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90927



909270



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## Level 1 Biology, 2016

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

9.30 a.m. Wednesday 23 November 2016

Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of biological ideas relating to micro-organisms.	Demonstrate in-depth understanding of biological ideas relating to micro-organisms.	Demonstrate comprehensive understanding of biological ideas relating to micro-organisms.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

**You should attempt ALL the questions in this booklet.**

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–8 in the correct order and that none of these pages is blank.

**YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.**

Excellence

TOTAL

23

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**QUESTION ONE: PRESERVING FOOD**

Fresh food can be spoiled and go off due to the presence of micro-organisms. Freeze-drying is one way of preserving food so that it can be stored for a long time before use. The diagram below shows how freeze-drying is carried out.



Adapted from: <http://www.lio-licious.com/useful-info>

Discuss how the process of freeze-drying helps to preserve food.

Your answer should:

- describe the environmental factors required for micro-organisms to carry out life processes
- describe where the micro-organisms that spoil food come from
- explain how micro-organisms carry out life processes that cause food to spoil or go off
- explain what the freeze-drying process does that helps to preserve food.

\* Many micro-organisms carry out the seven life processes of MRS GREEN, movement, respiration, sensitivity, growth, reproduction, excretion and nutrition. Many of these life processes however require specific conditions as many processes are facilitated by enzymatic reactions. As such, a specific temperature is required for optimum enzyme efficiency (too high will cause

the enzyme to denature; lose shape and function), furthermore, water is required in cellular reactions to, for example activate enzymes. Many micro organisms respire aerobically to provide organism ATP energy to carry out life processes (i.e growth). Glucose + oxygen  $\rightarrow$  ATP +  $\text{CO}_2$  and  $\text{H}_2\text{O}$ . Organisms that spoil food are saprotrophic, meaning they feed off dead organic matter and are decomposers. In this case, a saprotroph may have come from handling the food or is airborne. The process by which saprotrophs spoil food is called extra cellular digestion, of which is facilitated by enzymes. A micro-organism secretes enzymes onto the food molecule, causing it to break down into constituent molecules. This causes the food to change shape and smell. The enzymes are then reabsorbed via the hyphal tip or plasma membranes. By flash freezing the food, any microbes on the food will become inactive as their enzymatic reactions inactivate (as the enzymes if optimum temperature is not met). Furthermore, when the food is placed in a vacuum chamber, oxygen is removed, meaning that many aerobic microbes are unable to respire resulting in the death of many microbes. Moisture is then removed meaning that organisms can no longer carry out metabolic processes. When the food is placed in the oxygen and water proof package, the conditions are kept constant. This means that fungi or bacteria cannot respire or carry out metabolic processes in these conditions, and cannot replicate or reproduce as the conditions are too unfavorable. Because extra cellular digestion does not occur, the food remains fresher for much longer.

## QUESTION TWO: FUNGI AS PLANT PATHOGENS

Loss of crops or food spoilage due to fungal diseases caused by fungal pathogens can have a large impact on human food supplies.



(a)

(b)



(c)

(d)

Some fungal pathogens include (a) green mould on grapefruit, (b) powdery mildew on a zinnia, (c) stem rust on barley, and (d) grey rot on grapes.

Source: [www.boundless.com/biology/textbooks/boundless-biology-textbook/fungi-24/fungal-parasites-and-pathogens-152/fungi-as-plant-animal-and-human-pathogens-600-11819](http://www.boundless.com/biology/textbooks/boundless-biology-textbook/fungi-24/fungal-parasites-and-pathogens-152/fungi-as-plant-animal-and-human-pathogens-600-11819)

Discuss how fungi feed, grow, and reproduce as pathogens on plants, and how damage to crops or food spoilage from fungal pathogens can be minimised.

Your answer should:

- define the term pathogen
- explain how fungi feed, grow, and reproduce on plants
- explain how environmental factors allow fungi to grow quickly on plants
- explain how crop damage or food spoilage from fungal growth could be minimised
- compare the links between the methods used to control fungi and the expected changes to fungal growth and reproduction.

A pathogen is a micro-organism that causes disease.

Fungi feed via the process of extra-cellular digestion. Enzymes are manufactured close to the hyphal tip and then released onto the food molecule. This is because the moist hyphal tip can ~~at~~ only absorb small soluble molecules. The enzymes then break down food molecules into constituent molecules and it diffuses across the hyphal membrane to now be used for growth. Growth however can only occur if energy is received for cells. This is done by means of cellular respiration. Fungal cells in the presence of oxygen convert glucose<sup>(received by extracellular digestion)</sup> into ATP energy,  $\text{CO}_2$  and  $\text{H}_2\text{O}$ . ( $\text{Glucose} + \text{Oxygen} \rightarrow \text{ATP} + \text{CO}_2 + \text{H}_2\text{O}$ ). This is aerobic respiration, it is slower than anaerobic but however produces 38 ATP molecules as opposed to the 2 produced by anaerobic respiration. Fungi may also ferment and anaerobically respire ( $\text{Glucose} \rightarrow \text{alcohol} + \text{CO}_2$ ). The fungi then uses the energy to grow via mitosis or to create reproductive spores. Fungi can reproduce asexually or sexually. Once the fungi matures, it directs some of its hyphae upwards and uses some energy to create the sporangium, a large reproductive organ. Spores are produced here and once ready, burst, releasing spores into the air and nearby fruits i.e. green mould to another grapefruit. If the conditions are favourable, a hyphal tip will grow down and the cycle of feeding, growth and reproduction. If it is dark, fungi are able to grow fast on plants as there is no competition

\* EXTRA SPACE *seen*

### QUESTION THREE: NUTRIENT CYCLING

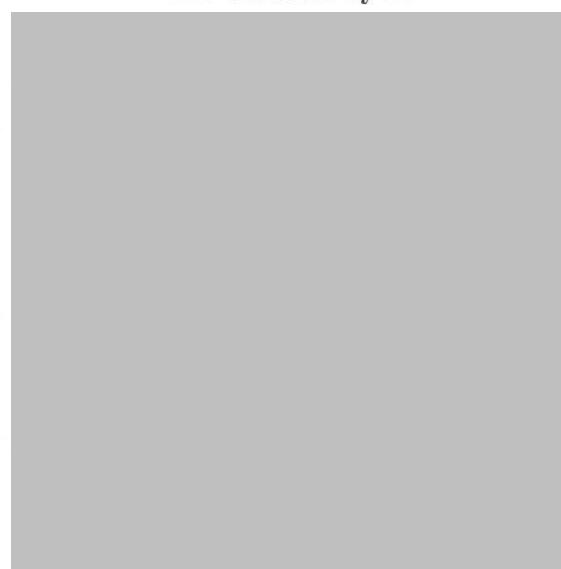
Nitrogen and carbon are two essential nutrients cycled by micro-organisms.

**The Nitrogen Cycle**



Sources: [https://en.wikipedia.org/wiki/Nitrogen\\_fixation](https://en.wikipedia.org/wiki/Nitrogen_fixation)

**The Carbon Cycle**



[www.thinglink.com/scene/700750299547041793](http://www.thinglink.com/scene/700750299547041793)

Compare and contrast the role of micro-organisms in nutrient cycling in the nitrogen and carbon cycles.

Your answer should:

- describe the role of micro-organisms in nutrient cycling in the nitrogen cycle
- describe the role of micro-organisms in nutrient cycling in the carbon cycle
- explain why nutrient cycling is important to the ecosystem
- discuss the similarities and the differences in the role of micro-organisms in nutrient cycling for the nitrogen and the carbon cycles.

*Micr-organisms play a large part of the nitrogen cycle. They convert atmospheric nitrogen into more useable forms i.e nitrates for plants (for proteins) as plants cannot use atmospheric nitrogen to make their amino acids and proteins. Furthermore, decomposing micro organisms release trapped nitrates into ammonium, preventing nitrogen from being trapped and locked up in dead organisms. Finally, they also convert nitrates in the soil to be converted bulk into nitrogen gas (denitrifying bacteria) thus completing the nitrogen cycle. In the carbon cycle, nitrogen is released back into the atmosphere through respiration and decomposition by heterotrophs.*

Cycle, micro-organisms prevent carbon from being locked up in dead organic matter. This is done by decomposing micro organisms that break down our organic matter back into carbon dioxide via respiration. Similarly, both the nitrogen cycle and carbon cycle involve decomposers that prevent the lock up of nutrients by breaking it down. In the carbon cycle it is directly released into the atmosphere, ~~whilst~~ to be used again, however in the nitrogen cycle it is released back into the soil. Furthermore in the nitrogen cycle has more extensive purpose for micro-organisms. In the carbon cycle, micro organisms only release locked carbon, whilst in the nitrate cycle, micro organisms facilitate the majority of it as they convert nitrogen into ammonium and nitrates, release nitrogen compounds locked in dead organisms and returns nitrogen back into the air. Nutrient cycling is important to the ecosystem because it allows organisms to safely reuse the nutrients for life processes. If ~~fore~~ there were no~~t~~ micro organisms then the whole ecosystem would collapse. The carbon cycle for example. Plants would use carbon, animals would get carbon from plants however once they died, the carbon would remain locked up in the dead organic matter, meaning eventually, as the carbon is no longer restored to the atmosphere, result in the ecosystem to collapse as plants cannot ...

photo synthesise, animals cannot get carbon from Plants etc. Furthermore, if no micro organisms existed in the nitrogen cycle, ~~with~~ Plants would be unable to use atmospheric nitrogen for proteins meaning they die, animals die as they are unable to get usable nitrogen from plants and

E8

QUESTION  
NUMBER

seen

Extra paper if required.  
Write the question number(s) if applicable.

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\* Q2.

for the fungi. Furthermore if the conditions are warm and damp, this provides water to activate enzymes, and an optimal temperature for the enzymes to work in, allowing metabolic processes to occur more efficiently and fast growth. In order to minimise fungal growth an efficient method may be to use anti fungal sprays. This disrupts the metabolic processes of fungi and is expected to kill the fungi and stop growth and reproduction (not visible and little amounts of fungi present). This however may be negative as the food is meant to be consumed by humans, and consuming antifungal sprays can hurt health. Another healthier method may be to store the fruit in a dry, light-filled environment. This removes many conditions required for growth (i.e no water for metabolic processes) however and would be expected to have a visible change (less fungi and less reproduction), however this does not guarantee <sup>no</sup> antifungal growth.

seen

3

any nitrogen in organic matter would be locked in dead matter, thus leading to the collapse of the ecosystem.

# Annotated Exemplar Template

## Excellence exemplar 2016

Subject:		Biology	Standard:	90927	Total score:	23
Q	Grade score	Annotation				
1	E8	<p>This is an E8 because it demonstrates comprehensive understanding of biological ideas relating to micro-organisms. It does this by providing evidence of multiple links between biological ideas relating to how the freeze-drying process helps to preserve food. For example, it discusses how the microbes digest food, linking it to the environmental factors involved and how this process is affected by lowering the temperature in the freeze-drying process. It also discusses links between the effect on the microbes of the removal of oxygen and moisture as occurs in the freeze-drying process.</p>				
2	E7	<p>This is E7 because it demonstrates comprehensive understanding of biological ideas relating to micro-organisms. It does this by providing one example of making multiple links between ideas in relation to the fungal life processes and/or minimising damage or spoilage to crops. For example, it links the process of respiration and energy release to fungal reproduction and growth. In order to obtain E8 it would need to provide another example of making multiple links. For example, it could have provided more depth in the link it made between changing one or more environmental factors (in this case moisture and light) to minimise fungal growth.</p>				
3	E8	<p>This is an E8 because it demonstrates comprehensive understanding of biological ideas relating to micro-organisms. It does this by providing evidence of multiple links between biological ideas relating to nutrient cycling. For example, it links the role of micro-organisms to plants requirement for nitrogen in a usable form for making plant protein. It also links the role of decomposing microbes to the breakdown of dead organic material through the process of respiration to the requirement for plants to have carbon dioxide for photosynthesis. In addition, it makes multiple links between biological ideas in relation to the importance of microbes in the process of nutrient cycling as well as the importance of nutrient cycling to the ecosystem as a whole.</p>				