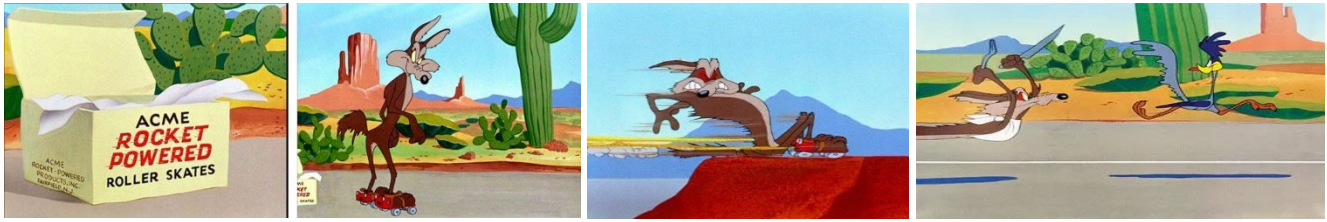# Wile E. Coyote's Roller Skate Chase

Click on the image to view an clip of this episode.

With the help of some Acme rocket powered roller skates, Wile E. Cote will attempt to snatch the Road Runner. We will use the TI-84 Plus CE and parametric mode to simulate this real-world scenario.

1. Press mode and select **Parametric** and **Simultaneous Graphing**.
   Please make sure you are also in **Radians**.
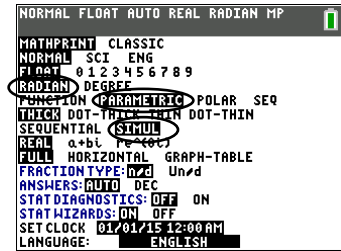
2. Press zoom 6: ZStandard for the standard window.
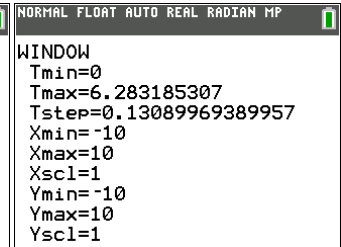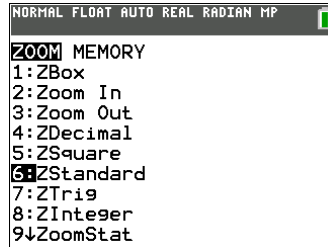
   Press window.
   Notice the standard settings are
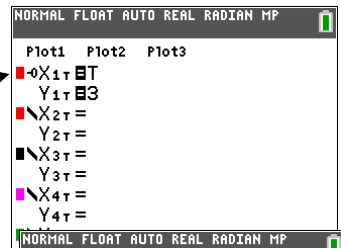 $0 \le t \le 2\pi$ in steps of Tstep = $\frac{\pi}{24}$
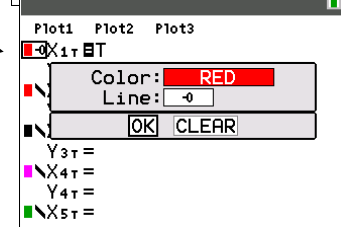   with $-10 \le x \le 10$ by $-10 \le y \le 10$.

3. Press y=.
   Enter $x(t) = t$, $y(t) = 3$ which will animate the Road Runner's path.
   Press ◀ until you can't any more, then press enter.
   Optional: Press ▶ (84CE) or enter (84) to change the graph style to animated path (⊸∣).

   Optional (TI-84CE only): Use the spinner to change the graph color to red.

   Press graph. Press trace and ▶ to observe the graph.

4. Press window to change the window settings for $-10 \le t \le 10$
   so the Road Runner traverses the *entire screen* for $-10 \le x \le 10$.

   TI-84CE: Change Tstep to 0.1 for convenience. Season to taste.
   TI-84: Change Tstep to 0.5 for convenience. Season to taste.
   This affects the speed of the graph.
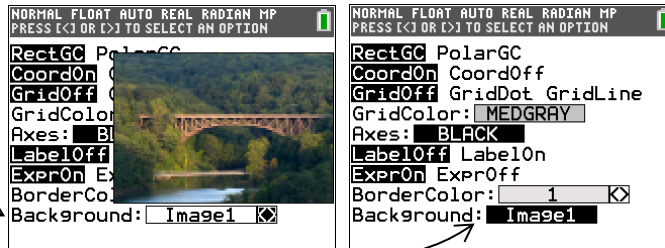
   Press graph to see Road Runner cross the screen.
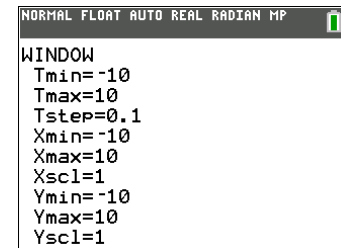
   TIP: To replay the graph, press 2nd [draw] **1:ClrDraw**. Press graph.

5. Optional (TI-84CE only):
Press 2nd [format] to access the Graph Format menu.
Place your cursor on the Background Spinner.
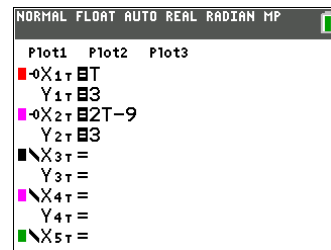Press ▶ on the spinner to select Image1.

Then press ▲ or ▼.
Image1 should be highlighted.

Press [graph] to see Road Runner cross the bridge.

6. Press [y=].
Enter $x(t) = 2t - 9$, $y(t) = 3$ to animate Wile E. Coyote's path.
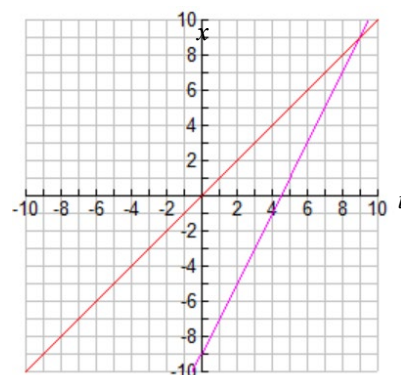Press 2nd [draw] **1:ClrDraw**. Press [graph].
What do you notice? What do you wonder?

7. To the right are the graphs of $x(t) = t$ and $x(t) = 2t - 9$.
Notice x is on the **vertical** axis.
What connections are there between the graphs to the right
and the animation of Road Runner and Coyote?

8. Work with a partner with the same calculator model and graph style settings as yours.
Clear or deselect Wile E. Coyote's previous formulas graph in $x2$ $y2$. Describe how does he move for each.
Sketch a graph of $x(t)$ for each below. What symmetry do you notice in the graphs and the speeds?

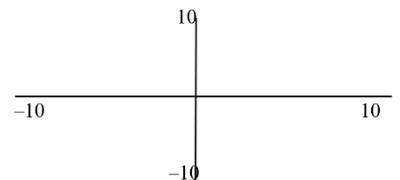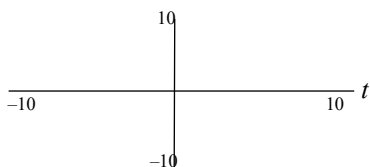Partner A enters: $x(t) = 10\cos(0.1\pi t)$ Partner B enters: $x(t) = 10\sin(0.1\pi t)$
                                   $y(t) = 3$ $y(t) = 3.5$

Description of how he moves (left, right, speeds up slows down):   Description of how he moves (left, right, speeds up slows down):

$$x(t) = 10\cos(0.1\pi t) = 10\cos\left(\tfrac{\pi t}{10}\right)$$ $$x = 10\sin(0.1\pi t) = 10\sin\left(\tfrac{\pi t}{10}\right)$$

9. On your grapher pick two of the parametric equations below. Assign one to Road Runner and another for Wile and
enter them both into your grapher, using the same window as before (and the same graph styles for each). Observe
how each moves across the bridge. Notice when each speeds up and slows down and which one overtakes the
other. Which formulas go back and forth? Make connections with the graph of $x(t)$ vs t.
Optional: Construct your own set with $-10 \le x(t) \le 10$ for $-10 \le t \le 10$.

$x(t) = 10 - 2|t|$ $x(t) = 10 - 0.2t^2$ $x(t) = 0.01t^3$
$y(t) = 3$ $y(t) = 3$ $y(t) = 3$

$x(t) = \tan\left(\tfrac{\pi t}{20}\right)$
$y(t) = 3$

ACME

&%$@!

2

Imagine the graph of the function $x(t)$ vs t is
crushed by an Acme Anvil and is flattened
onto the horizontal line $y = 3$.

Wile E. Coyote's Flying Wing Suit

With the help of a handy Acme flying wing suit and some bird seed, Wile E. Cote will attempt to drop down from the sky to snatch the distracted Road Runner.

Click on the image to see the animation.

$x = t^{51}$ $\qquad$ $y = 3$

1. We will use the parametric equations $x(t) = t^{51}$, $y(t) = 3$ for the Road Runner's path. Before entering these into your grapher, discuss the following with your group.
   a. Describe the behavior of the graph of $x(t) = t^{51}$, shown to the right, for $-1 < t < 1$. What do you notice about his speed?

   b. Describe the behavior of the graph of $x(t)$, shown to the right, for $t < -1$ and $t < -1$. What do you notice about his speed?

   c. At $t = 0$ Road Runner is at position x _____ $y =$ _____ .
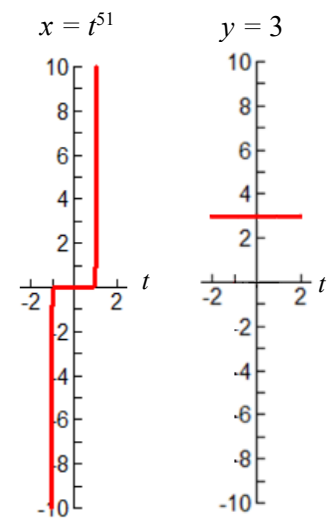
2. We will use the parametric equations $x(t) = e^{-t}$, $y(t) = e^{-t} + 3$ for Wile E. Coyote's path. Before entering these into your grapher, discuss the following with your group.

   a. i. Eliminate the parameter to report the path in terms of y and x.

   $y(x) =$ _____ (This is called an *explicit* form.)

   ii. What kind of function is this?_____
   iii. Complete: As x increases, the graph of $y(x)$ _____.
   $\qquad\qquad\qquad\qquad$ {increases, decreases}

   $\qquad\qquad$ As t increases, the graph of $y(x)$ _____.
   $\qquad\qquad\qquad\qquad\qquad$ {increases, decreases}
   b. On $-2 \le t \le 2$, does Wile E. Coyote ever reach Roadrunner?   YES NO

$x = e^{-t}$ $\qquad$ $y = e^{-t} + 3$
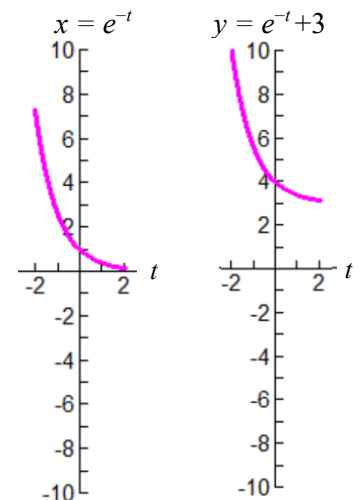
3. Press $\boxed{\text{Y=}}$, enter the formulas into your grapher. Press $\boxed{\text{window}}$ to change the window settings to simulate this from $-2 \le t \le 2$ with Tstep = 0.01. Press $\boxed{\text{graph}}$.

4. Finale: The parametric equations $x = -\sqrt{t}$, $y = -4.9t + 3$ simulate the image to the right. Eliminate the parameter to report the path explicitly in terms of y and x.
$$y(x) = \underline{\hspace{3cm}} , \quad x \le 0$$

3

Click on the image to see the animation.