

Exploring Motion Graphs

Part I: Introduction

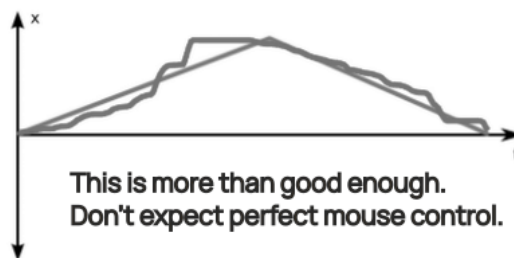
In your web browser, navigate to www.gigaphysics.com, then select the **Exploring Motion Graphs** lab. In this lab, you will learn about both position vs. time and velocity vs. time graphs with the help of a draggable caterpillar. You will drag the caterpillar with the mouse, and the computer will then graph the motions you made, allowing you to learn by discovery.

Before you try to create the specific motion graphs in this lab, spend a moment getting used to the draggable caterpillar. Use the mouse to drag it back and forth a bit. You will find that the caterpillar always stays on the ground, so your only concern is the side to side motion. Then, when you release the caterpillar, you will see a red line appear for the graph.

Part II: Position vs. Time Graphs

From the **Which graph?** menu, select **Position vs. Time 1** and look at the graph that shows on the screen. Since this is a position vs. time graph, the vertical axis represents the location of the caterpillar along the ground, while the horizontal axis represents the elapsed time.

Now drag the caterpillar to try to create a graph that looks like the one on the screen. (Don't expect it to be perfect. Nobody can control the mouse that perfectly.) For that matter, don't worry about it if your first attempt isn't even close, or if you have to take a wild guess for your first attempt. The point of this lab is to explore and learn by trying different things. Keep trying until you figure out how the caterpillar should move in order to create this graph, then answer the two questions below.



What did the caterpillar do when the graph stopped going upward and started going downward?

What did the caterpillar do in order for the graph to return to the horizontal axis at the end?

Now choose **Position vs. Time 2**. As before, experiment until you understand how to produce the graph on the screen, then answer the questions that follow.

On a position vs. time graph, what does it mean when the graph has a perfectly horizontal segment?

What does it mean when the position vs. time graph is below the horizontal axis instead of above it?

Now switch to **Position vs. Time 3** and experiment until you can create the graphs.

The first segment of this graph is much steeper than the final segment. What did you have to do with the caterpillar to do to make the first segment so much steeper than the final segment?

Finally, repeat the experimentation with **Position vs. Time 4**. The curve will be challenging to replicate closely, so remember not to demand perfection.

This time, the graph is a curved segment that gradually gets steeper. What does the caterpillar have to do to create this curved feature?

Part III: Velocity vs. Time Graphs

As you experiment to create the velocity graphs, you will need to be even less picky than you were for the position vs. time graphs. Controlling the velocity with the mouse is even harder than controlling the position, and your graph to be jittery. Just aim for the same general features.

Now select **Velocity vs. Time 1**. These graphs will be different. The vertical axis no longer shows the caterpillar's position but rather its velocity, or how fast it is moving. When you have the graph close enough to get the idea, answer the following question.

What does it mean when a velocity vs. time graph has a straight horizontal segment?

What did the caterpillar have to do to make the second, higher horizontal segment?

Now choose **Velocity vs. Time 2** and experiment as before.

What does it mean when the velocity graph is below the horizontal axis instead of above it?

Now on to **Velocity vs. Time 3**.

What did the caterpillar have to do for the velocity to return to the horizontal axis at the end?

Finally, try **Velocity vs. Time 4**.

How did you create the final segment that sloped downward, below the horizontal axis?

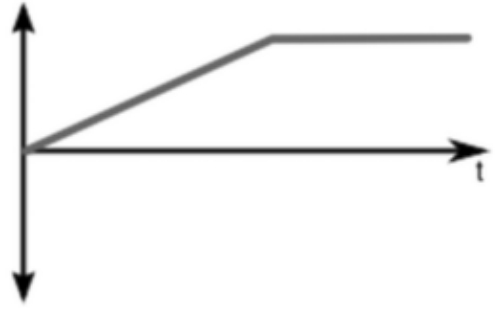
Part IV: Review and Apply

Complete the table below, contrasting the meaning of different features of a position vs. time graph with their meanings on a velocity vs. time graph.

Graph feature	Meaning on position vs. time graph	Meaning on velocity vs. time graph
horizontal segment		
at horizontal axis		
below horizontal axis		

...continued on the next page

Suppose that the graph at the right is a position vs. time graph that describes the motion of a dog. Write a brief description of what the dog is doing according to this graph.



Now suppose that the same graph is the dog's velocity vs. time graph. Again, write a brief description of what the dog is doing in this graph.
