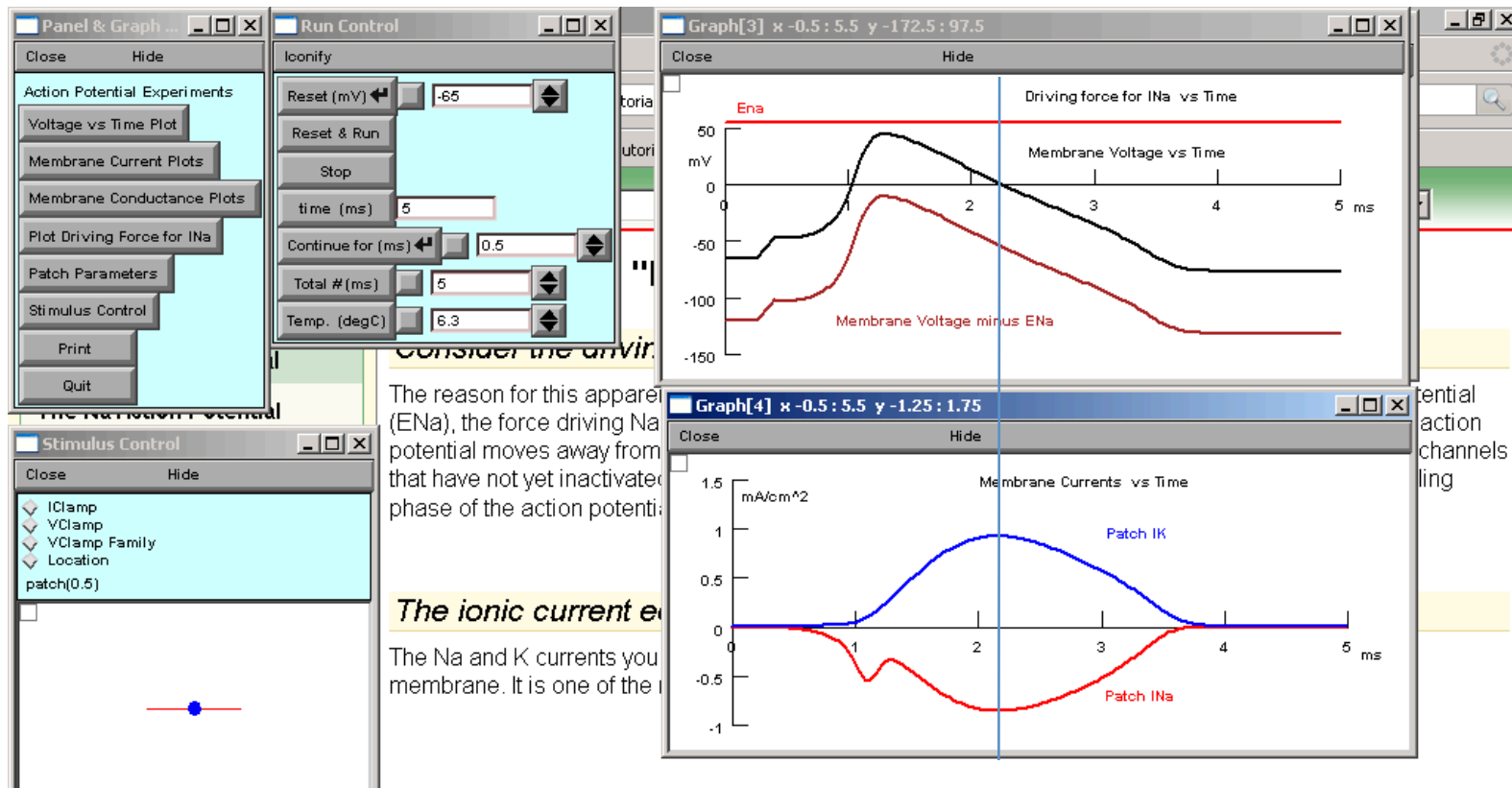


Completed Lab G

With Bonus

Why is I_{Na} so "kinky" with two phases? Why does it not have a smooth time course since the voltage and g_{Na} —and even I_K —all have smooth time courses?

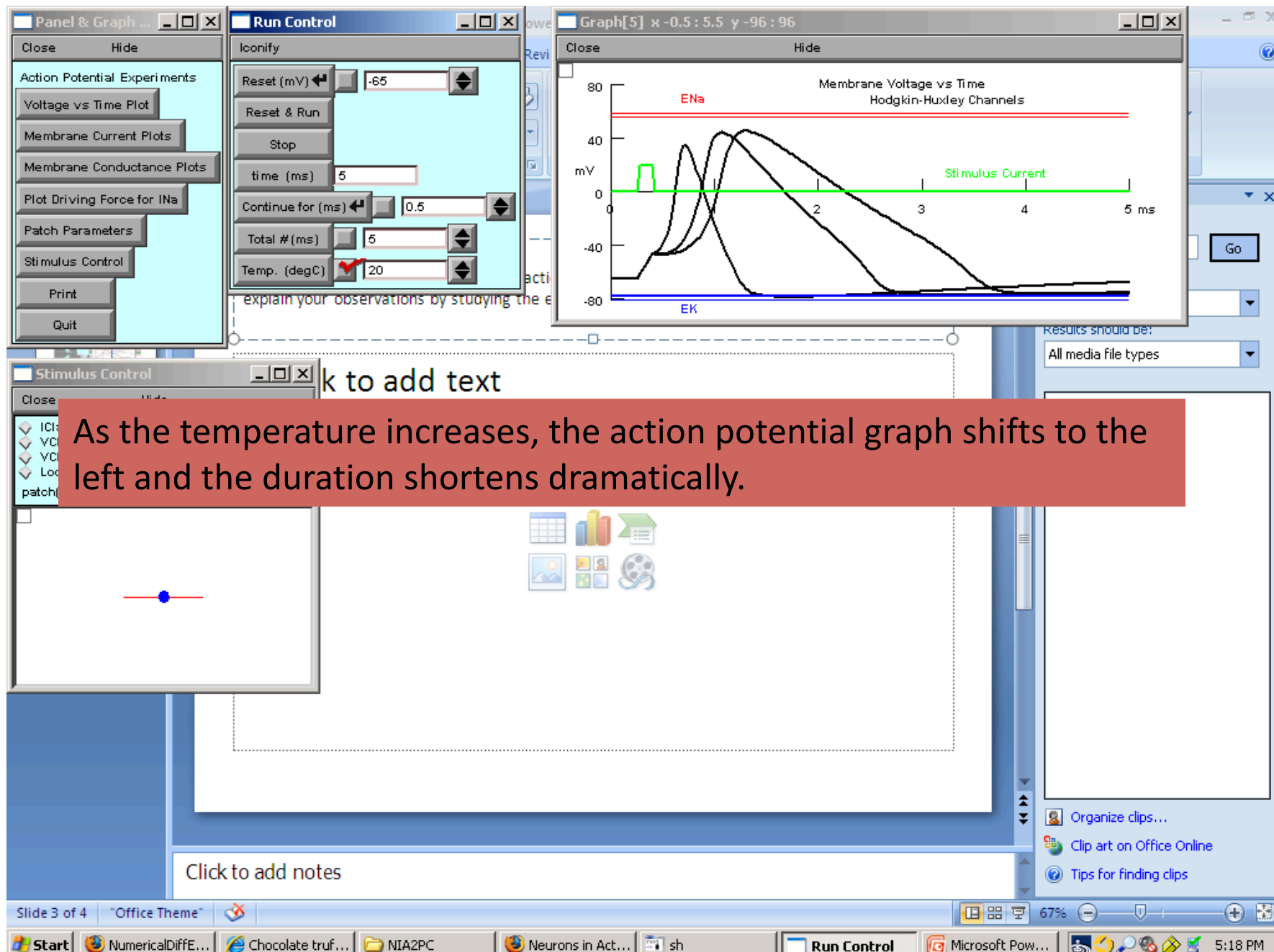


Consider the driving force for I_{Na} (E_{Na}), the force driving Na^+ ions through the membrane. As the action potential moves away from the peak, the driving force increases for channels that have not yet inactivated.

The ionic current I_{Na}
 The Na^+ and K^+ currents you see on the membrane. It is one of the...

To solve the main problem at the top, membrane current versus time graphs were graphed and analyzed. The minimum point ($x=2.25$) on the Patch I_{Na} matches the x-intercept of the first graph. As the action potential approaches the Na^+ equilibrium potential (E_{Na}), the force driving Na^+ ions through the membrane approaches zero. Thus I_{Na} is reduced but again increases when action potential falls. The Na^+ current is actually largest during the falling phase of the action potential.

What happens to the duration of the action potential if you change the temperature? Can you explain your observations by studying the effect of temperature on the underlying conductances?



By how much must you reduce the two conductances to block the generation of the action potential?

1. Be sure that the Patch Parameters are set correctly. Click the "Patch Parameters" button.

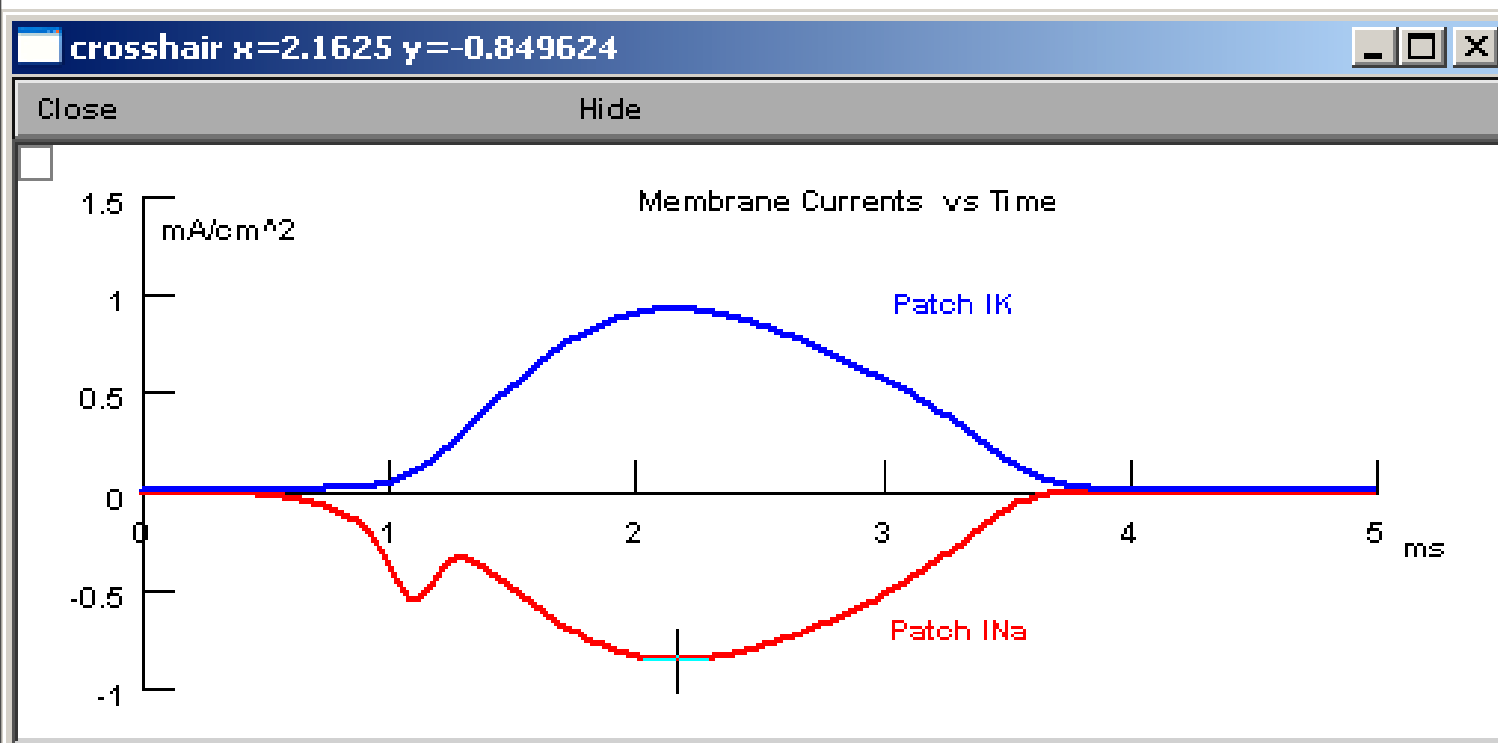
After the 6th try, (1/32) the action potential is totally blocked. The second graph's pink lines are the halves of the prior ones.

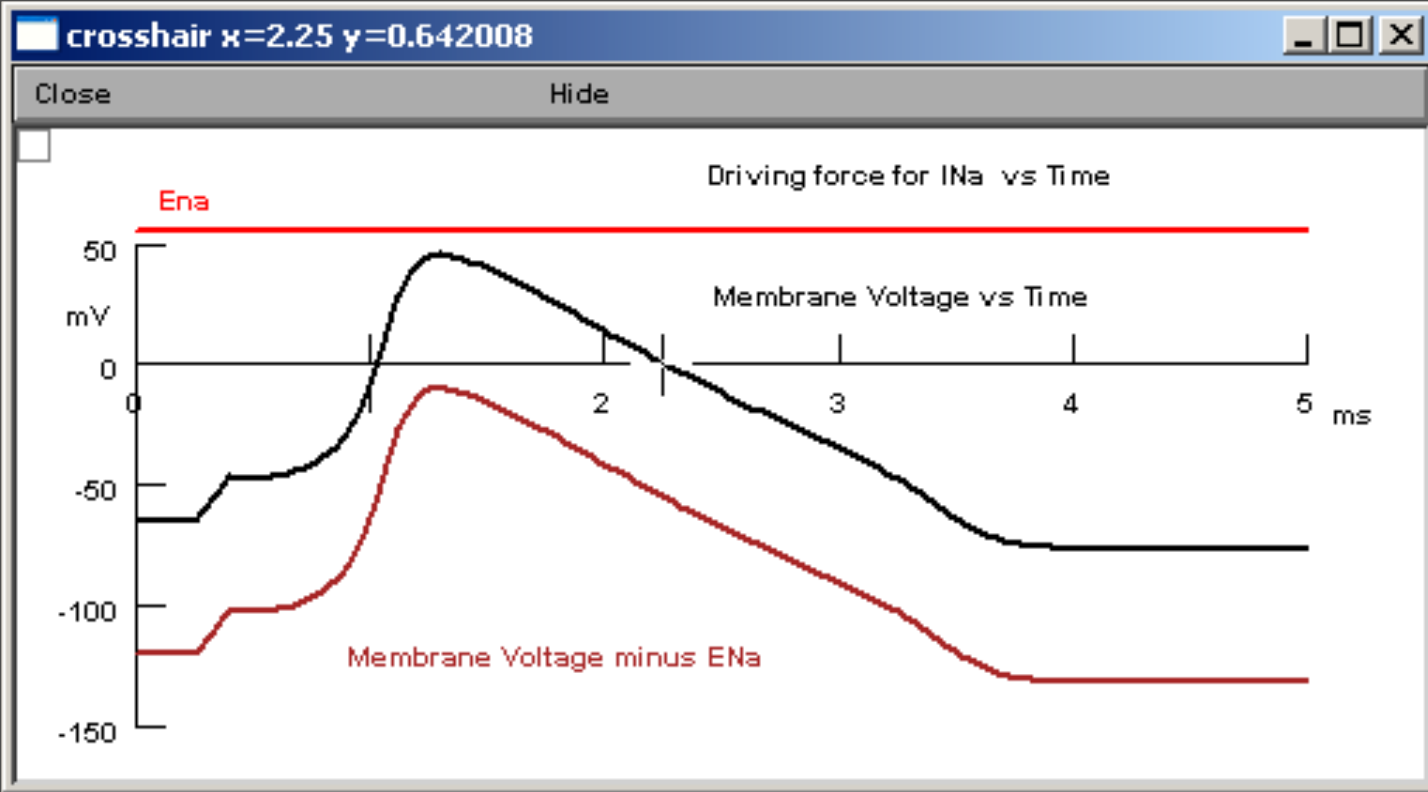
regenerative response disappears. Use Keep Lines to compare the action potentials in normal saline and at different degrees of block of the Na channels.

2. Question:
Which is more effective at blocking action potentials, a toxin that selectively blocks Na channels or the

Observation 1

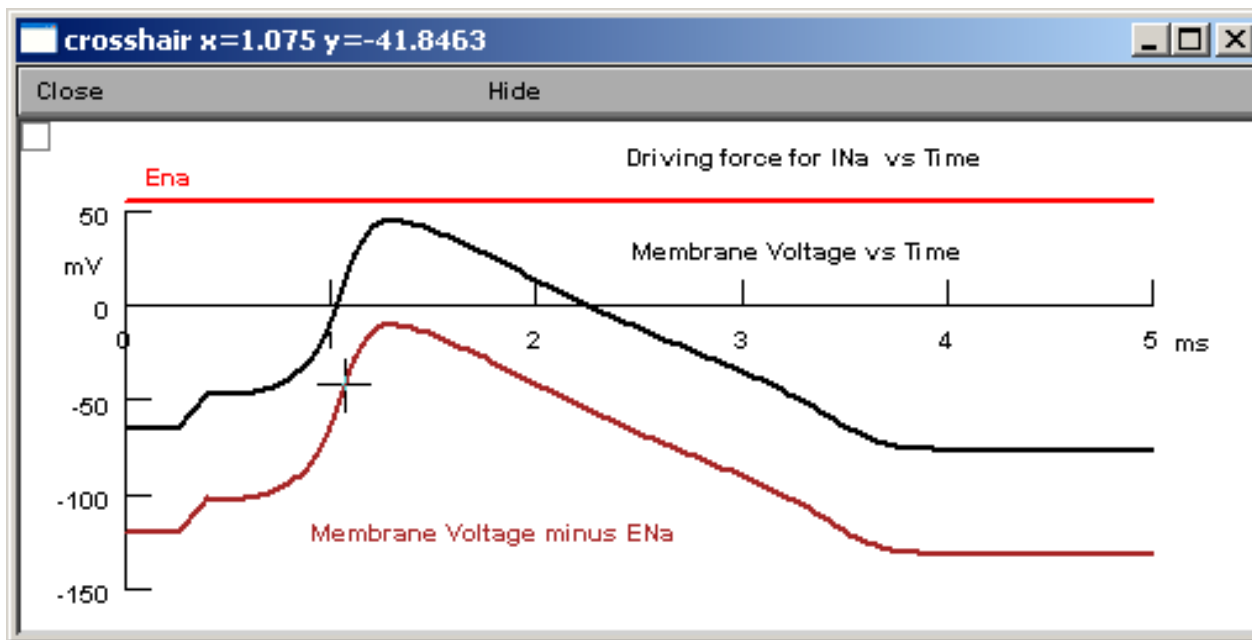
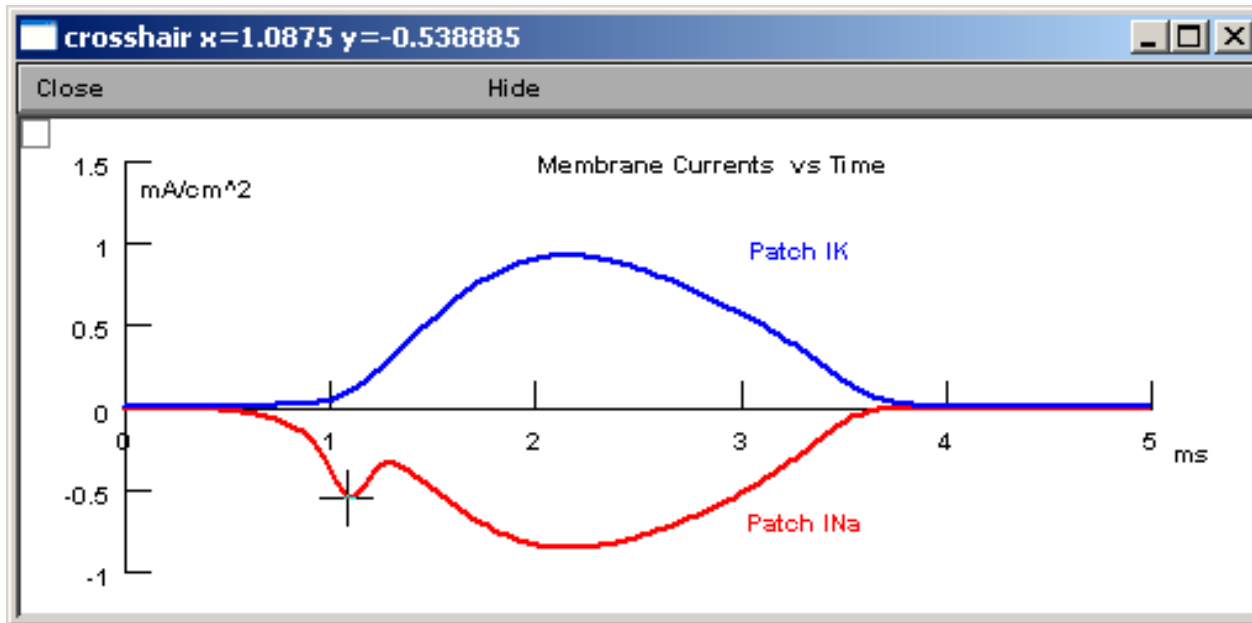
- To address the question “Why is I_{Na} so ‘kinky’ with two phases?” I found the time at which the minimum I_{Na} occurs from the I_{Na} vs time graph.
- The time was found to be around 2.16 ms



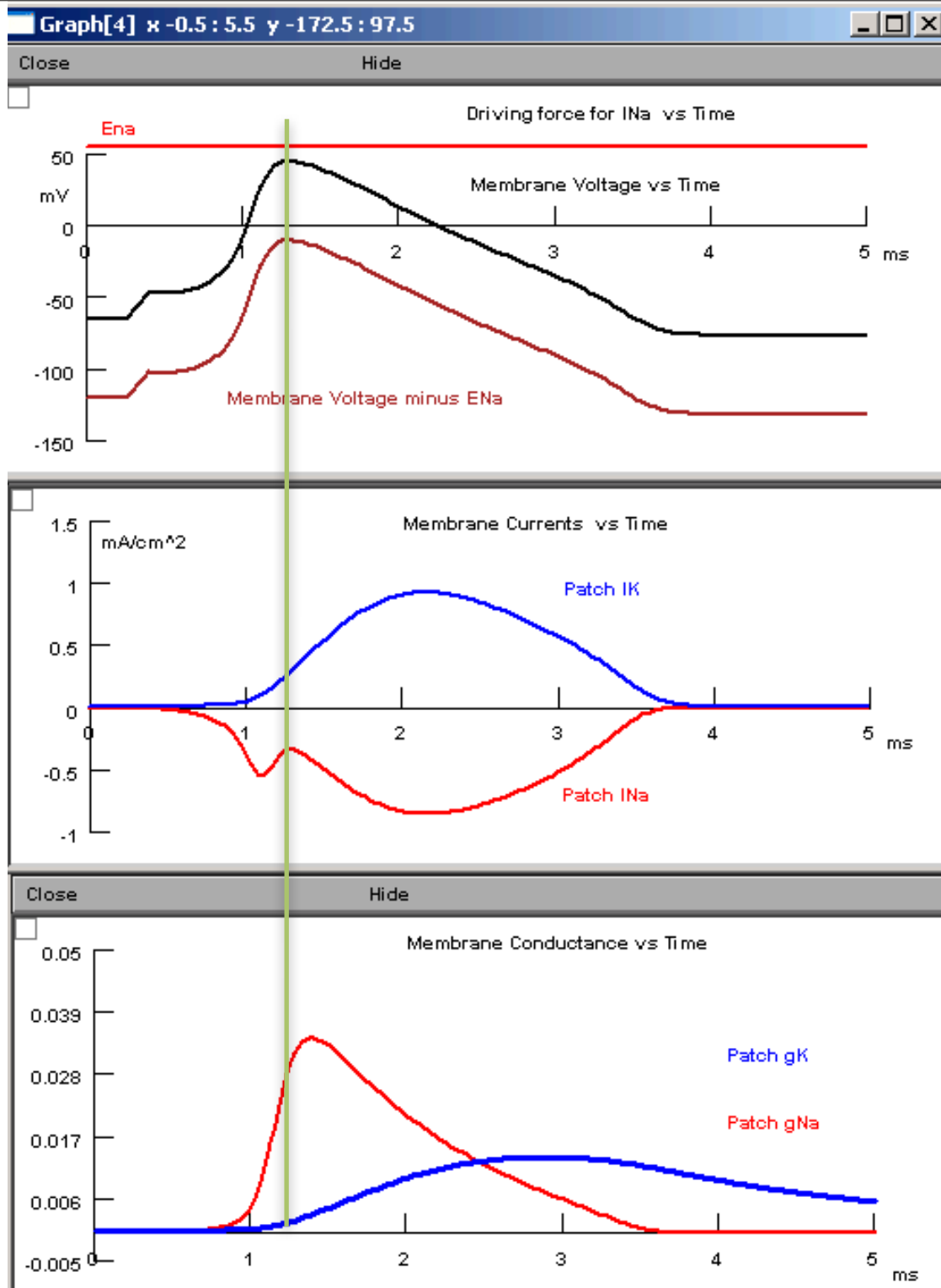


- 2.16 ms was the time at which membrane voltage equaled 0.
- Therefore, the Na current is the largest at the falling phase.

3



Notice that the kink in the sodium current corresponds to a time (1.1 msec) when the driving force for Na approaches zero (seen on the lower plot)—this is because the membrane voltage is approaching the E_{Na} . As the membrane voltage moves away from E_{Na} , we see that the I_{Na} can increase again. The Na current is actually largest during the falling phase of the action potential—an unexpected result.

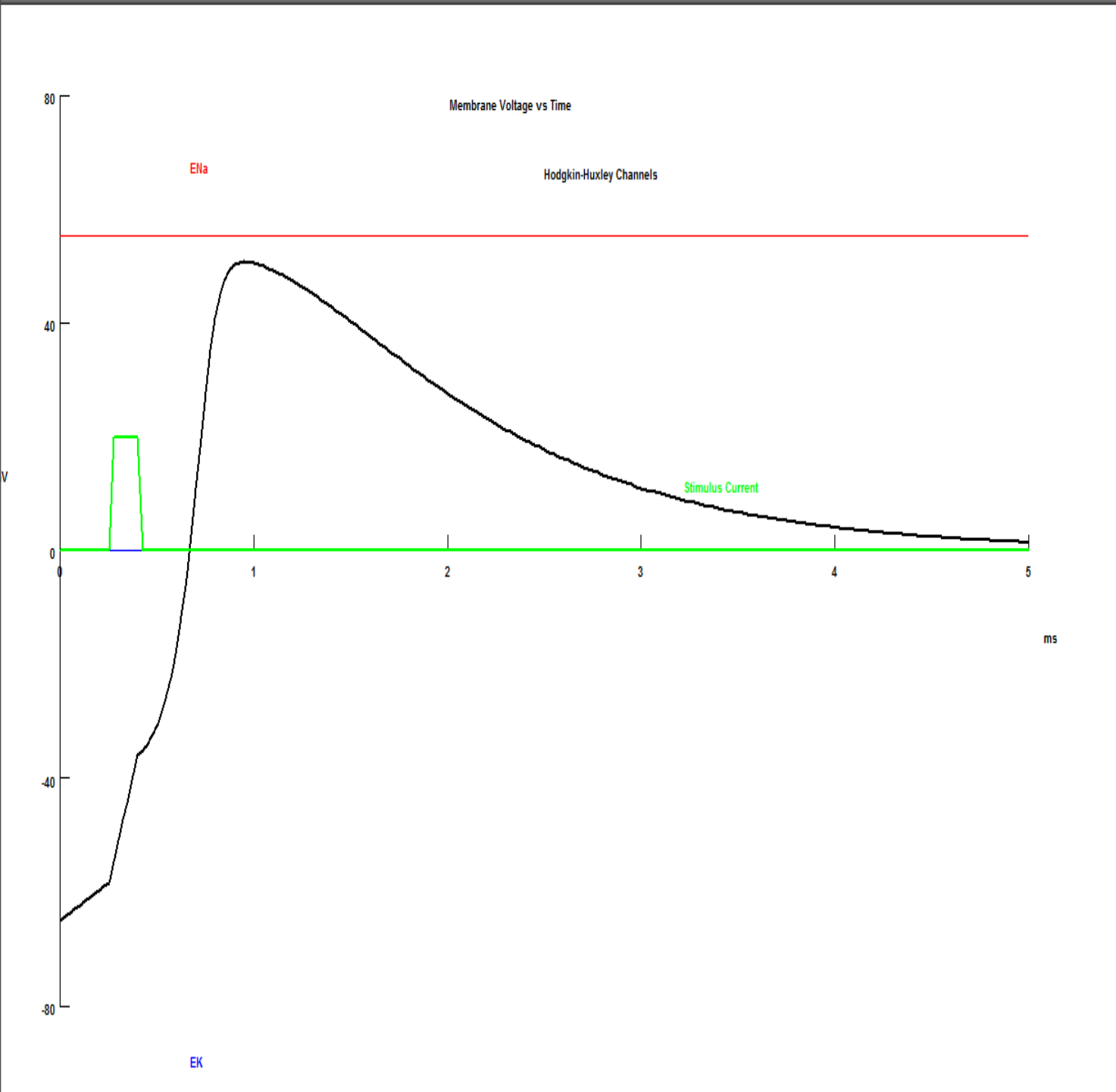


- When driving force is the least, I_{Na} into the cell decreases (green line)
- Greatest I_{Na} and g_{Na} occur during the falling phase of action potential

Observation #4 : Bonus

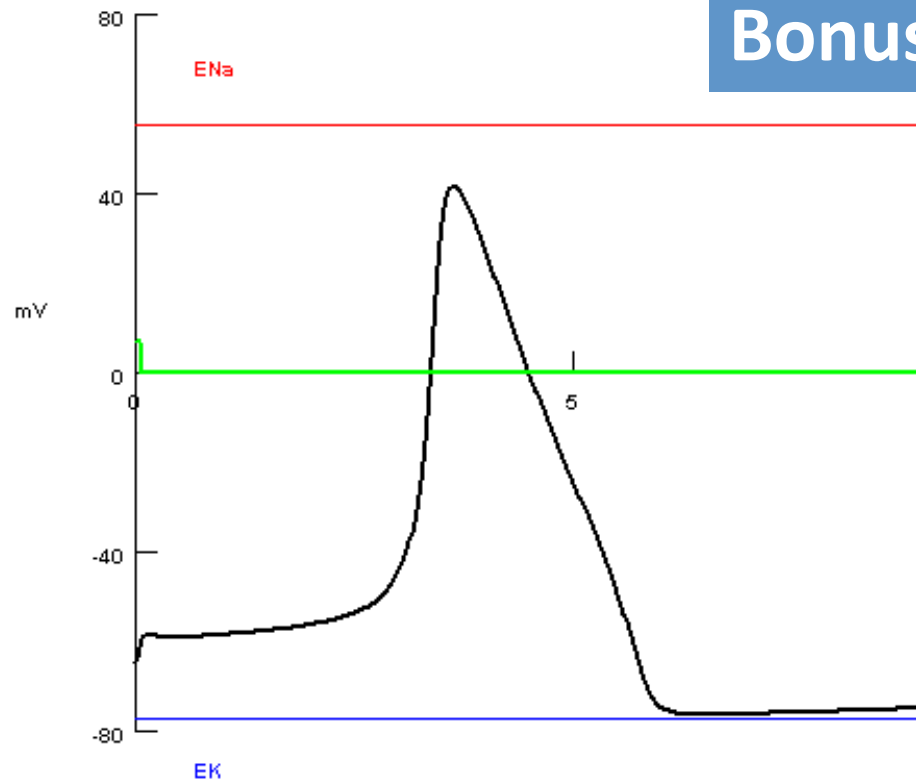
The tutorial goes through the effect of TTX, the Na blocker, but what about TEA, K Blocker?

Same as TTX, one would expect the shape to be solely depended on Na driving force.



And just as expected, the shape is only depended on the flow of K ion.

Bonus Problem



Action potential fired with 3 separate currents at $I = 0.07$ nA, lasting for 0.05ms each. They are introduced closer together in time to generate action potential as a result of temporal summation. An individual current at $I = 0.07$ nA for 0.05ms will not fire an action potential under the same circumstances.

Stimulus Control

Close Hide

- ◆ IClamp
- ◆ VClamp
- ◆ VClamp Family
- ◆ Location

patch(0.5)

IClamp[0] pulse

Delay (ms) 0

Duration (ms) 0.05

Amplitude (nA) 0.07

Stimulus Control

Close Hide

- ◆ IClamp
- ◆ VClamp
- ◆ VClamp Family
- ◆ Location

patch(0.5)

IClamp[4] pulse

Delay (ms) 0.06

Duration (ms) 0.05

Amplitude (nA) 0.07

Stimulus Control

Close Hide

- ◆ IClamp
- ◆ VClamp
- ◆ VClamp Family
- ◆ Location

patch(0.5)

IClamp[3] pulse

Delay (ms) 0.03

Duration (ms) 0.05

Amplitude (nA) 0.07