Supplementary material 3. Instructions on Report Writing

Your grade for the final paper will be based on your construction and content of the final paper. Since this is a group final project worth 30% of the class grade, we expect a deeper paper than the lab reports. All group members should be contributing equally to the final paper and approve the final content. At the end of the paper list the contributions of each group member. Send us any questions you have about the assignment. We'll review drafts submitted to us by **Thursday, May 21**. We don't expect you to do everything we suggest below. We expect a solid, focused and coherent paper. Don't spread yourself too thin, especially in the Discussion.

- Your final report should contain the usual sections of neuroscience journal articles:
- Abstract: summary with conclusions and significance of work
- Introduction: why you did this study, brief background and a hint of the results
- Materials and Methods (how you did the study- See videos from the Allen Brain Institute (ABI) for their Methods. Go to: [https://sites.google.com/ucsd.edu/neuroedu/single-cell-electrophysiology#h.5z947irfoyzc]. Scroll down to "Related videos and Teaching Materials" and see "Virtual tour of patch clamping at the Allen Brain Institute" and "Slide deck for teaching this in the classroom". The "Slide Deck" has a patch clamp video [https://www.youtube.com/watch?v=mF7Vd5olw18] and also details on cell firing properties. These can be use as references too. The "Overview of the of the Cell Types Data Base" video also has information for your paper too.
- Results (what did you find?)- The Results should be in two parts.
    - In the first part, present the results from section I to III and describe the electrophysiology properties of neurons you choose. Include a morphology picture of the neuron from the ABI website if it's provided.
    - In the second part, present the results from section IV and describe the differences in properties between these two populations. Compare for example cell populations with different dendrite types, different transmitters, human epilepsy samples vs human tumors, or mouse neurons from different cortical areas. Consult with us for suggestions.
    - If you choose the same cell type for section IV and for section I to III, compare your measurements from single neurons to the distribution of the population.
    - Save the data and graphs generated from the code to put in your results sections. Make sure they are labeled properly and with proper figure legends. Always show raw cell firing traces first before analyzed data. This demonstrates the quality of your data before detailing the measured properties
    - Consider choosing neurons that have been targeted for optogenetic expression. For example, if you chose parvalbumin neurons, a paper examining PV-Cre mice might help you establish the functional role of these neurons in brain activity. The Jackson Laboratory is a good resource for finding the target neurons of a transgenic line.
- Discussion (what this all means)
    - Parts I-III, talk about the differences and similarities in the electrophysiology properties between two/three neurons you measure.
    - Part IV, talk about the differences and similarities in the electrophysiology properties between two/three neuronal populations you examined. Talk about why there might be a huge variation in certain properties (such as resting potential) among neurons of the same population.

    - Compare your measurements to what is known in the literature on the neuron types you studied. What is known about the function of these neurons and their projections to other brain areas? Does morphology correlate with function?
    - Other Discussion topics to explore: Consider ionic currents that cause differences in electrophysiology properties? For example, why do parvalbumin-expressing neurons have narrower spikes compared to glutamatergic neurons? Parvalbumin neurons tend to fire at a higher rate than glutamatergic neurons in the cortex. Which ionic currents might explain the difference in firing properties between glutamatergic neurons and parvalbumin neurons? Are there differences in firing properties between neurons from patients with epilepsy and patients with tumors? Do firing patterns correlate with expression levels of certain ion channels?
- Some other ideas to explore: This final project requires more effort and creativity than the lab reports. Try pushing the data in a new direction such as one of the suggestions below or something you come up with.
    - We encourage you to trying some of the different analyses of action potential and firing properties.
    - Consider including NeuroSim simulation for comparison if applicable. A simulation is always a plus. If you are interested in this we can guide you to some specific NeuroSim exercises that would be appropriate.
    - Look up studies that targeted your chosen neurons with optogenetic expression. For example, if you choose parvalbumin neurons, you could look for a paper using PV -Cre mice. This may suggest the role the neuron types might play in brain activity.
    - There is modeled data for some neurons in the database like this under "select neuron model". (http://celltypes.brain-map.org/experiment/electrophysiology/623427407) You can discuss differences between the modeled and the actual ABI data.