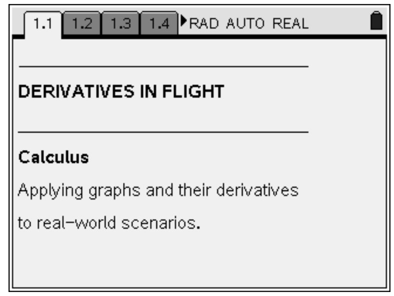
Derivatives can provide important details in real-world problems that involve height and velocity. The slope of the tangent line to a curve gives information about the velocity of a moving object.



- **Open the TI-Nspire document *Derivatives_in_Flight*.**
- **Press ctrl ▶ to move to page 1.2 and begin the activity.**

Lucia is doing an experiment for her physics class. She built a small water rocket and launched it from a platform 2 feet above the ground. The graph models the flight of the rocket, where *x* represents the time (*t*) in seconds and *y* represents the height, in feet, of the rocket.

1. On page 1.4, grab the white point labeled *x* on the *x*-axis and move it to see the slope $f'(t)$ of the tangent line change as you move along the graph. The slope of the tangent line at each point represents the **velocity** of the rocket at that time.

   a) What is the value of $f'(t)$ when $t = 0$? What does this value represent? ____________________

   ____

   b) At approximately what value(s) of *t* is the derivative $f'(t) = 0$? What happens to the flight of the rocket when the derivative is zero? ______________________________

   c) What is the approximate velocity of the rocket when it hits the ground?

   ____

- **Move to page 1.8.**

2. If the value of the derivative $f'(x)$ is plotted as the *y*-coordinate for each value *x*, the ordered pairs $(x, f'(x))$ trace out the graph of a new function, $y = f'(x)$, the *derivative function*. Use the up arrow on page 1.9 to change the value of *x* in the top window and see the graph of the derivative traced out in the bottom window.

   a) What do you notice about the flight of the rocket when $f'(x) > 0$? When $f'(x) < 0$?

   ____

   b) What happens to the rocket when $f'(x)$ changes from positive to negative?

   ____

   c) In relation to the flight of the rocket, what determines whether the graph of the derivative is negative or positive?

   ____

➢ **Move to page 2.1.**

Nora also built a water rocket and launched it from a platform 2 feet above the ground. The graph approximates the flight of the rocket, where *x* represents the time (*t*) in seconds and *y* represents the height, in feet, of the rocket.

3. On page 2.3, grab the white point labeled *x* on the *x*-axis and move it to see the slope of the tangent line change as you move along the graph.
   a) What is the velocity of the rocket when it is launched? When it hits the ground?

   ____

   b) How many seconds had passed when the rocket reached its maximum height?

   ____

   c) Describe the flight of Nora's rocket.

   ____

➢ **Move to page 2.7.**

4. Use the up arrow on page 2.8 to change the value of *x* in the top window and plot the graph of the derivative function $f'(x)$.
   a) What can you say about the flight of the rocket when $f'(x)$ is positive, negative, and zero?

   ____

   b) Compare the flight of Nora's rocket to the flight of Lucia's rocket. Which rocket went faster and higher? Which was going faster when it hit the ground?

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