Electrophysiology of Frog Sensory Receptors

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This introductory neurophysiology laboratory examines the innervation patterns of frog cutaneous sensory nerves, and the sensory receptor properties of graded response and adaptation. Sensory receptors depolarize when stimulated by a specific stimulus, producing a generator potential. The generator potential is transformed into an action potential on the sensory neuron axon, and is transmitted to the spinal cord and cerebral sensory cortex. Sensory receptors demonstrate the property of graded response. The stronger the stimulus, the greater the number of generator potentials produced by the receptor, and sent as action potentials to the sensory cortex. The increased number of action potentials are interpreted by the sensory cortex as a stronger stimulus. Sensory receptors also demonstrate the property of adaptation. When a stimulus is applied to a sensory receptor continuously over a period of time, the receptor produces fewer generator potentials as time progresses. The reduced number of action potentials received by the sensory cortex are interpreted as a weakening stimulation.

The innervation patterns of cutaneous sensory nerves are examined by exposing cutaneous sensory nerves innervating the frog's dorsal surface. A flap is produced by making three incisions, with the longitudinal portion of the flap lateral to the dermal plica. Elevating the skin flap exposes the cutaneous sensory nerves extending from the body wall to the skin flap midline. A pair of recording electrodes connected to an oscilloscope are positioned to contact the exposed cutaneous sensory nerve. As the cutaneous touch receptors are stimulated by rubbing a glass rod on the skin, the action potential produced along the cutaneous sensory nerve is traced on the oscilloscope screen. Areas of innervation for each sensory nerve are determined and mapped on a diagram of the frog's dorsal surface.

Graded response is examined by stimulating the proprioceptors in the frog's toe joint with varying weights. The peroneus communis nerve is located and positioned over recording electrodes. The tendon of the interosseous muscle on the fourth digit bone is isolated and connected to a thread. Weights ranging from 0.5 to 10 g are added to the thread to stimulate the proprioceptors and produce sensory nerve action potentials along the peroneus communis nerve. The weight applied and the number of the action potentials observed during the first 2 seconds are recorded, plotted using an *X*-*Y* graph, and statistically analyzed for correlation.

Adaptation is examined by stimulating the proprioceptors of the frog's toe joint with weight continuously over a period of time. The number of action potentials observed in 2 seconds (at 30-second intervals) and the time interval are recorded. The data are plotted using an *X*-*Y* graph, and statistically analyzed for correlation.