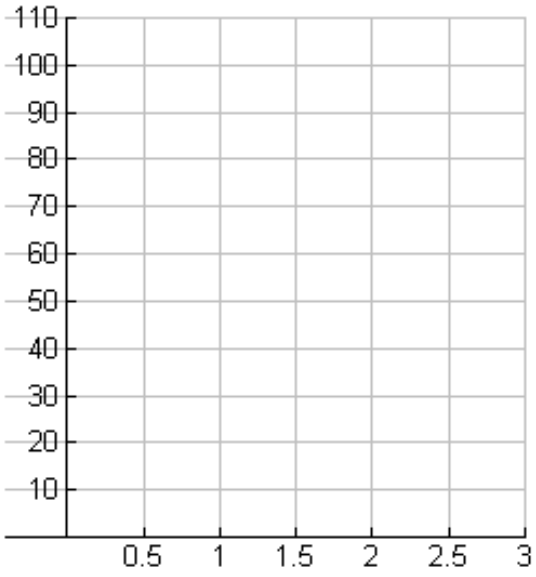
Investigation 2.1

Danger Dan dared to climb to the top of the ultra-high dive. Leaning out he is a bit overcome by the 100 foot drop to the pool below. Nonetheless, Dan does the dive. Simply stepping out he begins his decent according to the formula $d = 16t^2$ where *d* is the number of feet traveled in *t* seconds after Dan leaves the diving board.

For convention, let the moment when Dan touches the water in the pool be the end of his "dive".

1. Define a function, $f(t)$, to describe Danger Dan's position during his dive.
2. Graph $f(t)$ on the grid provided. (Be sure to provide accurate data points every ½ second.)
3. Calculate the average speed for Dan during his entire dive.
4. How is that average speed you found in the last question visually seen in the graph? (Add any details to the graph that might help.)
5. Calculate the average speed for Dan during the last 1 second of his dive. Graphically represent this.
6. Calculate the average speed for Dan during the last ½ second of his dive. Graphically represent this.
7. Using your graph, estimate how fast Dan was traveling at the instant he entered the water. Explain your reasoning/method.



Let *x* = the number of seconds until Dan enters the water.

8. Complete this table to show successive average speeds.
9. According to your table, what do you think is the instantaneous speed when Dan entered the water?

x	Average speed for the last *x* seconds of his dive.
1	
.1	
.01	
.001	
.0001	
.00001	

Define a function, $g(x)$, to describe the average speed during the last *x* seconds of Dan's dive.

10. What is the domain of *g*?
11. Graph *g* on your calculator to determine it's basic shape. What kind of function do you think *g* must be?
12. Algebraically simplify *g* and validate your prediction from the last problem.
13. Explain why $g(0)$ does not exist. What value do you think would be reasonable for $g(0)$ if it did exist?