INSTANTANEOUS VELOCITY, AN EXAMPLE OF THE DERIVATIVE

\[ \Delta t = \text{time it takes for black strip to pass through photogate} \]
length of black strip = position\((t + \Delta t)\) - position\((t)\)
velocity at the tip of the arrow \(\approx\)
\[
\frac{\text{position}(t + \Delta t) - \text{position}(t)}{\Delta t}
\]

*instantaneous* velocity at the tip of the arrow =
\[
\lim_{\Delta t \to 0} \frac{\text{position}(t + \Delta t) - \text{position}(t)}{\Delta t}
\]

As we get better approximations to the velocity at the tip of the arrow, we are also approaching the measurement of a tricky beast in the form of

"0" or, \(\frac{\text{small length}}{\text{small time}}\)

Mathematically, we tackle the problem of finding the instantaneous velocity, or the velocity at *exactly* the tip of the arrow, by taking a limit.

Physically, we must settle for the best measurement our device will allow. Notice our physical limitations- for example, our photogate won't respond to an object with the width of a hair, and our clock can't measure a very small time interval, like 0.00000007683 seconds.