Experiments in Information Processing and Neurophysiology
Simulation at jondarkow.com

The dependent variable in the simulation is the membrane potential of Neuron 1 and Neuron 2. The membrane potential is measured at the axon hillock of each neuron (units are in millivolts.)

I. Experiment 1: Information Processing

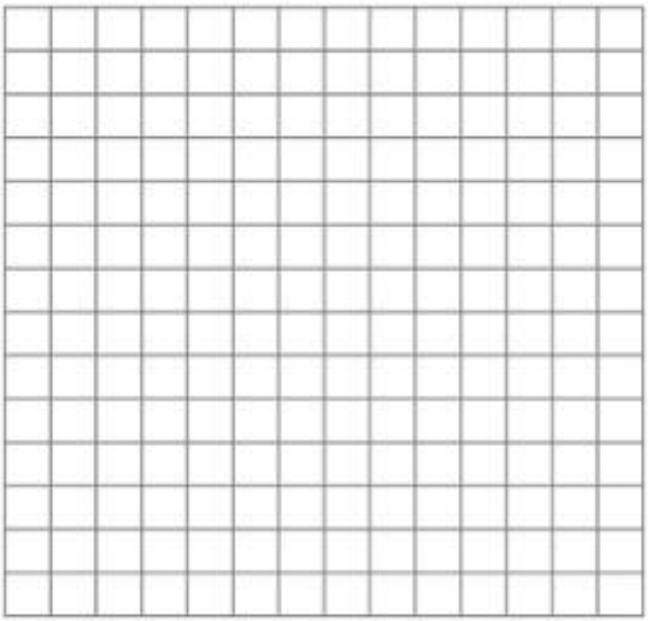
Neurons modify signals by receiving neurotransmitters from multiple neurons. Some can be inhibitory, others excitatory. Assume the neurons in the simulation originate in the sacral region of the spinal cord (Neuron 1), and innervate the *rectus femoris* muscle (Neuron 2). When Neuron 2 sends a signal to the *rectus femoris* muscle, the muscle contracts extending the leg at the knee.
Using the simulation determine which neurotransmitter is excitatory, and which is inhibitory, GABA or glutamic acid.

(a) **Record your data in the appropriate tables below**. Because the simulation allows for randomness, be sure to run each condition 5 times, and calculate the mean.

	GABA	GLU	N1	N2
Maximal membrane potentials of N1 and N2 when glu was the neurotransmitter	0	60		
	0	60		
	0	60		
	0	60		
	0	60		
	Average			

	GABA	GLU	N1	N2
membrane potentials of N1 and N2 when gaba was the neurotransmitter value taken at 16.5 msec	30	0		
	30	0		
	30	0		
	30	0		
	30	0		
	Average			

(b) **Create** an appropriately labeled graph illustrating how each neurotransmitter affects the depolarization of the neurons.



(c) Which neurotransmitter is excitatory, and which is inhibitory? Support your claim with evidence.

d) Determine the minimal dosage necessary for the neurotransmitter to activate the neurons in this pathway.

e) **Explain** why having a higher concentration of this neurotransmitter does not impact the response of these neurons.

(f) **Explain** which neurotransmitter would be released to extend the knee at this neural pathway?

(g) **Explain** which neurotransmitter would be released to flex the knee at this neural pathway?

II. Experiment 2: Neurotoxins

Neurotoxins interfere with neuronal function. Like any toxin though, dosage matters. The EPA sets limits on the acceptable amounts of different toxins that humans can be exposed to in the environment. In this simulation you will work with each of the neurotoxins and determine the following:

- *How the neurotoxin impacts these neurons*
- *Biochemical explanation of this impact.*
- *minimal allowable dosage humans can be exposed to*

Set GABA to 0, and glutamic acid to 60.

Use the explore mode tab to provide you with background to understand each neurotoxin.

TTX

(a) Where is this neurotoxin found and what does it to?

(b) Run the simulation and determine the impact of TTX on N1 and N2 in this circuit. Draw the results in the graph to the right

(c) Explain why these results occurred.

(d) What is the minimal allowable dosage of TTX that humans can be exposed to?

Sarin

(a) How is this neurotoxin used and what does it do?

(b) Run the simulation and determine the impact of sarin on N1 and N2 in this circuit. Draw the results in the graph to the right

(c) Explain why these results occurred.

(d) What is the minimal allowable dosage of sarin that humans can be exposed to?

Botulinum

(a) Where is this neurotoxin found and what does it do (you will have to google search where it is found?

(b) Run the simulation and determine the impact of botulinum on N1 and N2 in this circuit. Draw the results in the graph to the right

(c) Explain why these results occurred.

(d) What is the minimal allowable dosage of botulinum that humans can be exposed to?

(e) What are botox injections used for and how do they work?