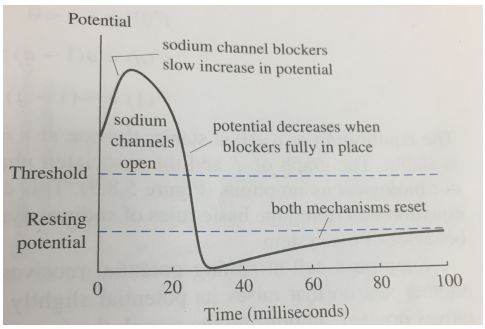
5.8 Part 1: Neuron Basics

Expected Voltage behavior

- We expect voltage to do something like this:



- Our task is to create this mathematically.

Na-Channels

- Let v be potential in the cell.
  - $v = 0$ - resting
  - $v = a$ - activation threshold
  - $v = 1$ - sodium channels completely open.
- Assumptions for sodium channel:
  - small deviation above rest should not activate the cell.
  - if v goes even a bit above a, then v should increase.
- Draw a graph that does this.

- We should try:
$$\frac{dv}{dt} = -v(v-a)(v-1)$$
- Stress: We chose this equation to conform to our expectations of the Na-channel mechanism.
- We can analyze this equation:
- Make a phase-line diagram.
- 0 and 1 are stable, while $v = a$ is unstable.

Slow Potassium Channels

- New state variable: w = degree of openness of the K-channel.
  - $w = 0$ - potassium channel is shut
  - large w - potassium channel is more open
- Assumptions:
  - When $v = 0$, K-channel is closed ($w = 0$).
  - When v is big, K-channel needs to get more open (large w).
  - If the K-channel opens too much, it wants to start closing.
$$\frac{dw}{dt} = \epsilon(v - \gamma w)$$
- Check: does this match what we expect the K-channel to do in special instances?