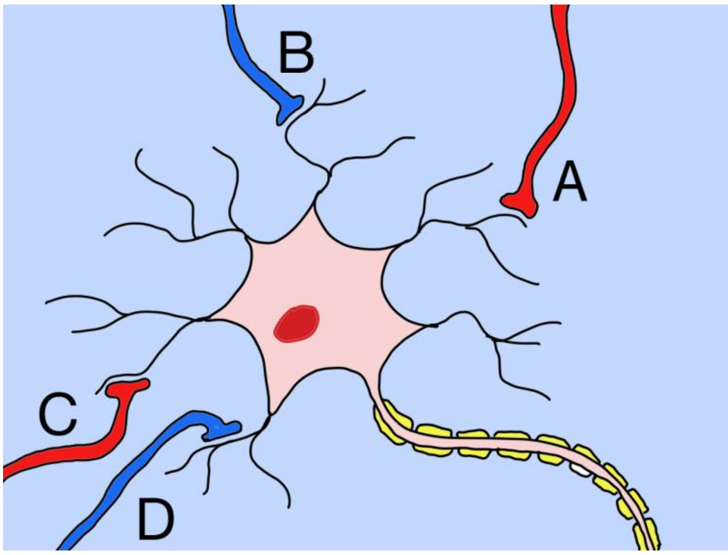
Neuronal firing rates and synaptic activity



Recall that each neuron generates action potentials at a certain frequency. Every action potential is the same but a neuron can increase or decrease the frequency with which it generates them. The frequency at which a neuron is generating action potentials is its **firing rate**.

Neurons change their firing rate in response to the messages they receive from incoming synapses on their dendrites. The incoming synapses can be **excitatory**, which means they tell the receiving neuron to *increase* its firing rate, or they can be **inhibitory**, which means that they tell the receiving neuron to *decrease* its firing rate.

The messages being sent from the incoming synapses depend, in turn, upon the firing rates of their neurons. The diagram shows a neuron that receives four incoming synapses. A is an excitatory synapse, so if A were to increase its firing rate, the receiving neuron would also increase its firing rate. B is an inhibitory synapse, so if B were to increase its firing rate the firing rate of the receiving neuron would decrease.

The firing rate of the receiving neuron is determined by the sum of *all* incoming synaptic activity. In the diagram, A and C are excitatory synapses and B and D are inhibitory synapses. Work out what would happen to the firing rate of the receiving neuron under the following circumstances.

	Effect on firing rate of receiving neuron (increase, decrease or no change).
C increases its firing rate; A, B and D remain the same.	
D Increases its firing rate; A, B and C remain the same.	
A decreases its firing rate; B, C and D remain the same.	
B decreases its firing rate; A, C and D remain the same.	
A, B, C and D all increase their firing rate by 10%.	
A, B and C increase their firing rate by 10%; D remains the same.	
A and C decrease their firing rate by 10%; B and D remain the same.	
A and C increase their firing rate by 10%, B and D decrease their firing rate by 10%.	

Answers

	Effect on firing rate of receiving neuron (increase, decrease or no change).
C increases its firing rate; A, B and D remain the same.	Increase (more excitatory than inhibitory inputs).
D Increases its firing rate; A, B and C remain the same.	Decrease (more inhibitory than excitatory inputs).
A decreases its firing rate; B, C and D remain the same.	Decrease (more inhibitory than excitatory inputs).
B decreases its firing rate; A, C and D remain the same.	Increase (more excitatory than inhibitory inputs).
A, B, C and D all increase their firing rate by 10%.	No change (excitatory and inhibitory inputs are equal).
A, B and C increase their firing rate by 10%; D remains the same.	Increase (more excitatory than inhibitory inputs).
A and C decrease their firing rate by 10%; B and D remain the same.	Decrease (more inhibitory than excitatory inputs).
A and C increase their firing rate by 10%, B and D decrease their firing rate by 10%.	Increase (more excitatory than inhibitory inputs).