$\boxed{\text{3.6 Section}}$ Algebraic Approach

$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

Example: $f'(x)$ when $f(x) = x^2 + 3x - 2$

$\boxed{\text{Step 1}}$ $f(x+h) = (x+h)^2 + 3(x+h) - 2$

Alternate way to look @ it: $f(\ ) = (\ \ )^2 + 3(\ ) - 2$

$\boxed{\text{Step 2}}$ $f(x+h) = (x+h)^2 + 3(x+h) - 2$

$= (x+h)(x+h) + 3(x+h) - 2$

$= x^2 + 2xh + h^2 + 3x + 3h - 2$

$\boxed{\text{Step 3}}$ $f(x) = \lim_{h \to \emptyset} \frac{f(x+h) - f(x)}{h}$

Plug in:

$-\cancel{x^2} - \cancel{3x} + \cancel{2}$

$$\lim_{h \to \emptyset} \frac{(\cancel{x^2} + 2xh + h^2 + \cancel{3x} + 3h - \cancel{2}) - (x^2 + 3x - 2)}{h}$$

$\boxed{\text{Step 4}}$ $\lim_{h \to \emptyset} \frac{2x\cancel{h} + h^{\cancel{2}} + 3\cancel{h}}{\cancel{h}}$

$\boxed{\text{Step 5}}$ $\lim_{h \to \emptyset} 2x + h + 3$

$\boxed{\text{Step 6}}$ Plug in $h = \emptyset$; $\boxed{2x + 3}$

Example: $f(x) = \dfrac{3}{x-2}$

$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

$\boxed{\text{Step 1}}$ Find $f(x+h) = \dfrac{3}{(x+h)-2}$

$\boxed{\text{Step 2}}$ $f'x = \lim\limits_{h \to 0} \dfrac{f(x+h) - f(x)}{h}$

$$= \lim_{h \to 0} \frac{\left(\frac{3}{x+h-2} - \frac{3}{x-2}\right)}{h} \qquad h = \frac{h}{1}$$

$\boxed{\text{Step 3}}$ $\lim\limits_{h \to 0} \left(\dfrac{3}{x+h-2} - \dfrac{3}{x-2}\right) \dfrac{1}{h}$

$\boxed{\text{Step 4}}$ Find LCD (lowest common denominator)

LCD $= (x+h-2)(x-2)$

, So: $\lim\limits_{h \to 0} \left(\dfrac{3(x-2) - 3(x+h-2)}{(x+h-2)(x-2)}\right) \dfrac{1}{h}$

$\boxed{\text{Step 5}}$ Distribute and Cancel out

, So: $\lim\limits_{h \to 0} \left(\dfrac{\cancel{3x} \cancel{-6} \cancel{-3x} - 3h \cancel{+6}}{(x+h-2)(x-2)}\right) \dfrac{1}{h}$

, So: $\lim\limits_{h \to 0} \left(\dfrac{-3\cancel{h}}{(x+h-2)(x-2)}\right) \dfrac{1}{\cancel{h}}$

When $h = 0$; $\dfrac{-3}{(x-2)(x-2)} = \boxed{\dfrac{-3}{(x-2)^2} = \text{derivative}}$