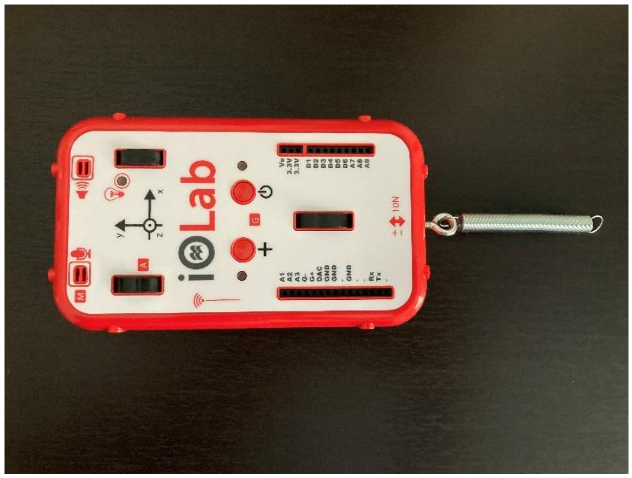
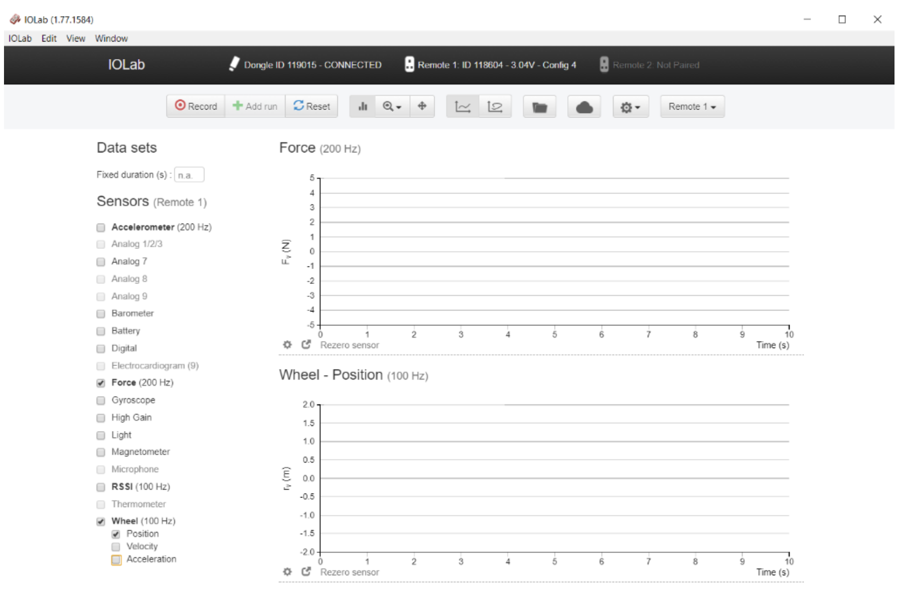
iOLab Spring Force

Purpose: To analyze the force exerted by a spring as the length of the spring is varied.

Screw the screw eye in your iOLab kit into the force sensor. Make sure that you screw it all the way in – it takes many turns. Then attach the spring from your iOLab kit in the screw eye. When you are done with this, your iOLab device should look like this:

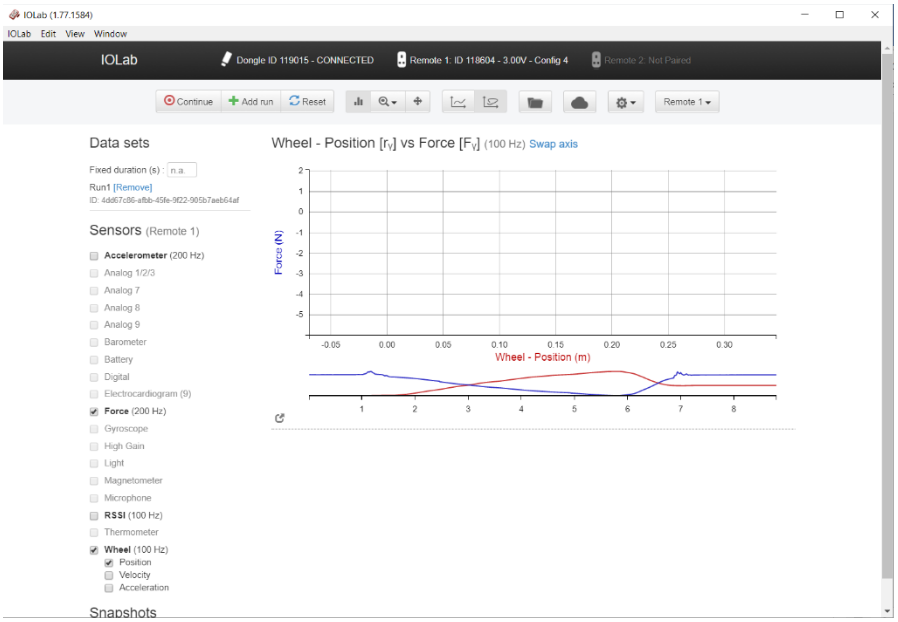


Place your iOLab wheels down on a table or shelf that is at least a meter long. Open the iOLab app, and in the window select the Force and Wheel Position displays.



Press the “Record” button. Grasp the free end of the spring with one hand, and pull the iOLab until the force sensor records a force of about 5 N. Then stop.

There are two buttons near the top of the window that control the graphs that are displayed. The one on the left gives the display shown above. Press the other button – the one on the right. That button shows a display in which the two recorded quantities – in this case force and position – are plotted against each other. Make sure that force is on the y-axis and position is on the x-axis. If that is not the case, press the "Swap axis" control next to the plot title. Your display should look something like this:



The graph immediately below the force vs. position graph shows a summary of the force and position vs. time graphs you saw previously. Move your cursor to that graph and to the time at which you began to stretch the spring. Left click and then hold the left click down while you move the cursor to the right until you have gotten to the time when you were no longer stretching the spring longer. Then let go of the left click. At this point, you will have a force vs. position graph for the time range during which you were stretching the spring longer. It should be (almost) a straight line.

Once again, go to the row of buttons near the top of the window. Press on the button that looks like a magnifying glass. That will activate an analysis tool for the force vs. position graph. Find the x and y coordinates at both ends of the graph. Then calculate the slope of the line. Your final answer should be in units of Newtons per meter (N/m).

Take a screen shot of your iOLab window and paste it into a Word document.

Your result is that the force exerted by a spring depends linearly on the amount by which it is stretched from its equilibrium length. In addition, the spring exerts a restoring force – when you make the spring longer, the force it exerts is in the direction that would return the spring to its equilibrium length. That's why the force exerted by a spring is generally written $F = -kx$. The slope you calculated above is the "spring constant" k.

Type the spring constant you've determined into the Word document that contains the screen shot, and submit it via Canvas.