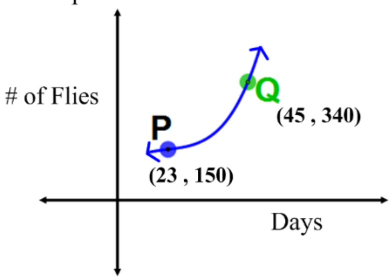
GN_Rates of Change and Derivatives   Calculus   Name______________________
Unit 2_Day 1   Date________________

Recall:
*Slope:

*Average Rate of Change

- The rate of Change between **<u>TWO</u>** points
- $\frac{Change\ in\ a\ quantity}{Change\ in\ Time}$
- The slope of the **secant** line between two points on a curve
- $\frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x - x_1} = \frac{f(x+\Delta x) - f(x)}{\Delta x}$ ****This is called a Difference Quotient****

Example:



Average Rate =

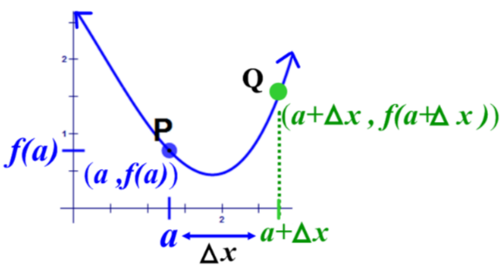
This average rate is also the slope of the secant line passing through point P and point Q. Write the equation for the secant line $\overleftrightarrow{PQ}$.

*Instantaneous Rate of Change

Suppose you wanted to know exactly how fast the population of flies is changing at a specific instant on day 23. How could you calculate this?

Instantaneous Rate =

The graph below illustrates the instantaneous rate of change at a point "a". ($x = a$)

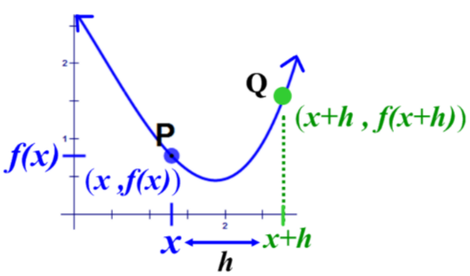


Instantaneous Rate of Change=

$$\lim_{\Delta x \to 0} \frac{f(a+\Delta x) - f(a)}{(a+\Delta x) - a} = \lim_{\Delta x \to 0} \frac{f(a+\Delta x) - f(a)}{\Delta x}$$

**When this limit exists, it is called the derivative of "$f\ at\ a$".
**This derivative at $x = a$ is denoted by $f'(a)$

The graph below illustrates the general form of instantaneous rate of change where Δx is replaced by "***h***". (See demonstration with Calculus in Motion- Define Derivative and NDER)



The General Definition of Derivative

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

Beside the General Definition of Derivative given in the previous page, the derivative at a point "***a***" is:

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

<u>**Derivative**</u> is also known as:

- Slope of the tangent line at a point on the curve
- Instantaneous rate of change
- Slope of a function at a point
- Rate of change such as: velocity, speed, acceleration

<u>***Notations***</u> used to denote the derivative of (x) :

Notation	***Read as***
$f'(x)$	*f prime of x*
y'	*y prime*
$\frac{dy}{dx}$	*"dy dx" or "the derivative of y with respect to x"*
$\frac{df}{dx}$	*"df dx" or "the derivative of f with respect to x"*
$\frac{d}{dx}f(x)$	*"d dx of f at x" or "the derivative of f at x"*

Note:

*If $f'(x)$ exists, then we say ***f*** is differentiable at ***x***.
*Differentiable function is one that is differentiable at every point of its domain.
*To Differentiate is to find the derivative of the function.

Example.
#1 – 7 . Given: $f(x) = 2x^2 - 4x + 1$

1. Find the general derivative, $f'(x)$.

2. Why isn't the slope a constant?

3. Find the slope of this curve at $x = 2$.

4. Write the equation of the line tangent to this curve at $x = 2$.

5. Write the equation of the line normal to this curve at $x = 2$.

6. Write the equation of the horizontal tangent to this curve.

7. Write the equation of the line tangent to this curve at $x = -1$.