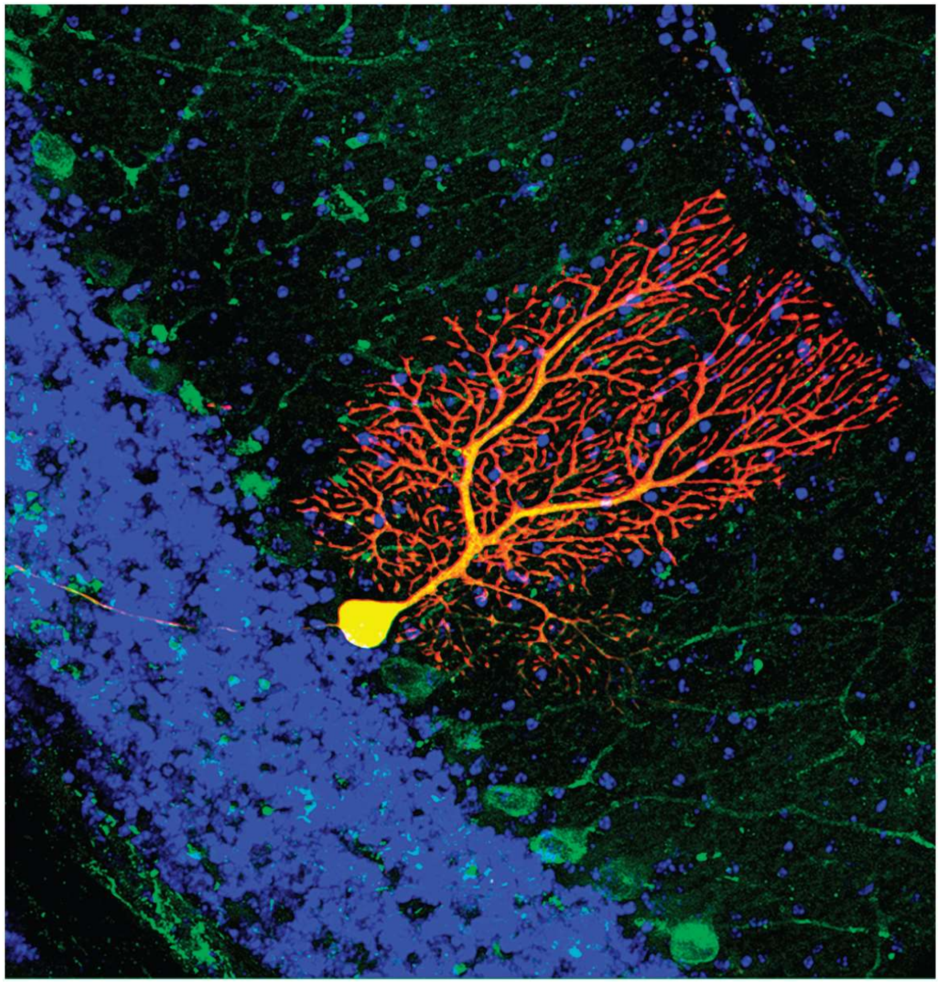
Chapter 12

Neural Coding



Neural Circuits

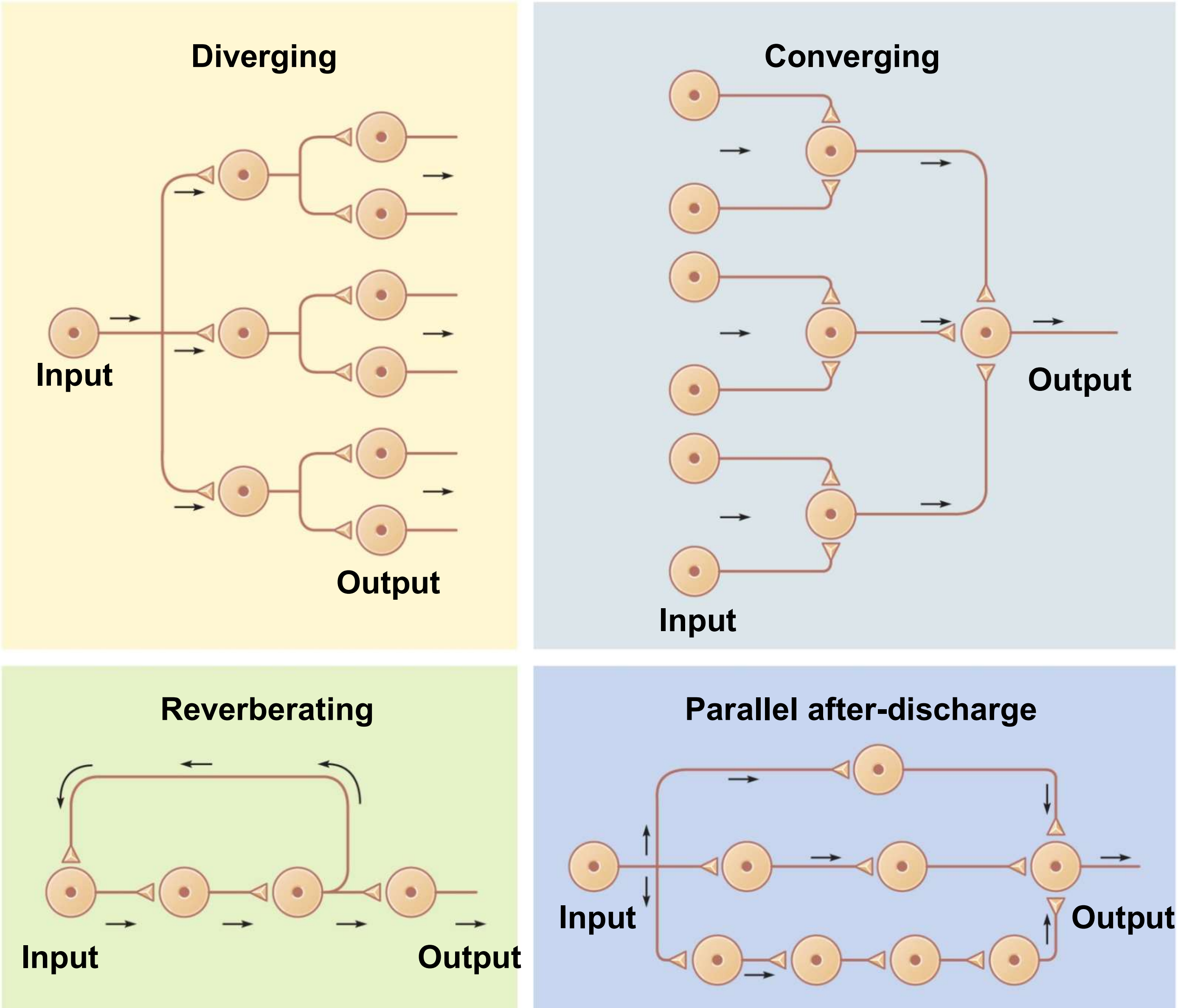


Figure 12.30

Memory and Synaptic Plasticity

- physical basis of memory is a pathway through the brain called a **memory trace** or **engram**
  - along this pathway, new synapses were created or existing synapses modified to make transmission easier
  - **synaptic plasticity –** the ability of synapses to change
  - **synaptic potentiation** - the process of making transmission easier
- kinds of memory
  - **immediate**, **short**- and **long-term** memory
  - correlate with different modes of synaptic potentiation

Immediate Memory

- **immediate memory** – the ability to hold something in your thoughts for just a few seconds
  - essential for reading ability
- feel for the flow of events (sense of the present)
- our memory of what just happened "echoes" in our minds for a few seconds
  - reverberating circuits

Short-Term or Working Memory

- **short-term memory (STM)** - lasts from a few seconds to several hours
  - quickly forgotten if distracted
  - calling a phone number we just looked up
  - reverberating circuits
- facilitation causes memory to last longer
  - **tetanic stimulation** – rapid arrival of repetitive signals at a synapse // causes Ca^{2+} accumulation and postsynaptic cell more likely to fire
  - **post-tetanic potentiation** - to jog a memory
    - Ca^{2+} level in synaptic knob stays elevated
    - little stimulation needed to recover memory

Long-Term Memory

- types of long-term memory
  - **declarative** - retention of events that you can put into words
  - **procedural** - retention of motor skills
- physical remodeling of synapses // new branching of axons or dendrites
- molecular changes - **long-term potentiation**
  - changes in receptors and other features increases transmission across "experienced" synapses
  - effect is longer-lasting

Molecular Changes and Long-Term Memory

- molecular changes are called **long-term potentiation**
- method described
  - receptors on synaptic knobs are usually blocked by Mg^{+2} ions
  - when bind glutamate and receive tetanic stimuli, they repel Mg^{+2} and admit Ca^{+2} into the dendrite – Ca^{+2} acts as second messenger
    - more synaptic knob receptors are produced
    - synthesizes proteins involved n synapse remodeling
    - releases nitric oxide that triggers more neurotransmitter release at presynaptic neuron