General cutaneous sensations essay

LAB 2 GENERAL CUTANEOUS SENSATIONS INTRODUCTION This lab involves the examination of cutaneous receptors. There are four exercises. For this lab, report your observations in a formal report, according to the formatting prescribed in Lab Report Format. doc which is found on Blackboard under Assignments/Before You Begin. Equipment needed: Metal calipers or compass with pencil 2 or more blunt probes (ball point pens or forks with blunt tines) 3 pennies 1 liter ice water in large container liter hot water in large container (make sure it is bearable to the touch) 1 liter room-temperature water in large container Felt-tip markers, blue, red, and black (not permanent) Stop watch or digital watch Introduction: A sensation is defined as a state of awareness, of the internal or external environment. For a sensation to occur, four criteria must be met. First, there must be a stimulus. This is a change in the environment, to which we will become aware. Next, there must be a receptor. A receptor is a cell, or an organ, which is sensitive to the stimulus.

There also must be an afferent (sensory) nerve pathway, to carry signals to the central nervous system. Finally, there must be sensory cortex, where the signals will be analyzed and interpreted consciously. The skin is responsive to a number of stimuli. These include light touch, deep pressure, vibration, and changes in temperature. Any stimulus must be of threshold magnitude to be detected. All sensory systems have a limit to their sensitivity; any stimulus below a minimum magnitude cannot elicit a response. The receptors for general cutaneous sensations are small, modified nerve endings.

They are scattered throughout the skin and underlying fascia. These receptors are adapted to be most sensitive to certain stimuli: Type of receptorStimulusTypical Sensation Mechanoreceptorsmechanical agitationtouch, pressure, vibration Thermoreceptorschanges in temperatureheat, cold Nociceptorsdamage to tissuespain Proprioceptorsmuscle lengthbody position. Receptors must be capable of transduction, the conversion of stimulus energy into graded generator potentials that eventually reach and propagate as action potentials along nerve fibers.

Typically, the stimulus causes sodium channels to open across cell membranes or subcellular membranes, depolarizing the receptor, to some degree. The magnitude of the generator potential is usually proportional to the magnitude of the stimulus: Weak stimulusfew ion channels openedweak depolarization Strong stimulusmore channels openedstrong depolarization. The generator potential results in the release of neurotransmitter from the receptor, where it synapses with an afferent neuron. The neurotransmitter then elicits action potentials in the afferent neuron.

The stream of action potentials eventually arrives at the sensory cortex, where it is interpreted mentally as some sort of sensation. Stimulus magnitude (also called intensity) is encoded by action potential firing rate. This is the only means of encoding intensity, because action potentials do not vary in magnitude. A low rate of firing is interpreted as a weak sensation; a fast rate is interpreted as a more intense sensation. EXERCISE 1: STRUCTURE OF TOUCH RECEPTORS Meissner’s corpuscles are receptors for light touch. These are located in the upper dermis, usually within dermal papillae.

This location places them as close to the body surface as possible, thus enabling them to respond to light agitation of the skin. Within the corpuscle, the sensory nerve ending is coiled, parallel to the plane of the skin surface. Compression of the skin (by touching) deforms the receptor, causing depolarization. Pacinian corpuscles are receptors for deep pressure. These are typically located in the lower dermis or underlying fascia. Their deep location makes them sensitive only to more profound deformation of the skin.

Notice the concentric layering of connective tissue surrounding the nerve ending. Deformation of this tissue results in depolarization of the neuron. Both light touch and deep pressure are fast-adapting senses. The bulb of connective tissue is involved with adaptation. When deformation of these receptors first occurs, there is a burst of electrical activity. If the stimulus is sustained, the bulb then mechanically adjusts to it, and allows the sensory nerve to repolarize. The effect is loss of sensation. As soon as the pattern of deformation changes, the neuron immediately depolarizes again.

The overall effect is to increase sensitivity to changes in the pattern of physical contact (touch) with the environment. Observations to make: Look at the photo of a Meissner's corpuscle in the book, and locate the receptor. Observe the nerve fibers within the capsule (bulb). Notice how they are arranged parallel to the skin surface. Describe briefly — Look at the photo of a Pacinian corpuscle. Notice the onion-like bulb of connective tissue.

Describe briefly — EXERCISE 2: LOCATION & DENSITY OF CUTANEOUS RECEPTORS PART A: TOUCH RECEPTOR DENSITY

The density of touch receptors varies with location on the body. The fingertips, toes, and lips have the greatest density. These areas of the body have the highest tactile resolution: the ability to discriminate between one and two points of stimulation. You will use a two-point discrimination test to compare tactile resolution (and receptor density) on various parts of your body. An estheiometer is used for this test. The device uses modified calipers which touch the skin (a compass with a pencil could also be used). The distance between the caliper points is adjustable, and can be measured.

The minimum distance between points, which can be determined as two points of contact, is called the two-point threshold. Begin the test by closing the calipers (to a single point of contact) and gently touch the skin of the test subject. The subject should have his/her eyes closed. Open the calipers slightly and repeat the process. Keep repeating the process, opening the calipers a little more each time, until the subject reports two points of contact. Record the distance between points, in millimeters: | Area Tested | Two-Point Threshold (mm) | | Cheek (of the face! | | | Back of hand | | | Palm of hand | | | Fingertip | | | Lip | | | Back of neck | | | Sole of foot | | | Back of calf | | | Small of the back | | Explain what you observed, and why you think it occurred in that way: PART B: TACTILE LOCALIZATION This tests the ability to determine where tactile stimulation has occurred. Using a felt-tip marker, touch the skin of the test subject. His/her eyes should be closed. The subject then will try to touch the exact spot with a marker (of a different color); measure the distance between the two marks. | Area Tested | Distance (mm)

| | Cheek (of the face! | | | Back of hand | | | Palm of hand | | | Fingertip | | | Lip | | | Back of neck | | | Sole of foot | | | Back of calf | | | Small of the back | | Explain what you observed, and why you think it occurred in that way: PART C: ADAPTION OF TOUCH RECEPTORS Sensory adaptation enhances sensitivity to changes in the environment. It also allows us to become less sensitive to nonessential stimuli. Being constantly aware of the same pattern of tactile stimulation (e. g. pressure of clothes on the skin) would be very distracting. A new pattern (e. g. , a scorpion crawling up your leg) probably has far more significance. Have the test subject close his/her eyes, and rest a hand and forearm on a table. Place a coin on the back of the person's hand. Note how long it takes for the sensation to cease. Record the time interval: Repeat the test on the forearm, and record the time (always include the units of measurement after the number; here they are " sec" which is the standard abbreviation for " seconds"): Once the sensation has ceased, stack two more coins on top of the first one. Does the sensation return? Record how long the sensation persists:

Are the same receptors being stimulated (with 3 coins vs. only 1)? Explain your answer: EXERCISE 3: LOCATION AND DENSITY OF TEMPERATURE RECEPTORS Carefully draw two squares, each 2 cm on a side, on the anterior of the test subject's forearm: 2 cm In preparation, immerse at least two blunt probes in ice water. The subject's eyes should be closed during the test. Remove one blunt probe from the container of ice water, and wipe it dry. Gently touch the probe to the skin in the left square, starting from the upper left corner. If the subject reports the sensation of cold, mark the spot with a blue marker pen. If not, continue testing, in a systematic manner, across the square.

Repeat the procedure, until the entire square has been thoroughly mapped. Switch probes frequently, so they remain cold. Repeat the procedure, in the right square, with probes soaked in warm (45o C) water. Mark this square with a red pen. Switch probes often, so they remain warm. Remember: the subject is to report temperature, not touch. Explain what you observed, and why you think it occurred in that way: EXERCISE 4: ADAPTATION OF TEMPERATURE RECEPTORS As with touch, sensory adaptation occurs with temperature receptors. Place two 1-liter containers on the desk, and fill both with water that is very warm (almost hot) to the touch, but still bearable.

Have the test subject immerse his/her right hand in one of the containers for two minutes. Compare the sensation at the beginning of immersion with that at the time interval: Beginning ________________________ After two minutes ______________________ Now, with the subject's right hand still in the water, immerse his/her left hand in the other container. Begin timing now. Which hand feels like it is in hotter water? __________________________ Keep both hands immersed, until both hands feel the same temperature. Record how long it takes for both hands to feel the same temperature. Now remove the subject's right hand from the warm water, and place it in a container of water at room temperature. Record the sensation of the right hand:

Explain what you observed, and why you think it occurred in that way: PREPARE and SUBMIT REPORT Report all your observations in a formal report, according to the formatting prescribed in Lab Report Format. doc which is found on Blackboard under Assignments/Before You Begin. A sample lab report is provided at the same location to help you become familiar with the required formatting. A formal lab report, written in careful and concise scientific prose, contains a title, your name, abstract (short summary in 2-3 sentences of work performed, including a terse summary of the results), introduction (a few sentences), methods, and results & discussion. The entire report should be at most 3 pages.

Your report will be graded according to the Lab Report Grading Scheme found on Blackboard under Assignments/Before You Begin. Do not copy text from these directions into your report. However, you may re-express ideas in highly abbreviated fashion — being concise, and simultaneously rich and accurate in scientific content, is a hallmark of excellent scientific prose. To save time, you may copy the blank tables from this document to insert into your lab report, and then fill in your observational data. Be careful to include all the requested observations and data, and answers to all questions, plus comments as needed. Submit your report via Assignments on Blackboard.