Exploration 26: A Motion Antiderivative Problem

<u>Objective</u>: Given an equation for the velocity of a moving object, find equations for the displacement and acceleration.

Tay L. Gates wants to determine the characteristics of his new pickup truck. With special instruments he records its velocity at 2-second intervals as he starts off from a traffic light.

t seconds	velocity, ft/sec
0	0
2	4.5
4	6.9
6	8.8
8	10.4
10	11.9

1. Show that the power function

$$v(t) = 3t^{0.6}$$

   fits these data closely.

2. Write an equation for Tay's acceleration, $a(t)$. Is the acceleration getting larger or smaller as time goes on? Tell how you figured this out.

3. Velocity is the derivative of displacement. Thus, displacement is the **antiderivative** of velocity. Write an equation for $x(t)$, the truck's displacement from the middle of the intersection. Use the fact that the truck was initially at $x(0) = -50$ feet from the center of the intersection at $t = 0$ when the light turned green.

4. Use the equation in Problem 3 to predict where Tay's truck was 10 seconds after he started accelerating.

5. Calculate the answer to Problem 4 directly from the data in the table, using the trapezoidal rule.

6. How long does it take before the truck is 100 feet beyond the intersection?

7. What did you learn as a result of doing this Exploration that you did not know before?