Are you ready for SK320?

Contents

1 Introduction

If you are intending to study SK320, you should make sure that you have the necessary background knowledge and skills to be able to enjoy the module fully and to give yourself the best possible chance of completing it successfully.

Read through these notes carefully and work through the questions in Section 3.

The notes cover the knowledge and skills you should already possess, and the questions will provide a useful exercise for all prospective students of SK320.

If you find that you can answer most of the questions then it is likely that you are well prepared to take on SK320. However, if you are not confident in answering most of the questions you should consider doing some additional preparatory work before starting SK320, or studying one of the modules mentioned in Section 2.

2 Suggested prior study

SK320 Infectious disease and public health is an OU Level 3 science module thatmakes intellectual demands appropriate to the third year of a conventional degree. The module contains a lot of information and we strongly recommend that if you plan to study this module at the same time as other modules, you restrict yourself to no more than 30 credits in addition to SK320.

The module is compulsory for the Q71 BSc in Health Sciences and an optional component of the Q64 BSc in Natural Sciences. The module develops some of the subjects covered in the following OU Level 1, Level 2 and Level 3 modules:

- SDK100 Science and health: an evidence-based approach
- S294 Cell biology
- SDK125 Introducing health sciences: a case study approach
- SK299 Human biology
- S317 Biological science: from genes to species

It is not assumed you will have studied all of these modules. It is however assumed that you will have a level of biology knowledge that is commensurate with that in S294 or SK299. If you have not studied any of these modules you will find the biology in SK320 more challenging and will have to do more background reading. Studying SDK100 will help to prepare you for the health-related issues and the epidemiology in SK320, which is likely to be more of a challenge if you are from a purely biological academic background.

In an analysis of the 16J cohort of students, it was found that 63% of students gaining a Pass 1 in the exam had previously studied S294. However, only 21% of students that failed the exam had previously studied S294. Similar trends can be seen in other years. Other modules that were often studied by Pass 1 students, but not often by students who fail the module were: SK288, SK277 and SXHL288. The module team strongly recommend that you study one of these modules before attempting SK320.

3 Key concepts self-assessment questions

Answering the questions below requires the sort of knowledge that you need in order to study SK320.

Question 1

Indicate by inserting P (plant), A (animal) and B (bacteria) alongside each cellular component, which features are present in eukaryotic cells (P and A) and prokaryotic cells (B).

cell membrane	*Provide your answer...*
cell wall	*Provide your answer...*
chloroplasts	*Provide your answer...*
cytoskeleton	*Provide your answer...*
cytoplasm	*Provide your answer...*
cytosol	*Provide your answer...*
DNA	*Provide your answer...*
mitochondria	*Provide your answer...*
nucleus	*Provide your answer...*
nuclear membrane	*Provide your answer...*
organelles	*Provide your answer...*
ribosomes	*Provide your answer...*
rough endoplasmic reticulum	*Provide your answer...*

Answer

cell membrane	P, A, B
cell wall	P, B
chloroplasts	P
cytoskeleton	P, A
cytoplasm	P, A, B
cytosol	P, A, B

DNA	P, A, B
mitochondria	P, A
nucleus	P, A
nuclear membrane	P, A
organelles	P, A
ribosomes	P, A, B
rough endoplasmic reticulum	P, A

Where P = plant, A = animal and B = bacteria.

Question 2

What processes would probably be occurring to a major extent in each of the following cells?

(a) A cell in which there is a great deal of rough endoplasmic reticulum.

Provide your answer...

Answer

- Synthesis and export of proteins.

(b) A cell in which the Golgi apparatus is large.

Provide your answer...

Answer

- Secretion.

(c) A cell with a high rate of lysosomal activity.

Provide your answer...

Answer

- Degradation of cell debris or ingested particles.

(d) A cell in which there is a great deal of smooth endoplasmic reticulum.

Provide your answer...

Answer

- Production of phospholipids and steroids or detoxification of ingested substances.

(e) A cell with large numbers of mitochondria.

Provide your answer...

Answer

- Production of ATP.

Question 3

Describe the following cellular processes:

(a) secretion

Provide your answer...

Answer

- Secretion is the process whereby substances, predominantly proteins or glycoproteins, are released from the cells where they have been produced, e.g. hormones, enzymes.

(b) phagocytosis

Provide your answer...

Answer

- Phagocytosis is the engulfing and subsequent digestion of particulate matter, e.g. cell debris, foreign particles, invading pathogens.

(c) apoptosis

Provide your answer...

Answer

- Apoptosis is the controlled destruction of cells, also known as programmed cell death.

(d) differentiation

Provide your answer...

Answer

- Differentiation is the collection of changes that take place in a cell as it becomes specialised.

Question 4

(a) What are the differences between a virus and a bacterium?

Provide your answer...

Answer

A virus generally consists of nucleic acid (DNA or RNA) enclosed within a protein coat. Viruses are not cells and can only reproduce by infecting host cells and utilising their mechanisms to produce new viral particles. Bacteria are cells containing their own genetic material and can grow and reproduce independently.

(b) Which of the following diseases are caused by viruses and which by bacteria?

(i) anthrax

- ☐ bacterium
- ☐ virus

(ii) acquired immunodeficiency syndrome (AIDS)

- ☐ virus
- ☐ bacterium

(iii) common cold

- ☐ virus
- ☐ bacterium

(iv) bubonic plague

- ☐ bacterium
- ☐ virus

(v) polio

- ☐ virus
- ☐ bacterium

(vi) food poisoning

- ☐ bacterium
- ☐ virus

(vii) smallpox

- ☐ virus
- ☐ bacterium

Question 5

Measles and chickenpox are both caused by viruses. Explain why a person who has recovered from measles and has never had chickenpox, is unlikely ever to suffer from measles again but is just as susceptible to chickenpox as before?

Provide your answer...

Answer

The molecular structures of the measles and chickenpox viruses include different epitopes, which can be distinguished by the human immune system. Memory cells that are committed to respond to the measles epitopes develop as the person recovers from the first infection, and these give protection against a subsequent infection with measles. But these memory cells have specific receptors that bind only to the measles epitopes; they cannot give any protection against the chickenpox virus.

Question 6

Use the terms ‘best adapted’, ‘fitness’ and ‘selection pressure’ in explaining the evolution of antibiotic-resistant bacteria in a society where antibiotics have been over-prescribed and people have often failed to complete the course of treatment

Provide your answer...

Answer

A bacterial population in a single person consists of many billions of bacterial cells, which vary in their susceptibility to being killed by a particular antibiotic.

When the bacteria are exposed to the antibiotic, the most susceptible bacteria die first, so – over time – the proportion of more resistant bacteria increases in the population. These bacteria have the highest *fitness* under these conditions, that is, they are the *best adapted* to survive exposure to the antibiotic for long enough to reproduce and pass on their ‘resistance’ genes to their progeny. The antibiotic exerts *selection pressure* on the bacterial population, driving it towards greater antibiotic resistance. If the antibiotic is not administered in an optimal dose for a long enough period, the best adapted (i.e. most resistant) variants will survive and re-populate the person. Everyone who subsequently becomes infected with these more resistant bacteria will need even stronger doses of that antibiotic to eradicate the infection. If the cycle of inadequate antibiotic treatment is repeated often enough, after many generations all of the bacteria in the population will have evolved complete antibiotic resistance.

Question 7

In a particular population it has been calculated that, on average, people catch a cold once every two years. Calculate the average number of colds people from this population might expect to catch in a five-year period and in a six-month period.

Provide your answer...

Answer

In five years: 5 × (1/2) = 2.5 colds. In six months: (1/2) × (1/2) = 1/4 = 0.25 cold.

Question 8

Four quantities, none equal to zero, are represented by the letters *a*, *b*, *c* and *d* and are in the relation $a \times b = c \times d$. Express quantity *c* in terms of *a*, *b* and *d*.

Provide your answer...

Answer

Dividing both sides by *d* (this is acceptable since *d* is not zero) gives $c = (a \times b)/d$.

Question 9

550 children attend school A, 250 attend school B. Over a given year, 20 children from school A get measles, and 10 from school B. Calculate the overall proportion of children from schools A and B who get measles, and express this as a percentage.

Provide your answer...

Answer

The total number of children is 550 + 250 = 800, of whom 20 + 10 = 30 get measles. So the proportion required is 30/800 = 0.0375 or 3.75%.

Question 10

Four quantities, none equal to zero, are represented by the letters *a*, *b*, *c* and *d* and are in the relation $c = (a \times b)/d$. Express quantity *b* in terms of *a*, *c* and *d*.

Provide your answer...

Answer

Multiplying both sides by *d*, then dividing both sides by *a* (this is acceptable since *d* and *a* are not zero) gives $b = (c \times d)/a$.

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