Harvard Life Sciences Outreach **November 30th, 2017**
Understanding learning through *Drosophila melanogaster*

Part I Activity Instructions: Do our flies learn?

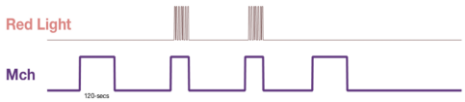
1. Open the excel file titled "FruitFlyLearning.xlsx".
2. Select the sheet called "PartI_Activity".
   This sheet consists of a table of the behavior of 30 flies before and after training. The pre- and post-training columns both measure how long each fly spends in the "B" chamber (away from "odor A").
3. Select all the data in columns B and C by highlighting (B1:C31) with your mouse.
4. Once you've selected the data in columns B and C, click on "**Insert**" on the top ribbon.
5. From the "**Chart**" options, choose to represent the data as a "**2D Line with Markers**" (or "**Marked line**").
6. At the top of the sheet, under the "**Design**" tab, choose "**Switch Row/Column**". (or you can do this by right-clicking on the graph and choose "**Select Data…**". Next choose "**Switch row/column**.")
7. To best see the data, you can select and **delete the legend** indicating the colors that correspond to each fly.

Once you've plotted the data, consider this **question**: Has every fly learned?

Part II Activity Instructions: Which training protocol (long or short intervals) prepare the flies to retain their training longer?

We will be determining the effects of training flies with two different protocols. What is the main difference between Protocol 1 and Protocol 2?

Protocol 1



Protocol 2

1. Select the sheet called "PartII_Activity".
   This sheet consists of two tables. Each table represents the behavior of 30 flies *after* training. One table (columns H-M) represents the flies after being trained by protocol 1; the other table (columns O-T) represents 30 other flies after being trained by protocol 2. Each column represents a time we test the flies after their training (1 hr, 2hrs, 3hrs post training, etc…)
2. First we will average the results for all the flies at each time point after training. For table 1, after 1 hr:
   a. **Select cell I33**, and type **"=AVERAGE(**" into it.
   b. Now highlight cells I3 – I32 to capture the data for all thirty flies at this time point. This will look like "**"=AVERAGE(I3:I32**".
   c. Finish the command by typing an end parenthesis "**)**" so that your entire command looks like **"=AVERAGE(I3:I32)**". Hit **enter** to get your average value for this column.

3. **Drag the equation in I33 through columns J, K, L, and M**. Do this by selecting the bottom right corner of the box highlighting I33 and dragging it through column M. This will calculate the average for each column.
4. Repeat steps 2 and 3 for the second table (flies who were trained with a longer interval). Start by **selecting cell P33** and typing **"=AVERAGE(P3:32)**". Hit **enter**. Then drag this equation through to column T.
5. Your work is summarized in a chart at A13. This chart is pulling the data from the cells in which you just calculated from both tables, but it is in a form that is easily graphed.
6. Highlight cells A14-F16. Graph it going to "**Insert**" at the top. Select the "**Chart**" from the options, choose to represent the data as a "**Marked Line**" (or a "**2D Line with Markers**").

Once you've plotted the data, consider this **question**: Which protocol (lessons separated by a long interval or a short interval) allowed the flies to retain their training longer?

Part III Activity Instructions: Is the difference between training protocols statistically significant?

1. Select the sheet called "PartIII_Activity", which picks up where Part II ended.
2. In addition to the average value for each column, which you've already calculated, we can also calculate the standard deviation (a measure of the variance) for each column. Let's start by typing **"=stdev.s(**" in cell I34, right below the average value you've already calculated for the column.
3. Select cells I3 – I32. The equation should now look like **"=stdev.s(I3:I32**".
4. Finish the equation by typing an end parenthesis, so that it looks like **"=stdev.s(I3:I32)**". Hit **enter** and it will calculate the standard deviation for column I.
5. **Drag the I34 cell across columns J, K, L, and M**, and standard deviations will be calculated for these columns as well.
6. Repeat steps 2-5 for the second table. Start by selecting cell P34 and typing **"=stdev.s(P3:32)**". Hit **enter**. Then **drag** this equation through to column T.
    - Note that the standard deviation values for the two columns now populate cells B6-F6 and B13-F13, respectively.
7. Now let's add our standard deviation values to our graph. **Select** the graph (it is the same as the one you've already generated.)
8. Select the **data in the graph from Protocol 1**.
8. Choose "**Design**" along the top ribbon. Choose "Add Chart Element," which gives you a menu. [If you do not have the "Design" tab, select the graph, and then select the "**+**" button that appears next to it. Then choose "**Error Bars**" and "**More Options…**"]
9. Select "**Error Bars**" and then "**More Error Bars Options**"
10. Under "**Error Amount**" choose "**Custom**" and the hit "**Specify Value**"
11. **Select cells B6-F6** as the "**Positive Error Value**" *AND* as the "**Negative Error Value**".
12. Hit "**OK**". This adds error bars to each data point for your graph of protocol 1.
13. **Repeat steps 8-12** for the data from protocol 2.
    - This time the "**Positive**" and "**Negative Error Value**" to **select are in cells B13-F16**.

Once you've plotted the data, consider this **question**: Is the difference between the two protocols significant? How can you tell?