# Synapses and Synaptic Transmission

The nervous system consists of billions of neurons organised into a highly communicative network. Electrochemical signalling (via action potentials) is used to transmit information along neurons. However, the action potentials cannot travel between neurons. Where one neuron forms a junction with another, a different process of communication takes over. The junctions between neurons are called synapses. Compared to neurons, synapses are very small. A single neuron might form synapses with many thousands of other neurons. Synapses are formed between the terminal button of a presynaptic neuron and the dendrite of a postsynaptic neuron. Synapses transmit signals in one direction only, from presynaptic to postsynaptic neuron.

Synaptic transmission is triggered by an action potential reaching the terminal button of the presynaptic neuron. When this happens, small spherical structures called synaptic vesicles migrate to the end of the terminal and merge with the presynaptic membrane. This causes them to release a few molecules of a chemical called a neurotransmitter into the synaptic gap. Once released, the neurotransmitter diffuses into the cerebro-spinal fluid that fills the synaptic gap.

Through diffusion, some of the neurotransmitter molecules come into contact with structures on the post-synaptic membrane called receptors. The neurotransmitter molecules fit into the receptors like a key in a lock, stimulating them. When the neurotransmitter binds to the receptor it changes the probability that the postsynaptic neurone will produce an action potential.

There are two types of synapse, excitatory and inhibitory. In an excitatory synapse, an increase in the concentration of neurotransmitter makes it *more likely* that the postsynaptic neurone will produce an action potential. In an inhibitory synapse, an increase in the concentration of neurotransmitter makes it *less likely* that an action potential will occur. A neuron receives many thousands of incoming synapses, some of which are excitatory and some of which are inhibitory. If the excitatory synapses are more active than the inhibitory ones it produces more action potentials: its rate of firing increases. If the inhibitory synapses are more active than the excitatory ones, its rate of firing decreases.

Mechanisms are necessary that remove neurotransmitter from the receptors and the synaptic gap. If there were no such mechanisms levels of neurotransmitter would build up over time and keep stimulating the postsynaptic neuron even when this was not wanted. Two mechanisms act to remove excess neurotransmitter. In one of them, an enzyme is released that breaks down neurotransmitter molecules, rendering them inactive. In the other, a mechanism called a re-uptake pump catches neurotransmitter molecules and recycles them in new vesicles in the presynaptic neurone.

Different neurones in different brain areas use different neurotransmitters. Some of the more prevalent neurotransmitters in the brain are dopamine (DA), serotonin (5-HT) and noradrenaline (NA).