1. Learn two standard notations for the derivative of a function at a letter location.

- **Leibniz notation.**
  \[
  \frac{df}{dx} \quad \text{or} \quad \frac{d}{dx} \left( \text{stuff} \right)
  \]
  - Note that \( x \) is both the input variable for the function and the specific location where you are computing the derivative.
  - A function can have an input variable other than \( x \). Whatever the input variable is, that letter must also be in the denominator of the Leibniz notation.
  - You don’t need to know that it’s called “Leibniz notation.” You just have to know how to use it and what all the letters mean.

- **Prime notation.**
  \( f'(x) \)
  Again, \( x \) is both the input variable for \( f \) and the location where you are computing the derivative.

2. Get very good at computing the derivative at a letter location for some simple functions. There are quick rules for this that you must memorize:

Assume that \( a \), \( b \) and \( n \) are constants; \( f \) and \( g \) are any functions that have \( x \) as input.

- **Constant Rule:** \( \frac{d}{dx} (a) = 0 \)
- **Power Rule:** \( \frac{d}{dx} (x^n) = nx^{n-1} \)
- **Exponential Rule:** \( \frac{d}{dx} (e^x) = e^x \)
- **Linearity Rule:** \( \frac{d}{dx} (af + bg) = a \frac{df}{dx} + b \frac{dg}{dx} \)

You don’t have to know the names of the rules. You just have to be able to use them correctly. You will be tested on your ability to use the rules without the use of a calculator. You should start practicing them now without using a calculator.

If you want examples of how to use them, here are some sources:

- Your text book, Section 3.1, pages 171–179, cover these rules. The book has examples and covers where the rules come from.
• There are some decent videos online. Here are two from Khan Academy

**Basic Power Rule**

**Application to Polynomials (and more)**

3. Learn what an **antiderivative** is.

An antiderivative of \( f(x) \) is any function \( F(x) \) such that \( F'(x) = \frac{dF}{dx} = f(x) \).

4. Be able to determine if a guess is an antiderivative or not by taking the derivative of the guess and checking if it gives the appropriate derivative.

**Example:** If the derivative is \( \frac{df}{dx} = 3x^2 + 5e^x \)

- Guess an antiderivative: \( f(x) = x^3 + 5e^x \).
- Check your guess by taking its derivative

\[
\frac{d}{dx} (x^3 + 5e^x) = 3x^2 + 5e^x
\]

The antiderivative is not unique, so there is more than one possible answer.

5. Get good at computing antiderivatives quickly. Here are some quick rules

Assume that \( a, b \) and \( n \) are constants; \( f \) and \( g \) are any functions that have \( x \) as input.

- If \( \frac{df}{dx} = x^n \) then \( f(x) = \frac{1}{n+1} x^{n+1} + (\text{any constant}) \) (provided \( n \neq -1 \)).
- If \( \frac{df}{dx} = e^x \) then \( f(x) = e^x + (\text{any constant}) \)
- If \( \frac{dh}{dx} = a \frac{df}{dx} + b \frac{dg}{dx} \) then \( h = af + bg + (\text{any constant}) \)

**Khan Academy Antiderivative Intro.**

- Your textbook, Section 4.9, pages 350–355, covers antiderivatives. Note your textbook covers many more examples than you need to know at this time.