

MENTOR HIGH SCHOOL- KITENDE

COMPETENCE BASED ASSESSMENT

END OF TERM 11 EXAMS 2025

S.5 BIOLOGY

TIME 2 ½ HOURS

NAME..... SIGN.....

INSTRUCTIONS

Attempt all items

Each item carries 20 scores.

ITEM 1

A large mixed-animal research farm has reported a steady but puzzling decline in animal health and productivity over the past three months. There is no clear disease outbreak, yet:

Layer hens are producing fewer eggs, and some display breathing difficulties despite no signs of viral infection.

Dairy cows have drastically reduced milk yields, though their diet and general behavior remain unchanged.

Piglets on the same farm are losing weight, and several develop frequent skin lesions that take long to heal, even in clean pens.

A cross-disciplinary team of animal scientists, nutritionists, and biologists investigates. Samples from various animal organs are taken, but initial blood and pathogen tests return normal.

Upon close examination of tissue condition through routine observations and microscopy, the team notes the following:

In the respiratory tract of hens, the lining appears abnormally smooth, with minimal mucus and poor particle clearance.

The intestinal surface of cows seems flattened with fewer projections, and nutrient absorption appears inefficient.

The skin of piglets appears thin and fragile, with poor resistance to abrasion or infection.

The team also learns that a new insulation material was installed in the animal houses 4 months ago to “reduce heating costs,” but its chemical composition hasn’t been verified. Additionally, the water supply system was redirected from a nearby industrial reservoir due to drought conditions

Task

- (a) Based on the observed tissue features, infer the type of epithelial tissues likely affected in each animal group.
- (b) Explain how the structural changes observed impair normal tissue function in each case
- (c) Develop a hypothesis for how environmental or management factors may have led to the epithelial damage and design a multi-step plan addressing Biological recovery of damaged tissues.

Item 2

A veterinary outreach team is called to a progressive livestock farm where the manager has noticed something strange. Although animals appear to be feeding and drinking normally, many of them—especially young goats and sheep show signs of fatigue, stunted growth, and difficulty walking. The animals are less playful, avoid running, and in some cases show bowed limbs and abnormal posture.

The farm had recently adopted a modern, low-movement rearing model using concentrated feed and restricted outdoor grazing. While this has improved feed efficiency and minimized infections, it has also reduced natural movement and sunlight exposure. Physical injuries were ruled out by the veterinary team. However, simple movement assessments reveal reduced joint flexibility and brittle bones in some post-mortem samples.

Further tissue analysis reveals:

A pale, spongy internal texture in long bones.

Poor cartilage flexibility at joints.

Limited growth plate activity in developing animals.

The farm manager is unsure whether the issue is nutritional, genetic, or environmental. You are part of a biology student team asked to analyze the issue from a tissue and adaptation perspective

Task

- (a) Describe the observed features (porous bones, poor cartilage, and joint stiffness) and infer the types of connective tissues involved. Support your reasoning using structural clues.
- (b) Explain how specific structural components in these tissues (cells, matrix, and arrangement) normally contribute to stability, movement, and growth. Discuss what might happen functionally when these structures are altered or underdeveloped.
- (c) Identify two often-overlooked adaptations of bone and cartilage that help animals withstand physical stress. Explain how the absence or weakness of these adaptations might explain the symptoms observed on the farm.

Item 3

A school-based agricultural research project uses a controlled greenhouse to grow spinach, beans, and maize for nutritional and commercial studies. Over the last month, students observed unusual patterns: the spinach and beans grew slowly, had yellowing leaves, and produced significantly less biomass than expected, even though light, water, and carbon dioxide levels were kept constant. Maize plants showed better growth but with pale green leaves.

The students suspected a pathogen but lab tests ruled that out. Under the microscope, leaf cells from the affected plants revealed unusually small and pale chloroplasts, with few visible grana. Mitochondria appeared fewer in number and irregular in shape compared to control samples from healthy field-grown plants.

A new biology teacher challenged the students to think deeper: Could the problem be rooted in the organelles themselves, particularly those responsible for energy transformation? The nutrient solution used lacked proper trace element analysis, and the greenhouse has been using recycled water with slight pH fluctuations.

You are a biology team assigned to diagnose the issue and recommend solutions, focusing on the structure and function of chloroplasts and mitochondria.

Task

- (a) Describe the structure and role of chloroplasts and mitochondria in plant nutrition and energy metabolism. How might their dysfunction affect plant growth and development?
 - (b) Explain at least two key structural adaptations of each organelle that enhance their efficiency in energy transformation processes.
 - (c) i) How can the observed symptoms help differentiate between chloroplast malfunction versus mitochondrial malfunction? What specific symptoms would suggest one over the other?
- ii) Propose a detailed strategy to restore optimal function of chloroplasts and mitochondria in the affected plants. Consider both immediate corrective actions and long-term prevention strategies

END

Do not wait for opportunities. Create your own