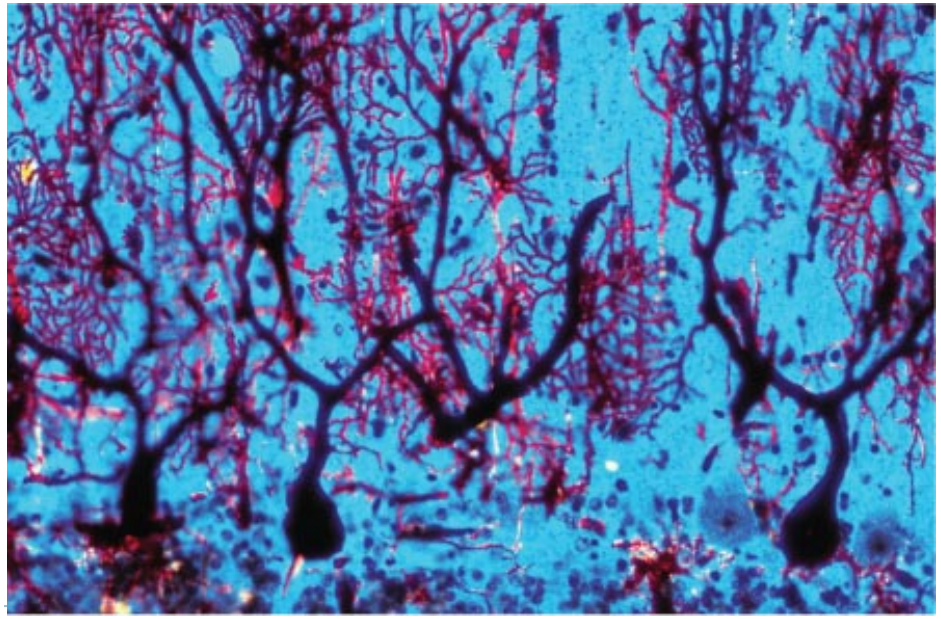
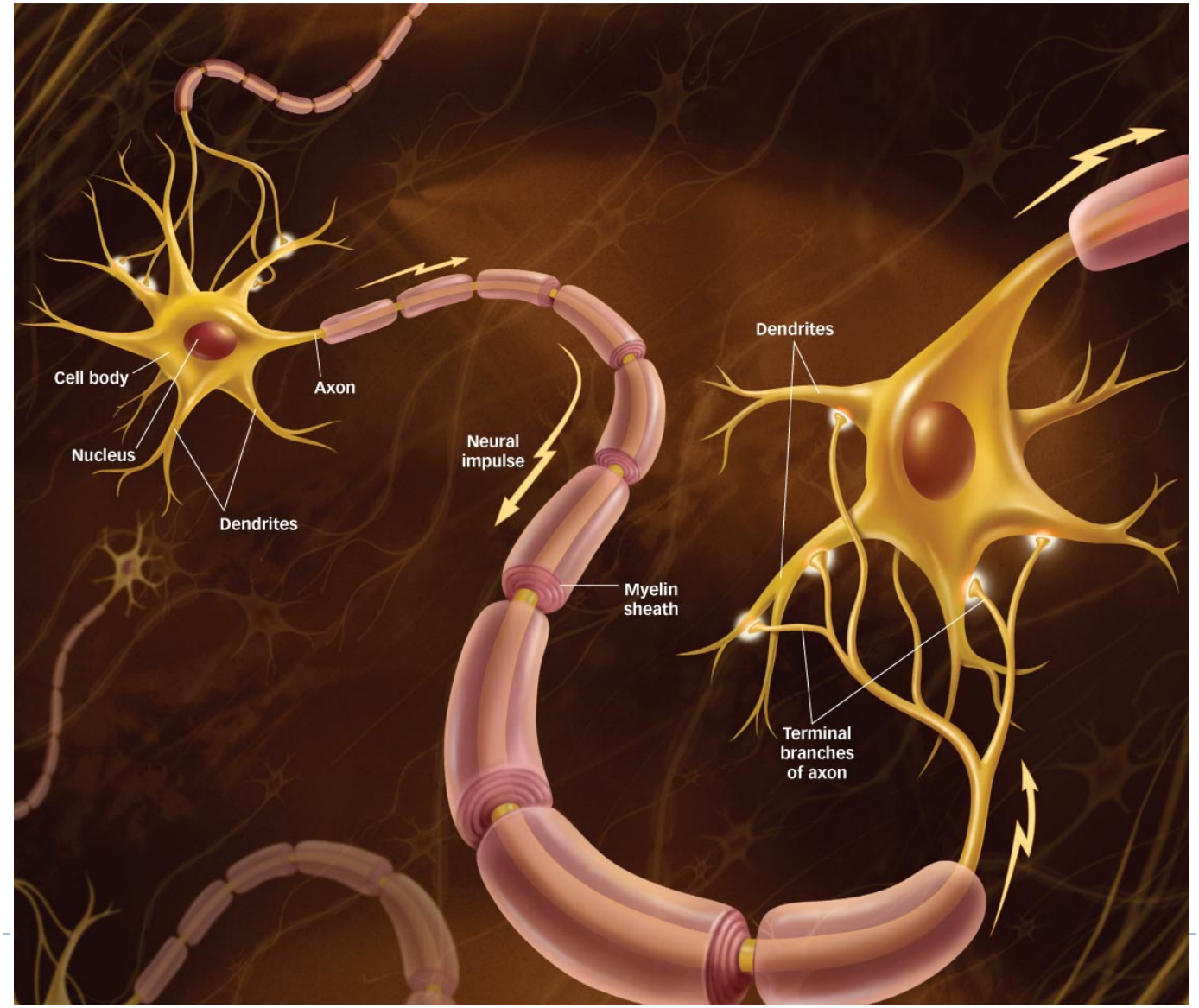
Neuroscience and Behavior

Neurons: The Origin of Behavior

- **Neurons**: cells in the nervous system that communicate with one another to perform information-processing tasks
- **Santiago Ramón y Cajal** (1852-1934): first stained neurons in the brain



Components of a Neuron

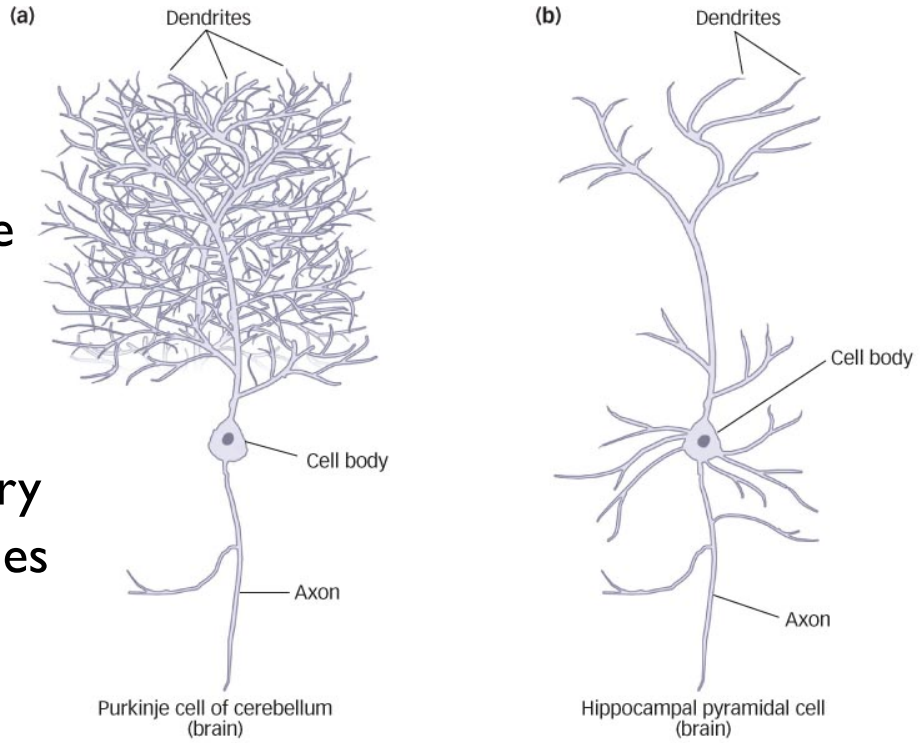


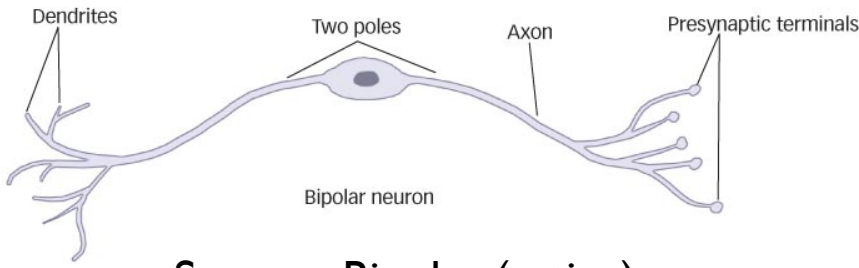
Types of Neurons

- **Sensory neurons**: neurons that receive information from the external world and convey this information to the brain via the spinal cord
- **Motor neurons**: neurons that carry signals from the spinal cord to the muscles to produce movement
- **Interneurons**: neurons that connect sensory neurons, motor neurons, or other interneurons

Interneuron Purkinje (Cerebellum)

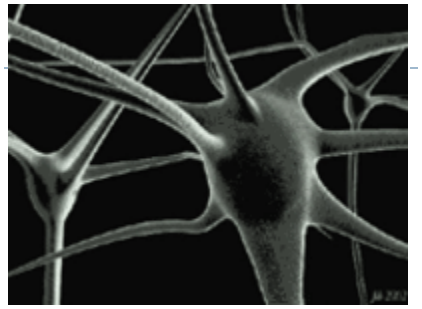
Interneuron Pyramidal (Cerebral Cortex)





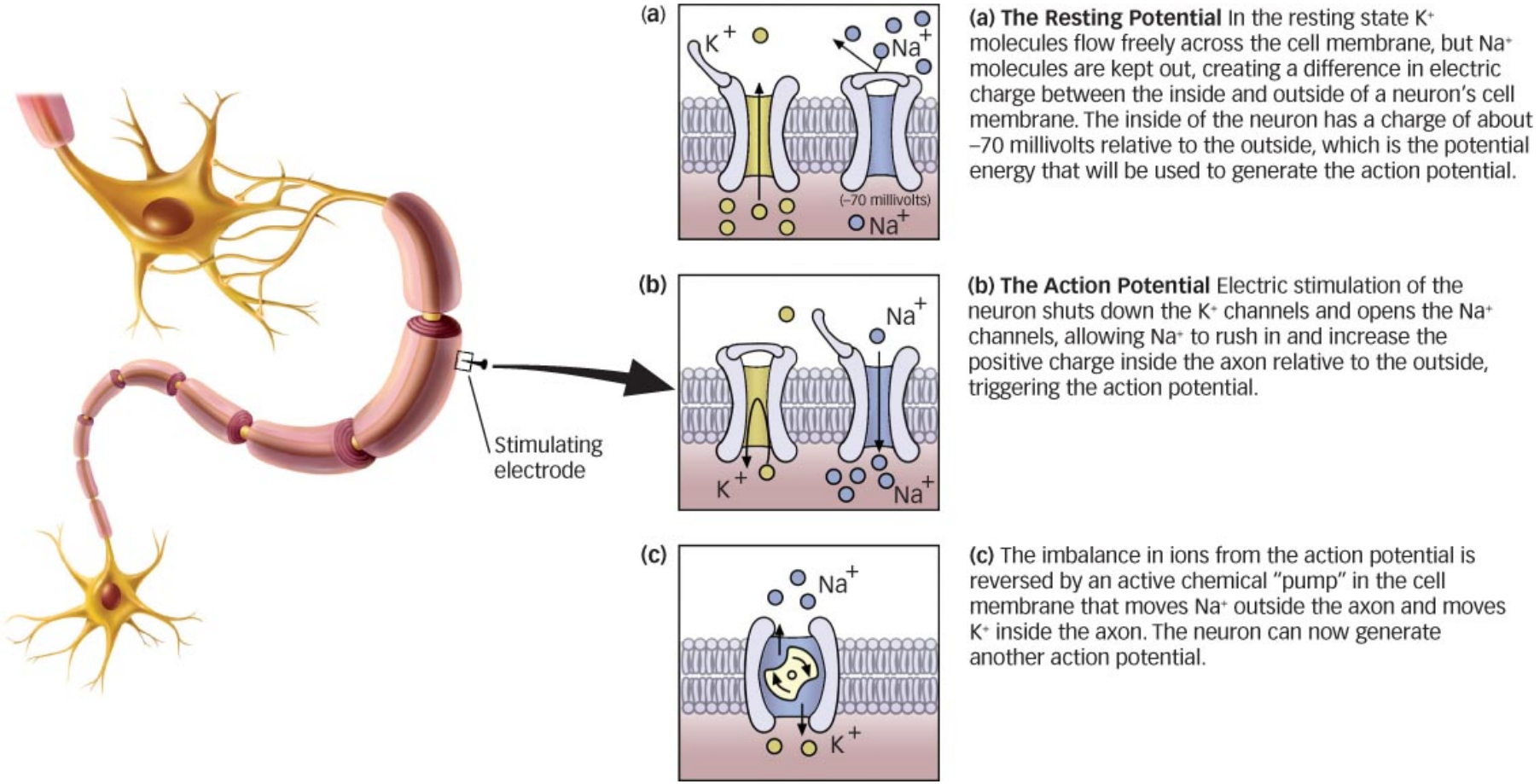
Sensory Bipolar (retina)

Embodied Cognition



- **Mirror neurons**
  - Neurons that fire both when the animal is performing the action and when it observes another animal performing the action.

Electric Signaling: Conducting Information Within a Neuron
The Resting and Action Potentials

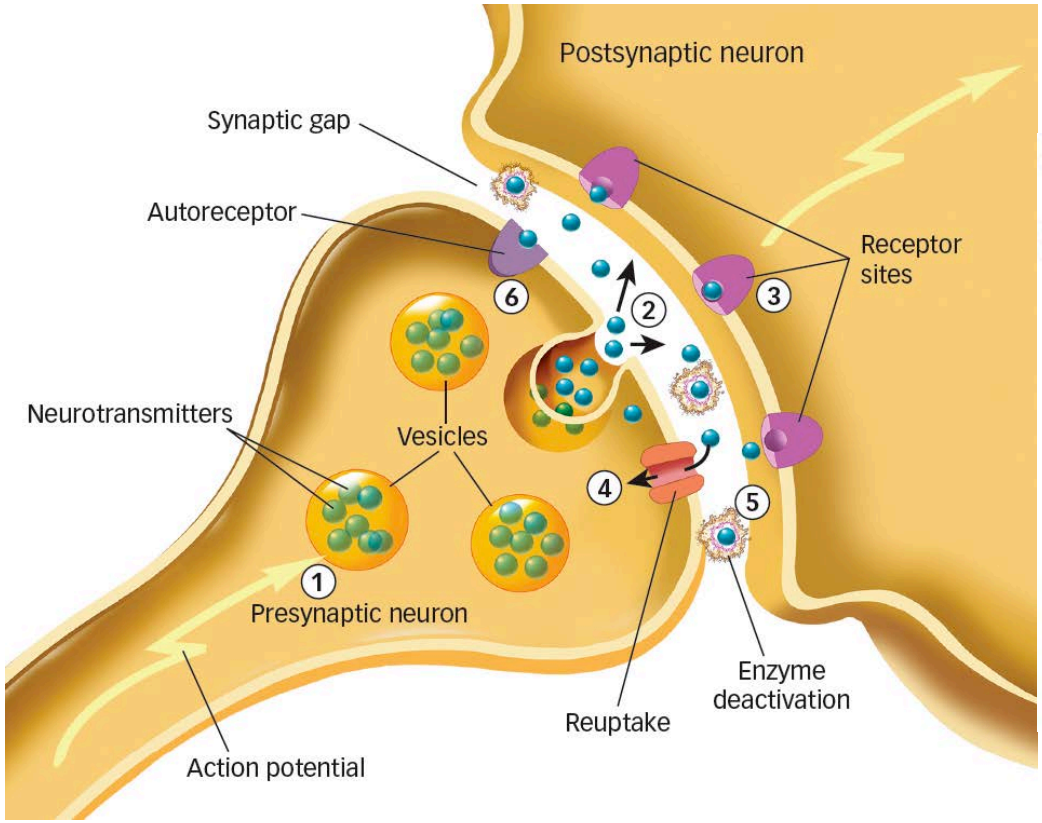


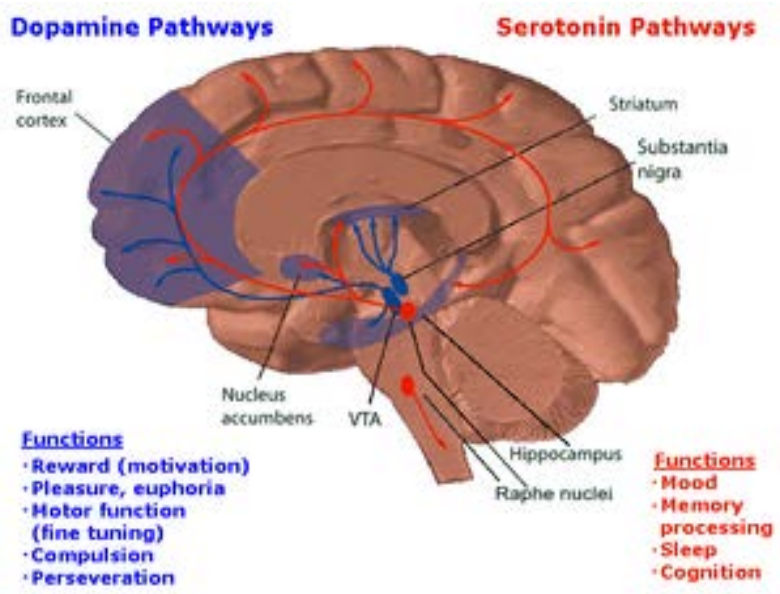
(a) The Resting Potential In the resting state K^+ molecules flow freely across the cell membrane, but Na^+ molecules are kept out, creating a difference in electric charge between the inside and outside of a neuron's cell membrane. The inside of the neuron has a charge of about –70 millivolts relative to the outside, which is the potential energy that will be used to generate the action potential.

(b) The Action Potential Electric stimulation of the neuron shuts down the K^+ channels and opens the Na^+ channels, allowing Na^+ to rush in and increase the positive charge inside the axon relative to the outside, triggering the action potential.

(c) The imbalance in ions from the action potential is reversed by an active chemical "pump" in the cell membrane that moves Na^+ outside the axon and moves K^+ inside the axon. The neuron can now generate another action potential.

Synaptic Transmission



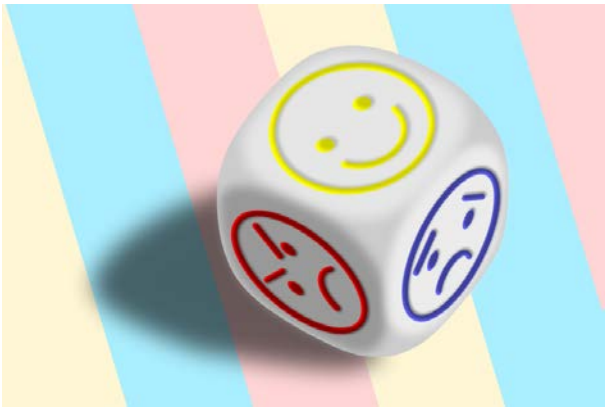


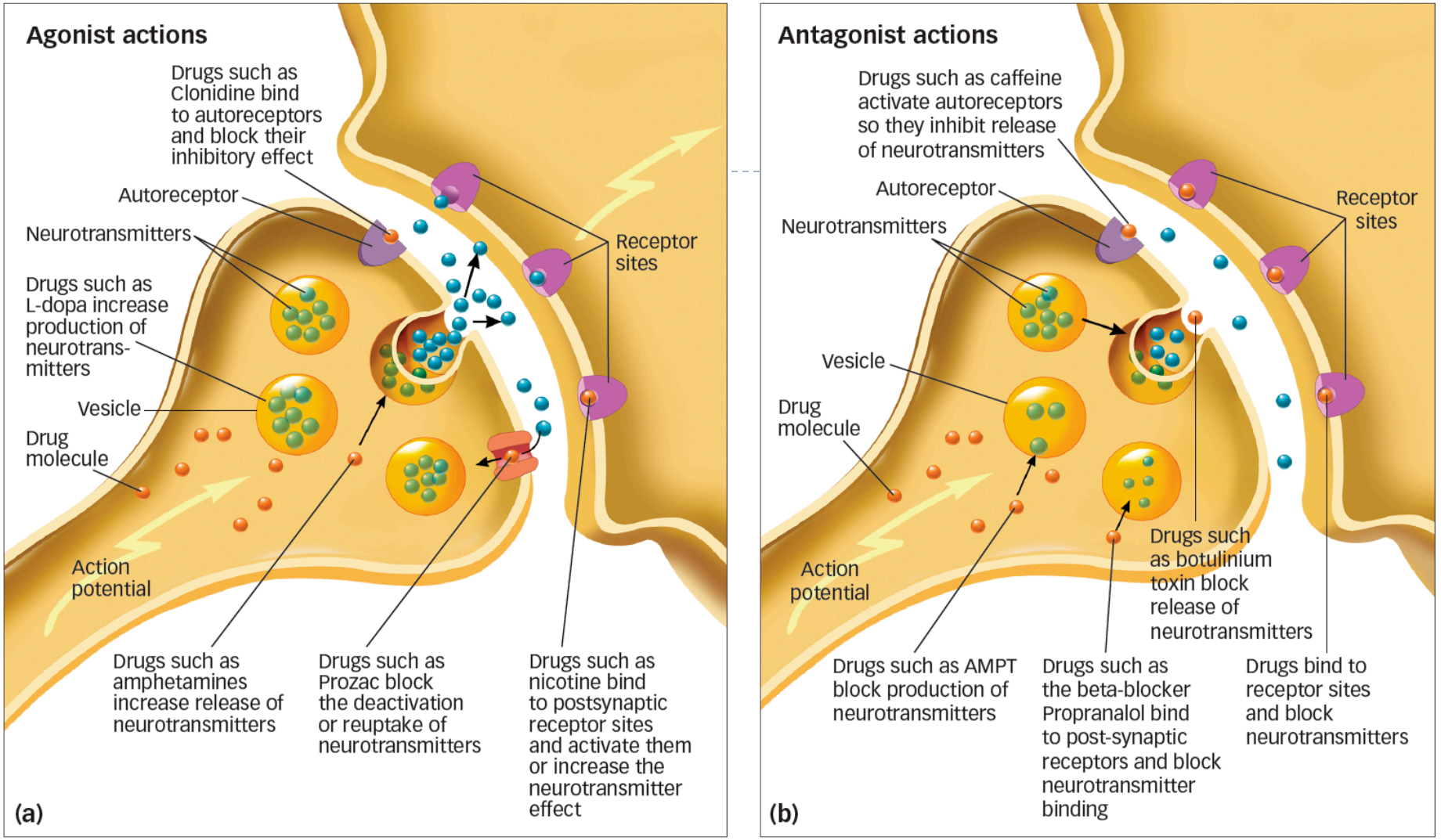
Types and Functions of Neurotransmitters

- **Acetylcholine (ACh)**: involved in a number of functions including voluntary motor control
- **Dopamine (DA)**: regulates motor behavior, motivation, pleasure, and emotional arousal
- **Glutamate**: major excitatory neurotransmitter involved in information transmission throughout the brain
- **GABA**: major inhibitory neurotransmitter in the brain

Types and Functions of Neurotransmitters

- **Norepinephrine (NE)**: influences mood and arousal
- **Serotonin (5-HT)**: involved in the regulation of sleep and wakefulness, eating, and aggressive behavior
- **Endorphins**: chemicals that act within the pain pathways and emotion centers of the brain





The Actions of Agonist and Antagonist Drugs