REFLEX ARC

Reflexes are simple, involuntary, stereotyped motor actions generated in response to specific sensory stimuli. Reflexes operate through the reflex arc.

RECEPTOR A
AFFERENT (SENSORY) NERVE B
SPINAL CORD OR BRAIN C (INTEGRATING SYNAPTIC CENTER)
EFFERENT (MOTOR) NERVE D
EFFECTOR E

SPINAL NERVE F
GANGLION G
DORSAL ROOT H
VENTRAL ROOT I
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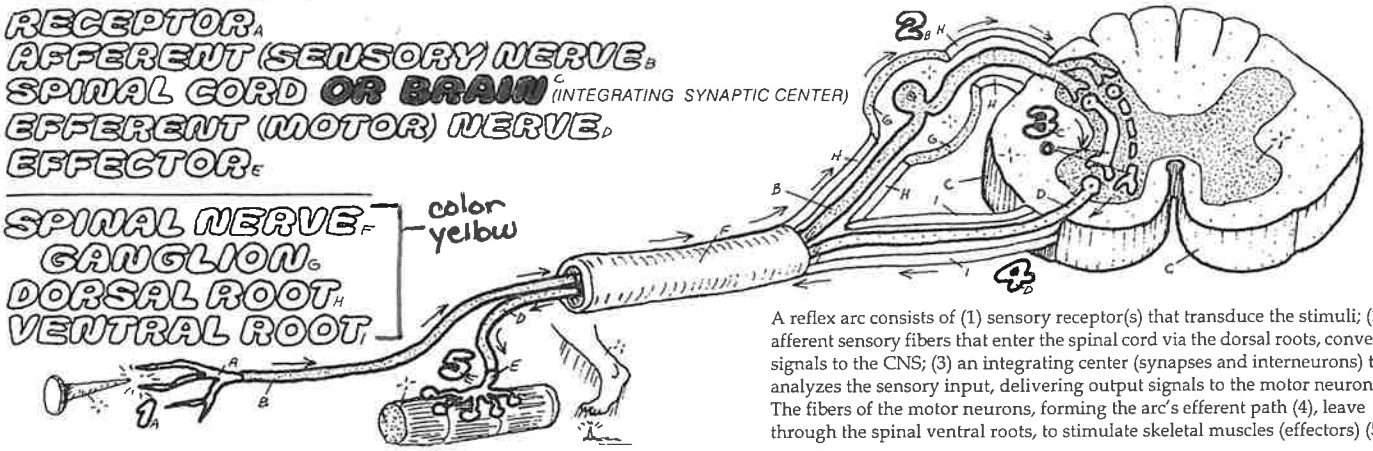
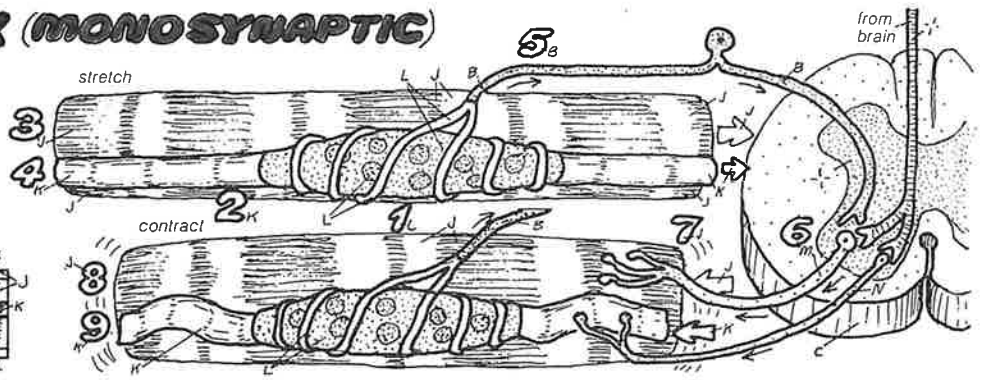


A reflex arc consists of (1) sensory receptor(s) that transduce the stimuli; (2) afferent sensory fibers that enter the spinal cord via the dorsal roots, conveying signals to the CNS; (3) an integrating center (synapses and interneurons) that analyzes the sensory input, delivering output signals to the motor neurons. The fibers of the motor neurons, forming the arc's efferent path (4), leave through the spinal ventral roots, to stimulate skeletal muscles (effectors) (5).

STRETCH REFLEX (MONOSYNAPTIC)

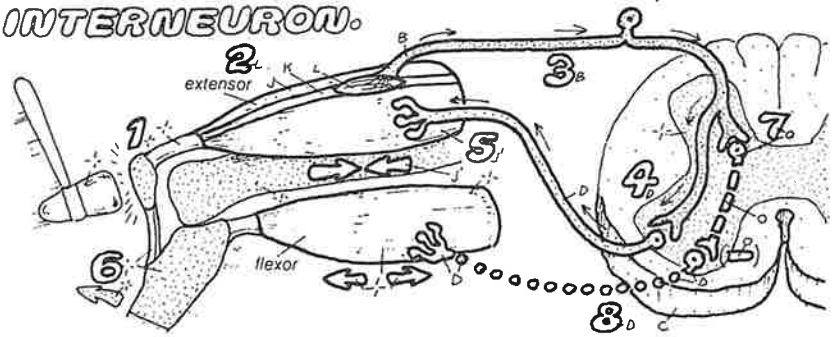
SKELETAL MUSCLE J
SPINDLE FIBER K
MIDDLE ZONE L
ALPHA EFF. FIB. M
GAMMA EFF. FIB. N



Simplest reflexes operate via only one synapse (monosynaptic reflex), as in the stretch reflex (SR), which functions to keep muscle length and tension (tonus) constant. The sensory receptor for SR (1) is in the middle segment of intrafusal fibers found in the muscle spindle (MS) (2). Stretching of the muscle (3) stretches the spindle fibers (4), activating the MS stretch receptors and the associated sensory fibers (5). These monosynaptically excite the large α motor neurons (6), which excite the ordinary muscle fibers (extrafusal) (7). Contraction of these fibers shortens the muscle (8) and relaxes the spindle fibers (9), terminating the SR and muscle contraction.

KNEE JERK REFLEX (EXTENSOR); (POLYSYNAPTIC INHIBITORY SYNAPSE);

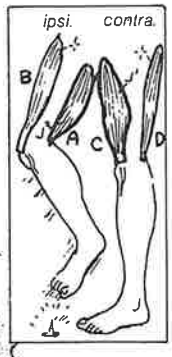
! → INTERNEURON O

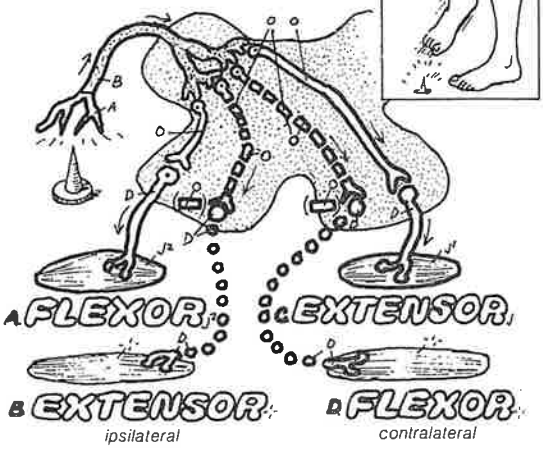


The stretch reflex is involved in the knee jerk reflex. A tap on the patellar tendon (1) stretches the extensor muscle (EM) (2) and its spindle. The spindle discharges, exciting the associated sensory fibers (3) that excite the motor neurons to the EM (4). Contraction of EM (5) extends the lower leg (6) (knee jerk). Simultaneously, ipsilateral flexors must relax for extensors to function. To do this, branches of sensory fibers from MS activate inhibitory interneurons (7), which, in turn, inhibit the motor neurons to the flexor muscle (8).

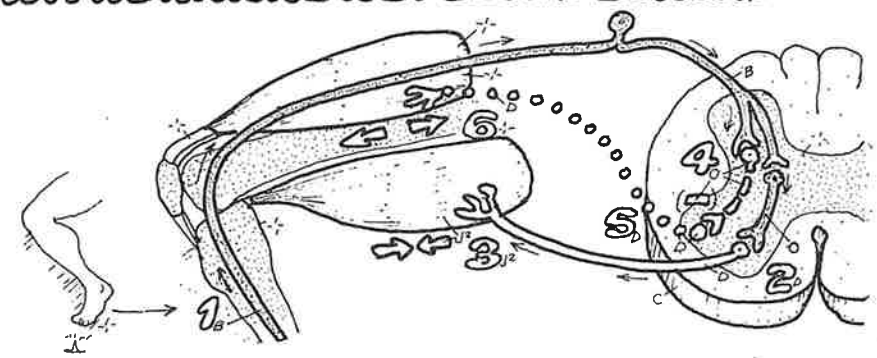
CROSS EXTENSOR REFLEX

In a standing position, painful stimulation of one foot causes flexion (withdrawal) of the ipsilateral leg, as well as the extension of the contralateral leg (crossed extensor reflex), to stabilize posture. By utilizing various inhibitory and excitatory interneurons, the ipsilateral leg flexors are activated and the extensors inhibited, and vice versa in the contralateral leg.





WITHDRAWAL REFLEX (FLEXOR)



The withdrawal reflex is a defensive flexor reflex elicited in response to noxious (painful) stimulation of the foot. Sensory pain signals (1) excite motor neurons to the flexor muscles (2), eliciting flexion and withdrawal of the leg (3). Simultaneously, via inhibitory interneurons (4), motor neurons to the extensor muscles are inhibited (5) to relax the extensors of the same leg.