Unit 5 Lecture 14

SENSORY, MOTOR, and INTEGRATIVE SYSTEMS

RECEPTORS AND SENSATIONS

A sensation is defined as the conscious and subconscious awareness of changes in the external or internal environment. The components of sensation are:

- Stimulation of the sensory receptor
- transduction of the stimulus
- generation of nerve impulses
- integration of sensory input.

Sensory stimuli are divided into the special senses of vision, hearing, taste, smell and equilibrium, and the somatic senses of touch, temperature, pain, itch, and proprioception. Each type of receptor is sensitive to a distinct stimulus. That receptor is a transducer that converts the signal into an intracellular signal. Major types of receptors based on stimulus include chemoreceptor (sensitive to changes in chemical concentration), pain receptors (sensitive to tissue damage), thermoreceptor (sensitive to mechanical forces), photoreceptors (sensitive to light), and mechanoreceptors (sensitive to mechanical forces such as changes in pressure or movement of fluids). Receptors can also be classified on their location: exteroceptors, interoceptors, and proprioceptors. Sensory receptors vary from free nerve endings to encapsulated nerve endings in specialized receptor cells.

Sensory impulses

When receptors are stimulated, changes occur in their membrane potentials. Receptor potentials are transferred to nerve fibers triggering action potentials if the threshold is surpassed. Sensations are feelings from sensory stimulation. A particular part of the sensory cortex interprets every impulse that reaches it in the same way. The cerebral cortex projects a sensation back to the region of stimulation. Sensory adaptations are adjustments of sensory receptors to continuous stimulation. Impulses are triggered at slower and slower rates.

Somatosensory modalities

There are four somatosensory modalities: touch, proprioception, temperature, and nociception which include pain and itch. Secondary sensory neurons cross the midline so that one side of the brain processes information from the opposite side of the body. Ascending sensory tracts terminate in the somatosensory cortex. Some responses to irritants are protective spinal reflexes. Fast pain is transmitted rapidly by small, myelinated fibers. Slow pain is carried on small unmyelinated fibers. Pain may be modulated by descending pathways from the brain or by gating mechanisms in the spinal cord. Referred pain from internal organs occurs when multiple primary sensory neurons converge onto a single ascending tract.

Integrative Functions of the Cerebrum

Integrative functions of the cerebrum include wakefulness and sleep and learning and memory. Why do we wake up? When do we wake up? What controls arousal? The reticular activating system (RAS) keeps the brain conscious or aware of self and the environment. Circadian rhythms are controlled by an internal clock in the suprachiasmatic nucleus. When the RAS is activated arousal occurs and wakefulness or consciousness is the result. Sleep is an easily reversible state of inactivity with two phases: REM (rapid eye movement) sleep and slow-wave sleep (non-REM).

Learning is the acquisition of knowledge about the world around us. Without learning, mistakes would occur again and again. Associative learning occurs when two stimuli are associated with each other; i.e. Pavlov's dog experiments. Non-associative learning includes imitative behaviors such as learning a language.

Memory is the ability to retain and recall information. There are different levels of memory storage and memory changes. Information is first stored in short term memory, but will disappear unless consolidated into long-term memory. The consolidation of short term memory into long term memory appears to involve changes in the synaptic connections of the circuits involved in learning. Working memory is a special form of short term memory processed in the prefrontal lobes. Working memory allows us to collect and process facts from short and long term memory and connect them in a logical order to solve problems or plan actions. Reflexive memory is a special type of long term memory that is automatic and does not require conscious processes for its creation or recall. It has also been called procedural memory. A number of motor activities and how to do things are examples. Declarative memory requires conscious attention for its recall.

Why is this chapter important?

This chapter tells us about sensory and motor pathways, the process of sensations, the types and functions of sensory receptors, and the sensations they produce. The integrative function of the cerebrum is covered as wells as wakefulness and sleep, and the different types and stages of learning and memory.