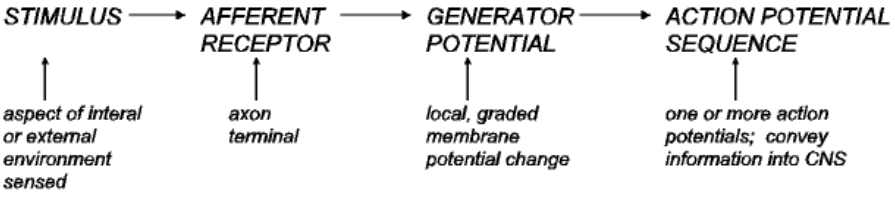
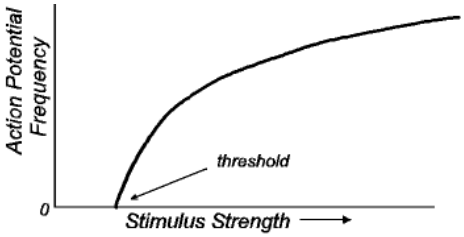
INTRODUCTION

Sensory Receptors: Sensory receptors (or sensory endings or sensory organs or afferent endings) are axon endings (simple receptors) or sensory organs (e.g. retina) that respond to appropriate stimuli to generate action potentials, which are then conducted into the central nervous system (afferent input)

RECEPTOR PHYSIOLOGY

A. Transducer Function





Note: the *Generator Potential* is sometimes termed the *Receptor Potential*

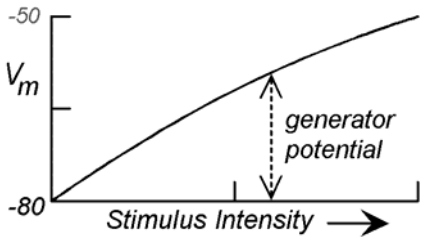
B. Generator Potential

1. Define: Membrane depolarization at a sensory ending that is caused by the application of a stimulus

2. Characteristics

   a. passive electrical spread to adjacent sections of the axon (<u>not</u> an action potential); decrements with distance

   b. graded according to stimulus intensity (<u>not</u> all-or-none)



3. Channels causing the generator potential are *stimulus sensitive*, not voltage or neurotransmitter sensitive and are not blocked by local anesthetics. (However, voltage sensitive channels are present on the adjacent parts of the axon – in myelinated fibers, at the first node of Ranvier.)

4. Classified by the type of energy to which they normally respond; this type of energy is termed their ***adequate stimulus***

<u>Examples</u>	<u>Adequate Stimulus</u>
Mechanoreceptor	mechanical distortion (e.g. touch, pressure)
Thermoreceptor	temperature (e.g. warm, cold)
Chemoreceptor	particular chemical (e.g. H+, O2, sugar)
Nociceptor	painful stimuli
Proprioceptor	relative position of body parts (e.g. receptors in muscles, tendons, joints)

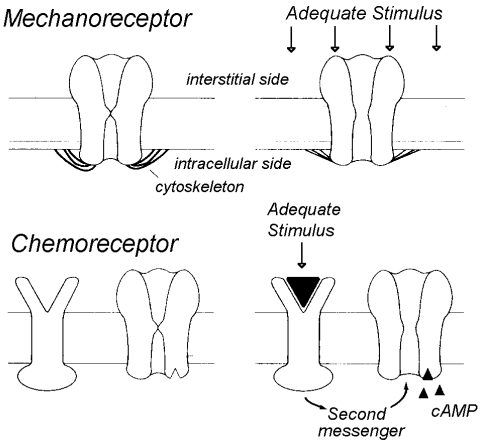
RECEPTOR PHYSIOLOGY

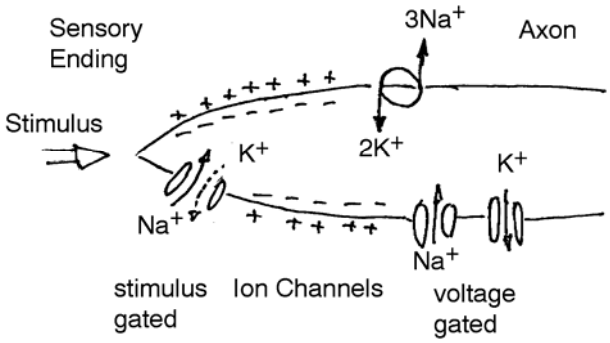
B. Generator Potential (continued)

4. Mechanism

Adequate Stimulus → *Afferent Channel Reconfigures (graded opening))* → *P-Na & P-K (nonspecific) INCREASE* → *Na Influx* → *Vm Depolarization*

Channel types: ionotropic – directly effect ionic permeability -- and metabotropic (alter internal cell production of "second messengers", e.g. G-protein coupled)





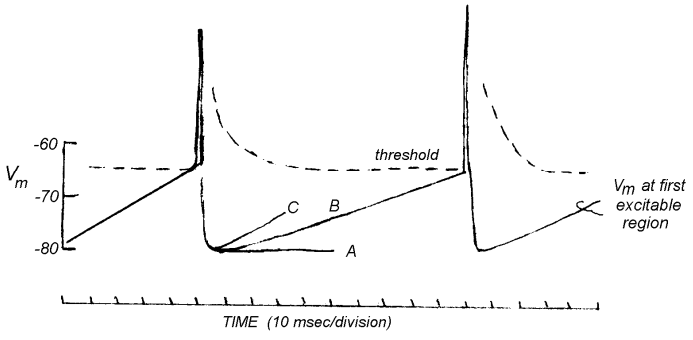
C. Repetitive Discharge (firing frequency)

1. Mechanism

Generator Potential → *Passive Spread of Depolarization to Adjacent Na Excitable Channels* → *Excitable Membrane Reaches Threshold* → *Action Potential* → *Recovery of Excitability*

2. Determination of firing rate

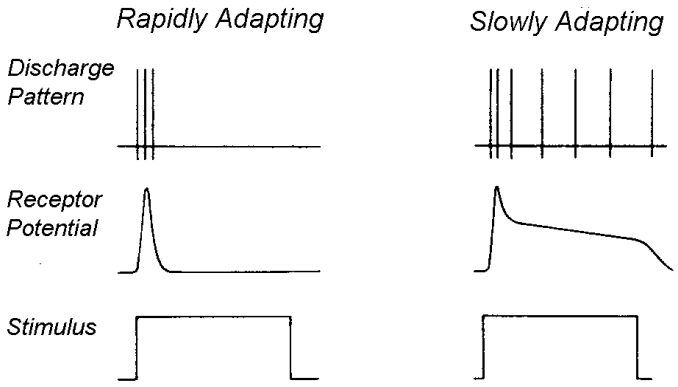
Stimulus ⇑ ⇒ Time to reach threshold ⇓ ⇒ Firing frequency ⇑



ADAPTATION

A. Define: decay of discharge rate when stimulus intensity is held constant
OR
Response to rate of change of stimulus rather than (or in addition to) the magnitude of the stimulus

B. Pattern



C. Classification

1. rapidly adapting: respond with a burst of APs when stimulus is applied rapidly and then declines to zero; AP frequency depends on the amplitude and rate of application of the stimulus (phasic discharge) – detect stimulus change

2. slowly adapting: responds with burst of APs when stimulus is applied rapidly, following which discharge frequency declines but not to zero (both phasic and tonic components) or continue to discharge at a constant rate as long as stimulus is maintained; AP frequency depends on amplitude of stimulus only (tonic discharge only)

D. Cause: inherent in transducer mechanisms