## Neurotransmission of signals

–*Describe the steps in neurotransmission.*

– *Describe the ionic basis for neurotransmitter release.*

–*List the major neurotransmitters and describe their mode of action.*

–*Describe the basic organization of the nervous system.*

## Conduction of Action Potentials

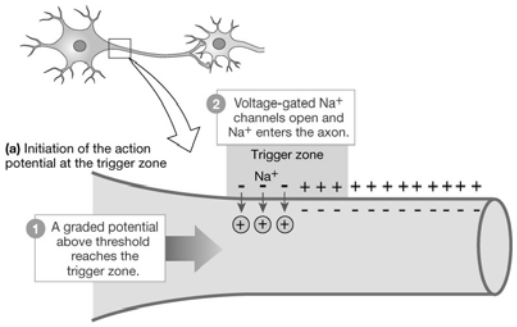



Figure 8-14a: Conduction of action potentials

## Mechanism of Vg Na+ channels

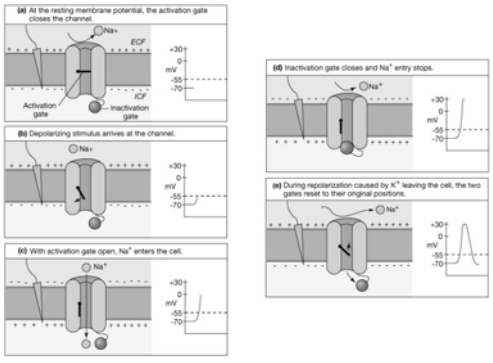
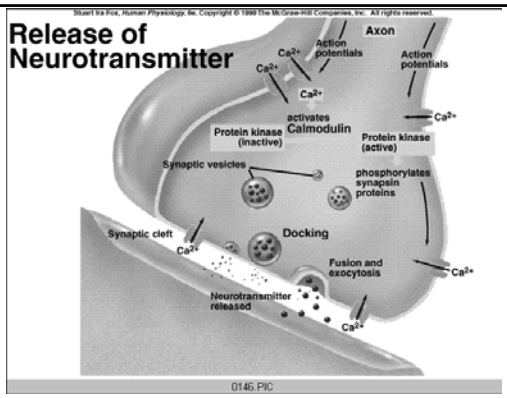



Figure 8-10: Model of the voltage-gated channel Na+




# Neurocrines

**Table 8-4: Major Neurocrines**

| CHEMICAL | RECEPTOR | TYPE* | RECEPTOR LOCATION | KEY RECEPTOR AGONISTS/ANTAGONISTS** |
|---|---|---|---|---|
| Acetylcholine (ACh) | Cholinergic | | | |
| | Nicotinic | ICR ($Na^+$, $K^+$) | Skeletal muscles, autonomic neurons, CNS | Nicotine—agonist<br>Curare—antagonist |
| | Muscarinic | GPCR | Smooth and cardiac muscle, endocrine and exocrine glands, CNS | Muscarine—agonist<br>Atropine—antagonist |
| **Amines** | | | | |
| Norepinephrine (NE) | Adrenergic (α, β) | GPCR | Smooth and cardiac muscle, endocrine and exocrine glands, CNS | α agonist—phenylephrine<br>β antagonist—propranolol |
| Dopamine (DA) | Dopamine (D) | GPCR | CNS | Antipsychotic drugs—antagonists<br>Bromocriptine—agonist |
| Serotonin (5-hydroxytryptamine, 5-HT) | Serotonergic (5-HT) | ICR ($Na^+$, $K^+$) GPCR | CNS | Sumatriptan—agonist<br>LSD—antagonist |
| Histamine | Histamine (H) | GPCR | CNS | Ranitidine (Zantac®), cimetidine (Tagamet®)—antagonists |

* ICR = ion channel-receptor, GPCR = G protein-coupled receptor. AMPA = α-amino-3-hydroxy-5-methylisoxazole-4-propionic acid. NMDA = N-methyl-D-aspartate. LSD = lysergic acid diethylamine. N/A = Not applicable.
** This list does not include many chemicals that are used as agonists and antagonists in physiological research.

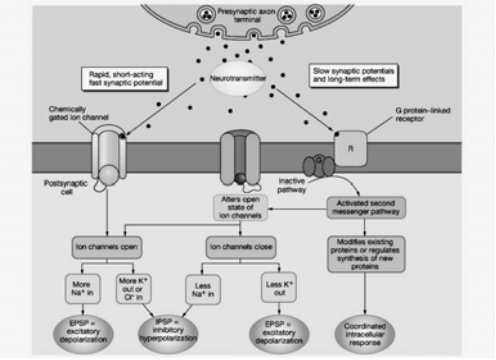
# Neurocrines

**Table 8-4: Major Neurocrines (continued)**

| CHEMICAL | RECEPTOR | TYPE* | RECEPTOR LOCATION | KEY RECEPTOR AGONISTS/ANTAGONISTS** |
|---|---|---|---|---|
| **Amino Acids** | | | | |
| Glutamate | Glutaminergic | | | |
| | AMPA | ICR ($Na^+$, $K^+$) | CNS | |
| | NMDA | ICR ($Na^+$, $K^+$, $Ca^{2+}$) | CNS | |
| GABA (γ-aminobutyric acid) | GABA | ICR ($Cl^-$) GPCR | CNS | |
| Glycine | Glycine | ICR ($Cl^-$) | CNS | |
| **Purines** | | | | |
| Adenosine | Purine ($P_1$) | GPCR | CNS | |
| **Gases** | | | | |
| Nitric oxide (NO) | None | N/A | N/A | |

* ICR = ion channel-receptor, GPCR = G protein-coupled receptor. AMPA = α-amino-3-hydroxy-5-methylisoxazole-4-propionic acid. NMDA = N-methyl-D-aspartate. LSD = lysergic acid diethylamine. N/A = Not applicable.
** This list does not include many chemicals that are used as agonists and antagonists in physiological research.

## Possible mechanisms of NT action




## Neurotransmitters and Receptors

- ACh receptor (cholinergic)
  - nicotinic
  - muscarinic
- NE and E receptor (adrenergic)
  - $\alpha_1$ and $\alpha_2$ (alpha)
  - $\beta_1$ and $\beta_2$ (beta)

## Acetylcholine

- nicotinic receptor

  *... is a $Na^+$ / $K^+$channel*

- muscarinic receptor

  *... is a G-protein coupled receptor that links to 2nd messenger; five known forms*

## Norepinephrine/Epinephrine

- adrenergic receptors, alpha and beta

  *... are G-protein coupled receptors, linked to 2nd messengers*

## Neurotransmission of signals

–*Describe the basic organization of the nervous system.*

–*List the steps in neurotransmission.*

## Organization of the Nervous System

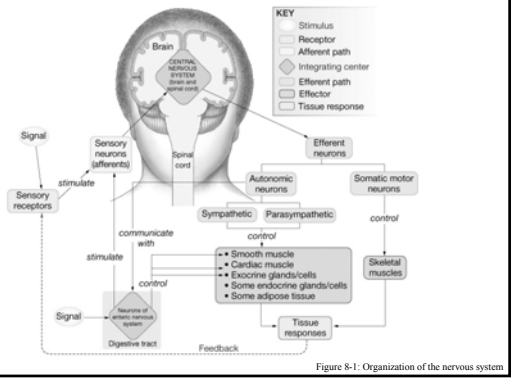



Figure 8-1: Organization of the nervous system