ACTIVITY SHEET ANSWERS

Chapter 9 Suggested answers

9.1 Enzyme reaction rate: temperature

1 For each temperature they would have a test tube with milk only. This would show whether the milk would coagulate at a particular temperature without the enzyme present.

2 Independent – temperature, dependent – reaction rate

3 The results showed that rennin had the best reaction rate at 40°C.

4 By using a control and doing multiple tests per temperature it would be said that the results are reliable. The results from each of the tests at the various temperatures were all similar showing that the results were not anomalies.

5 At 20°C the temperature does not provide enough initiation energy for the substrate and enzyme to collide to start the reaction. The enzyme is therefore inactive. Above 40°C the temperature is too high and the enzyme denatures.

6 Students' answers may vary. Suggested answer:

The difference in the investigated temperature is 10°C. This does not allow for an accurate indication of the most optimal temperature for rennin to function. After narrowing down where the optimal range lies, the student should complete another set of tests at smaller temperature increments, e.g. 30, 33, 36, 39, 41, 43, 46 and 49°C to determine more accurately the optimal temperature for rennin.

9.2 Enzymes

1 a Metabolism: the sum of all chemical reactions within the organism

b Anabolism: a chemical reaction that builds up complex molecules from more simple ones

c Catabolism: a chemical reaction that breaks down complex molecules into simpler products

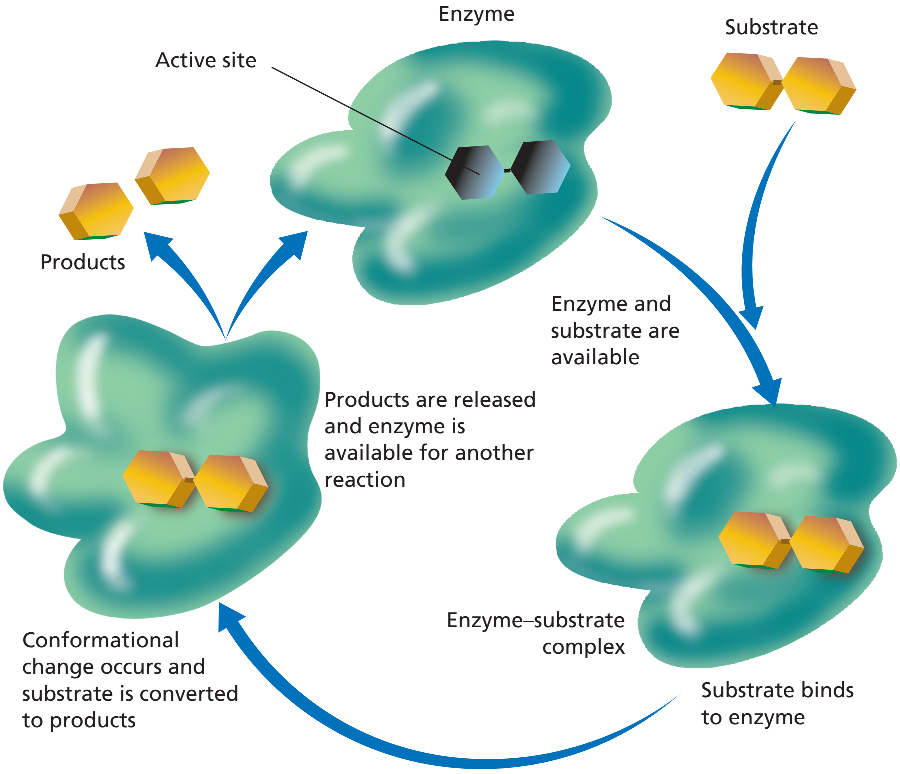
d Exergonic: a chemical reaction that releases energy

e Endergonic: an energy-requiring chemical reaction

f Catalyst: a substance that is used to speed up a chemical reaction without being used up in the reaction

g Activation energy: the energy required to initiate a reaction

2



3 The induced fit model explains that the active site of an enzyme can undergo specific changes induced by the substrate to achieve a high degree of specificity with the substrate. As the bonds of the substrate are stretched by molecular interactions, the energy required to kick-start the reaction is significantly lowered.

4 **a** Lysozyme: pH 4–5

Pepsin: pH 2

Trypsin: pH 6–7

b The nature of the small intestine is alkaline (basic). According to the graph, pepsin stops functioning effectively outside an approximate pH range of 3.5–4. Therefore as pepsin enters into the small intestine the pH changes and causes the enzyme to denature. Due to the active site being changed the enzyme can no longer function.

5 A non-competitive inhibitor is a molecule that binds to an enzyme at another site other than the active site. It changes the shape of the enzyme, which prevents the substrate from binding at the active site. When there is a high concentration of product in the cell the non-competitive inhibitor will bind with the enzyme to stop the synthesis of the product. When the products are removed from the cell the inhibition will decrease and the enzyme will move back into the active state. The non-competitive inhibitor helps to regulate the concentration of products in the cell.

9.3 Chemical reactions: photosynthesis

1 Light-dependent stage: Chlorophylls, carotenoids and xanthophylls absorb light energy within the thylakoid membranes. Electrons within the pigments become energised. This energy is used to split water molecules to form hydrogen ions and oxygen. The oxygen is a by-product of the reaction and is released at this stage. ATP is formed in this stage by the bonding of ADP and P.

Light-independent stage: The light-independent reactions occur in the stroma, the gel-like matrix within the chloroplast. Hydrogen ions and ATP formed in the light dependent stage are used to convert carbon dioxide, taken in from the atmosphere, into glucose. When ATP is used it is broken down into ADP and P, which can be reused in the light dependent stage. The glucose is the monosaccharide used to build complex polysaccharides such as cellulose and starch.

2 **a** The chloroplasts were suspended in the water solution. Some of the water molecules had labelled oxygen molecules. The chloroplasts used the water molecules from the solution in the light-dependent stage. When the water molecules were broken down in the reaction the labelled oxygen was released into the airspace.

b The solution is expected to become colourless. When the water molecule is split in the thylakoid, oxygen is given off and hydrogen ions are formed. The hydrogen ions then reduce the hydrogen acceptor and as a result the solution becomes clear.

9.4 Chemical reactions: cellular respiration

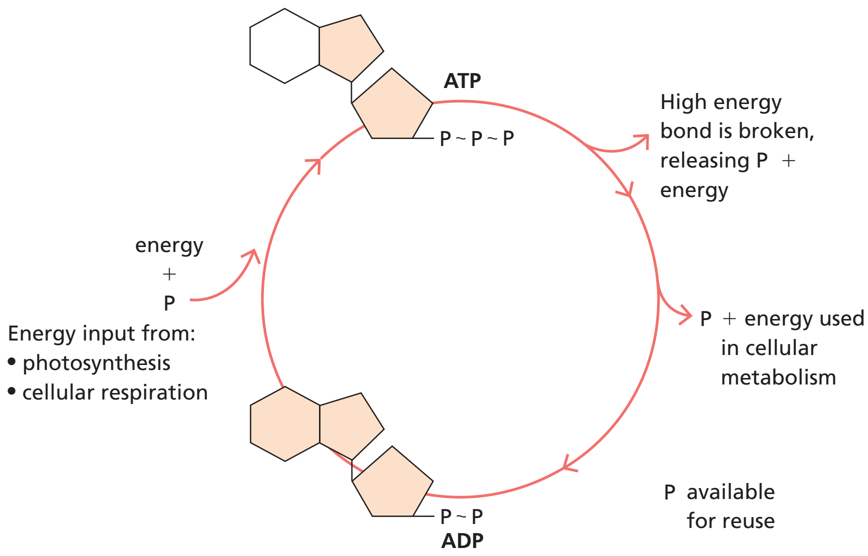
1 Student answers may vary. Students could make the following arguments:

Correct: The majority of the reactions for biochemical pathway occur in the mitochondria producing the largest portion of energy therefore it can be considered as the site of cellular respiration.

Incorrect: Glycolysis, the starting reaction of cellular respiration, occurs in the cytoplasm to form pyruvate and two molecules of ATP. The pyruvate then moves into the mitochondria where it reacts with oxygen to form 34 ATP molecules, carbon dioxide and water. While most of the reactions occur in the mitochondria not all of them do, therefore the mitochondria is the main site for cellular respiration but not the only site required for the pathway.

2 **a** ATP is a nucleotide containing adenosine attached to a sugar, which is bound to three phosphates. It is a renewable energy source. When a cell requires energy to drive an endergonic reaction, the high-energy chemical bonds attaching the last phosphate group to ATP are broken releasing energy. The remaining molecule is ADP and has two remaining phosphates. This reaction is catalysed by ATPase. Energy from an exergonic reaction can be used to add a phosphate group to ADP to convert it to ATP.

b



3 a At the start of the run, the blood would be supplying his cells with oxygen. Cellular respiration would use the oxygen to break down glucose and release the 36 molecules of ATP. As the man continued through the training run the exercise became more strenuous. The body could not deliver the required amount of oxygen to the cells, and continue providing the cell with energy, so the body started to go into anaerobic respiration also known as lactic acid formation. After the man finished the training run, oxygen would once again become available; the lactic acid would then revert back to pyruvate for aerobic respiration.

b Anaerobic respiration

glucose → lactic acid + 2ATP

$C_6H_{12}O_6 \rightarrow 2CH_3CH(OH)COOH + 2ATP$

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