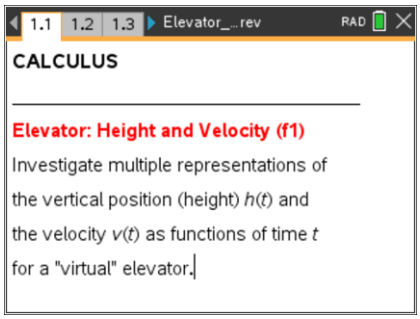
## About the Mathematics

These documents are based on the context of the rectilinear (straight line) vertical motion of an elevator. The motion of an elevator is a particularly nice context for introducing ideas related to rectilinear motion (position, velocity, speed, acceleration, etc.) because the connection to the vertical coordinate of related graphs is more natural and does not require the additional mental work of representing functions depicting horizontal motion (for example, of a car).




The Elevator: Height and Velocity documents allow the user to provide a height function *h* to "drive" the motion of an elevator. The document produces a corresponding velocity function by differentiating the given height position function. The height function drives the motion of the elevator as the user advances the value of time *t* via a slider.

## Math Objective

- Students will have an opportunity to work with linked graphical and physical representations of the vertical motion of an elevator.

## Using the Documents

The two documents differ in how the user sets the height function *h*. In *Elevator_Height_and_Velocity_f1.tns,* the function **f1**(*x*) represents the height **v**(*t*) (with *x* interpreted as *t*). The user can get access to **f1** by pressing ctrl G to reveal the function entry line. In *Elevator_Height_and_Velocity_PWL.tns,* the height function **h**(*t*) is presented as a continuous piecewise linear graph that can be directly manipulated by moving the vertices that connect the linear pieces of the graph up or down by grabbing and dragging.

**TI-Nspire™ Technology Skills:**

- Download a TI-Nspire document
- Open a document
- Move between pages
- Grab and drag a point
- Click on a minimized slider
- Enter text on the function entry line

**Tech Tips:**

- Make sure the font size on your TI-Nspire handheld is set to Medium.
- You can hide the function entry line by pressing ctrl G.

**Lesson Materials**

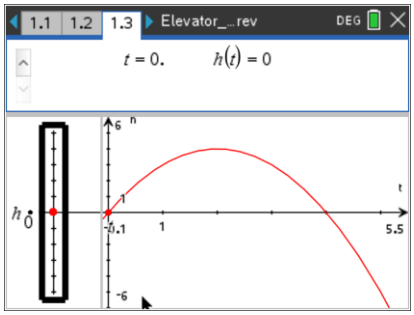
Elevator_Height_and_Velocity_f1.tns

Elevator_Height_and_Velocity_PWL.tns

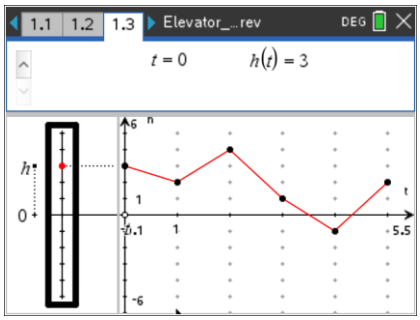
Visit www.mathnspired.com for lesson updates.

On page 1.3, the height function is displayed in the graphing window on the right. On page 1.4, the corresponding velocity function (determined by differentiating the user-defined height function) is displayed.

On page 1.5, both graphs (with time axes aligned) are displayed. In all three cases, a slider has been set up to allow the user to change the value of time *t* (alternatively, the time point can be grabbed and dragged along the horizontal axis), and a virtual depiction of the elevator's motion is enacted dynamically. When the height graph is present, the vertical coordinate aligns with the position of the elevator.



f1.tns file



pwl.tns file

## Possible Applications

Natural questions to ask with these documents concern physical interpretations of the graphical characteristics of the height and velocity functions, especially in terms of direction of movement. A common mistake is to think of the direction of the velocity graph as corresponding to the direction of the elevator's movement (as opposed to the *sign* of the velocity graph being the relevant characteristic).

With the piecewise linear height function, it is important to discuss why the velocity function is undefined when the slope of the height function changes at a vertex. Relating the value of the velocity to the slope of the height function graph is key. Being able to manipulate the graph allows for questions that ask for graphs that "tell a story" about the elevator's movement.