

Neuroscience BIO-311 - Ramdya

Exercise Solutions for :

Spinal cord & Cerebellum

1) Explain the concept of a “motor unit”.

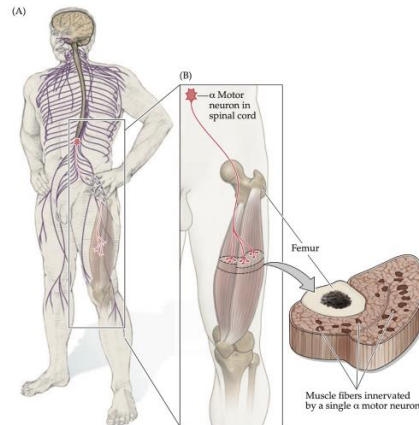
Each lower motor neuron innervates muscle fibres within a single muscle. A **motor unit** is by definition the motor neuron and all the muscle fibres with which it contacts. (A motor neuron pool for a single muscle is defined as all the motor neurons innervating it.)

The Motor Unit

Each alpha motor neuron synapses with multiple fibers in **one** muscle.

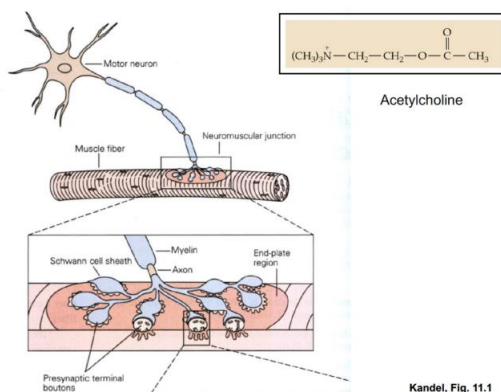
Motor unit: Alpha neuron + muscle fibers it contacts

NT at NMJ: **Acetylcholine**



2) Describe the anatomical structure of a neuromuscular junction. Which neurotransmitter type and receptor type are found in this synapse?

The NMJ (Neuro muscular junction) is the first place where the signal from the nervous system is conveyed in muscle cells. The neurotransmitter used in the synaptic gap is Acetylcholine.

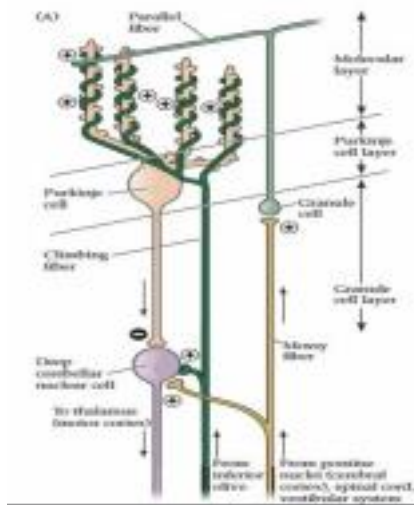


Acetylcholine is the neurotransmitter used at the neuromuscular junction —in other words, it is the chemical that motor neurons of the nervous system release in order to activate muscles.

On the left figure you can see the multiple postsynaptic terminal boutons from the same motor neuron on a single muscle fiber. Acetylcholine is degraded in the synaptic cleft into acetate and choline by acetylcholinesterase enzyme. Choline is then uptaken in the presynaptic

cell and acetyl-CoA (i.e., from the glycolysis) is combined with choline to produce acetylcholine which will be released by the vesicles.

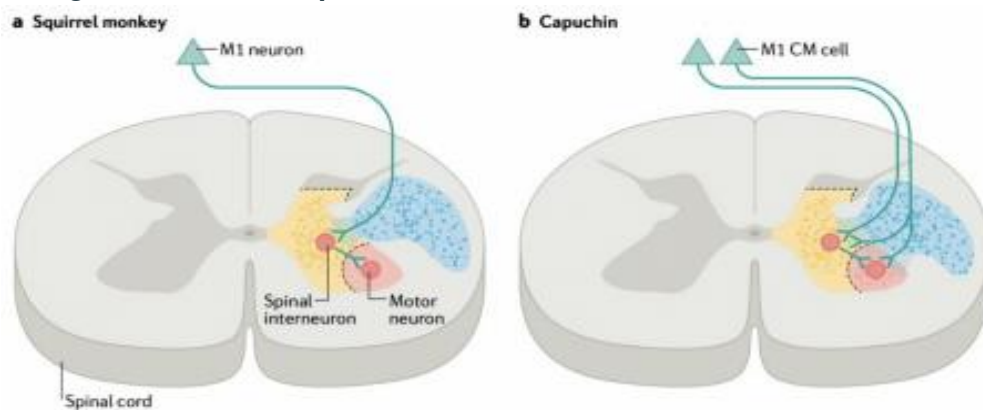
3) What are the 3 major cell types found in the cerebellar cortex and which one is the principal output and respective neurotransmitter?



- Basket cells
- Granule Cells
- Purkinje Cells

Purkinje cells are GABAergic

4) Do upper motor neurons always synapse onto lower motor neurons in the spinal cord, or in some species, does this differ? Consider drawing the spinal circuit of lower (alpha) motor neurons, sensory neurons from muscle, interneurons, and show descending motor neuron inputs



In species with simpler nervous systems (e.g. fish or amphibians), motor control is often more spinally mediated, with reflexes and local circuits being dominant. These species rely heavily on spinal interneurons to control movement, and many behaviors like swimming or simple reflexes are generated entirely within the spinal cord, without significant cortical input from upper motor neurons.

As species evolved more complex behaviors, central control from the brain (upper motor neurons) became more significant, but local spinal circuits and interneurons remained critical for the rapid processing of sensory and motor information (e.g. for reflex). In most mammals (including squirrel monkey, see figure), upper motor neurons contact local circuit interneurons and not directly the lower motor neurons.

Some primates (capuchin and humans), upper motor neurons project both on interneurons and also more rarely directly onto lower motor neurons. This is thought to allow more fine dexterous movements.