Lesson 2.3 … The Chain Rule for Finding Derivatives

The Chain Rule is one of the most powerful rules in Differential Calculus. It allows us to differentiate composite functions. To help see where the Chain Rule would be useful, consider the following ...

How would you differentiate ...

$y = 3x^2 - 4$

$y = 7x + 8$

$y = \sin x$

$y = x + \tan x$

But how do these functions compare?

$y = \sqrt{3x^2 - 4}$

$y = (7x + 8)^4$

$y = \sin 2x$

$y = x + \tan\left(x^2\right)$

These last four functions are all composite functions ... a "function within a function". For example, in the first one above, the "inside function" is $3x^2 - 4$ but then the "outside function" is the square root function. In the second one, the "inside function" is $7x + 8$ but then the "outside function" is raising the expression to the fourth power. In the third example, the "inside function" is the $2x$ and then the "outside function" is the sine function you are taking of 2x. Finally, in the last example, the "inside function" is the x^2 in the second term and the "outside function" is that the tangent function you are taking of x^2.

THE CHAIN RULE

If f and g are two differentiable functions, then $\frac{d}{dx}\left[f\left(g(x)\right)\right] = f'\left[g(x)\right] \cdot g'(x)$

- Think of this as the derivative of the "outside function" multiplied by the derivative of the "inside function".
- Start on the outside and work your way in!

Please see the recorded example problems posted for you in Canvas.