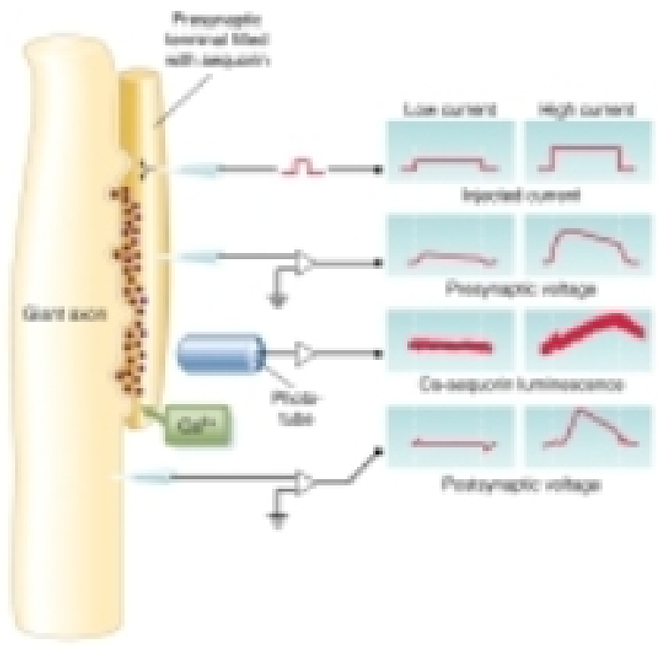
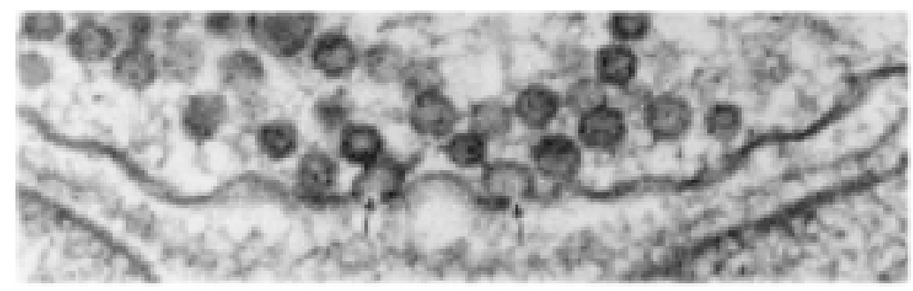
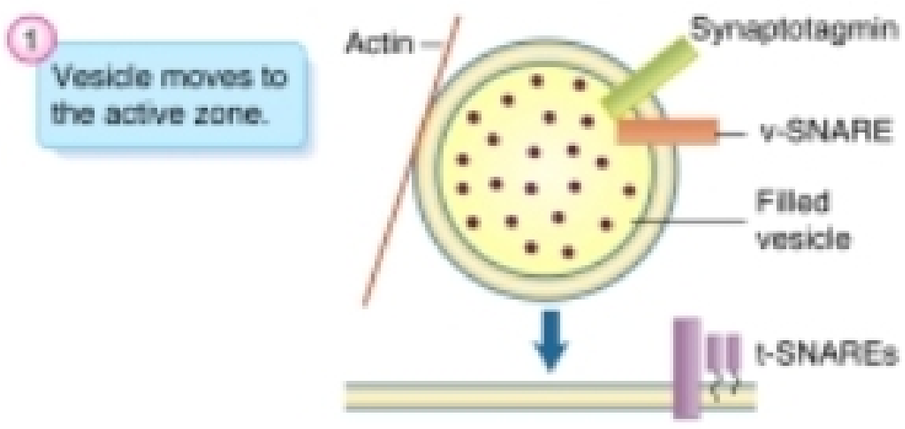
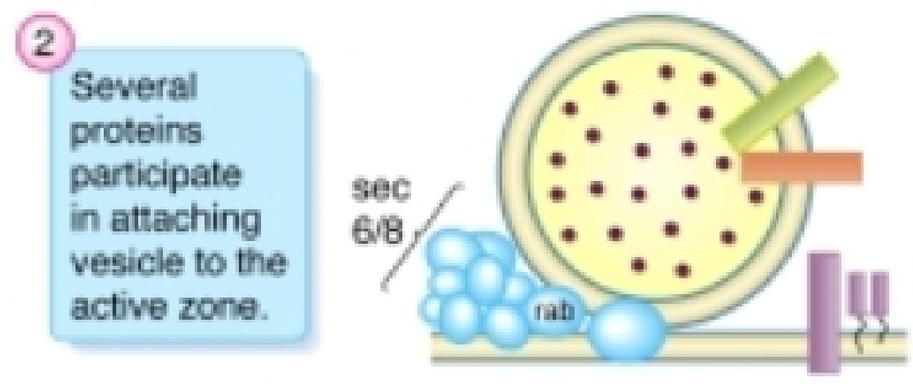
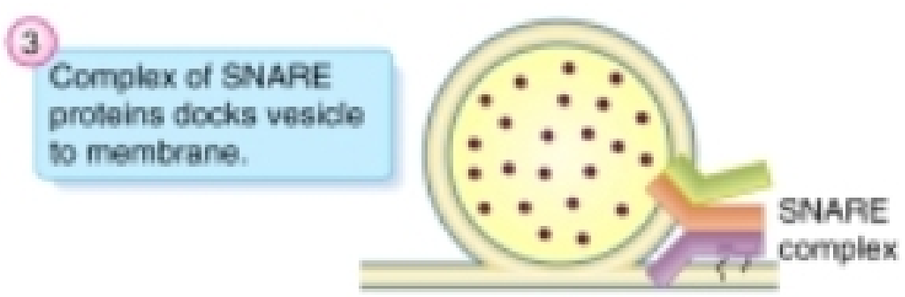

Low current
High current
Injected current
Presynaptic voltage
Giant axon
Ca-aequorin luminescence
Postsynaptic voltage




1
Vesicle moves to the active zone.
Actin
Synaptotagmin
v-SNARE
Filled vesicle
t-SNAREs


2
Several proteins participate in attaching vesicle to the active zone.
sec 6/8
rab


3
Complex of SNARE proteins docks vesicle to membrane.
SNARE complex

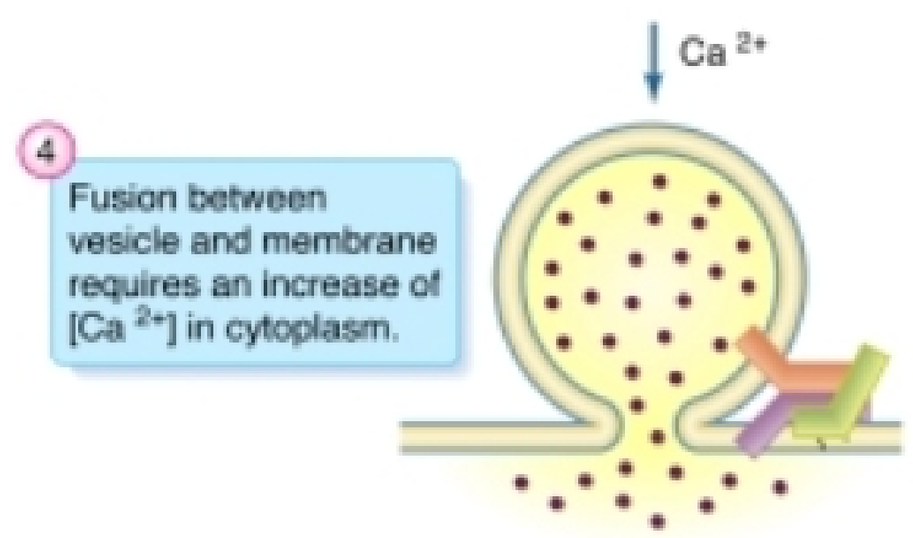
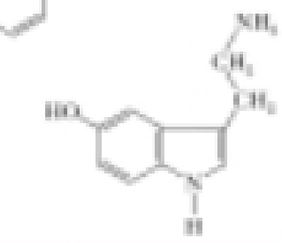

Ca 2+
4
Fusion between vesicle and membrane requires an increase of [Ca 2+] in cytoplasm.

Table 6-2 Typical small neurotransmitters, their structures, and functions

Neurotransmitter	Typical effects*	Structure
Acetylcholine (ACh)	Fast excitation; slow inhibition	
Glycine (Gly)	Fast inhibition	
γ-Aminobutyric acid (GABA)	Fast inhibition; slow inhibition	
Glutamate (Glu)	Fast excitation; slow change in postsynaptic metabolism	

*Notice that the effect of a neurotransmitter depends on the properties of the postsynaptic cell. For most neurotransmitters, however, it is possible to identify their most probable effect.

Table 6-2 Typical small neurotransmitters, their structures, and functions

Neurotransmitter	Typical effects*	Structure
Norepinephrine (Norepi)	Slow excitation; slow inhibition	
Dopamine	Differs with location but causes slow postsynaptic effects	
Serotonin (5-HT = 5-hydroxytryptamine)	Slow excitation or slow inhibition	

*Notice that the effect of a neurotransmitter depends on the properties of the postsynaptic cell. For most neurotransmitters, however, it is possible to identify their most probable effect.

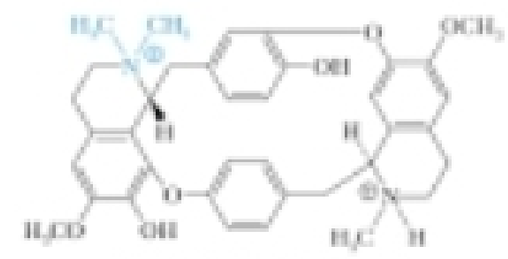
Table 6-2 Typical small neurotransmitters, their structures, and functions

Neurotransmitter	Typical effects*	Structure
Nitrogen oxide (NO)	Synaptic modulation	
Adenosine triphosphate (ATP)	Both fast and slow synaptic transmission	
Histamine	Slow modulation	

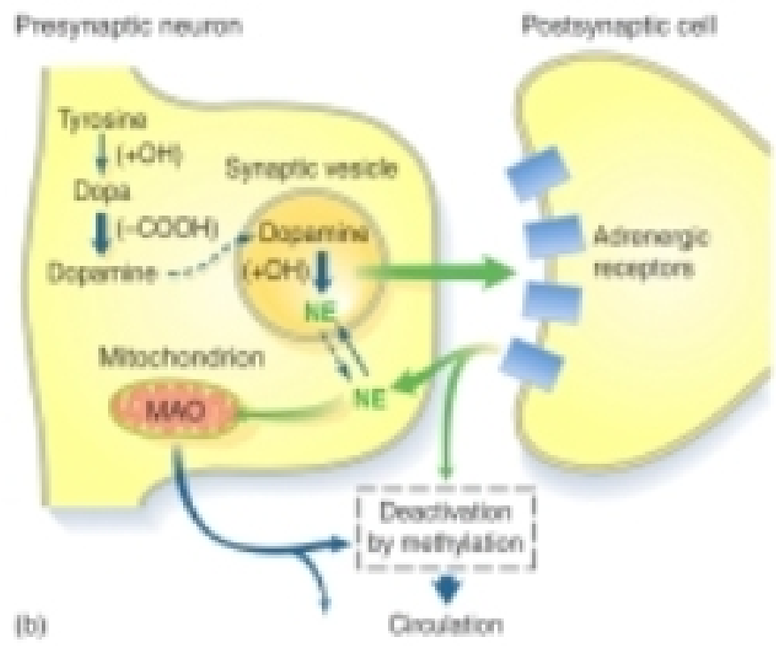
*Notice that the effect of a neurotransmitter depends on the properties of the postsynaptic cell. For most neurotransmitters, however, it is possible to identify their most probable effect.

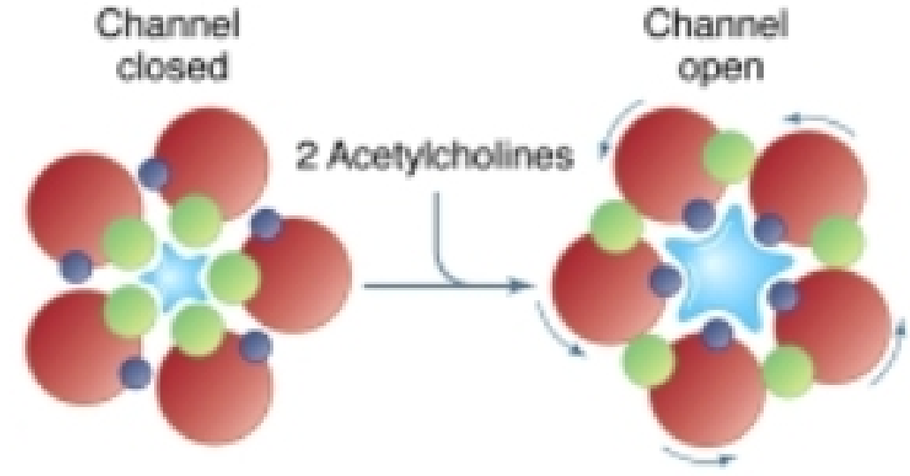
Acetylcholine (ACh)

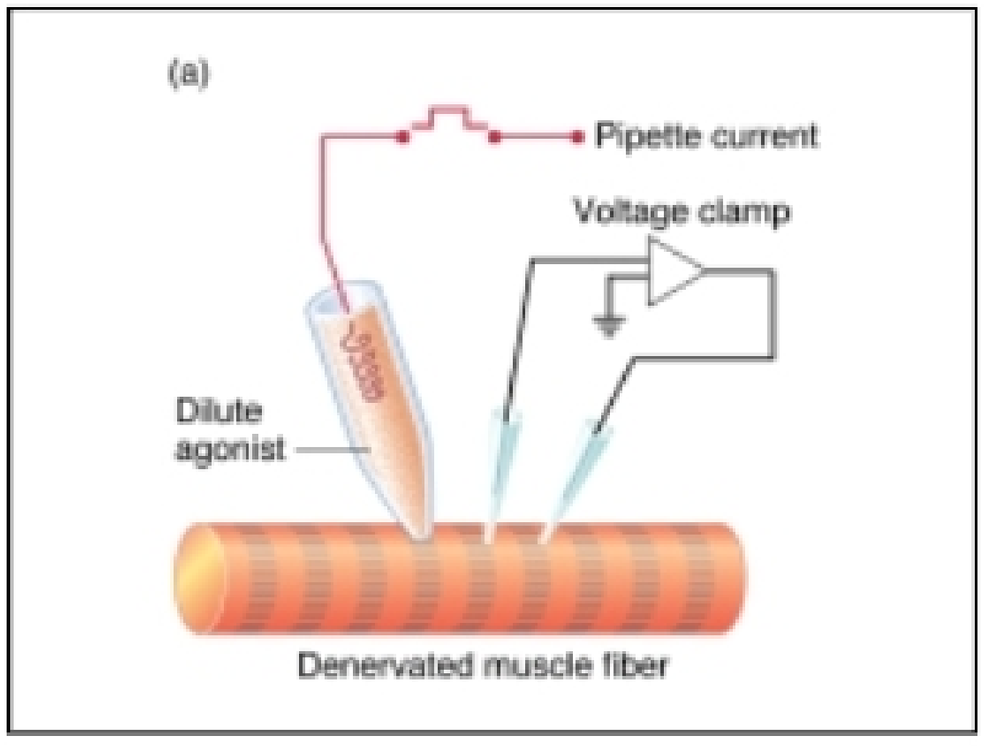
Carbachol, an ACh agonist

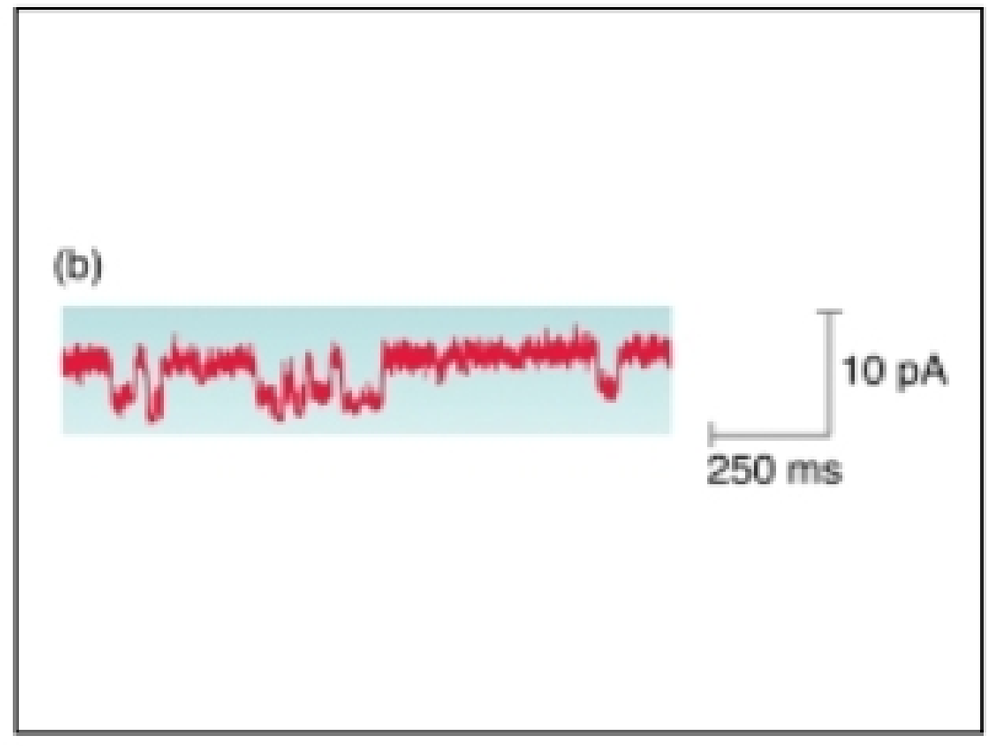


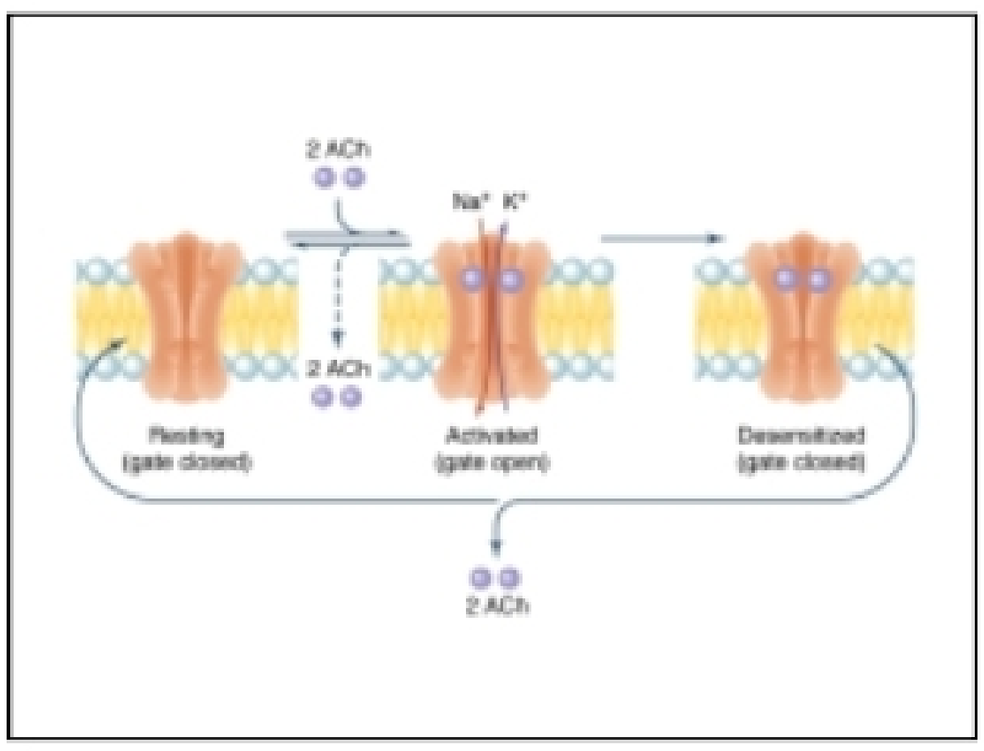
d-Tubocurarine, an ACh antagonist

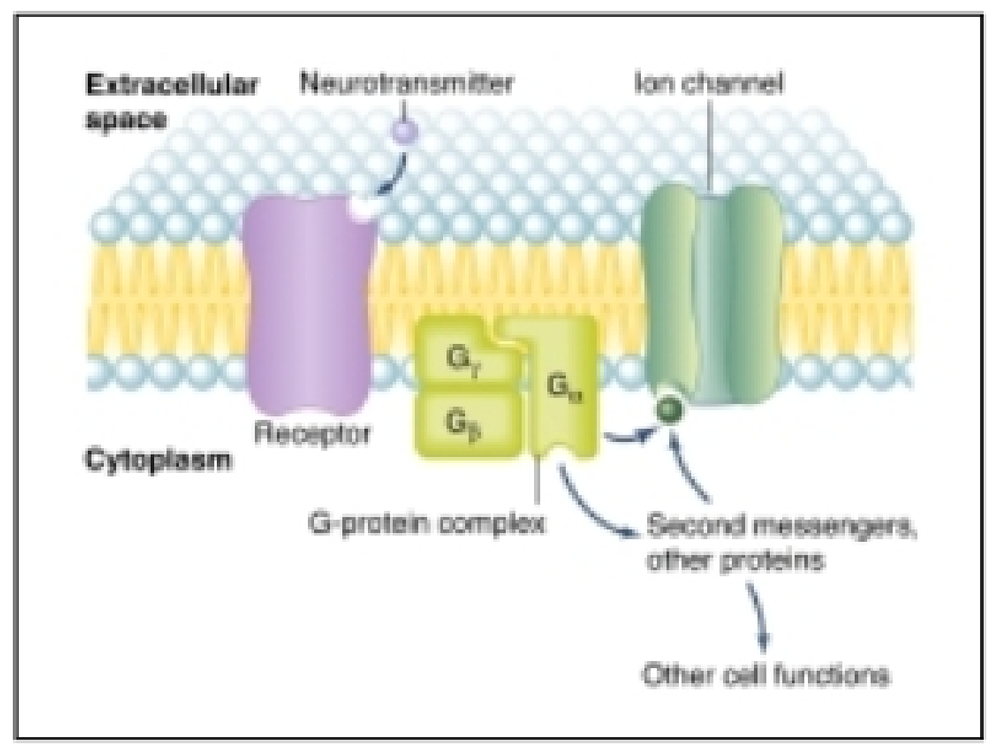


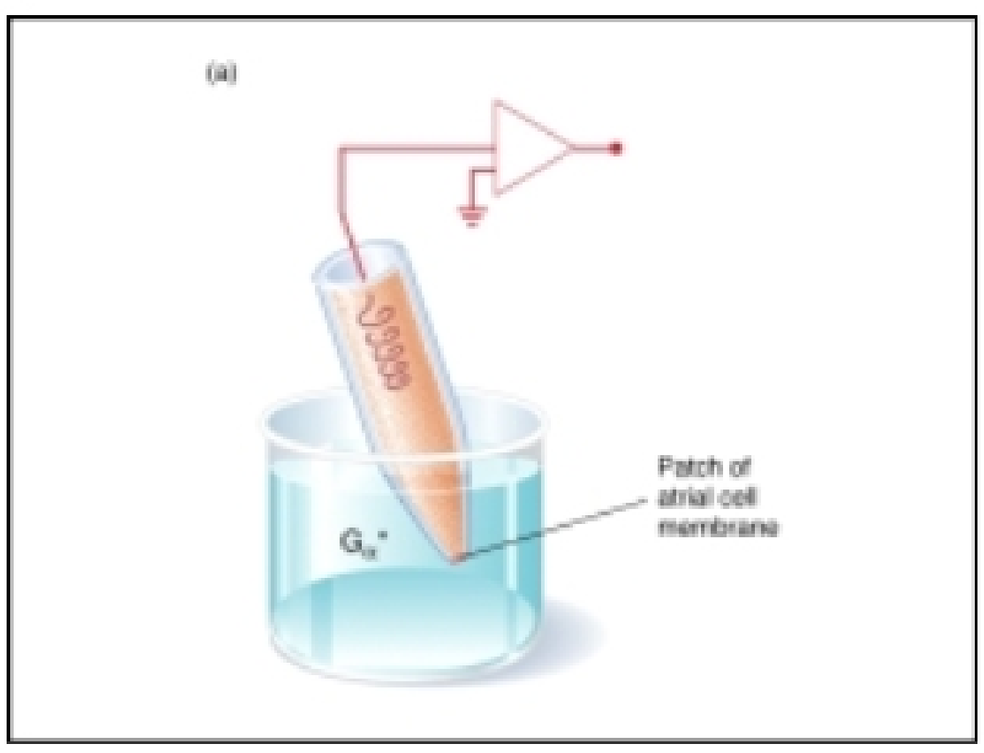


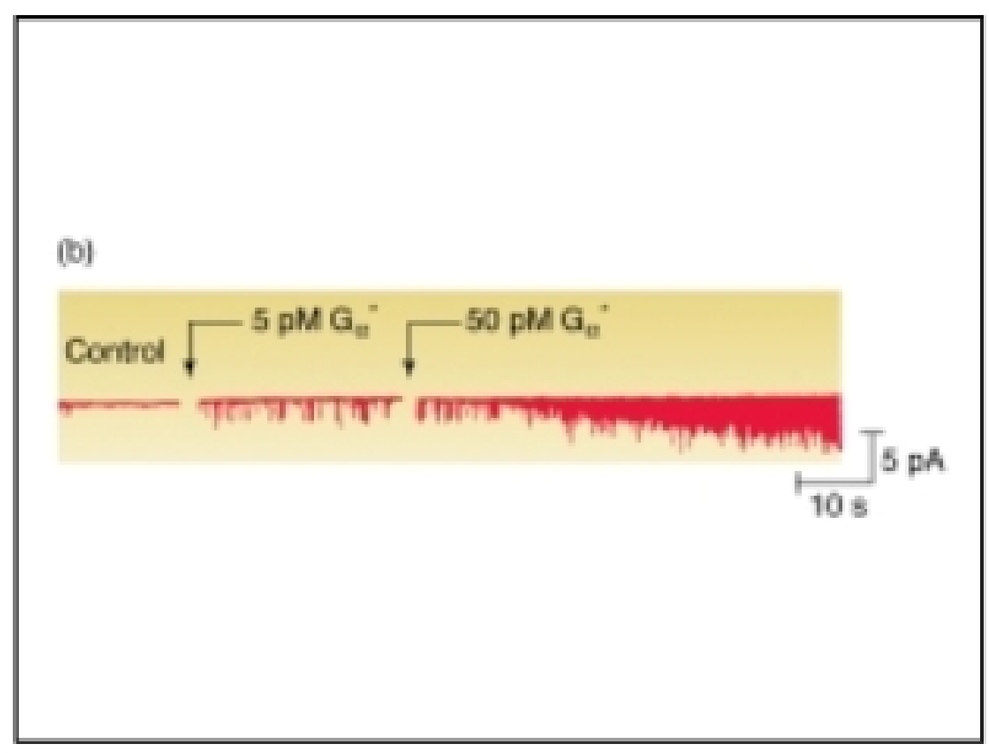

(a)
Pipette current
Voltage clamp
Dilute agonist
Denervated muscle fiber


(b)
10 pA
250 ms


2 ACh
Na+ K+
2 ACh
Resting (gate closed)
Activated (gate open)
Desensitized (gate closed)
2 ACh


Extracellular space
Neurotransmitter
Ion channel
Receptor
Cytoplasm
G-protein complex
Second messengers, other proteins
Other cell functions


(a)
Patch of atrial cell membrane


(b)
Control
5 pM
50 pM
5 pA
10 s