• Recall that you have some very quick rules for computing the derivative of a function at a letter location. Assuming that $a$, $b$ and $n$ are constants:

\[
\frac{d}{dx} (a) = 0 \\
\frac{d}{dx} (x^n) = nx^{n-1} \\
\frac{d}{dx} (e^x) = e^x \\
\frac{d}{dx} (\sin(x)) = \cos(x) \\
\frac{d}{dx} (\cos(x)) = -\sin(x) \\
\frac{d}{dx} (\ln(x)) = \frac{1}{x} \\
\frac{d}{dx} (af + bg) = a \frac{df}{dx} + b \frac{dg}{dx}
\]

• Be able to express a complex function in terms of its “insides” and “outside” pieces.

1. First determine what the “insides” (or stuff) is and call it the variable $u$.

\[ u = \text{stuff} \]

2. Rewrite the function in terms of $u$. Your outside function should be one of the basic functions listed above.

3. Find the derivative of $u$ (the insides) in terms of $x$ (labeled $\frac{du}{dx}$) and $f(u)$ (the outside) in terms of $u$ (labeled $\frac{df}{du}$).

4. Use the Chain Rule to find the derivative by multiplying the derivatives together.

\[ f'(x) = \frac{df}{dx} = \frac{df}{du} \cdot \frac{du}{dx} \]

5. Rewrite the final answer only in terms of the original variable $x$.

Once one gets good at finding the insides and outsides the above steps can be put together.
• For example if \( f(x) = \ln(x^2 - x^3) \), then

\[
\text{Insides: } u = x^2 - x^3 \\
\text{Outside: } f(u) = \ln(u)
\]

The derivatives of the inside and outsides are

\[
\frac{du}{dx} = 2x - 3x^2 \\
\frac{df}{du} = \frac{1}{u}
\]

Multiply the results together and rewrite only in terms of \( x \).

\[
f'(x) = \frac{df}{dx} = \frac{df}{du} \cdot \frac{du}{dx} = \left( \frac{1}{u} \right) (2x - 3x^2) = \left( \frac{1}{x^2 - x^3} \right) (2x - 3x^2) = \frac{2x - 3x^2}{x^2 - x^3}
\]

Recall \( u = x^2 - x^3 \) so replace \( u \) with its formula in \( x \).

• You can find more examples of using the Chain Rule
  - In your text book in section 3.4 on page 199.
  - At [Khan Academy](#) and more, linked form that page.
  - [Another Video](#), I think better than Khan Academy. You may disagree.
  - [University of Idaho Videos](#) More complex examples. Requires QuickTime.

• An antiderivative is any function such that if you take its derivative you get the original function.

  - Be able to check guesses for antiderivatives and determine if they are correct or not.
  - Be able to fix a guess for an antiderivative if it is close but slightly off.
  - Be able to find multiple antiderivatives for a single function.
  - Be able to find antiderivatives yourself via ‘guessing and checking’ method.