

AS 91156 Demonstrate understanding of life processes at the cellular level.

DNA Replication

(2014:1)

(b) Comprehensively discuss how and why cells divide.

In your answer;

- describe the process of mitosis
- explain the process of DNA replication and how it allows mitosis to occur
- discuss, by giving reasons, when and why different factors cause the cells to divide, AND provide examples to support your answer.

You may use diagrams to support your answer.

(2013:3)

Mitosis occurs during the life cycles of both animals and plants.

- (a) Describe what is meant by mitosis. The process of DNA replication is usually referred to as semi-conservative replication.
- (b) Explain the process of how chromosomes are replicated, and why the process is known as semi-conservative replication. You may draw a labelled diagram(s) to support your answer.
- (c) Almost all animals and plants develop from a fertilised cell that divides into different types of cells and tissues. The rates of mitosis vary considerably, depending on the location of the cells and the stage in the organism's life-cycle.

Discuss the statements above. In your answer include:

- a description of what affects the rate of mitosis
- reasons why the stages of an organism's life-cycle have different rates of mitosis
- at least two examples, with reasons, of the parts of plants and animals where the rate of mitosis is likely to be higher.

(2011:3)

DNA replication occurs at different rates during the lifetime of a plant or animal.

Evaluate this statement, including in your answer:

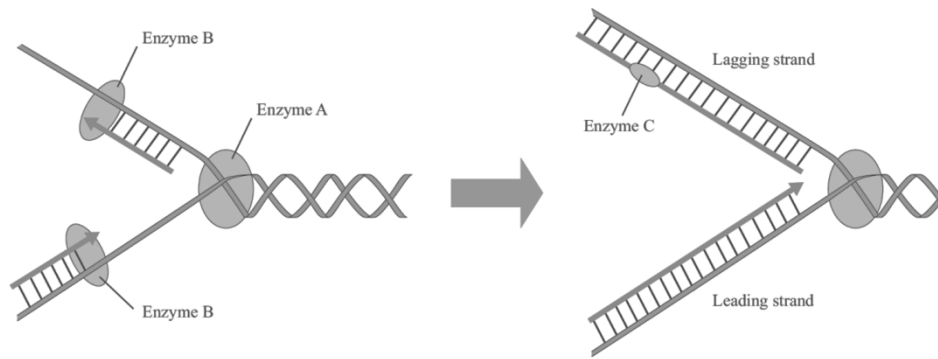
- a description of what DNA replication is
- an explanation of how the process occurs
- a discussion of why the rate of DNA replication varies during the lifetime of a plant or animal.

A labelled diagram may be used to support your answer.

(2011:1) *Note L3 AS90715

The diagram below shows a simplified representation of the process of DNA replication. A, B and C are enzymes involved in the process.

These questions were collated from the expired Level 2 AS 90464 Describe cell structure and function but are still useful for the new AS 91156 Demonstrate understanding of life processes at the cellular level. Some questions were collated from the Level 3 AS 90715 which included DNA replication.



- (a) Explain the purpose of DNA replication.
- (b) Discuss the role of enzyme action in the process of DNA replication.

In your answer you should:

- identify the enzymes shown in the diagram
- explain the role of each enzyme
- discuss the specific consequences if any of these enzymes should fail to function correctly.

(2010:1(b)) *Note L3 AS90715

When DNA is replicated, each of the parent strands acts as a template.

Explain why there is a difference in the way in which the parallel strands of DNA are replicated.

You may use a labelled diagram to support your answer.

(2009:1(b)) *Note L3 AS90715

The NF1 gene contains 8454 base pairs and codes for a protein called neurofibromin. Neurofibromin regulates the action of the Ras protein, which promotes cell division. Mutant forms of NF1 produce a protein that cannot regulate Ras properly.

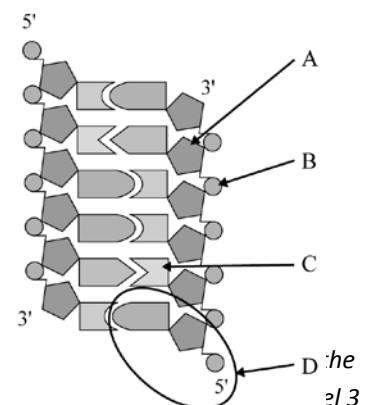
When DNA is replicated, it is important that cells make exact copies of genes such as NF1. Explain why replication of a gene needs to be exact, with reference to the role of the NF1 gene.

(2007:1) – *Note L3 AS90715

The following diagram shows part of a DNA molecule.

- (a) Identify the structures labelled A, B, C and D in the diagram.
- (b) DNA is able to make copies of itself. This process is controlled by several enzymes.

Describe the role of each of the following enzymes in DNA replication:



These questions were collated from the expired Level 2 AS 90464 Describe cell structure and new AS 91156 Demonstrate understanding of life processes at the cellular level. Some questions AS 90715 which included DNA replication.

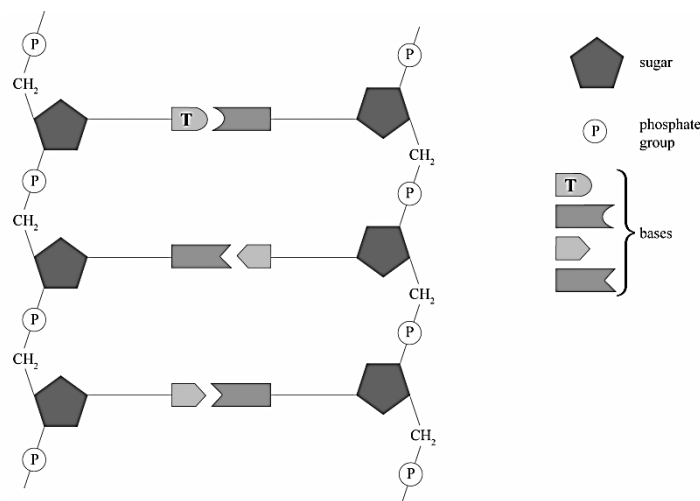
- (i) DNA polymerase
- (ii) DNA helicase
- (iii) DNA ligase.

(2006:1) – *Note L3 AS90715

DNA is a polymer, made up of a large number of sub-units (nucleotides).

- (a) The unlabelled diagram below shows the basic structure of a DNA molecule. Complete the diagram by giving information that clearly identifies:
- the four bases and their positions (one base has been identified in the diagram)
 - the number of hydrogen bonds between bases
 - the anti-parallel nature of the molecule
 - which end of the DNA strand new nucleotides are added to.

Simplified structure of part of a DNA molecule



- (b) Explain why DNA replication is necessary.
- (c) Discuss how DNA replicates. In your discussion, you should explain:
- how replication begins
 - the roles of the main enzymes involved
 - leading and lagging strands
 - Okazaki fragments
 - the source of materials for replication.

RECENT ANSWERS

(2014:1)

- (b) Mitosis is to replicate genetically identical cells for growth / repair / same function as parent cell in body (somatic) cells.

Process – replicated chromosomes separate, 2 new nuclei form, cell splits in two.

DNA replication process:

An enzyme separates the DNA double helix. Free nucleotide bases A T G C match the exposed bases using the complementary base pairing rule, ie A-T and G-C. Each new helix has one parent strand and one new strand (semi-conservative).

DNA replication allows cell division to occur because all cells must replicate their DNA before division, so that each new daughter cell has the identical genetic material to the parent cell, so it can function correctly and reproduce.

Cells divide for growth, repair, regeneration, asexual reproduction.

Cell division occurs when the distance between the cell membrane and centre of cell becomes so large that substances cannot diffuse fast enough to carry out cell processes. Therefore cells divide to have a high surface-to-volume ratio. This enables efficient chemical reactions.

Mitosis occurs during periods of growth and repair during infancy / childhood / early development in animals following the breaking of dormancy, and during seasonal growth in plants following damage to the organism when repair of tissue is necessary.

Cells will divide by mitosis when growth or replacement of cells needs to occur. This is determined by factors such as cell type / function, For example skin cells are programmed to divide more than brain cells.

Examples of cell types that divide often include, (but are not limited to) root cells, shoot tips, hair follicles, bone marrow, skin cells and mucous membranes. Cells that divide less often include Liver cells and Neurones.

(2013:3)

- (a) Mitosis is the process where a single cell divides, resulting in generally two identical cells, each containing the same number of chromosomes and genetic content as that of the original cell.
- (b) Semi-conservative replication is so named because each molecule of DNA that is created contains one new strand and one old strand.

Process of replication. (Names of enzymes are not necessary but may aid judgement of candidate's understanding.)

The two strands separate, exposing the bases (unwound by the enzyme helicase), which will act as the template. Two new polynucleotide chains are formed using the bases of the existing strands as a complementary template. (Carried out by DNA polymerase). Nucleotides join up following the base-pairing rule A-T and C-G. etc

- (c) Identifies and describes factors affecting the rate of mitosis. Eg, temperature, pH, presence of mutagens such as alcohol or radiation, availability of raw materials in the cell, hormones, enzyme activity

Mitosis is usually higher during periods of growth and repair during infancy / childhood / early development in animals following the breaking of dormancy, and during seasonal growth in plants following damage to the organism when repair of tissue is necessary.

Mitosis occurs at a higher rate in areas where most growth or replacement of cells is occurring, such as: root / shoot tips, hair follicles, bone marrow, skin cells, mucous membranes etc.

Mitosis rates increase in areas of cellular repair, the site of damage. Mitosis rates increase in cancer cells, etc

Answers will be found for the (expired) Level 2 AS 90464 at

<http://www.nzqa.govt.nz/qualifications-standards/qualifications/ncea/subjects/biology/expired-standards/>

Answers will be found for the Level 3 AS 90715 (Describe the role of DNA in relation to gene expression) at

<http://www.nzqa.govt.nz/ncea/assessment/search.do?query=biology&view=reports&level=03>

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