National Certificate of Educational Achievement
TAUMATA MĀTAURANGA Ā-MOTU KUA TAEA

Exemplar for Internal Achievement Standard

Chemistry and Biology Level 1

This exemplar supports assessment against:

Achievement Standard 92020

Demonstrate understanding of the relationship between a microorganism and the environment

An annotated exemplar is a sample of student evidence, with a commentary, to explain key aspects of the standard. It assists teachers to make assessment judgements at the grade.

New Zealand Qualifications Authority

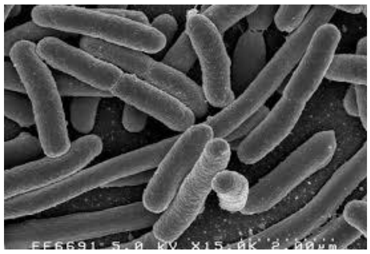
To support internal assessment

Grade: Achieved
For Achieved, the student needs to describe a life process of a microorganism, and an abiotic or biotic factor within an interconnected environment that affects the life process of the microorganism, using observations. This student has described reproduction and nutrition in *Escherichia coli* (only one life process needs to be described). The student has described a range of temperatures within the human host that affects the life process, using observations. This includes stating that there was slow growth at fridge and freezer temperatures, growth at 26 degrees Celsius and restricted growth at 40 degrees Celsius. For Merit, the student could link a change to an abiotic or biotic factor of the interconnected environment to the effect on the life process of the microorganism, using observations.

Microorganism

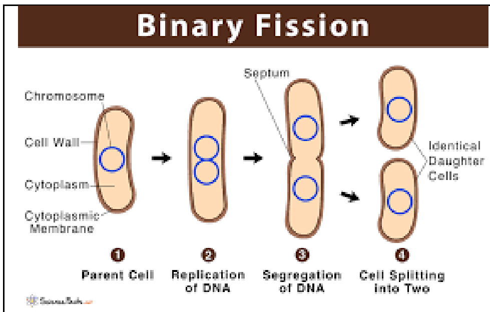
E.coli

The type of microbe that E.coli is, is a bacterium. E.coli are found in the intestines of people, animals and in our environment. It causes food poisoning. E.coli can be spread through contaminated food. Most warnings come from raw chicken and water or from infected animals or people.



MRS GREN-Reproduction

Binary Fission



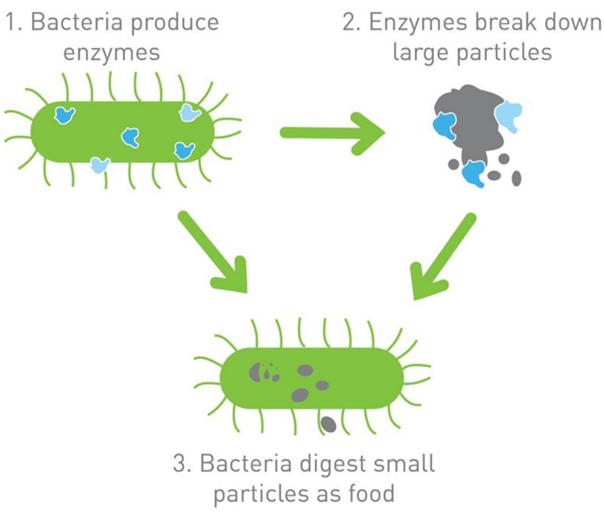
E.Coli reproduce by Binary Fission. This is asexual reproduction where E.Coli divides into two new bacteria cells. Each part carries one copy of the bacteria genetic material. A single E.Coli cell called the parent cell splits into two daughter cells. E. Coli can then become high in numbers really fast but this also means the daughter cells are identical clones of the parent.

Nutrition

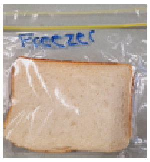
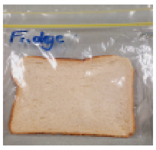
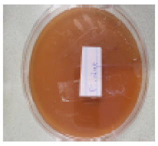
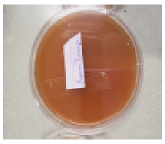
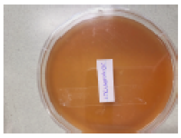
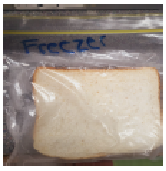
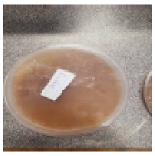
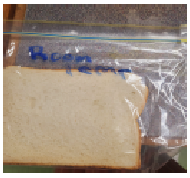
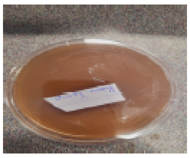
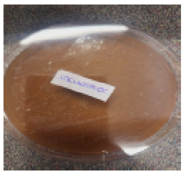
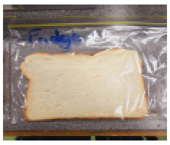
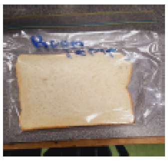
E. coli is able to use extracellular digestion to digest food by secreting enzymes from their cell walls. The enzymes break down the food into smaller pieces and then the bacteria absorb the nutrients.

Abiotic/Biotic factors

Temperature is an abiotic factor that affects E.coli in the human body.
This is a non-living factor. When we get sick we often get a fever which stops the E.Coli from reproducing more. Growth beyond 40 degrees C can be restrictive for E. Coli as it can no longer reproduce at this high temperature.



Experimental results:

	Freezer	Fridge	Room Temp	Incubator
Day 0	 	 	 	 
Day 2	 	 	 	 
Day 5	 	 	 	 

Day 6				
Day 7				
Day 8				

In our experiment we have put bacteria on agar plates and grew fungi on bread in zip lock bags placed in different environments. The temperature has affected the growth, as you can see the Fridge and freezer has a slow process because of how cold it is and has stopped spreading and reproduction, as for the room temp and incubator(26˚C) they grow much faster because they are more warmer because they reproduce more faster. Any higher than this and the growth would slow again as about 40 ˚C, reproduction and growth of E. Coli is restrictive. So in our body when we get a higher temperature close to 40, this would slow the reproduction of E. Coli. The Bacterai denatures and dies at these high temperatures.

Bibliography

Micro-organisms - Pass NCEA Biology

Pass NCEA Biology

https://www.passbiology.co.nz › biology-level-1 › micro...

Binary Fission | Cell Biology

YouTube · sci-ology

106.6K+ views · 4 years ago

Grade: Merit
For Merit, the student needs to link a change to an abiotic or biotic factor of the interconnected environment to the effect on the life process of the microorganism, using observations. This student has described movement in *Phytophthora agathidicida* and has described a range of soil moisture levels that affects the life process, using observations. The student has linked a change in water availability in the ngahere to the effect on the movement of *P.agathidicida*, using secondary data. This includes linking the relative moisture levels of the soil to the ability of the zoospores to move towards the kauri roots. For Excellence, the student could examine how the life process of the microorganism affects an abiotic or biotic factor of the interconnected environment, using observations.

Merit

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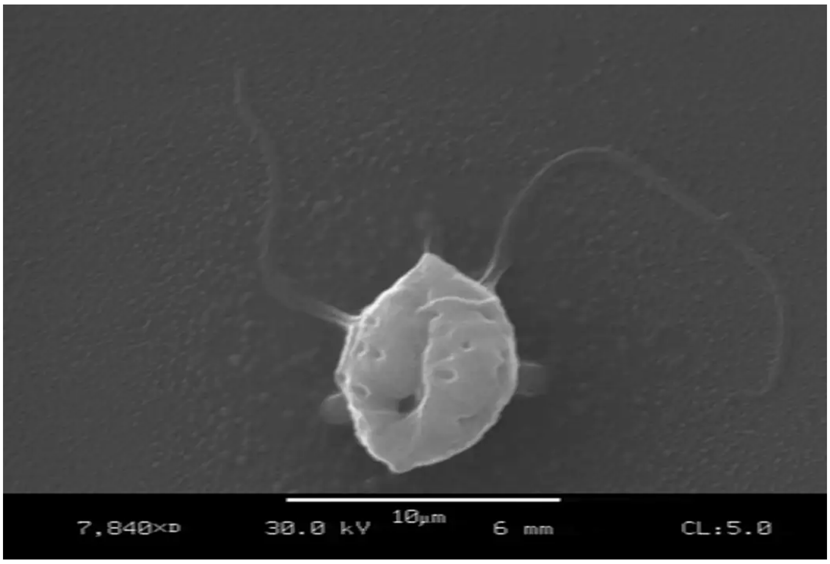
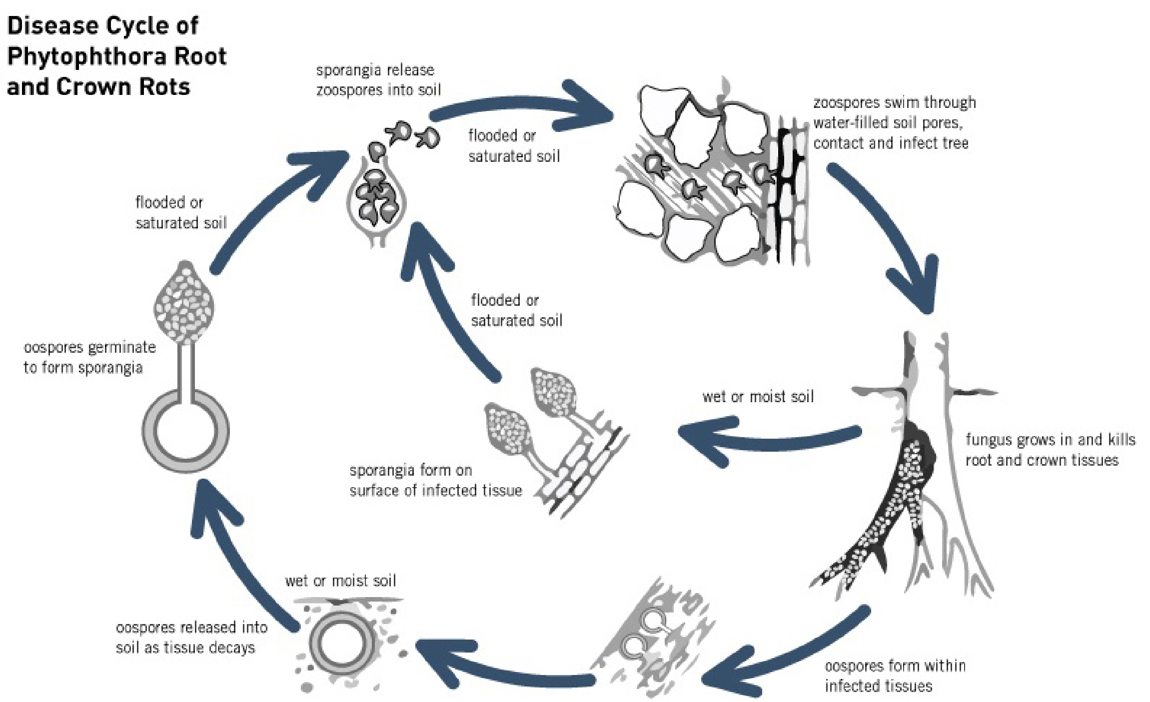
Kauri Dieback Report

Kauri Dieback is a fungus-type pathogen that damages the Kauri trees' root system. Its scientific name is Phytophthora Taxon Agathis (PTA). The disease reduces the trees' ability to take water and nutrients from the soil. There is no known cure for PTA, and no infected trees have lived. The disease has infected trees in Northland, Great Barrier, and the Coromandel Peninsula. PTA is a water mould, a particular type of fungus called an oomycete. Kauri trees are crucial for New Zealand's ecosystem because they protect the plant and animal life below. This report will compare and contrast how soil moisture levels affect the movement of PTA and how it spreads.

Phytophthora Taxon Agathis moves through the soil using tiny tail-like structures called flagella. Oospores are spores that are 'dormant' resting in the soil. Oospores get spread by humans or animals, such as pigs or dogs, who move and disturb the soil. Oospores eventually germinate to become sporangia (the reproductive organ of the disease), a structure that produces zoospores. Zoospores released during or after rain travel via the moisture in the soil. They move using their flagella to propel through the water and find Kauri roots to attach to.



Zoospores germinate to produce mycelia, the branded tubular structure that infects the Kauri roots. The mycelia spread throughout the tree's root system to inundate the tissues at the base of the Kauri trunk. After some time, the infected tree will no longer be able to carry nutrients and water to the tree canopy. Once a tree is infected, it becomes a breeding ground for PTA. More sporangia form in the infected areas of the tree's roots, releasing dozens of zoospores each time it rains. Oospores also form in infected tissue and get released into the soil. This cycle repeats, infecting more and more trees each time.



The most fluctuating abiotic factor in the spread of PTA is moisture levels in the soil. Phytophthora reproduces two ways, creating two different types of spores. Zoospores are a water-borne spore that perishes quickly without water and dies in seawater. If the moisture levels are correct, they can travel 0.7m an hour, the fastest way PTA spreads. Oospores are tough and live in the soil. They can survive in dried soil on boots and equipment for eight years.

The Kauri Protection Programme states “Zoospores are released during and immediately after rain.” This is because it is easier for them to move. The more moisture and liquid in the soil, the easier the zoospores can swim and find other Kauri roots. If there is little moisture in the soil, it restricts the oomycete's movement and can't infect other trees. We commenced an experiment using small pieces of bread dampened with different amounts of water to show how moisture levels affect the spread of fungi. We put the bread in an airtight bag for 72 hours.

Water Drops	Fungal Growth Coverage %
0	0
2	10
4	17
6	25
8	40
10	45

As we theorised, the pieces of bread grew mould, a fungus commonly found in everyday life. According to the table above the bread with more water was covered in a higher percentage of mould after 72 hours. This is compared to the bread with no or little water. This experiment helps to show us that with more water the mold can spread easier. Fungi's complete extracellular digestion, meaning they absorb nutrients through small molecules in their cell membranes. Digestive enzymes are secreted into the food source to break down the food enough to be absorbed. The Scipad states, "The enzymes released from the hypha tip require a wet environment for release and subsequent digestive activity." This means that fungi cannot complete nutrition without moisture. Therefore, water does not only help with movement and reproduction but nutrition as well.

Phytophthora movement affects the species surrounding biodiversity by destroying a core part of their environment. Scientifically, the Kauri tree provides a better soil environment for younger or smaller flora and fauna. Its root systems help support the steep hillsides of Aotearoa, and its thick canopy blocks harsh sunlight, rain and wind gusts, allowing the native plants below the canopy to grow. Animals, like native birds, also strive in this environment. So what makes a disease like PTA so concerning? If Kauri trees become extinct because of it, the repercussions could be detrimental to New Zealand wildlife.



The images above show two Kauri trees. The photos on the left depict a Kauri tree displaying symptoms of PTA. Some common symptoms are yellowing leaves, dead or dying branches, bleeding gum, and a thinning canopy. Advanced cases of PTA exhibit a dead tree with bare remains of a trunk and large branches. The image on the right presents a healthy Kauri tree full of thick and green foliage, protecting the environment below. Without the Kauri tree's dense canopy blocking out the sunlight and holding in moisture, the soil will harden and temperatures will rise creating a knock-on effect that will destroy the biodiversity. The above photos show us how a dead Kauri tree creates a hole in the protective layer of New Zealand forests.

To conclude, Phytophthora Taxon Agathis is devastating for Kauri, and high moisture levels help it move, reproduce and digest. This needs a serious solution fast before the knock-on effect destroys New Zealand's biodiversity.

Grade: Excellence
For Excellence, the student needs to examine how the life process of the microorganism affects an abiotic or biotic factor of the interconnected environment, using observations. This student has described respiration in yeast and has described a range of temperatures that affects the life process, using observations. The student has linked a change in temperature to the effect on respiration in yeast, using observations. The student has examined how respiration affects the pH of the interconnected environment, using observations. This includes examining how anaerobic respiration produces lactic acid which lowers the pH of the interconnected environment.

Excellence
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Yeast is a type of fungi, which is a type of microorganism. Yeasts can respire in two different ways, aerobically and anaerobically. Aerobic respiration in yeasts means they use oxygen to respire. The equation for this process is glucose + oxygen → carbon dioxide + water + lots of ATP. Anaerobic respiration in yeasts means they can respire without the need of oxygen. The equation for this process is glucose → ethanol + carbon dioxide + little ATP. Respiration plays in important part in making sourdough bread, this is to make the bread rise and produce its unique taste.

Temperature of Water Bath (°C)	Height dough has risen after 1 hour (mm)
15	0mm
35	23mm
80	2mm

Changing the temperature affects the rate of respiration because in our practical we found that putting our starter culture in 15°c, the yeast respired the slowest because the starter culture rose 0mm. We also found this in another practical we did, where we tested for the relationship between temperature and fungal respiration: where we found that a yeast and sugar solution in cold water didn’t respire as fast as it did in warmer water. We found this out from the amount of froth that occurred in the tubes as there wasn’t as much froth in the test tube in the cold water, and there was more froth in the warm water, meaning that the yeast respired the fastest in the warmer water. We also found that the yeast respired slow in 80°c as our starter culture only rose 2mm. We did something similar when we made yoghurt because we firstly heated the milk up to 85°c to kill the bacteria so they couldn't respire. However, when we put our starter culture in 35°c, we found that it rose 23mm, which means that the yeast respired the fastest. We did a similar thing when we made yoghurt because after we heated up the milk then added the lactobacillus, we put the yoghurt in a water bath at around 40°c, this meant the bacteria in the yoghurt respire faster and fermentation could happen.

The yeast respired the slowest at 15°c because the enzymes were not in their optimum temperature meaning the enzymatic reactions in the yeast were slow. This means the enzymes move at a slower rate and they don’t collide very often, all resulting in a slow respiration rate. The yeast respired the fastest at 35°c because at this warmer temperature, which is also the enzymes optimum temperature, glucose and enzymes have more energy and the enzymes reactions in the yeast move at a faster rate and they collide more frequently. Which results in an increased rate of respiration. The yeast also respired slow at 80°c, this occurred because at this high temperature the yeast denature the enzymes that are needed for respiration. When enzymes denature, the bonds holding the enzyme together are ruined, resulting in a loss of structure and they cannot function again. This is why the yeast did not respire much at 80°c. We also found something similar when we researched about making beer. One of the last steps to making beer is heating the liquid to a high temperature of around 80°c for a period of time, and this is to kill/denature microorganisms that could cause spoilage in the beer. This is a good explanation to why the rate of respiration was slow when we made sour dough bread starter.

Oxygen levels in the starter culture change over time, we can see this in resource one as it shows us over 12 days the oxygen levels in the starter culture decrease. On day 0 the oxygen levels were high at around 220ppm.
Then on day 2 it starts to decrease as the oxygen levels were around 130ppm. Then jumping to day 6 the oxygen levels were measured at approximately 48ppm. From day 9 – 12 the oxygen levels were about 0-1ppm. This is showing us how only 2 microorganisms tend to take over in the 12 days; yeast and lactobacillus because they can survive the environment.

Type of Bread	General Observations e.g. texture	Taste
Sourdough	**Denser texture seedy**	**Sour after taste Tangy**
Common Bakery Bread	**Fluffy Air bubbles Light**	**Mild Slightly sweet and salty**

Respiration in yeast causes oxygen levels in the starter culture to decrease over time as we saw in the graph. The reason for this is that aerobic respiration in yeast means that the yeast needs oxygen to respire. This respiration will decrease the oxygen levels because the oxygen is used to help turn glucose into carbon dioxide, water and energy, to make bread. While this is happening, yeast and lactobacillus come from the surroundings like the flour or the oxygen/air and settle in the sourdough starter because they are the only microorganisms that can take on the environment in the sourdough. Once all of the oxygen available is used up by aerobic respiration, the yeast and lactobacillus bacteria in the starter culture respire using anaerobic respiration which is also known as fermentation. This is why we see the graph decreasing. During anaerobic respiration (fermentation) in the lactobacillus bacteria, it uses glucose in the starter and produces lactic acid along with a little bit of energy. Anaerobic respiration in yeast is a process where glucose is turned into ethanol, carbon dioxide and a little bit of energy. When we tasted the sourdough bread, we could taste that it was very sour and had a bit of a tang to it while also being a little bit dense. The reason for the unique sourness and density we observed is because the lactic acid that was produced in the fermentation process lowers the pH of the starter. The yeast in the starter culture also plays a big part in the making of the sourdough bread because when the carbon dioxide is produced during respiration in yeast, it means that the sourdough bread can rise and give it an airier texture. When we tasted bakery bread, we noticed that the texture was a bit lighter and fluffier than the sourdough bread, the reason for this is because there is more oxygen in bakers bread as there is no starter culture meaning no fermentation time and the bread is baked almost straight away leaving not much time for respiration. We found something similar in another practical when we made yoghurt. The lactobacillus bacteria that we add, respires anaerobically. Which means it breaks down the lactose (which is a form of sugar present almost exclusively in milk) and turns it into lactic acid and a little bit of ATP (energy). The lactic acid produced is what gives yoghurt a sour taste. So, yoghurt and sourdough bread are similar because they both taste sour, and the sourness from both, is due to the lactic acid being produced when lactobacillus bacteria is respiring anaerobically.