

Basic Tactile Anatomy Atlas

Teacher's Instructional
Text, Volume I of II



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BASIC TACTILE ANATOMY ATLAS

Volume I

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PREFACE

The tactual illustrations and related texts in this two volume atlas have been designed to aid blind and visually impaired students in the study of the human body. Volume I includes illustrations of the skeletal, muscular, nervous, and endocrine systems. Volume II illustrates the structures of the cardiovascular, lymphatic, respiratory, digestive, urinary, and reproductive systems. Each tactual diagram is accompanied by brief braille description which can be found to the immediate left of the illustration. A printed version of each brailled text is contained in a separate booklet. The text serves as a caption and outlines the important information to be obtained through the tactual exploration of the diagram. Two supplemental illustrations have been included in the first volume. They are titled Pizza and Ice Cream Cone. These illustrations should be used as an introduction to the use of these tactile diagrams.

These educational materials would not be available without the contributions of many people. In particular the authors would like to recognize and thank Ms. Lisa Hoffman, a blind student whose determination to enroll in, and successfully complete, an anatomy course served as the impetus to create these educational materials, and Dr. Chester Glomski, whose encouragement and enthusiasm for the project spurred its development. This work was supported by the Instructional Materials Development Division of the National Science Foundation.

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Directions for Use of This Atlas

In anatomy structures are described in their anatomical position (where they are located in your body). For clarity the texts in this atlas will describe structures in the illustrations as you are facing them (where they are located on the page). For example, the liver is on the right side of your abdomen but you will be instructed to look for it on the left side of the illustration. Exceptions to this will be specified in the text.

The title of each diagram is located at the top of the page. Some diagrams contain a key which identifies a specific texture or symbol. These keys will be found at the bottom of the page. A fine label line has been used to connect each label to the structure it identifies.

You should begin your examination of each diagram by scanning the entire illustration to get a general idea of its contents. Next, you should refer to the accompanying text, which will guide you through your exploration and highlight the important features or structures to be identified.

Pizza

This diagram of a pizza introduces you to the way labels, textures, and keys are used in the tactile diagrams of the human body which you will be studying. In most cases a single page of text describing each diagram can be found on the page facing the illustration. This introductory diagram has 2 pages of text. Begin by locating the title, which is centered at the top of the page. Next, scan the entire diagram to get a general idea of its contents. Now you are ready to follow the directions which will help you locate specific structures. Immediately beneath the title locate a thick raised line. This is the outer edge of the crust of the pizza. Using both hands, trace it around completely. Now move inward from the line and examine the topping on the pizza. You should encounter fine dots. Move to the lower right corner of the page and locate these dots in a small square area. Immediately to the right you should find the word cheese. This small textured area and its label is called a key. If a key is used in a diagram to help you identify something, it will always be located on the bottom of the page. Return to the pizza and examine the cheese, which is spread evenly all over its surface. Next move to the upper left hand part of the illustration and locate the label for pepperoni. Follow the label line to its end. Here you should find a smooth, slightly raised, round item about the size of a quarter. This represents a piece of pepperoni on the pizza. Examine the entire pizza and count the number of pieces of pepperoni it

has. You should be able to locate 6. Now move to the lower left corner of the diagram and locate a label which reads mushroom. Trace this line till you reach the small item which represents a piece of mushroom on the pizza. Search for similar items throughout the pizza. You should find 5 mushrooms. We hope you like cheese, pepperoni, and mushrooms on your pizza. If not you can try to peel them off, but it will be very difficult. Good Luck!

Ice Cream Cone

This diagram of an ice cream cone can be used in the same manner as the diagram of the pizza to help you understand the use of the labels, textures and keys. Locate the title at the top of the page. Next scan the entire diagram. You should find the key on the bottom left of the page. There are 2 square areas with a word written to their right. The first square is smooth inside. The key tells you this represents vanilla ice cream. Just beneath the title locate the large scoop of vanilla ice cream on the top of the cone. Now examine the key in the lower left and find the texture used for chocolate ice cream. Locate the scoop of chocolate ice cream just beneath the vanilla. Now examine the cone. It is textured with small lines which cross each other. This texture is not included in the key at the bottom of the page because the cone has a label which helps you identify it. Find the word cone at the end of the label on its right side. Once again examine the entire diagram. You should now understand that it represents a cone with 2 scoops of ice cream, each of a different flavor.

Introduction to the Skeletal System

The following diagrams show some of the bones which make up the skeletal system of the body. The title of each diagram indicates the name of the bone illustrated. We have also identified the most significant parts or regions of each bone. Locate the labels for these and follow the label lines. Some of these parts actually stick out. These raised areas are formed by the pull of the tendons which attach a muscle to the bone at that point. Others are depressions. You will also note that some represent a hole (or foramen) through which nerves and blood vessels pass. The significance of each will be discussed in the accompanying text. Remember that all the bones have not been drawn to scale. To get a general idea about their size, it will be helpful to try to locate some of these bones on yourself. You should realize that you will not be able to feel all the parts of these bones since muscle and fat overlies some regions.

Anterior View of the Skeleton

This anterior (front) view of the skeleton introduces some of the major bones of the body. You will note that only a few of the bones are labeled. Some of these bones will be illustrated in detail in later diagrams. Begin by scanning the entire skeleton from the top of the page to the bottom and locate the skull, trunk and limbs. Now carefully study each bone. Begin with the skull, which forms the head, and move downward until you can feel the thin ribs, which have not been labeled. Continue in this direction noting the vertebrae of the spine and finally the curves of the bony pelvis. Next, move to your far right and locate the labels for the bones of the upper limb: the humerus of the arm and the outer radius and inner ulna of the forearm. The phalanges or bones of the fingers are also labeled. Examine the thigh and leg in the same manner. On the left side of the diagram you will find the labels for the femur, which is the bone of the thigh, and the thin, outer fibula and inner tibia of the leg. The toes or phalanges of the foot have also been labeled. Scan the diagram once again and get a general idea of the relative size and shape of the bones and the way they relate to one another.

Anterior View of Skull

This illustration identifies the major bones located on the front of the skull and the small openings located in these bones. The bones are labeled on the left side of the diagram while the openings are labeled on the right. Each bone is separated from an adjacent bone by a jagged immovable joint termed a suture. These are represented as raised lines within the figure. Begin by identifying the large orbits or sockets for the eyeballs. Between these locate the nasal cavity. Below the nasal cavity notice that the mouth is bounded by the upper and lower teeth. Beginning at the top of the skull and continuing on the left side of the illustration identify the bones which surround these openings. On the right side, identify the openings located in some of the bones. In life, these openings contain blood vessels and nerves which supply the skin and muscles of the face.

Typical Vertebra

This diagram shows the parts of a typical vertebra. A view of this bone from above is shown at the top of the page and a side view at the bottom. At the top locate a narrow raised projection labeled the spine of the vertebra. Since this spine is on the back side of your vertebra you should be able to feel these projections in the middle of your own back. Next find two similar structures called the transverse processes projecting to the left and right. The portion of bone joining the spine and the transverse processes is the lamina. Locate the two round, raised regions called the superior articular processes which mark where this vertebra meets the one above it. The bony pedicle joins this region to the somewhat rounded body of the vertebra. Note that all of these parts of the vertebra form a bony ring surrounding the vertebral foramen. This is actually an open space through which the spinal cord passes. Next examine the lateral view, which shows the back of the spine to your right and its body to your left. Note the intervertebral notch which helps to form the space through which a spinal nerve passes as it leaves the spinal cord.

Scapula

The scapula is a bone located in the shoulder and is commonly called the shoulder blade. In this diagram a back view has been drawn at the top of the page and a front view at the bottom. Begin by tracing the outline of this bone, noting its somewhat triangular shape. Next, locate the acromion process on the right side of the back view. Although not shown here, the clavicle (collarbone) is attached to this process by ligaments. From this point follow a raised ridge on the back side which is called the spine of the scapula. Above this is the supraspinous fossa and below is the infraspinous fossa. Next, imagine that you have turned the scapula around and examine the front view. Because of you have turned it around, in this view the acromion process juts out at the upper left. Note the labeled coracoid process to which ligaments attach for shoulder support. Next to this is an oval depression on the side of the scapula called the glenoid fossa. This is the site for joining the head of the humerus (the bone of the upper arm). Lastly, note the labeled vertebral border which in the body is located next to the upper vertebral column.

Typical Long Bone

This diagram shows a typical long bone which has been sliced open to allow you to examine its inner structure. Begin by tracing the outer edge of this bone. Notice that the upper and lower ends are somewhat rounded. They are each called an epiphysis. The narrow shaft of a long bone located between its two epiphyses is called the diaphysis. You should notice that the outer rim of each epiphysis is composed of small dots, which represent the articular cartilage which protects the ends of this bone. The smooth, slightly raised outer region of the entire bone is composed of dense, compact bone. The slight indentations just inside this compact bone represent the inner spongy bone. Locate the deep indentation in the center of the diaphysis. This region is called the marrow cavity and is the site for the production of blood cells. Within each epiphysis you will find a raised jagged line labeled the epiphyseal plate. This is the site of active bone growth in a child. Finally, locate the nutrient artery on the left which supplies the bone with blood.

Bones of the Hand

The bones of the hand may be separated into three different types. Open your right hand with your palm facing up. Now lay your hand to the right of this figure. The bones in this figure are just like the bones in your right hand. In this figure the little finger is on the left side while the thumb is on the right. Notice that the bones of the hand are separated into three groups. Begin at the bottom of the page and find the eight carpal bones. These bones are found at your wrist. In this figure each carpal bone is labeled with a symbol to help you identify one from the other. The ends of the radius and ulna are located at the very bottom of the page to show you how they are connected to the carpal bones. Move up the page and find five long bones called metacarpals. These are found in the palm of your hand and may be felt on the back of your palm. The ends of these bones form the large knuckles of your hand. The last group of bones are called phalanges. These are the bones which form your fingers and thumb. Notice that three phalanges form each finger while only two form the thumb.

Bones of the Foot

In this view you are looking down on the bones of the foot. The toes are toward the top of the page with the ankle toward the bottom. On the left side of the diagram from top to bottom identify the labels for the phalanges, metatarsals, and the tarsals. On the diagram of the bones, a space has been inserted between these sets of bones to help you locate their position. Note that the phalanges consist of numerous bones arranged in a line. The metatarsals consist of 5 single long bones. The tarsals are composed of 7 bones. Each bone has been labeled with a symbol.

Anterior View of Muscles

This anterior (front) view of the skeletal muscles of the body is useful for orientation and as an introduction to subsequent muscle diagrams. Begin at the top center of the page and locate the head. Next survey the entire body, noting the trunk and the upper and lower limbs. You will feel distinct lines or ridges which represent the direction of the muscle fibers of some of the muscles of the body. Although most of the muscles of the body are paired, meaning that we have one on each side, only one member of the pair is labeled. Return to the upper right side of the diagram and find the label for a muscle of the neck called the sternocleidomastoid. Also on this side of the diagram you should identify the biceps brachii of the arm. The deltoid muscle of the shoulder has been labeled on the left as are the quadriceps of the front side thigh. Other muscles which are easily felt but not labeled are pectoralis major in the upper chest and the abdominal muscles.

Posterior View of Muscles

This back view of the skeletal muscles of the body, like the front view, should be used for orientation. Begin at the top center of the page and locate the head. Next survey the entire body, noting the trunk and the upper and lower limbs. You will feel distinct lines or ridges which represent the direction of the muscle fibers of some of the muscles of the body. Although most of the muscles of the body are paired, meaning that we have one on each side, in this diagram only one member of the pair is labeled. Return to the upper right side of the diagram and find the label for a muscle of the neck and upper back called the trapezius. Also on this side of the diagram you should identify the hamstrings of the upper thigh. The triceps of the arm have been labeled on the right, as is the gastrocnemius of the back of the leg. Other muscles which are easily felt but not labeled are latissimus dorsi of the back and the gluteus maximus of the buttocks.

Superficial Back Muscles

In this figure find three bony structures. In the middle of the diagram find a line of raised dots passing from the head above to the pelvis below. These are the vertebral spines. Next, at the top and sides of the figure find two thick lines, the spines of the scapulae. The one on the right side of the figure is labeled. At the bottom of the figure on the right side locate the label for a part of the pelvis called the iliac crest, represented as a thick curved line. Move to the top of the figure and on the right side locate the label for the trapezius. Trace its muscle fibers from the spines to the scapula. Move to the middle of the figure on the right side and locate the label for latissimus dorsi. Notice that its muscle fibers pass from a smooth area next to the spines up toward the shoulder. At the shoulder notice that another muscle passes from the spine to the arm: the deltoid, labeled on the left. A small portion of three muscles located primarily on the front curve around the side of the body and can be seen on the back. They are the external abdominal oblique and gluteus medius, labeled on the left and on the right the gluteus maximus.

Components of a Cell

This diagram shows a highly magnified cell and its contents. Under the title identify the labeled cell membrane and trace it around the cell. Imagine this represents the outline of a clock. The location of organelles in different cells may vary, but in this cell we will use the positions of the numbers on a clock to locate them. Begin at 10 o'clock with the nuclear envelope surrounding the nucleus. In the nucleus note the raised nucleolus and textured areas which represent nuclear chromatin or genetic material. Continue in a clockwise direction and identify both smooth and rough endoplasmic reticulum which carry cellular products, granules for storing substances, mitochondria which produce energy, and ribosomes which make protein. In the center of the cell find the Golgi apparatus which packages and stores products, and a centriole needed for mitosis. Follow the label lines to each structure and examine its size and shape.

Multipolar Neuron

The multipolar neuron is a nerve cell which transmits motor nerve impulses to initiate muscle contraction. At the top of this cell locate the multiple branches labeled on the left as dendrites. They receive information from other nerve cells and transmit it to the cell body to which they are attached. Examine the inside of the cell body and locate the round, raised nucleus. Feel the fine textured dots which depict the Nissl substance, which is responsible for producing neurotransmitter. The labeled axon hillock has no Nissl substance and marks the beginning of the cell's axon. The single axon carries neurotransmitter down its length to be released at its terminal bouton, labeled in the lower right. Here it is released to stimulate the dendrites of another neuron or a muscle cell. Notice that as you trace down the axon you can feel raised thickened regions representing a fatty coating labeled the myelin sheath. There are places along the axon called the Nodes of Ranvier in which there is no myelin. The nerve impulse can jump from node to node, thus reaching the terminal bouton more quickly.

Lateral View of Brain

This view of the left side of the brain depicts the gyri (bumps) and sulci (grooves) found on a cerebral hemisphere. Although each of the gyri and sulci have names, only two will be studied in this diagram. Find the key at the bottom of the page. Note that the precentral gyrus is striped while the postcentral gyrus is composed of small raised dots. Locate the top of the brain and move toward the back until you reach the central sulcus labeled on the diagram. Notice that in front of the sulcus is the precentral gyrus. This is involved in the control of movement in all parts of the body. Behind the sulcus is the postcentral gyrus which is involved in perceiving and locating touch and pain on the body. Trace the pre- and postcentral gyri down until they end. The large groove at the end of the gyri, the lateral fissure, is labeled on the diagram.

Lobes of the Brain

In this side view of the left hemisphere (half of the brain), the bumps and grooves have been removed and replaced with various textures. Notice in the key at the bottom of the page that each texture represents a lobe or region of a hemisphere. Locate the top of the brain and move to the back until you reach the central sulcus labeled on this diagram. Observe the large striped area in front of the sulcus. This represents the frontal lobe which affects movement. Behind the sulcus note the parietal lobe composed of large raised dots. It is involved in general sense perception. Return to the central sulcus and move your fingers down until you reach the lateral fissure labeled on the diagram. Beneath the fissure is an area composed of small dots, the temporal lobe. It is responsible for hearing. Finally, pass your hand back along the lower edge of the temporal lobe until you reach a small smooth area. This is the occipital lobe, which is involved with vision. The insula, considered to be a fifth lobe, cannot be seen in this view.

Eye

Begin at the left of the page and find the path of light label. It is a dashed line. Follow this line and identify a thin line, the conjunctiva, separated from a thicker line, the cornea. After passing through the cornea you enter the eyeball. You then pass through a chamber filled with a watery fluid and a narrow channel termed the pupil, and enter an egg-shaped structure called the lens. After the lens you enter a large chamber filled with a clear jelly-like material. After this chamber your journey is almost over. Note that surrounding this chamber is a thick dotted structure termed the retina. The dots represent the millions of cells in the retina. Note that where the dashed line ends there is a dent in the retina. This is where vision is the sharpest. Under this spot is another dent called the optic disc. This is where the optic nerve is formed. It is attached to the back of the eyeball on the right of the page. Notice on the outside of the eyeball a smooth curved line labeled the sclera; this protects and shapes the eyeball. Finally, two muscles, the superior and inferior rectus, and some wavy lines representing blood vessels are also shown.

The Ear

Examine the bottom of the page and note that from left to right the ear is divided into three parts. The external ear gathers sound and consists of the auricle, its lower part (the ear lobe), and a tube passing from left to right called the external auditory meatus. Notice that the meatus ends at the tympanic membrane (eardrum). In this figure it is a thick raised cupped structure. The tympanic membrane separates the external from the middle ear. Note that a series of three bones or ossicles are in line with it. Under the ossicles find the opening of another tube called the Eustachian or auditory tube. Although it is not shown in this figure, the Eustachian tube passes from the pharynx to the middle ear. The middle ear transmits the sound to the inner ear. Finally identify the parts of the inner ear. These include the thick round semicircular canals responsible for balance and, under these, the spiraling cochlea involved with hearing. On the right side of the page find two textured nerves, one on top of the other. Note that the top nerve or vestibular nerve is attached to the semicircular canals while the one on the bottom or cochlear nerve is attached to the cochlea.

Endocrine Glands

This diagram illustrates the glands which make up the endocrine system. These glands produce hormones and secrete them through the blood stream to many areas of the body. They have been drawn within a slightly raised figure representing the head and torso of the body. Begin by tracing the outline of this figure starting with the head which can be found beneath the title. Notice only the tops of the arms and legs have been drawn. Next locate the labels on the left side of the illustration and trace their label lines to the following raised and textured endocrine glands: the pituitary beneath the brain, thyroid in the neck, two adrenal glands above the flattened kidneys, pancreas in the abdomen, ovaries in the pelvis for females and testes in the scrotal sac near the upper thigh for males. Note the relative size, shape, and location of each. In the upper right portion of the diagram locate the four small, raised parathyroid glands located on the back side of the thyroid gland, which has been removed from the body and turned around for your examination.

Pituitary Gland

In this diagram the pituitary gland has been split in half. The front part of the gland is to your left while the back part is to your right. Begin at the bottom of the page and examine the anterior pituitary which is textured with small raised dots. Notice how the anterior pituitary narrows as you move up toward the brain. A thin raised line separates the textured anterior from the smooth posterior pituitary. Find within the posterior pituitary several raised dots. These dots represent hormones which have passed from the brain into the gland. As you trace these dots upward note that they are located within an axon of a neuron. At the top these dots end within a cell body of a neuron located in the hypothalamus of the brain. Note the labels for each. The hypothalamus is actually located at the bottom of the brain near the optic nerve fibers. Although the entire brain is not shown, you will find these optic nerve fibers in a bundle on the lower front part of the hypothalamus. The hormones in the posterior pituitary gland come from the hypothalamus, while the hormones in the anterior pituitary are produced by cells within this part of the gland.

Pancreas

This diagram shows the pancreas and the internal structures involved in its role as an endocrine gland. Trace the outline of the pancreas and note the labels for its head, body and tail. In your body the large head is located near your duodenum and liver, while the narrow tail is near your spleen. The middle is the body. Explore the interior of the pancreas and locate clusters of dots which represent cells. These clusters are like islands scattered throughout the gland and therefore have been named the Islets of Langerhans. The large dots are the beta cells which produce insulin. The smaller dots are the alpha cells which secrete the hormone glucagon. After a meal, insulin is released to allow the blood sugar or glucose to enter the cells of the body to be used for energy. In starvation, glucagon is secreted to break down the glycogen stores in the liver, thus releasing glucose for the body. Unlike the enzymes produced by the pancreas for digestion, which are secreted into a duct, insulin and glucagon are secreted into the bloodstream.



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