DUNMAN HIGH SCHOOL
YEAR 4 BIOLOGY
INFECTIOUS DISEASES

13B

Name: ..... [ ]

Class: .

Grade: .....

Date: 15 May 2023

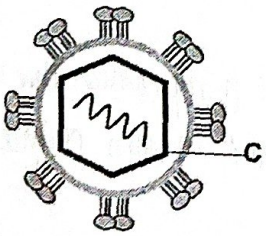
At the end of the worksheet, are you able to:

	Check (✓/×)
state that infectious diseases can be spread from person to person whereas non-infectious diseases cannot and identify examples of each	☐
state that vaccines contain an agent that resembles a pathogen and prevent infectious diseases by stimulating white blood cells to quickly produce antibodies when the pathogen invades	☐
explain that antibiotics target bacteria by preventing synthesis of cellular structures but are ineffective against viruses due to structural and reproductive differences	☐

Structured Questions

1 Dengue is a viral infection transmitted by the bite of an infected female *Aedes* mosquito.

Figure 1.1 shows a dengue virus while Figure 1.2 shows part of the dengue viral cycle in a human skin cell.



Dengue virus

Figure 1.1

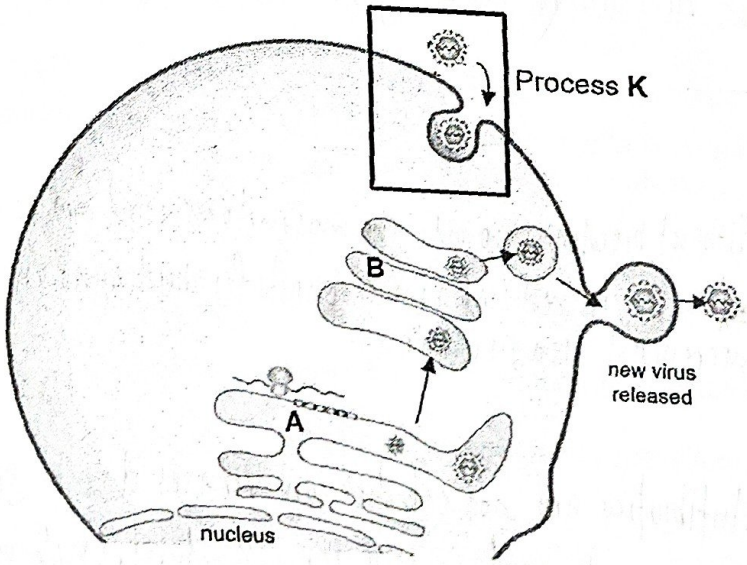


Figure. 1.2

a) Name structure **C** in Figure 1.1.

Capsid ..... [1]

b) Besides the presence of **C**, describe one other structural difference between the dengue virus (Figure 1.1) and human skin cell (Figure 1.2).

The human skin cell has a nucleus, but the dengue virus does not.

..... [1]

c) (i) With reference to Figure 1.2, name and describe the process **K** through which the dengue virus enters the skin cell.

endocytosis

The dengue virus enters the skin cell by ~~phagocytosis~~ [phagocytosis]. During phagocytosis, the dengue virus is taken into the cell by inward folding of the cell membrane to form vesicles that separate from the membrane allow dengue virus to enter skin cell.

(ii) describe **two** differences between simple diffusion and the process in (ci).

Simple diffusion is a passive process that does not require energy while phagocytosis is a form of active transport, which requires energy.

Molecules involved in simple diffusion travel down a concentration gradient while molecules involved in phagocytosis travel against a concentration gradient.

d) The dengue virus uses the skin cell's organelles to make viral proteins.

With reference to Figure 1.2, describe the processes that occur at organelles **A** and **B** which results in the synthesis of new viral proteins.

A: Viral DNA replicates at the ribosomes and folded at the rough endoplasmic reticulum. Transport vesicles ~~the fu~~ containing viral DNA are pinched off from RER.

B: Viral DNA is chemically modified and packaged in the Golgi apparatus.

e) The most effective way to reduce the occurrence of dengue virus in Singapore is to remove their breeding grounds. Explain why.

Without breeding grounds, the mosquitoes would not be able to reproduce. This will ~~red~~ result in reduced number of hosts for the dengue virus and in turn reduce the occurrence of dengue virus.

f) Antibiotics are not used to treat viral infections.

Explain why antibiotics do not affect viruses.

Antibiotics are not effective on viruses due to structural differences between viruses and bacteria. Cellular structures, such as bacterial cell walls, cell membranes and ribosomes, are absent in viruses.

2

a) Cholera is an example of an infectious disease. It is a disease characterized by vomiting and frequent watery diarrhoea. If left untreated, rapid dehydration can occur.

Define the term *infectious disease*.

An infectious disease is a disease that can be transmitted from person to person, and they are caused by disease causing microorganisms called pathogens, which include bacteria and viruses. [2]

b) The bacterium that causes cholera releases a toxin that enters the epithelial cells in the small intestine. Upon entry, the toxin stimulates the secretion of chloride ions out of the epithelial cell.

Figure 2.3 shows the effect of the toxin. The arrows indicate the direction of movement of the toxin and chloride ions.

large intestine cannot absorb fast enough

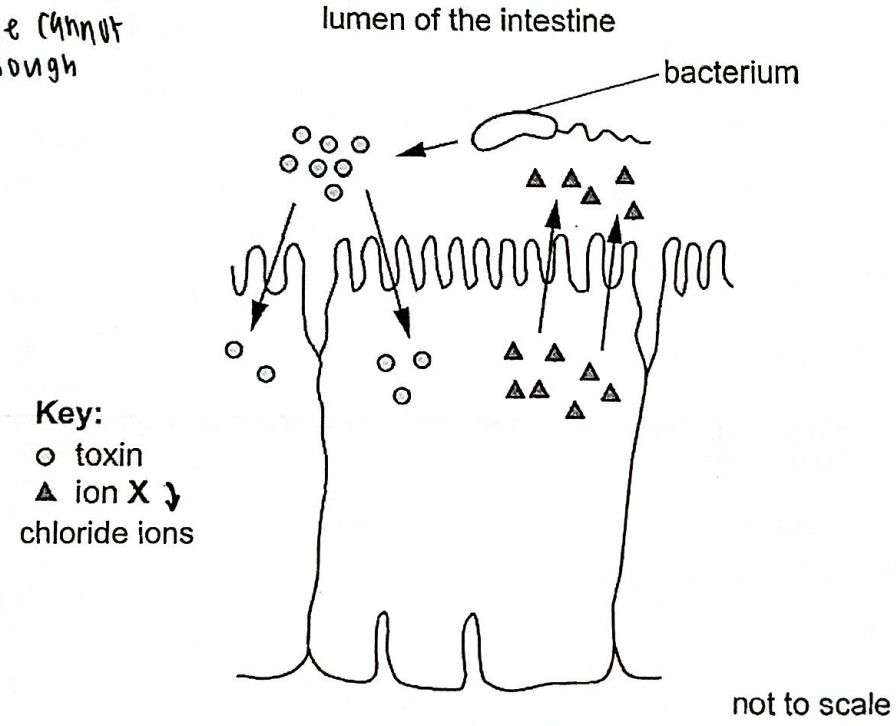


Figure 2.3

Describe how the movement of the chloride ions out of the epithelial cells result in watery diarrhoea.

when the chloride ions move out of the epithelial cells, the concentration of chloride ions in the epithelial cells decrease. Therefore, ~~ion X will~~ the toxin will enter the epithelial cell and lead to a decrease in digestive ~~function~~ function, which results in watery ~~diarrhoea~~ diarrhoea [3]

Using genetic engineering, it is possible to produce a form of chloera toxin consisting only subunit B. This can be combined with inactivated bacterial cells to produce a vaccine against cholera.

Outline how this vaccine can give protection against cholera.

When the ~~vaccine~~ vaccine enters the body, the ~~bacteria~~ bacterial ~~cells~~ cells and the ~~chloera~~ cholera toxin stimulate white blood cells to produce antibodies, proteins that are produced to destroy a pathogen. The antibodies would then protect the receiver of the vaccine against cholera, as the antibodies would destroy the ~~chloera~~ cholera toxins should the ~~recipient~~ receptor's immune system be exposed to the cholera toxin again.

1a) capsid / protein coat

b) Human skin cell has membrane bound organelles / organelles / nucleus / rough ER / Golgi apparatus / cell membrane / ribosomes whereas virus does not.

Subject of comparison must be clear.

Reject: 1) structures not present in figures
2) single stranded RNA in virus but double stranded DNA in humans
3) location of genetic material or any mention of nucleoid region

ci) Endocytosis [BOD: Phagocytosis]

Virus is taken into the cell by **inward folding of the cell membrane** to form **vesicles** that separate from the membrane.

Reject: engulf / enclose / envelops / fuse

ii)

Subject of comparison	Simple Diffusion	Endocytosis
Use of energy	No	Yes
	Passive process	Active process (Reject: active transport)
Specific	No	Yes
Type of material	Small / uncharged molecules (Reject: water soluble / ions)	Large molecules
Concentration gradient	Requires / Substances moves down the concentration gradients / Moves from high to low concentration	Does not require concentration gradient Reject: against concentration gradient
Membrane	Not required	Required (Reject: across / through the membrane)
	Does not require vesicles	Requires vesicles
	Substances moves across / through the membrane	Substances enters cell without moving across / through the membrane
Controllable	No	Yes
Direction [BOD]	One	Two

Subject of comparison must be clear.

Reject: equilibrium, fuse

d) **A:** 1) **Translation** of / **Translate mRNA/RNA** [Reject: Synthesis of protein]
2) **Folding** of **polypeptide** [Reject: protein]

B: **chemically modifies** and **packages** viral proteins / substances [R: DNA/RNA/Virus]

e)	1) Reduce number of vectors / mosquito population 2) Less place to lay eggs 3) Prevent mosquito from surviving till maturity 4) easier to kill mosquito at larval stage / disrupt mosquito life cycle Reject: Prevent mosquito from breeding / reproducing / killing of virus
f)	antibiotics (only) used against bacteria idea that antibiotics act at a cell structure not possessed by virus ; e.g. viruses, do not have, a cell wall / a cell surface membrane / ribosomes antibiotics do not act on, protein coat / capsid / capsomeres / viral envelope suggestion that viruses are, inside host cells / not within reach ; antibiotics act only on, living / growing, cells (viruses do not grow) ; Any 2
2a	Infectious diseases can be transmitted from person to person, and they are caused by disease causing organisms called pathogens, which include bacteria and viruses.
b	Chloride ions lower the water potential in the lumen Water move out of the epithelial cells by osmosis Water absorption not fast enough in the large intestine, resulting in watery diarrhoea
c	primary immune response occurs ; white blood cells/lymphocytes are activated antibodies are secreted secondary (immune) response / response on further infection, is faster ; higher levels of antibodies produced (during further infection) ;