

ELEMENT OF CONSTRUCT ONE**Cellular Organization, Respiration, and Molecular Analysis****ITEM 1: KIBULI SS**

Communities living near a battery recycling plant in Jinja District reported poor seed germination, stunted growth, yellowing leaves and reduced yields in bean plants grown around the factory. Farmers also observed that crops growing closer to the factory drainage channel were more severely affected than those grown farther away despite receiving similar rainfall and agronomic practices.

Environmental scientists suspected that untreated industrial effluents released from the recycling plant were responsible for the observed effects. Laboratory analysis of the effluents detected acidic wastes, heavy metals and traces of cyanide compounds. Soil and root samples from bean plants growing near the drainage channel and from plants growing in uncontaminated soil were analyzed. In addition, some bean plants growing near the drainage channel were found to dry out.

The findings are shown in Table 7.

Parameter	Bean plants in uncontaminated soil	Bean plants in contaminated soil
Heavy metal concentration in root tissues (mg g^{-1} tissue)	0.04	2.6
Percentage of actively dividing root tip cells (%)	82	24
Chromosome abnormality index (%)	4	58
Ethanol concentration in root tissues (mg g^{-1} tissue)	0.2	3.8
Rate of mineral ion uptake (mg g^{-1} root h^{-1})	11.3	2.7

Task:

(a) Analyse how the industrial effluents account for the observations shown in Table 7 and the condition of the bean plants.

(b) Evaluate the effectiveness of measures that farmers, factory managers and environmental authorities can implement to restore soil productivity and protect the surrounding communities.

ITEM 2: OUR LADY OF AFRICA NAMULYANGO

Brian had experienced recurrent chest infections and poor growth since childhood. Although he consumed adequate meals, he remained much thinner than his peers and often complained of fatigue during routine physical activities. Medical examination revealed that he was suffering from an inherited disorder that resulted in the accumulation of thick mucus around epithelial tissues lining the respiratory tract, pancreatic ducts and absorptive surfaces of the small intestine.

A laboratory report revealed the following about Brian.

Table 1:

Parameter	Healthy Adolescent of the same age	Brian
ATP production rate at rest (arbitrary units)	100	47
Rate of protein synthesis in body cells (arbitrary units)	100	51
Rate of cell division in body tissues (arbitrary units)	100	43
Skeletal muscle mass (% body mass)	42	24

Following the diagnosis, health workers recommended administering pancreatic enzyme supplements before meals, provision of oxygen therapy during severe respiratory distress and introduction of a balanced diet

Task:

- (a) Explain how the inherited disorder may have contributed to the differences observed in **Table 1** and the challenges experienced by Brian.
- (b) Evaluate the effectiveness of the proposed strategies in improving Brian's condition.

ITEM 3: NAMILYANGO COLLEGE

Moses is a 42-year-old manager at a food-processing factory in Kampala. For several months, he experienced persistent body weakness and frequent episodes of dizziness, particularly during mild evening jogging. Over time, he also developed frequent urination, excessive thirst and progressive weight loss despite maintaining a regular feeding routine. A minor injury sustained during jogging healed unusually slowly, and he occasionally developed yellowish eyes and passed out dark urine.

Medical investigations revealed prolonged exposure to industrial chemicals used in food processing and preservation. Some of the chemicals accumulated in body tissues and disrupted normal cellular functioning, as shown in Table 6 below.

Parameter	Healthy individuals	Moses
Average glycolytic enzyme activity in mature red blood cells (%)	95	28
Functional rough ER and Golgi apparatus in pancreatic cells (%)	94	33
Polymerase activity in most body cells (%)	96	31
Concentration of lactic acid during mild exercise	2.0	8.5

Following the investigations, the medical team recommended the following interventions:

- Mandatory use of appropriate protective gears by workers handling industrial chemicals.
- Regular medical screening and monitoring of workers exposed to industrial chemicals.
- Installation and maintenance of effective ventilation systems within the factory
- Continuous worker training on safe handling, storage and emergency response procedures related to industrial chemicals

Task:

- (a) Using the medical information table 6, explain how exposure to the industrial chemicals resulted in the health challenges experienced by Moses.
- (b) To what extent can the proposed interventions prevent other factory workers from developing the health challenges experienced by Moses?

ITEM 4: MT. ST. MARY'S NAMAGUNGA

Musa had worked as an industrial chemist in a factory that manufactured pesticides and industrial solvents for over 15 years. During this period, he was repeatedly exposed to low concentrations of some chemicals despite observing routine safety precautions.

Over time, Musa developed persistent fatigue, reduced physical endurance, slow recovery from minor injuries and progressive loss of body mass despite consuming adequate meals. Medical investigations revealed that one of the chemicals accumulated in body tissues and:

- caused alteration in the DNA bases responsible for producing certain membrane transport proteins in skeletal muscle cells;
- interfered with the functioning of the enzyme involved in the final stages of aerobic respiration.

Further investigations revealed that Musa had unusually high concentrations of amino acids in his blood and an elevated rate of amino acid deamination in the liver compared to healthy individuals.

To investigate the effects of the chemical on Musa's body, clinicians compared selected physiological parameters of Musa with those of a healthy worker of the same age and nutritional status at rest. The results are shown in **Table 2**.

Parameter	Healthy Worker	Musa
ATP concentration in skeletal muscle cells (arbitrary units) at rest	100	36
Rate of protein synthesis in skeletal muscle cells (arbitrary units)	100	46
Rate of tissue regeneration (arbitrary units)	100	31
Lean skeletal muscle mass (% body mass)	48	27

Following the diagnosis, health workers proposed the following strategies to improve Musa's condition:

- Immediate removal from further exposure to the chemical and transfer to a chemical-free work environment.
- Provision of a high-energy, high-protein diet.
- Use of gene therapy to restore the normal production of membrane transport proteins in skeletal muscle cells.

Task:

- (a) Analyse how exposure to the chemical caused the observed differences between Musa and the healthy worker.
- (b) Assess the effectiveness of each proposed intervention in improving Musa's condition.

ELEMENT OF CONSTRUCT TWO

Plant physiology and adaptation

ITEM 5: TRINITY COLLEGE NABBINGO

A farmer in Wakiso District established a nursery bed using two varieties of a cereal crop, Variety A and Variety B. Preliminary observations showed that the seeds of Variety A germinated rapidly and uniformly, while those of Variety B germinated slowly and irregularly. After four weeks, the seedlings were transplanted to a semi-arid region in northeastern Uganda where daytime temperatures frequently approached 40°C, soil moisture was low and daylight lasted approximately 14 hours per day throughout most of the growing season.

Several weeks after transplantation, plants of Variety A developed broad green leaves, flowered earlier and exhibited vigorous growth. In contrast, plants of Variety B produced relatively small yellowish leaves, flowered later and showed poor vegetative growth despite being grown under similar management practices.

Agricultural extension workers investigated selected characteristics of the two varieties. Their findings are shown in **Table 2**.

Parameter	Variety A	Variety B
Ratio of gibberellins to abscisic acid in germinating seeds	High	Low
Cytokinin concentration in young shoots (arbitrary units)	100	42
Critical photoperiod for flowering (hours)	12	15
Net photosynthetic rate at 40°C and low soil moisture ($\mu\text{mol CO}_2 \text{ m}^{-2} \text{ s}^{-1}$)	24.6	8.7

Task:

- (a) Analyse how the characteristics shown in **Table 2** contributed to the differences in germination, leaf development, flowering and growth observed between **Variety A** and **Variety B**.
- (b) Propose and evaluate strategies to improve the growth and productivity of **Variety B** in the region.

ITEM 6: OUR LADY OF AFRICA SS, MUKONO

A farmer had for many years successfully grown the same variety of a fruit crop in an open field where it consistently flowered and produced high yields under the prolonged bright sunny conditions experienced in her area.

Following the establishment of a cosmetics and pharmaceutical manufacturing industry in a neighbouring district, agricultural extension workers organized a workshop on the commercial production of trees that produce valuable plant excretory products. During the workshop, the farmer learnt that **essential oils** and **saponins** were in high demand for the manufacture of cosmetics, soaps and medicines. Hoping to diversify her source of income, she planted rows of fast-growing trees that produce these excretory products in one section of her fruit garden while leaving the remaining section as an open field. Both sections continued to receive similar amounts of fertilizer, irrigation and pest control throughout the growing season.

Several years later, after the trees had become well established, the farmer observed noticeable differences in the performance of the fruit crop growing in

the two sections of the garden despite similar agronomic management. She therefore invited agricultural researchers to investigate the observations. Their findings are shown in Table 1.

Parameter	Open field	Agroforestry section
Mean stem curvature (°)	4	29
Stem height: stem girth ratio	7.4	17.9
Mean number of days to 50% flowering	58	71
Mean fruit yield (t ha ⁻¹)	18.6	10.2

Task:

- (a) Analyse how the farmer's decision to integrate the fast-growing trees into one section of the garden accounts for the differences observed in Table 1.
- (b) Evaluate the farmer's decision to integrate the fast-growing trees into the fruit garden as a strategy for improving both household income and long-term food security.

ITEM 7: KIBULI SS

For many years, farmers in Fort Portal (1,500 m above sea level) successfully cultivated maize and beans under favourable environmental conditions. Beans consistently produced higher yields than maize.

Following increased human settlement and land shortage, some farmers relocated to Bundibugyo (900 m above sea level), where they established new gardens near the Sempaya Hot Springs. After several growing seasons, they observed that maize now produced higher yields than beans. However, when both crops were planted in soils close to the hot spring marshes, seedling establishment was very poor in both crops, although maize consistently recorded slightly higher seedling survival than beans.

Agricultural extension workers investigated the situation and obtained the results shown in Table 1 below.

Parameter	Maize	Beans
Net photosynthetic rate under high temperature and intense light (arbitrary units)	104	49
Mean glycolate concentration in leaves (mg g^{-1} fresh mass)	2.4	17.8
Mean stomatal conductance ($\text{mmol m}^{-2} \text{s}^{-1}$)	118	236
Percentage seedling survival in saline marsh soil (%)	6	4

The extension workers proposed the following strategies to improve crop productivity in the area:

- Establish salt-tolerant vegetation around the hot spring marshes.
- Irrigate crops using water obtained away from the hot springs.
- Introduce crop varieties with improved tolerance to salinity and high temperature.
- Relocating to another area

Task:

(a) Account for the differences in the productivity and seedling survival of maize and beans under the environmental conditions described.

(b) To what extent are the proposed strategies likely to be effective in improving crop productivity around the Sempaya Hot Springs?

ELEMENT OF CONSTRUCT THREE:**Humans and Animal Physiological Integration****ITEM 8: KIBULI SS**

Helly, whose blood group was A⁻, was five months pregnant with her first child when she and her husband Kelly (blood group A⁺) were involved in an accident during a field excursion to the rocky slopes of Mount Elgon. Helly lost a large amount of blood and received emergency treatment. During the same incident, she brushed against stinging nettle plants and developed mild itching around the affected skin.

Helly later recovered and gave birth to her first child, Aisha. Two years later, she conceived again but missed routine antenatal care. During this pregnancy, she again came into contact with stinging nettle plants while collecting firewood. This time, she developed widespread skin redness, severe itching, rapid breathing and dizziness. Shortly after birth, her second baby, Brick, was admitted for medical examination. The results obtained are shown in Tables 8a and 8b.

Table 8a: Clinical findings in the two newborns

Parameter	Aisha	Brick	Normal infant reference
Blood group	A ⁺	A ⁺	—
Yellowing of the sclera	Absent	Marked	Absent
Degree of anaemia	None	Severe	None
Liver and Spleen size	Normal	Enlarged	Normal

Table 3b: Physiological responses following exposure to stinging nettle.

Parameter	First exposure	Second exposure	Normal reference
Histamine concentration (ng mL ⁻¹)	3.4	14.9	0.3–1.0
Heart rate (beats min ⁻¹)	84	120	70–100
Breathing rate (breaths min ⁻¹)	20	34	12–20

Action potential frequency in pain receptors (Hz)	24	50	0–5
Skin blood flow (mL min ⁻¹)	96	215	80–120

Clinicians proposed the following interventions:

- Administer anti-Rh immunoglobulin to eligible Rh-negative mothers.
- Monitor newborns at risk and provide appropriate treatment
- Remove embedded stinging hairs from the skin as soon as possible and administer antihistamines where appropriate.
- Administer adrenaline and closely monitor respiratory and cardiovascular function in patients with severe allergic reactions.

Task:

(a) Analyse how the events experienced by Helly account for the observations shown in Tables 3a and 3b.

(b) Evaluate the effectiveness of the proposed interventions in preventing and managing the observed complications.

ITEM 9: NABISUNSA GIRLS SS

Rose, Shamim and Keren gave birth within the same month and attended the same health centre for antenatal and postnatal services. During the first year after birth, a measles outbreak occurred in their community. Health workers observed that Rose's baby developed only mild symptoms and recovered quickly, whereas the babies of Shamim and Keren experienced severe infections and required repeated medical attention. Differences were also observed in the babies' social behaviour and attachment to their mothers.

To investigate the possible causes of these differences, medical officers collected the information shown in Table 4.

Parameter	Rose	Shamim	Keren
Number of times the baby is breastfed in 24 hours	8	3	8
Mother's immunization during pregnancy	Yes	Yes	No

Baby's immunization after birth	As recommended	No	Irregular
Baby rejects people other than mother	Yes	No	Yes

Task

- (a) Analyse the causes of the differences in the severity of measles infection among the babies.
- (b) To what extent did the practices of the three mothers promote the survival and wellbeing of their babies?

ITEM 10: KAWEMPE MUSLIM SS

A troop of baboons inhabited a highland forest reserve where temperatures were normally moderate throughout the year. However, an unexpected cold spell caused temperatures to fall sharply for several consecutive days. Following the incident, smaller baboons, particularly juveniles, became inactive more quickly and showed signs of hypothermia more frequently than larger adults.

Researchers observed that the baboons frequently huddled together during cold mornings. Adult females often positioned themselves around the juveniles, while one old female repeatedly remained on the outer edge of the group throughout the night, exposing herself to the extreme cold while shielding the younger members of the troop.

To investigate the influence of body size on survival during the cold spell, researchers compared selected physiological parameters of smaller and larger baboons during cold exposure. The results are shown in Table 7.

Parameter	Smaller Baboons	Larger Baboons
Core body temperature during cold exposure (°C)	34.1	37.4
Number of action potentials generated by thermoreceptors (impulses min ⁻¹)	640	210

Heart rate during cold exposure (beats min ⁻¹)	148	92
Position of oxygen dissociation curve during cold exposure	More right-shifted	Less right-shifted

Task:

(a) Analyse how the physiological differences in table 7 contributed to the survival of the smaller baboons during the unexpected cold spell.

(b) Evaluate the effectiveness of the following in promoting the survival of the baboon troop during future cold spells:

- i. Provision of supplementary food by wildlife officials.
- ii. The natural survival strategies exhibited by the baboons.

ITEM 11: UBUNTU HILL SCHOOL

During the National Olympic selection trials at Soroti Sports Complex (altitude 1,130 m above sea level; average daytime temperature 31°C), athletes participated in endurance runs, sprint drills, balance tests and reaction-time assessments.

Mariam, who had trained at Kakindu Stadium in Jinja District (altitude 1,120 m above sea level), developed extreme body weakness, rapid heartbeat and shortness of breath during an uphill endurance run. She also failed to maintain balance during rotational movement tests, exhibited delayed responses to the starter's gun and eventually collapsed before completing the final event.

Jane, who lived and trained on the slopes of Mount Elgon in Kapchorwa District (altitude 2,300 m above sea level; average temperature 21°C), completed all activities successfully and qualified for the national team. Medical records further indicated that Mariam had recently recovered from a condition that had affected some of her peripheral nerves.

The national athletics medical team obtained the results shown in Table 8.

Parameter	Jane	Mariam
Blood oxygen saturation (%)	95	84
Stroke volume (mL beat ⁻¹)	125	96
Relative viscosity of endolymph in the semicircular canals	Low	High
Percentage of functional Schwann cells surrounding motor neurones (%)	96	71

One physician recommended immediate administration of pure oxygen and a concentrated glucose solution, while another recommended a period of high-altitude residence and training.

Task:

- Using evidence from table 1 and pre-selection training environments, account for the differences in performance between Mariam and Jane during the selection trials.
- Evaluate the effectiveness of the proposed interventions in improving Mariam's health and athletic performance.

ITEM 12: GAYAZA HIGH SCHOOL

During an educational field excursion to Queen Elizabeth National Park at the end of a prolonged dry season, Biology students visited several watering points during the hottest hours of the day. Air temperatures exceeded 38°C, surface water was scarce and many grazing areas had dried up.

The students observed that hippopotamuses remained submerged for long periods, buffaloes frequently wallowed in mud, elephants rested beneath trees while spraying themselves with water and dust, and Uganda kobs grazed mainly during the early morning and late evening.

Researchers compared selected physiological parameters of these mammals under cool morning conditions and during the hottest part of the day. Their findings are presented in Table 1.

Parameter	Cool morning	Hot afternoon
Mean skin blood flow (arbitrary units)	42	91
Mean plasma osmolarity (mOsm kg ⁻¹)	288	307
Mean plasma ADH concentration (pg mL ⁻¹)	3.2	9.6
Mean cardiac output (L min ⁻¹)	16.5	24.8
Mean core body temperature (°C)	37.2	37.5

Task:

- (a) Analyse how the environmental conditions experienced during the hottest part of the day account for the physiological changes shown in Table 1.
- (b) Evaluate the extent to which the observed behavioural adaptations among the mammals are likely to enhance their survival during prolonged hot, dry conditions.

ELEMENT OF CONSTRUCT FOUR

Genetic, evolutionary, and ecological dynamics

ITEM 13: ST. HENRY'S KITOVU

Over a period of 15 years, increasing human settlement around Kidepo Valley National Park resulted in extensive clearance of woodland vegetation for agriculture, charcoal production and fuelwood. During the same period, prolonged droughts became more frequent and severe, while wildfires occurred repeatedly during the dry seasons. Consequently, the abundance of many shrubs and medium-seeded plants declined, whereas drought-resistant grasses producing very small seeds and a few woody tree species bearing large, hard-coated seeds became increasingly common.

Researchers studying a native finch species observed that, before these environmental changes, most birds possessed beaks of intermediate size. Over time, birds with noticeably smaller or larger beaks became increasingly common, whereas those with intermediate-sized beaks became rare. The findings obtained are shown in Table 1.

Parameter	2010	2015	2020	2025
Mean abundance of medium-sized seeds (kg ha^{-1})	92	61	29	11
Small-beaked finches (%)	12	24	40	46
Intermediate-beaked finches (%)	76	52	20	8
Large-beaked finches (%)	12	24	40	46

In addition, researchers made the following observations:

- Hawk populations increased whereas snake populations declined.
- Bird species feeding mainly on insects became less abundant.
- Seed germination of native shrubs declined markedly in frequently burnt areas.
- Nesting success of the finches was lowest during years with the most extensive fires.

Task:

- (a) Explain how the human activities and the resulting environmental changes account for the observations shown in Table 1 and the additional observations.
- (b) Propose and evaluate the various interventions in restoring ecosystem stability and conserving the finch population in Kidepo Valley National Park.

ITEM 14: SEETA HIGH SCHOOL, MAIN COMPUS

Communities around a large wetland in Eastern Uganda depended on fishing as their major source of income. The wetland originally supported a fish species that occurred as two ecological varieties, one found mainly in shallow waters and the other in deeper parts of the wetland.

As the human population increased, fishermen increasingly used small-mesh nets in shallow waters, resulting in a marked decline in the shallow-water variety. Reduced fish catches later prompted many community members to convert parts of the wetland into crop gardens, fragmenting it into four isolated swamps.

Several years later, environmental authorities restored the wetland, and prolonged rainfall reconnected the swamps into a single large wetland. When controlled fishing resumed, fishermen observed that the original fish species was still present but less abundant than before. They also recorded several fish populations that differed in body colouration, habitat preference and feeding behaviour. Researchers investigated the fish populations and obtained the results shown in **Table 1**.

Parameter	Before fragmentation	Current population
Relative abundance of the shallow-water variety (%)	68	19
Relative abundance of deep-water fish variety (%)	32	53
Number of fish species recorded	1	4
Mean heterozygosity (%)	84	41
Number of feeding niches occupied	2	5

Task:

(a) Analyse how ecological and genetic factors account for the observations shown in **Table 1**.

(b) Suggest and evaluate the strategies to conserve fish biodiversity in the restored wetland

ITEM 15: KINGS COLLEGE BUDDO

Communities living along River Namatala depend on fishing for food and income. For many years, the river supported a highly palatable native fish species that was widely consumed and sold in local markets. However, over the last two decades, untreated organic sewage from nearby settlements has increasingly been discharged into the river. Fishermen observed a decline in the native fish and a rapid increase in a less preferred invasive fish species, raising concerns about food security and household incomes.

Ecologists discovered that tolerance to the prevailing river conditions in the invasive fish is controlled by a dominant allele A, while susceptibility is

controlled by a recessive allele *a*. To investigate the observed changes, ecologists compared historical records with data collected from the river during the current season. Their findings are shown in Table 1.

Further analysis of the current invasive fish population showed that 900 out of every 10,000 individuals exhibited the oxygen-intolerant phenotype.

Table 1

Parameter	Before sewage discharge	Current population
Dissolved oxygen concentration (mg L^{-1})	8.4	2.1
Relative abundance of native fish (%)	82	18
Relative abundance of invasive fish (%)	18	82
Frequency of low—oxygen tolerant phenotype (%)	64	91

At the end of the survey, ecologists proposed treating of sewage before discharge into the river, pouring warmer water into heavily polluted sections of the river and restocking the river with the native fish species.

Task:

- (a) (i) Analyse how human activities contributed to the observed changes in fish populations and oxygen-tolerance traits in the river.
- (ii) Predict the likely future changes in fish populations and allele frequencies if the current environmental conditions persist.
- (b) Assess the effectiveness of the proposed interventions in improving food security, conserving biodiversity and influencing future allele frequencies in the fish populations.

ITEM 16: GOMBE SECONDARY SCHOOL

Farmers participating in a large cabbage-growing scheme near Lake Kyoga experienced severe destruction of cabbage leaves by caterpillar pests. To control the infestation, they repeatedly applied the same broad-spectrum

pesticide over several growing seasons. Although the pest population initially declined, the infestation later became more severe than before pesticide application.

At the same time, nearby sections of Lake Kyoga became increasingly covered by water hyacinth. Fish kills became more frequent, and populations of fish-eating birds declined noticeably. Investigations by the National Environment Management Authority (NEMA) revealed that runoff from the cabbage gardens was entering the lake ecosystem. They also reported extensive use of fertilizers in the cabbage fields.

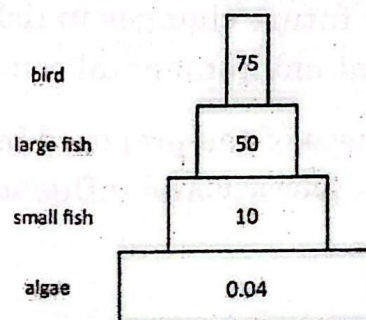
The study also established that resistance to the pesticide in caterpillars was controlled by a dominant allele (R), while susceptibility was controlled by a recessive allele (r).

Selected findings from the investigation are presented in Table 4 and Figure 1.

Table 4: Ecological and genetic changes observed in the study area

Parameter	Before intensive pesticide use	Current condition
Percentage of resistant caterpillars (RR + Rr)	18	91
Percentage of susceptible caterpillars (rr)	82	9
Mean number of predatory insects per cabbage garden	84	11
Average cabbage yield (kg acre ⁻¹)	1240	520
Dissolved oxygen concentration in lake water (mg L ⁻¹)	9.4	3.1

Figure 1: pesticide concentration at different food chains in the lake



Based on the findings, NEMA proposed the following interventions:

- Adopt Integrated Pest Management (IPM).
- Control water hyacinth using mechanical and biological methods.
- Regular monitoring of water quality to detect and control eutrophication.

Task:

- (a) Explain how human activities contributed to the observed changes shown in table 4 and figure 1.
- (b) Justify the proposed interventions for restoring biodiversity, ecosystem stability and sustainable food production in the study area.

ITEM 17: KAKUNGULU MEMORIAL SCHOOL

During an ecology field study at **Sempaya Hot Springs**, Biology students visited an area where prolonged geothermal activity had exposed a new rocky surface. Over time, pioneer organisms colonised the cooler surrounding rocks and were gradually replaced by a diverse plant community. However, increasing tourist trampling, firewood collection and livestock grazing later removed much of the vegetation, exposing patches of bare ground.

In contrast, vegetation growing near the hot spring salt marshes remained exposed to high temperatures throughout the year. Researchers observed that these areas became increasingly dominated by naturally heat-tolerant flowering plants, while many heat-sensitive species became less common. Laboratory investigations showed that enzymes extracted from the heat-tolerant plants remained active at temperatures that caused enzyme denaturation in neighbouring species.

When two heat-tolerant plants were crossed, 612 out of 810 offspring survived under hot spring conditions, while 198 failed to survive. The findings are presented in Table 1.

Parameter	Immediately after disturbance	Recovering area (10 years later)	Undisturbed community
Mean soil depth (cm)	0.4	11.3	43.2

Plant species richness	3	22	64
Percentage vegetation cover (%)	7	56	97
Number of ecological niches occupied	2	11	28

Researchers proposed the following strategies to restore the degraded ecosystem around the hot springs:

- Introduce pioneer plant species onto newly exposed ground.
- Add organic compost to accelerate soil development.
- Propagate naturally heat-tolerant plants in degraded hot spring marshes.
- Transfer the heat-tolerance characteristic into other pioneer species using biotechnology.
- Restrict livestock grazing, tourist trampling and firewood collection in regenerating areas.

Task:

- (a) Analyse how ecological, evolutionary and genetic factors account for:
- (i) the observations shown in Table 1.
 - (ii) the increasing dominance of heat-tolerant plants around the hot spring marshes and the pattern of inheritance of heat tolerance among the offspring.
- (b) Evaluate the extent to which the proposed strategies are likely to restore and conserve the ecosystem around the hot springs.

END.