

90927 Demonstrate understanding of biological ideas relating to micro-organisms ANSWERS

DIGESTION AND REPRODUCTION PROCESSES (2013:1)

(a) Describe the processes of digestion and reproduction in bacteria and in fungi.
You may use labelled diagrams.

(b) Compare and contrast these processes of digestion and reproduction in bacteria and in fungi.
In your answer:

- explain the process of digestion in bacteria and in fungi
- explain the process of reproduction in bacteria and in fungi
- discuss the similarities and differences between digestion and reproduction in bacteria and in fungi, making links between the structures of the organisms and the processes.

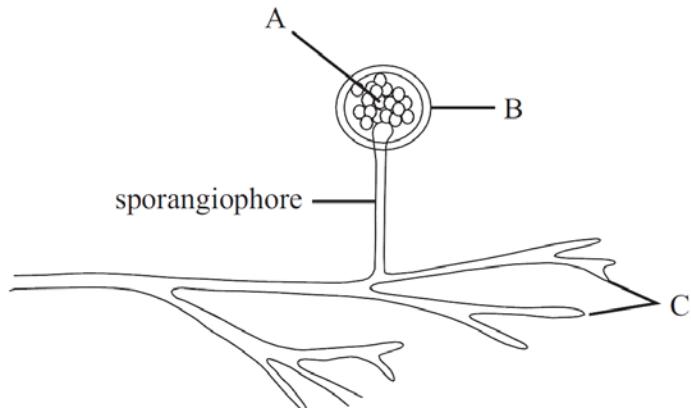
Both the bacteria and fungi are able to use extracellular digestion to digest food. Fungi secrete enzymes through the hyphae AND bacteria secrete enzymes through their cell wall.

Both bacteria and fungi are able to reproduce asexually. Bacteria reproduce by the process of binary fission, whereby the bacterium **replicates its DNA /genetic material** before the cell divides into two.

Fungi reproduce by producing many spores that are able to be carried away by wind and grow new fungi.

FUNGI (2011:1)

The diagram below shows the generalised structure of a mould, which is a type of fungus.



Each of the parts labelled A, B and C is important in reproduction or feeding.

Discuss the roles that parts A, B and C play in reproduction or feeding.

In your answer you should:

- name the parts A, B and C
- identify the role of each part in either reproduction or feeding
- explain how each of the parts A, B and C carries out its role in either reproduction or feeding
- relate the role of each part to the survival and / or reproduction of the fungus.

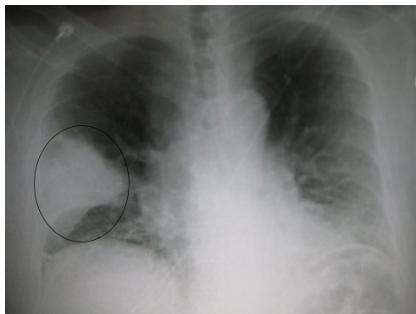
A: Spores are the reproductive units for fungi: they carry the genetic code / DNA to produce another identical fungus OR they are small / light to be carried a distance by wind to land and germinate / start growing on a food source (ie need to link form to function).

B: Sporangia are sacs, which carry / produce the spores. They have a waterproof cell wall, which protects the developing spores. When the spores are ripe / mature, they burst, releasing the spores into the air.

C: The feeding hyphae carry out extra-cellular digestion, secreting enzymes to break down food molecules outside of the fungal organism. The nutrients are then absorbed. The nutrients that are absorbed allow the fungi to grow and reproduce, increasing its chance of survival.

INFECTIOUS PNEUMONIA (2011:3)

Pneumonia is a condition in humans where the lungs become inflamed. It can occur for a wide range of reasons, but is often caused by either a viral or a bacterial infection.



The X-rays below show lungs unaffected by pneumonia (A) and lungs showing a pneumonia infection (B).

(a) Describe how infectious pneumonia could be passed between people.

Pneumonia can be spread by coughing / hand-to-hand contact / blood.

(b) Describe what measures could be taken to reduce the risk of spreading infectious pneumonia.

The risk of infection can be reduced by isolating those with infections / good hygiene practices / coughing into a sleeve / frequent hand washing / antibiotics / vaccination etc.

(c) Discuss how the life processes of bacteria and viruses can cause infections, such as infectious pneumonia.

In your answer you should:

- describe how both bacteria and viruses reproduce
- compare and contrast bacterial and viral reproduction, and explain how each process causes disease
- consider the role of bacterial excretion in producing symptoms in bacterial pneumonia.

Reproduction of viruses and bacteria causes infections for different reasons.

Viruses reproduce in a living cell, and because they can make many hundreds of viruses inside each cell before it dies, this causes many more cells to die / organs to malfunction, which leads to illness.

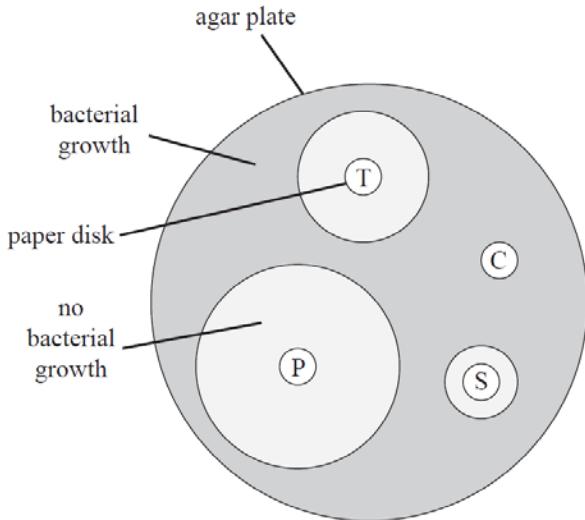
Bacterial reproduction doesn't destroy living cells, but instead increases the number of bacteria so that the amount of toxin they excrete increases. It is the toxin which then causes inflammation in parts of the body.

ANTIBIOTICS (2013:2)

Antibiotics are used routinely to treat infections. Not every antibiotic is effective against every species of bacteria. Scientists can carry out experiments to show how effective an antibiotic will be against specific bacteria. In this experiment, a culture of bacteria is spread over an agar plate using sterile techniques. Then, paper disks containing antibiotic are placed carefully onto the agar plate, which is then incubated for two days. The results of one test are shown below.

Effectiveness of three antibiotics against *E. coli*

Key	
C	Control
P	Penicillin
S	Streptomycin
T	Tetracycline



Discuss the experiment, explaining which antibiotic would be most effective against the *E. coli* infection and how this can be determined.

In your answer you should:

- describe which antibiotic was the most effective and explain how this can be determined
- explain the purpose of the control in this experiment
- explain why the agar plate should be sterile before the bacteria are placed on it
- explain how the agar plate is inoculated to get an even growth of bacteria.

The most effective antibiotic would be penicillin because the area around it where no bacteria grew is the biggest. This is because the antibiotic stopped the bacteria from being able to reproduce / killed the bacteria. In this experiment, the paper disk is there to show that the presence of the paper disk has no effect on bacterial growth OR to compare the control with the experimental results.

Before beginning the experiment, the agar plate is sterile. This is so that any bacteria that grow are due to the experiment, not contamination / to prevent contamination adversely affecting the experiment in some way. Bacteria are transferred by using a (sterile) swab/loop and moving it in a zig-zag pattern across the agar plate OR a reasonable alternative method.

CULTURING MICROBES (2012: 1)

A nutrient agar plate was left open on the bench in a laboratory. It was then sealed up and incubated at 25°C. The photo below shows the plate after a few days, with smaller images of similar colonies shown magnified under a microscope.

The plate shown has colonies of both bacteria and fungi.

Discuss the growth of colonies shown on the plate.

In your answer you should:

- describe the conditions needed for micro-organisms to reproduce
- describe how the micro-organisms arrived on the plate
- explain the relationship between the structures and functions of the micro-organisms, and how they look on the plate
- explain why bacteria and fungi have survived and reproduced on the agar plate, but viruses have not.



Both arrive by air, the fungus as spores and the bacteria as single bacterial cells. This was possible because the plate was left open on a bench. Once on the agar, the conditions were ideal for the bacteria and fungi to grow. Both the bacteria and fungi were able to use extracellular digestion to digest food by secreting enzymes from their cell walls. This gave them the energy needed to reproduce.

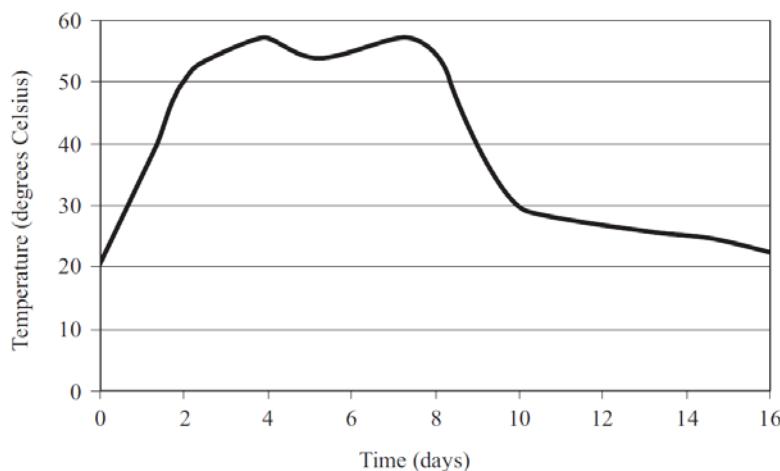
Fungi look fuzzy as they have sporangia / hyphae above the agar and bacteria look smooth as they have a slime capsule. Fungi are able to release spores from these sporangia to reproduce. Because the plate was incubated at 25°C, the conditions for reproduction were ideal, and they were able to reproduce fast. Bacteria reproduce by binary fission by duplicating their DNA and pinching their cell wall to form two cells and as they had both nutrients and a warm environment they were able to reproduce to visible levels. Because viruses need living cells to reproduce / replicate them, they cannot grow on an agar plate.

COMPOST AND NUTRIENT CYCLING: (2013:3)

Compost is decayed organic matter. Composting is the process carried out by saprophytic micro-organisms turning organic matter such as vegetable matter and manure into compost. A successful compost heap requires good air flow. Compost, carbon dioxide, water, and heat are produced.



Temperature changes in compost over the first few days



- (a) Describe the term saprophyte.
- (b) Refer to the graph and explain the temperature changes that occur in the compost. Link these temperature changes to the life processes of the micro-organisms and the process of composting.
- (c) Discuss the role of composting in the cycling of carbon.
In your answer, consider why good air flow is needed in composting, and link this to a life process.

A saprophyte is an organism / bacteria / micro-organism that feeds on / gains nutrients from dead / decomposing / decaying material / waste products – not lives off.

This respiration produces heat, which increases the temperature of the compost. (After day 8) the heat / toxins kill the micro-organisms.

Good air flow lets in more oxygen for aerobic respiration. The decomposers are aerobic so need O₂. During the first 8 days the bacteria and fungi are reproducing rapidly, because there is plenty of food, and are carrying out aerobic respiration. Aerobic respiration is more efficient / releases more energy OR anaerobic respiration is less efficient / releases less energy / has undesirable products.

Without decomposition, nutrients such as carbon would be locked up in living and dead animals and plants. The decomposition of these materials releases carbon, in the form of CO₂, which is then able to be used by plants / producers / for photosynthesis.

PRESERVING FOOD (2012: 2)

Fruit and vegetables can be canned so that they can be stored for a long time. Analysis of food canned over 45 years ago shows it to be safe to eat.

When food is canned, the can and its contents are heated to very high temperatures and then quickly sealed with a sterilised lid to exclude any air.

(a) Discuss at least TWO ways in which contamination with micro-organisms is reduced in the canning of food.

In your answer you should relate each of these ways to the life processes of micro-organisms.

Sterile lid means microorganisms aren't introduced, as they have been killed, so can't reproduce and therefore spoil the food.

High food temperatures kill microorganisms so they cannot respire or reproduce, which means the food will not spoil unless opened / will be safe for consumption.

Removal of air bubbles limits oxygen and prevents aerobic respiration by microorganisms.

(b) Explain why canned food must be refrigerated once opened.

In your answer you should refer to the life processes of micro-organisms.

Fridge has cool or cold temperature and therefore slows (NOT kills or stops) microorganisms reproduction / respiration.

FOOD STORAGE (2011:2)

Milk can be found in many forms. For long-term storage, milk is heated and turned into milk powder. The picture below shows two forms of milk – liquid milk (left) and milk powder (right).



Discuss why the milk powder can be stored for a longer time than liquid milk.

In your answer you should:

- describe the difference between the two milk products in terms of water content
- consider the effect that this difference in water content has on storage temperature requirements
- relate both water content and temperature of storage to the long-term storage and spoilage of the two products
- relate the water content and temperature to the life cycle of bacteria.

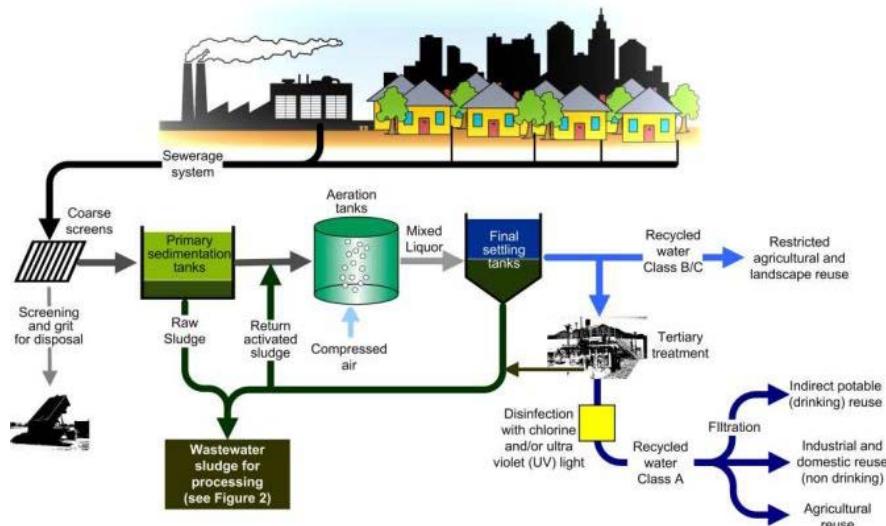
Micro-organisms need water to reproduce, milk contains water and needs to be stored in the fridge / at a low temperature to limit bacterial reproduction. Powder does not need to be stored in the fridge/at a low temperature as bacterial growth is already limited by a lack of water.

OR

Milk powder treated at a high temp has no bacteria, so there are none to reproduce. Therefore it can be stored at room temperature. However, liquid milk contains small numbers of bacteria. These will reproduce in milk as it contains water and nutrients. Therefore it needs to be stored in the fridge to slow the rate of reproduction down.

SEWAGE TREATMENT (2012:3)

Sewage contains water-borne waste from toilets and household waste water, along with some industrial waste and storm water. The main aim of sewage treatment is to remove or reduce solid waste and organic material. Once this is done, the water can be safely discharged into rivers or the sea. The diagram below shows a typical sewage treatment plant.



(a) Explain why sewage treatment is important.

Human faeces contain large quantities of bacteria. Preventing these from entering drinking water and food reduces the risk of infection spreading / as naturally occurring bacteria break down waste in waterways, they use large amounts of dissolved oxygen, making the water anaerobic / killing the fish / plants

(b) During secondary treatment, sewage enters an aeration tank. The tank contains bacteria, and has air pumped into it.

Discuss the role of bacteria in the aeration tanks during treatment of sewage.

In your answer you should:

- describe the role of the bacteria in the sewage plant and explain how this relates to their life processes
- explain the significance of air being added into the aeration tank
- consider the raw materials that enter the tanks and the products generated from the bacterial action.

As the bacteria feed on the organic material in the tank, they carry out aerobic respiration. This produces carbon dioxide and water as waste products. Without air / oxygen being pumped into the tank, the bacteria are unable to carry out aerobic respiration, and instead their respiration becomes anaerobic. For this reason the aeration tank has air pumped in to it.

If conditions in the tanks remain highly oxygenated, the aerobic bacteria are in the best conditions for them to feed and reproduce. This means that the tank will continue to function as it should and the bacteria will continue to convert the organic waste to carbon dioxide and water. If the conditions change, and the tank loses its oxygen supply, anaerobic bacteria / respiration will take over as the aerobic bacteria will not be able to survive. This will result in the tank becoming smelly, and the production of methane.