

Student Name: _____



BIOLOGY 2020

Unit 3

Key Topic Test 7 – Cellular signals

Recommended writing time*: 45 minutes

Total number of marks available: 45 marks

QUESTION BOOK

* The recommended writing time is a guide to the time students should take to complete this test. Teachers may wish to alter this time and can do so at their own discretion.

Conditions and restrictions

- Students are permitted to bring into the room for this test: pens, pencils, highlighters, erasers, sharpeners and rulers.
- Students are NOT permitted to bring into the room for this test: blank sheets of paper and/or white out liquid/tape.
- No calculator is allowed in this test

Materials supplied

- Question and answer book of 9 pages.

Instructions

- Print your name in the space provided on the top of the front page.
- All written responses must be in English.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic communication devices into the room for this test.

SECTION A – Multiple-choice questions

Instructions for Section A

Select the response that is **correct** for the question. A correct answer scores 1; an incorrect answer scores 0. Marks are not deducted for incorrect answers. If more than 1 answer is completed for any question, no mark will be given.

Question 1

The receptors on cells must be specific to the signalling molecule that interacts with it. This means that

- A. the receptor and the signalling molecule are the same shape
- B. the signalling molecule changes shape to fit the receptor in an induced fit
- C. the signalling molecule is flexible and can fit multiple receptors
- D. the signalling molecule and the receptor have complementary shapes

Question 2

Cytokines are a group of signalling molecules that may be released as part of an immune response. A source of cytokines could be

- A. antigens
- B. lymph nodes
- C. T cells
- D. interferon

Question 3

Animal hormones are released from cells or glands and interact with other cells in the body that have the specific receptor for that signalling molecule. Insulin is a hormone that is involved in endocrine signalling meaning that the signalling molecules

- A. travel to receptors on surrounding target cells
- B. move through the blood to the target cells
- C. bind to receptors on the same cell
- D. reduce blood glucose levels

Question 4

Signal transduction is a 3-step process involving reception, transduction and cellular response. Transduction in this context means that

- A. more signalling molecules are made to activate other cells
- B. an external G protein is activated which interacts with an internal receptor
- C. secondary messengers are activated
- D. the cellular response alters gene expression

Question 5

Estrogen is a steroid hormone that is produced in both males and females. Estrogen travels throughout the body and affects multiple cells. When it interacts with a cell, estrogen

- A. attaches to a receptor on the surface of the cell and activates a G protein
- B. attaches to an internal cell receptor and forms a transcription factor
- C. diffuses through the cell membrane and attaches to the G protein
- D. activates the cell to increase in size

Question 6

Insulin is a peptide-based hormone that is produced in response to high blood sugar levels leading to a response that removes glucose from the blood. To cause this to happen insulin

- A. attaches to an intracellular receptor
- B. enters the cell via facilitated diffusion
- C. attaches to DNA as a transcription factor
- D. attaches to an extracellular receptor

Question 7

Cortisol is a hormone released from the adrenal gland that diffuses through target cell membranes and binds to a receptor making a receptor hormone complex. This complex then

- A. causes a signal cascade to activate enzymes in the cell
- B. attaches to the nucleus and causes signal amplification
- C. attaches to DNA and triggers gene transcription
- D. is transcribed into mRNA and synthesises proteins that alter cell activity

Question 8

Signalling molecules are the stimulus that cause target cells to produce a response that alters the cells function. Hydrophobic signalling molecules produce a different response to hydrophilic molecules. The difference in response is identifiable as

- A. hydrophobic molecules cause proteins to be synthesised
- B. hydrophobic molecules activate enzymes within the cell
- C. hydrophilic molecules attach to receptors on the surface of cells
- D. hydrophilic molecules create transcription factors

Question 9

Apoptosis is often classified as programmed cell death. This means that

- A. humans can write code identifying which cells are meant to die
- B. cells rupture and release the cells contents.
- C. blebs form and burst when phagocytes release cytokines
- D. a death ligand initiates an organised cellular response

Question 10

Apoptosis happens regularly in organisms in response to internal or external signals. To identify if a cell is undergoing apoptosis you would expect to observe

- A. blebs bursting
- B. cells shrinking
- C. an inflammation response
- D. cell lysis

Question 11

The mitochondrial pathway for apoptosis occurs due to DNA damage, ischemia and oxidative stress. The pathway begins with

- A. a death ligand attaching to an external receptor
- B. caspases breaking down the cell's cytoskeleton
- C. the mitochondrial membrane becoming permeable
- D. a death ligand attaching to the mitochondria signalling the release of caspases

Question 12

Death ligands are a type of cytokine released by immune cells to control cell death. Once a death ligand attaches to a receptor

- A. cytochrome C is released by the mitochondria
- B. signal amplification results in mitochondria producing more caspases
- C. a transcription factor attaches to DNA
- D. caspase activation occurs

Question 13

Once enzymes have been activated in apoptosis the order of steps involved in the death of the cell are

- A. condensing the nucleus, forming blebs, fragmenting chromosomes
- B. fragmenting chromosomes, condensing the nucleus, forming blebs
- C. forming blebs, condensing the nucleus, fragmenting chromosomes
- D. cytochrome C release, caspase activation, cytoskeleton cleaving

Question 14

In an embryo, apoptosis occurs to sculpt the organism and remove cells that are not required. As an adult, the main purpose of apoptosis is to

- A. regulate mitosis so mutations don't occur
- B. remove immune cells that recognize non-self cells
- C. remove virally infected cells
- D. recycle organelles for use in cancer cells

Question 15

Unregulated apoptosis can exacerbate or cause autoimmune disease or neurodegenerative diseases because

- A. only virally affected cells should be removed in apoptosis
- B. apoptosis may remove cells that are functioning normally
- C. apoptosis removes immune cells
- D. the cells that undergo apoptosis are no longer undergoing programmed cell death

SECTION B – Short-answer questions

Instructions for Section B
Answer **all** questions in the space provided. Write using a blue or black pen.

Question 1

Pheromones are an example of a peptide-based signalling molecule that causes a response in target cells. An example of an organism that uses pheromones is the codling moth. It is a major pest to agricultural crops like apples and pears where the larvae infest the fruit preventing it from forming. Female codling moths release pheromones when food is available which attract male moths. The receptor for the pheromone is found in the antenna of the male moth.

- a.** What are the 3 steps of signal transduction that occur when a pheromone is released?

3 marks

- b.** What type of receptor would the pheromone attach to in male antenna cells? Explain

3 marks

- c.** What response would this type of signal have on the antenna cells of male moths?

2 marks

As part of the process of controlling the codling moth in orchards, farmers install pheromone traps which contain a synthetic version of the pheromone. These traps are found to be very effective at reducing damage to the crops they are protecting

- d.** What is the mode of transmission of pheromones?

1 mark

- e.** Would male or female moths be caught in the pheromone traps? Explain how this would be effective at protecting crops?

4 marks

Total 12 marks

Question 2

Hormones like testosterone act on many cells within the body by attaching to an androgen receptor found in the cytosol of a cell. Testosterone increases levels of growth hormone proteins which leads to increasing bone density and production of red blood cells

- a. Is testosterone hydrophobic or hydrophilic? Explain

2 marks

- b. What cellular response would occur once testosterone enters a cell that would lead to growth hormone being produced?

2 marks

- c. Testosterone can have different effects depending on the type of cell it enters. Explain how this is possible.

2 marks
Total 6 marks

Question 3

Apoptosis is a natural regulatory process of programmed cell death after a cell receives a signal resulting in the removal of cells that are no longer needed or may be a threat to an organism.

- a. Name 2 pathways that can result in apoptosis.

2 marks

- b.** For each pathway listed in 3a above, outline the 3-step process that leads to apoptosis

6 marks

- c.** Caspases are enzymes that are activated in response to each pathway. What effect do caspases have?

2 marks

- d.** HIV infection leads to immune deficiency ultimately leading to AIDS. Explain the role apoptosis plays in causing immune deficiency.

2 marks

Total 12 marks

END OF KEY TOPIC TEST