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**ANTIDERIVATIVE**

# DEFINITION:

**A function  $F$  is an antiderivative (or primitive or indefinite integral) of  $f$  on an interval  $I$  if  $F'(x)=f(x)$  for all  $x \in I$ .**



# FUNDAMENTAL THEOREM OF CALCULUS

# *FUNDAMENTAL THEOREM OF CALCULUS*

*If  $f$  is continuous on the interval  $I=[a, b]$  then  $F$  has an anti derivative on  $I$*

***PROOF:***

*Define a function  $F_0$  on  $I$  by*

$$F_0(x) = \int_a^x f(t) dt \quad a \leq x \leq b$$

0



If  $x$  and  $x+h$  both lie in  $I$

$$\text{Then } F_0(x+h) - F_0(x) = \int_a^{x+h} f - \int_a^x f$$

$$= \int_a^{x+h} f + \int_x^a f$$


$$= \int_x^{x+h} f = f(x)h$$

where  $x \in (x, x+h)$   
(by mean value thm)

$$F_0(x+h) - F_0(x) / h = f(x)$$

As  $h \rightarrow 0, x \rightarrow x$ . Since  $f$  is continuous on  $I$ .



A photograph of a field of yellow daffodils in the foreground, with a clear blue sky and some light clouds in the background. The flowers are in various stages of bloom, with some fully open and others as buds. The grass is green and dense.

**$F(x) = f(x)$  as  $h \rightarrow \infty$ .**

**Therefore  $F'(x) = f(x)$  for all  $x \in I$   
 $F_0$  is an anti derivative of  $f$ .**

**Hence the theorem proved.**

A solid orange circle is located in the bottom right corner of the slide.