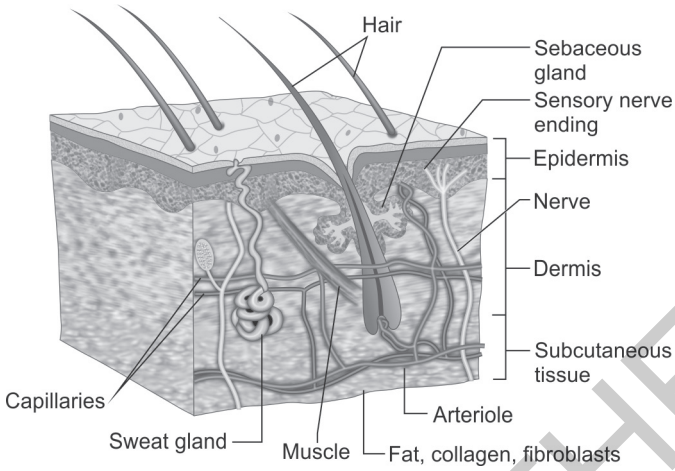

Fig. 2.27: Structure of skin.

SUMMARY

- The mind-body relationship is an important component of holistic medicine, which is a healthcare philosophy that seeks to treat the whole person, not just their symptoms.
- The mind develops at different ages, such as throughout childhood, adolescence, and old age. Mind functions at the conscious, subconscious and unconscious level
- Genotype is unique genetic makeup. The genetic makeup, as distinguished from the physical appearance, of an organism or a group of organisms.
- Phenotype is the outward expression of a trait. The observable physical or biochemical characteristics of an organism are determined by both genetic makeup and environmental influences.
- Behavioral genetics is concerned with the genetic transmission of traits that give rise to patterns of behavior, or it's the study of the relative influence of genetics and environment on behavior.
- "Nature versus nurture" is a psychology term related to whether heredity or the environment most impacts human psychological development
- Inherited behaviors are behaviors that are passed down genetically. Genes control things like type and color of hair type, eye color, and height—but individuals don't usually think of them as controlling their behavior.
- The relationship between the brain and behavior seems to be the successor of the famous Cartesian mind-body dualism, where the brain is the physical/biological component and behavior is the mental/psychological aspect.
- Sensation is defined as the process of the sensory organs transforming physical energy into neurological impulses the brain interprets as the five senses of vision, smell, taste, touch, and hearing.

Multiple Choice Questions

1. **The body-mind relationship is most closely studied under which branch of psychology?**
   A. Abnormal psychology
   B. Cognitive psychology
   C. Health psychology
   D. Environmental psychology
2. **The concept of the body-mind relationship refers to:**
   A. The physical split among mind and body

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B. How mental states influence physical health and vice versa
C. How only the brain influences behavior
D. The idea that the body and intellect are unconnected

3. **Which one of the following accurately illustrates how genetics impacts behavior?**
A. Genes and the environment interact to shape behavior
B. Genes determine behavior without environmental influence
C. Only the environment shapes behavior
D. Behavior is largely the result of learning

4. **Twin studies are frequently employed in behavioral genetics research to:**
A. Understand environmental effects on behavior
B. Compare the impact of heredity vs environment on behavior
C. Study the impact of nutrition on health
D. Determine brain development stages

5. **Which area of the brain is largely responsible for higher cognitive skills including reasoning, decision-making, and problem-solving?**
A. Brainstem
B. Cerebellum
C. Occipital lobe
D. Frontal lobe

6. **Neurotransmitters are chemicals that:**
A. Protect the brain from injury
B. Transmit electrical signals between brain cells
C. Allow neurons to communicate with each other
D. Control reflexes

7. **Which part of the brain is primarily associated with emotion regulation?**
A. Amygdala
B. Hippocampus
C. Medulla
D. Thalamus

8. **The minimum amount of stimulation required to detect a sensory input is referred:**
A. Sensory adaptation
B. Difference threshold
C. Absolute threshold
D. Signal detection

9. **Which sensory system is primarily responsible for balance and spatial orientation?**
A. Auditory system
B. Vestibular system
C. Olfactory system
D. Gustatory system

10. **The difference between sensation and perception:**
A. Perception is a physical process, whereas feeling is a mental process
B. Sensation involves interpretation, whereas perception involves detection
C. Sensation is the detection of stimuli, perception is the interpretation of that information
D. Perception occurs in the body, whereas feeling occurs in the brain

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Key Answers

1. C	3. A	5. D	7. A	9. B
2. B	4. B	6. C	8. C	10. A

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Sheela Upendra PhD is a distinguished academician and healthcare professional with nearly 27 years of experience spanning clinical practice and nursing education. She currently holds the esteemed position of Deputy Director and Professor at Symbiosis College of Nursing, Symbiosis International (Deemed University), Pune, Maharashtra, India.

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She is an accomplished researcher with 125 publications, including 55 indexed in Scopus and Web of Science, and has authored two textbooks. Her contributions have earned her numerous accolades, including the International Distinguished Researcher in Nursing Award, the RULA Research Peace Award, and recognition as the Best Nurse Researcher and Best Teacher by the Trained Nurses Association of India, Pune city branch. She also serves as a reviewer and editorial board member for Scopus-indexed journals.

Her career is further highlighted by her affiliation with the World Research Council and her academic achievements, which include being a gold medalist in her undergraduate program and a university topper in her postgraduate studies. Driven by a deep belief that research forms the bedrock of academic excellence, she is passionate about fostering innovation and leadership within the nursing profession.

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