

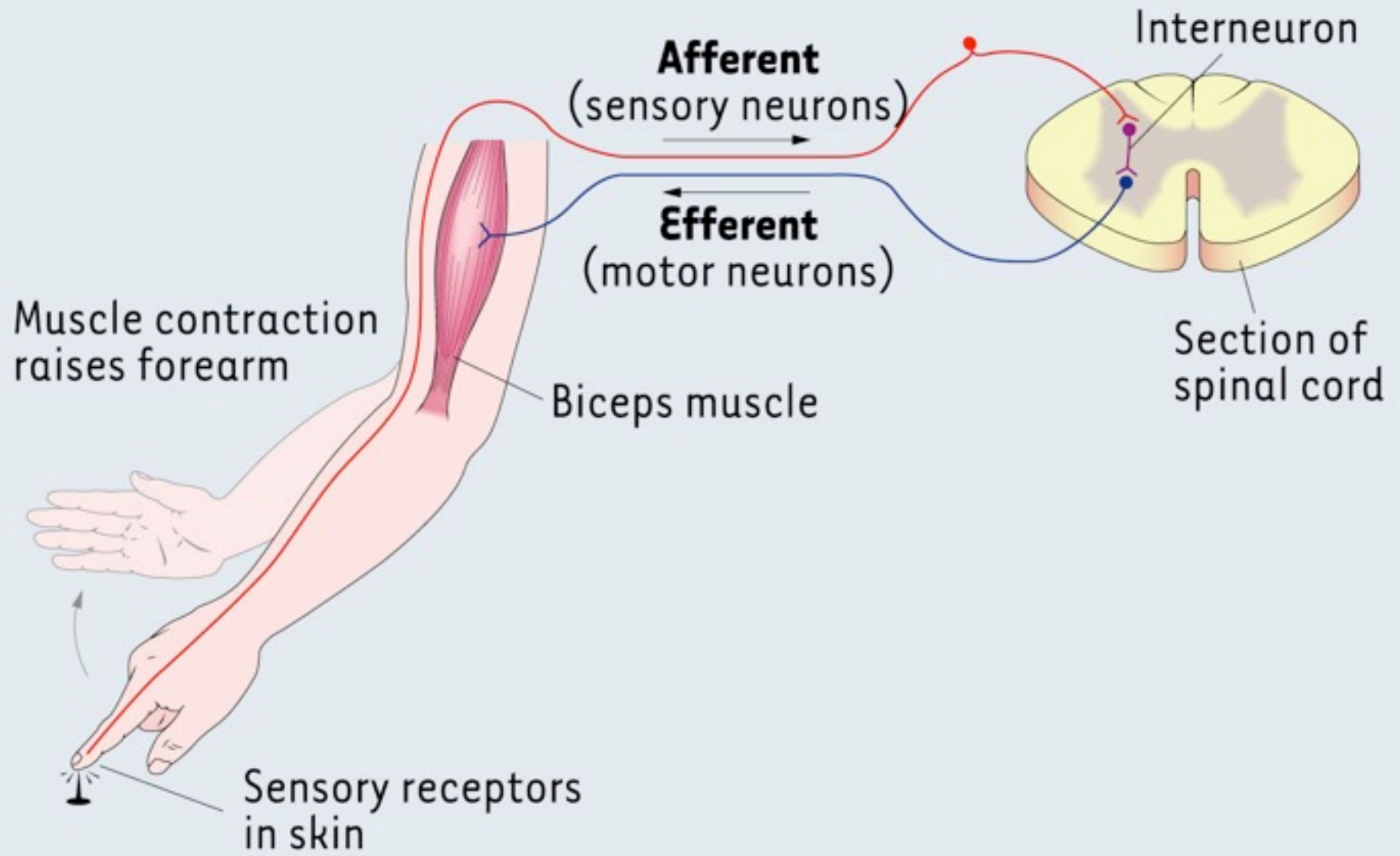
Neurons: Consciousness as an Emergent Property

One ant is no ant.

A million ants is a viable community of organisms that exhibits coordinated, “self-directed” behaviour.

One neuron is no neuron.

100 billion neurons is you.



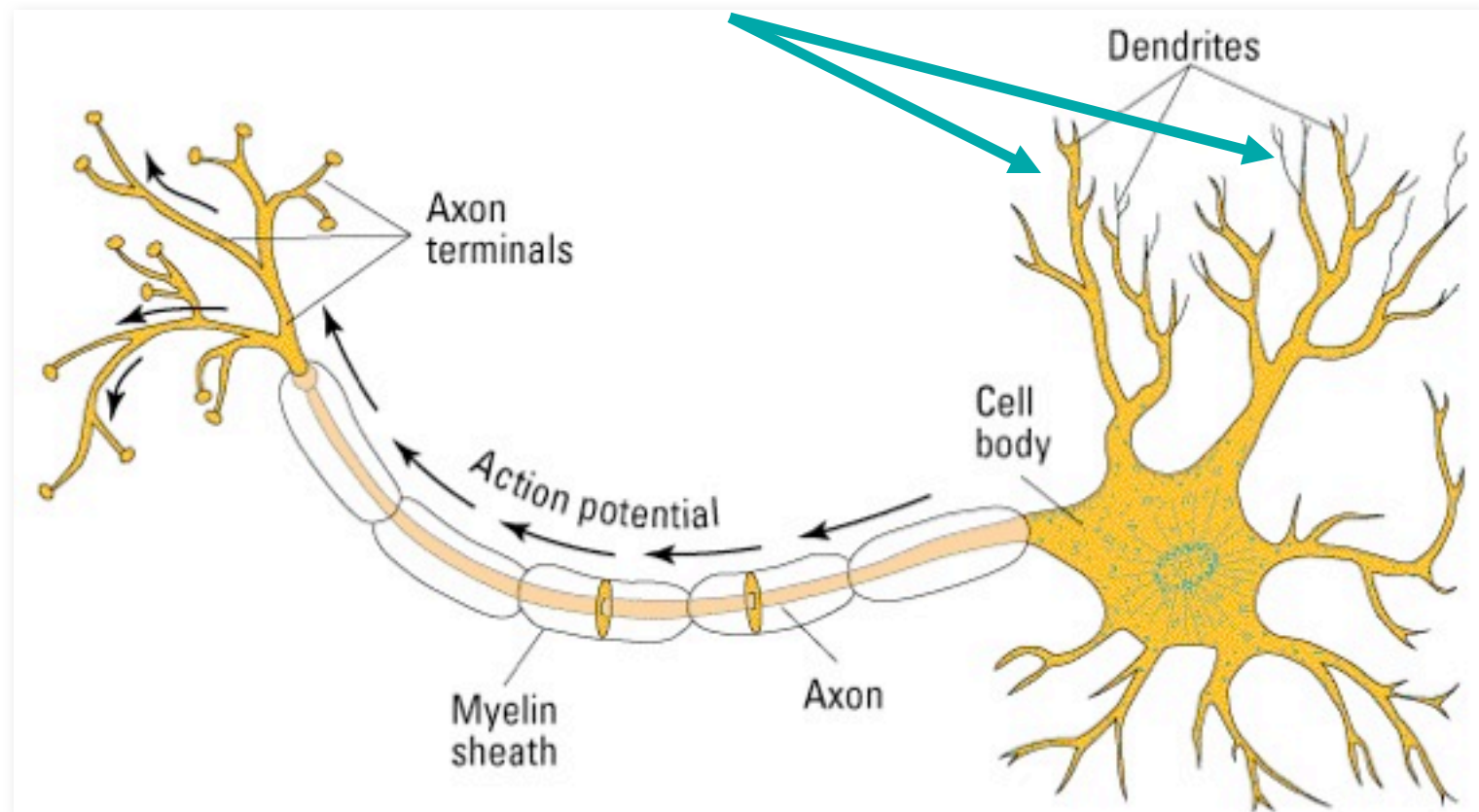
Interneurons:

Interneurons vastly outnumber Motor and Sensory Neurons (several million of each compared to ~100 billion interneurons)

Interneurons facilitate within-CNS transmission of information

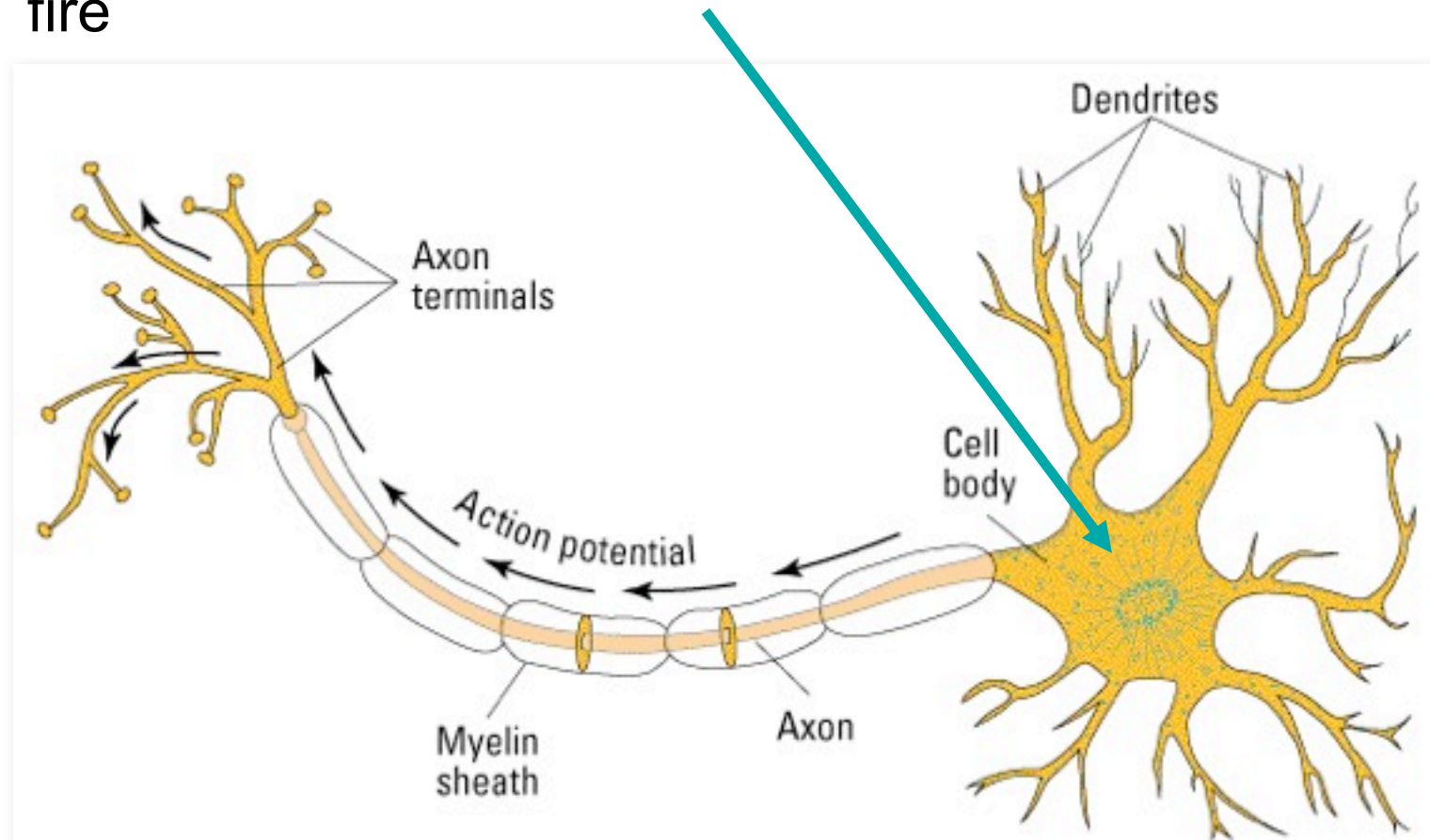
Structure of a Neuron

- Dendrites
 - receive information from other neurons and transmit towards the cell body



Structure of a Neuron

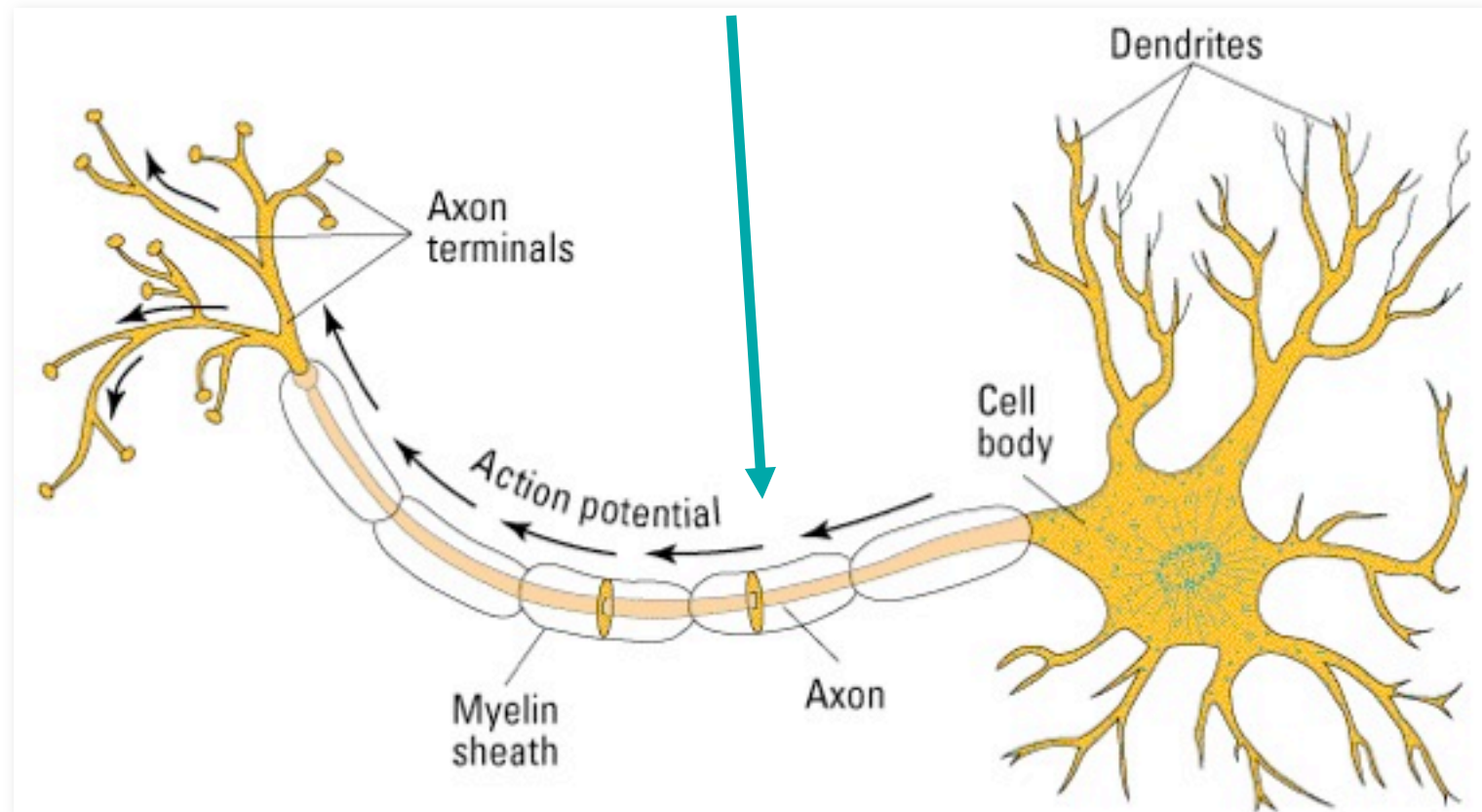
- Cell body
 - keeps the neuron alive and determines whether it will fire



Structure of a Neuron

- Axon

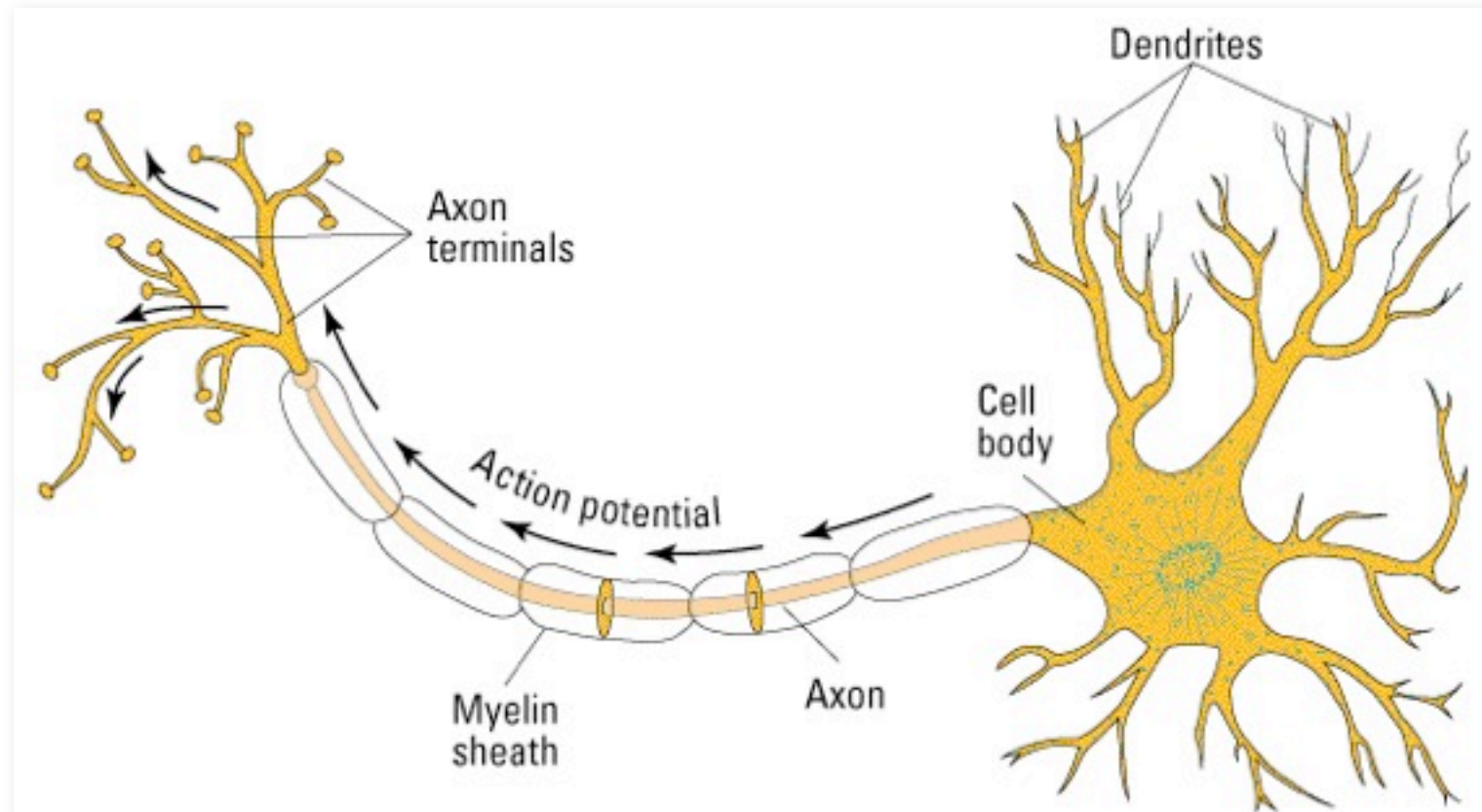
extending fiber that conducts impulses away from the cell body



Structure of a Neuron

- Myelin Sheath

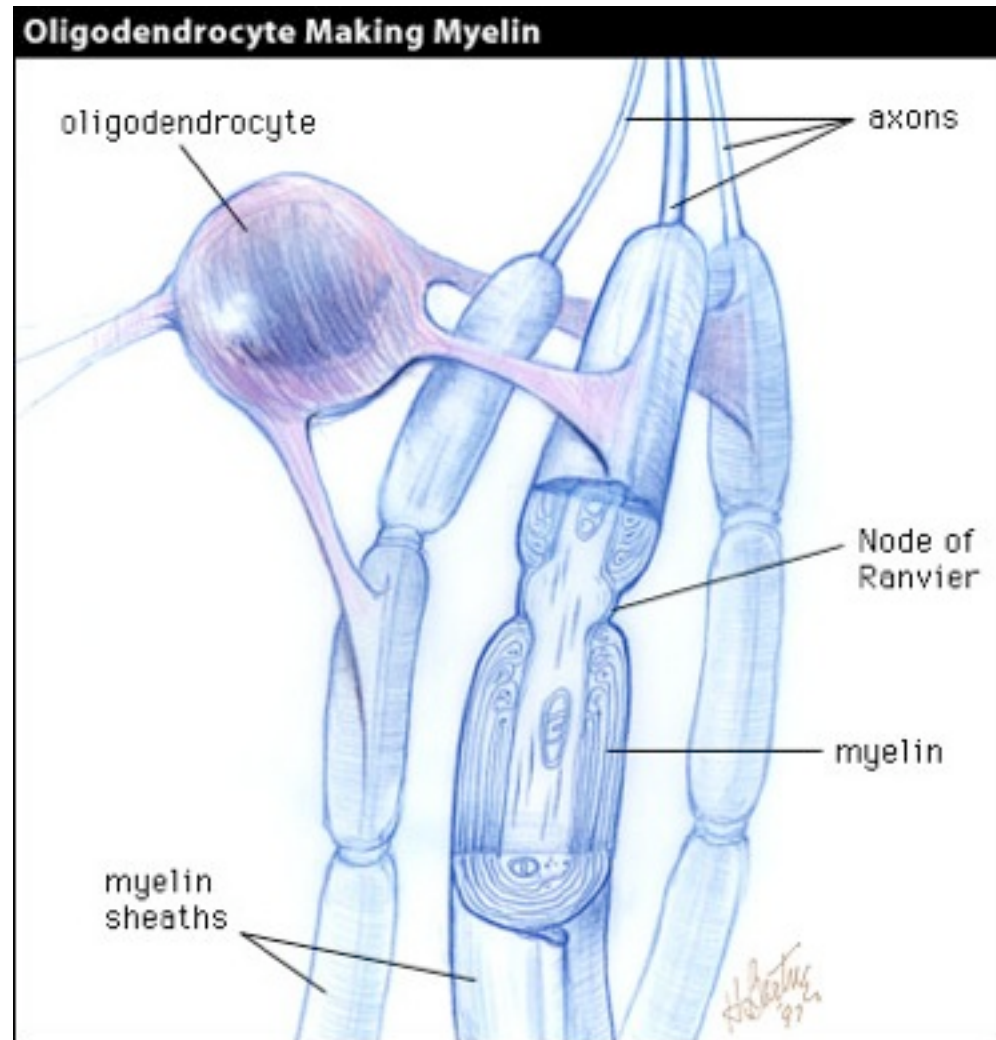
Fatty insulation that may surround the neuron's axon



Myelin

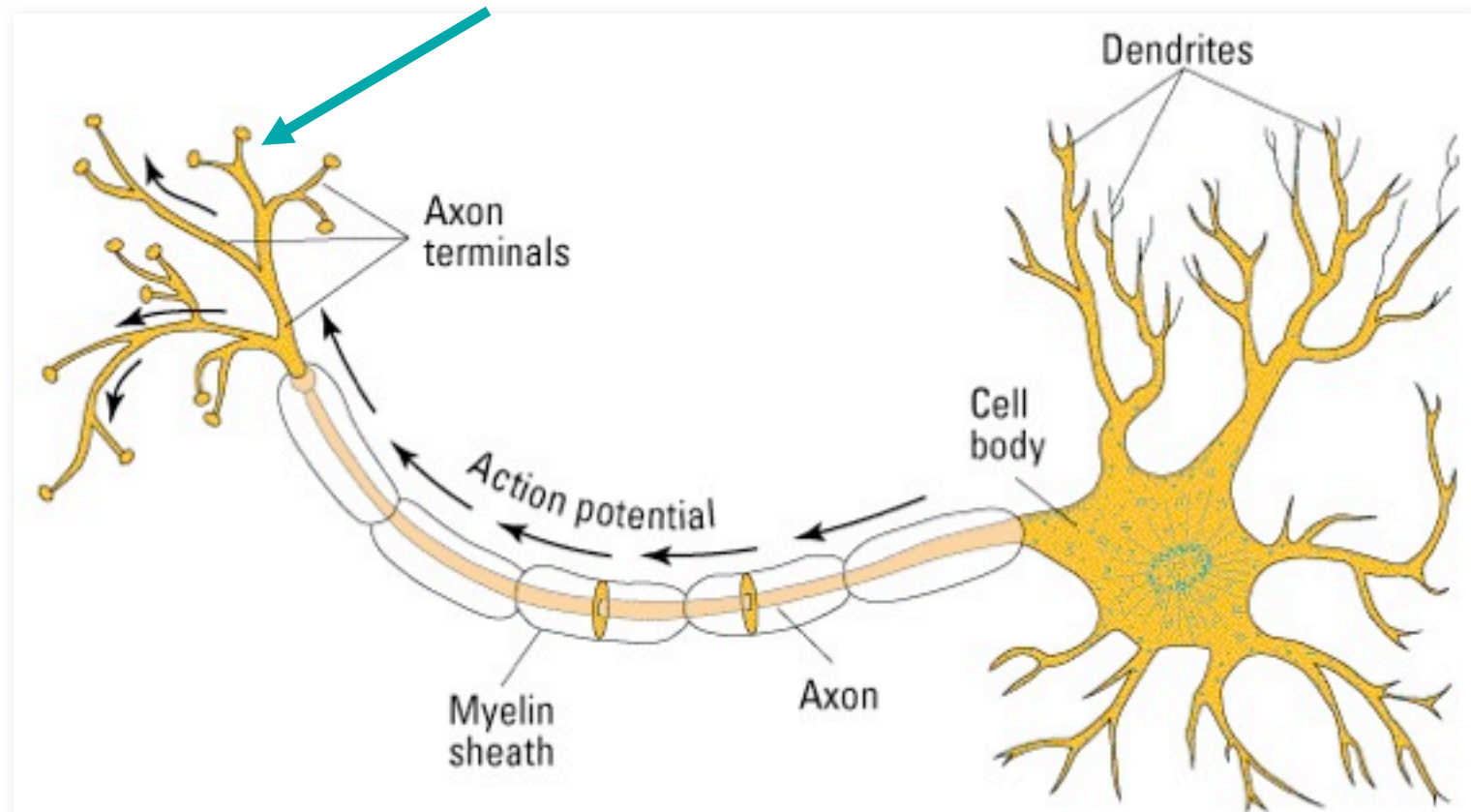
Myelin prevents signals in adjacent cells from interfering with each other, reducing resistance, thereby speeding up the conduction of neural impulses.

- Multiple sclerosis is caused by a loss of myelin
- Myelination of brain regions accompanies many developmental leaps



Structure of a Neuron

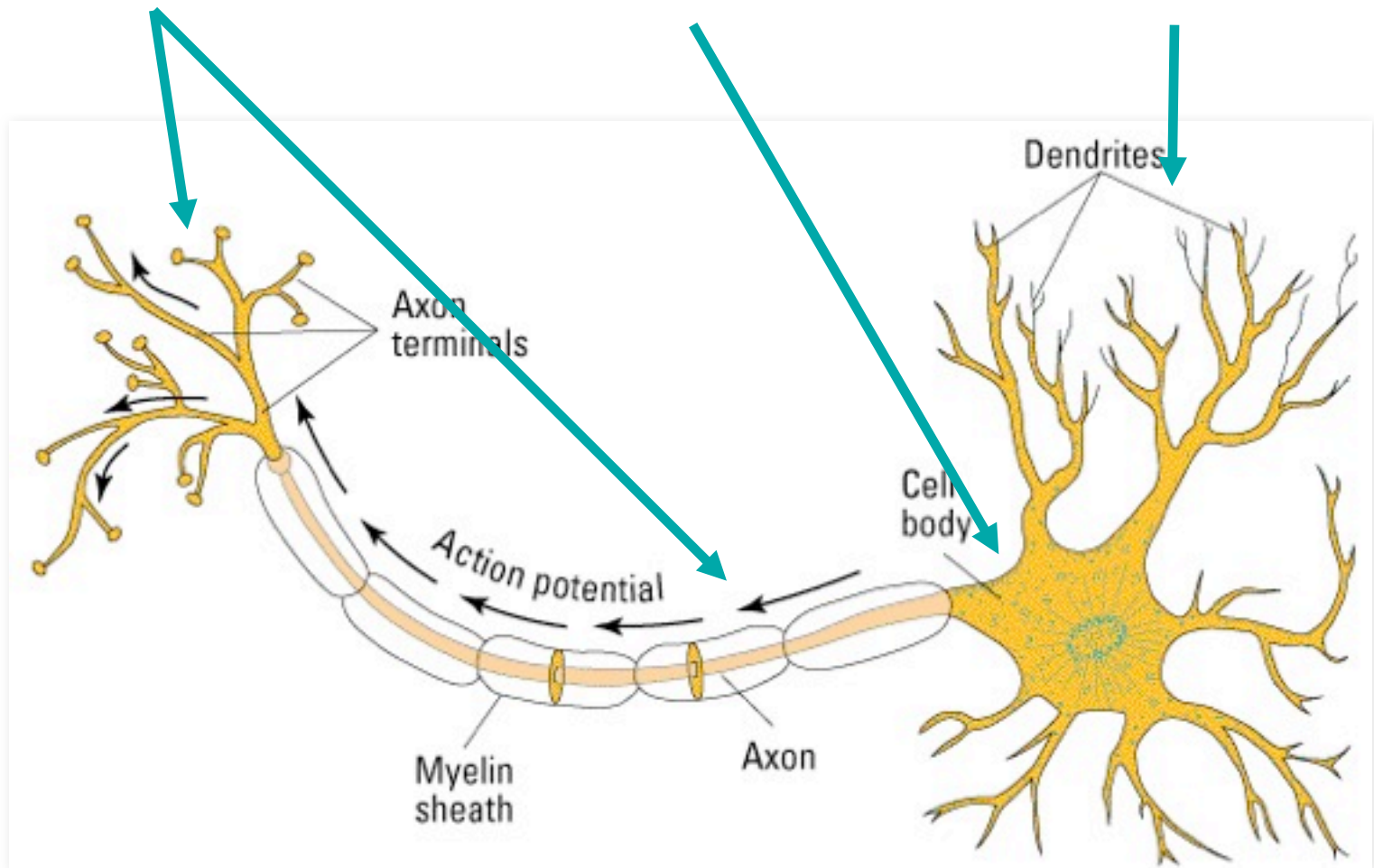
- **Terminal Buttons (or Axon Terminals)**
receive the action potential from the axon and transmit information on to other neurons through release of neurotransmitters



Information
Transmission

Information
Integration

Information
Collection



Neurons are Communication Devices

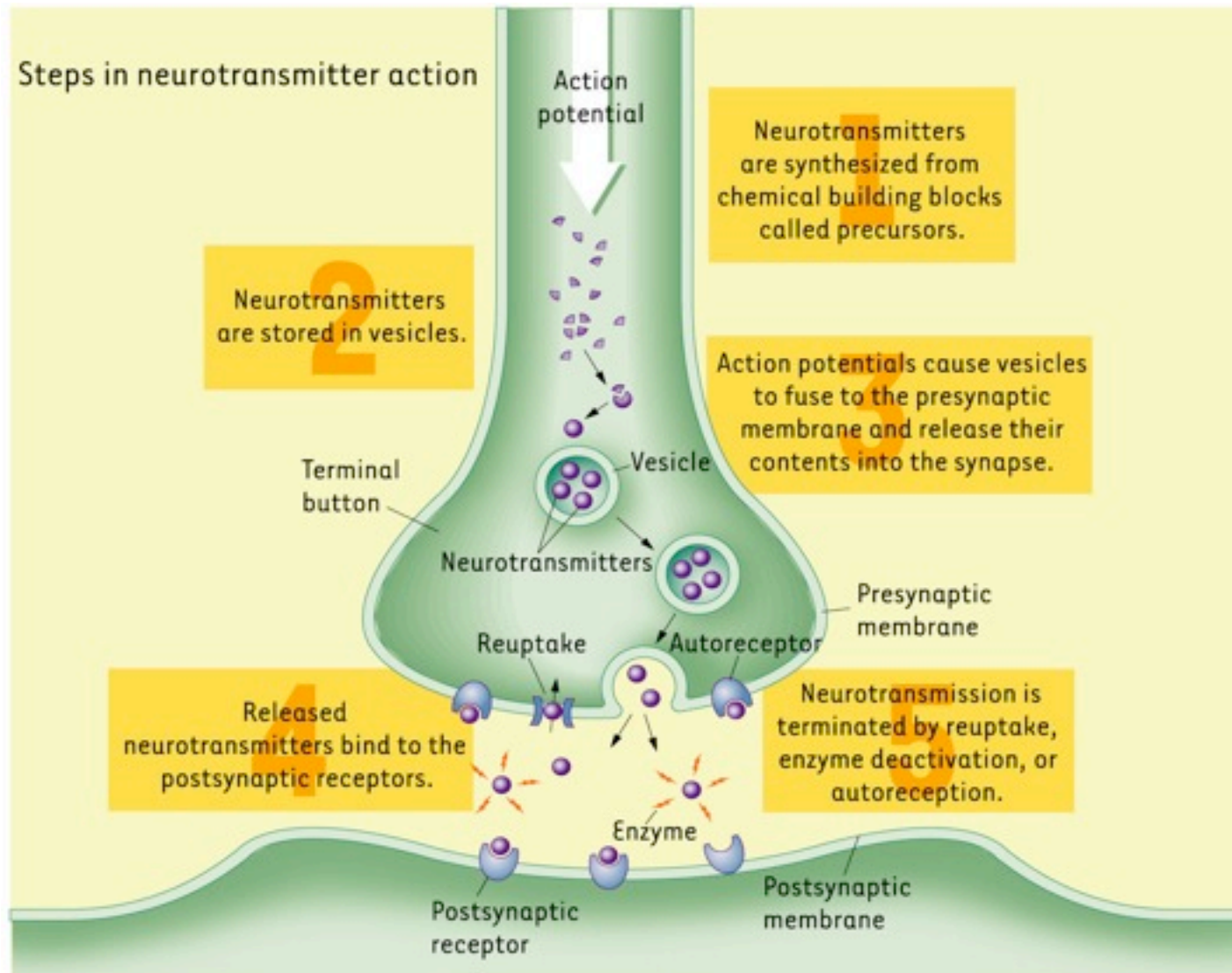
Whether neurons “talk” or not depends entirely on **electrical charges**, which in turn depend on **chemical interactions**.

Electrical → Chemical

At the **terminal buttons**, the electric charge causes little sacs (**vesicles**) to release chemicals called **neurotransmitters**

These are released into the **synaptic cleft**, the space between the terminal button's membrane, and the dendrites of other neurons.

Neurotransmitters Bind to Receptors Across the Synapse



Key Neurotransmitters

Glutamate: excitatory: cognitive, seizures, motivation

GABA: inhibitory, seizures, anxiety; e.g., Anti-anxiety meds (benzodiazepines (Valium, Xanax) help GABA bind more effectively to post-synaptic receptors

Acetylcholine (ACh): PNS vs. CNS: muscle/motor vs. higher cognition (learning, memory), plasticity, Alzheimer's, etc.

Epinephrine/Nor-e: fundamental arousal/alertness fcts.

Serotonin: mood, emotion, motivation, impulse control, etc.

Dopamine: reward (+ motor functions., planning & many higher-level interactions with cognitive functions.)

and..... then there's a huge variety of other peptides, implicated in basically everything... :)

Dopamine

Dopamine activity in the nucleus accumbens is a practically universal PLEASURE mechanism....and the common bond among drugs of enjoyment, experimentation, and abuse

The Dopamine System

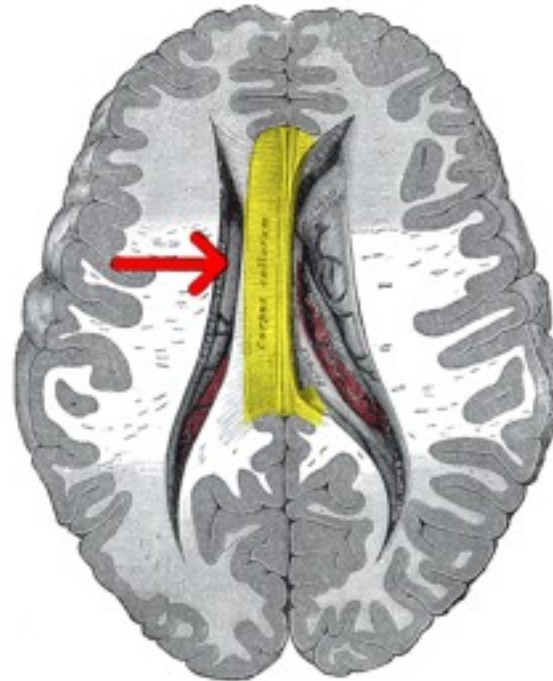
Nestler & Malenka (2004): **Drugs of abuse commandeer the brain's natural reward circuitry. Stimulation of this pathway reinforces behavior, ensuring that what you just did you will do again.**

- therefore, learning is strongly affected by reward, and the rewarding effects of, for e.g., cocaine are mediated through the same mechanisms which have evolved for highly functional, adaptive reasons, like learning and motivation....kind of ironic, isn't it?

The Split Brain

The two hemispheres of the brain are actually two mini-brains connected by a bundle of fibers, the **corpus callosum**

- from the late 1900s until the 1960s, debate raged as to whether cutting the corpus callosum would help people with epilepsy



Being of two minds...

Left hemisphere: logic, linear thinking, language

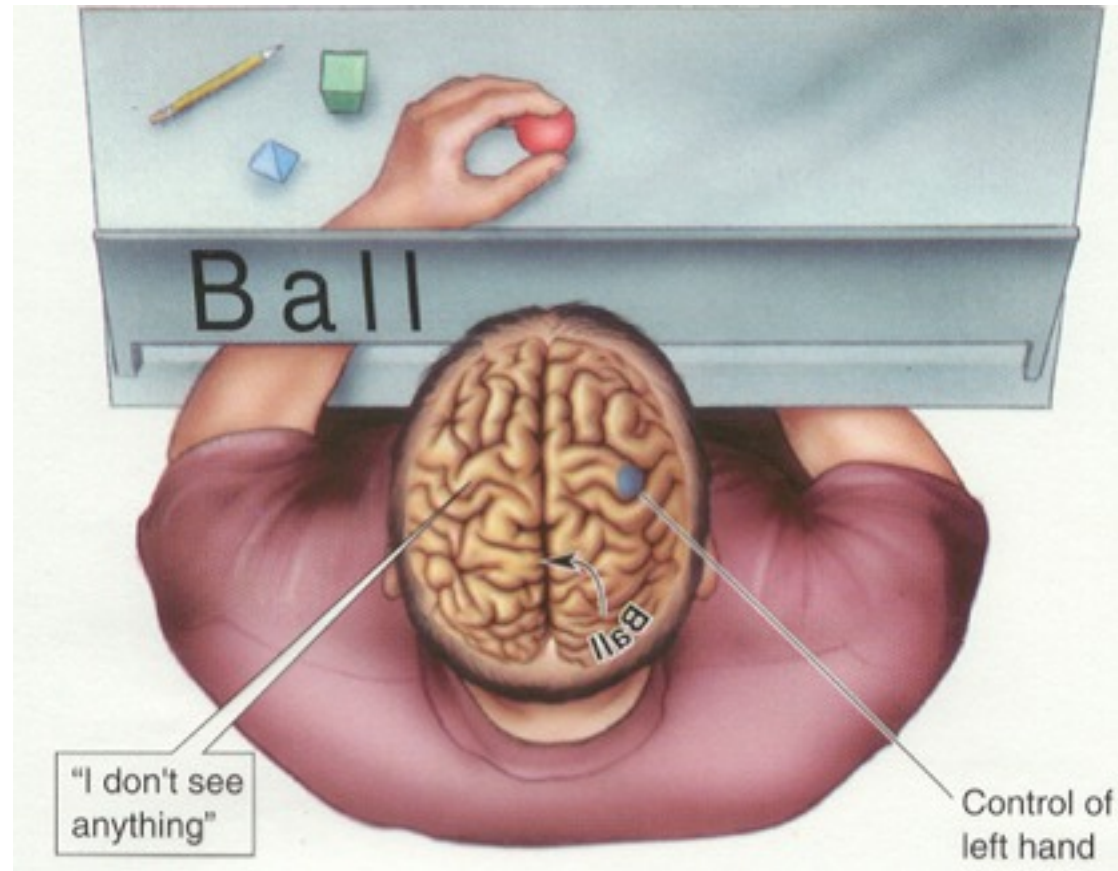
Right hemisphere: emotion, spatial processing,
music

"The great pleasure and feeling in my right brain is more
than my left brain can find the words to tell you."

Roger Sperry

Split-Brain Experiments

When asked to point to the item that was seen, the left hand (RH) pointed to the image seen by the right hemisphere



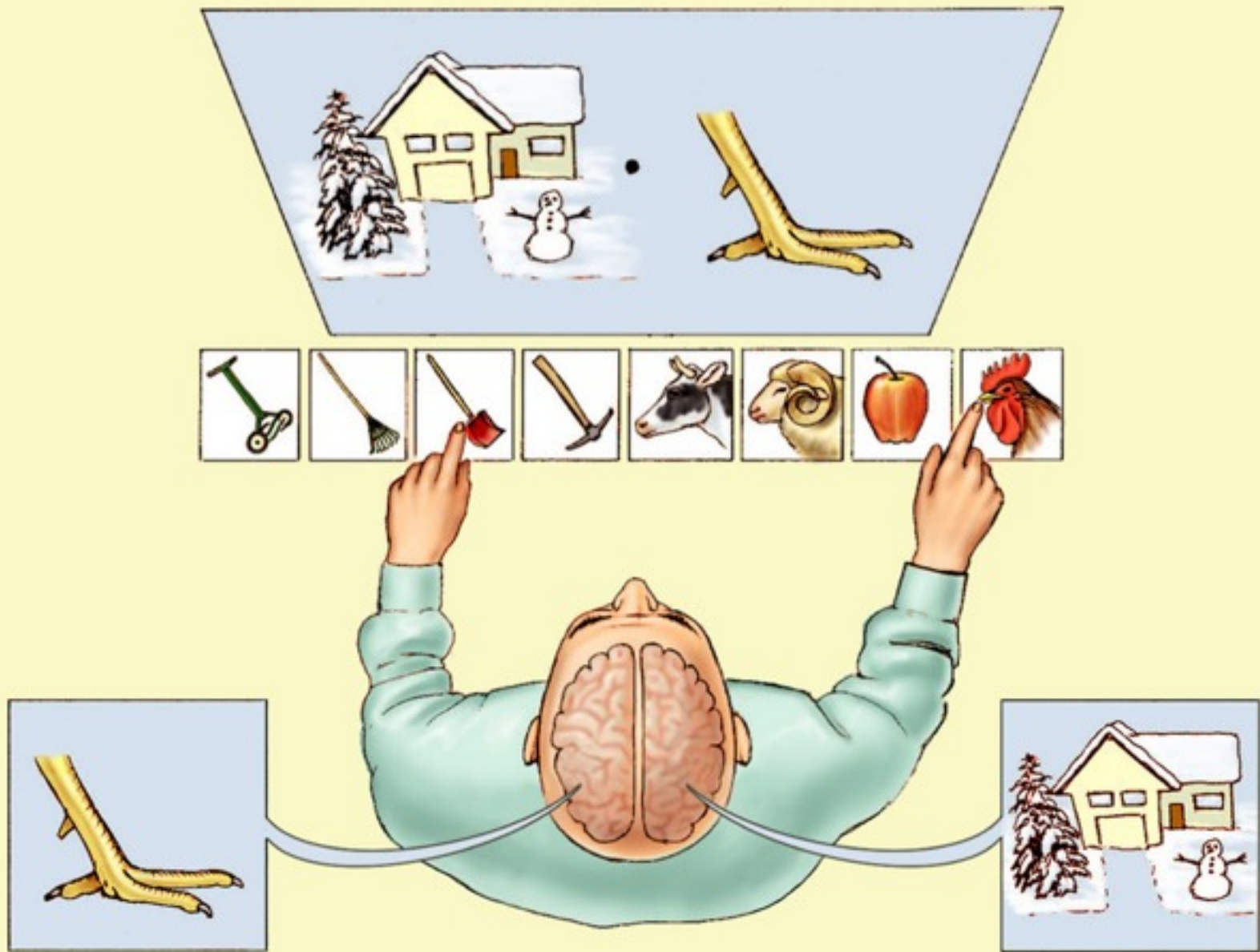


FIGURE 4.19