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SUPERVISOR'S USE ONLY

Level 1 Biology, 2015

90927 Demonstrate understanding of biological ideas relating to micro-organisms

2.00 p.m. Friday 20 November 2015

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 2–12 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

24

ASSESSOR'S USE ONLY

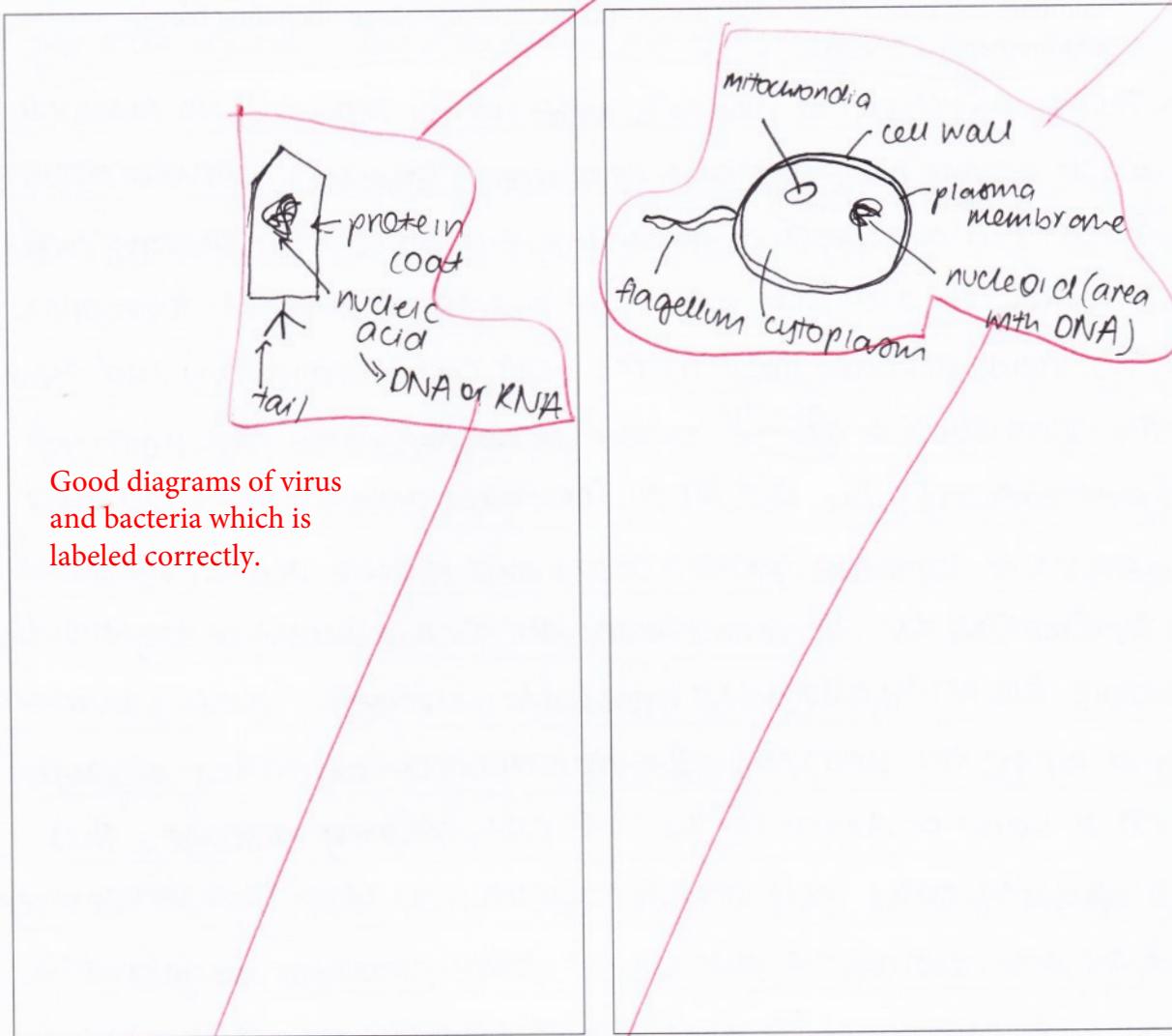
QUESTION ONE: MICROBES AND ILLNESS

Two students, Manaaki and Angela, were sick and went to the doctor on the same day.

Manaaki was told that he had the common cold, which is caused by a viral infection, and was advised to stay home and rest.

Angela had a sore throat, which is caused by a bacterial infection, and was prescribed a 10-day course of antibiotics.

- (a) Draw labelled diagrams of a virus and a bacterium.



- (b) The symptoms developed very differently for Manaaki and Angela before they saw the doctor. Manaaki's symptoms (caused by a virus) had become worse suddenly in the morning, while Angela's symptoms (caused by bacteria) became worse gradually throughout the day.

Explain why Manaaki developed the symptoms more quickly than Angela.

In your answer you should:

- explain how the reproduction of viruses and bacteria affected how quickly Manaaki and Angela developed the symptoms
- compare and contrast the way viruses and bacteria reproduce, including their requirements of energy.

explanation of the virus lytic cycle.

Explains that the virus relies on the energy from the host cell for its replication.

The reproduction of viruses is what causes Manaaki to fall sick which is why his symptoms appeared so quickly. Viruses require with DNA/RNA a host cell to reproduce, meaning that it uses the energy from the host cell and does not have to produce any of their own.

To reproduce, the virus attaches itself to the host cell (adsorption) and then the virus itself or genetic content is released into the host cell (penetration). The DNA/RNA then takes over the host cell and instructs it to make protein coats and nucleic acids. (synthesis)

Once all the new viruses are then assembled together (maturation) before the newly assembled viruses are released, usually bursting and killing the host cell. The reproduction of viruses always cause harm or death to the host cell, causing disease. This is why Manaaki feels sick so quickly as when the viruses reproduce, they are causing the disease. It takes time for Angela to develop symptoms because it is not just the reproduction of the bacteria that causes her to feel symptoms (sickness). Bacteria

reproduce by binary fission. The parent cell replicates its DNA and the cell elongates (one at each pole). The DNA is pulled to each cell pole. The plasma membrane pinches the cytoplasm in half and new cell walls form, creating two daughter cells. The rapid reproduction of bacteria itself does not cause harm to Angela (unless it is parasitic like the virus). This is why

Links the symptoms of (virus) Manaaki to the death of the affected cells

Links the reproduction of the virus to the speed of the symptoms

Explains binary fission

Links the production of toxins to the bacteria and also links this to the reproduction explaining that large populations produce large volumes linking to time for symptoms to show.

It takes a while for Angela to show symptoms. When the bacteria reproduce, it produces small amounts of toxins (poisonous). This takes a while to accumulate, but the toxins produced by the bacteria could cause the sore throat. It takes a while for the toxins to build up to cause disease. The toxins can damage cells, block internal signals and overstimulate cells causing the cell's death. The sheer numbers of bacteria can cause disease but this also takes time to reach large volumes, meaning it takes time for symptoms to show. Bacteria require energy to reproduce, carrying out extracellular digestion to get their nutrients to perform respiration to get ATP.

bacteria and viruses both reproduce by copying their genetic content so the new bacteria and viruses are identical to the parent. This is so they have all the information to carry out processes to survive. If the parents were successful in that environment the "offspring" are likely to survive as well unless the environment changes. The reproduction is also asexual.

Viruses need a host cell to reproduce, while bacteria do not. Bacteria can reproduce on a food source, where the energy needed to carry out reproduction is derived from extra-cellular digestion of their food source. Viruses need a living host cell to be able to reproduce and do not need any energy to reproduce, instead deriving it from the host cell.

Comparison of the difference where the energy comes from for reproduction between viruses and bacteria

- (c) Angela was prescribed antibiotics to help her get better. Some bacteria can become resistant to some antibiotics.

Explain how antibiotics work on bacteria and how bacteria can become resistant to antibiotics.

In your answer you should:

- explain how life processes of bacteria can be affected by antibiotics
- explain how bacteria can develop antibiotic resistance if Angela did not complete her 10-day course of antibiotics
- explain how this process might affect Angela's symptoms.

explains giving an example of how an anti biotic may work - in affecting the cell wall of the bacteria. (other ways were also accepted)

Antibiotic resistance explained

effects of taking antibiotics

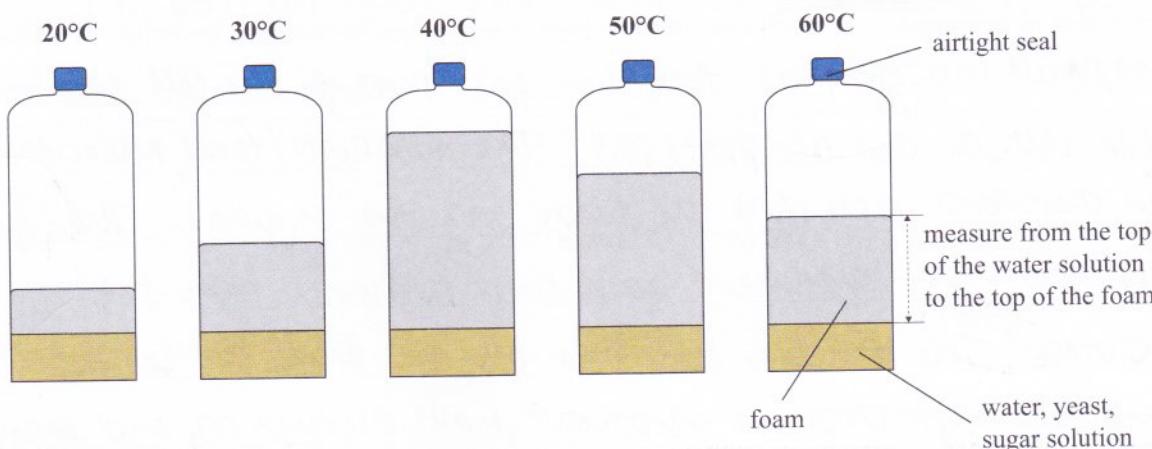
effects of not finishing the course of antibiotics.

Antibiotics stop the life processes of bacteria (Movement, Sensitivity, Respiration, Growth, Reproduction, Excretion, Nutrition) so that the bacteria can no longer survive. The antibiotics also sometimes target and affect the cell wall of the bacteria. This causes the bacteria to die. When Angela only completes part of her 10-day course, the bacteria have ~~to~~ all been exposed to the antibiotics, but not all have been killed off. Those ^{bacteria} that have been exposed to small doses of antibiotics, will most likely survive developing resistance to the antibiotics. (Not enough antibiotics to kill off the cell.) These anti-biotic resistant bacteria will ~~reproduce~~ reproduce by binary fission, where the daughter cells have identical genetic content to the parent cell. This means the daughter cells develop resistance to the anti-biotics and these cells reproduce until the entire colony has antibiotic resistance. Angela probably would've stopped taking the anti-biotics early because she felt better and thought all the bacteria were gone. When the anti-biotic resistant bacteria reproduce and multiply in numbers, she will regain her symptoms that she had originally as the bacteria ~~are~~ ^{make} her ill again. However, they are now resistant to anti-biotics and cannot be treated.

QUESTION TWO: THE SCIENCE OF MAKING BREAD

The following experiment was set up by a group of Year 11 students who wanted to investigate respiration in fungi (yeast) cells. When fungi (yeast) are mixed with sugar and water, foam forms, and may be measured to indicate the amount of carbon dioxide produced.

Year 11 Fungi Respiration Experiment



The type of yeast the students used was dried active yeast.

The instructions say to refrigerate the container after opening. There is an **airtight** seal on the top of the container under the lid that must be removed before use.

Discuss what the students can determine about respiration from their experiment.

In your answer you should:

- describe three conditions required for the growth of fungi (yeast)
- describe anaerobic respiration
- explain how fungi (yeast) gain their nutrients
- identify the optimal temperature for growing fungi (yeast) as shown in the experiment above, and explain how this can be applied to the production of bread and the storage of fungi (yeast)
- (yeast) **Conditions for fungal grow are described as: warmth, moisture (could have added nutrients)**
- discuss the importance of keeping the fungi (yeast) sealed and refrigerated once opened.



http://www.hellokiwi.co.nz/index.php?route=product/product&product_id=231

The three conditions ^{needed} ~~are~~ for fungi are nutrients, moisture and warmth (temperature). Anaerobic respiration, is respiration without the presence of oxygen. Respiration is the process by which energy is produced ^{into forms the cell can use} from the glucose in food. ~~less~~ In the absence of oxygen (anaerobic respiration), less energy is produced than aerobic respiration. Anaerobic respiration of yeast has glucose as a reactant and results in alcohol,

Describes anaerobic respiration (requires no oxygen) its reactant and products.

carbon dioxide and small amounts of energy as products.

sugar solution

~~glucose~~ → carbon dioxide + alcohol + some energy

Extra cellular digestion is explained. The break down of food molecules into molecules small enough to pass through the cell membrane.

The fungi (yeast) in the experiment gain their nutrients by performing extracellular digestion. The fungi ^{in general} secrete enzymes from their hyphae. The fungi ~~secret~~ enzymes break down the food into molecules small enough that they can pass through the cell membrane for use in cellular and life processes. The nutrients (food molecules) are then absorbed back into the fungi via the hyphae. The fungi (yeast) in the experiment gain their nutrients from the

^(food)
sugar solution! The ~~the~~ sugar contains glucose that can be used in anaerobic respiration to ~~make~~ make alcohol, CO_2 , and energy.

The optimal temperature for the respiration of yeast is 40°C . This can be seen by the large volume of foam produced, which indicates that at 40°C the enzymes worked at the most efficient rate, meaning respiration worked at the fastest ~~at~~ rate. This tells us that for the production of bread, it should happen at 40°C as this is when the yeast works ^{at} their best optimum. This means that at 40°C the dough will rise the most and create the best bread and it will happen the fastest as the rate of respiration is at the optimum.

It also tells us that fungi (yeast) should be stored at low temperatures (refrigerated) because the 20°C experiment produced the least foam (CO_2) meaning respiration was slow. It is important that the yeast is kept in the refrigerator once opened, so that it reduces the chance of the yeast respiring (respiration is slow at cold temperatures because it is far from the enzyme's optimum temperature). If the yeast respires in the container before being used, when used in bread, it will not rise as after being active in the container, the yeast may have died. It is also important to keep the yeast refrigerated sealed as it stops the yeast from being contaminated. If the yeast is exposed to air that

may

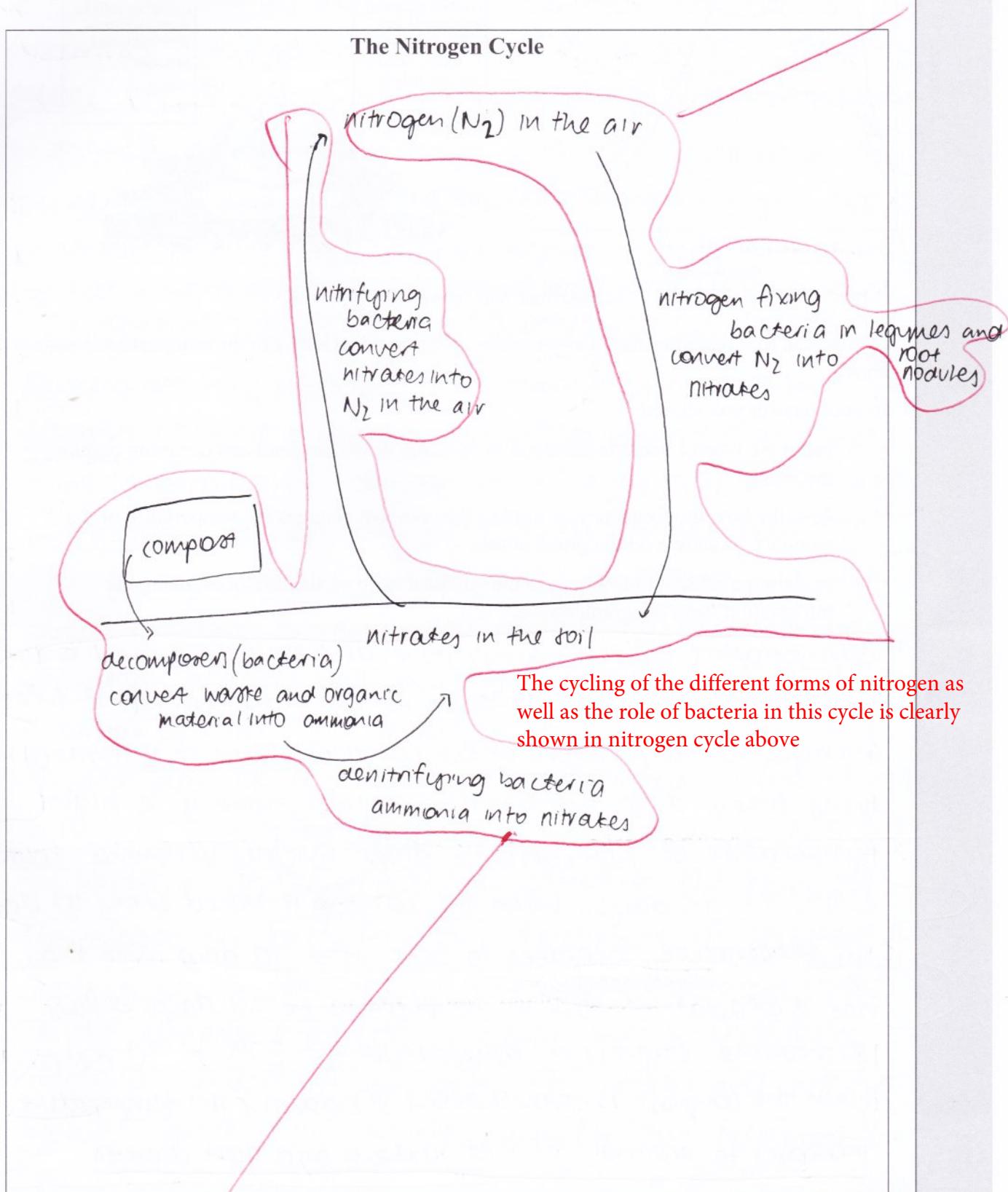
→ extra

QUESTION THREE: A PILE OF COMPOST

Compost is decayed organic matter. Composting is the process carried out by bacteria, turning organic matter such as vegetable matter and manure into compost. A successful compost heap requires good air flow.

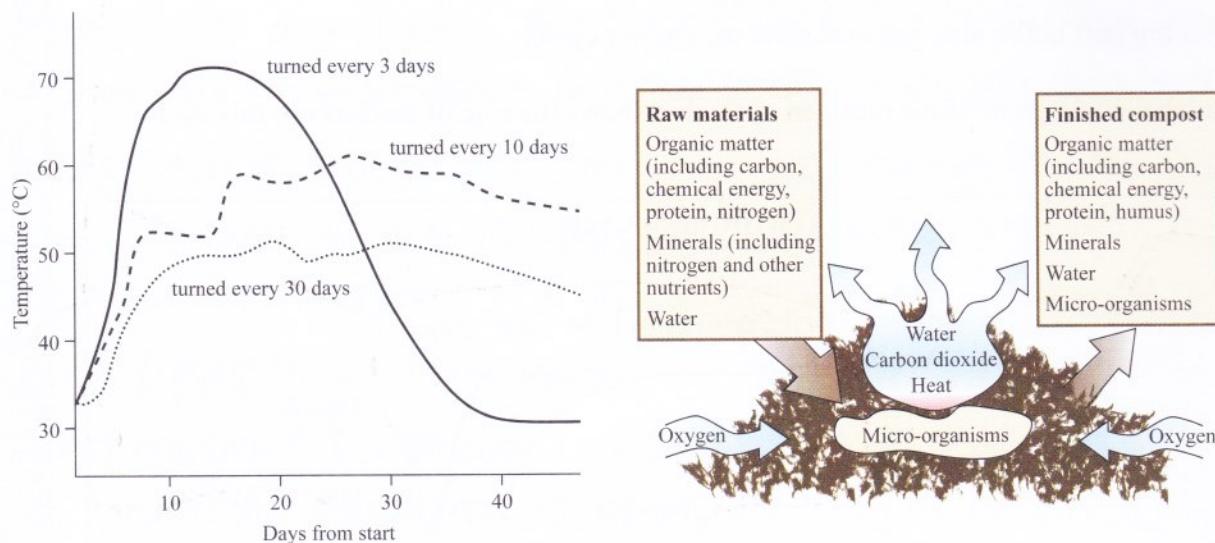
Bacteria play a big part in the nitrogen cycle and the carbon cycle.

- (a) Draw a labelled diagram of the nitrogen cycle that shows the role of **bacteria** in this cycle.



(b)

The Carbon Cycle: How the frequency of turning the compost affects its temperature over a period of 40 days

Adapted from: <http://goo.gl/sVfgZ>

Discuss the role that microbes play in releasing carbon dioxide from the compost heap shown above.

In your answer you should:

- name the type of bacteria involved in breaking down the dead and decaying organic material
- describe how the frequency of turning the compost changes the temperature of the compost, as shown on the graph above
- explain the effect of turning over the compost heap on the microbes, using the information from the graph above.

Correct vocabulary
described -
sprophytes/
decomposers.

Information in the graph is used to explain the changes in temperature over 40 days

Saprophytic bacteria break down decaying and dead organic matter/material. The frequency at which the compost is turned changes the temperature of the compost. When it is turned every three days between 10-20 days, there is a high temperature of 70°C, before it drops quickly becoming colder (30°C) at 40 days. When the compost is turned every 10 days the temperature increases to 50°C after 10 days and then has a steady increase (slightly wobbly) in temperature to 57°C at 40 days. When the compost is turned every 30 days, the temperature increases to around 47°C at 10 days and then almost

links the changes in temperature to aerobic respiration and availability of oxygen due to turning over of the compost.

Links temperature to enzyme activity

could have mentioned resources run out.

(c)

cycling of nitrogen and carbon analysed with respect to the nutrient cycles.

Stays constant (or a slight decrease). Enzymes are very sensitive to temperature. Turning over the compost introduces oxygen into the compost heap. Turning over the compost heap often (3 days) increased the activity of the microbes at the beginning. The microbes perform aerobic respiration using glucose + oxygen to form carbon dioxide + water + energy. The energy increases the temperature of the heap, the turning at 3 days shows the ~~fast~~ ^{high} rate of respiration as the temperature reaches 70°C. Respiration requires enzymes that if too hot, denature, the shape changing and no longer work. This is shown by the sudden decrease in gradient, after the temperature gets too hot (enzymes can no longer carry out respiration). The turning every 10 days had a reasonable ~~high~~ fast rate of respiration by the microbes, as the temperature rose to 60°C and the enzymes in the microbes did not denature. Analyse the importance of the bacteria in cycling carbon and nitrogen in the compost heap. ~~extra~~

Bacteria are very important in releasing/cycling carbon and nitrogen, otherwise it could be locked up in dead plants and animals. Bacteria in compost heaps ~~undergo~~ do aerobic respiration (glucose + oxygen → carbon dioxide + water + ATP). The glucose contains carbon that was locked up in the dead/decaying organic matter ($C_6H_{12}O_6$). Bacteria undergo respiration (aerobic) and convert ~~glucose~~ (with the help of oxygen) to carbon dioxide. The carbon in the CO_2 can now be released into the atmosphere to continue the cycling of carbon. (It could be taken in by plants doing photosynthesis). If not for the bacteria, the carbon would be locked up. Nitrogen also helps release N_2 back into the atmosphere to continue the cycling of N_2 . Bacteria (decomposers) break down ~~waste~~ raw materials in the compost heap into ammonia. Denitrifying bacteria convert the ammonia into nitrates and nitrifying bacteria convert the nitrates into N_2 gas, releasing it back into the atmosphere. When it is back in the atmosphere E8

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

QUESTION NUMBER

3c) It can be cycled again. Without the bacteria, the nitrogen is still fixed in the compost heap. Bacteria are important in compost heaps because they are needed to release the carbon and nitrogen back into the atmosphere to continue the cycle. Without the bacteria, a lot of the world's carbon and nitrogen could be locked up in dead, decaying organic material.

2) contain moisture or nutrients (or it could be exposed to moisture and nutrients), this will also activate the yeast to respire before it is meant to be used. When it runs out of moisture or nutrients, the yeast would die and also ~~be~~ not work when respire when used to then make bread. Once open, it is important to keep the yeast ~~sealed~~ sealed and refrigerated to stop the activation of the yeast so that when used to make bread, it will respire to produce alcohol, CO_2 , energy and the dough will rise.

3b) denature as the rate of respiration must have been sustained to sustain the temperature. Turning every 30 days probably did not ~~proto~~ introduce enough oxygen in the heap for the optimum level ~~for~~ for the microbes to perform respiration. A flatter gradient shows that ~~aerobic~~ respiration was not as efficient as there may not have been enough oxygen to perform aerobic respiration all the time. The temperature was below 50°C at all times during the experiment showing how there was not much respiration ^{by the microbes} as not much energy was produced.

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