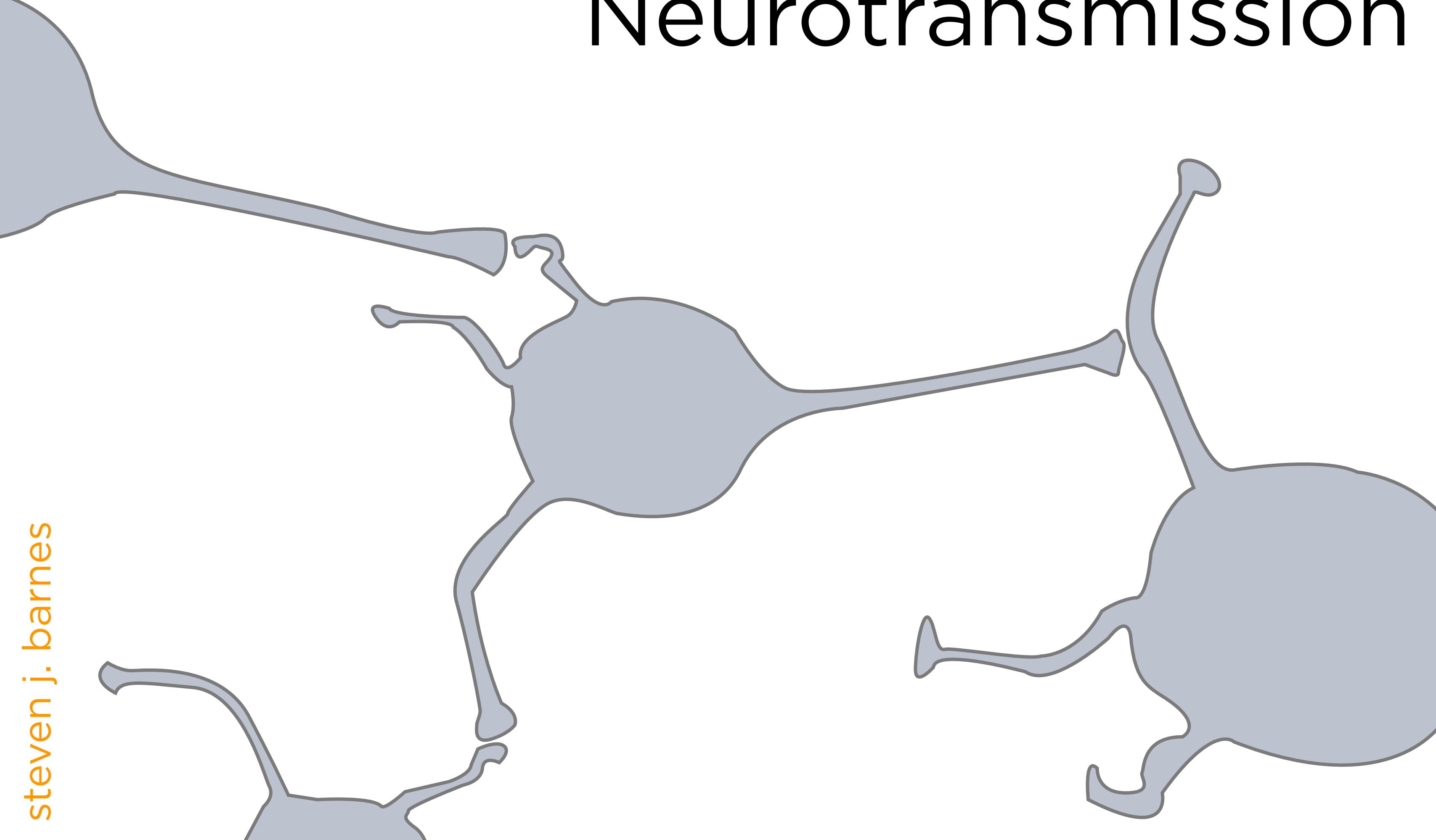


Neurotransmission

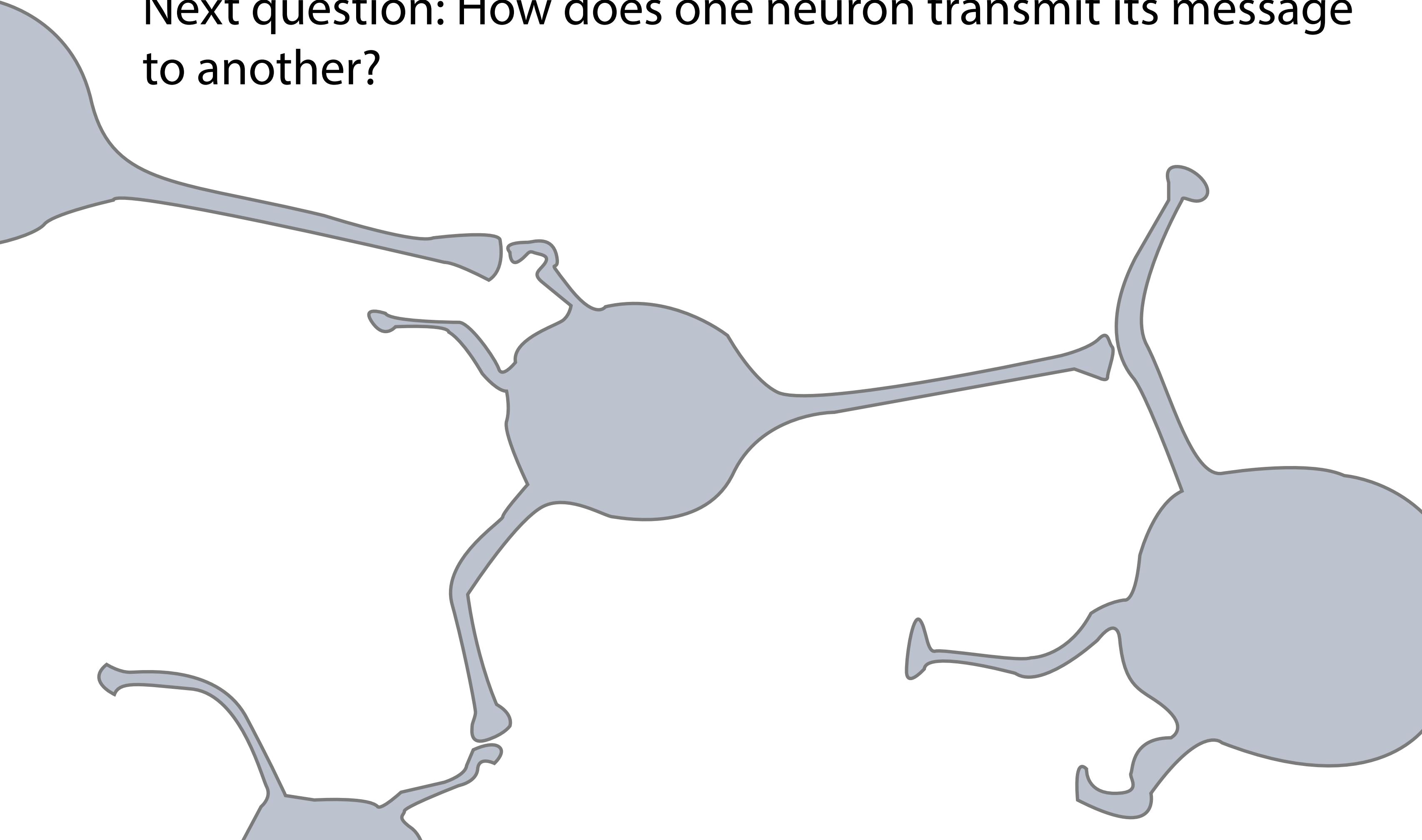


steven j. barnes

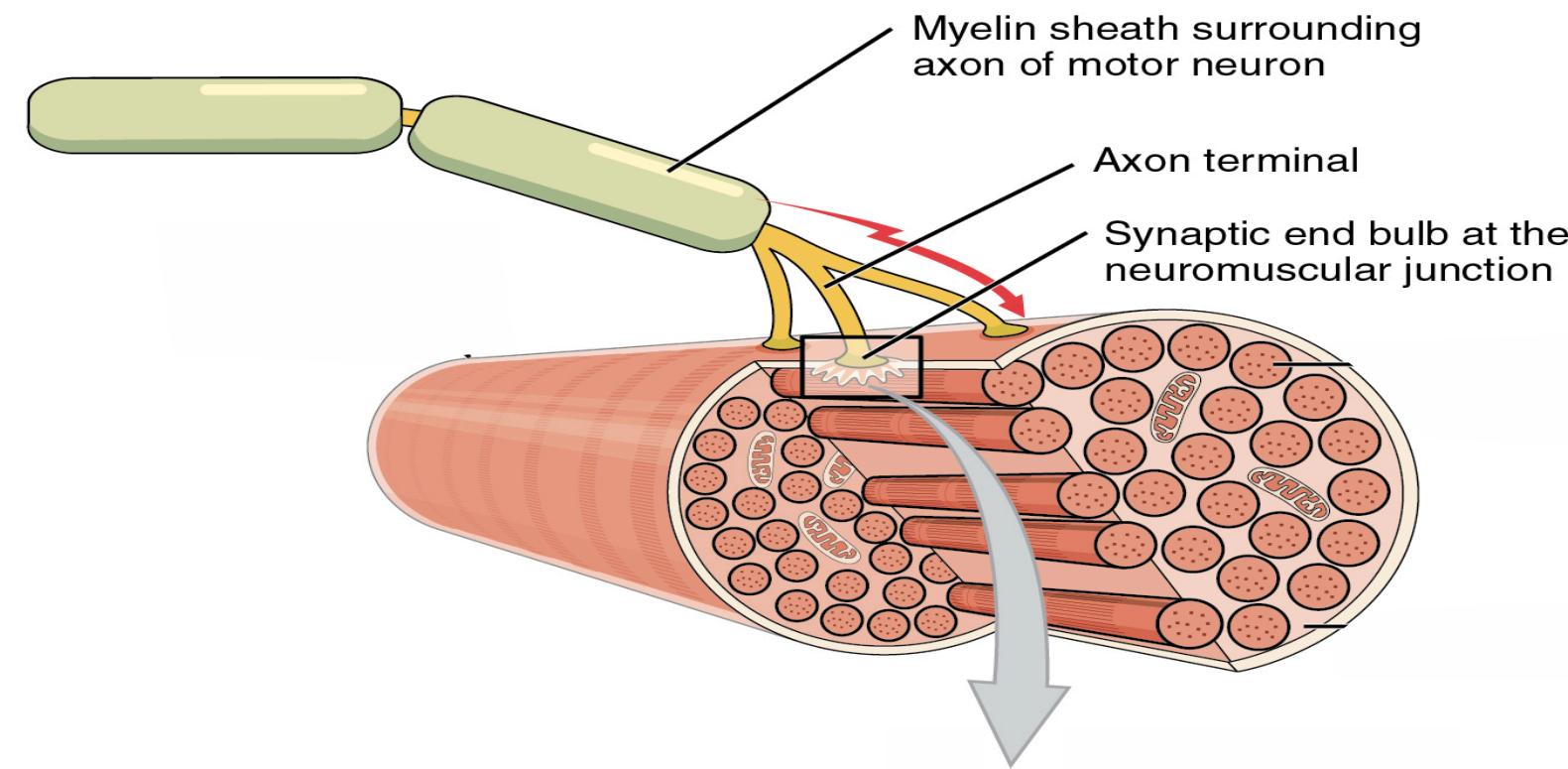
- Name the synapse upon which the classic view of synaptic transmission was based.
- Explain each of the many ways in which the classic view of synaptic transmission was incorrect.
- Explain what is meant by a 'tripartite synapse.'

Lecture Learning Objectives

Next question: How does one neuron transmit its message to another?

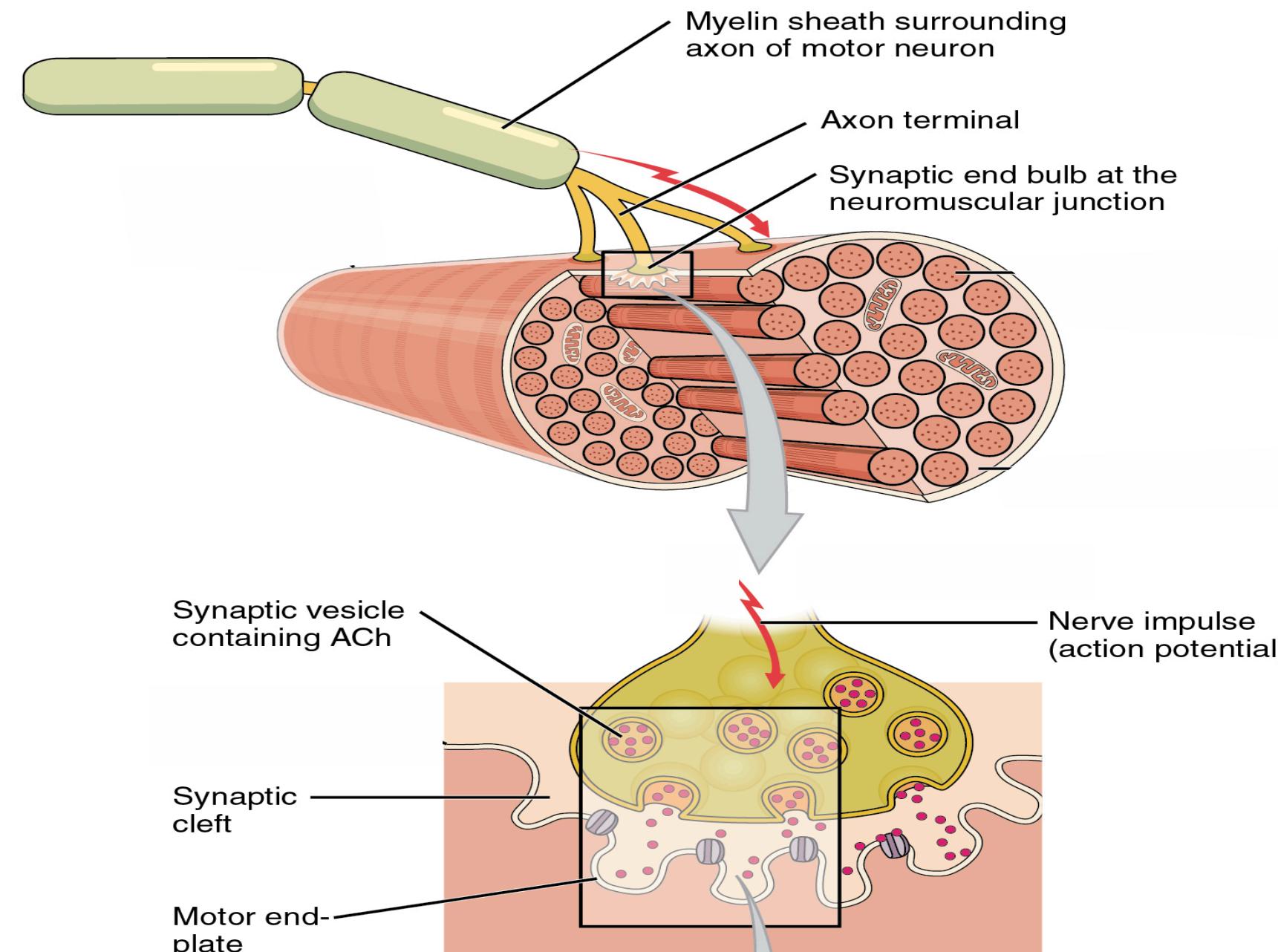


The classic model of neurotransmission was based on work done at one synapse: the neuromuscular junction.



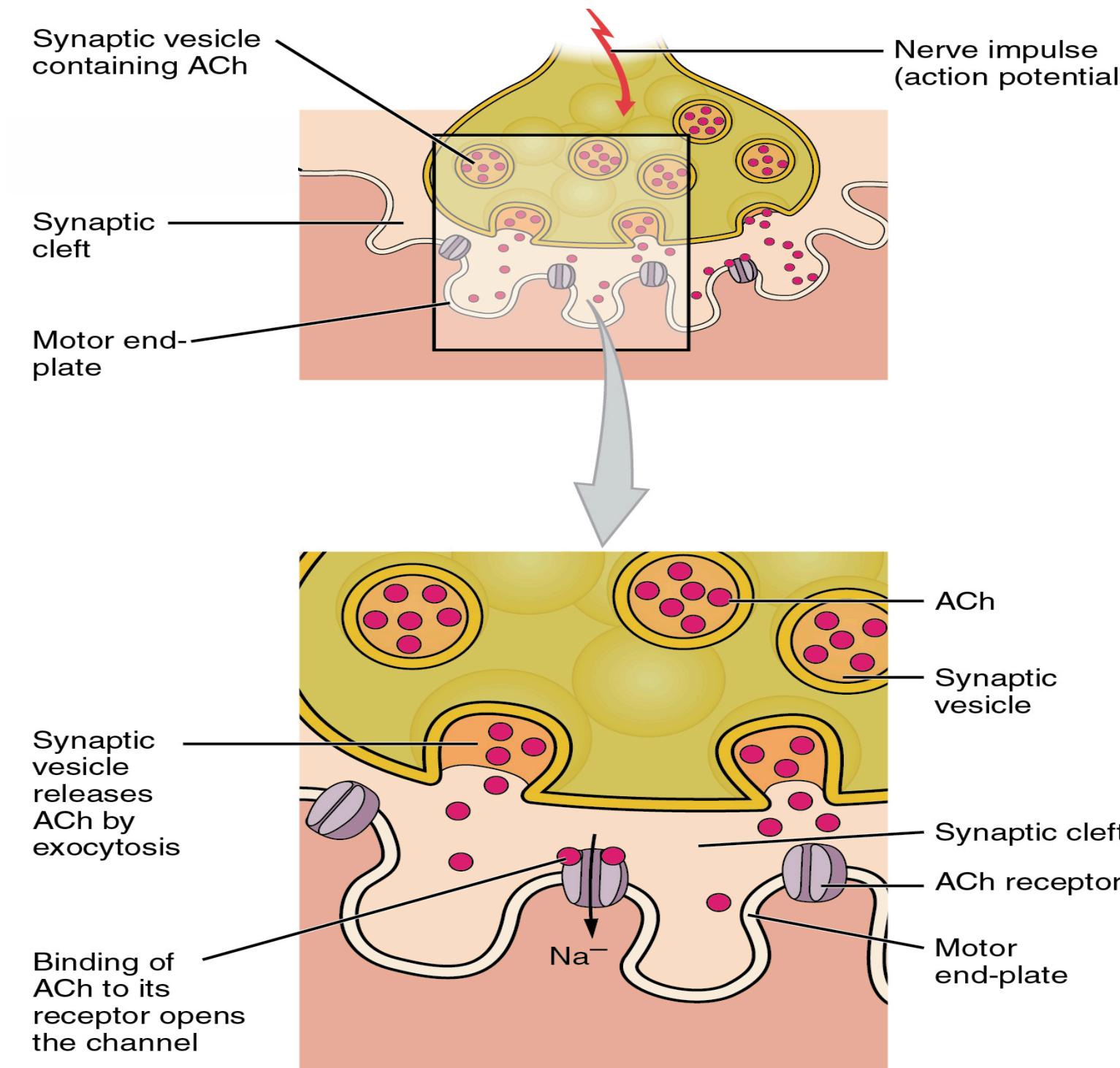
Classic View of Neurotransmission

The classic model of neurotransmission was based on work done at one synapse: the neuromuscular junction.



Classic View of Neurotransmission

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Classic View of Neurotransmission

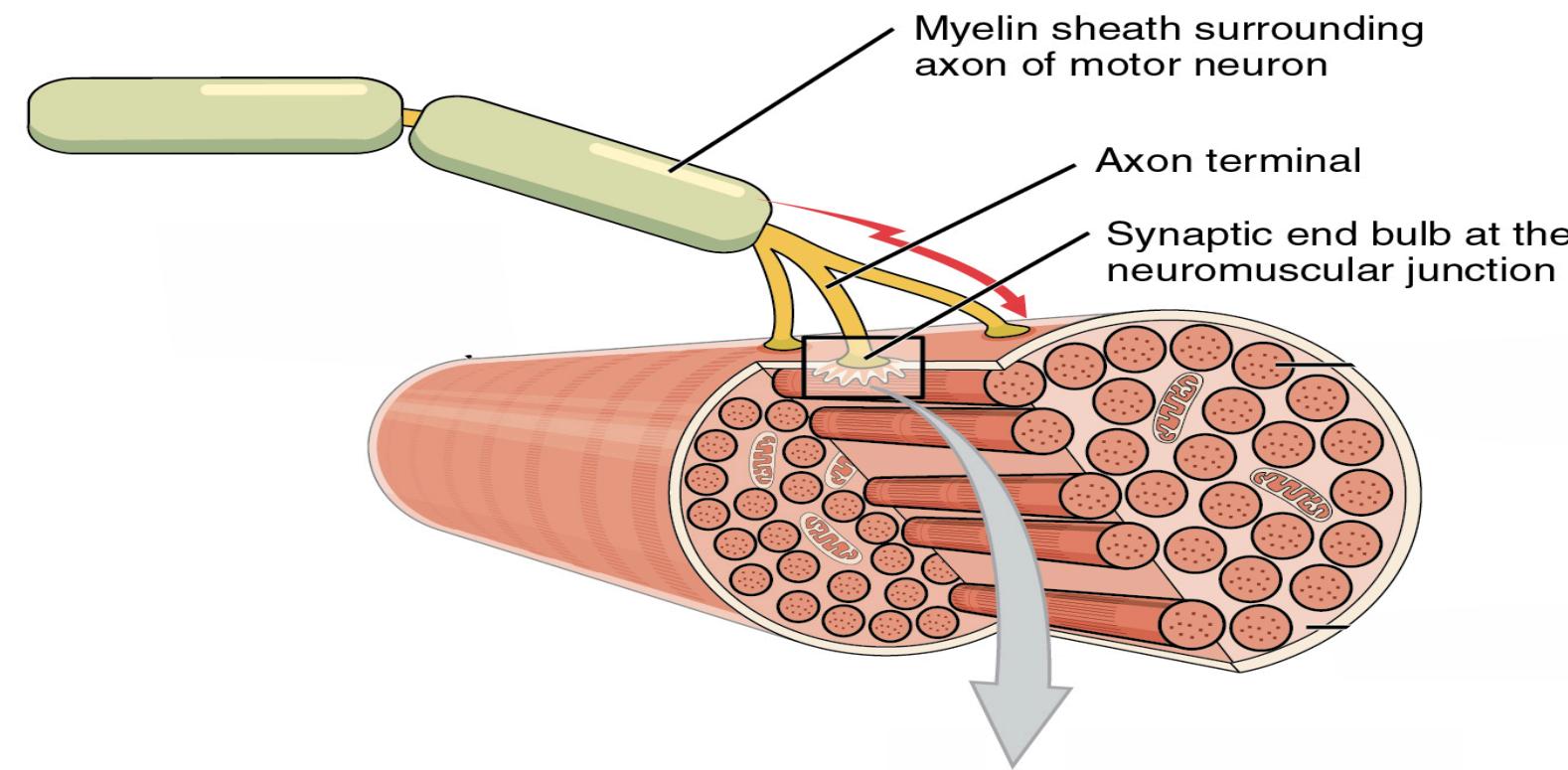
The classic model of neurotransmission was based on work done at one synapse: the neuromuscular junction.

What was true for that synapse was once (incorrectly) generalized to all nervous system synapses:

1. Each cell has a single input.
2. Neurotransmission occurs at directed synapses.
3. Neurotransmitters are deactivated by enzymes (e.g., acetylcholinesterase).
4. Neurotransmitters are packaged in vesicles.
5. Neurotransmitters produce EPSPs or IPSPs.
6. Each neurotransmitter has a single receptor.
7. Each cell releases a single neurotransmitter.

Classic View of Neurotransmission

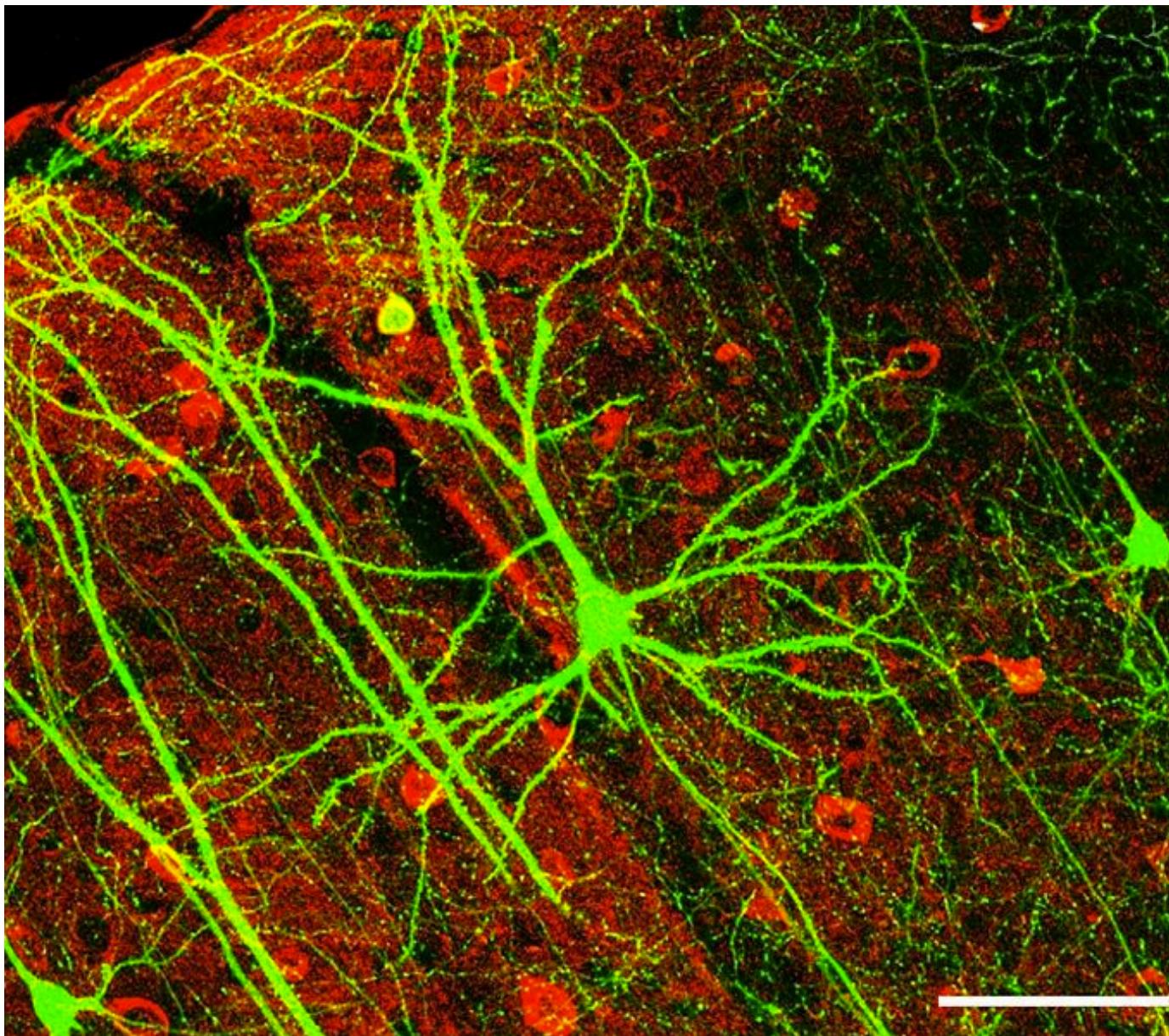
Claim 1: Each cell has a single input.



True at the neuromuscular junction: Each muscle fiber receives input from only one motor neuron.

Adjustments to the Classic View

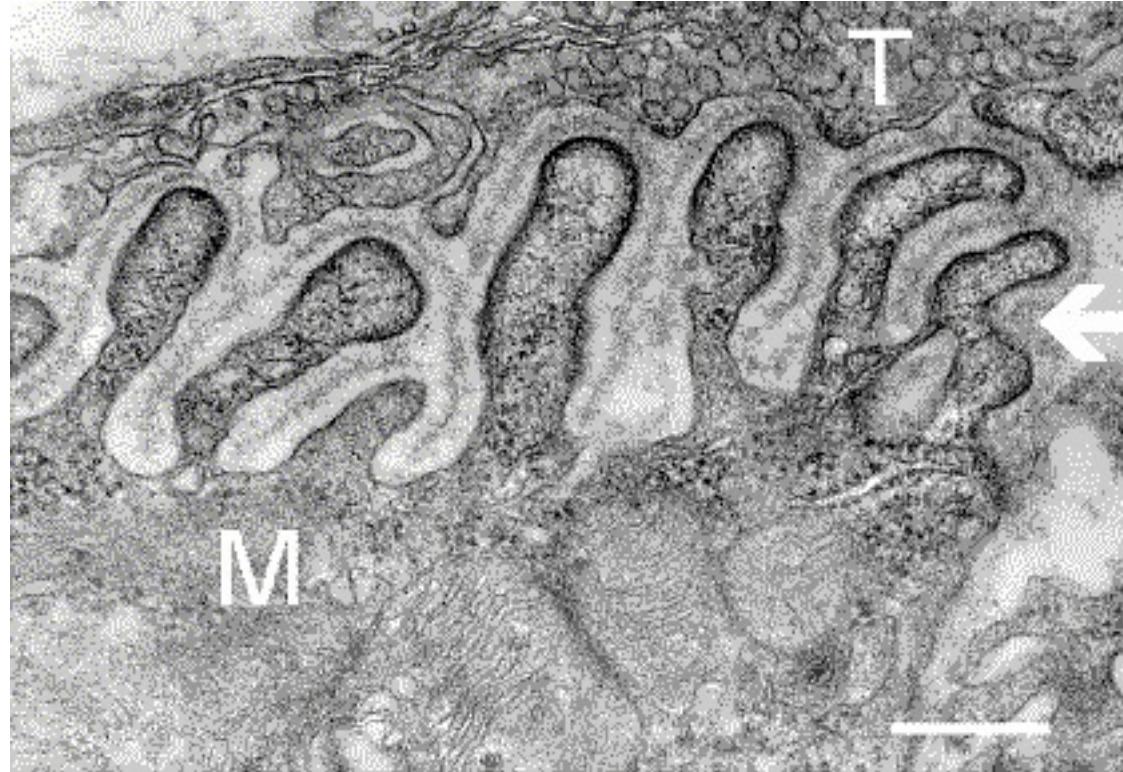
Claim 1: Each cell has a single input.



But the neuromuscular junction is an exception. Most cells in the nervous system receive input from many cells.

Adjustments to the Classic View

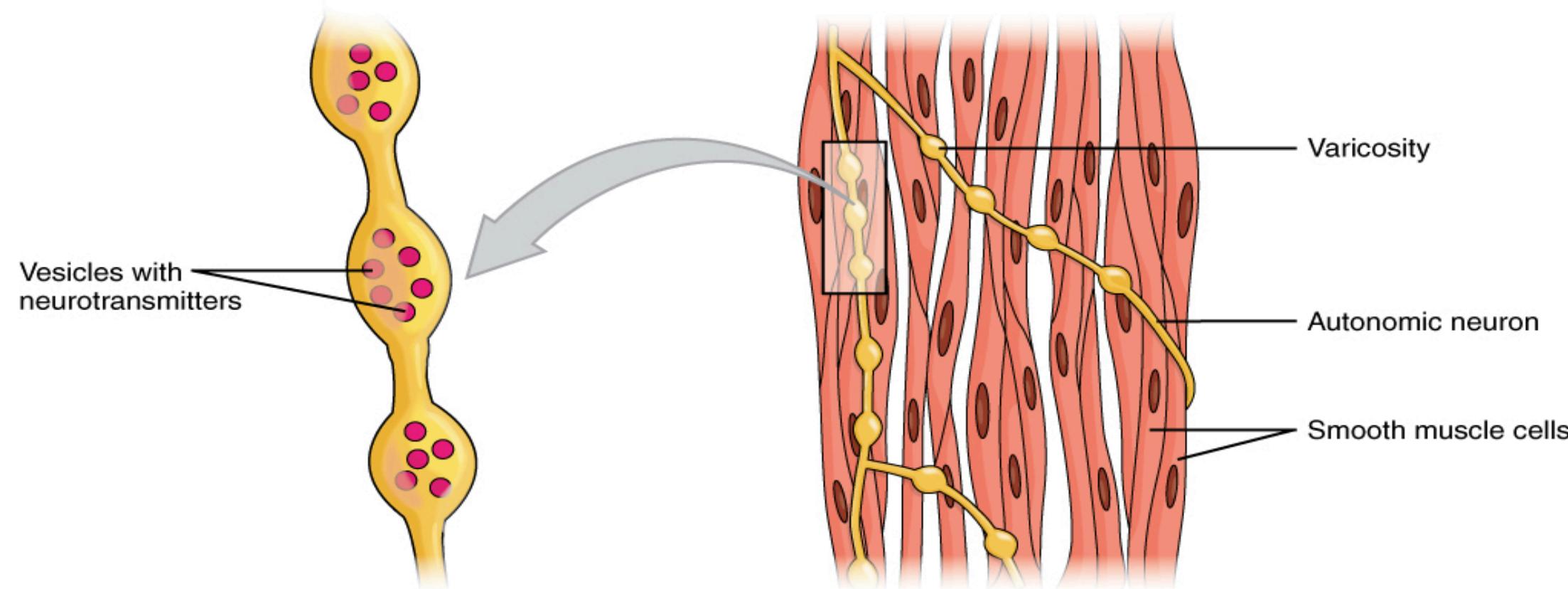
Claim 2: Neurotransmission occurs at directed synapses.



True at the neuromuscular junction: The boutons from the motor neuron lie directly adjacent to the muscle fibers.

Adjustments to the Classic View

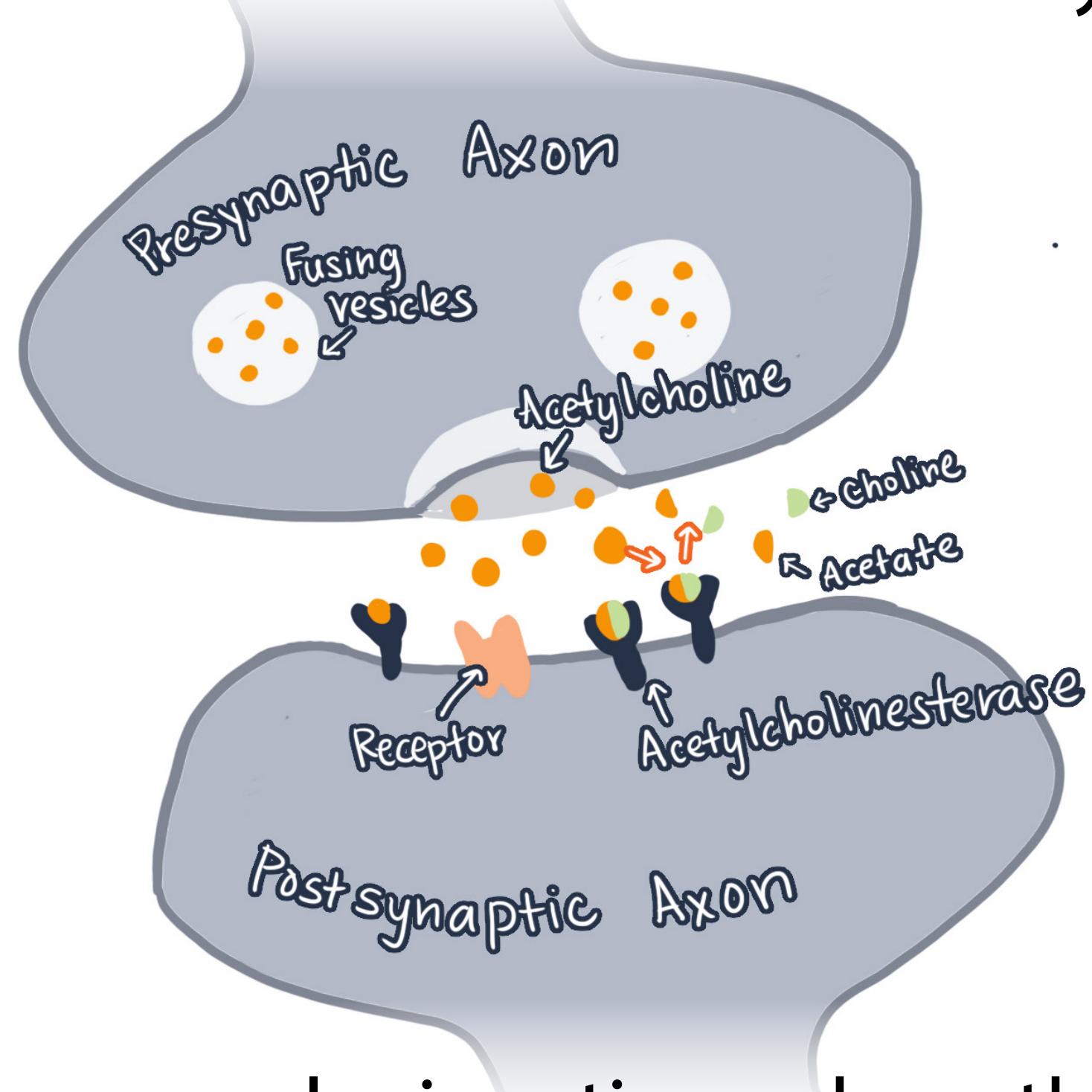
Claim 2: Neurotransmission occurs at directed synapses.



But not necessarily true elsewhere: Non-directed synapses are also possible.

Adjustments to the Classic View

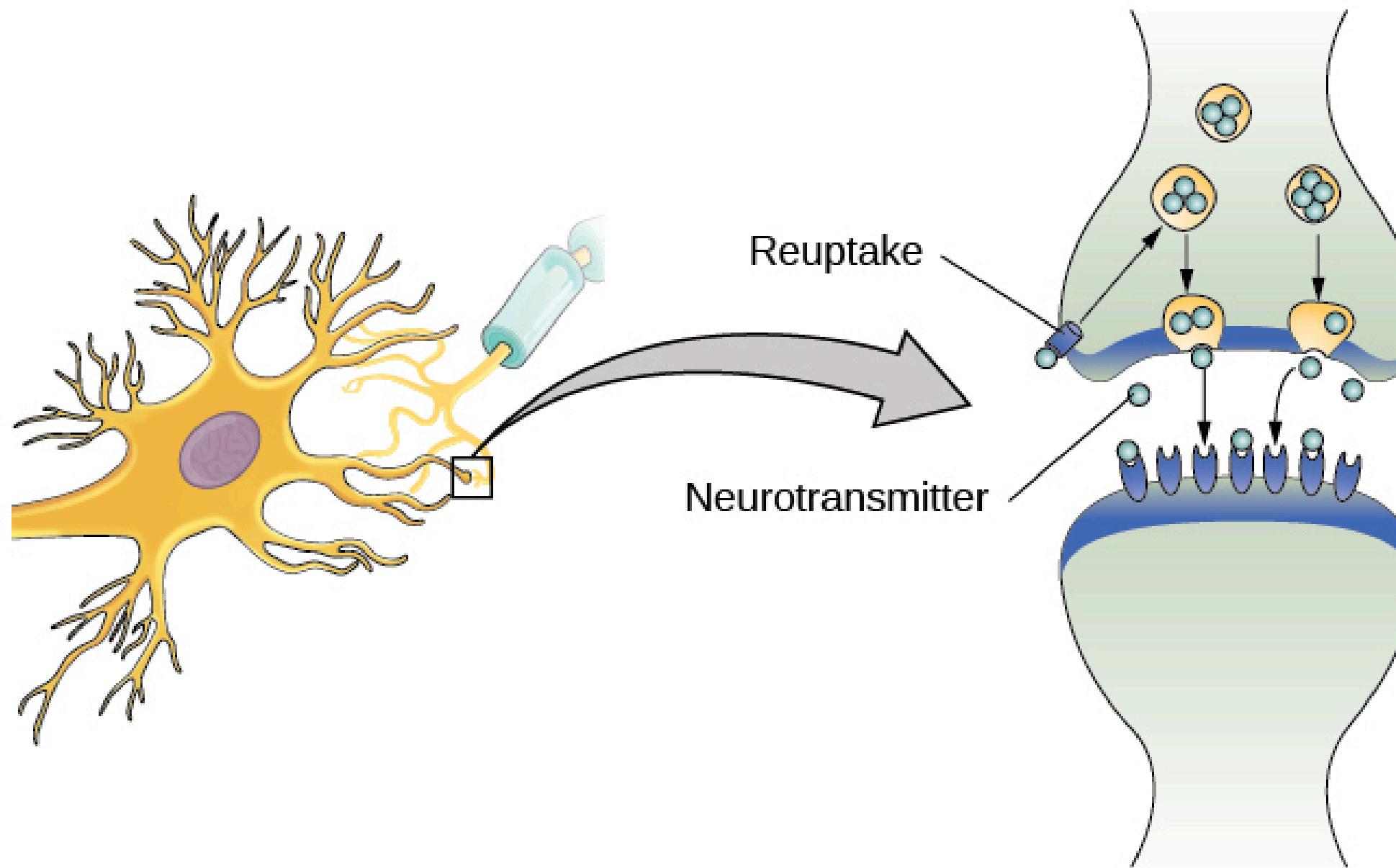
Claim 3: Neurotransmitters are deactivated by enzymes.



True at the neuromuscular junction, where the enzyme acetylcholinesterase deactivates acetylcholine (ACh).

Adjustments to the Classic View

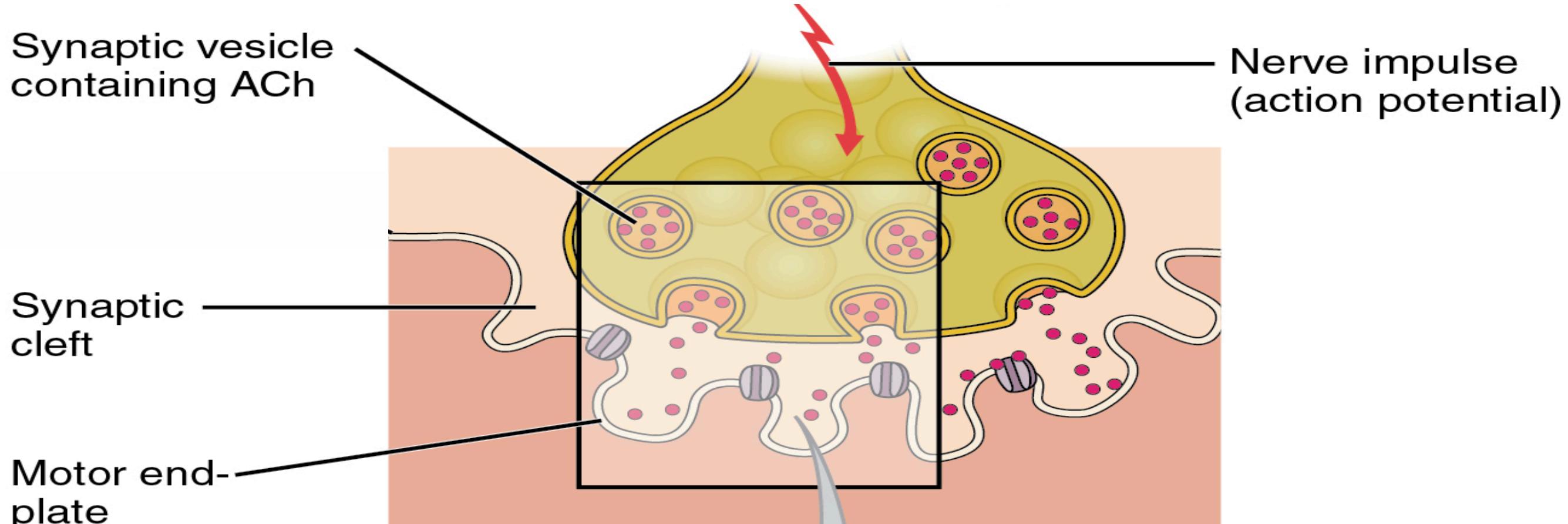
Claim 3: Neurotransmitters are deactivated by enzymes.



But rare at non-cholinergic synapses, where reuptake is the major mechanism for deactivation of neurotransmitters.

Adjustments to the Classic View

Claim 4: Neurotransmitters are packaged in vesicles.



True at the neuromuscular junction, where ACh is packaged in vesicles prior to release into the synapse.

Adjustments to the Classic View

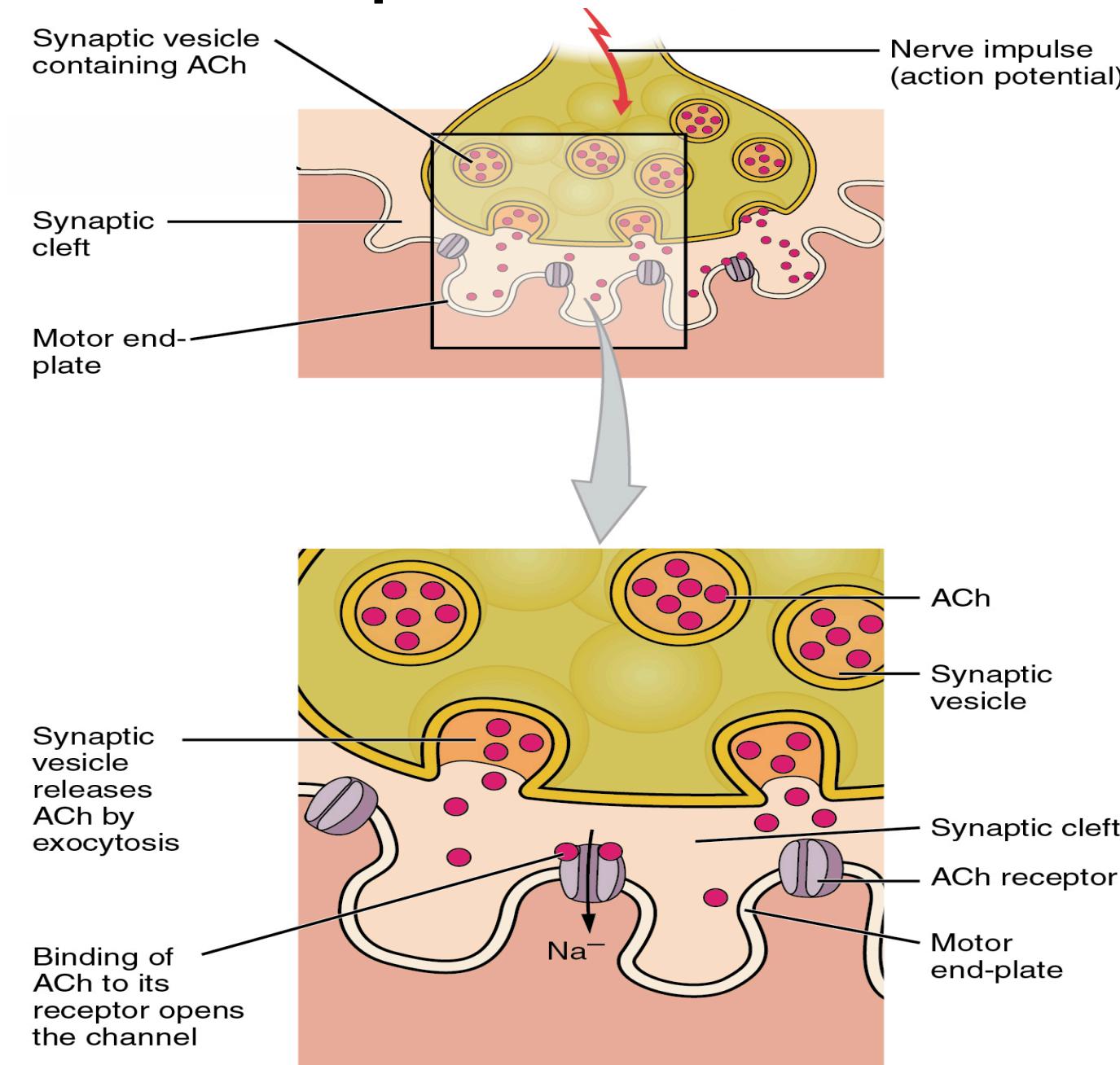
Claim 4: Neurotransmitters are packaged in vesicles.

True for many neurotransmitters, but not all: For example, the ‘unconventional’ transmitters are not packaged in vesicles.



Adjustments to the Classic View

Claim 5: Neurotransmitters produce one of either EPSPs or IPSPs.



True at the neuromuscular junction for skeletal muscles, where ACh produces EPSPs.

Adjustments to the Classic View

Claim 5: Neurotransmitters produce one of either EPSPs or IPSPs.

Whether or not a neurotransmitter produces an EPSP or IPSP was later shown to be a function of the receptor type/subtype.

Adjustments to the Classic View

Claim 6: Each neurotransmitter has a single receptor.

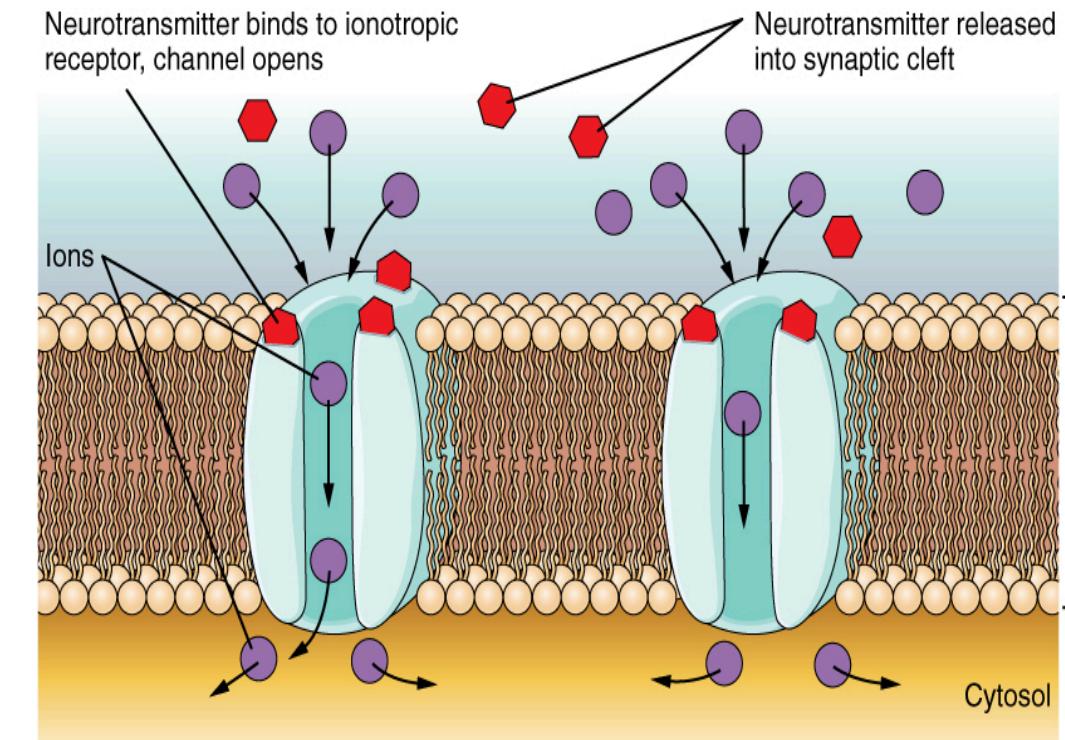


It was discovered that some ACh receptors bind nicotine better than muscarine, whereas for others the reverse is true.

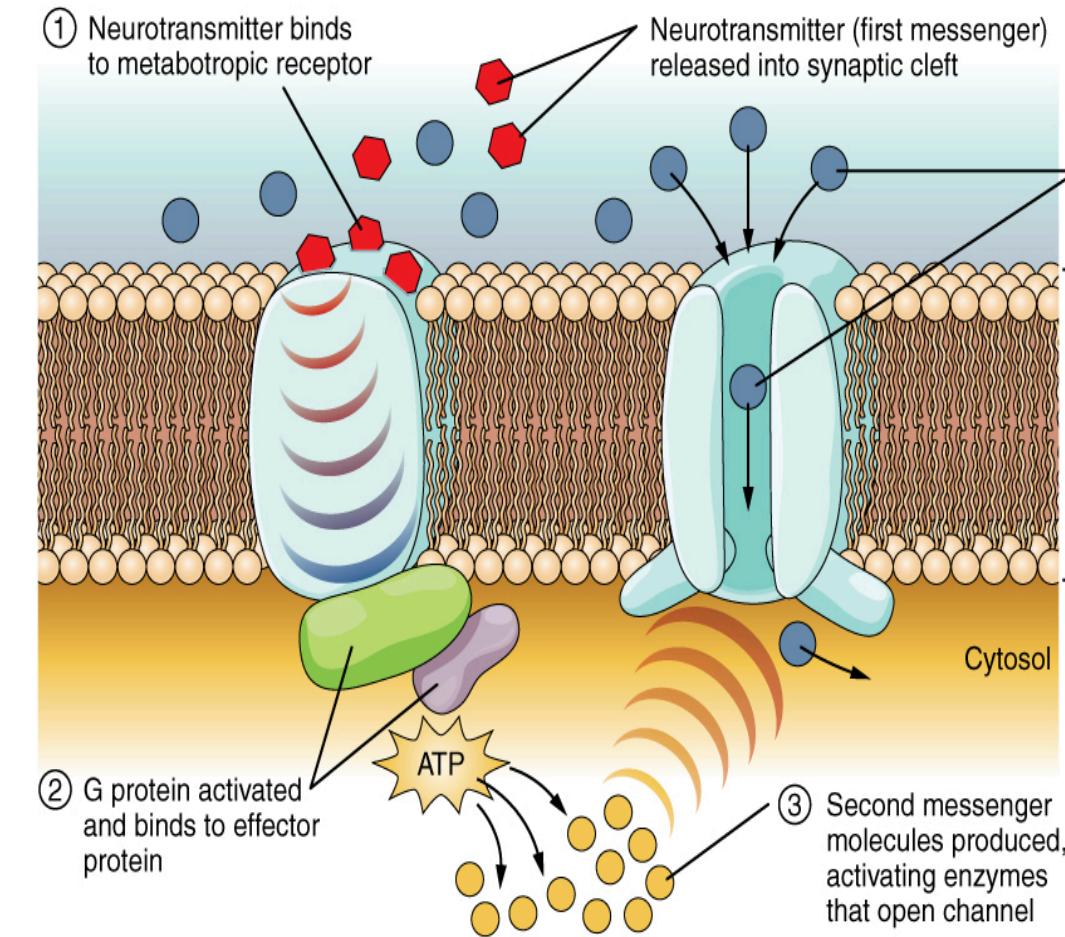
(these two receptor types are distributed differently in the PNS: many nicotinic receptors exist at synapses between motor neurons and skeletal muscle fibers, whereas many muscarinic receptors are in the autonomic NS).

Adjustments to the Classic View

Nicotinic and muscarinic receptors are ionotropic and metabotropic receptors, respectively.



(a) Direct activation brings about immediate response



Adjustments to the Classic View

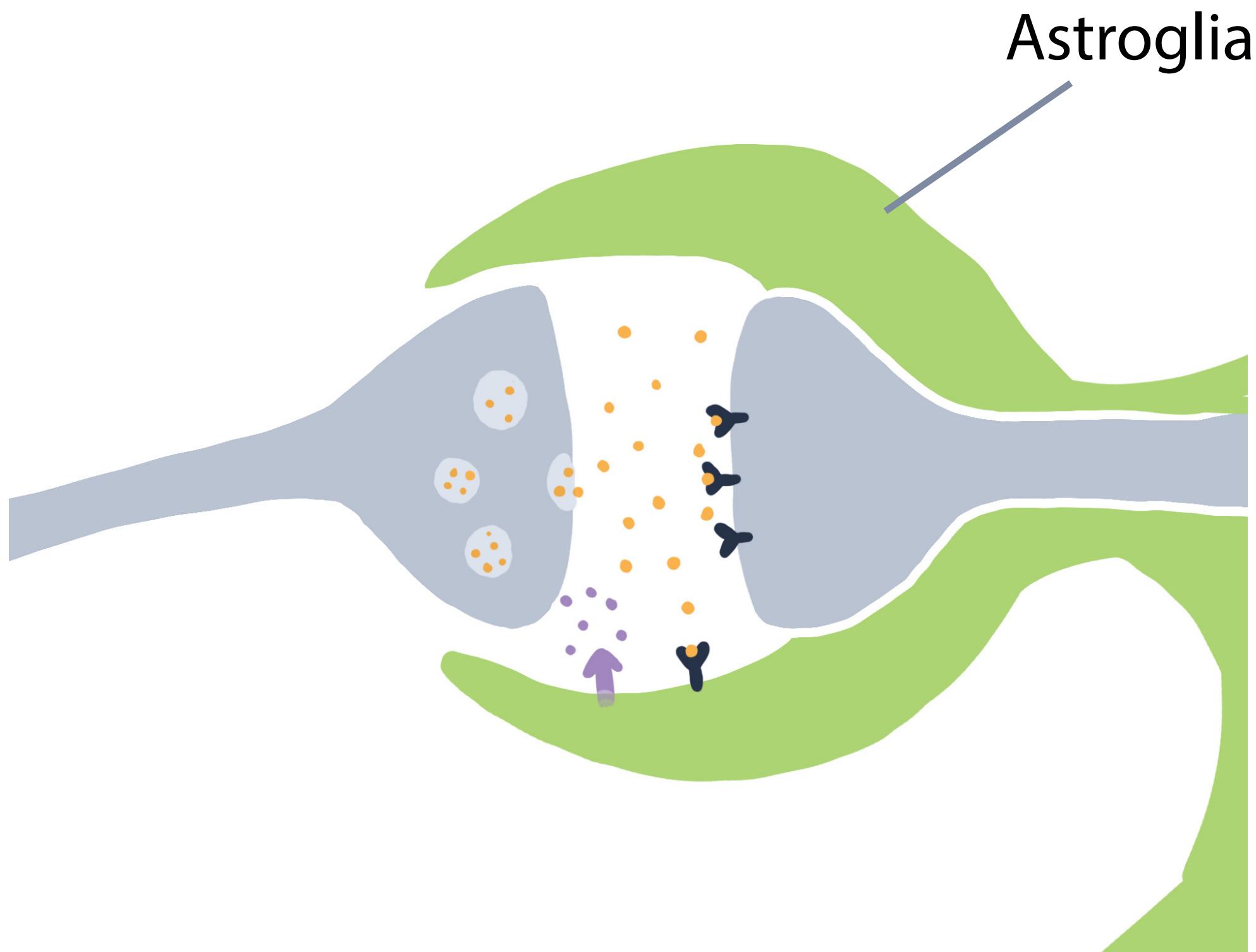
Claim 7: Each cell releases a single neurotransmitter.

‘Coexistence’ of different transmitters has been found in many cells in the nervous system.

Adjustments to the Classic View

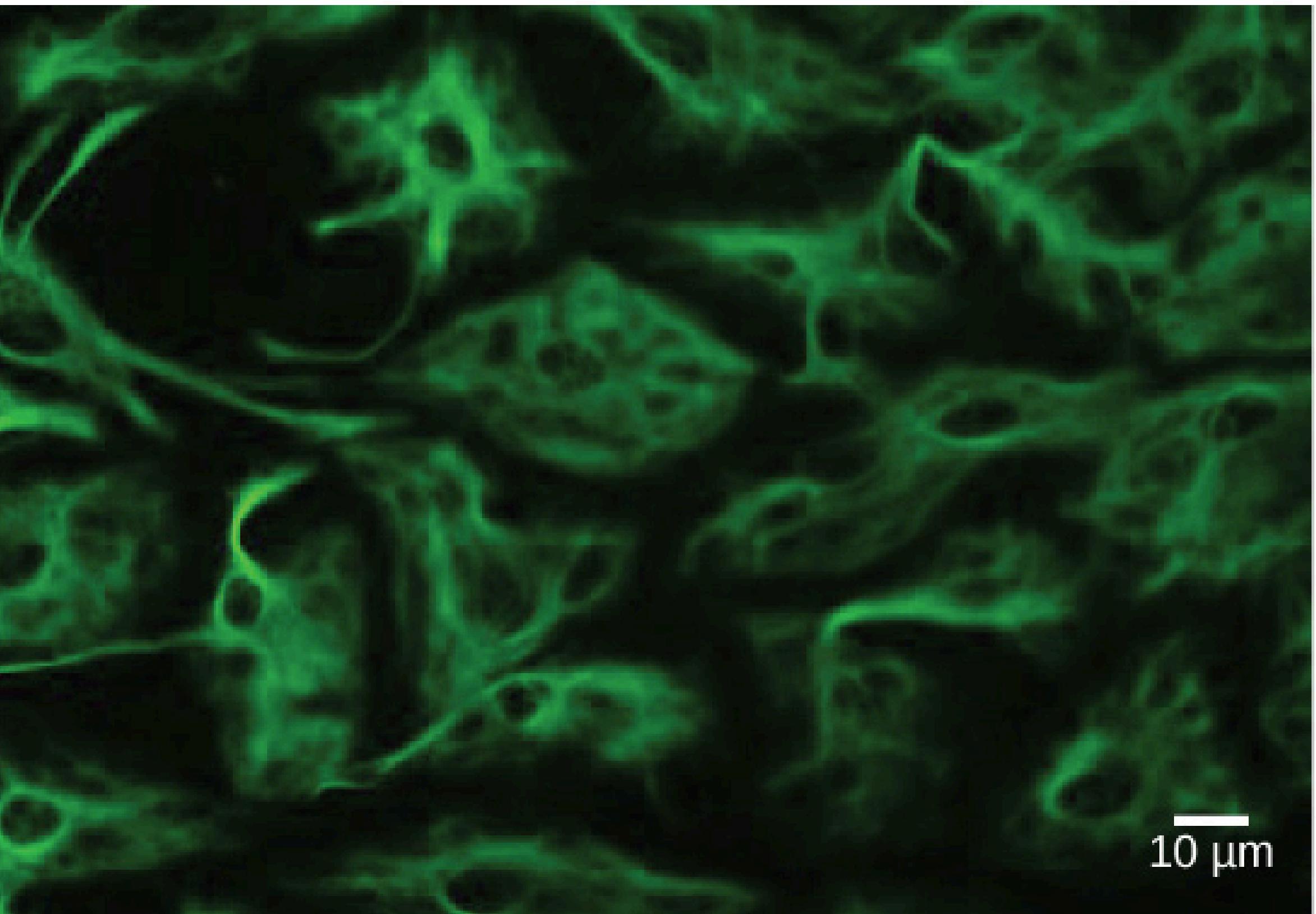
In general: Neurotransmission is a complicated and heterogenous activity.

Adjustments to the Classic View



Astroglia

Tripartite Synapse



Glial Networks