Notes: Touch

All regions of our bodies are sensitive to touch. The largest sense organ is your skin. **Mechanoreceptors** located throughout the skin make it possible to sense touch, pressure, and tension.

Our Skin has several different types of Sensory Receptors that are just below the surface of the Skin. Each type of receptor responds to a different stimulus:

- **THERMORECEPTORS** -respond to heat and cold
- **MECHANORECEPTORS** -respond to mechanical pressure
- **PAIN RECEPTORS** -responds to tissue damage.

In humans, the receptors for touch are concentrated in the face, tongue, and fingertips. Sensory receptors for hot or cold are scattered directly below the surface of the skin. There are 3 to 4 warm receptors for every cold receptor.
Body hair also plays an important role in the ability to sense touch. Large numbers of mechanoreceptors are found in the skin at the base of hair follicles.
Note the role of hair in the sense of touch.

Sensory receptors can be more concentrated in different places of our bodies. The most touch sensitive areas are the fingers, toes and lips.

Pain Receptors are located throughout the skin. The sensation of pain can be experienced as either prickling pain (fast pain) or burning and aching pain (slow pain). Pain receptors are stimulated by mechanical, thermal, electrical, or chemical Energy.

Summary of Sensory Receptors
Receptors for the general senses are scattered throughout the body and are relatively simple in structure. These receptors are classified according to the nature of the stimulus that excites them.

Important sensor classes include:
Pain: They are common in the superficial portions of the skin, in joint capsules, within the periostea of bones, around the walls of blood vessels, plus a few in deep tissues or most visceral organs. These can produce fast pain (prickling) or slow pain (burning or aching).

Temperature (thermoreceptors): They are free nerve endings scattered immediately beneath the skin surface and located in skeletal muscles, the liver, and hypothalamus. Cold receptors are three to four times more numerous than warm receptors, but there are no known structural differences between the two.

Chemical stimuli (chemoreceptors): They respond only to water-soluble or lipid-soluble substances that are dissolved in surrounding fluid. There are no well-defined chemosensory pathways in the brain or spinal cord, with the exception of taste and smell. Neurons within the respiratory centers of the brain respond to

concentrations of hydrogen ions and carbon dioxide molecules in the cerebrospinal fluid. Receptors in the periphery monitor the oxygen concentrations of arterial blood (found in carotid and aortic bodies).

Touch / pressure / position (mechanoreceptors): They are sensitive to stimuli that distort their cell membranes. They contain mechanically regulated ion channels, which open and close in response to movement. There are three classes: tactile, baroreceptors, and proprioceptors.

Tactile receptors provide the sensations of touch, pressure, and vibration. Distinctions between them are not well defined. Fine touch and pressure receptors provide detailed information about a source of stimulation, including the exact location, shape, size, texture, and movement. These receptors are extremely sensitive and have relatively narrow receptive fields. Crude touch and pressure receptors provide poor localization and information. Tactile receptors range in complexity from free nerve endings to specialized sensory complexes complete with accessory cells and supporting structures. There are at least six tactile receptors on the skin and called by various names according to the source:

- **Free nerve endings** are sensitive to touch and pressure. They are situated between epidermal cells and have no apparent differences in structure with those of the free nerve endings that provide temperature or pain sensations.
- **Root hair plexus** is made up of free nerve endings to detect hair movement.
- **Merkel's discs** are fine touch and pressure neurons located in the lower epidermal layer of the skin.
- **Meissner's corpuscles** are fine touch and pressure receptors located in the eyelids, lips, fingertips, nipples, and external genitalia.
- **Pacinian corpuscles** are large receptors sensitive to deep pressure and to pulsing or high-frequency vibrations. They are found in the skin, fingers, breasts, and external genitalia, as well as in joint capsules, mesenteries, the pancreas, and walls of the urinary bladder.
- **Ruffini corpusles** are located in the dermis of the skin and are sensitive to pressure and distortions of the skin.

Baroreceptors monitor changes in pressure. These receptors consist of free nerve endings that branch within the elastic tissues in the walls of organs. When pressure inside the organ changes, the elastic walls stretch or recoil. Baroreceptors monitor blood pressure in the walls of major blood vessels and play a major role in cardiac function and in adjusting blood flow to vital tissues. In the lungs, they monitor the degree of lung expansion, where the information is then passed on to centers in the brain which sets the pace for respiration. Baroreceptors in the digestive and urinary tracts trigger various reflexes, including the elimination of wastes.

Proprioceptors monitor position of joints, tension in tendons and ligaments, and the state of muscular contraction. Of all the sensory receptors, the proprioceptors are the most structurally and functionally complex. Two examples of this complexity are found in *tendon organs*, which monitor the strain on a tendon, and in *muscle splindles*, which monitor the length of a skeletal muscle. They, however, do not

adapt to constant stimulation; and each receptor must continually send information to the CNS.

Sensory receptors for the senses of:

- **Touch**
- **Smell (olfaction):** The sense of smell is provided by paired olfactory organs located on either side of the nasal septum. Each is comprised of olfactory epithelium, which consists of olfactory receptors, supporting cells, and basal cells (stem cells). Olfactory receptors are highly modified neurons, amounting to between **10 and 20 million** packed into a 5 cm^2 area. However, these cannot compare with those of some animals. A dog sniffing for specified illegal items has an olfactory receptor surface **72 times** greater than that of its handler.
- **Taste (gustatory):** The sense of taste is provided by gustatory receptors distributed over the surface of the tongue (in epithelium pockets) and adjacent portions of the pharynx and larynx in individual organs called taste buds. The four primary taste sensations are: sweet, salty, sour, and bitter. The sweet taste buds lie in a small area on each side of the tip of the tongue. Progressing toward the back of the tongue, sweet is followed by salty, sour, and bitter.
- **Vision:** The sense of vision is the most relied upon of all the senses. Visual receptors, contained in the eyes, are able to detect light and create visual images.
- **Hearing:** The sense of hearing, and associated equilibrium, is provided by the inner ear in a receptor complex located in the temporal bone of the skull. The receptors are hair cells which are simple mechanoreceptors. These hair cells respond to the two different stimuli providing an appropriate response.