Excel in Biology
For
Lower secondary
in Just a Day
Volume 6

Lower Secondary Biology seminar
At Buddo Secondary School
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CONTENTS

Chapter 1	Biology Examination Format	2
Chapter 2	Items	5
Chapter 3	Responses	17

Chapter 1:
Biology Examination Format

Biology has two examinations papers, namely:

1. **553/1 BIOLOGY PAPER 1 (THEORY)**

- This paper consists of **two** sections, **A** and **B**. It has **seven** examination items, which are developed basing on **five** categories of inter-related topics called **elements of construct**.
- Section **A** has **three compulsory** items.
- Section **B** has **two** Parts; **I** and **II**. Answer **one** item from each part.
- Answers to Section **A must** be written in the spaces provided while answers to section **B must** be written in the answer booklet(s) provided.
- Answer **five** items in all.

Elements of Construct for 553/1 Biology paper 1 (Theory)

Section A		
Item	**Element of construct**	**Topics/sub-topics**
Item 1	**EC 2:** Understands how plants obtain and use nutrients to meet their requirements during which raw materials and products are carried to and from various organs involved.	• Structure of flowering plants • Nutrition in green plants. • Transport in plants. • Growth and development in plants • Reproduction in plants (both sexual and asexual)
Item 2	**EC 4:** Appreciates how the human body is coordinating various activities to ensure normal functions of body systems.	• Chemical coordination in humans. • Nervous coordination in humans. • Receptor organs in man • Locomotion in mammals.
Item 3	**EC 5:** Appreciates how characteristics are inherited in living organism, passed to generations through reproduction and are manifested as organisms grow.	• Growth and development in animals. • Sexual reproduction in humans. • Genetics, Inheritance, Variation and Selection.

Section B		
Part I: **Item 4** and **Item 5**	**EC 1:** Understand diversity of living things and sustainability of natural resources.	• Viruses. • Insects. • Physical and chemical properties of soil. • Soil erosion and conservation. • Concept of ecology. • Food chains and food webs. • Association in Biological communities. • Humans and the natural environment.
Part II: **Item 6** and **Item 7**	**EC 3:** Understands how mammals obtain and use nutrients to meet their energy requirements during which raw materials and products are carried to and from various organs involved.	• Nutrition types and nutrient compounds. • Nutrition in mammals. • Transport in mammals. • Gaseous exchange. • Aerobic and anaerobic respiration in mammals. • Excretion in animals.

2. 553/2/3 BIOLOGY PAPER 2/3 (PRACTICAL)

- This paper consists of **two** examination items, which are developed basing on the **two** categories of inter-related topics called **elements of construct**.
- Answer **both** items in the spaces provided.
- Drawings should be made in the spaces provided. Use **sharp pencils** for your drawings. Coloured pencils or crayons should **not** be used.

Elements of Construct for 553/2/3 Biology paper 2/3 (Practical)

Item	Element of construct	Topics/sub-topics
Item 1	**EC 1:** Appreciates scientific inquiry/process skills in Biology.	• Food tests. • Enzyme activity. • Soil. • Osmosis. • Diffusion. • Respiration.

Item 2	**EC 2:** Appreciates the structure and function in living organisms.	• **Arthropods**, mainly **insects** such as housefly, termites, cockroach, honey bees, etc. • **Parasites** such as ticks. • Whole **flowering plants** or **parts of a plant**, which include roots, stems, leaves, flowers and fruits. • Mammalian **teeth**. • **Vertebrae**, the backbones of a mammal.

Chapter 2: ITEMS

553/1 BIOLOGY PAPER 1 (THEORY)

SECTION A

1. PLANT BIOLOGY

Item 1

Last season, Juma faced a challenging growing period for his maize crops due to late planting. The crops were exposed to severe drought, causing water stress symptoms such as droopy leaves during the day. Additionally, an armyworm infestation significantly damaged stems and fruits, further reducing the crop's growth. However, the maize crops were seen with more prop roots, taut stems with greener leaves. The maize gave some yields, despite being lower than expected.

Task

a) Describe how the conditions experienced affected the maize's processes, leading to poor yield.
b) How did the maize manage to give some yields despite the prevailing conditions?

Item 2

Kaggwa, a farmer in Busana, Kayunga district, faced challenges in his two gardens, one in the wetland and the other on the upland, during the previous growing season. In the wetland garden, his rice crops were submerged by floods for a week, resulting into rotting of roots and white leaves. Meanwhile, in the upland garden, his bean crops had weak stems and some wilted. However, with little rain, these crops developed many apical buds, nodes, stronger stems and had numerous root nodules. The upland garden gave more yields than the wetland garden.

Task

(a) Explain how the conditions experienced in the two gardens affected the normal plant functioning leading to poor yields?

(b) How did the bean plants in the upland garden manage to give more yields than the crops in the wetland garden?

Item 3

Isabirye is a famous tomato farmer in Nawampiiti, Luuka district. However, in the previous growing season, his tomatoes at fruit development stage were infected with fungi. In just four days, the fungi caused decay of most leaves, fruits and stems. The tomato plants fought the fungal infection; however, the harvest was very low with small-sized fruits.

Task:

(a) Explain how the fungal infections affected the tomato plant functioning leading to low harvest and small sized fruits?

(b) Explain how the tomato plants could have fought the fungal infection to give some yields/harvest.

Item 4

Kyomugisha is a potato farmer in Kisoro, Western Uganda. One day, a severe hailstorm hit her garden, causing significant damage. The leaves were torn, stems were broken, and flowers fell off. Kyomugisha was worried that this damage could affect the potato tubers. After some time, when all hope was gone, she noticed new buds emerging out the soil from the tubers still beneath. These produced numerous nodes, elongated internodes and an extensive shoot system. The Irish potato garden revived.

Task

(a) Explain to Kyomugisha how the processes in her plants were affected by the hailstorm.

(b) How did the Irish potatoes manage to revive after sometime?

2. HUMAN COORDINATION AND LOCOMOTION

Item 5

Mr. Okiror, a 50-year-old resident of Soroti City, a regular heavy drinker, struggled with a certain health disorder for many years. One day after a night of drinking alcohol at a club, he forgot to take his medication and neglected to follow his doctor's dietary advice. Thereafter, he experienced blurred vision, increased thirst, frequent urination, fatigue, dizziness and finally he fainted. He was rushed to the hospital, where his blood sugar level was found to be very high above normal. The doctors provided treatment to him and his condition stabilized.

Task

(a) Explain

(i) the possible physiological causes of Mr. Okiror's health condition.

(ii) how his behaviour led to worsening of his health condition?

(b) How can Mr. Okiror and others with the same health disorder can prevent similar complications and manage their condition effectively?

Item 6

During his holiday visit, Opio noticed that his family members were sick. His elder brother was thirsty, hungry, and urinating often. Their grandmother had a swelling on her neck. Their father was having difficulty in seeing things nearby. Opio was concerned and decided to help his family members to get the medical care they needed.

Task

(a) (i) Identify the possible health conditions affecting Opio's relatives.

(ii) Explain the possible causes of the health conditions affecting Opio's relatives.

(b) Suggest ways to manage or treat the health conditions affecting Opio's relatives.

Item 7

A house maid was cooking milk for the baby and suddenly the boiling milk raised and spilled out of the sauce pan into the fire. The maid heard the hissing sound from the cooking place. She got scared, her heartbeat and breathing rate increased and she strongly rushed to remove the sauce pan from the stove. On touching the pan, she immediately released it. She experienced painful muscle cramps in her hands.

Task

(a) Explain how the maid's body coordinated to bring about her reaction:
   (i) after the hissing sound of the spilling milk.
   (ii) leading to releasing of the hot saucepan.

(b) Explain how the maid's body can overcome the painful experience in her hands.

3. GENETICS, GROWTH, DEVELOPMENT AND REPRODUCTION

Item 8

John and Sarah have been married for 15 years and have three children: Michael, Olivia, and Sophia. Michael has sickle cell anaemia, Olivia is very healthy, and Sophia often gets malaria. John, who is healthy, starts to doubt if he is the father of the children. This caused tension between John and Sarah. To resolve the issue, they all went to the hospital for blood tests. Laboratory results showed that:

- John is indeed the father of all three children.
- Both John and Sarah are carriers of the sickle cell trait.
- Sarah has a Human Papilloma Virus (HPV) infection.

Task

(a) (i) Explain to John and Sarah how they can prevent transmitting the virus infection to each other.
   (ii) Use a genetic diagram to show John how both he and Sarah are responsible for the health conditions present in their children.

(b) Suggest ways for John and Sarah to help their children manage their health conditions and live healthy lives.

Item 9

Mary became pregnant at 13 years old while in Primary 5. She was expelled from school, and her parents forced her to live with her boyfriend in a nearby village. Mary faced many challenges during pregnancy and didn't receive antenatal care. She gave birth to a child with albinism. The boyfriend denied being the father, claiming he couldn't have a child with albinism since he's dark-skinned. Doctors conducted tests, which showed that:

- The boyfriend is indeed the father of the child.
- Both Mary and her boyfriend are carriers of the albinism gene.

Task

(a) State the consequences of Mary's actions to her life.
(b) Using scientific principles, convince Mary's boyfriend that he is the father of their child.
(c) What advice would you give to other teenagers to avoid facing similar consequences as Mary?

Item 10

Adong, a farmer in Lacor village, Gulu, planted two varieties of beans in the same garden: one with yellow seeds and the other with green seeds. To her surprise, the first harvest produced only yellow seeds. She was puzzled, wondering why none of the seeds were green. The following season, Adong planted the yellow seeds from the previous harvest. This time, the crop yielded a mix of yellow and green seeds. When she took the mixed seeds to the market, customers preferred buying single-coloured seeds, and Adong had to sell her mixed seeds at a lower price. She wondered how to manage her crop to produce uniform seeds and increase her earnings in future harvests.

Task

(a) What factors contributed to the differences in seed colour in Adong's bean harvest?
(b) Using genetic crosses, explain to Adong how differences in the bean harvest came about.
(c) Suggest best practices for Adong in order to produce preferred uniform seed colour.

SECTION B

Part 1: DIVERSITY OF LIVING THINGS AND SUSTAINABLE USE OF NATURAL RESOURCES

Item 11

Residents of Bufundi Parish in Kabale District cultivate Irish potatoes on the hillsides after clearing the natural vegetation. During the heavy rainfall in April 2025, flooding and landslides occurred, causing damage to homes and crops. Stagnant water pools formed in the valleys, leading to outbreaks of waterborne and vector-borne diseases. In a meeting with residents, the district environmental officer held them responsible for the challenges they were facing and emphasized the need for sustainable land management practices in the area.

Task

(a) Explain to the residents how the challenges they are facing arose.
(b) Advise the residents on sustainable land-use practices and explain the benefits of adopting them.

Item 12

The Uganda Wildlife Authority (UWA) has reported an increase in poaching near game parks, leading to a decline in wildlife populations. There is also growing encroachment on park boundaries for agricultural activities, which threatens biodiversity and disrupts ecosystems. Additionally, wildlife attacks on humans and livestock have become more frequent, putting communities at risk and straining local resources.

Task

(a) Explain to the people living near the game parks how their activities affect wildlife.
(b) What actions can the Uganda Wildlife Authority (UWA) take to reduce the negative impact of human activities near game parks?

Item 13

The Uganda National Environment Management Authority (NEMA) has observed that industries along the shores of Lake Victoria are releasing untreated industrial waste into the lake. Additionally, nearby homes and schools are discharging untreated sewage into the water. These pollutants have led to a decline in aquatic wildlife diversity, especially fish populations. The degradation of water quality has also impacted

livelihoods dependent on fishing, tourism, and other lake-related economic activities, posing a serious threat to the country's economy.

Task

(a) Explain the effects of the activities being done around the shores of Lake Victoria.

(b) What should be done to overcome the challenges experienced in the lake.

Item 14

Mr. Kiwanuka lives in a small house surrounded by a thick bush and a nearby swamp with stagnant water, which serves as his source of water for domestic use. Due to the lack of a latrine, he often disposes of his wastes in the bush. Recently, he has developed severe diarrhea, headache, joint pain, and fever. Despite his symptoms, Mr. Kiwanuka attributes his illness to witchcraft by his neighbours.

Task

(a) Explain to Mr. Kiwanuka how his own actions have caused his poor health conditions so that he can live in harmony with his neighbours?

(b) How important are such areas when not disturbed by man?

Item 15

Amooti purchased a fertile, bushy piece of land in Kiboga for maize cultivation. He cleared the bush, cut down all trees, and burned the cut vegetation before planting maize. His harvests were excellent for the first two years. To maintain high yields, he regularly applied herbicides to control weeds and pesticides to protect his crop from army worms. However, in the third year, his maize harvest declined significantly. Disappointed, he was unsure of the cause.

Task

(a) Explain to Amooti the causes of the decline in his crop harvest.

(b) What should Amooti do to improve the crop yield in his garden and why should he conserve the land he is using.

Item 16

In the recent times, climatologists have noted a number of environmental challenges. Some of them have been partly associated with the increased levels of greenhouse gases released in the atmosphere from different human activities such fossil fuel burning, industrialization and agriculture. The table below shows how the concentrations of three gases, Carbon dioxide (CO_2), Methane (CH_4) and Nitrous oxide (N_2O) have increased between 2010 and 2023. The concentration of the gases in the atmosphere in certain years have been measured in part per million.

Year	CO_2 (pmm)	CH_4 (pmm)	N_2O (pmm)
2010	390	1800	323
2015	400	1830	328
2020	415	1880	333
2023	419.3	1922.6	336

Task

(a) Explain how human activities contributed to the observed trend and explain the environmental challenges that resulted due to the concentrations of such gases in the atmosphere.

(b) Provide practical remedies to lower the concentrations of such gases in the atmosphere?

Part 2: MAMMALIAN PHYSIOLOGY

Item 17

During an end-of-year celebration in Wakiso District, Bbosa (blood group **A**) and Nakiboneka (blood group **B**) were involved in a motorcycle accident. Without helmets, they suffered serious injuries to the head, chest, elbows, and knees, losing a lot of blood. Both were unconscious, with difficulty breathing and weak heartbeats.

They were rushed to Mulago National Referral Hospital, where doctors found their blood levels critically low. Urgent transfusions were needed, so the medical team tested the blood groups of three relatives: **P**, **Q**, and **R**, to find suitable donors. The table below shows the blood groups of the relatives.

Relatives	Blood groups
P	B
Q	A
R	O

Task

(a) Explain how the accident affected the normal functioning of the Bbosa's and Nakiboneka's bodies.

(b) With reasons, identify the most suitable blood donors for Bbosa and Nakiboneka from relatives **P**, **Q**, and **R**. Suggest practical ways Bbosa and Nakiboneka can manage their lives after recovery to improve their future wellbeing.

Item 18

Tom, a 30-year-old boda boda rider from Natete, regularly eats deep-fried foods like chips and rolex from roadside vendors, drinks sugary sodas, smokes due to peer pressure, and rarely exercises. Over time, he gained excess weight and began suffering from persistent coughing, fatigue, and difficulty breathing. He was recently hospitalized, where doctors found complications in his respiratory, cardiovascular, and urinary systems. After treatment, Tom was discharged with advice on improving his diet and lifestyle. However, due to work stress and limited knowledge, he struggles to make meaningful changes.

Task

(a) According to the doctors, which major body organs are likely to be affected by Tom's condition? Explain how his lifestyle may have led to problems in these organs.

(b) Suggest practical and affordable steps Tom can take to live a healthier life and avoid further complications.

Item 19

In 2024, Ali and Hussein were top runners at Masaka Secondary School, chosen to represent their houses in the inter-house athletics. For five days before the event, Hussein trained daily and ate well, mainly posho and beans. Ali, thinking his talent was enough, skipped meals and did little training. On the competition day, Hussein won all his races. Ali became weak during the 800-meter race and collapsed before the finish line, breathing heavily. Fellow students carried him to a shaded area, gave him glucose, and let him rest. After about an hour, Ali regained some strength.

Task

(a) Explain why:
   (i) Hussein won all his races.
   (ii) Ali did not win most of the events and collapsed.
   (iii) Ali regained strength after rest.

(b) Suggest advice to Ali and other athletes to avoid similar problems in the next competition.

Item 20

During a dry season, Derrick used water from borehole **A** to irrigate crops of the Northern Garden and used water from borehole **B** to irrigate crops of the Southern Garden. 20 minutes after irrigation, he noticed that crops of the southern garden developed weak soft stems while those of the northern garden became upright and healthy. He was worried that this could affect the yields from the southern garden, but he could not understand what was wrong with the water from borehole B and why it was causing the crops to droop while that from borehole A was good for the crops.

You have been provided with specimen **Q** whose tissues behave like the tissues of the crops in Derrick's Garden.

Solutions **C** and **D** which are samples of water collected from the boreholes.

Task:

Carryout a scientific investigation using the solutions provided and specimen **Q** to explain how the water from the boreholes affected the plants in the two gardens of Derrick.

Your design and investigation should include the following

(a) Aim, hypothesis, variables, apparatus/requirements

(b) Procedure for investigation and results

(c) (i) Identify the borehole sources from which the solutions **C** and **D** were obtained.

(ii) Explain to Derrick how water from the two boreholes affected his crops.

Item 21

Gloria is a local brew maker in one village. She mixes millet flour with yeast in a plastic drum covered with a thick cloth to keep it warm around 40^0C and in just 30 minutes, the millet begins to turn sweet, an indicator that the yeast is already working. In the brewing room, she keeps water in jerrycans for use, some of the water is not so clean so she does not use them for mixing the yeast and millet. One day Gloria requested her young brother Ronald to help her. Ronald picked a random jerrycan of water and used it to mix the yeast before adding it to the millet, he covered the drum very well just like Gloria always does. Gloria returned home and tasted the mixture but it was not sweet. Gloria suspects that

Ronald could have used the wrong water for mixing and Ronald does not understand why the nature of water matters in the process. Yeast is known to contain an enzyme that breaks down starch into maltose before forming alcohol.
You have been provided with solution **G** which is a sample of the yeast solution and solution **H** which is a sample of the millet flour used.
You have also been provided with solutions **K**, **L** and **M**, which are samples of the water found in three different jerrycans in room that day, one of which Ronald used.

Task:
Carryout investigations using the samples provided as use the result to determine which solution/s is suitable for use to mix the yeast and explain to Ronald how the wrong solution/s affect the process of alcohol formation.
Your design and investigation should include the following
(a) Aim, hypothesis and variables
(b) Procedure for investigation and results
(c) (i) Identify which solution/s that is most suitable for use in mixing the yeast.
(ii) Explain to the Ronald how the solution/s affect's the process of alcohol formation.

Item 22
Julius obtained two breeds of a certain crop. On planting, he observed a difference in sizes of some structures on the two plant breeds. At harvest time, the yields from breed A were higher than that of breed B. He wonders why the two crops gave different yields yet he provided similar conditions to the crops.
You have been provided with specimen A and B which were collected from the two breeds respectively.
Task
(a) Identify the plants parts A and B, give reasons for your answer.
(b) Explain how one of the structures A or B could have led to low yields.
(c) Draw and label the specimen that could have caused poor yields in one of the breeds.

Item 23

Jane and Shakirah are farmers whose gardens are located 100 meters apart. Immediately after weeding her overgrown bushy banana plantation, Jane went to help Shakirah plant maize in her garden. At harvest time, Shakirah observed other mature plants in her garden some of which she had seen in Jane's banana plantation. Shakirah wondered how the other plants reached her garden.

Specimens **X** (Desmodium fruit), **Y** (maize seed) and **W** (Bean pod), are plant parts collected from the mature plants in Shakirah's Garden.

Tasks:

(a) (i) Using observable features, identify specimens X, Y and W.

(b) (ii) State the specimen(s) most likely to have been brought to Shairah's garden unintentionally. Give reason(s) for your answer.

(c) Draw and label specimen X

Chapter 3:
RESPONSES

1. (a)

- The drought caused drooping of leaves, which reduced the surface area for trapping sunlight energy hence reducing the rate of photosynthesis and consequently resulted into poor yields; VE
- The drought caused stomata closure which reduced efficient gas exchange hence affecting uptake of carbon dioxide, reducing the rate of photosynthesis hence leading to poor yields; VE
- The armyworm ate the maize stems damaging the phloem and xylem vessels which reduced efficient translocation of manufactured food nutrients and water and mineral salts respectively to other parts of the plant; VE
- Armyworm infestation damage fruits and this reduced the number and quality of maize grains. hence low yield VE

(b)

- The maize crops developed greener leaves/more chlorophyll to allow maximum absorption of sunlight energy thus ensuring efficient photosynthesis to support growth; AE
- The maize crops developed more prop roots to allow increased absorption of water and nutrient which enabled efficient photosynthesis and consequently promoted growth/ provide firm support to the plant leaves in an upright position to trap more sunlight energy needed for maximum photosynthesis/support flowers upright for pollination to take place; AE
- The taut stems, provided firm support to the plant leaves in an upright position enabling the leaves to trap maximum sunlight energy needed for efficient photosynthesis/ensured proper functioning of the xylem and phloem, slowing efficient transport of water and mineral salts as well as manufactured food throughout the plant; AE

2. (a)

Wetland Garden (Rice Crops)

- Flooding led to root submergence, causing roots to rot due to lack of oxygen/anaerobic respiration. The rotten leads to reduced absorption of water and mineral salts, limiting photosynthesis and nutrient transport.
- Flooding caused submergence of leaves for a week (or leaching of essential minerals, like nitrogen, magnesium) resulting into white leaves/low chlorophyll formation (chlorosis) thus leading to a reduction in the photosynthesis and consequently poor yields;

Upland Garden (Bean Crops)

- Water stress (dry period) made the stems to become weak leading to damage of the xylem and phloem vessel which reduced efficient transport of water, mineral salts and food to other parts of the plant/ resulted into failure to provide support to the plant leaves in an upright position to receive sunlight hence reducing the rate of photosynthesis;
- Water stress (dry period/little rain) made the leaves to wilt leading to reduced surface area for absorption of sunlight and hence reduced rate of photosynthesis.

(b)

- Many apical buds promoted continuous growth at the tip of the plant leading to formation of more branches for transporting water and mineral salts / many leaves for absorption of sunlight for photosynthesis / many flowers for sexual reproduction (pollination and fertilisation).
- Many nodes, leading to production of more leaves, increasing surface area for trapping sunlight for photosynthesis and gaseous exchange leading to growth / many nodes which formed many flowers that attracted pollinators leading to increased chances of pollination and fertilization
- Stronger stems, which support upright growth for better light absorption for photosynthesis / with normal xylem and phloem for efficient transport of nutrients and water.
- Numerous root nodules containing Rhizobium bacteria that fix atmospheric nitrogen to enhance soil fertility for better growth and pod development.

3. (a)

- Decay of leaves led to loss of leaves reducing the surface area for absorption of sunlight for photosynthesis. Hence reduced rate of photosynthesis.
- Decay of fruits direct damaged to reproductive/fruit parts limits the number and quality of fruits.
- Decay of stems damages the xylem and phloem, hence hindering the transportation of water, salts and nutrients / decay of stem weak/reduce structural support leading to wilting and collapse of the plant, hence reduced surface area for absorption of sunlight for photosynthesis.

(b)

- Plants may produce antimicrobial compounds (like phytoalexins) to slow fungal growth.
- Strengthening of cell walls in unaffected areas to block further invasion.
- Some stems, leaves, or fruits might have escaped complete decay, allowing continued photosynthesis and fruit development.
- If dry weather followed the infection, it may have limited fungal spread and given plants a brief window to recover.

4. (a)

- Torn leaves reduced the leaf surface area for trapping sunlight energy thus hindering efficient rate of photosynthesis/ damaged the stomata reducing surface area for gaseous exchange/uptake of CO2, hence reducing rate of photosynthesis.
- Hailstorms broke the stems, damaging the phloem and xylem vessel which prevented efficient the translocation of the manufactured food/ transport of water and mineral salts to other parts of the plants;
- The hailstorms also damaged the flowers (fallen flowers) which reduced the chances of efficient pollination and fertilization since flowers contain the reproductive parts (stamen/pistil).

(b)

- The Irish potatoes developed many nodes, which sprouted to form more leaves, increasing surface area for trapping sunlight for photosynthesis and gaseous exchange leading to growth;

- The Irish potatoes' internodes elongated, exposing leaves to trap more sunlight, leading to manufacture of more food resulting to growth;
- The potatoes developed extensive shoot system, leading to production of more leaves, increasing the surface area for trapping sunlight for photosynthesis and gaseous exchange leading to growth;
- The Irish potatoes formed many buds, which sprouted to form more adventitious roots thus increasing surface area for maximum absorption of water and mineral salts;

5. (a) (i)

- Insulin deficiency, his body/pancreas/beta-cells of Langerhans either doesn't produce enough insulin or the beta-cells failed to produce insulin, which is essential for glucose/sugar regulation.
- This leads to high blood sugar/glucose (hyperglycemia) instead of being stored or used by cells.
- This leads to osmotic diuresis (excessive urination and dehydration).
- Loss of water and salts leads to dizziness and fatigue.
- Reduced fluid in tissues may affect brain and eye function, causing blurred vision and fainting.

(ii)

Heavy alcohol consumption:

- Alters liver/insulin function and can lead to increase in blood sugar above normal level.
- Lead to memory loss:
  - causing Mr. Okiror to forget taking his medication, which regulate insulin levels and without sufficient insulin, glucose accumulated in his bloodstream.
  - Causing him not to follow doctor's advice and ended up eating foods high in sugar, which are broken down into sugars leading to increase in blood sugar.

(b)

- To take prescribed medications to maintain stable blood sugar levels.
- Follow dietary advice / eat a balanced diet with controlled carbohydrate intake / monitor portion sizes to avoid rapid increase in sugar levels.
- Reduce / stop alcohol intake to minimize its impact on blood sugar levels / memory loss.

- Regularly check blood glucose levels to ensure they remain within a target / normal range and adjust treatment plans if outside the normal ranges.
- Engage in regular physical activity so as to increases glucose uptake in muscles, reducing blood sugar levels / to enhances the body's response to insulin / to maintain a healthy weight, reducing diabetes complications.

6. (a) (i)

Relative	**Health condition**
Elder brother	Diabetes mellitus;
Grandmother	Goitre;
Father	Long sightedness/hypermetropia;

(ii) Explanation of the causes

Relative	**Explanation of the cause(s)**
Elder brother with Diabetes mellitus	Damage to the insulin producing cells in the pancreas (Beta cells of islets of Langerhans) leading to little or no production of insulin hormone responsible for regulating blood sugar levels; Loss of sensitivity/responsiveness of the body cells to insulin hormone linked to old age; lifestyle habits such as lack of physical exercises; improper diet; and obesity;
Grandmother with Goitre	Due to iodine deficiency in her diet which is needed for formation of thyroid hormones;
Father with long sightedness	Due to a short eyeball which causes light rays from nearby objects to be focused behind the retina/Due to a thin/flattened lens;

(b) Management or treatment of the health conditions

Health conditions	**Management strategies**
Diabetes mellitus	•Take insulin injections/insulin pumps to provide insulin necessary for controlling the blood sugar levels; •Regular physical exercises to help utilize the excess blood sugars; •Have a balanced/healthy/proper diet to avoid

	excess intake of sugars; •Regular medical checkups to allow early monitoring and management of the blood sugar levels;
Goitre	•Feeding on food rich in iodine/iodized foods/Iodine supplements to provide sufficient amount of iodine needed for formation of thyroid hormones; •Use of radioactive iodine therapy to help shrink the overactive thyroid gland; •Surgery to help remove or reduce the swollen/enlarged thyroid gland;
Long sightedness	•Wearing spectacles containing convex/converging lenses to help converge the light rays from nearby objects to the retina; •Regular eye checkups to easily monitor the changes and adjust prescriptions as needed;

7. (a) (i) After hearing the hissing sound

- Sound waves were collected by the ear pinna, turned into vibrations by the ear drum which were then converted into impulses by the cochlea;
- The impulses were transmitted to the brain via the auditory nerve, which brain interpreted and processed the information;
- Through the hypothalamus, the adrenal gland was stimulated to release adrenaline hormone into the blood;
- The adrenaline hormone was transported in blood to the heart, where it caused an increase in the heart beat in order to supply more blood with nutrients to skeletal muscles, causing them to contract and relax rapidly enabling her to rush towards the sauce pan.

(ii) Releasing of hot sauce pan

- The heat receptors in the fingers detect the heat stimulus and convert it into electrical impulses which then travels along the sensory neurone to the spinal cord for processing;
- In the spinal cord, the impulses are then transmitted to the relay neurone across the synapses in the grey matter;
- The relay neurone in turn sends the electrical impulses to the motor neuron across the synapses;

- The motor neuron then transmits the impulses from the spinal cord to the effector muscles, causing them to contract and relax rapidly which enabled her to withdraw her hand rapidly from the hot sauce pan.

(b) Management of the burn

- Run cool water around the affected area for some time so as to reduce the pain/burning sensation;
- Apply a cool clean cloth on the area to reduce/minimize the inflammation;
- Remove any clothing and jewelry near the affected area to avoid further tissue damage;
- Cover the affected area with a clean, loose/non-sticky clothing to protect it from infection;
- Take some pain medications/pain killers/pain relievers so as to reduce on the pain;

8. (a) (i)

- Abstinence Until Treated/Avoid sexual contact until medical professionals confirm it's safe.
- Sarah should follow prescribed treatment to manage or eliminate active HPV infection.
- Use condoms consistently and correctly to reduce HPV transmission risk.
- Both partners should attend health checkups, including cervical screening for Sarah.
- They should go for HPV vaccination to protect themselves against future infection or reinfection.

(ii)

Let **N** represent allele for normal haemoglobin
n represent allele for sickle-cell anaemia } UE

Parental phenotypes: Normal man X Normal woman } UE

Parental genotypes: **Nn** X **Nn;**

Meioses:

Gametes: **N** **n** **N** **n** } UE

Random fertilization: } UE

Offspring genotypes: **NN** **Nn** **Nn** **nn** } UE

06

Offspring genotypes: 1NN, 2Nn and 1nn.

Offspring phenotypes: } UE

- 1 normal (e.g., Olivia and Sophie with low resistance to malaria),
- 2 carriers (who has high resistance to malaria), and
- 1 sickle cell anaemia (e.g., Michael (who has very high resistance to malaria but at a risk sickle cell anaemia)

(b)

For Michael (Sickle Cell Anaemia):

- Ensure regular medical checkups and early treatment for pain episodes.
- Keep him hydrated to prevent sickling of red blood cells.
- Provide a balanced diet rich in iron and folic acid.
- Avoid high altitudes and strenuous activity.
- Educate him on the importance of resting and recognizing early symptoms.

For Sophia (Frequent Malaria):

- Use insecticide-treated mosquito nets to prevent mosquito bites.
- Ensure anti-malarial medication and regular testing.
- Improve household sanitation and avoid stagnant water.
- Strengthen immunity through proper nutrition.

For All Children:

✓ Create a healthy, supportive environment.
✓ Encourage open communication about health.
✓ Educate them on hygiene, nutrition, and lifestyle habits.

✓ Seek counselling or support groups if tension arises due to health challenges.

9. (a)

- Expulsion from school halted her education, limiting future career and life opportunities.
- Pregnancy at a young age may attract shame or blame from family and community.
- Lack of antenatal care increased risks of complications for both mother and baby.
- At 13, Mary likely faced emotional stress, fear, and loss of independence.
- Being sent to live with her boyfriend at a young age removed her autonomy and safety.
- Responsibilities of early motherhood and domestic strain restrict personal growth and aspirations.

(b)

Let **N** represent allele for presence of melanin in skin;
n represent allele for absence of melanin in skin; } UE

parental phenotypes: Normal man X Normal woman } UE

parental genotypes: **Nn** **Nn** } UE

mesios:

gametes: **N** **n** **N** **n** } UE 06

Random fertilisation: } UE

Offspring genotypes: **NN** **Nn** **Nn** **nn** } UE

Offspring genotypes: 1NN, 2Nn and 1nn.
Offspring phenotypes: 1 normal, 2 carriers and 1 albinism. } UE

(c)

- Abstinence/delay sexual activity, focus on education and personal growth first; early parenthood has lasting challenges.

- Stay in school, education empowers future opportunities and informed choices.
- Understand reproductive health, learn about pregnancy, STIs, genetics, and body changes.
- Avoid / report pressure or abuse, speak to trusted adults or authorities if faced with unsafe relationships.
- Seek guidance and support, attend health talks, counseling, and peer support groups.
- If sexually active use protection/contraceptives, e.g. condom to prevent unwanted pregnancies and infections.

10. (a)

- Genetic inheritance, seed colour is controlled by genes. The yellow seed trait is dominant, and the green trait is recessive.
- Cross-pollination between varieties, growing both types together allowed cross-pollination, leading to hybrid seeds.
- Dominance of traits, in the first season, yellow seeds appeared because the dominant allele masked the green trait.
- Genetic segregation in second generation, planting seeds from hybrids led to a mix of yellow and green due to mendelian inheritance patterns.

(b)

Let **A** represent allele for yellow seeds;
a represent allele for green seeds;

parental phenotypes: yellow seeded plant X green seeded plant

parental genotypes: **AA** **aa**

meiosis:

gametes: **A** **A** **a** **a**

Random fertilisation:

F1 Offspring genotypes: **Aa** **Aa** **Aa** **Aa**

Let **A** represent allele for yellow seeds

a represent allele for green seeds

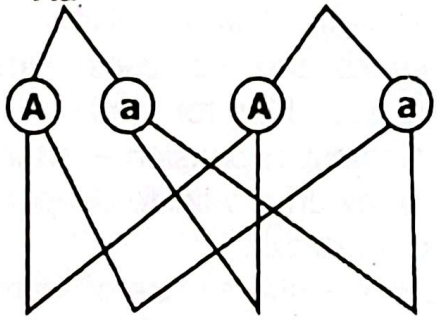
parental phenotypes: yellow seeded plant X ~~green~~ yellow seeded plant

parental genotypes: **Aa** **Aa**

mesios:

gametes: **A** **a** **A** **a**

Random fertilisation:



F2 Offspring genotypes: **AA** **Aa** **Aa** **aa**

Offspring genotypes: 1AA, 2Aa and 1aa.

Offspring phenotypes: 3 yellow and 1 green.

11. (a)

- Clearing of natural vegetation from hillsides, removed trees and shrubs that anchored the soil and this increased vulnerability to soil erosion, landslides, and runoff during heavy rains.
- Cultivation on slopes without control measures/no terracing or contouring worsens erosion risk.
- Heavy rainfall (in April 2025) triggered landslides on (unstable) slopes / downhill runoff flooded valleys and settlements.
- Formation of stagnant water pools in valleys due to poor drainage. The stagnant water became breeding grounds for mosquitoes (vector-borne diseases) and housed contaminated water (waterborne diseases).

(b)

Practice	Benefit
Agroforestry & Reforestation	Reduces landslides, improves biodiversity
Terracing & Contour Farming	Minimizes erosion, retains water for crops
Mulching & Cover Cropping	Enhances soil health, reduces crop failure
Improved Drainage	Prevents disease outbreaks, protects homes and gardens

12. (a)

- Poaching reduces wildlife populations, especially endangered species like elephants or rhinos. – disrupts predator–prey relationships, leading to imbalanced ecosystems.
- Encroachment for farming, clears natural vegetation, destroying habitats and food sources and increases human–wildlife conflict as animals stray into farms searching for food.
- Noise, pollution & settlement expansion – alters animal behavior and breeding patterns and may drive wildlife deeper into parks or closer to people, increasing risk of attacks.
- Competition for resources – human use of water sources and grazing land near parks reduces availability for wild animals and this can lead to migration, stress, or increased aggression in animals.

(b)

- Strengthen enforcement: increase patrols and surveillance with technology like drones or camera traps / enforce anti-poaching laws with strict penalties.
- Create buffer zones between farmland and park boundaries to reduce direct contact use community.
- Community education about the value of biodiversity.
- Alternative livelihoods / provide training in bee-keeping, crafts, or fish farming to reduce dependence on poaching and farming in protected areas.
- Introduce safe fencing methods and crop types that deter animals.

13. (a)

Effects of the activities done

- Discharge of untreated industrial wastes into the lake introduces toxic chemicals which results into death of aquatic animals such as fish/The chemicals may also build up in the bodies of different organisms affecting organisms along the food chains/disrupts food chain;
- The untreated industrial wastes also introduce chemicals such as acids, heavy metals which may lead to diseases and organ damage in animals;
- Discharge of untreated sewage results into eutrophication/ enrichment of water with nutrients which supports rapid growth of algae, resulting into death of aquatic animals due to lack of oxygen/algal blooms

hinder navigation/hinder light penetration affecting the other photosynthetic plants under water;
- The untreated sewage also contains disease causing organisms like bacteria, viruses and fungi which facilitates the spread of water borne diseases;
- The untreated sewage contaminates the water, making it dirty with a foul smell which makes it unsafe and unpleasant for recreation activities and drinking;

Solutions to overcome the challenges
- Proper treatment of industrial and sewage before disposal to avoid further contamination of the water bodies with chemicals;
- Set strict environmental laws/policies against poor waste disposal/regulate the number of industries in the area;
- Proper waste management through recycling and reusing of the wastes to minimize/reduce on the discharge of wastes;
- Sensitize/educate the mass/public awareness campaigns about the dangers associated with water pollution and improper waste disposal;
- Use of cleaner production methods to minimize on the release of wastes into the waterbodies;

14. (a)
- Improper disposal of wastes due to lack of latrine causes contamination of the water sources leading to spread of water borne diseases like cholera, dysentery thus leading to ill health such as diarrhea, headache/ The poorly disposed wastes or stagnant water can act as breeding grounds for vectors thus leading to spread of diseases responsible for his ill health;
- Living near thick bushes which can act as breeding grounds for mosquitoes can result into mosquito bites hence leading to malaria responsible ill health;
- Use of unboiled/untreated water for domestic uses from the swamp may also contain harmful micro-organisms like bacteria leading to diseases which may affect his internal body organs/cause diseases;

(b) Importance of conserving swamps
- Act as habitats for some wild animals like fish, birds, insects/Act as breeding grounds for some animals;
- Play a role in water purification by filtering wastes/pollutants out of the water thus keeping it clean;

- Control flooding by absorbing excess rainwater;
- Can act as fishing ground thus proving food to other organisms;
- Support livelihoods by providing raw materials like papyrus, sand;
- Can serve as recreation and tourism centres thus providing employment opportunities to people and government revenues;
- Provides water for domestic and industrial uses;

15. (a)

- Clearing of the bush/cutting down of all trees leaves the land bare, exposing it to the agents of soil erosion leading to loss of soil fertility and consequently poor crop growth;
- Burning of the vegetation destroys the dead organic matter which reduces the humus content of the soil resulting into soil infertility/Kills the useful soil organisms that would aerate the soil thus affecting the soil fertility;
- Mono-cropping/growing of maize seasonally caused nutrient exhaustion leading to soil infertility;
- Application of pesticides and herbicides caused alteration of soil pH thus affecting proper crop growth/kill useful organisms like pollinators and soil living organisms;

(b)

- Use of organic fertilizers to improve on the soil fertility;
- Practice crop rotation/mixed farming with legumes to help increase soil fertility;
- Use of cultural and biological pest control measures to avoid further introduction of dangerous chemicals to the soil;
- Use of soil erosion control methods such as mulching, planting of cover plants and trees/ afforestation/reforestation/agroforestry to prevent direct impact of rain drops onto the bare soil surface;
- Practice bush fallowing/allowing the land to rest for some time to regain its soil fertility;
- Use of hand weeding to avoid use of herbicides that may kill useful soil organisms and pollinators;
- Timely planting and harvesting to avoid peak pest seasons;

Why should he conserve such an environment?

- Act as a source of habitat for some wild animals;
- Source of food to man and other animals;
- Source of herbal medicine for some ailments;

- Roots of the plants hold the soil particles together thus preventing soil erosion;
- Thick vegetation provides soil cover/holds soil particles together which prevents soil erosion;
- Trees act as windbreaks.
- Trees prevent air pollution/purify air by absorbing carbon dioxide thus prevent global warming by taking up Carbon dioxide;
- Trees provide oxygen used in cellular respiration;
- Trees help in rainfall formation;
- Source of raw materials like timber needed for construction;
- Act recreation and tourism centres thus providing employment opportunities and government revenue;

16. (a)

- Burning of fossil fuels causes release of large amounts of Carbon dioxide into the atmosphere;
- Industries also release large amount of Carbon dioxide from burning of fossil fuels as well as release of nitrous oxide from industrial processes;
- Agricultural practices such as use of nitrogen based fertilizers can result into increased release of nitrous oxides into the atmosphere/ agricultural farm animal excreta/wastes can decompose under action of bacteria resulting into release of large amounts of methane gas into the atmosphere;

Environmental challenges that can result from accumulation of such gases

- Accumulation of such greenhouse gases in the atmosphere can form a blanket which can trap heat from the sun resulting into global warming/ climatic changes/changes in weather patterns;
- Some react with water leading to formation of acidic rains that may alter soil pH thus affecting crop growth;
- Air pollution resulting into respiratory diseases to man and his animals;

(b)

- Practice afforestation/reforestation/agroforestry/planting of more tree so as to increase the utilization of Carbon dioxide gas by plants during photosynthesis;
- Use of alternative energy sources like electricity, solar energy etc. so as to reduce/minimize on the use of carbon-based fuels;

- Use of organic fertilizers/manures in order to avoid further release of nitrous oxides into the atmosphere;
- Proper waste management through recycling and reusing to avoid further release of more Carbon dioxide and methane gases into the atmosphere;
- Sensitizing/educating the masses about the dangers of deforestation/excessive use of carbon-based fuels;
- Setting strict laws/policies to help regulate the number of industries in the area;

17. (a)

Blood loss: Reduced blood volume led to weak heartbeat (due to low pressure and oxygen delivery) / unconsciousness due to low nutrient and oxygen supply to brain.

Head injuries led to brain damage/trauma and this disrupted coordination and consciousness.

Chest injuries resulted into difficulty in breathing due to damaged ribs or lungs.

Limb injuries (elbows and knees) caused damage to joints and muscles limits mobility and increases pain.

(b)

Recipient	Most Suitable Donors	Why?
Bbosa (A)	Q (A), R (O)	Q shares same group; R is universal donor/ lacking A and B antigens.
Nakiboneka (B)	P (B), R (O)	P shares same group; R is universal donor/ lacking A and B antigens.

Practical ways to improve future wellbeing

- Always wear helmets and protective clothing to prevent head and body trauma.
- Eat iron-rich foods to restore blood levels (e.g., beans, liver, spinach).
- engage in physiotherapy and light exercise to rebuild strength.
- seek counselling to cope with trauma and regain confidence.
- Regular medical checkups to monitor healing, blood pressure, and neurological health.

- Raise road safety awareness: share their experience to educate peers on safety and emergency readiness.

18. (a)

- **Respiratory system**: Smoking introduces tar and harmful chemicals that damage lung tissue, reducing elasticity and gas exchange. This led to chronic coughing, fatigue, and shortness of breath due to reduced oxygen intake.
- Cardiovascular system: Sugary sodas and fried foods increase cholesterol, excess weight and sugar levels. This promotes plaque buildup in arteries, raising blood pressure / increases the risk of heart disease and stroke.
- Urinary system: Poor diet and dehydration from sugary drinks may affect kidney filtration / high blood sugar and processed foods can lead to diabetes-related kidney damage or infections.

(b)

- Eat home-cooked meals with boiled or steamed foods instead of deep-fried / include affordable high-fibre foods like matooke, beans, groundnuts, greens, and fruits / reduce sugary drinks and drink clean water often.
- Quit smoking gradually to reduce effects on respiratory system.
- Physical exercises to burn out excess fats
- Regular health checkups for blood pressure, sugar level, and breathing assessments.

19. (a)

(i) Why Hussein Won All His Races

- Consistent Training on improved cardiovascular and muscular endurance/enhanced oxygen delivery and waste removal during exercise.
- Feeding on posho and beans: Provided carbohydrates for energy and proteins for muscle strength.

(ii) Why Ali Did Not Win and Collapsed

- Lack of Training led to Poor stamina, muscle fatigue, and inefficient oxygen use during running.
- Skipped Meals and he had low blood sugar (hypoglycemia) reduced available energy.

- Overconfidence Without Preparation/Talent alone couldn't compensate for physiological limitations.

(iii) Why Ali Regained Strength After Rest

- Rest in Shaded Area – Reduced body temperature and slowed metabolic demand. This allowed the heart rate and breathing to normalize.
- Glucose Administration boosted blood sugar, replenished energy and this supported brain and muscle recovery.

(b)

- Train consistently before events improve fitness, endurance, and mental discipline.
- Eat a balanced diet regularly – include carbohydrates, proteins and vegetables / eat before competitions to fuel performance.
- Stay hydrated / drink clean water throughout the day, especially before and after training.
- Get adequate rest and sleep to allow muscle recovery and mental focus.
- Avoid overconfidence or neglect – talent must be supported by effort and discipline.
- Understand your body / listen to signs of fatigue and take preventive actions like stretching and warming up.

20. (a)

Aim of the experiment (A)

An experiment to investigate the effect of the concentrations of solutions C and D on the specimen
Q so as to explain how the water from the boreholes affected the plants in the two gardens of Derrick.

Hypothesis (H)

Solution C has a higher solute concentration than the cells in specimens Q while solution D has a
lower solute concentration. Or
Solution D has a higher solute concentration than the cells in specimens Q while solution C has a lower solute concentration.

Variables in the experiment (V)

Independent variable; concentration of solutions C and D Dependent variables; change in length of the cylinders

Controlled variables; volume of solution C and D, initial length of the cylinders

Procedure (C)

1. Two petri dishes were labelled C and D
2. Using a measuring cylinder, 10 cm^3 of solution C and D was measured and placed into two separate petri dishes respectively.
3. Using a cork borer, cylinders were made out of specimen Q.
4. The cylinders were each cut to length 3 cm using a ruler
5. The cylinders were placed into the solutions C and D in the petri dishes for 20 minutes
6. After 20 minutes, the cylinders were removed and their length measured again.

Solutions	Initial length of cylinder (cm)	Final length of cylinder (cm)	Change in length	Texture
C	3			
D	3			

Results (D)

Analysis of results and conclusion (AR)

- Solution C was obtained from borehole B and D from borehole A
- Solution C has a higher concentration than the cells in specimen Q, water. By the process of osmosis, water moved from the cells in specimen Q with a lower solute concentration into the surrounding solution with a higher solute concentration. This caused the cells in specimen Q to become flaccid, thereby causing the whole tissue in specimen Q to become soft and shortened. This explained why the crops in Muto's Garden became dropped.

  Solution D has a lower concentration than the cells in specimen Q. By the process of osmosis, water moved from the surrounding solution with a lower solute concentration cell in specimen Q with a higher solute concentration. This caused the cells in specimen Q to become turgid, thereby causing the whole tissue in specimen Q to become hard and long. This explained why the crops in Muto's Garden became healthy.

21.

22. (a)
Specimens A and B are leaves (I)
Reasons: They have a lamina, they have mid-rib, they have veins, they have a leaf stalk.

(b) Specimens A led to poor yields because
- It has a narrow lamina which reduces surface area for trapping sunlight needed for photosynthesis and hence.
- Some regions of the lamina lack chlorophyll which reduces the amount of sunlight trapped resulting low rate of photosynthesis and hence low yields.

(c) A drawing of the specimen that caused poor yields/ A drawing of specimen A that caused poor yields.

23.
(a) (i)
Identity: Fruit ✓I2
Reason: two scars / seeds / pericarps ✓I2

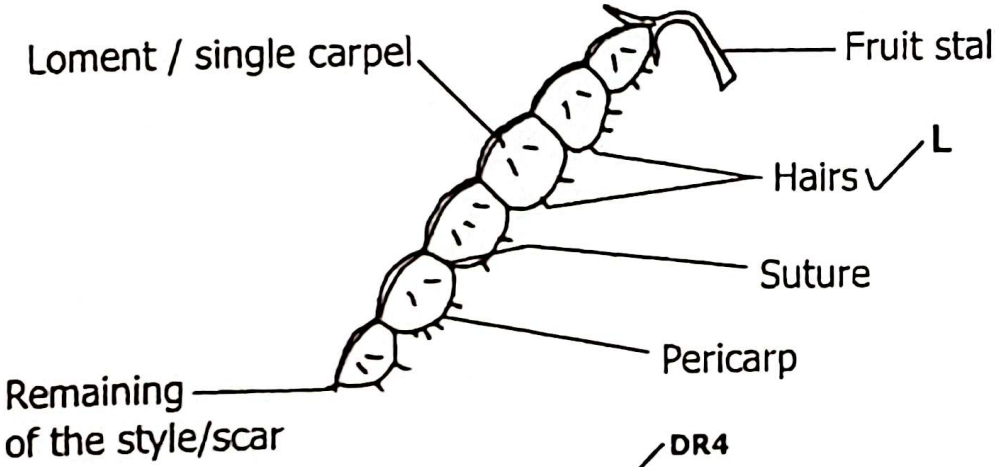
Or

Specimen	**X**	**Y**	**W**
Identity	Schizocarp	Caryopsis	Legume
Reason	Loment/segment/ mericarps Transverse lines of weakness	pericarp and seed coat fused together	longitudinal sutures / lines of weakness ✓I2

(ii)
Specimen **X**
- Has sticky hairs / hairs with hooks that attached on to Jane's clothes and later dropped off.
- Transverse sutures / lines of weakness which break into loments /segments / mericarps that drop off.

(b) Draw and label specimen X.

A DRAWING OF SPECIMEN **X** ✓ DR4



A ✓ DR4

O ✓ DR4

N ✓ DR4

X1 - X5 ✓ DR4

OR