

# Assignment #1

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## Question 1

The pufferfish contains the neurotoxin tetrodotoxin, which can kill. The pufferfish is a traditional delicacy in Japan known as *fugu*; it requires a well-trained chef to prepare the fish properly so that it can be consumed with enjoyment and not death.

- What is the effect of tetrodotoxin on a single nerve axon?
- When a suprathreshold stimulus is presented to a single nerve axon with tetrodotoxin, what is the axonal response (provide a sketch)? Be sure to explain why the response is shaped the way it is.



Figure 1<sup>1</sup> Pufferfish

## Question 2

Suppose you have a nerve axon that has relative permeabilities for K, Na, and Cl of 1:0.03:0.1; however, you do not know what these relative permeabilities are and you are trying to estimate them through an experiment. Inside the neuron, the concentrations of each ion is measured as  $150 \text{ mol/m}^3$ ,  $15 \text{ mol/m}^3$ , and  $9 \text{ mol/m}^3$ . Provide one or more ionic solutions, with known ionic concentrations, that you would use to determine the relative permeabilities. Assume that the axonal behaviour follows the Goldman-Hodgkin-Katz equation. For each solution that you use, compute the observed transmembrane potential that would be measured. Show how one can determine the relative permeabilities, with these solutions and transmembrane potentials.

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<sup>1</sup> Take from [http://en.wikipedia.org/wiki/Image:Puffer\\_Fish\\_DSC01257.JPG](http://en.wikipedia.org/wiki/Image:Puffer_Fish_DSC01257.JPG)

### Question 3

Two stimulation scenarios are used on a nerve axon:

1. a suprathreshold stimulus is presented at the left end of a nerve axon; and
2. suprathreshold stimuli are presented at the two ends of a nerve axon.

Sketch the observed transmembrane potential at three measurement sites for each stimulation scenario:

- i. at 25% the length of the axon;
- ii. at 60% the length of the axon; and
- iii. at 75% the length of the axon;

where 0% is the left end of the axon and 100% is the right end of the axon. Be sure to explain your justification of the observed transmembrane potential.