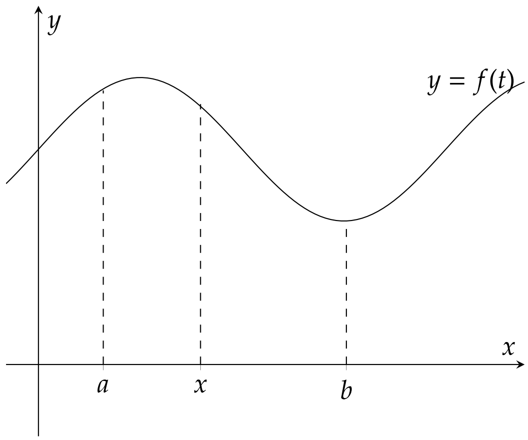
Fundamental theorem of calculus shows how integration is the opposite of differentiation. This implies that every continuous function $f(x)$ has an antiderivative $F'(x)$.
Through the fundamental theorem of calculus, we are trying to prove that the rate of change in the area under the curve is given by the value of the curve.

$$F(x) = \int_a^x \square f(t)dt,\ a < x < b$$

$$F'\square(x) = \frac{d}{dx}\left[\int_a^x \square f(t)dt\right] = f(x)$$



Example 1: We let $F(x)$ be a function of the area under the curve $y = f(t)$

By the fundamental theorem, $\frac{d}{dx}\int_\pi^x \frac{\sin^2 t}{\ln(t-\sqrt{t})} = \frac{\sin^2 x}{\ln(x-\sqrt{x})}$

NOTE: All you need to do is substitute x into the pronumeral!
Example 2: Fundamental theorem with chain rule

$$\frac{d}{dx}\int_0^{x^2} 2tdt$$

$$\frac{d}{dx}F(x^2) = F'(x^2) \times 2x$$

$$= 2x^2 \times 2x$$

$$= 4x^3$$

1. substitute x^2 into the pronumeral
2. Multiply by the derivative of x^2 i.e. $2x$

3.3 WORKED EXAMPLE

Find $g'(\pi)$ if $g(x) = \int_{-\pi}^{x} \sin tdt$

3.4 WORKED EXAMPLE

Find $g'(2)$ if $g(x) = \int_8^x (8x^2) + (9x-1)^3 dt$