Assessment Schedule – 2023

Biology: Demonstrate understanding of biological ideas relating to micro-organisms (90927)

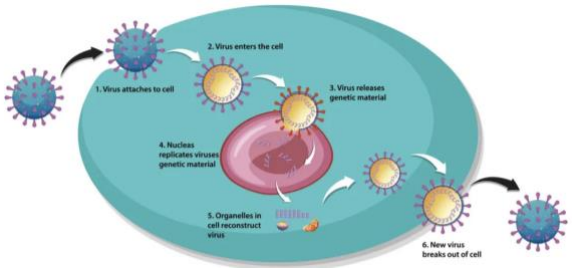
Assessment Criteria

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate ***understanding*** involves: • defining, using annotated diagrams, and giving characteristics of, or an account of, micro-organisms.	*Demonstrate* ***in-depth understanding*** involves: • explaining the biological ideas relating to micro-organisms.	*Demonstrate* ***comprehensive understanding*** involves: • linking biological ideas relating to micro-organisms; may involve explaining, elaborating, applying, justifying, relating, evaluating, comparing and contrasting, or analysing.

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 7	8 – 13	14 – 18	19 – 24

Question One

Achievement	Achievement with Merit	Achievement with Excellence
Identifies: *A pathogen* is a microbe that can cause disease. **Describes:** *How a virus reproduces*, including at least THREE of: attachment to cell, injects genetic material into cell, takes over cell functioning (including genetic material copied), protein coats produced, viruses assemble, viruses released from cell. AND / OR uses a labelled diagram. For example:  Sourced: https://www.dreamstime.com/viral-replication-infographic-education-illustration-image193604419 *Why a virus is unable to survive without a host* may include: • Viruses are non-living / don't feed by extracellular digestion. • A virus must have a living cell to survive and reproduce / viruses need a host cell for reproduction. • It can take over the cell to produce copies of itself. It is inactive outside of a living host cell. *Advantages* may include: • Viruses are very host-specific. • An insect virus is likely not effective / able to infect another type of organism. • Viruses can reproduce quickly. • Viruses can kill their hosts.	**Explains:** *How a virus reproduces* may include: • The virus attaches to host cells via the protein coat so it can inject viral genetic material through the cell membrane and into the cytoplasm. • Viral genetic material is replicated using host cellular machinery, meaning new protein coats can be made and assembled with the new (viral) genetic information. *Why a virus is unable to survive without a host* may include: • Viruses are non-living microbes in that they do not need to feed, but instead utilise the energy inside living cells to reproduce. • Viruses must have a living cell to survive because they can't reproduce without a living host. Viruses reproduce by entering another living cell and making copies of themselves inside the host cell, using the 'machinery' of the host cell. This is their only means of reproduction and, therefore, survival. • Viruses are often thought to be non-living because they cannot reproduce by themselves, and do not grow, feed, respire, or excrete waste; therefore cannot survive for long in the environment without a host. *Advantages* may include: • Viruses are very specific to their host, which means that a caterpillar virus is likely safe for humans to handle. • Viruses reproduce quickly in a living cell, making hundreds of viruses inside each caterpillar cell before it dies, and this kills the host more quickly. • Because viruses destroy the host cell during reproduction (by bursting / lysing the host cell), they are pathogenic. This means they cause disease to the host, therefore protecting the crops. *Disadvantages* may include: • Because most viruses take several days to kill their host, there is likely time for some damage to crops before the host dies. • A particular load or threshold of virus particles must be reached before the caterpillar dies, meaning very high doses may be needed for pest control to be effective.	Uses biological characteristics to **discuss** advantages and disadvantages of virus use, and why it is not a safety issue in the environment. *Advantages and disadvantages* may include: • Because viruses destroy the host cell during reproduction (by bursting / lysing the host cell), they are pathogenic. This means that they cause disease to the host – in this case, the caterpillar. If the caterpillars are diseased, they are less likely to eat and damage the apple crops, and ultimately, they will die. While using a virus is a very effective way to control the pests, disadvantages should also be considered. These include the time taken for a virus to infect and, therefore, affect the host. The time taken for the virus to enter the host cell, use the machinery and burst the cell means that there is a delay from application of the virus to pest death. In the meantime, the pest can continue to eat / damage the crop. *Why having virus particles … is not a problem* may include: • Most viruses are very specific to their host. A particular virus will infect a particular host. This means that if a virus is used to infect the caterpillar that is eating the apples, it is likely that it will not infect other caterpillars, insects, or other organisms / animals, including humans. • Because a virus requires a host to reproduce, if there are viruses in the soil / on plant leaves (e.g., due to top overspray when applying the virus), they will not be able to replicate, and will essentially lie dormant until they are inactivated by sunlight / high

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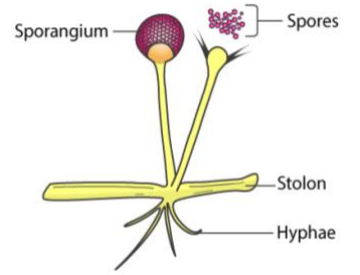
Disadvantages may include: • It takes time for a virus to kill the host so is not an immediate kill / solution. • Viruses may be effective against only one life stage of the pest insect (e.g. the larval stage). • Viruses can be killed / inactivated by sunlight or high temperatures. *Other accurate descriptions will also be accepted.*	*Why having these virus particles in the soil and wider environment is not a problem* may include: • Most viruses are very specific to / can only infect their host. This means that if a virus is used to infect the caterpillar that is eating the apples, it is likely that it will not infect other caterpillars, insects, other organisms / animals, or humans. • In the environment, sunlight or high temperatures can kill / inactivate viruses, therefore can only survive for a short time without a host. *Other accurate explanations will also be accepted.*	temperatures, or successfully infect the insect host. *Other accurate discussions will also be accepted (making multiple links between ideas).*

N1	N2	A3	A4	M5	M6	E7	E8
Limited / partial attempt to define ONE biological characteristic of a virus.	**Defines** TWO biological characteristics **OR** identifies advantages or disadvantages *But not enough evidence for Achievement.*	**Briefly describes** at least TWO biological characteristics **AND** describes ONE of: • advantages • disadvantages • the safety of the virus in the environment.	**Describes** at least THREE biological characteristics **AND** describes TWO of: • advantages • disadvantages • the safety of the virus in the environment.	**Explains** TWO of: • a range of biological ideas related to a virus • advantages • disadvantages • the safety of the virus in the environment.	**Explains** THREE of: • a range of biological ideas related to a virus • advantages • disadvantages • the safety of the virus in the environment.	**Discusses** the biological ideas by: • elaborating on advantages and disadvantages **OR** • evaluating / justifying the safety of the virus in the environment.	**Discusses** the biological ideas by: • elaborating on advantages and disadvantages **AND** • evaluating / justifying the safety of the virus in the environment.

N0 = No response; no relevant evidence.

Question Two

Achievement	Achievement with Merit	Achievement with Excellence
Describes: *The structure of a fungus* including at least THREE of: mycelium, hyphae, spores, sporangium, AND / OR uses a labelled diagram to describe. For example:  Sourced: https://byjus.com/biology/kingdom-fungi/ **Describes**: *Life processes (e.g., feeding, respiration, growth, reproduction)* may include: • Fungal hyphae grow through the plant tissues by cell division. • Fungi feed by extracellular digestion. • Fungi reproduce / are spread by producing sporangia / spores. • Fungi respire to make energy. • Fungi require food, warmth, moisture, and oxygen to grow. *Environmental factor(s) affecting the process* may include: • Water allows chemical reactions to happen (e.g. extracellular digestion). • Appropriate temperature / warmth is needed to enable reactions to occur at a rate that sustains life. • Oxygen availability effects respiration type. • A food source required to enable nutrition / respiration. *Other accurate descriptions will also be accepted.*	**Explains**: *Life processes (e.g., feeding, respiration, growth, reproduction)* may include: • Fungi feed by the process of extracellular digestion, as in, they secrete digestive enzymes from their hyphae into the plant cells / surrounding substrate. • Fungi grow through a process of cell division, which allows the hyphae to extend in length. Growth like this is required so that the fungi can move into new food sources when the old ones are used up. • Fungi reproduce by spores. Spores are required because the fungi need to be dispersed away by wind / air from the parent hyphae to source new substrates. Once on a new substrate / plant, they will grow into a new fungal organism using the new food source. *Environmental factors affecting the packaging* may include: • water availability needs to be controlled at the optimal level to increase the rate of extracellular digestion. If the water availability is too high / too low then extracellular digestion will slow down. • temperature needs to be controlled at the optimal level to increase the rate of life processes. If the temperature is too high / low then life processes will slow down. • oxygen availability needs to be controlled at the optimal level to increase the rate of respiration. If the oxygen is too low then the fungi will do anaerobic respiration. This does not make enough energy for growth and can create toxic compounds. • Fungi require enough food / plant material so that they can gain nutrition through extracellular digestion to grow. *How the packaging is created* may include: • Mycelium / fungal body fills the space in the mould as they grow and break down the plant material to make the packaging. *Other accurate explanations will also be accepted.*	**Discusses**: *How the packaging is created, based on the life processes of fungi and environmental factors* may include: • Fungi feed by the process of extracellular digestion. In the process of creating the packaging, the fungi can feed on the plant cells provided. To feed by the process of extracellular digestion, fungi secrete digestive enzymes from their hyphae into the plant cells / surrounding substrate. The enzymes are required because the food / substrate needs to be broken down / digested into smaller, soluble pieces so that it can be reabsorbed through the hyphae wall. This process occurs more rapidly when there is sufficient water present. This is because water is required to allow the enzymes that are released into the food to function properly, allowing the food to be broken down and reabsorbed. This means that the packaging container / environment must provide a source of water. This could be achieved by increasing the humidity within the room, or directly watering the container. • Part of the process of creating the packaging is to provide the fungi with plant material. This is a good source of food and water for the fungi, allowing it to grow successfully and, therefore, create the packaging. • Fungi grow through a process of cell division, which allows the hyphae to extend in length. This is how fungi are able to move into new food sources. Warm temperatures will also result in rapid growth of fungi. This is because the rate of growth is controlled by enzymes which work more quickly in warmer temperatures. However, in cooler temperatures, cell division will occur more slowly, and thus the rate of growth will also be reduced. Therefore, it is important that the mushroom packaging is kept in a warm temperature environment during the growth / production phase, and then stored in a cool area once it is complete. *Other accurate discussions will also be accepted (making multiple links between ideas).*

N1	N2	A3	A4	M5	M6	E7	E8
Limited / partial attempt to define ONE biological characteristic of a fungus.	**Defines** TWO biological characteristics of a fungus, or relevant environmental factors. *But not enough evidence for Achievement.*	**Briefly describes** biological characteristics **AND** briefly describes: • life processes (TWO) **AND** • environmental factors (TWO).	**Describes** biological characteristics **AND** describes: • life processes (TWO) **AND** • environmental factors (TWO).	**Explains** at least ONE of**:** • biological ideas related to fungi • environmental factors influencing the fungus • how the packaging is created.	**Explains** at least TWO of: • biological ideas related to fungi • environmental factors influencing the fungus • how the packaging is created.	**Discusses** how the packaging is created, making links between ONE life process and ONE environmental factor.	**Discusses** how the packaging is created, making multiple links between TWO life processes and TWO environmental factors.

N0 = No response; no relevant evidence.

Question Three

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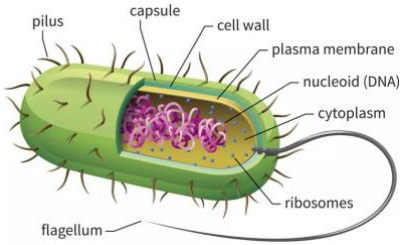
Identifies: *The structure of bacteria*, including at least THREE of: cell wall, cytoplasm, genetic material / DNA / RNA, or plasmid. AND / OR uses a labelled diagram to describe. For example:  Sourced: https://www.thoughtco.com/prokaryotes-meaning-373369 **Describes:** *Life processes* which includes: • Bacteria grow and reproduce by binary fission / asexual reproduction – a process where a single bacterial cell divides into two identical 'daughter' cells. *Note: must provide a description of binary fission, i.e., more than simply using the term.* • Bacteria make energy through respiration. *Antibiotics and how they affect bacteria* may include: • Antibiotics kill bacteria (are bactericidal). • Antibiotics prevent bacteria from building their cell walls. • Antibiotics disrupt the cell membrane of bacteria. • Antibiotics disrupt cell processes of bacteria. *Antibiotic resistance* may include: • When bacteria develop the ability to stop antibiotics from affecting them. • Antibiotic resistance stops an antibiotic from working effectively against bacteria.	**Explains:** *How life processes of bacteria can be affected by antibiotics* may include: • They either prevent the bacterial cells from reproducing so the bacterial population remains the same, allowing the host's defence mechanism to fight the infection; or they kill the bacteria by, for example, stopping the mechanism responsible for building their cell walls. • They interfere with the bacterium's ability to repair its damaged DNA / making what it needs to grow, which limits its ability to grow and reproduce. • Antibiotics can stop the growth, nutrition, and reproduction of bacteria by interfering with the structure / function of the bacterial cell wall. *Explains antibiotic resistance and how resistance can develop* may include: • Because bacteria reproduce so quickly, there are plenty of opportunities for mistakes / mutations to get made in the genetic replication process and for resistant variants to arise. • Resistant variants with favourable mutations are able to grow successfully in the presence of the antibiotic, replacing the bacteria that can't. • When an antibiotic is used, resistant bacteria have a greater chance of survival than those that are susceptible. Susceptible bacteria are killed or inhibited by an antibiotic, resulting in a selective pressure for the survival of resistant strains of bacteria, which then reproduce by binary fission. • Bacteria can share their resistance between one another via plasmids / another named example. This means that they don't need to be in the presence of the antibiotic – they just need to interact with a resistant microbe This can happen between unrelated bacteria.	**Discusses:** *How life processes of bacteria can be affected by antibiotics* AND *How antibiotic resistance can develop* may include: Bacteria reproduce so quickly, there are plenty of opportunities for favourable mutations to occur. This naturally occurring genetic variation in any bacterial population. For example, as members of a bacterial population are genetically different from each other, some of them are possibly able to survive the antibiotics since some of the population may be naturally more resistant. So, when a person takes antibiotics, some bacteria may survive due to this natural resistance. These bacteria are then able to grow and reproduce, resulting in a population made up entirely of resistant bacteria. Resistant variants can arise wherever bacteria encounter antibiotics – in human and veterinary medicine, in agriculture, in sewage systems, and out in the wider environment. These resistant bacteria can share their genetic information (including antibiotic resistance) through methods such as plasmids; therefore bacteria can be resistant to an antibiotic they have never encountered. *How antibiotic resistance in bacteria can be reduced* may include: • Antibiotic-resistant bacteria can spread between people or between animals. Antibiotic resistance is therefore one of the biggest threats to global health, food security, and the environment today. It can impact anyone, of any age, in any country. Over-exposure / using antibiotics when they are not needed (e.g. topical infections) or appropriate (e.g. for viral / fungal infections) drives bacteria to become more resistant, as they have more opportunities to be exposed to selection pressures and become resistant. Ensuring antibiotics are taken for the full course reduces the likelihood of resistant bacteria developing as the more

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How antibiotic resistance can develop may include: • Mistakes in DNA / mutations during replication can make resistant variants. • Bacteria can share genetic information, which could include resistant genes. • Natural selection / selection pressures favour bacteria with resistance to survive and reproduce. *Actions that can reduce antibacterial resistance* may include: • Use antibiotics only when necessary / prescribed by a doctor / health specialist, and use full course. • Don't use left-over / out of date / share antibiotics. • Use other techniques to control skin infections where possible (e.g. wash and keep covered with a plaster / bandage, rather than using topical antibiotic cream). • Make sure there is appropriate use of antibiotics in agriculture / farming. *Other accurate descriptions will also be accepted.*	*Explains how certain actions can reduce antibacterial resistance*: • Use for targeted bacterial infections only (i.e. do not share) as the more antibiotics are used, the more opportunities bacteria will have to adapt and become resistant. • Use for the full course as the more resistant bacteria will survive longer during the course. If stopped early, they are still present and can then reproduce. • Don't use left-over / out-of-date antibiotics as the chemical composition of the drug may have changed, likely decreasing its efficacy. • Use other techniques to control infections, where possible, (e.g. wash and keep covered with a plaster / bandage rather than using topical antibiotic cream) as the more antibiotics are used, more opportunities bacteria will have to adapt and become resistant. *Other accurate explanations will also be accepted.*	resistant bacteria will survive for longer during the course. If stopped early, these resistant bacteria are still present and can then reproduce increasing the population of resistant bacteria. Similarly, left-over / out-of-date antibiotics will have decreased efficacy due to the chemical composition of the drug having changed. The more resistant bacteria will be less effected by the reduced action of the antibiotic so would still be present and can then reproduce increasing the population of resistant bacteria. *Other accurate discussions will also be accepted (making multiple links between ideas).*

N1	N2	A3	A4	M5	M6	E7	E8
Limited / partial attempt to define ONE of: • biological characteristics of bacteria • antibiotics • antibiotic resistance • how to reduce resistance.	**Defines TWO** of: • biological characteristics of bacteria • antibiotics • antibiotic resistance • how to reduce resistance.	**Briefly describes** biological characteristics **AND** describes TWO of: • antibiotics • antibiotic resistance • how to reduce resistance.	**Describes** biological characteristics **AND** describes THREE of: • life processes • antibiotics • antibiotic resistance • how to reduce resistance.	**Explains** TWO of: • how life processes of bacteria may be affected by antibiotics • how antibiotic resistance can develop • how antibiotic resistance may be reduced.	**Explains** THREE of: • how life processes of bacteria may be affected by antibiotics • how antibiotic resistance can develop • how antibiotic resistance may be reduced.	**Discusses** with links: • how life processes of bacteria may be affected by antibiotics **AND** • at least ONE biological idea about how antibiotic resistance can develop **OR** • how antibiotic resistance can be reduced.	**Discusses** with links**:** • how life processes of bacteria may be affected by antibiotics **AND** • at least TWO biological ideas about how antibiotic resistance can develop **AND** • how antibiotic resistance can be reduced.

N0 = No response; no relevant evidence.