S.5 SAMPLE BIOLOGY ITEMS

ITEM 1

In **Wakiso District**, vegetable farmers using water from a nearby wetland began noticing poor crop performance. Plants showed **yellowing leaves, weak stems, and reduced growth rate**. Some farmers also experienced **skin irritation after frequent contact with the water**.

Further observations in the area showed that:

- Water from the wetland had visible surface films
- Crops grown on raised beds appeared healthier
- Areas with improved drainage showed better plant recovery
- Farmers who used protective gloves reported fewer skin problems
- Soil from affected areas felt sticky and poorly aerated

Table 1: Cellular and Molecular Indicators in Plants

Parameter	Healthy Plants	Affected Plants
Enzyme-controlled metabolic rate (%)	100	45
Cell membrane stability (%)	100	50
Water uptake efficiency (%)	100	60
Vacuole function (%)	100	55
Parenchyma tissue activity (%)	100	55

Task

(a) Analyse how changes in **enzyme activity, membrane stability, water movement, vacuole function, and tissue activity** contributed to poor plant growth and the observed human health effects.

(b) Propose appropriate measures that would restore crop productivity and reduce exposure risks.

RESPONSE

(a) *Reduced **enzyme activity** (100% to 45%) lowers catalytic efficiency of metabolic pathways; fewer enzyme–substrate complexes form due to altered active sites, reducing **ATP production** from respiration; low ATP limits active transport and biosynthesis, resulting in reduced growth and weak tissues.*

*Decreased **cell membrane stability** (100% to 50%) disrupts the **phospholipid bilayer** and membrane proteins; increased permeability leads to leakage of ions and metabolites; loss of selective transport reduces nutrient uptake and ion balance, impairing cellular function.*

*Reduced **water uptake efficiency** (100% to 60%) limits osmotic entry of water into cells; low turgor pressure reduces cell expansion; this leads to wilting, reduced elongation, and poor structural support in plants.*

*Impaired **vacuole function** (100% to 55%) reduces storage of water, ions, and wastes; decreased vacuolar pressure lowers **turgidity**, weakening cells and reducing mechanical support of tissues.*

*Reduced **parenchyma tissue activity** (100% to 55%) lowers metabolic functions such as storage and photosynthesis; fewer functional cells reduce overall productivity and growth of plant tissues.*

*In humans, exposure to contaminated water disrupts **epithelial cell membranes** and enzymes, irritation results from membrane damage and inflammatory responses due to entry of harmful substances.*

(b) Strategies

***Wastewater treatment** ensures removal of toxic substances; prevents enzyme inhibition and membrane damage; restores normal cellular metabolism in plants.*

***Improved drainage systems** reduce water stagnation; increase soil aeration and oxygen availability; supports respiration and ATP production in root cells.*

***Use of protective gear** prevents direct contact with harmful substances; protects epithelial tissues from membrane disruption and irritation.*

Application of organic matter *improves soil structure; enhances water retention and aeration; supports enzyme activity and root function.*
Relocation of farming activities *reduces exposure to pollutants; allows normal cellular processes to resume in crops.*
Environmental regulation enforcement *limits pollutant discharge maintains ecosystem stability and supports long-term plant productivity.*

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https://www.youtube.com/@bioclasshub-h3b?sub_confirmation=1

ITEM 2
In **Mbale District**, a secondary school introduced practical lessons involving biological samples. However, students reported difficulty obtaining clear observations during laboratory work. At the same time, a nearby clinic recorded increasing cases of infections that were not responding well to treatment. Additional findings included:

- Some learners skipped proper slide preparation steps
- Samples left exposed for long periods showed visible changes
- Certain treatments worked in some patients but failed in others
- Laboratory equipment was sometimes shared without cleaning
- Properly handled samples gave more reliable results

Table 2: Cellular and Microbial Functional Indicators

Parameter	Normal Condition	Observed Condition
Bacterial reproduction rate (%)	100	150
Enzyme activity in cells (%)	100	70
Membrane permeability (%)	100	130
Cell structural organisation (%)	100	60
Efficiency of stain uptake (%)	100	50

Task
(a) Evaluate how variations in **cell structure, enzyme function, membrane properties, and microbial activity** influenced the laboratory observations and infection patterns.
(b) Suggest practical ways of improving laboratory outcomes and managing the infection challenges.

RESPONSE
(a) *Increased **bacterial reproduction rate** (100% to 150%) results from rapid **binary fission**; favourable conditions increase DNA replication and cell division; leads to high microbial population and infection persistence.*
*Reduced **enzyme activity** (100% to 70%) affects intracellular metabolic pathways; enzymes involved in replication and protein synthesis function less efficiently; results in abnormal cellular processes and reduced effectiveness of treatments.*
*Increased **membrane permeability** (100% to 130%) alters the **fluid-mosaic membrane**; uncontrolled movement of substances occurs; may enhance entry of drugs but also allows loss of essential metabolites, affecting cell survival and function.*
*Reduced **cell structural organisation** (100% to 60%) indicates disruption of cytoplasm and organelles; in eukaryotic cells, this affects compartmentalisation; in prokaryotes, it affects cellular efficiency; leads to poor function and abnormal observations.*

*Low **stain uptake efficiency** (100% to 50%) results from poor preparation and altered cell walls/membranes; stains fail to bind properly to cellular components; reduces visibility of structures under the microscope.*
Poor laboratory practices reduce accuracy of observations; contamination increases microbial activity and alters results; improper handling affects reliability of biological investigations.

(b) Strategies

- ***Proper slide preparation** ensures intact cell structures; improves visibility and accuracy of observations under the microscope.*
- ***Correct staining techniques** enhance contrast; allow clear identification of cell components and structural differences.*
- ***Sterilisation of equipment** eliminates microbial contamination; reduces unwanted bacterial growth and improves experimental reliability.*
- ***Controlled antibiotic use** prevents development of resistant strains; ensures effectiveness of treatment on bacterial infections.*
- ***Maintaining hygiene** limits spread of microorganisms; protects both laboratory work and human health.*
- ***Training in laboratory procedures** improves accuracy in handling samples; ensures correct use of equipment and* reliable results.

TAP THE LINK BELOW

https://www.youtube.com/watch?v=Ma2a5GaZyLc&t=5s