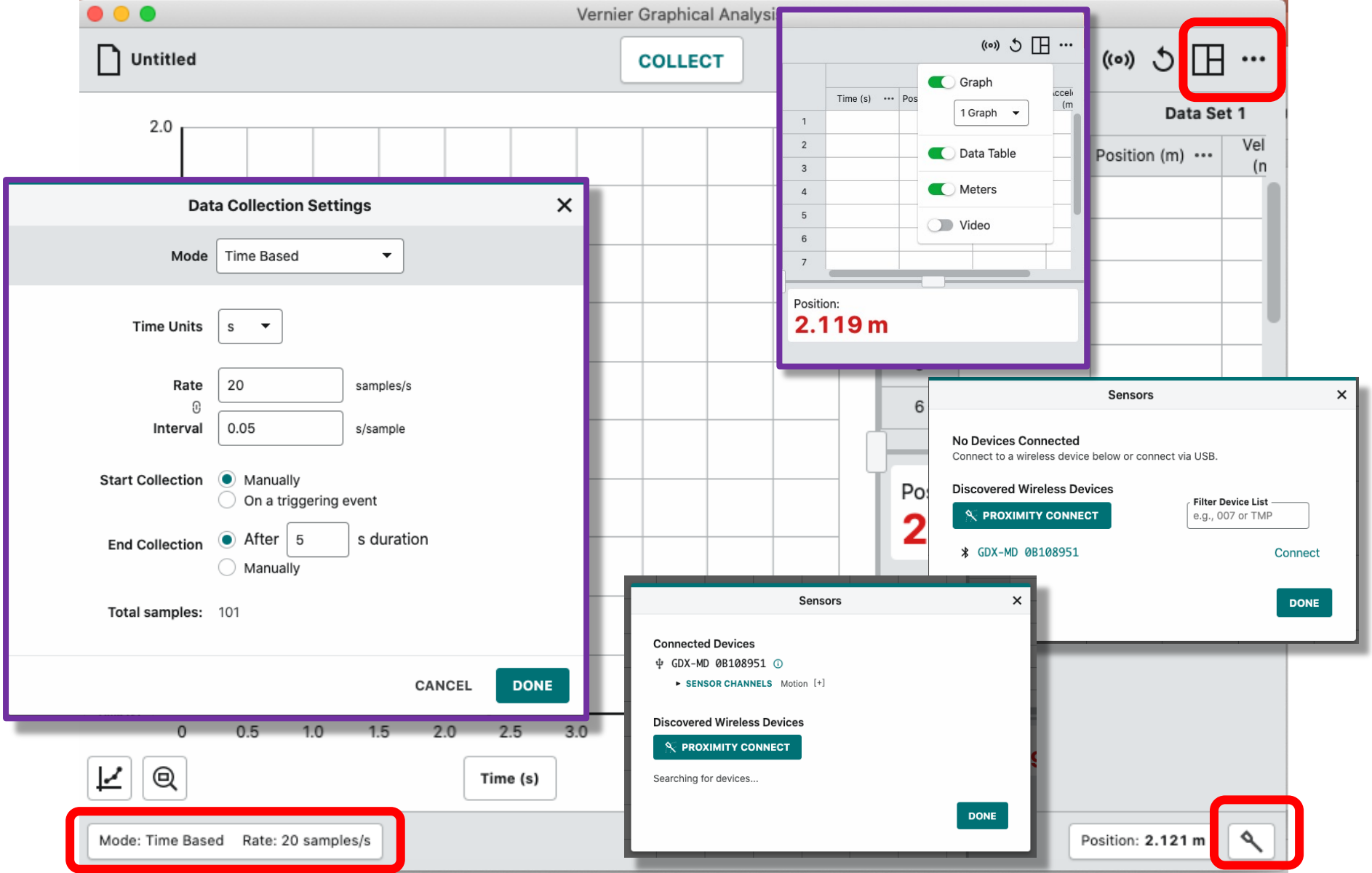
GoDirect Motion

Acceleration and deceleration of a model VW Bus

The bus should never get any closer than about a foot away from the detector.
It needs to stay aligned as it moves for best results. It only needs to move a *few* meters – do **NOT** try to make it go as far as possible!

1. Connect GoDirect Motion detector to Graphical Analysis – either by Bluetooth (check unit ID number) or USB cable.
2. Under Data Collection Settings make the duration of the experiment 8 seconds (the default is 5 s).
3. Align the VW Bus with the line of sight of the detector. Click Collect (or press space bar) and then “launch” the bus.
4. Graphs should show clearly the motion of bus from release until it stopped. If there are any erratic points then make adjustments to your procedure and repeat the experiment.
5. Repeat with a significantly “stronger” launch.
6. Once you have satisfactory graphs, share the data with team members and save the file to your laptop.


Vernier Graphical Analysis
Untitled
COLLECT
Data Set 1
Position (m)
Vel (n
2.0
Data Collection Settings
Mode
Time Based
Time Units
s
Rate
20
samples/s
Interval
0.05
s/sample
Start Collection
Manually
On a triggering event
End Collection
After
5
s duration
Manually
Total samples:
101
CANCEL
DONE
0
0.5
1.0
1.5
2.0
2.5
3.0
Time (s)
Graph
1 Graph
Data Table
Meters
Video
Time (s)
Position:
2.119 m
Sensors
No Devices Connected
Connect to a wireless device below or connect via USB.
Discovered Wireless Devices
PROXIMITY CONNECT
Filter Device List
e.g., 007 or TMP
GDX-MD 0B108951
Connect
DONE
Sensors
Connected Devices
GDX-MD 0B108951
SENSOR CHANNELS
Motion [+]
Discovered Wireless Devices
PROXIMITY CONNECT
Searching for devices...
DONE
Mode: Time Based
Rate: 20 samples/s
Position: 2.121 m

Using the **Velocity vs. Time** graph:

1. Use coordinates of two points to find the average acceleration caused by the "motor" (spring) – is this a constant acceleration?
2. Find a point or interval for which the acceleration was zero while the bus was in motion. How can you tell?
3. Put a line of best fit on the interval when the bus was coasting to a stop (after the motor quit). Based on the coefficients of the best fit equation, what was the acceleration for this part of the motion?
4. Select a certain interval of time and then, under the graph tools menu, choose View Integral and note the "Area" result. This should equal the displacement of the bus.

Using the **Position vs. Time** graph:

1. Use the graph tools to determine the maximum speed – is the result consistent with the Velocity vs. Time data?
2. Trace along the graph and use initial and final positions to calculate displacement that occurred for a certain interval. Compare this displacement to the area under the curve from the Velocity graph for the same interval of time.
3. Highlight the part of the graph where the motor was working. What would be an appropriate curve fit – choose one that you think is best.
4. Repeat the previous step but highlight the interval where the bus was coasting and choose quadratic. View the actual data points – is this a good match?

Using the **Acceleration vs. Time** graph:

1. Compare the acceleration values shown on this graph with the acceleration values previously determined using the Velocity Graph.
2. Experiment with the Integral tool on this graph – what would area under the curve represent? Try highlighting the positive accelerations and negative accelerations separately.
3. At what point(s) in time is acceleration zero while the bus is in motion? What is happening at that time? How does this relate to the velocity and position graphs?

Using all graphs and any of the analysis tools:

1. The stronger launch results in a greater maximum speed and a greater overall displacement of the bus. Calculate the ratio of the speeds and the ratio of the displacements. (For example, the maximum speed of the stronger launch might be 1.3 times the maximum speed of the weaker launch.) Is the ratio the same? If not, why are the ratios different?
2. Is the greater speed and displacement because the motor (spring) produces a greater *acceleration* or is it because the acceleration caused by the motor lasts a greater amount of *time*? Or is it *both*? Support your claim.