WARMUP!!

It's time to play, Name that Derivative!!!

For each function, let's see how many cells you need to see before you can figure out a general rule for the derivative

$f(x) = x^2$

x	f '(x)
1	2
2	4
3	6
4	8
5	10
x	2x

$f(x) = x^3$

x	f '(x)
1	3
2	12
3	27
4	48
5	75
x	$3x^2$

$f(x) = x^4$

x	f '(x)
1	4
2	32
3	108
4	256
5	500
x	$4x^3$

Based on these, can you find the pattern?

Power Rule: If $f(x) = x^n$, then $f'(x) =$ $n x^{n-1}$

2.2a Derivative Shortcuts!!

ESSENTIAL LEARNING TARGETS

At the end of this lesson, you will be able to:

- calculate derivatives of selected functions including polynomial, power, rational and trigonometric
- apply appropriate derivative rules including the sum and difference rule

Constant Rule!

Suppose we graph a constant function, what does it look like? What would the slope be?

Constant Rule: If y = c, then dy/dx = 0

(c is a constant)

2 more rules:

Constant Multiple Rule: If $y = cf(x)$, then $y' = cf'(x)$

Sum/Difference Rule: If $y = f(x) \pm g(x)$,

then $y' = f'(x) \pm g'(x)$

Putting it together, find y' for each below:

ex) $y = x^7$ $y' = 7x^6$

ex) $y = 5x^7$ $y' = 35x^6$

ex) $y = 5x^7 - 8x^3$ $y' = 35x^6 - 24x^2$

ex) $y = 5x^7 - 8x^3 + 12$ $y' = 35x^6 - 24x^2$

1) $y = x^{10}$ $\quad y' = 10x^9$

2) $y = 4x^3$ $\quad \frac{dy}{dx} = 12x^2$

3) $y = \sqrt[3]{x} = x^{\frac{1}{3}}$ $\quad y' = \frac{1}{3}x^{-\frac{2}{3}} = \frac{1}{3\sqrt[3]{x^2}}$

4) $y = \frac{4}{x^5} = 4x^{-5}$ $\quad \frac{dy}{dx} = -20x^{-6} = \frac{-20}{x^6}$

5) $y = 5x^8 - 3x^4 + 8x^{\frac{2}{3}} + 6x - \sqrt[5]{x} + \frac{2}{\sqrt{x}} + 0.875$

$x^{\frac{1}{5}}$ $\quad 2x^{-\frac{1}{2}}$

$y' = 40x^7 - 12x^3 + \frac{16}{5}x^{-\frac{1}{3}} + 6 - \frac{1}{5}x^{-\frac{4}{5}} - x^{-\frac{3}{2}}$

$= 40x^7 - 12x^3 + \frac{16}{5\sqrt[3]{x}} + 6 - \frac{1}{5\sqrt[5]{x^4}} - \frac{1}{\sqrt{x^3}}$

That's all great for finding general derivatives, but what about derivatives at specific points?

ex) If $f(x) = x^{-2}$, find $f'(2)$

$f'(x) = -2x^{-3} = \frac{-2}{x^3}$

$f'(2) = \frac{-2}{2^3} = -\frac{1}{4}$

ex) Suppose $f(x) = \sqrt[3]{x^2}$, write the equation of the line tangent to f(x) at x = 8

$f(x) = x^{\frac{2}{3}}$

$f'(x) = \frac{2}{3}x^{-\frac{1}{3}} = \frac{2}{3\sqrt[3]{x}}$

$f'(8) = \frac{2}{3\sqrt[3]{8}} = \frac{1}{3}$ ← slope

$f(8) = \sqrt[3]{8^2} = 4$ $(8,4)$ ← point

↑ do the root first

$y - 4 = \frac{1}{3}(x - 8)$

Let's talk Trig!!

If f(x) = sinx, then → $f'(x) = \cos x$

If f(x) = cosx, then → $f'(x) = -\sin x$

ex) Find the derivative of y = 8sinx - 3cosx

$y' = 8\cos x + 3\sin x$

ex) If $y = 3x^{-7} + 5 - 12\sin x$, find dy/dx

Approximating the value of a derivative based on information presented in a table

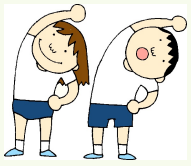
x	1	3	5	7	9
f(x)	4	8	10	3	-1

1) What is the average rate of change of f(x) from x = 1 to x = 9?

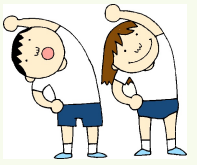
$$\text{aroc} = \frac{-1-4}{9-1} = \frac{-5}{8}$$

2) Estimate the instantaneous rate of change of f(x) at x = 5.

$$\text{iroc} = \frac{3-8}{7-3} = \frac{-5}{4}$$



REVIEW!!



1. Without using the word 'derivative' or 'differentiation', write in words what is meant by f'(2) = 4

2. If f(-6) = 10 and f'(-6) = 1/3, write the equation of the line tangent to f(x) at x = -6

What have we learned??

- What are the constant, power, constant multiple, and sum/difference rules for derivatives?
- What are the derivatives of y = sinx and y = cosx?