

Understandings, Applications and Skills (This is what you maybe assessed on)

	Statement	Guidance
8.1.U1	Metabolic pathways consist of chains and cycles of enzyme-catalysed reactions.	
8.1.U2	Enzymes lower the activation energy of the chemical reactions that they catalyse.	
8.1.U3	Enzyme inhibitors can be competitive or non-competitive.	Enzyme inhibition should be studied using one specific example for competitive and non-competitive inhibition.
8.1.U4	Metabolic pathways can be controlled by end-product inhibition.	
8.1.A1	End-product inhibition of the pathway that converts threonine to isoleucine.	
8.1.A2	Use of databases to identify potential new anti-malarial drugs.	
8.1.S1	Calculating and plotting rates of reaction from raw experimental results.	
8.1.S2	Distinguishing different types of inhibition from graphs at specified substrate concentration.	

Recommended resources:

<http://bioknowledgy.weebly.com/81-metabolism.html>

Allott, Andrew. *Biology: Course Companion*. S.I.: Oxford UP, 2014. Print.



8.1.U1 Metabolic pathways consist of chains and cycles of enzyme-catalysed reactions.

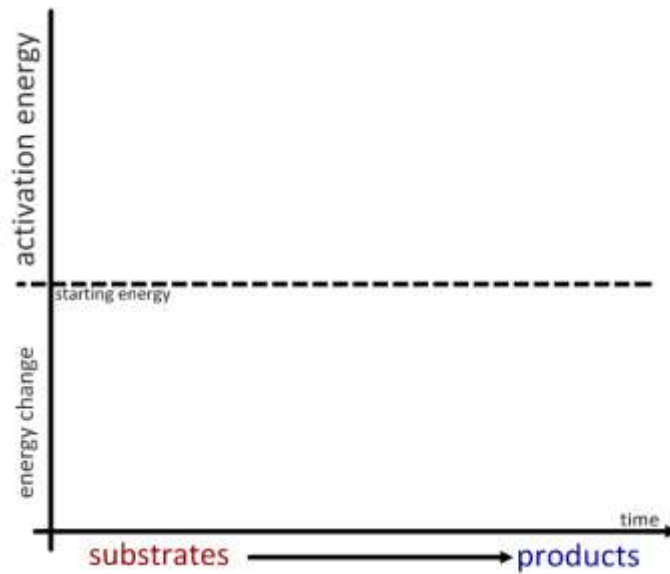
1. Define metabolism.
2. Describe what a metabolic pathway is and state how each step in the pathway is controlled.
3. Give an example of a linear metabolic pathway.
4. Give an example of a metabolic pathway that is a cycle.

8.1.U2 Enzymes lower the activation energy of the chemical reactions that they catalyse.

5. Define activation energy?
6. How do enzymes lower the activation energy of a reaction?



7. Complete the sketch graph to show how enzymes reduce the activation energy required for a reaction to occur.



8. Enzymes benefit organisms by speeding up the rate at which reactions occur. Typically by what factor are the reactions increased by?

8.1.U3 Enzyme inhibitors can be competitive or non-competitive.

9. Define an inhibitor.

10. Using diagrams, explain the difference between competitive and non-competitive methods of inhibition.

11. Outline one example of a competitive inhibitor.

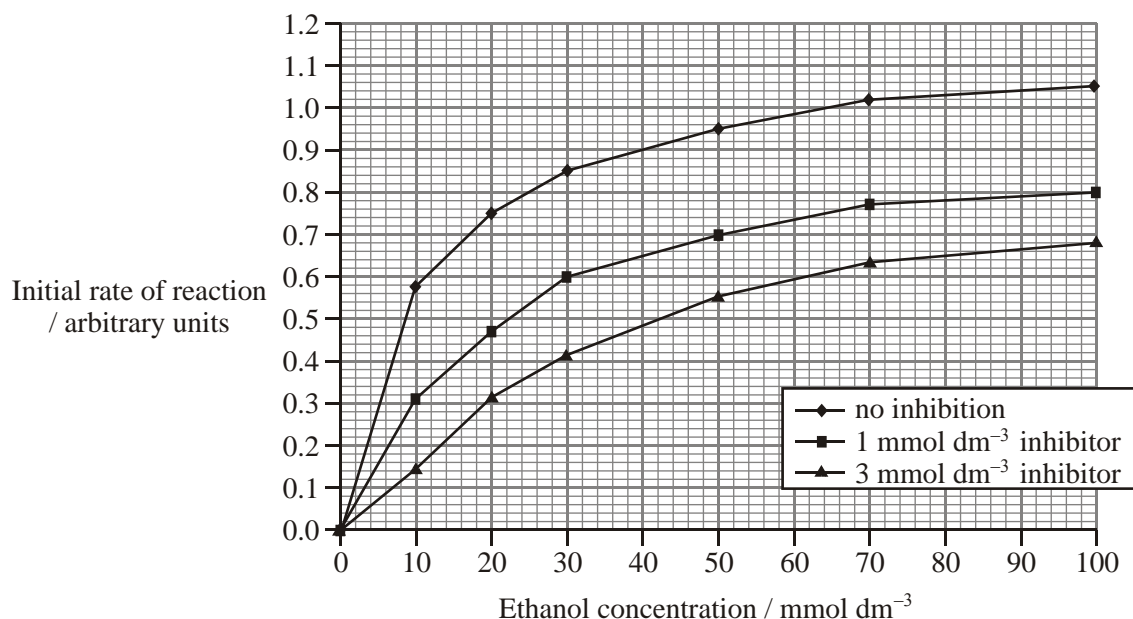
12. Outline one example of one non-competitive inhibitor.



8.1.S2 Distinguishing different types of inhibition from graphs at specified substrate concentration.

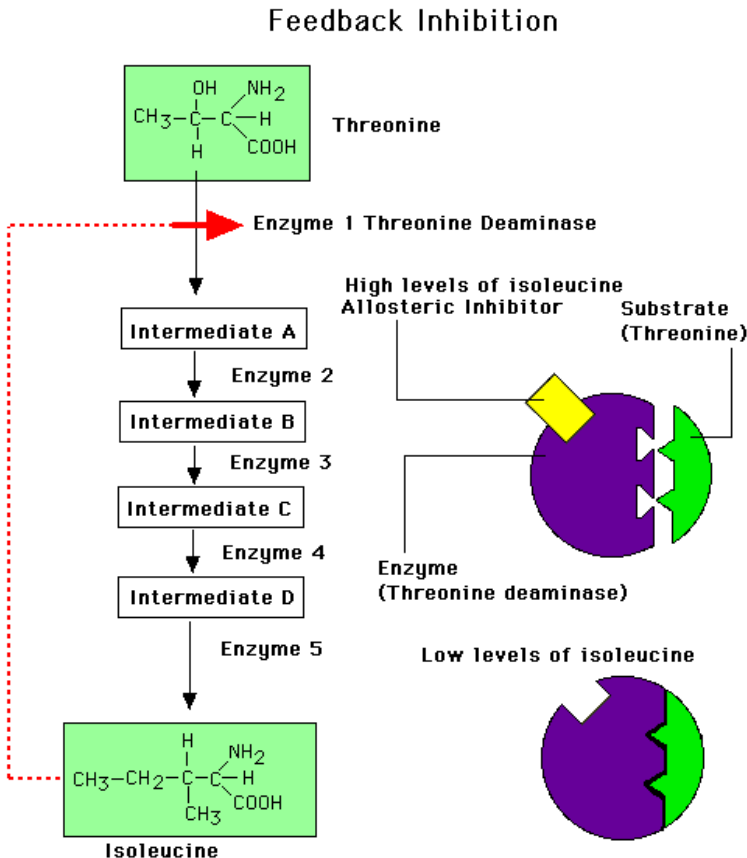
13. Sketch a graph to compare the effects of competitive and non-competitive inhibitors on the rate of enzyme activity at different substrate concentrations. Add annotations to explain the different effects the different types of inhibitor have upon the rate of enzyme activity.

14. Three experiments were carried out to measure the effect of inhibitor concentration upon an enzymes rate of reaction. The results for each experiment are shown in the graph below.



From IB Biology past papers [Source: R Taber, *Biochemical Education*, (1998) **26**, pages 239-242]



8.1.A1 End-product inhibition of the pathway that converts threonine to isoleucine.

<http://www.uic.edu/classes/bios/bios100/lecturesf04amfeedback-inh.gif>

- Isoleucine is an essential amino acid
- Bacteria synthesize isoleucine from threonine in a series of five enzyme-catalysed steps
- As the concentration of isoleucine increases, some of it binds to the allosteric site of threonine deaminase
- Isoleucine acts as a non-competitive inhibitor to threonine deaminase
- The pathway is then turned off, regulating isoleucine production.
- If the concentration of isoleucine later falls (as a result of its use) then the allosteric sites of threonine deaminase are emptied and the enzymes recommence the conversion of threonine to isoleucine takes place.

8.1.A2 Use of databases to identify potential new anti-malarial drugs.

16. Describe what is meant by the term Bioinformatics.

17. Bioinformatics has facilitated research into metabolic pathways is referred to as chemogenomics. Outline the process of chemogenomics.

18. What causes the disease malaria?

19. Increasing drug resistance to anti-malarial drugs has led to the use of bioinformatics and chemogenomics to try and identify new drugs. Outline how new potential drugs were identified.

8.1.S1 Calculating and plotting rates of reaction from raw experimental results.

The rate of reaction can be calculated using the formula:

$$\text{Rate of reaction (s}^{-1}\text{)} = 1 / \text{time taken (s)}$$

Time taken in enzyme experiments this is commonly the time to reach a measurable end point or when a standard event, caused by the enzyme reaction, has come to pass. This is usually measured by the effects of the accumulation of product, but can as easily be measured by the disappearance of substrates.

You will carry out several labs, which will give you the opportunity to collect data from which you can calculate the rate of reaction.

Citations:

Allott, Andrew. *Biology: Course Companion*. S.I.: Oxford UP, 2014. Print.

Taylor, Stephen. "Essential Biology 3.6, 7.6, C2 Enzymes.docx." Web. 30 Aug. 2014. <<http://www.slideshare.net/gurustip/essential-biology-36-76-c2-enzymes>>.

