Section B2: The Nature Of Nerve Signals (continued)

4. Chemical or electrical communication between cells occurs at synapses
5. Neural integration occurs at the cellular level
6. The same neurotransmitter can produce different effects on different types of cells
4. Chemical or electrical communication between cells occurs at synapses

- Electrical Synapses.
  - Action potentials travels directly from the presynaptic to the postsynaptic cells via gap junctions.
• Chemical Synapses.
  
  • More common than electrical synapses.
  
  • Postsynaptic chemically-gated channels exist for ions such as Na\(^+\), K\(^+\), and Cl\(^-\).

  • Depending on which gates open the postsynaptic neuron can depolarize or hyperpolarize.
Fig. 48.12
5. Neural integration occurs at the cellular level

- Excitatory postsynaptic potentials (EPSP) depolarize the postsynaptic neuron.
  - The binding of neurotransmitter to postsynaptic receptors open gated channels that allow Na$^+$ to diffuse into and K$^+$ to diffuse out of the cell.
• **Inhibitory postsynaptic potential (IPSP)** hyperpolarize the postsynaptic neuron.

• The binding of neurotransmitter to postsynaptic receptors open gated channels that allow K+ to diffuse out of the cell and/or Cl- to diffuse into the cell.
• **Summation**: graded potentials (EPSPs and IPSPs) are summed to either depolarize or hyperpolarize a postsynaptic neuron.
6. The same neurotransmitter can produce different effects on different types of cells

- Acetylcholine.
  - Excitatory to skeletal muscle.
  - Inhibitory to cardiac muscle.
  - Secreted by the CNS, PNS, and at vertebrate neuromuscular junctions.
• Biogenic Amines.

  • **Epinephrine** and **norepinephrine**.
    • Can have excitatory or inhibitory effects.
    • Secreted by the CNS and PNS.
    • Secreted by the adrenal glands.
• Dopamine
  • Generally excitatory; may be inhibitory at some sites.
    • Widespread in the brain.
    • Affects sleep, mood, attention, and learning.
  • Secreted by the CNS and PNS.
  • A lack of dopamine in the brain is associated with Parkinson’s disease.
  • Excessive dopamine is linked to schizophrenia.
• **Serotonin.**
  
  • Generally inhibitory.
  
  • Widespread in the brain.
  
  • Affects sleep, mood, attention, and learning
  
  • Secreted by the CNS.
• **Amino Acids**

• **Gamma aminobutyric acid (GABA).**
  
  • Inhibitory.

  • Secreted by the CNS and at invertebrate neuromuscular junctions.
• Glycine.
  • Inhibitory.
  • Secreted by the CNS.
• Glutamate.
  • Excitatory.
  • Secreted by the CNS and at invertebrate neuromuscular junctions.
• Aspartate.
  • Excitatory.
  • Secreted by the CNS.
• Neuropeptides.
  • Substance P.
    • Excitatory.
    • Secreted by the CNS and PNS.
• **Met-enkephalin** (an endorphin).
  • Generally inhibitory.
  • Secreted by the CNS.
• \textbf{Gasses} that act as local regulators.
  • Nitric oxide.
  • Carbon monoxide.