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Calculating a Derivative by Definition

$$f(x) = 3x - 2.$$

$$\begin{aligned}
f'(a) &= \\
\lim_{x\to a} \frac{f(x)-f(a)}{x-a} &= && \text{definition of derivative} \\
\lim_{x\to a} \frac{(3x-2)-(3a-2)}{x-a} &= \\
\lim_{x\to a} \frac{3x-3a}{x-a} &= && \text{subtract like terms} \\
\lim_{x\to a} \frac{3(x-a)}{x-a} &= && \text{factoring} \\
\lim_{x\to a} 3 &= 3.
\end{aligned}$$

Note we know the slope of this line was 3, and the tangent line to a line is 3 so this matches.