

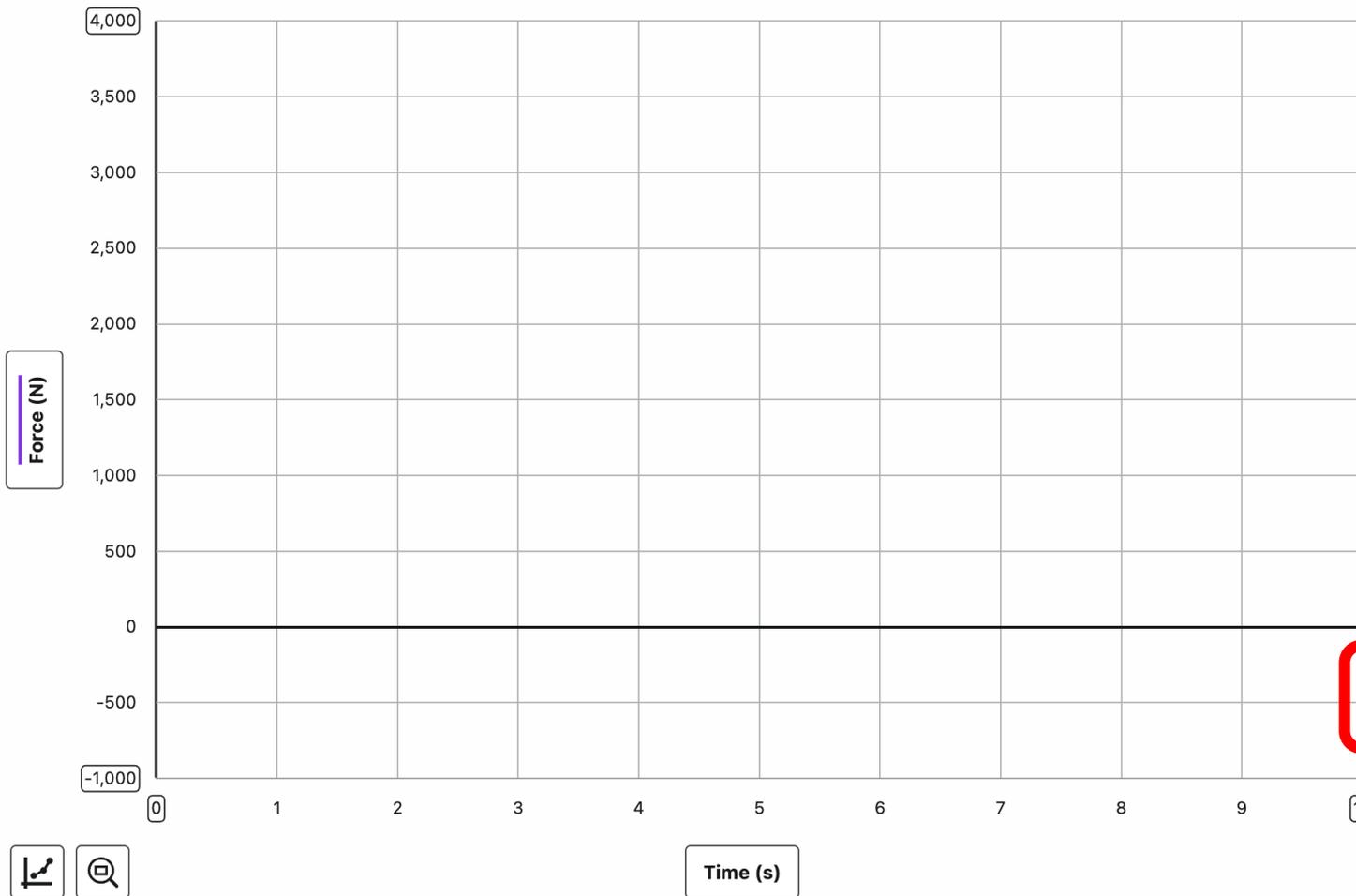
Hang Time

- Goal: test Newton's laws and the concept of normal force. And, just for fun: who has the greatest hang time and who has the least hang time?
- Set scale to 3500 N, and connect Force Plate to LabQuest Mini.
- Adjust Data Collection to 100 samples per second for duration 5.00 s.
- Stand on plate, click Collect, and then jump and land on plate.
- Repeat for each student and share the data.



Try not to lose the twist tie! Please return the cable to this condition when finished.





Force: ...
18 N

FORCE PLATE 3500N ⓘ
LabQuest MINI

Calibrate

Zero

Reverse

Units N ▾

Untitled

COLLECT



Data Collection Settings



Mode Time Based

Time Units s

Rate 100 samples/s

Interval 0.01 s/sample

Start Collection Manually
 On a triggering event

End Collection After 5 s duration
 Manually

Total samples 501

Remote Logging Disabled EnabledData Marking Disabled Enabled

CANCEL

DONE

Force: ON

Force (N)

4,000

3,500

3,000

2,500

2,000

1,500

1,000

500

0

-500

-1,000

0

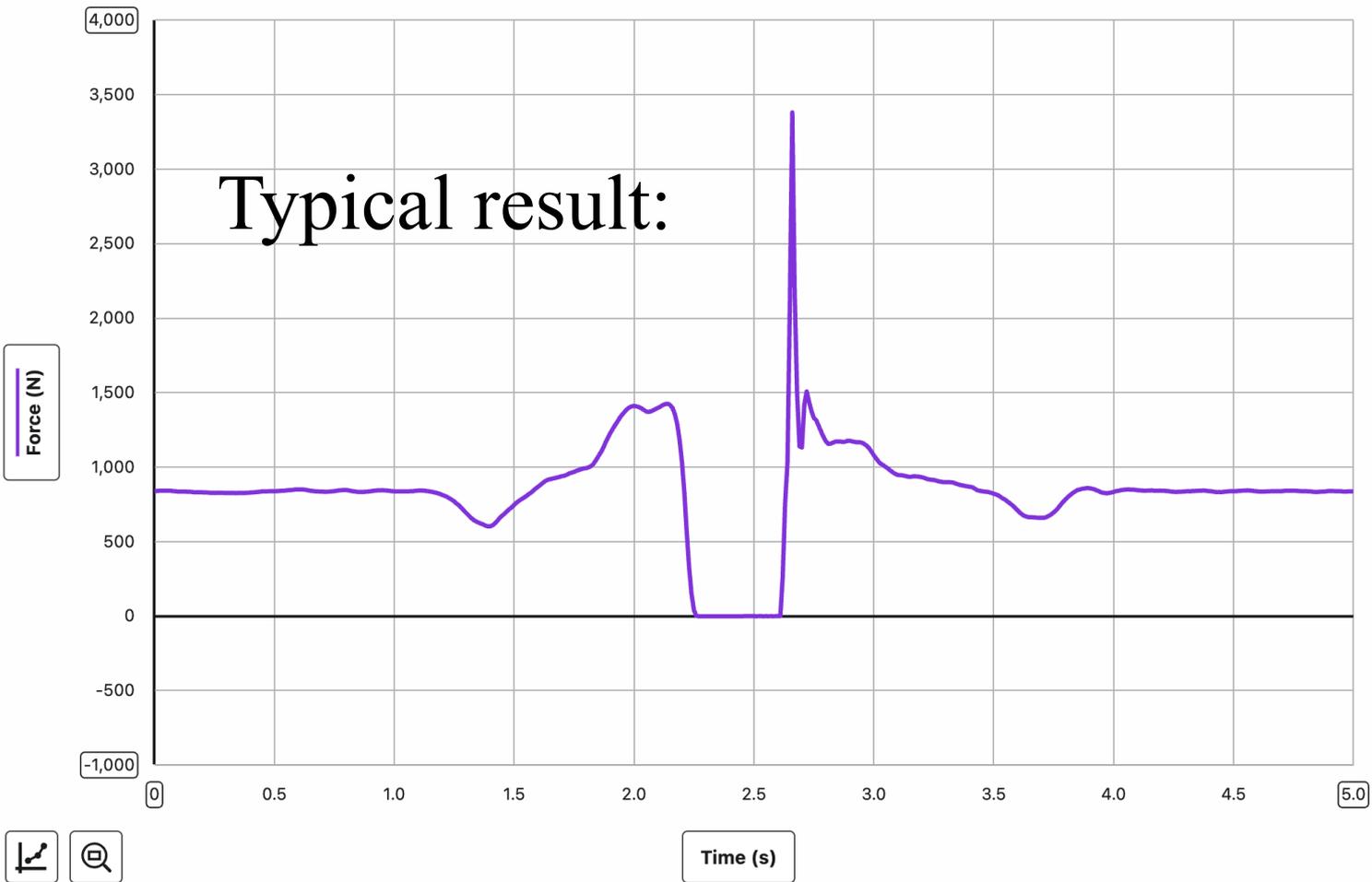
1



Mode: Time Based Rate: 50 samples/s

Force: 0 N





Typical result:

Force: ...
-1 N



Time (s)

1. Using the force data find your "hang time" – the precise amount of time you were actually in the air.
2. Using your hang time, determine your initial velocity at the instant you left the plate.
3. Using the force data, determine your weight and then calculate your mass.
4. Create a column of values that is equal to your acceleration based on the force that was measured.
5. Create a column of values equal to your velocity.
6. How do the results support the 2nd and 3rd laws of motion?

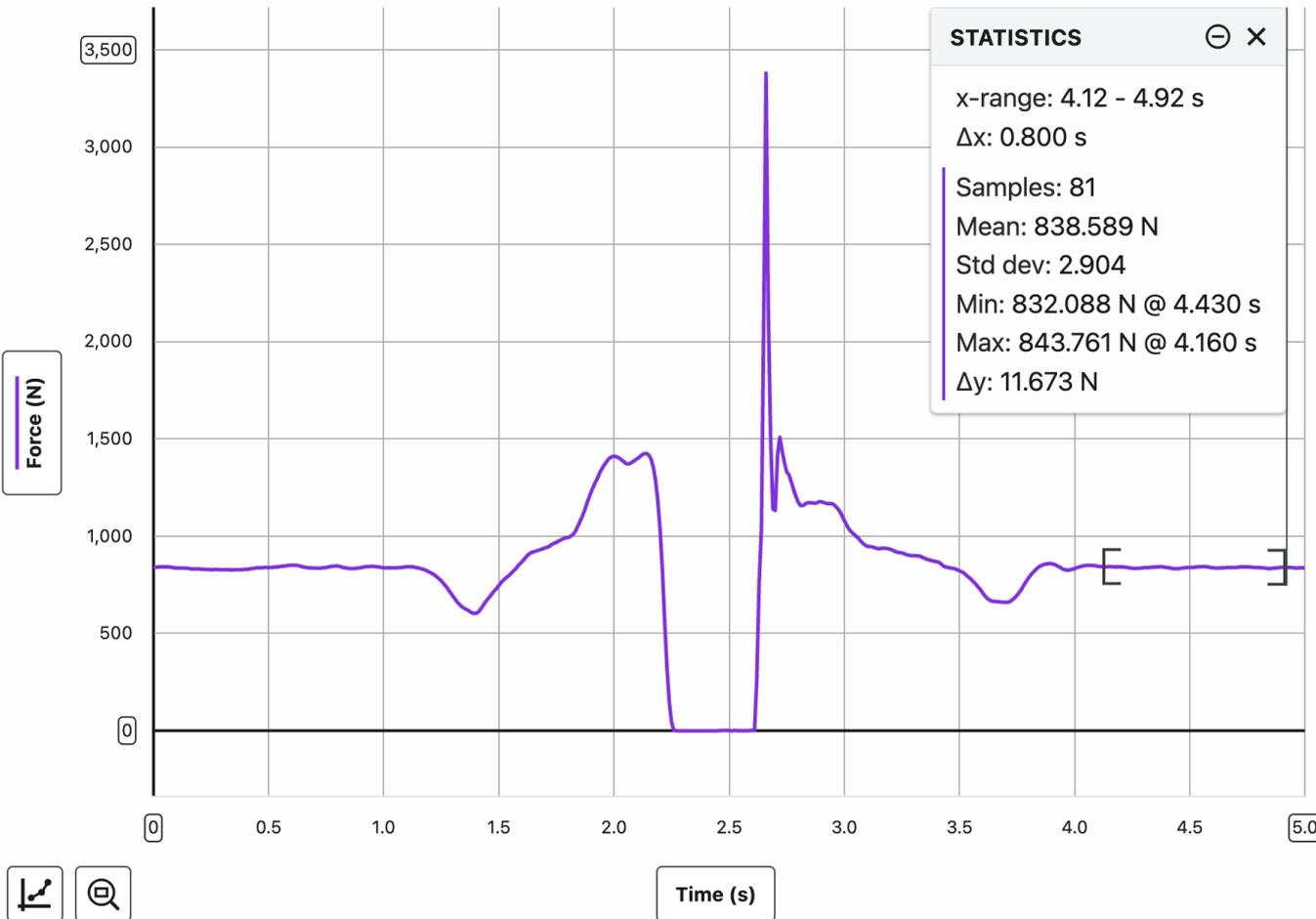


Data Set 1

	Time (s)	Force (N)
1	0.00	
2	0.01	
3	0.02	
4	0.03	
5	0.04	
6	0.05	

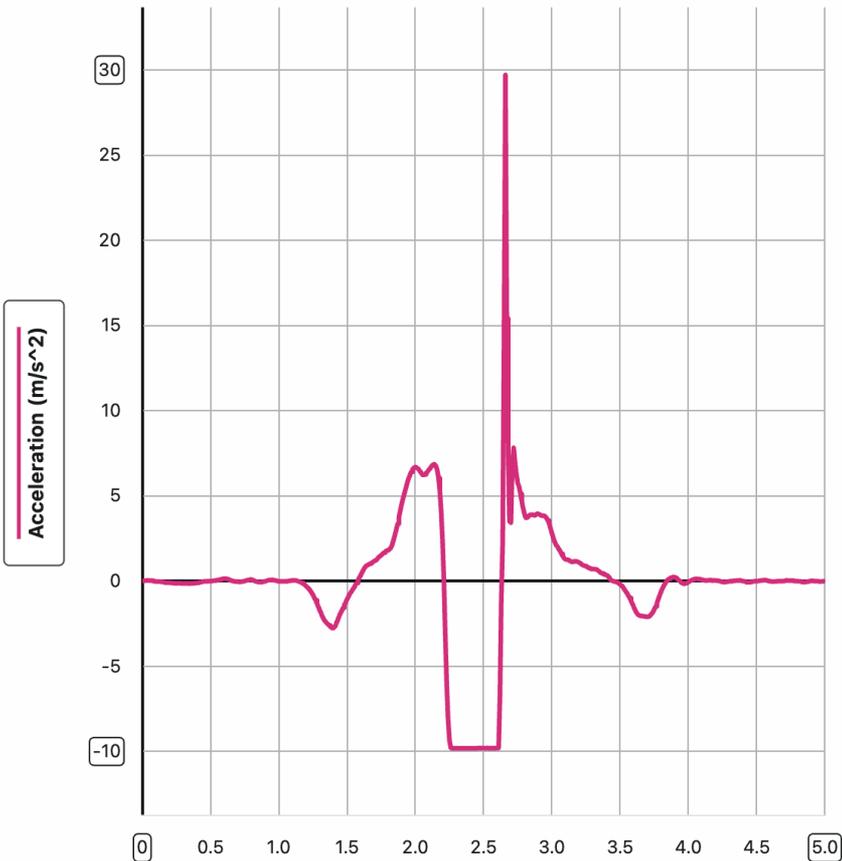
Force: **-1 N**





Data Set 1		
	Time (s)	Force (N)
1	0.00	
2	0.01	
3	0.02	
4	0.03	
5	0.04	
6	0.05	

Force: **0 N**



Data Set 1					
	Time (s)	Force (N)	Accelerati... (m/s^2)	Velocity (m/s)	
1	0.00	839	0.000	0.000	
2	0.01	840	0	0.000	
3	0.02	841	0	0.000	
4	0.03	84			
5	0.04	84			
6	0.05	84			

Acceleration and Velocity are calculated columns!

Force:
-1 N

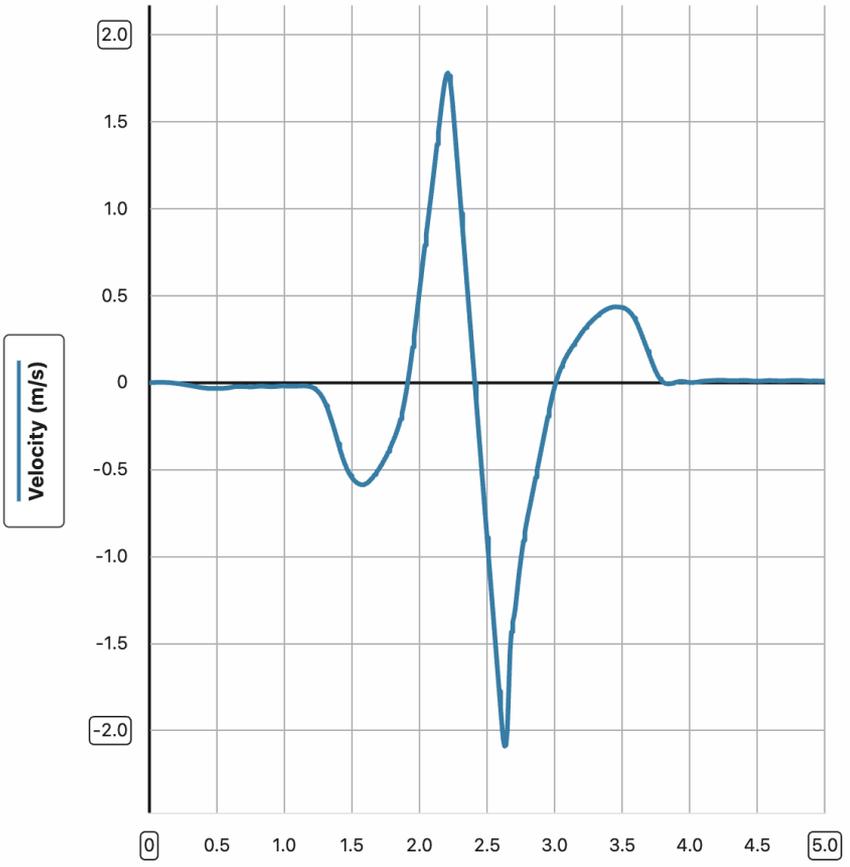
Acceleration:
-9.815 m/s^2

Velocity:
0.009 m/s



Time (s)

COLLECT



Data Set 1						
	Time (s)	Force (N)	Accelerati... (m/s^2)	Velocity (m/s)		
1	0.00	839	0.000	0.000		
2	0.01	840	0.015	0.000		
3	0.02	841	0.030	0.000		
4	0.03	841	0.030	0.001		
5	0.04	842	0.045	0.001		
6	0.05	841	0.030	0.001		

Force: **0 N**

Acceleration: **-9.800 m/s^2**

Velocity: **0.009 m/s**



Time (s)

1. Time in air: $\Delta t = 2.61 - 2.26 = 0.35 \text{ s}$

2. Initial velocity: $v_0 = g\Delta t = 9.8\left(\frac{0.35}{2}\right) = 1.7\frac{\text{m}}{\text{s}}$

3. Mean force measured while at rest: 838.6 N

weight = 839 N , mass $m = \frac{F_g}{g} = \frac{838.6}{9.8} = 85.6 \text{ kg}$

4. Acceleration: $a = \frac{\Delta F}{m} = \frac{F_N - mg}{m} = \frac{F_N - 838.6}{85.6}$

5. Velocity is the antiderivative of the acceleration as a function of time – in Graphical Analysis use the function: integral(“Acceleration”, “Time”)

6. How do the results support the 2nd and 3rd laws of motion? The velocity determined by applying the 2nd Law is consistent with the amount of time the person was in the air. The maximum upward velocity calculated was 1.77 m/s , which is close to the value 1.72 m/s , which was based solely on hang time. However, the velocity at the instant $t = 2.26 \text{ s}$ calculated by integrating velocity does not match quite as well. The 3rd Law is indirectly supported by this experiment because we must assume that the upward force of the plate on the person is equal and opposite to the downward force of the person’s feet pushing on the plate (which is really what is measured by the plate).