

LAB 7 - HILL FUNCTION

MATH 1170

OCTOBER 2 2018

In this lab, we'll explore modeling enzyme activity by Hill Function.

- study the form of Hill function
- understand what each parameter represent
- practice symbolically compute derivatives

Hill Functions

Hill functions are used to model a variety of chemical and biological processes. A common application of the Hill equation is modeling cooperative enzymes, where the binding of a molecule at one site alters the affinity of the enzyme for its substrate and hence regulates the enzyme activity. Positive cooperativity occurs when an enzyme has several sites to which a substrate can bind, and the binding of one substrates molecules increases the rate of binding of other substrates.

Cooperativity can be recognized by plotting binding rate against substrate concentration. The form of the Hill function is as follows:

$$H(s) = \frac{As^n}{k^n + s^n} \quad (1)$$

where $A > 0, k > 0$, and $n \geq 1$. In the Hill function we write down, $H(s)$ is the rate of binding and s is the substrate concentration. This week, we will explore some features of these exciting functions.

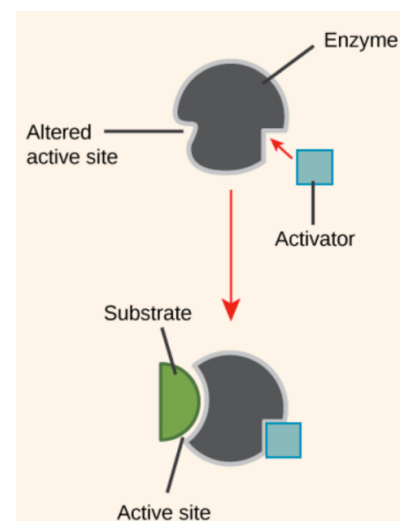
Question 1:

For this question, write a script that plots the function $H(s)$ and its derivatives. You need to complete this code by finding the first derivative for $H(s)$. (Hint: You can use the symbolic derivative tool from lab 6).

Question 2:

Generate different plots, each with different values of your choice of A, k, n to explain each of the following by using your code from Question 1:

- How does changing A change the Hill function¹?
- How does changing k change the Hill function?
- How does changing n change the Hill function?



¹ Hint: Fix k and n , generate graphs for at least two different values of A

Question 3:

In the application listed above, A , k , and n all have a meaning that relates to enzyme binding. I have given you a list of possible interpretations of these constants below. Which of these three constants do you think represents:

- How cooperative the enzymes are?
- The maximum binding affinity?
- The concentration of substrate when binding affinity has reached half its maximum value?

Explain your reasoning.