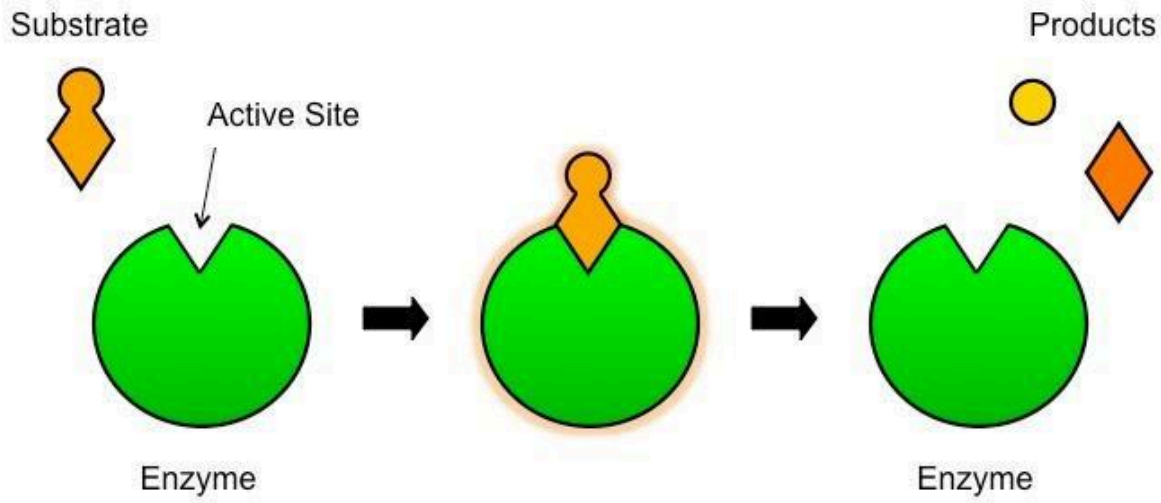
Year 12

IB BIOLOGY

2.5 Enzymes



Name:

Teacher: Mr Trent

2.5 Enzymes

Understandings

- Enzymes have an active site to which specific substrates bind.
- Enzyme catalysis involves molecular motion and the collision of substrates with the active site.
- Temperature, pH and substrate concentration affect the rate of activity of enzymes.
- Enzymes can be denatured.
- Immobilized enzymes are widely used in industry.

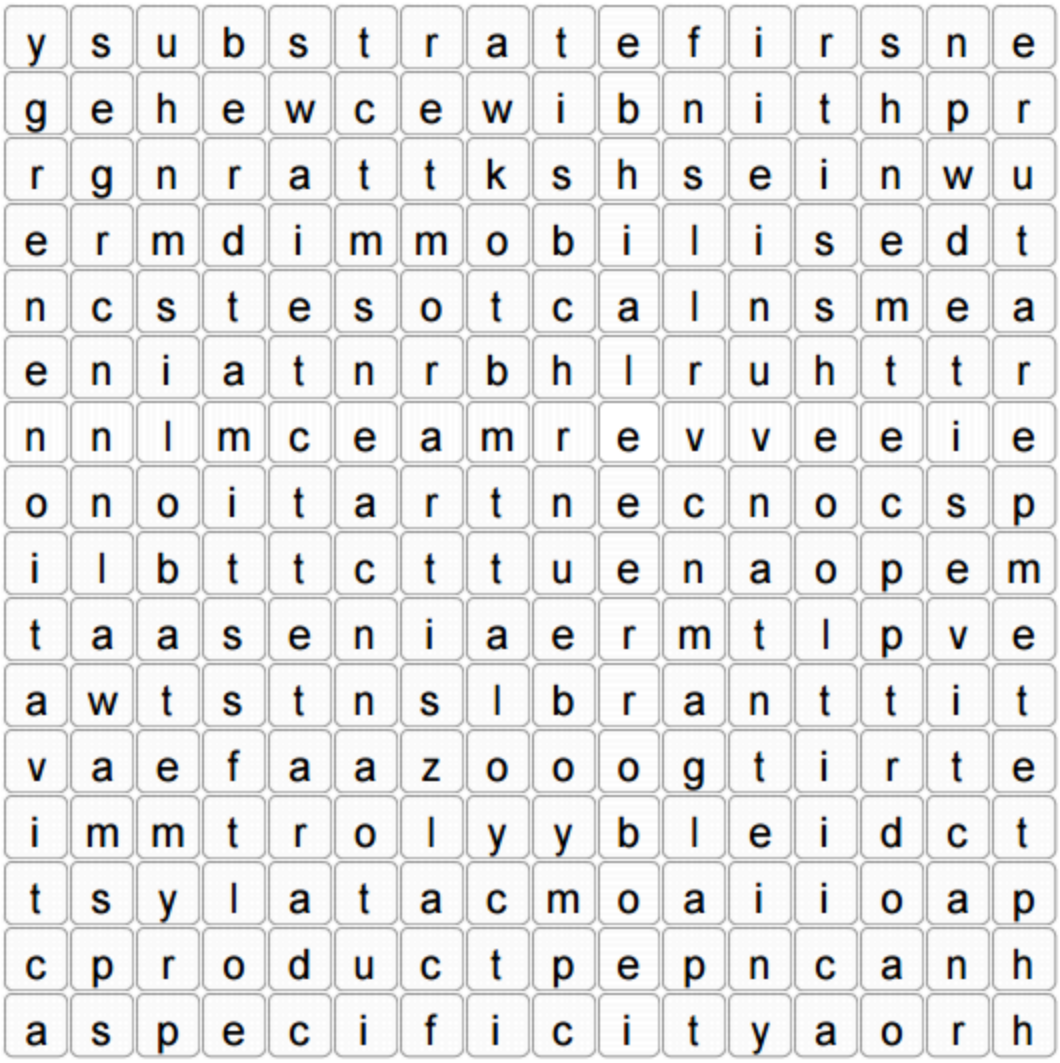
Applications and Skills

Application: Methods of production of lactose-free milk and its advantages.

Skill: Design of experiments to test the effect of temperature, pH and substrate concentration on the activity of enzymes.

Skill: Experimental investigation of a factor affecting enzyme activity **(Practical 3)**

Key Words



Words to find:

activation energy, active site, anabolic, catabolic, catalyst, concentration, denaturation, enzyme, immobilised, lactose, metabolism, ph, product, specificity, substrate, temperature.

Use the words from the list to complete the definitions:

Key Word	Definition
	Speeds up a chemical reaction without being used up itself
	Speeds up reactions in living things - biological catalyst
	Reactions which build molecules
	Reactions which break down molecules
	All the chemical reactions involved in maintaining living cells/organisms
	The substance that an enzyme acts upon
	The substance produced after the enzyme has acted
	A space on the enzyme molecule where the substrate molecule fits
	Energy needed to break bonds and start a reaction, lowered by enzymes
	Only one substrate fits the active site, so only one reaction is catalysed
	A disaccharide found in milk which cannot be digested by some people
	Enzymes which are attached to inert substances when used in industry
	Permanent loss of enzyme function due to extremes of pH or temperature
	Three factors which affect enzyme catalysed reactions.

What are Enzymes?

- An enzyme is a biological c_____ made of _____. A _____ protein that increases the rate of a biochemical reaction by lowering the _____ threshold

- This means it speeds up/slows down reactions. (circle the correct answer).

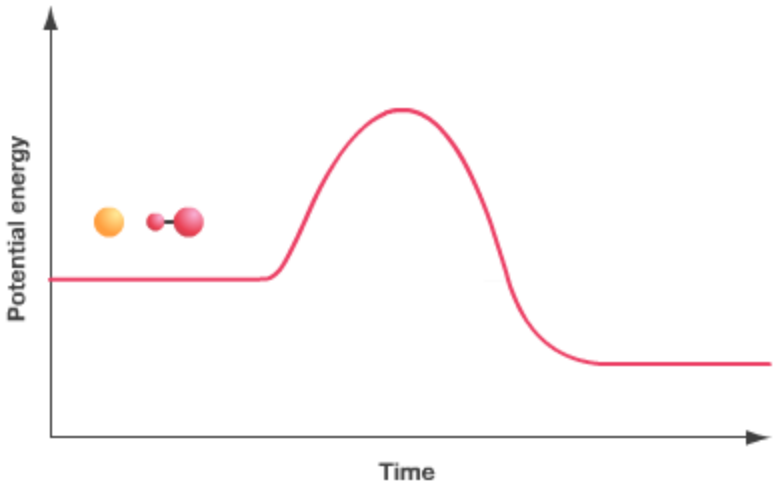
- A specific substrate is _____ to the _____ site of an e_____. Draw and label this below:

- The enzyme is the same as a l_____ and the substrate acts as a key. The most current model is the _____ fit model, where the enzyme will make _____ changes to fit the substrate. The enzyme is like a _____.

- If the enzyme's active site changed shape, the substrate _____ fit into the enzyme. The enzyme has become d_____. Draw an image of a denatured enzyme below:

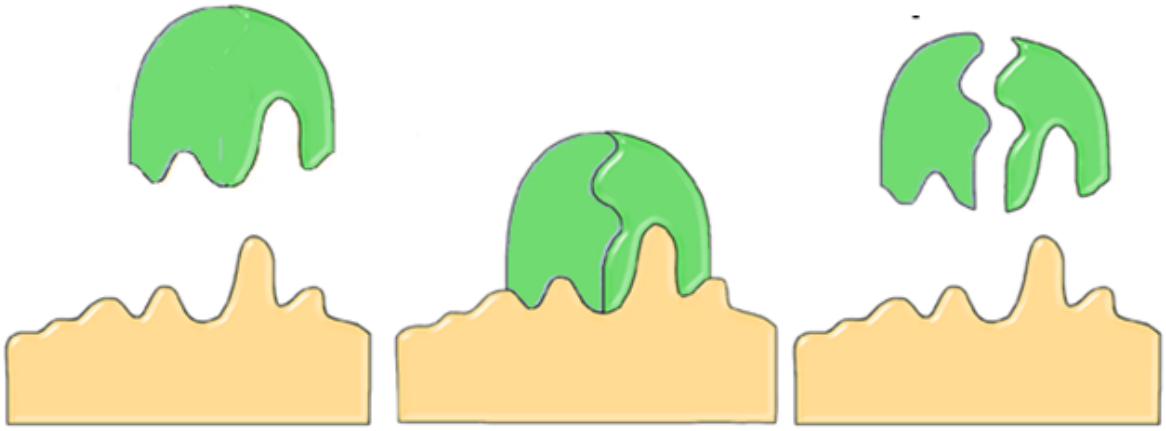
- Enzymes have an o_____ temperature and pH. As the temperature increases, there are more _____ due to increased _____ energy. Draw a graph which shows this below

Annotate the graph below



Add the following labels to the diagram:

Enzyme, substrate, enzyme-substrate complex, active site, products.



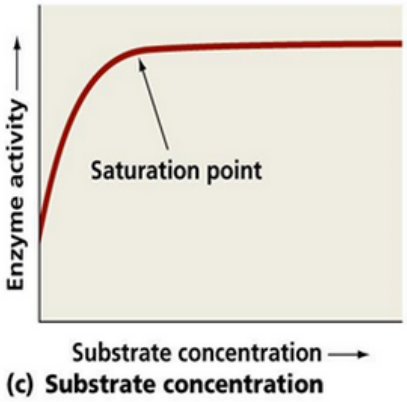
What gives the active site its specific shape?

What is collision theory?

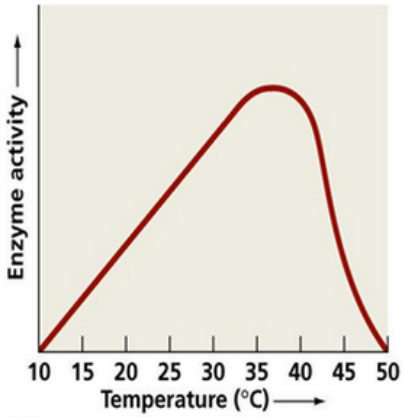
What 3 factors can speed up the rate of reaction? Draw them below

Effect of temperature, pH and substrate concentration on enzyme activity

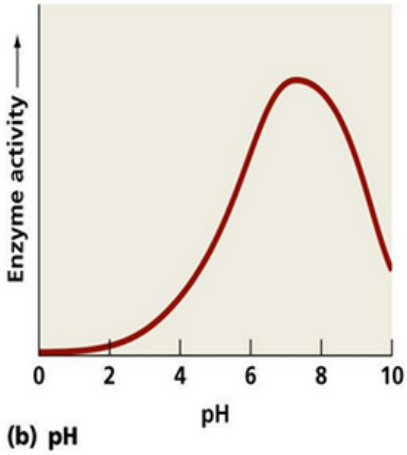
Watch the video http://www.youtube.com/watch?v=D2j2KGwJXJc
Describe and explain each of the graphs.



(c) Substrate concentration



(a) Temperature

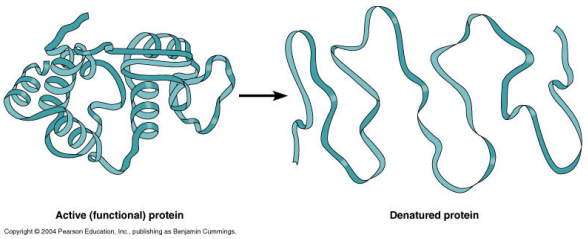


(b) pH

Denaturation

Define **Denaturation:**

Use the diagram to explain why the enzyme cannot function once it has been denatured:



Explain how high temperatures and pH can denature enzymes:

Design and carry out an investigation to determine the effect of temperature or pH on enzyme activity

Skill: Design of experiments to test the effect of temperature, pH and substrate concentration on the activity of enzymes.

Design of a controlled experiment to investigate one of the factors mentioned above.

Background

Variables:

Research Question:

Materials:

Hypothesis:

Results:

Conclusion

Lactose Free Milk

https://www.youtube.com/watch?v=MA9boI1qTuk

What is lactose intolerance and why does it occur?

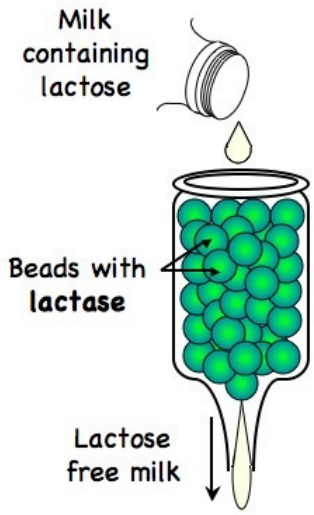
What are the symptoms?

In which ethnic populations is lactose intolerance prevalent?

Watch this http://www.youtube.com/watch?v=P7e9Mj9ATpQ

Write the word equation for the breakdown of the disaccharide lactose into its monosaccharides:

Use the diagram to explain how lactose free milk can be formed:



1. Which of the following will cause an enzyme to permanently lose its properties?

I. Hydrolysis

II. Freezing to –20°C

III. Dissolving it in water

A. I only

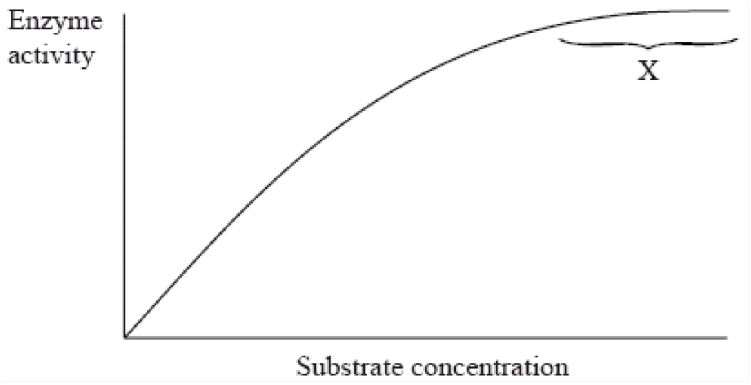
B. II only

C. I and II only

D. I and III only

(Total 1 mark)

2. The graph below shows the effect of substrate concentration on enzyme activity. What conclusion can be drawn about section X of the graph?



A. The enzyme has started to denature and the reaction slows down.

B. The reaction has finished and the substrate has been used up.

C. The enzyme is saturated and is working at its maximum reaction rate.

D. Some of the enzyme has been consumed and the reaction has reached a plateau.

(Total 1 mark)

3. Which variable has the **least** effect on enzyme activity?

A. Temperature

B. Light intensity

C. pH

D. Substrate concentration

(Total 1 mark)

4. (a) Define the term *active site*.

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(1)

(b) Explain enzyme-substrate specificity.

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(3)

5. Describe the use of biotechnology in the production of lactose-free milk.

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(6)

1. A [1] 2. C [1] 3. B [1]

4. (a) site on surface/portion of the enzyme/protein to which the substrate binds
(b) enzymes fit together with substrates (similar to a lock and key);
active site has shape that gives specificity;
enzymes catalyze a reaction with a specific substrate;
example of named enzyme and its substrate;
substrate held precisely in (optimum) position to make/break bonds/carry out reaction / chemical interaction occurs between enzyme and substrate;
Accept these points shown in an annotated drawing. 3 max

5. a particular yeast (growing in natural milk) contains lactase;
biotechnology companies can grow/culture the yeast;
lactase (an enzyme) is extracted from the yeast;
natural milk contains lactose/milk sugar; when added directly to milk,
lactase converts lactose into simpler forms;
same effect when milk is passed past immobilized (on surface or beads) lactase;
simpler forms of sugar (glucose and galactose) are easily absorbed (in the small intestine);
a commercial market exists for lactose-free milk /
lactose-free milk is example of biotechnology's economic impact;
some people are lactose intolerant/cannot digest lactose in milk/have lost lactase activity in intestinal cells;
consuming lactose-free milk allows lactose intolerant people to be nourished by milk without discomfort (abdominal cramps and diarrhoea);
many Asians are lactose intolerant whereas less common among other groups (northern Europeans and some Africans);
biotechnology produced in one part of world is more useful in another;
6 max