O' Level

Biology

Integrated With Technology

LEARNER'S BOOK

NCDC
NATIONAL CURRICULUM
DEVELOPMENT CENTRE

FOR GOD AND MY COUNTRY
THE REPUBLIC OF UGANDA
Ministry of Education and Sports

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Contents

Background

This Learners' Handbook contains information on Biology Integrated with Technology activities related to topics in the UCE Biology Curriculum. The practical activities in this Handbook provide an economical product or provide a service. Comparing it to a number of Biology textbooks, that have the conventional practical activities, most of which are done in school laboratories, do not directly relate to everyday life experiences.

Foreword

It should be appreciated that Science and Mathematics are key learning aspects that play a vital part in our lifestyle. At home, within a community, national and internationally learners meet with Science and Mathematics functional knowledge. Therefore, the need to broaden an understanding and skill development is of paramount importance for sustainable development.

We find it easier to carry out scientific and Mathematics activities outside the classroom for example making garments, bread, alcohol, ice cream and furniture. All these activities are directly related to what is learnt in Sciences and Mathematics at school but no reference to them is done thus making these subjects abstract and less interesting. This is to appeal to the users of this book to avoid neglecting innovations that guide learning but embrace all the Science/ Mathematics concepts in the curriculum.

Preface

The major reason for undertaking this new approach to teaching-learning Sciences and Mathematics at O level is to improve the academic achievements and interest of learners.

The idea of integrating Technology into Sciences and Mathematics at lower secondary education was conceived after realizing that Science and Mathematics teaching at this level hardly generated interest in the learners. In addition, these learners were lacking in practical skills and rarely applied Science and Mathematics to everyday life situations.

The National Curriculum Development Centre (NCDC) has developed this new approach of teaching Science and Mathematics by including practical activities that enable learners to come up with products or be able to offer services to the community leading to national sustainable development by generating their own income.

Acknowledgement

This book was developed and prepared in a series of writing and discussion workshops organised by the National Curriculum Development (NCDC) between 2007 and 2011.

I wish to acknowledge the contribution of the subject panel members, teachers and learners from various schools who participated at trial activity phase and other education stakeholders that provided input and direction of this material.

I am grateful to all those who worked behind the scenes for the commitment in ensuring the work is done and feedback from the field is incorporated. I also thank the African Development Bank (ADB) Project Phase-III for the financial support.

Last but not least, I wish to recognise agencies, companies and websites for the reference materials and pictures used in this book.

Connie Kateeba
Director NCDC

Introduction

The idea of integrating Biology with Technology is a result of efforts to improve performance and developing an interest in the Biology teaching-learning process. It involves integrating the Biology concepts taught into real-life experiences.

The integration of the principles of Biology with Technology encourages the application of theoretical knowledge to sustainable economic development. It aims at providing information and knowledge to learners that can be used to develop competences that can result in the provision of a service and/or a commercial product. Entrepreneurial skills are integrated with biological concepts with a view to achieving academic excellence and economic development.

Rationale

The purpose of developing a learner's book which integrates Biology with Technology is to guide the teaching-learning process towards academic achievement by applying the knowledge acquired in a classroom setting to real-life experience. Learners should develop the ability to use abstract knowledge or concepts to develop a commercial product or provide a service with a view to improving the standard of living and achieving sustainable development.

Use of the Learner's Handbook

This handbook is intended for learners of Biology at Ordinary Level of education. It will help to enhance the implementation of the Biology subject principles to everyday life experiences. The benefits of integrating Technology into Biology are to, among others:

- generate interest in the teaching-learning process, through the application of acquired scientific knowledge to new situations and economic development.

- encourage the use of challenging tasks to discover knowledge/ information, develop skills of innovativeness (creativity), and interactivity in addition to critical thinking competences.
- acquire skills for providing services and making products for consumption and sale.
- attain academic excellence.

The learner, therefore, is expected to transfer the knowledge acquired or relate academic concepts to everyday life by becoming innovative and improving the quality of life in the community.

How to Use this Handbook

This handbook is meant to be used together with the class notes or the Biology syllabus. In order to understand the concepts contained in this book, you should have prior knowledge of Biology which you will relate to the given activities.

The handbook includes:

- Guidelines on Biology integrated with Technology concepts, in which an economic activity is indicated or may be developed.
- Competences that you the learner should develop when carrying out the activities.
- Follow-up activities to enhance further learning of the Biology concepts or how you can apply the knowledge attained in other areas or similar activities.

What to learn

Biology integrated with Technology should have a positive influence on the teaching-learning process through enabling the learner to:

- develop an interest in learning biological principles and understanding the significance of concepts to everyday life.

- understand ways in which human beings influence the natural trends in the environment and communities for economic development.
- apply the Biology knowledge further in day to day life phenomeno.
- recognise the use of biological concepts to solve problems and improve standards of living.
- communicate accurate biological facts for sustainable education and development.
- design and develop procedures for carrying out investigations related to the community values and economic development.
- develop the ability to interpret data and write logical, precise and clear reports leading to the production of a product or service of value in our day-to-day lives.
- use available resources, local materials and facilities to carry out project work/research to obtain information that improves the quality of community life.
- relate various concepts and explain their relationship to phenomena in the environment.
- harmonise scientific information with prior experiences in order to predict the future impact on everyday life.

Assessment

i) **Continuous assessment**

It is recommended that the teacher carries out continuous assessment basing on concepts/topics, through tests, quizzes, assignments, concept paper presentations in seminars, projects, experimental activities, etc. The assessment should reflect the acquisition of the following testable competences or learning outcomes:

a) Knowledge of:

- principles and generalisation identified in the syllabus.
- trends and sequences of phenomena.
- classification and categorising.

- investigation, procedures and techniques or methods.
- conventions and accurate presentation of facts.
- ways and means of defining terms and specifics.

b) Comprehension ability to:

- translate facts and communicate knowledge accurately in correct language.
- interpret and explain concepts.
- extrapolate, describe and determine the implications or effects of a phenomenon.

c) Application ability to:

- use abstract knowledge or situations to solve a problem.
- design and develop a project activity that is based on the value of service and providing quality life.
- be creative and innovative in producing items that are of commercial value to society.
- manage and predict future environmental effects and carry out sustainable development.

d) Analysis of:

- items through identification.
- relationships and interaction of principles/concepts.
- principles, systematic arrangement/organisation and structure of concepts.

e) Synthesis ability to:

- develop ideas from experiences and knowledge.
- plan a set of activities basing on situations or the information provided.

- make deductions from the data provided.

f) Evaluation of:

- terms and logical communication of knowledge.
- judgement of external criteria, materials and information.
- evidence, accuracy and consistency of information.

g) Practical abilities to be developed include:

- application of knowledge to practical situations.
- manipulation of apparatus and performing experiments or integrating theory.
- making and recording observations accurately, or demonstrating understanding.
- presentation of data in an appropriate form, or in a selected format.
- drawing conclusions from observations made or responses.
- assessing the suitability of the procedure, experiment and observations made in support of the conclusion.
- making drawings of natural structures accurately.

ii. Summative assessment

The Uganda National Examinations Board (UNEB) will administer a Biology principal subject examination at the end of the fourth year of study.

The test blue-print developed for this examination is based on the Biology teaching syllabus content specifications. UNEB will also provide the regulations for the examination.

Note. The examination comprises the same set of papers that are traditionally used in the standard Biology subject examinations and based on any part of the teaching syllabus. The format is indicated below.

Examination Format

There will be two papers (a theory paper and a practical paper).

Theory paper (2 ½ hours)

The theory paper will consist of three sections**: A, B and C.**

Section A consists of multiple choice questions **(30 marks).**

Section B consists of structured questions **(40 marks.)**

Section C consists of four essay questions. Candidates will answer only two questions in this section **(30 marks).**

(Total: 100 marks)

Practical paper (2 hours)

The paper will consist of three compulsory questions (**60 marks).** The questions set may be on explanatory notes of new or unfamiliar biological data which may include photographs. Questions requiring laboratory practical procedures will also be set.

Note: For further information on assessment of the Biology examinations, refer to UNEB regulations.

Target

At primary school level Biology concepts were briefly mentioned in the Science subject content. Therefore, a link between Primary Science and Secondary Biology knowledge will be helpful. This book is aimed at guiding and enhancing understanding of Biology content and developing the skills of learners at lower secondary school level for sustainable education and economic development.

Learners should follow the Biology curriculum content and use the book to supplement the knowledge, with the help of application activities related to everyday life. Creativity or innovation by learners is encouraged to ensure that economic benefits and academic excellence are attained. Additional or different activities may be carried out but accuracy of knowledge and facts should be considered.

Scope and Depth

This Learner's handbook supplements the activities and concepts developed from detailed content harmonised with the principal Biology curriculum covered during Biology lessons with the teacher. The units were designed to ensure that the learner covers detailed theory concepts and supplements them with practical activities, and they integrate practical application skill development into the learning process.

The following table summarises a sequence of topics for Biology Integrated with Technology units:

Topic	*Sub-topic*
1.0 Diversity of Living Things	*1.1 Introduction to Biology*
	1.2 Classification
	1.3 Hand Lenses and Microscopes
	1.4 Animal and Plant Cells
	1.5 External and Internal Features of Flowering Plants
	1.6 Economic Importance of Insects
2.0 Soils	*2.1 Soil Formation, Composition, Profile and Components*
	2.2 Soil Properties and Soil Conservation
3.0 Nutrition in Organisms	*3.1 Nutrients*
	3.2 Nutrition in Plants
	3.3 Nutrition in Animals
	3.4 Nutrition in Fungi
4.0 Transport in Plants and Animals	*4.1Transport in Animals*
	4.2 Transport in Plants

5.0 Gaseous Exchange and Respiration	*5.1 Gaseous Exchange*
	5.2 Aerobic Respiration
	5.3Anaerobic Respiration
6.0 Excretion and Homeostasis	*6.1 Excretion in Plants*
	6.2 Excretion in Animals
	6.3 Homeostasis
7.0 Coordination in Plants and Animals	*7.1 Response in Plants*
	7.2 Chemical Coordination in Vertebrates
	7.3 Response in Animals and Behaviour
	7.4 Receptor Organs in Mammals
8.0 Locomotion	*8.1 Locomotion in Mammals*
	8.2 Locomotion in Insects, Birds and Fish
9.0 Growth and Development in Plants and Animals	*9.1 Growth and Development in Plants*
	9.2 Growth and Development in Animals
10.0 Reproduction in Organisms	*10.1 Asexual Reproduction in Lower Organisms*
	10.2 Asexual Reproduction in Plants
	10.3 Sexual Reproduction in Plants
	10.4 Sexual Reproduction in Animals
11.0 Genetics and Evolution	*11.1 Mitosis and Meiosis*
	11.2 Genetics
	11.3 Evolution and Variation
12.0 Interrelationships	*12.1 Food Chains and Webs*
	12.2 Changes in Population
	12.3 Associations in Organisms
	12.4 Human and Natural Environment

Chapter 1: DIVERSITY OF LIVING THINGS

Introduction

The diversity of living things involves the grouping, identification and classification of organisms based on the characteristics of living things that indicate variations. These characteristics are discovered through studying organisms (Biology) and these studies are split into various branches, such as zoology (the study of animals), botany (the study of plants), ecology (the study of organisms in relation to surroundings), anatomy (the study of organisms' structure), physiology (the study of the functioning of body systems), nutrition (the study of food and feeding) and heredity/genetics (the study of how parents pass on characteristics to offsprings), among others.

The external and internal features of living things are necessary in the study of organisms and their role in everyday life. These features are controlled by body cells whose ideal structure is revealed through using microscopes and / or hand lenses which are also used to magnify and study other parts of living things.

The findings of these studies are used to formulate standard biological guiding statements or questions that are set using biological keys to explain the diversity of organisms.

Requisite Knowledge

- *Characteristics of living things and non-living things*
- *Names of common groups of organisms*

Outline of major concepts

1.1 Introduction to Biology

1.2 Classification

1.3 Hand lens and microscope

1.4 Animal and plant cells

1.5 External and internal features of flowering plants

1.6 Economic importance of insects

1.1 Introduction to Biology

Inquiry question: *Using your knowledge of primary school Science, indicate the areas that are directly related to the study of living things which apply to everyday life experiences at home and in the community. In what ways do they lead to economic development and improved standards of living*?

Background information

Biology is the study of the world in which we live, through controlled and orderly observations and innovations. We study Biology in order to understand and apply knowledge of living things to everyday life. Its goal is to enable us to know ourselves and certain associations that determine sustainable development in the world in which we live.

Several Biology subfields have explained special ways of looking at living things. These have led to the acquisition of information on the mode of life systems and integration into the socioeconomic development activities of the community and the environment. Therefore, Biology is not the kind of 'space' in which you should look for improved standards of living only but also develop your ability to critically think and creatively apply knowledge, to understand the universe.

You should be able to:

- Show the importance of Biology in everyday life by linking it to primary Science.
- Predict the value of studying Biology in improving the quality of life

and national development.

Activity 1.1.1 Information on Myths and Indigenous Science

Aim To develop an interest and appreciation of the information on the study of living things.

What you need

- Writers or a musical and drama club activity theme.
- Resource person.

Note

- Work with a friend or in a place where you can freely reflect and predict the future or life after school.
- Use your talent to discover your professional skills, interest or hobby.

What to do

In a group:

- Make a list of professions or types of specialised work that require knowledge of biological Science to produce a product or to provide a service. Consider the areas of nutrition, health, education, environment, tourism, agriculture, sports Science, etc.
- Plan activities based on your professional/specialist choice list, in a role play either by writing a story/a poem/a music piece/drama presentation on the person you want to become in future.
- Present what you have written to your class/school.
- Visit the professional or specialist of your choice at their workplace in your community and offer voluntary service time of two hours per month so that you can develop the community service skills of the resource person.

Explanatory note

Use indigenous Science knowledge to demonstrate your talent and abilities towards work and community development.

Expected results

To develop interest and innovations related to biological concepts.

At the workplaces or in the community service area, activities vary from being part of the support staff to being a professional staff member. Ensure that you belong to one of the groups.

Conclusion

Write a summary report on your role as a specialised worker in the community.

Evaluation

You are planning a weekend trip to have new experiences. What facts do you need to know and how would you plan for your well-being and safety?

Follow-up activity

- Use the skills attained as a community service worker to participate in an economic development activity. Study examples in ***fig.1.1a.***

Fig.1.1a Various service workers. Which of them reflects your future professional choice?

Activity 1.1.2 Public Speaker

Aim

To develop skills in self-help projects of the community.

What you need

Resource person, classmates or friends

Note

The topic of discussion should encourage team work so as to improve standards of living.

What to do

Organise a debate or public talk on the role of a biological scientist or profession on community development.

Ensure that you prepare highlights on how to work together to protect the environment and bring about community economic development.

Explanatory note

Ensure that you educate the community and fellow students. Participate in simple activities such as providing first aid or maintaining a clean school and community environment.

Expected results

Explain the role of an environmental club or a health and sanitation club or association in your school.

Conclusion

Produce an activity plan and demonstrate it to the school administration or class. Ensure that you are a role model to the school and community.

Evaluation

Assume that a scientist has an idea that can significantly alter our way of life. Suggest ways of implementing the idea to improve the living standards of the community.

Follow-up activity

- Organise a patriotism association in which members are registered at a fee to provide a commercial community-based service, e.g. tree planting, waste management/rubbish collection, room cleaning (clinics, salons, toilets, markets/shopping areas, homes, water sources or roads), agricultural services, etc.

1.2 Classification

Inquiry Question: *What is the possible criteria that can be used in grouping living things and non-living things?*

Background information

The diversity of living things is reflected in the many kinds of organisms that exist in the universe. Scientifically, organisms are classified and arranged into groups known as taxa (plural). The singular is taxon.

Taxon is comprised of a group of organisms that have common features that distinguish them from other groups of organisms. Closely related organisms are grouped according to the following levels of taxa, starting from the largest group of classification, as illustrated in **fig. 1.2a** below:

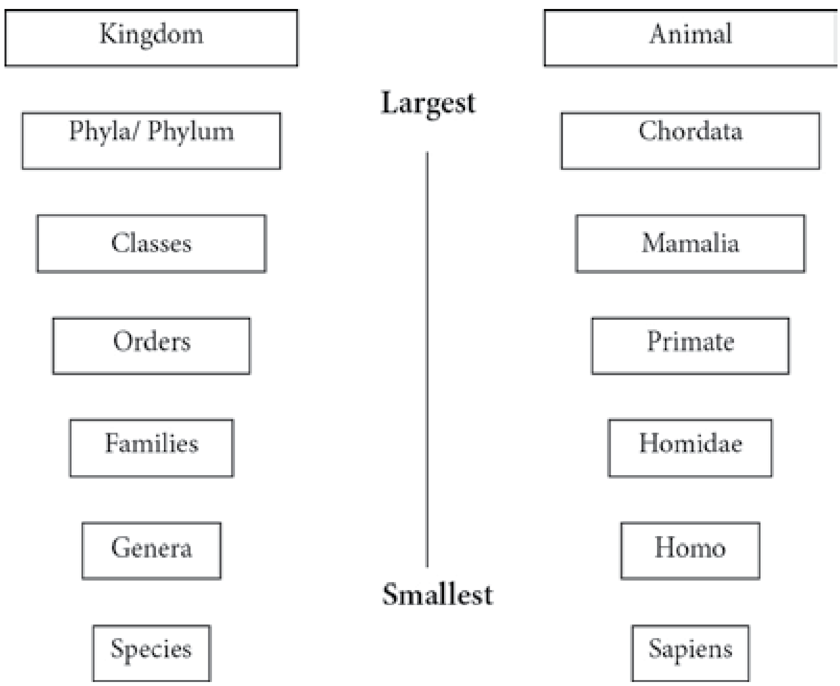


Fig. 1.2a Descending taxa.

Study it and compare it with various groups of organisms, e.g. animals.

Living things are classified and named on the basis of various features and characteristics. In the late 1800's, a biologist, Carl Linnaeus, developed a basic binomial system for classifying organisms. According to this system, an organism, once identified, is given a binomial name constructed from the generic name and the specific name, thus forming the scientific name.

The scientific name of an organism is developed from the genus and species resulting in the binomial theory, e.g. man is a *Homo sapiens*, domestic cat is *Felis catus,* maize is *Zea mays*, etc. The common names are not normally used because they are not universal. In addition, they may be applied indiscriminately in the same language or in different languages or regions.

Biological keys, referred to as dichotomous keys, are used in the identification and grouping of unknown organisms or specimen. The dichotomous key is constructed using a pair of statements referring to the alternative characters of the unknown specimen. During construction of the keys, indicating the differences and similarities in the characteristics of the unknown organism or specimen is used as a basis for grouping together or separating the unknown items.

Sampling methods used to estimate the number of organisms in a community area during classification is vital for economic development planning. This population growth of organisms determines the future trend of environmental impacts.

You should be able to:

- State the identification features of organisms, using the characteristics of living things and non-living things.
- Construct and use a biological key to identify organisms.
- Use quantitative sampling methods of collecting organisms and determining population density.

Activity 1.2.1 Organising Items in a Home

Make a list of items you can name in your home.

Aim

To categorise items to create order and a well-planned environment.

What you need

A list of items from your home or dormitory.

Note

Name both living things and non-living things in summary form.

What to do

- Study the items in your home or dormitory.
- Group them according to the items found in specific rooms or outside the house or dormitory, e.g. bathroom, bedroom, kitchen, dining room, sitting room, reading room, animal house, compound, etc.
- Name and put them into two groups A and B.
- Then for each group, divide again into A1, A2 and B1, and B2.
- How many groups have you formed so far? Form A3, A4, A5, and B3, B4, B5 groups.
- Continue grouping until you have only one item in each group and name it.

Explanatory note

Using information known on the use of your home or dormitory item, or living / non-living features, complete the flow diagram in **fig 1.2b** below;

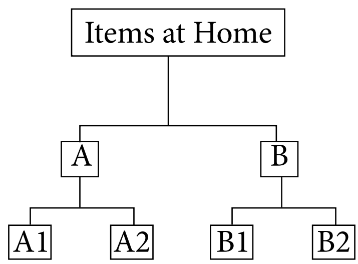


Fig. 1.2b Flow diagram of unknown items.

Complete it using information from your home or dormitory in terms of groups A and B.

Expected results

Make an accurate record of items in your home and place them in the expected area or place and order, so that they appear neat and easy to identify when required. Suggest what to do with the unwanted items found in your home.

Conclusion

Ensure both your classroom and home or dormitory items are organised and in a suitable order every day to improve the appearance of the environment.

Evaluation

Write a name list of 20 different animals within 10 minutes. Then make a list of 20 plant names (you may write them in your local language) within 10 minutes. Which list took a longer time to write and why? From your list, identify the animals and plants that are beneficial to you economically. Show how you have contributed to their sustainability.

Follow-up activity

- Carry out a commercial activity e.g. labelling items like animal rest places, or plants in the school or community to keep the environment neat and well organised.

Activity 1.2.2 See and Cut

Aim

To be able to group items.

What you need

Medium-sized hard box or a cardboard and markers.

Note

Use a clean paper box.

What to do

- Using a box or cardboard, make five of each of the following shapes and sizes:
- 4cm x 4cm square
- 4cm x 5cm rectangle
- 4cm diameter circle
- 4cm triangle
- Mix the 20 cards and then sort and arrange according to the number of sides.
- How many groups have you developed?
- Study the pictures in fig. 1.2c below.
- Name the animals that you have ever seen in your home area.
- Write a name and a specific taxon on a card, then arrange the cards according to the hierarchy of a biological classification.

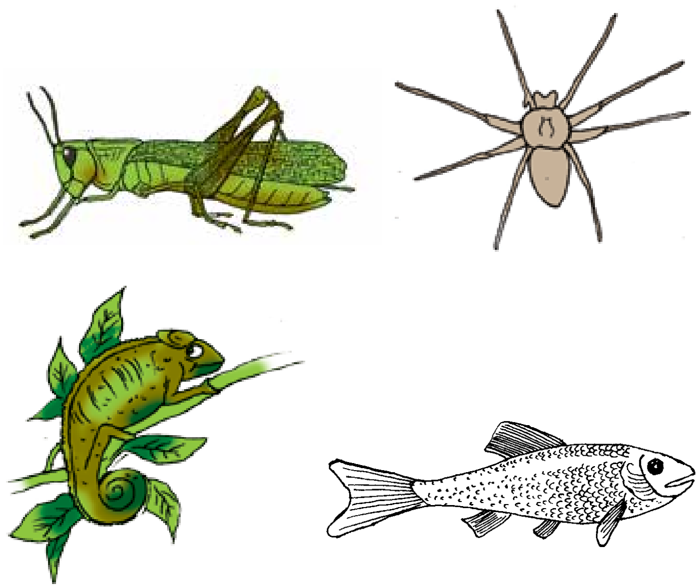


Fig 1.2c Different kinds of living organisms. As an exercise name the organisms.

Explanatory note

You should be able to identify and name organisms in the environment by making a list of animal and plant groups common in your home area and those that are not common.

Expected results

- Write the major characteristics of the following organisms:
  - i) animals
  - ii) plants
  - iii) fungi
- Discuss the characteristics of unicellular organisms.

- Identify the organisms in fig 1.2d below using the following names: algae, bacteria, viruses and protozoa.

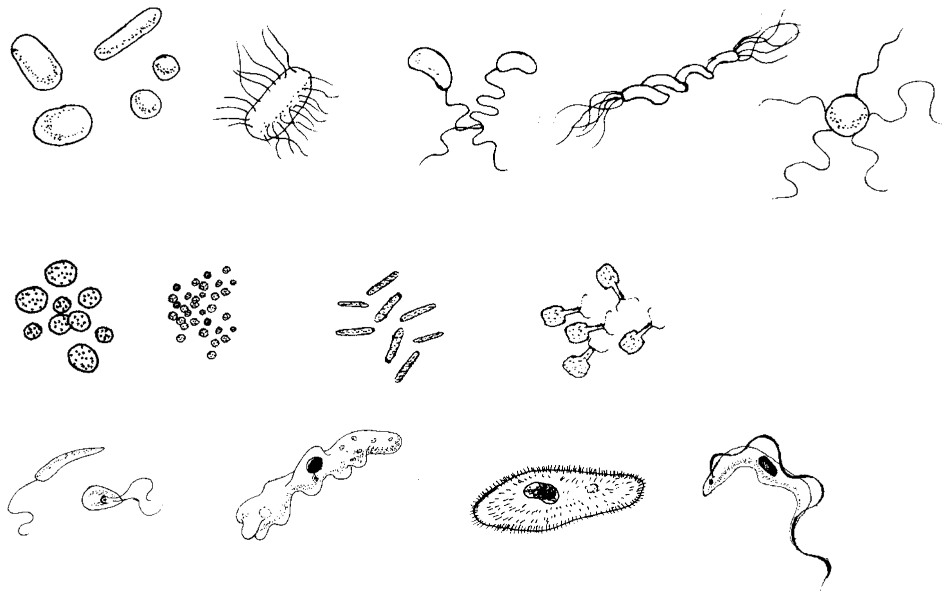


Fig. 1.2d Examples of microorganisms from different kingdoms

1.State the differences between the algae and protozoa
2.Outline the economic importance of:
i) bacteria ii) viruses iii) protozoa

Conclusion

Organisms are grouped into five kingdoms: Animalia, Plantae, Protoctista, Fungi and Monera. These are very broad groups. With the help of your teacher sub-divide each kingdom to phylum or division level.

Give two common examples of each taxon/smaller group that you have named.

Evaluation

Group yourselves into the following scientists:

i. Animal taxonomistii. Plant taxonomist iii. Ecologist

In the above groups, study a nearby community and come up with a list of identified organisms. Recommend ways in which they can interact and lead to sustainable economic development. Find out how you can implement your ideas in that community.

Follow up activity

- Visit two farms or markets or supermarkets and make a list of items obtained from living things. For each item, state the group of living things (use kingdom, phylum/ division name or a scientific / local name). Then make name tags of items for sale.

Activity 1.2.3 Waste Management

Aim

To sort the rubbish according to the groupings of organic and inorganic items.

What you need

Two rubbish collection pits, heavy duty gloves, paraffin, a match box, six different coloured dust bins (two brown, two green, two yellow), two wheelbarrows, sheets of manila paper in three different colours (green, pink, yellow), etc

Note

- Children or animals should not access the rubbish pits.
- Take care and protect your body during the activity.
- You can use local language to indicate the organic and inorganic rubbish.
- Ensure dustbins have fixed covers and uniform colours for each kind of rubbish grouping.

What to do

- Prepare two fenced or protected rubbish pit areas at school or at home.
- Use well-labelled signposts to indicate the organic / inorganic rubbish pits.
- Place a set of three dustbins (brown, green and yellow) at the main entry of the school or home and another three at your classroom or at your home kitchen entry.
- Label the dustbins as follows: brown – inorganic rubbish; green – organic rubbish, yellow inseparable organic and inorganic rubbish.
- Write on the manila paper the regulations and procedures on how to group and deposit the rubbish.
- Write examples of items on coloured charts. Use green for organic, pink for inorganic, and yellow for inseparable inorganic and organic.
- Using the charts, sensitise members of your class, school or home on how to group the inorganic and organic rubbish before depositing it in the dustbins.
- Sort and separate into groups, the inorganic and organic rubbish.
- Every day after school hours, e.g. at 6.00pm, using the two wheelbarrows, collect the inorganic and organic rubbish, separately, from the dustbins.
- Deposit inorganic and organic rubbish in the two rubbish pits, respectively.
- On Friday afternoon, burn the inorganic rubbish in the pit or sort the items to be taken for sale to recycling points or factories.
- Then leave the organic rubbish to decompose in the pit and regularly use the manure to improve soil fertility by selling to farmers / horticulturalists. You can sell the black soils /loam soils formed in the organic pits after a year.

Explanatory note

Grouping rubbish items enhances classification of living things and non-living things. This is because organic rubbish items are mainly from living things while inorganic rubbish items are frequently obtained from non-living things.

Expected results

Through rubbish collection, items are grouped and classified as products of living things or products of non-living things. Explain what other contribution you are providing to your class or school or home environment.

Conclusion

Show how your activity can be beneficial to organising, arranging/ordering the environment and improving the economic situation of the community.

Evaluation

Make a list of other items that require classification or grouping to ensure an improved standard of life and sustainable development.

Follow up activity

- Using an association, promote the idea of an organised way of rubbish collection that may be carried out by the whole school and community.
- Ensure that all classes or families participate in a commercial rubbish collection business to keep a clean environment.

Activity 1.2.4 Making a Herbarium

Aim

To make a herbarium for the identification of threatened plant species.

What you need

- Plant presser/wooden boards
- Old newspapers

- Labels
- Small envelopes
- Camera

Note

- Preserve the plant materials using suitable chemicals.
- Work with the Agriculture department or resource person and your teacher.
- Avoid destroying the plants.

What to do

- Identify crops, e.g. cotton, vanilla, etc. in your area that are threatened by human activities and environmental conditions, or which are about to become extinct or destroyed.
- Observe mature plants in a natural environment and make a record of all observable features. Take a photograph of the plant.
- Collect some mature fruits/seeds and place them in a small envelope.
- Uproot and observe plant roots where possible.
- For small plants, place them between newspapers and put them in a plant presser. Take larger photographs of the plants.
- Change the newspapers every two days until the plant is dry.
- Mount the plant on a piece of suitable material or paper using transparent sellotape. Seal the envelope containing the dried fruits/seeds.
- Organise a plant album collection for display or developing small billboards for sale.
- Set up a plant study centre to provide information on edible or extinct plant species.

Explanatory note

To train in classification of plants using major features and to guide the history of plants for sustainable development.

Expected results

Develop a plant reference centre where a fee is collected to obtain information on the natural environment of extinct food crops. This is intended to allow regeneration of the plant species by agriculturalists or environmentalists.

Make a record of the plant using the following:-

- Date of collection
- Habitat
- Plant habit (size, shape)
- Stem (height, diameter, shape, texture, hardness, etc.)
- Leaves (types, texture, shape, etc.)
- Inflorescence
- Fruits
- Roots
- Local name
- Scientific name
- Uses of the plant

Conclusion

A national plant display herbarium/'museum' of plants or data bank is required! What is your contribution towards achieving this in your community?

Evaluation

Show the value of classifying and identifying threatened plant species.

Follow up activity

- Collect other plants and mount those using suitable methods to build up your herbarium.
- Develop a book or magazine or fliers on the uses of rare and extinct plants in your region to be sold for information and to tourists.
- Prepare similar documents for sale on wildlife in Uganda using animals like mammals, birds or insects. Or you could put together stamp collection comprised of pictures of such animals.

Activity 1.2.5 A Botanical Garden

Aim

To set up a small botanical garden or a horticulture plant seedling bed.

Fig 1.2g Flower garden. Compare this with one in your home or community.

What you need

- Planting materials of identified plant species.
- A plot of land of about 10 by 10 metres in area or suitable containers such as tins, basins, etc.

Note

- The planting materials must be viable.
- Use commercial plant species that promote economic development.

What to do

- Divide the plot of land into portions corresponding to the kinds of plant species or label containers.
- Plant each type in a separate portion of the garden or if containers are used place them on a veranda or rooftop of your home for protection.
- Put a label on each portion indicating name (local or scientific) and economic importance.

- Care for the plants until they mature and properly classify them for sale (either as food crops, ornamental plants or cash crops for environmental protection).

Explanatory note

Show the value of classification of plants through organising a piece of land or use of low-cost material for economic development.

Describe the characteristics of the plants in each portion or container.

Expected results

Make a record of the observable features of the mature plants in the plots or containers.

Group and identify the economic activity of the plant species grown.

Conclusion

Explain whether it is possible to sell the plants or utilise them for food without classifying them.

Evaluation

Show the value of plant characteristics in economic development of a community.

Follow-up activity

- Identify plants of economic value from other regions of the country and introduce them to your community.

Activity 1.2.6 How to construct a dichotomous key

Aim

To write and construct a dichotomous key.

What you need

A pencil, a pen, a book, a boy , a girl, a mango tree.

Note

Work in groups or with a friend.

What to do

Label the items above as A – pencil; B – pen; C – book;
D – a boy; E- a mango tree; F- a girl.

Fill the table below of physical features by writing yes/no:

Physical feature of the item	*Items*					
	A	*B*	*C*	*D*	*E*	*F*
It is made of woody material						
It is made of plastic material						
Has hair on the body						
Leaves develop on it						
Have female features e.g.......?						
Have male features e.g.......?						
Name any other observable feature you have noted on the items						

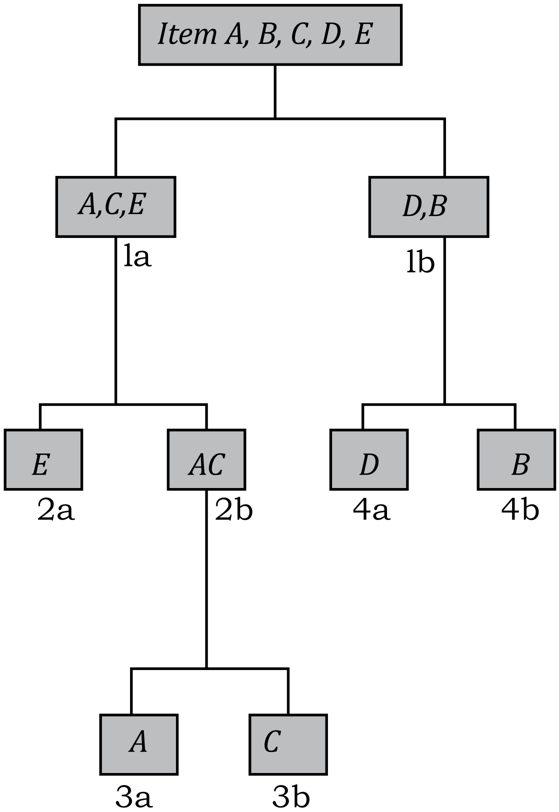


Fig.1.2h Flow diagram.

Using the above group items A, B, C, D and E physical features. Write statements 1a, 1b, 2a, 2b, 3a, 3b,4a,4b

Using the physical features of the steps and items indicated in the flow diagram above, construct pairs (a, b) of statements 1-4 and fill the spaces below:

1. a………………………………………………......go to 2.
   b......……………………………………………go to 4.
2. a………………………………….(E) is a mango tree.
   b………..………………………………………..go to 3.
3. a……………………………………………A is a pencil.
   b………………………………………………C is a book.
4. a…………………………………………....D is a boy.
   b………..……………………………B is a Bic pen.

Write as many pairs of statements from 1a - 4b as possible. Each one of you should write at least three sets of statements (1a -4b).

Explanatory note

Write pairs of statements that distinguish organisms or items from each other as you have done above. These statements should identify and organise items in an orderly manner. Assist in making name tags for sale or in filing or keeping records of items in trading centres, like supermarkets, shops, offices, homes, etc.

Expected results

Group items/organisms according to the characteristics observed, by constructing pairs of statements that show alternative descriptions of the items or organisms.

The above set of statements represents a dichotomous key of items A to F. You may use other items, where possible, to construct another table of external features.

Conclusion

Identify items/organisms using a dichotomous key.

Distinguish living things and non-living things using features that are observable.

Evaluation

Using the above procedure, construct another key using item F girl as part of the statements and make pairs 1-5 of (a, b)

Follow-up activity

- Alternative dichotomous keys can be used in classifying living things to their taxa.
- Construct a flow diagram and write dichotomous keys of each set of diagrams (**A and B)** shown in ***Fig1.2i.***

A - Types of leaves

B – animals.

Fig 1.2i Locally available items in a habitat:

1.3 Hand Lenses and Microscopes

Inquiry question: *Can you think of organisms that can be seen using unaided eyes and those that cannot be seen using a magnifying lens (aided eye)?*

*Study **fig.1.3a** and name the items shown.*

a

b

c

d

Fig.1.3 a: Are photographs a, b, c and d showing items that use lenses to improve visibility of an object.

Background information

The human eye is a crucial organ in using the hand lens and the microscope to study items. There are certain organisms that can be seen with unaided eyes, while others are too small to be seen. In such a case, one has to use a hand lens or microscope that will enable one to see distinct, clear images. The proper functioning of these instruments is limited by the power of the magnifying lens and the kind of illumination used.

A hand lens is a convex magnifying lens surrounded by a metal or plastic boundary with a handle marked with specific magnification power, e.g. X2 or x10, etc. The microscope has a series of lenses arranged to carry out magnification. There are two major types of microscopes i.e. the light microscope which requires a source of light and the electronic microscope, which uses a beam of electrons instead of light to produce an image.

You should be able to:
- *use the hand lenses and microscopes to study organisms.*
- *take care of the microscope.*
- *identify microorganisms using microscopes.*
- *observe the economic effects of microorganisms in the environment.*

Activity 1.3.1 The water drop magnifier

Aim

To use low-cost material to justify the magnification of items by magnifying lenses.

What you need

A roll of wax paper, a small cup of water, old newspapers.

Note

Make sure the water is clear and the wax paper is smooth.

What to do

- Cut 10 cm wide strips of the wax paper from the roll.
- Place the strips over a small newspaper text or any small object to be magnified.
- Put a drop of water of 0.5 cm in diameter at the wax strip.
- Observe the size of the letters or object in the form of an image as seen under a water drop.
- Try out drops of different diameters.
- Substitute the wax paper with any other materials such as glass sheets, transparencies or translucent regular paper and compare the results.
- What is the use of the paper strips and the water drop in this activity?

Explanatory note

The water drop on paper is convex/rounded on top, because of the water-repellent properties of paper (hydrophobe). This gives the drop the shape of a magnifying lens.

Try to note the sizes of objects at the roadside observed through a car window when it is raining during the day and at night. Compare the images. Or compare your ability to see objects on a misty and clear morning day, or in smoky and clear areas. Provide an explanation for the differences noted.

Expected results

- Which diameter of water drop magnifies better (small or larger)?
- What properties of the drop determine magnification?
- Name the structure of the eye that is used to magnify objects in a similar way as shown.

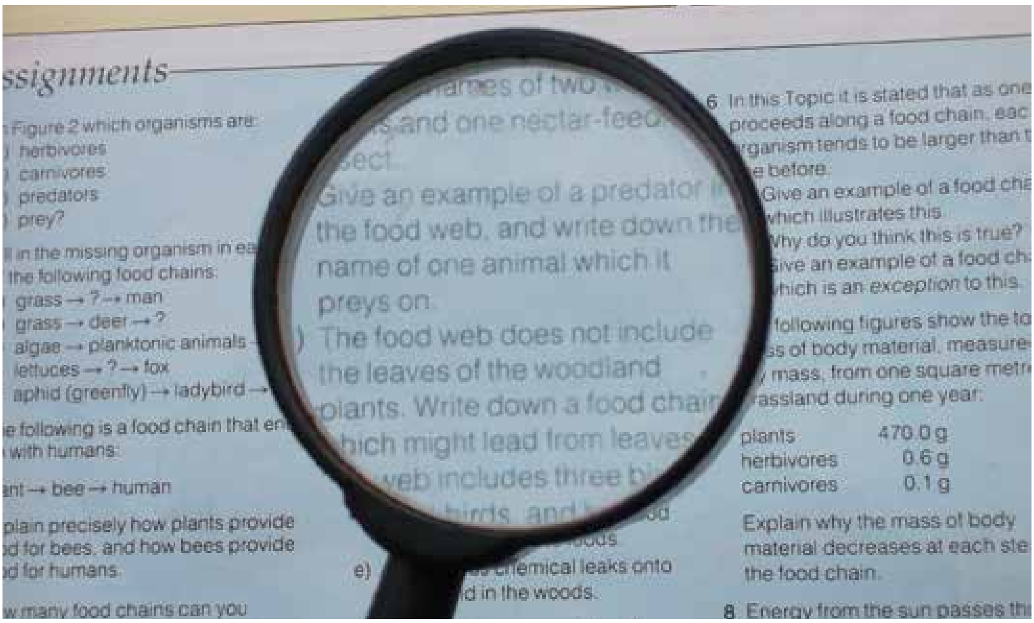


Fig. 1.3b is an illustration of magnified words

Place water in a glass bottle or drinking glass and deep your finger in or place small objects in the water and compare the size of the object and image seen through a glass with water.

Conclusion

The smaller the drop and the more curved the upper surface of water, the stronger the magnification. The letters appear to be of a larger size than their actual size.

How can a water drop act as a magnifier just as the hand lens and microscope do?

In everyday life organisms are able see objects because they have the eye organs. How can you relate this activity to the normal functioning of the eye parts you studied in primary Science?

Evaluation

List environmental conditions that cause poor visibility of objects in the environment and how they are prevented or reduced.

Compare the visibility or sight of your eye when you have tears or when there is a drop of water on it and when the eye is dry. State the importance of natural eye magnification in your everyday activities.

Follow-up activity

- Relate real-life experiences to the role of the 'water drop', i.e. explain the importance of a suitable percentage of water vapour in air or of atmospheric humidity in the environment and the use of a moist eye and care of eyes with proper hygiene.
- Demonstrate the activities that maintain a natural habitat with suitable levels of atmospheric water vapour.

Activity 1.3.2 Making a simple magnifier

Aim

To make a simple hand lens and a microscope using low-cost material.

What you need

Used light bulb (Grope), plywood box, cardboard/ light bulb box, small mirror/polished metal, a torch bulb, sellotape (adhesive tape), water, a small object, e.g. leg of an insect.

Note

Use transparent light bulbs and a small pen-shaped bulb.

What to do

A. Make a hand lens – magnifier by using a globe light-bulb, as the one shown in ***fig. 1.3c.***

- Remove the filament wire of the bulb or use a thin wire of 10 cm long twisted into a loop. Then place a drop of water in the loop. This can be used to magnify small objects.
- Using the bulb half-filled with water, magnify the small objects.

Fig 1.3c: Example of a bulb that may be used in magnifying objects

B. Construct a simple light microscope by using the small box.

- Make a small hole of 2 cm diameter at the top.
- Fit a small mirror in the box at an angle so that light can be reflected through the small hole.
- Then fit the torch bulb lens and fix it into a small hole (6mm) in a metal strip using sellotape.
- Fix the strip of metal onto the box at an adjustable position.

- This strip is adjusted to focus the object
- Magnify small objects by placing them on top of the box.

Explanatory note

The set-ups show how objects can be magnified. Explain the term 'magnification' and show its importance in your life.

Expected results

Using procedures A and B, what happened to the size of the small object used?

Objects focused using set-up A and B show differences in size compared to the actual object. Why?

Conclusion

Describe the role of the bulbs in set-ups A and B.

Evaluation

Visit the laboratory of a nearby health centre to use a microscope and request your teacher to provide a hand lens. Compare your set-up A and B with the hand lens and microscope and how the set-ups be improved.

Follow-up activity

- Use low-cost materials to carry out other scientific investigations.
- Using a microscope, identify microorganisms in a nearby stream or well or any other water source.

Activity 1.3.3 Observation of organisms

Aim

To identify differences between images of organisms observed using the unaided eye and those seen under a hand lens or microscope.

What you need

Hand lens, microscope, glass slide, cover slips, water in a small cup, thin letters from newspapers, pond water.

Note

Pond water must be clear and filtered out. Use gloves when collecting the water to avoid transmission of water-borne diseases.

What to do

- Cut a tiny letter ’e’ and put it on plain white A4 paper as a background.
- Observe it using a hand lens and draw.
- Transfer the letter on to a glass slide. Place a drop of water and cover slip over the glass slide and observe under the low power lens of a microscope and draw.
- Replace letter ‘e’ with pond water and repeat the above steps.

Explanatory note

State the differences between images (drawings) and objects of letter ‘e’ cut and pond water seen using a hand lens and those seen under a microscope.
Note: The object is the item seen using unaided eye and the image is seen with the aided eye.

Expected results

i. Make drawings of the image of letter ‘e’ under the following headings:
   Letter ‘e’ seen under a hand lens
   Letter ‘e’ seen under a microscope

ii. Make drawings of images of pond water seen under hand lens and microscope.

iii. Show the differences in size of images (drawings) and objects seen using a hand lens and those seen under a microscope.

iv. Explain the 'magnification'.

Conclusion

State the importance of a hand lens and a microscope when studying organisms. Inform the community about invisible microorganisms that live in water or air but can be seen using a microscope as shown in ***fig. 1.3d.***

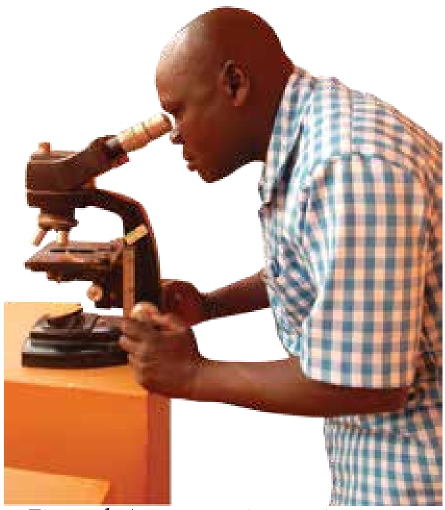


Fig 1.3d: A person using a microscope.

Evaluation

List organisms in pond water that cannot be seen using the unaided eye but can be seen using a microscope.

If one is suffering from malaria, what instrument can be used to find out what organisms are present in the blood that has caused the disease? Mention other disease-causing microorganisms that you know.

Follow-up activity

- Observe water samples from different sources under a microscope and describe what you see.

- Visit health centre laboratories to learn more about the use of microscopes or eye clinics to see the use of hand lenses and other magnifying lenses.
- Study ***fig.1.3e*** and compare it with the one you find at a health centre. Explain the use of different parts of a microscope.

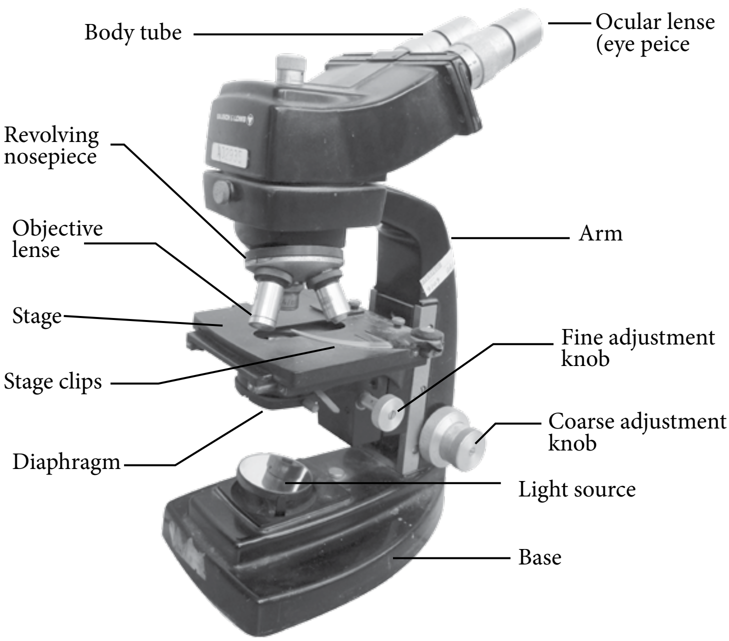


Fig.1.3e: Illustration of a microscope

Activity 1.3.4 A visit to health centres

Aim

To practise using a microscope and slide preparations

What you need

Boiler/container, source of heat, funnel for filtering, fine piece of cloth for filtering/sieve, purifier like water guard (if available), packing materials.

Note

Using microscope, which is expensive, to identify micro-organisms may not be a routine for you but to practise how it is used is possible. Just visit a laboratory of a nearby health centre and study how to use a microscope with the technical person. At the same time, sell boiled water to the patients.

What to do

- Ensure the water has no visible solid particles.
- Put water in a boiler/container such as a saucepan and cover it.
- Put it on a source of heat and boil the water.
- Boil for about 25 minutes to destroy all the (invisible) microorganisms.
- Allow the water to cool while covered to prevent contamination
- Filter or decant the cool water to purify it or if possible add purifying chemicals like Water Guard to precipitate the salts quickly and purify water just like the filter or decant process.
- Pack the water (e.g. in suitable polythene packs or bottles) to keep it clean and pure for drinking and other purposes.
- Use the microscope at the health centre and with the assistance of the health worker or technician, examine samples of the water packed for sale to identify the microorganisms, if any.

Explanatory note

- Study ***fig 1.3f*** and indicate which method is suitable for your community.

Fig 1.3f: The different methods used in providing safe drinking water to communities.

Sensitise your customers the values of boiling water (to kill the invisible microorganisms seen using a microscope but not the unaided eye). Compare the results of pond water or water samples from different sources in activity **1.3.4**.

Expected results

Show a record of patients visiting the health centre laboratory, and relate the number of patients suffering from water-borne diseases to consumption of boiled and unboiled drinking water.

Conclusion

Interpret your data from the health centre and list other sources of water borne disease-causing microorganisms.

Sensitise the community on the alternative ways in which water-borne disease-causing microorganisms are transmitted and how to protect themselves.

Evaluation

Different stages of parasitic microorganisms are responsible for causing diseases. Show how the use of a microscope can contribute to preventing or reducing the spread of a parasite in your community.

Follow-up activity

- Work with your teacher to plan activities, how the school can contribute to encouraging the community to use safe water to improve health standards.

1.4 Animal and Plant cells

Inquiry question: *Cells of the body are microscopic and consist of parts known as cell organelles that can be seen under a microscope. Is it reasonable to compare them to bricks making up a house? What is your opinion?*

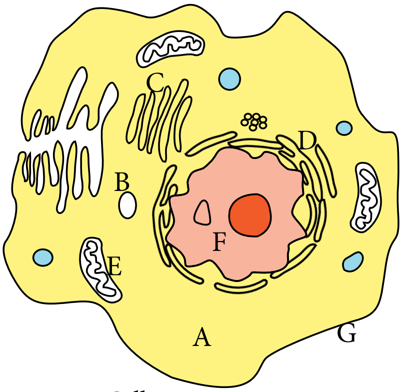


Fig. 1.4a: Cell parts.

i. ***Arrange the cell parts A-G to form a complete general cell.***

ii. ***Name the parts and state the function(s) of each part.***

Background information

A cell is the basic unit that makes up the body of a living thing. Similar cells are grouped to form a tissue. Groups of tissues form an organ and organs are arranged in series to form a functional unit known as a system. Then systems are organised to form an organism. Therefore, all organisms are developed from cells, which form the parts of their body that determine and control the physiological activities within living things.

The bodies of organisms are either **unicellular** or **multicellular.** Unicellular organisms are microscopic e.g. bacteria, protozoa, viruses, some algae and fungi whereas multicellular organisms are macroscopic organisms e.g. vertebrates and invertebrates, flowering plants and non-flowering plants. Multicellular organisms are made up of many cells carrying out processes in the body while unicellular organisms are single-celled but able to carry out all physiological functions of the organism using organelles.

You should be able to:

- *explain the role of cells in living things.*
- *discuss the term, cell specialisation.*
- *draw the various specialized cells of living things.*

Activity 1.4.1 General structure of a cell

Aim

To name and draw the basic structure of a living cell.

What you need

Scissors, cardboard box, marker, manila paper, glue.

Note

Use standard diagrams of a living cell.

What to do

- Cut the cardboard into different parts of a cell and stick them onto the manila paper using glue to construct an animal and a plant cell.
- Pin up your work on a wall then draw the cells.
- State the differences between the animal cell and plant cell.
- Study the ***fig.1.4b*** below and state the functions of the parts.

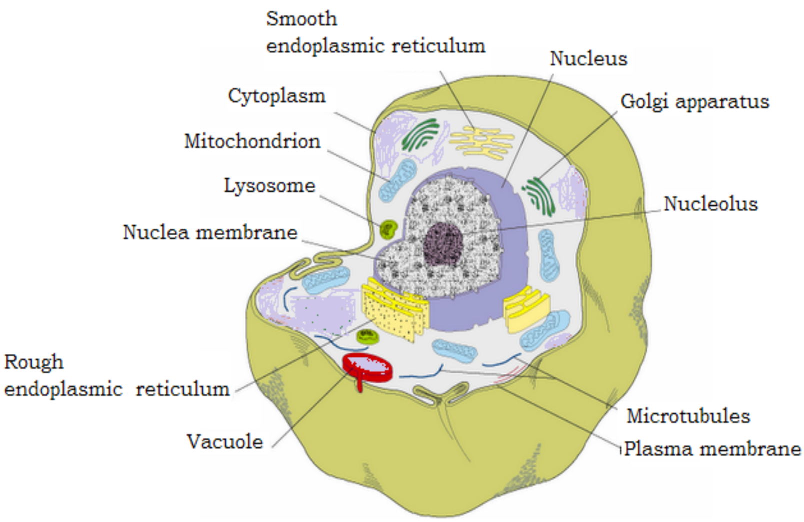


Fig. 1.4b: Idealised details of cell parts.

Explanatory note

Living cells have parts or organelles that carry out functions of the cell. For example, the nucleus determines the structure and function of the cell. Therefore, every cell in the body has a particular structure necessary for its activities. This implies that cells are specialised.

Expected results

Identify the typical cell structures and state the function of each part. Write structure and function on a card, and insert/stick the card against the parts on the manila.

Conclusion

Compare your diagrams with that in this handbook. Is there any difference in representation of a drawing of a cell and constructing the parts? How about the functions of the parts in a typical cell?

Evaluation

Show how each part of a cell plays a unique and an important role in the life of a cell.

Follow-up activity

- Identify the differences between the plant and animal cell structures.

Activity 1.4.2 Cell specialisation

Aim To relate cell structure modification to the function of the cell.

What you need

Plant tissue culture centre/growing onion meristem tissues (onion bulb with growing roots), or eggs of a hen, a diagram of a typical plant cell or an animal cell.

Note

To show plant cell modifications, work with resource persons from the plant tissue culture centres or with your teacher

What to do

- Observe the onion plant root cells under a microscope or break a bird’s egg and identify the parts.
- Draw what you have observed and name the identified parts of the onion plant root cell or bird’s egg.
- Study the parts of an ideal plant or animal cell in the diagram and compare it with your drawing.
- Relate the cell parts named in your drawing to the function of the cell structure represented.
- Demonstrate on a small scale, the economic role of the onion plant root cell or the bird’s egg, by letting these cells grow and develop in suitable conditions, and sell their products.

Explanatory note

Cell types in living things are able to carry out specific physiological roles or activities that sustain the life of the organisms. In this case, the onion plant root cells or the bird’s egg cell promote growth and development. Predict other uses of these cells in the life of plants or animals.

Expected results

Compare and contrast the general cell structures of a typical plant cell to the onion plant root cell or an ideal animal cell with the bird’s egg.
Describe the importance of the onion plant root cell to the life of the onion plant or the bird’s egg cell to the life of a hen.

Conclusion

Does cell specialisation show cell structures that form the basic unit of life in organisms?

Show other forms of plant and animal cell specialisation.

Apart from specialisation in plant and animal cells, outline the structural modifications in single-celled organisms like bacteria, viruses, protozoa and fungi.

Evaluation

State the function of the parts labelled a-d in the ***fig.1.4c*** below and indicate how the bird's egg is modified to suit its role. Describe the benefits the hatching bird gets from the egg during development.

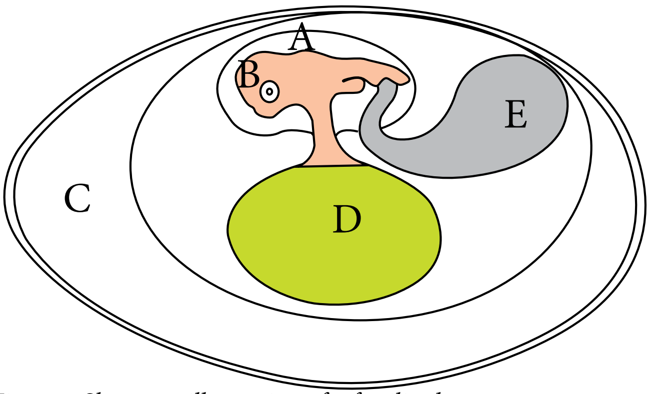


Fig 1.4c: Shows an illustration of a fertilised egg

Follow-up activity

- Visit centres where tissue culture is a technique used to reproduce and grow plants and crops.
- Draw and label cell structures of the following unicellular organisms: Bacterium, a spirogyra (alga), paramecium, an amoeba and yeast (fungi). Show how they are modified to carry out various physiological roles.
- Discuss in a group whether viruses are unicellular organisms or not.

1.5 External and Internal Features of Flowering Plants

Inquiry question *Referring to your community, explain why the flowering plants have survival ability in their habitat.*

Background information

Flowering plants are angiosperms and they include monocotyledonous and dicotyledonous plants. Some flowering plants reproduce sexually by use of flowers as the reproductive organs. The flowers bear the gametes that fuse to form a zygote. The zygote develops into an embryo which grows and develops into a new plant. You should have noted, some flowering plants can also reproduce by vegetative propagation (asexually) using their vegetative parts. For example, the sweet potato plant flowers but it is grown using the vegetative parts. Find out the vegetative parts used to grow sweet potatoes. Study ***fig. 1.5a*** and name the part of the sweet potato plant shown.

Fig 1.5a: Sweet potato tubers.

Such plant organ modifications are used in your homes. List the economic importance of the tubers that are common in your area.

Flowering plants have organs, known as leaves, stems, roots and flowers that form its body structure and carry out various roles for the plant and other organisms. Flowering plants have survival abilities in their habitats which have significance for economic development and sustainable environment. Human beings have utilised the structural and functional characteristics of flowering plants to improve their daily lives. An example is food production which improves health and income.

You should be able to:

- *identify flowering plant organs that are important for economic development and a sustainable environment.*
- *grow and develop food crops and ornamental plants for economic development and improved standards of living.*
- *preserve plant species to ensure continued food supply and prevent the extinction of useful plants.*
- *use the information to conserve flowering plant species and improve yields and the varieties of plants.*

Activity 1.5.1 Modifications of plant organs

Aim

To grow and conserve plants with economic development and sustainable environment value.

What you need

A well prepared garden plot, watering /irrigating cans, water source

Choose only one set of plant materials from those below:

1. Seedlings of trees (pine, eucalyptus, avocado, mango, orange, lemon, guava, or jackfruit).
2. Seedlings of ornamental plants.
3. Seeds/grains of (maize, beans, peas, ground nuts, simsim, millet, sorghum or vegetables like cabbage, lettuce, spinach, cauliflower, tomato, or any other greens).
4. Vegetative propagating organs of plant stems or leaves or roots e.g. plant parts of corm/rhizome/tuber/cutting/sucker/bulb (of

yam, cassava, ginger, Irish potato, sweet potato, banana, onion, or a horticultural plant).

Note

The soil type and size of the plot to be used should determine the set of plant materials to be grown.

From the set, choose 2 plant items and ensure that the soils to be used are fertile.

What to do

- With the help of a resource person or the agriculture department, prepare the plot of land to be used for planting.
- Sub-divide the land into four plots and label the areas as:
  i. Seedbed **A,** ii. Plant **A**, iii. Seedbed **B** , iv. Plant **B**
- Choose the two plant items and label them **A** and **B**, respectively.
- Then plant in the seedbeds labelled. After the growing period in the beds, transplant to the planting area to allow continued growth and development of the plants.
- Allow the plants to mature and sell the plant products or utilise the products for economic development.
- Ensure the continuity of your planting project and the supply of plant products.

Explanatory note

You should be able to demonstrate the significance of flowering plants for the economic development of a nearby community.

Grow and develop plants for economic development and an improved standard of life. Flowering plant organs have environmental protection roles, such as:

- maintaining the water patterns or cycles through evaporation of water/the transpiration process in leaves.
- providing oxygen for respiration.

- reducing carbon dioxide pollution through photosynthesis.
- providing food products.
- beautifying of the surroundings.
- providing construction materials, etc.


Fig 1.5b: Plant seedling beds

Expected results

Grow plants that are useful to human beings and other organisms. Show how these plants lead to economic development.

Conclusion

Prepare an action plan. Show continuity of the planting and product supply. Relate the biological roles of the plants grown to economic development and a sustainable environment.

Evaluation

Demonstrate how flowering plant organ modifications have; i. contributed to the survival of organisms.

ii. improved the living standards of human being through human's constant interventions.

Follow-up activity

Flowering plant organs have various roles in sustaining the environment and economic development. Utilise the plants you have grown to discover other benefits or plant products that can be obtained from the plant organs, e.g. fruits may be eaten or sold as organs or extracts, such as fruit juice, may be packed and sold. Tree plants supply fruits, firewood, timber, etc but also maintain the water resources and natural bio-cycles in the habitats, etc.

Activity 1.5.2 Preservation of plant products

Aim: To produce items from flowering plant organs.

What you need: Suitable packing materials, a grinder, juice squeezer or extracting materials and plant organs from the list below.

Choose one plant item from each of the sets indicated:

- **i.** **Seeds and grains e.g.** maize, rice, beans, peas, groundnuts, simsim, soya, millet, sorghum or any other cereals.
- **ii.** **Fruits e.g.** pineapples, bananas, oranges, passion fruit, tomatoes, cucumbers, bitter tomatoes.
- **iii.** **Stems e.g.** sugarcane, mango stem.
- **iv.** **Leaves e.g.** green vegetables.
- **v.** **Root e.g.** cassava, carrots.

Note

Choose two kinds of plant materials from any two sets above.

Work with a resource person or the Home Economics Department or Foods and Nutrition Department in your school.

What to do

- Choose two plant materials from the above sets; from one kind you should be able to make powder using a grinder and from the second plant material extract juice using a juice squeezer or extractor.
- Using suitable methods preserve the powder and the juice.
- Pack in suitable materials.
- Design labels to indicate the values of the products and how to use the packed plant extracts.
- Sell the products to your schoolmates and the community.

Explanatory note

Flowering plant features or organs are vital for plant food storage to help the growth and development of the plants. These have been used by human beings to improve their nutritional standards, but they are also essential for economic development.
Identify flowering plant parts that you can use to promote health standards in the community and a constant food supply.

Expected results

Show the structural function of flowering plant organs in a plant and relate how human beings are utilising these organs in economic development and sustaining the environment.

Conclusion

Use suitable procedures to continuously supply preserved food materials and to provide a suitable diet to humans.

Evaluation

Use ***fig.1.5c.*** To study and identify the plant organs. State the procedures for preserving the materials.

Fig 1.5c: Various flowering plant products sold in a market.

Follow-up activity

Give a practical demonstration of ways of preserving domestic animal food materials from flowering plants. Form packs of animal feeds according to age and kind of animal.

Activity 1.5.3 Tree planting programme

Aim

To produce flowering plant gardens.

What you need

Fruit tree seedlings (mango or jack fruit), or banana suckers, or seedlings of pasture grasses.

Note

Choose flowering plant trees or grasses that are suitable and readily available in your community.

What to do

Choose a piece of land in a nearby area or if possible around the fence of the school playground.

Grow one kind of plant from the suggested list above, on a well prepared piece of land, or develop a fence or boundary area of trees around the games field.

Supervise the growing plants to maturity and harvest the fruits or pasture for sale in the community.

Explanatory note

The external features of flowering plants improve beauty of the surroundings but also provide shelter and food to other organisms, thus improving economic and health standards. The internal features are tissues, which play various roles in the plant. List the internal structures of each organ and state their functions. Relate these functions to economic development and sustainable environment.

Expected results

Relate the role of the flowering plants you have planted to national economic development. Show how this project has improved your standard of living and that of the community in your area.

Conclusion

The xylem tissues in roots and stems conduct water and dissolved mineral salts from the soils to other parts of the plant. Economically, these provide water as a raw material for photosynthesis that provides food reserved in storage organs eaten by other organisms. The transportation of water by the xylem tissues also contributes to the transpiration process that is vital in maintaining the water cycle. This is essential for sustaining the global water resources. Xylem tissue is the wood used as fuel and to make furniture, etc.

Use the same area to grow papaw, sugar cane, or maize plants, and then compare the structure of the mature plants and their contribution to your economic development.

Evaluation

Is it ever practicable to anticipate economic development and thus prevent ecological damage?

Mention the biochemical differences that exist between plant roots and stems.

Study ***fig. 1.5d*** and propose an activity you would like to practise to show the value of flower types and leaf arrangements in the economic development of human beings.

Fig. 1.5d: Types of flowers and leaves.

Study the picyures and indicate the differences in the physical structure of flowers and leaves.

Follow-up activity

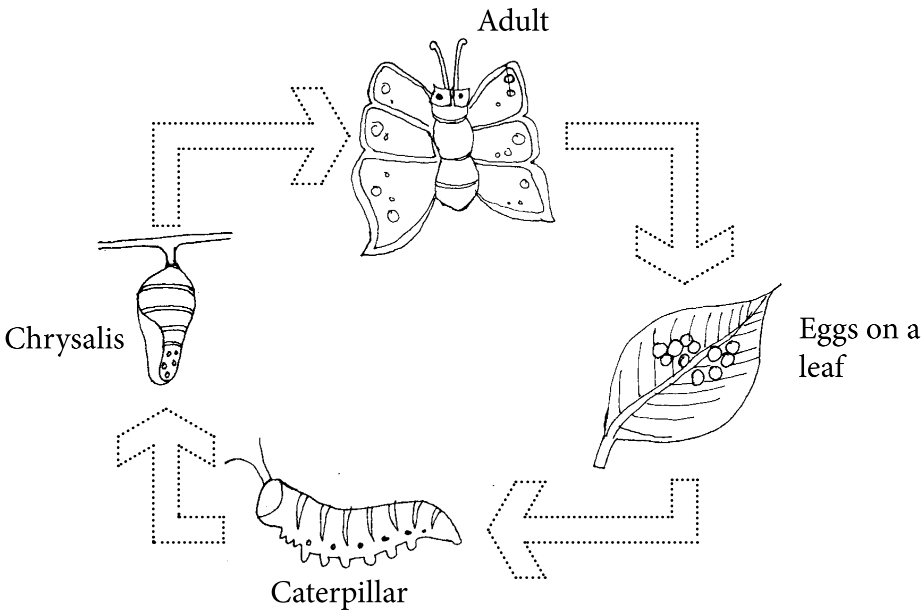
Set up an activity that involves the community in planting flowering plants and pastures. Organise interest groups in your community, such as traders, pastoralists, charcoal burners, horticulturalists, etc, to grow plants on free land, e.g. the roadsides for beauty at the same time promoting economic development.

1.6 External Features, Life cycles and Economic Importance of Insects

Inquiry question: *Using body features, identify the following insects in your home or nearby area: houseflies, butterflies, locusts, cockroaches, bees, termites, or ants. Show their economic importance to your family or community.*

Background information

Drosophilae or fruit flies are common on foods like bananas, jackfruit, oranges or food remains in the environment. Most of the time human beings strive to destroy them, especially when found inside their houses but ignore the butterflies, cockroaches and sometimes houseflies. On the other hand, poultry birds welcome the fruit flies in addition to other insects as a source of food. In your opinion, what are the features of the fruit fly's life cycle that promote economic development and which ones are harmful?



Figs 1.6a : The life cycles of a housefly, mosquito, and butterfly.

Study ***fig.1.6a*** and write the differences between the life cycles of insects shown.

Compare the economic importance of the life cycles of the drosophila to that of the housefly, mosquito, tsetse fly, and butterfly.

You should be able to:

- *observe and identify the development stages of insects, which are useful and harmful to other organisms.*
- *carry out silkworm or bee rearing methods and procedures.*
- *provide the conditions required for harvesting their products.*
- *participate in activities aimed at controlling harmful insects.*

Activity 1.6.1 Rearing insects for economic products

Aim Demonstrate the economic value of insects.

What you need

A. For Silkworm rearing

Mulberry plants

Well ventilated room/shelter

Wire mesh refer to ***fig.1.6b.***

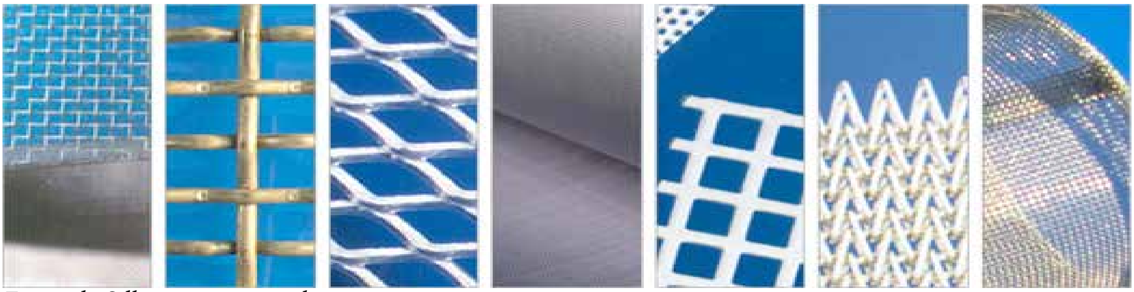


Fig. 1.6b: Silkworm wire meshes.

Study the picture and identify the design used in your area. State the advantages and disadvantages of using the different designs.

Note

Use a resource person or visit a silkworm rearing farm.

The cocoon of silkworm pupa must be removed before the adult butterfly matures.

The room/shelter for the silkworm project should be kept dry.

What to do

A. Practise the method for rearing silk-worm.

- Get mulberry seedlings and plant them on a well prepared one or two acre plot depending on the number of worms/larvae to be kept. These plants take about six months to mature.
- Have a well ventilated room or build a special shelter in which you can put a wire mesh supported from the floor.
- Get/buy silkworms from a reputable farm or resource person.

- Put the worms/larvae on the wire mesh and feed them with the mature mulberry plants, as shown in ***fig.1.6d.***

Fig. 1.6d: Silkworms on mulberry leaves.

- The shelter should not be damp.
- Observe and record the date when the larvae begin to pupate.
- Remove the pupae between 7-10 days after the onset of pupation.
- Weigh them and pack them in packages of 1kg each for sale.
- The cost of the product should be clearly written on each packet.

B. Practise the method for beekeeping by using: ropes/wooden supports.

What you need

Bucket with a cover, knife, funnel, beehive and worker bees.
Note that you need to identify features of a worker bee by studying ***fig.1.6e*** shown. Then compare beehives in your community with the one shown.

Fig. 1.6e: A worker bee and a beehive in a protected area surrounded by bees.

Note

Use a resource person or bee-rearing farm.

The hive should be placed in an area that cannot be disturbed by human beings or animals.

Method of Beekeeping

- Make a beehive of adequate size, i.e. 150 cm x 80 cm. It should have about three compartments with one small circular entrance into it.
- Survey the nearby surroundings and find an area where there is a variety of flowers and good air circulation.
- Using ropes or wooden support stands, hang the beehive on a tree firmly or place it on a stable and strong stand.
- Monitor to see whether any bees have sighted it and are using it.
- Flowering plants can be planted in the vicinity of the beehive to encourage quick production of honey.
- When the worker bees become very aggressive whenever one approaches the beehive, this is a sign that some honey has been produced in the hive.
- Go to the hive around 8pm and light a fire to produce smoke. This will chase the bees away.

- Remove the honey and wax using a knife and put them in the bucket and cover them.
- Remove the honey from the wax and pour it in bottles of varying sizes for sale.

Explanatory note

Silkworm rearing uses the larval stage of the life cycle of the butterfly to produce threadlike structures that can be refined and made into cloth. The threadlike structures are produced at the pupa stage.

Beekeeping uses the adult stage of the life cycle of worker bees. Beekeeping can be done together with horticulture planting activity to ensure maximum untilisation of land.

Expected results

Show the use of products from butterflies and bees, through simple methods of rearing the insects.

Conclusion

Demonstrate the products obtained from silkworms and bees, and determine the relationship between their lifecycle and economic development.

Evaluation

Carry out a small-scale activity of rearing silkworms or beekeeping at home or at school so that you can improve the skills for sustainable education.

Follow-up activity

Make a beehive. Show the role of bees in the pollination of flowering plants and crop production by rearing bees.
Rear butterflies and demonstrate their role in crop production.

Activity 1.6.2 Making a Beehive

Aim To make Beehive.

What you need

A wooden box or mature tree e.g. palm plant, a knife, rope/wire, nails, a roof sheet, elephant grass,

Note

Ensure you observe your community's environmental regulations and get guidance from the teacher.

Three types of beehives can be made:

i. Log hive or reed hive
ii. Top bar hive
iii. Box hive

What to do

1. **Log hive**: Log hive is formed by cutting a stem of a mature tree as shown in ***fig.1.6f.*** The inner area is scrapped out and a hollow space is obtained.

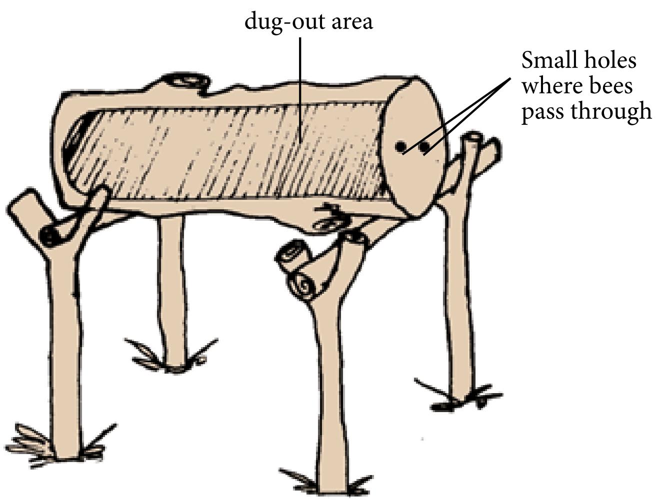


Fig. 1.6.f: A log bee hive.

Study the picture and make a similar hive following the steps below.

Steps.

i) Cut a mature plant e.g. a palm tree

ii) Use a knife or your hands to scrap out the soft inner structure.

iii) Clean the inner space to give a smooth appearance.

iv) Using ropes or wires, hang the hollow log on a tree.

v) Cover both entrances to the hollow log leaving small holes enough for the bee to enter.

vi) Constantly check to find out if bees have occupied the hive.

2. **Bee hives from reeds.** Follow the steps below to make another form of a beehive.

Steps:

i. Collect reeds or twigs; banana fibres or ropes.

ii. Bend three reeds to form circles of different sizes as shown in ***fig.1.6g.***

Fig. 1.6g: Folded reeds. Note and estimate the proportions of the diameters of the rings.

iii. Place longer reeds/twigs of 90cm and tie them on the three circles. Each reed/twig should be very close to the previous one as shown in ***fig.1.6h.***

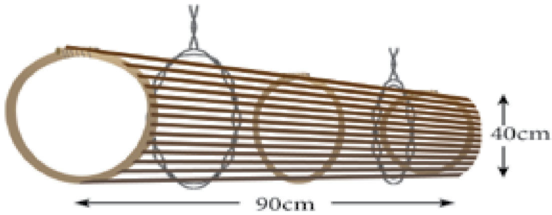


Fig.1.6h: The arrangement of the longer reeds around the circles formed in ii./ in fig.1.6g

iv. Cut a used jerry can or used tin to be used as a cover for the hollow front. Punch in small holes big enough for bees to enter and leave the hive as shown in fig.1.6i.

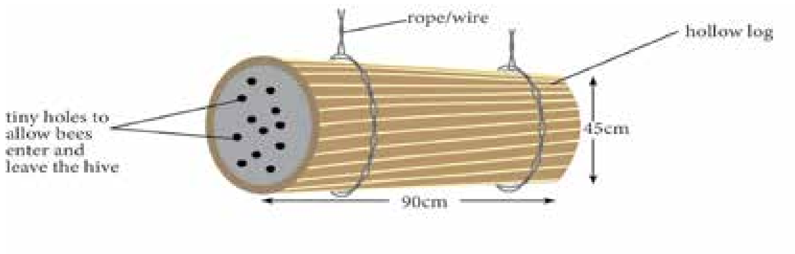


Fig.1.6i: A completed beehive

v. Smear the outside of the hive with cow dung to close off any tiny gaps between the reeds.

vi. Locate a tree in a quiet area and hung the hive on support 1.5-2 metres above ground as shown in fig.1.6j to protect it from bee eaters or predators.

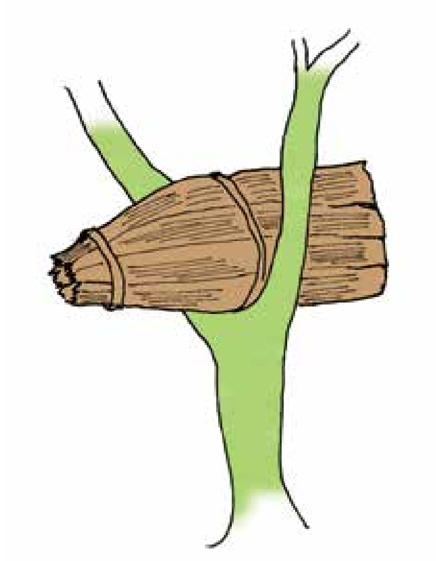


Fig. 1.6j: A reed beehive covered in banana fibres supported by a tree.

vii. Constantly check to find out if bees have occupied the hive.

3. **Top bar hive:** This type of beehive is easy to construct, easy to inspect and extraction or harvesting of honey is quick. There is very little disturbance to the brood nest.

Steps:

i) Obtain thin, flat wood of length 90cm x 20cm x 40cm.

ii) Nail the frame together as shown ***fig.1.6k.***

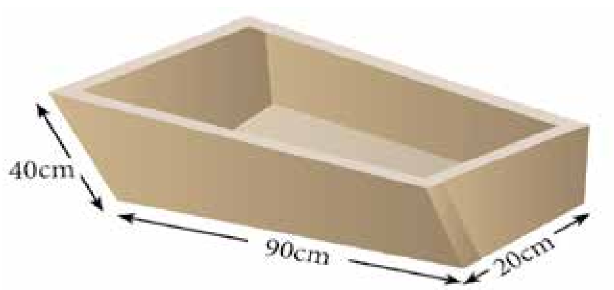


Fig.1.6k shows a wooden frame

At the base of the front surface punch in holes big enough for the bees to enter.

iii) Place bars of wood close together to cover the top of the hive.

iv) Tie the ropes or wires around to cover the hive and hung it on a tree.

v) Your bee hive should look as the structure shown in ***fig.1.6l.***

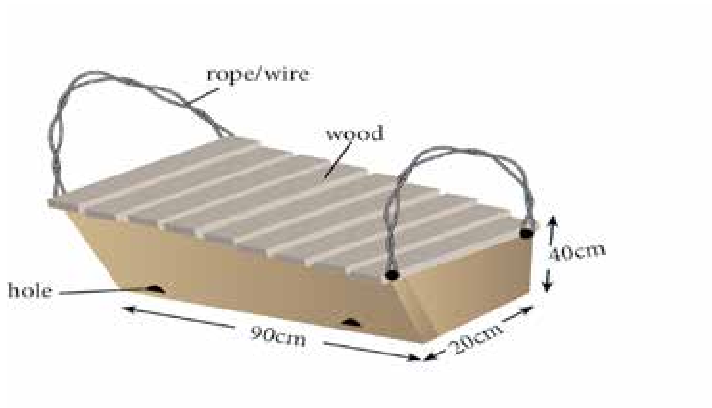


Fig.1.6l: A completed top bar hive.

vi) Place your bee-hive on a support 1.5-2 meters above ground level to protect it from bee eaters that might come at night and destroy the hive.

vii) Shelter the hive from rain by thatch grass covered with a roofing sheet. ***Fig. 1.6m*** shows an example of a top bar bee hive.

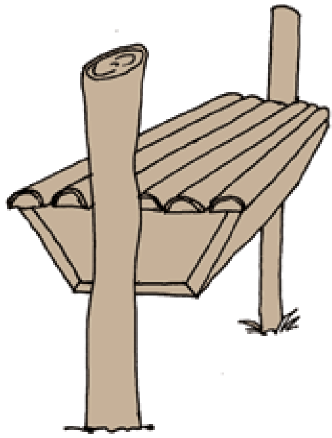


Fig.1.6m: A top bar beehive

Explanatory note

This height also helps to keep the entrance of the hive clear of grass so that bees can easily locate it.

Grass keeps the hive cool. High temperatures will cause the wax, honeycomb and honey to melt and leak through cracks.

Expected results

Make various types of beehives for sale. Initiate bee rearing activity in your community and sell bee products e.g. wax for candle making.

Conclusion

Demonstrate the functions of rearing bees in a protected environment.

Evaluation

Initiate making beehives and rearing of bees for economic development.

Follow-up activity

Visit bee rearing farms or persons in your community and make a box bee-hive as one shown in ***fig 1.6n.***

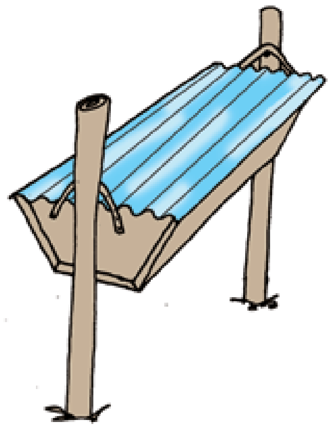


Fig.1.6n: A box beehive set in a bush

Activity 1.6.2 Control of harmful insects

Aim

To identify the harmful stages of the life cycle of insects.

What you need

Breeding areas of common insects like the mosquito, housefly, butterfly, or tsetse fly; slashers, pangas, hoes, disinfectants, insecticides, motor oil, fire source *or* materials used for cleaning the surroundings.

Note

Choose one kind of insect that is common in the immediate environment, and study its harmful effects on human beings and other living things.

What to do

- Identify the breeding areas of insects (a named insect in the immediate community) and study the surroundings.
- Carry out a suitable technique of creating unfavourable conditions in the breeding area or destroying the harmful stages of the insects. For example:
    i. Cut all overgrown bushes or grass around homes.
    ii. Remove or drain the stagnant water and clear or cover the areas which cause poor drainage of water.
    iii. Ensure proper disposal of rubbish, e.g. put all the household refuse/debris in a compost pit or bin, and cover or empty it regularly.
    iv. Dig and build pit latrines at a distance of 30 m from the house.
    v. Spray insecticides on any insects visiting the house, and cover all cooked food.
    vi. Boil drinking water and package food products properly.
    vii. For the sick, provide first aid and seek medical treatment, in case of the onset of any infections or physical discomfort.

Choose any of the above techniques and provide a service to your community at a fee.

Explanatory note

Some insects cause harm to other living things, at different stages of their life cycle as a result of development requirements. Identifying and destroying these stages would help reduce or eradicate the harmful effects.

Expected results

Design an activity plan that promotes economic development while at the same time controlling the harmful effects of insects on other living things for improved health standards.

Conclusion

Use simple but effective low-cost materials to promote economic development while at the same time controlling the harmful activities of insects in the community.

Evaluation

Demonstrate the sensitisation plan of the community on harmful insect control. Train other members of your class to carry out the above control techniques for economic development.

Follow-up activity

Refer to chemistry: preparation of pesticides and mosquito repellants. Demonstrate growing of the night rose or *omujaja (luganda)*, plants or smoking using pine, eucalyptus or any other scented plant to repel insects.

Observe and identify other harmful organisms apart from insects e.g. ticks, snails, rats, or cats. Demonstrate ways of controlling such organisms in the nearby community.

Chapter 2: SOIL

Introduction

Soil forms the upper surface layer of the earth that supports living organisms. Soil types are mainly classified as sand, loam and clay depending on parent rock, topography, climate, composition and percentage of components. This forms the soil structure which determines its properties and in turn influences economic development activities and sustainable environment.

Requisite knowledge

- *Types of soil and their properties*
- *Soil erosion types, causes and prevention*
- *What soil fertility is*
- *Carbon, nitrogen and water cycles*

Outline of major concepts

2.1 Soil formation, composition, profile and soil components

2.2 Soil properties and soil conservation

2.1 Soil Formation, Composition, Profile and Soil Components

Inquiry question: *Describe the major economic activities done on the different types of soil in your community.*

Explain whether the soil type is suitable for the economic activities.

Background information

The formation of different types of soil depends on the original material from which soil is obtained (parent rock) or topography (landscape) of the area or climate. Soil organisms and the time taken to form soil influence its structure and texture, or composition, in terms of particle spacing/aeration and particle size. This is a basis of classifying types of soils, as shown in **Table 2.1 a** below.

Types of particle	*Particle size in diameter (in mm)*
Clay	*0.0002 - 0.002*
Silt	*0.002 - 0.02*
Sand	*0.02 - 2.0*

Table 2.1a: Soil types and estimated soil particle size range

Soil components such as inorganic and organic materials are another component used for classifying soil. For example, the loam type of soils is better described using soil nutrients, the activity of soil microorganisms', water drainage capacity, and aeration percentage.
Relate loam soils to sand and clay soils to show the differences between the three types of soils.

You should be able to:

- *identify areas where different types of soil erosion have taken place.*
- *describe ways of soil formation.*
- *identify soil components and state their functions.*
- *describe the soil profile of an area.*

Activity 2.1.1 Composting organic waste

Aim

To form useful soil components from organic waste.

What you need

Plot of land, space, plant and animal waste, ash.

Note

- Cover the heap in the pit to reduce waste through decomposition as suitable temperatures are maintained by heat from the sun and by the wind.
- Do not add hot manure to garden soil because it can scorch the plants.
- Sprinkle water on the heap from time to time to keep conditions moist.

What to do

- Dig two deep pits about 1m by 1m in area.
- Put small branches or dry maize plants followed by dead leaves at the bottom of the pit.
- Add a layer of animal waste.
- Add a layer of soil. Add ash if available.
- Keep on adding layers as in steps 2 to 4 until all the animal waste has been put into the pit.
- Cover the mound with cut vegetation, e.g. banana leaves/grass.
- Sprinkle water on the heap to keep conditions moist.
- Insert a piece of wood which you can pull out after two weeks and feel its end to determine the temperature of the decomposing waste.
- Replace the piece of wood and feel the dipped end every week until it does not feel hot (this takes about 1 month).

Alternatively

- After the first two weeks, remove the decomposing matter and put it into the second pit, alternating the layers as above.
- Apply manure to the garden.

Activity 2.1.2 Formation of humus from animal residues

Aim

To prepare manure to improve soil fertility.

What you need

Poultry residues/goat/cow dung, a plot of land or a garden hoe.

Note

Do not dig very deep because the humus materials need water to be distributed to other areas through soil drainage and surface water flow.

What to do

- Dig two deep pits/ trenches of about 1m by 1m in area.
- Fill the trenches with poultry residues, or goat/cow dung and cover the pits with soil so that animals do not disturb the materials.
- Leave them to decompose for one month and supply humus for sale to farmers.
- Or provide a service by digging the pits and preparing the humus for farmers on their gardens. You will not need to dig the humus out, the water dissolves the nutrients and drains it to other parts of the garden soil.

Explanatory note

Soil formation is by two major methods, weathering of parent rock and decomposition of organic materials. The decomposition process forms humus or manure that is used to improve soil fertility.

Expected results

Soil formation by the decomposition process improves soil fertility. Demonstrate ways of providing bigger quantities of humus, for sale.

Conclusion

In some areas, 'black soils' or loam soils are sold to farmers especially to horticulturalists, to improve soil fertility and crop yields. Identify a nearby area where such soils can be prepared using the organic materials for sale.

Evaluation

Humus forms the upper layer of soils. Show how the humus formation activities may protect the environment, including the soils in your area.

Follow-up activity

Use other organic materials from animal remains to form humus or soil manure.

Activity 2.1.3 Soil profile and quality

Aim

To compare the quality of soils and plant yields.

What you need

A plot of land that has different gradients (levels of landscape), three basins, a hoe, and banana suckers, seedlings of ornamental plants or bean seeds.

Note

Identify uphill soils, slopes and valley soil areas to be used.
Plant materials used should be of the same kind and quality.

What to do

- Study the structure of soils in a nearby area at different levels and illustrate the soil profile observed, compare with ***fig. 2.1b***.
- Divide the piece of land into three levels or identify three different nearby areas with different landscape formation or soil profiles.
- Using the basins, collect samples of soil from the above three sample areas, and label as follows i. Valley soils ii. Slope soils iii. Uphill soils.
- Identify the physical quality of the soil samples collected by noting the soil particle sizes, humus level presence, and the drainage of soils.
- Choose one of the above plant materials and plant it in the collected three soil samples.

- Provide all the necessary conditions required for the growth of the plant materials.
- Observe the rate of growth of the plant in different soil samples by observing the growth size after a week, a month, two months and three months.
- Then follow the yields in each soil sample depending on the type of plant used.
- When the plants mature, harvest, feed on them to improve health standards and sell the excess.

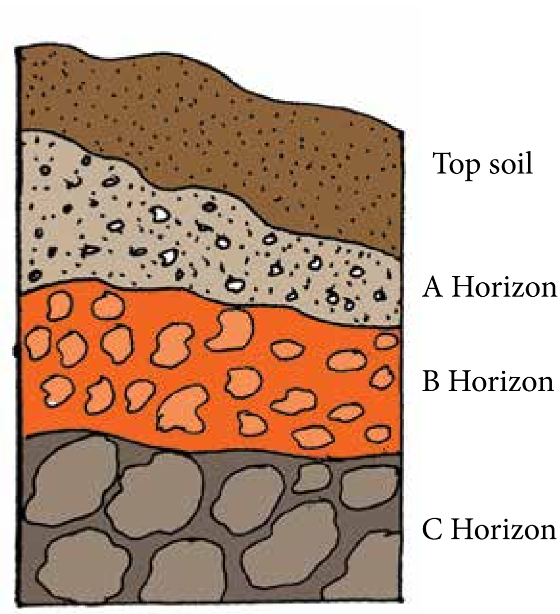


Fig.2.1b shows a soil profile.

Explanatory note

The soil profile shows the structure outline or soil arrangement according to soil particle sizes. This determines the types of soil at different levels of land, ranging from uphill and slope to valley soils. Soil arrangement/profile influences the quality of soil composition at different levels of the land or area, which in turn affects the growth rate of plants and yields.

Expected results

Observe and identify variations in the soil composition at different land levels. Show how soil profile study is useful in determining land use in your area.

Conclusion

The arrangement of different soil particles on a given landscape determines the type of soil at a given level, which in turn influences the economic development activity of the area. Study the land use of your community and indicate how suitable the activities being carried out are and suggest improvements for sustainable development.

Evaluation

Continue planting crops on various types of soil and show how to improve soil quality and land use in a nearby area.

Follow-up activity

Develop an action plan related to soil structure arrangement and national development in your community area. Work with your teacher, a resource person and community leaders.

Or carry out a similar plan with your family members on family land for improved land use related to the soil profile of the area.

Or visit stone quarry areas or mines, and establish the significance of these activities to soil formation, composition and components.

2.2 Soil Properties and Conservation

Inquiry question: *Explain the role of human activities in soil degradation in a nearby area. Demonstrate ways of soil conservation.*

Background information

Fertile soil contains adequate amounts of nutrients and optimum properties suitable for the growth and development of plants. A number of factors affect the concentration of various nutrients and properties, hence the need to encourage soil conservation. For example leaching, over-cropping, erosion etc. cause poor soils. Soil erosion is the washing away of topsoil. Most of the nutrients which are available to plants are found dissolved in soil in water form, in the top soil. So, if erosion is not prevented it may lead to soils with poor properties and insufficient nutrients for plant growth and development. Some of the methods used in preventing soil erosion are: mulching, contour ploughing , strip cropping, terracing, crop rotation etc.

You should be able to:

- *use knowledge of soil properties to make crafts and building materials.*
- *improve the products of different types of soils for economic development.*
- *carry out suitable human land use activities for economic development.*
- *practise soil conservation techniques.*

Activity 2.2.1 Mould the soil

Aim

To make soil products.

What you need

Clay/loam soils, firewood or kiln, water, brick modelling frame, drying machine/sunshine, or herbal plant powder.

Note

Choose suitable loam/clay soil types used in moulding crafts.

Work with the Fine Art Department or resource persons to help in developing the skills required for the production of soil products.

Follow recommended health standards and use the experienced personnel to protect users of the moulds you make.

What to do

- Identify an area /a plot of land with a suitable soil type for making moulds and take the soil to a shade or room where you will carry out the activity.
- Choose one of the following items to make from soil moulds.

a. Building bricks

- Identify ant hills, mould soils or clay soils in the nearby area and dig the mould to collect the soil into heaps.
- Mix the soil with water and 'thumb' or soften the mixture to make thick soils.
- Using brick modelling frames of desirable size, shape out the soil blocks as shown in ***fig.2.2a***.

Fig. 2.2a: Bricks made from soil

- Place them one by one in an orderly arrangement and dry them with a fire or sunshine /drying machine.
- When the bricks have dried, sell or use them for building a house.

b. Soil cooking stoves or moulds

- Dig loam or clay soils and clean the soils to remove any plant residues or particles.

- Soak the soil overnight to remove other impurities and decant, so that the soil dries a bit.
- 'Thumb' or soften the soil to form firm moulds and shape it into a cooking stove or a fireplace were firewood is used as in ***fig.2.2b.***


Fig 2.2b: A cooking stoves made from soil

c. Medicinal preservatives

- Identify suitable clay soil samples.
- Soak the soil over night to remove impurities.
- Decant to remove most of the water so that the soil dries a bit.
- Thumb/soften the soil to make thick blocks.
- Get herbal plant powder and mould it into the soil evenly.
- Form shapes of moulds.
- Dry the moulds under the sun and sell to the sick.

Explanatory note

In order to make items from soils as moulds, the properties of soils like water retention and drainage are considered. This is because the softening and shaping of the soil mould depends on the even wetness of the soil. Soils have varying pH ranges that depend on the mineral compounds dissolved. This property presents suitable conditions for preserving medicine in form of herbs which are utilised by herbalists. Sell the softened clay soil too!

Expected results

The soil moulds may be used to promote economic development. Which soil product activity is of value to the nearby community that you can practise and in the process develop skills to improve your standard of living?

Conclusion

Show distinct differences between the soil products obtained from clay and loam soils. Why is the sand soil type not used in moulding?

Evaluation

Demonstrate ways of improving soil product quality and durability.

Follow-up activity

Make tiles, ceramics (pots, cups, plates, etc.) or construct a house out of mud and wattle.

Activity 2.2.2 Description of soil characteristics

Aim

To identify human activities that destroy the soil structure and composition.

What you need

Sand soil, clay soil, loam soil, water, beakers, litmus paper

Note

Soil samples used should be dry.
Use the school laboratory facilities.

What to do

- Put 50gm of clay soil in a beaker.
- Add 100 cc of water, shake well and leave to stand for 20 minutes.
- Repeat the above procedure for sand soil and loam soil.
- Using litmus paper, find out the pH of each soil type.

- Take another sample of each soil, press it between two fingers.
- Mix it with a little water and feel it.
- Mix each soil with a little water and allow it to drop on the floor.
- Make soil moulds and shape the soil.
- Record your observations above in table. 2.2d.

Soil property	Clay soil	Sand soil	Loam soil
1.Size of soil articles			
2. pH of soil type			
3. Feel of soil			
4. Behaviour of soil when allowed to drop			
5.Moulding of the soil			

Table 2.2d: Fill in following the observation made.

Explanatory note

Recommend suitable human activities that may be practised using the clay, sand or loam soil types by referring to the above properties.

Expected results

Study ***fig.2.2e*** on soil types and name them. Indicate the soil characteristics of: (a) clay (b) loam (c) sand which need improvement in order to make them more useful in economic development.

Conclusion

Demonstrate the procedures of soil improvement techniques of each soil type.

Fig 2.2e: Soil types

Evaluation

Demonstrate cultivation on each soil type sample, by identifying which crop can grow on sand / loam / clay, soil types.

Follow-up activity

Write a report on the effects of human activities in destroying the soil structure and composition in a nearby area.

Activity 2.2.3 Mulching in a box

Aim

To demonstrate the importance of mulching in the conservation of soil water.

What you need

Dried plant leaves, viable bean seeds, 2 boxes or basins, loam soil, water

Note

The boxes or basins should be kept in optimum germination conditions.

What to do

- Put loam soil in two boxes or basins labelled **A** and **B.**
- Plant five bean seeds in each (**A** and **B**) with proper spacing.

- Place the boxes or basins in suitable conditions in a suitable place.
- Water the soil once a day until the bean seeds germinate and have three leaves.
- Cover the soil surface in box/basin **A** with the dry plant leaves/ materials, and leave box/basin **B** uncovered.
- Leave the settings **A** and **B** above to stand without watering for 5 – 7 days.
- Observe the rate of growth and development of the bean seeds in **A** and **B**.

Explanatory note

Give reasons for the appearance of seedlings in **A** and **B** in terms of plant firmness and quality. Predict the effects of soil types on the bean plant yields and propose how to improve yields in the different soil types.

Soil conservation is a set of management strategies for preventing soil from being eroded from the earth's surface or becoming chemically altered by over use, salinisation, acidification or other soil contaminants.

The principal approaches to soil management are: choice of vegetation cover, salinity management, encouraging the health of beneficial soil organisms, erosion prevention, and mineralisation. Other ways are: contour ploughing, wind rows, crop rotation, use of fertilisers and resting the land (bush fallowing).

Expected results

Observe and explain the appearance of seedlings in box/basins **A** and **B** after seven days.

Conclusion

Explain the role of mulching in the conversion of soil water.

Evaluation

- Outline other uses of mulching in improving soil fertility.
- Identify other materials that can be used in mulching.

Follow-up activity

Prepare a model garden of any food or cash crop and mulch it. Ensure care of the crops to provide high yields for consumption and sale. Use it as a demonstration garden for the community.

Study the figure below and identify a similar garden in your locality and suggest ways of improving it.

Fig 2.2f: Unmulched banana plantation

Activity 2.2.4: Intercropping

Aim

To demonstrate intercropping.

What you need

Plot of land, sweet potato cuttings, banana suckers, bean seeds, maize grains.

Note

Choose any other two plants which are easily available for the activity.

Planting should be at the start of the rainy season to provide optimum conditions for growth and development.

What to do

- Prepare the piece of land.
- Divide it into two plots and label one **Plot A.** Plant only one crop, either maize, or sweet potatoes or banana. Label second **Plot B**, plant maize seeds and bean seeds (a row of maize followed by a row of beans) or bean seeds and banana plants.
- Observe the top soil characteristics in **Plot A** and **Plot B,** before planting.
- Keep monitoring plant growth and development rate and crop yields in the two plots.

Explanatory note

Top-soils or surface soils in both plots differ in character and appearance. Identify the distinct property of soil that is causing the difference. Relate plant growth and development to the character of the soils observed and explain how they are affecting the crops.

Expected results

Show the role of intercropping in soil fertility maintenance.

Conclusion

Demonstrate the procedure of intercropping for sustainable economic development. State and explain the importance of intercropping in soil conservation.

Evaluation

Explain the importance of intercropping in soil conservation. Compare performance of plants which are intercropped with those that are not.

Follow-up activity

Using other crops, practise intercropping and train the community on the value of this method for economic development.

Chapter 3: NUTRITION IN ORGANISMS

Introduction

This is the study of the chemical components of food known as nutrients and their significance to organisms. All organisms need food materials to obtain nutrients for survival, but the procedure of obtaining them varies among organisms.

The nutrition methods are grouped as:

- Autotrophic (photosynthesis and chemosynthesis), in which organisms are able to manufacture organic from the inorganic nutrients they obtain from soils or water resources.
- Heterophytic, where organisms depend on other organisms for nutrients.

In everyday life, the process of feeding or obtaining nutrients is given a distinct schedule in all living things. This is followed by physiological assimilation of nutrients in the body that is translated physically into economic development activities, which need to be demonstrated to ensure improved health and survival. *Study **fig.3.0**. below and identify the food materials. Suggest the importance of these food materials for the economic and physical wellbeing of human beings. How often do you feed on the types of food shown? Are they of value to your life? Demonstrate a sustainable method of supplying those foods to your community.*

Fig 3.0 shows a plate of fruit salad that is occasionally served at a wedding or in a hotel buffet but that is rare in meals in the majority of Ugandan homes.

What is your opinion and that of your community on such diets?

Requisite knowledge

Food test procedures used to test for nutrients in food materials.

Nutrient compounds and their chemical composition and importance to the body.

Mechanisms of nutrition in organisms, including the concept of enzymes.

Outline of major concepts

3.1 Nutrients

3.2 Nutrition in Plants

3.3 Nutrition in Animals

3.4 Nutrition in Lower Organisms

3.1 Nutrients

Inquiry question: *Explain why nutrients are referred to as chemicals of life.*

Background information

In Ugandan families, because of the modern lifestyle, individuals seem to have succumbed to some nutrient deficiency illnesses and others will sooner or later fall prey. To avoid this one needs to get a proper balanced diet every day. Organisms show signs of well-being when fed on a diet with desirable and required body nutrients to activate the physiological processes.

Nutrients are obtained by organisms to ensure fitness and excellent health. It is therefore important to appreciate the role of food materials that provide the nutrients to the body, for the efficient functioning of the physiological processes and productive life.

Explain how nutrients maintain the physiological processes of life, like growth and development, reproduction, gaseous exchange and respiration, excretion and homeostasis.

You should be able to:

- *state the components of a balanced diet and participate in planning balanced meals.*
- *observe and identify causes of food deficiencies and provide a remedy.*
- *show the community how to maintain body health through nutrition.*
- *explain the causes of food spoilage and contamination and provide prevention methods.*
- *explain methods of preserving food materials for continued supply.*

Activity 3.1.1 Simple improvement in meals

Aim

To demonstrate components of a planned balanced meal.

What you need

Water/passion fruit/oranges, fish/bean seeds, sweet potato/maize flour, cabbage/ green vegetables, food test reagents and equipment.

Note

- Food test procedures should be carried out in the school laboratory with the help of a technician or teacher.
- Any other set of foods may be used to show a balanced meal.
- Prepare a meal with the help of a resource person or the Home Economics Department.
- Ensure proper hygiene for good health standards.

What to do

- Carry out food tests on the above set of foods in their raw form. (Use the conventional procedure.)
- Prepare juice from the fruits, a vegetable salad, sauce and a meal food, from the above food list.
- Predict the food values of the meal you have prepared.
- Write a recommended balanced breakfast, lunch and dinner meal from the set of food listed above.
- Set up a 'meal serving' room or area or meal packs, for providing a balanced diet to your classmates or community at a cost.

Explanatory note

Meals should be prepared for purposes of health and survival not principally for the sake of eating. All the essential nutrients of the body need to be included in a diet irrespective of the costs involved in obtaining food materials.

Expected results

Develop a list of 5 menus, using readily available and affordable food materials used in preparing balanced meals, to be served at breakfast, lunch and dinner time.

Explain the food value of the food materials in the menu list you have developed.

Conclusion
Use simple food materials in the nearby area to provide balanced meals to your family. Inform the community that 'a diet is not all about body size but the type of food eaten'.
Evaluation
Is it possible to demonstrate a balanced diet without being expensive? Give reasons for your answer.

Follow-up activity
Develop a mini-project at home that supplies food materials at a low cost for balanced meals in your community.

Activity 3.1.2 Facts about individual taste
Aim
To promote nutrition for good health in human beings.

What you need
- Food test reagents and equipment.
- Fresh and dried fruits: tomatoes, pepper, avocados, melons, bananas, pineapples, oranges, tangerines, lemons, guavas, cucumber, pawpaw, mangoes
- Vegetables: onion, cabbage, broccoli, carrot, cauliflower, corn, beetroot, eggplant, garlic, beans, peas, lettuce, spinach, nuts, pumpkins
- Grains: millet, sorghum, rice, maize
- Tubers; cassava, potatoes, yams
- Animal products: products of fish, chicken, goat, sheep, pig, cattle, rabbit, duck, and other poultry

Note

- If you know any other readily available food materials, add them to the list.
- Grow and develop some of the food materials above for sale.

What to do

- Choose four types of food materials from the above sets, at least one type from each set list, e.g. tomatoes, onion, millet, cassava, fish.
- Carry out the conventional food test on samples of the food materials chosen.
- Identify the food values and show how their deficiency in meals affects health.
- Suggest suitable meals for the following individuals in Table 3.1a. Use the above lists of food materials and provide a reason for your recommendation.

Meals	*Child of 1-5 year*	*Child of 6-13 year*	*Girls of 13-18 year*	*Boys of 13-18 year*	*Adult of 19-45 year*	*Adult 45+ year*
Breakfast						
Lunch						
Dinner						
Cost						

Table 3.1a: Recommended meals for individuals.

- Prepare and sell your recommended food products to the above individuals in the nearby area as food supplements to their preferred diet.
- Arrange various meals for different days to ensure individual tastes and preference are taken care of.
- Indicate common health protection nutrients offered by the food materials you have used above.

- Train your classmates and community about the facts related to taste and health.

Explanatory note

Food materials are designed to ensure a healthy, productive and effective body. Elimination of toxic waste every day is as vital as gaining energy for body development or for academic excellence or for work to earn money. However, most individuals in their day-to-day lives eat not for health but base what they eat on preference and availability. The body cycle follows a daily routine but their eating programme depends on energy expenditure not health needs. You should always plan to provide food materials for health and economic development.

Expected results

For example, supply the following foods for health not taste.

i.Pumpkin, onions and fish products provide carbohydrates, proteins, calcium, and other mineral nutrients*. Show the significance of pumpkin, onions and fish in the diet of children and adults.* Pumpkin, onions, and fish products help in the proper and efficient functioning of the pancreas and thyroid glands; therefore, they are important for individuals with diabetes and goitre. *Outline the physiological roles of the pancreas and thyroid glands in the body.*

ii.Cabbage, pawpaws, oranges, and ripe bananas ***(fig. 3.1b)*** are known to prevent problems of digestion, detoxify blood, and to prevent heart disease. *Identify which organs of the body are protected by feeding on such food materials. State the related diseases that are prevented by these foods.*

Fig. 3.1b shows samples of varieties of ripe bananas and onions which you can choose for the above activity.

Conclusion

Explain the importance of feeding for health and to meet the body requirements rather than taste.

Evaluation

Discuss the reasons for eating fruits and vegetables early in the day or after 8.00 pm and eating heavier foods at lunch time and before 8.00 pm in case you are not a night worker.

Follow-up activity

Together with a health worker or resource person or the Home Economics Department, develop a diet list for individuals with common chronic diseases, e.g. diabetes, hypertension, sickle cell anaemia, HIV, etc.

Draw a proper food material (feeding) plan with essential food nutrients for animals other than human beings.

Activity 3.1.3 Procedure for preserving food

Aim

To show the procedures for ensuring continuous food material supplies.

What you need

Varieties of sweet potato tubers

Note

Select different sweet potato tuber kinds. See ***fig. 3.1c.***

Fig.3.1c: Varieties of sweet potato tubers.

Study them and make a selection of two kinds.

What to do

- Collect a heap of each of the two kinds of sweet potato tubers of average size.
- Wash and dry off the water from the sweet potato tubers.

- Peel off the outer layer using a knife.
- Slice the tuber into thin flat pieces.
- Dry the pieces on a clean mat or iron sheet for 7-14 days.
- Store the dry potato pieces in a clean container and cover to prevent microorganisms, rodents or contamination which may cause food poisoning.
- Pound the pieces to form a powder and pack in a suitable material for sale.
- The powder can be used to prepare a variety of dishes served as part of meals. For example, mingle powder in boiling water to make porridge, or a paste for consumption. Mix ½ kg of the flour in 2 litres of water for the paste.
- Prepare other foods for sale.

Explanatory note

Plant food materials are obtained from plant organs. Hence the need to promote food material preservation to prevent food scarcity and to ensure continuous food supply.

Expected results

Show different ways of preparing preserved food materials, to provide a balanced diet.

Conclusion

Demonstrate procedures for sweet potato preservation.

Evaluation

Pack various quantities of the preserved food materials and supply them to the community or use the products of preserved food for sale.

Follow-up activity: Use other plant food materials which are available in the community, like cassava tubers, maize grains, rice, millet, etc to prepare preserved food materials.

Set up a project of plant food crops to continuously supply food materials to the community.

3.2 Nutrition in Plants

Inquiry question: *Plants are known to be autotrophic organisms manufacturing food nutrients. Is this a major contribution to other organisms? Explain your opinion.*

Background information

Photosynthesis is primarily known as the mode of nutrition of plants in all ecosystems (terrestrial and aquatic environments). Through this process, plants manufacture food that is utilised by the plants themselves and other organisms. The process also provides mechanisms of environmental conservation such as:

- sustaining a stable global water cycle, which influences the rain patterns and water resources quality and quantity.
- regulating carbon dioxide percentage levels in the atmosphere to prevent air pollution and global warming, therefore maintaining optimum environmental temperatures and a suitable carbon dioxide cycle.
- providing oxygen for controlling the respiration process of other organisms using oxygen.

It is, therefore, necessary to establish other economic roles of the plant photosynthesis process to other organisms.

You should be able to:

- *explain how plants make their own food.*
- *show the significance of products of photosynthesis.*
- *identify the right procedures for harvesting plant organs.*
- *observe and recommend human activities that conserve the products of photosynthesis.*

Activity 3.2.1 Eating raw foods

Aim

To show the importance of plants as a source of food for other organisms.

What you need

Tomato fruits, groundnut seeds, blackjack leaves, cassava root tubers, cassava leaves, sweet potato tubers, sweet potato leaves, a hen, a goat, human being, cooking facilities.

Note

Get fresh plant organs from a garden to ensure that the photosynthesis process has occurred uninterrupted (preferably collect the plant materials between 10am-2pm). Using the above list, get mature plant organs and animals.

What to do

- Collect the above plant organs and form two sets (**A** and **B**) of all the listed plant materials.
- The plant materials in **set A** should be labelled raw or uncooked e.g. raw tomato fruit.
- Plant materials in **set B** should be boiled until ready to eat and labelled cooked, e.g. cooked tomato fruit.
- Serve all plant material items in sets A and B, separately, to the animals (hen, goat, human being). For instance, the human being should eat the raw tomato first then the cooked tomato next.
- Observe the response to eating raw and cooked tomatoes. Note the taste preference. Continue until all plant food materials have been tasted.
- Then feed the hen followed by the goat using the same procedure as that used for the human being. Observe and note the preference.
- Prepare a list of your food products that you intend to sell to the

community, indicating the value of eating more raw plant food materials as compared to the cooked ones.

Explanatory note

The taste preference differs between the raw and cooked because the raw contains the original form of manufactured food materials in plant organs. On the other hand, the cooked plant organs contain mainly the slightly altered composition of food materials of photosynthesis process. Some nutrients in the plant organs are destroyed by cooking or their content in the plant material is reduced.

For instance, cooked tomatoes are extremely acidic and acidify the system. Raw tomatoes are extremely alkaline and more beneficial. Groundnuts are best eaten raw because of the high concentration of protein, oils, iron and calcium in them. They help in removing the residues of toxic waste products. Avoid overeating nuts because of the difficulty of digesting them; furthermore, roasted nuts have a high acid content.

Expected results

Carry out food tests on the sets (**A** and **B**) above and relate the food value of photosynthesising plant organs to the feeding of other organisms.

Conclusion

Demonstrate the importance of food products of photosynthesis in plant organs to other organisms.

Evaluation

The conventional test or procedure to show evidence of the photosynthesis process in plants is very important in experimental studies in the laboratory. Relate your activity results with this test and write the method you would use to show the importance of photosynthesis.

Follow-up activity

Extract oil from groundnut seeds and test its food value using the conventional food tests.

Prepare a demonstration garden of groundnuts/tomatoes/cassava at home and sell the products to the community.

Activity 3.2.2 Plant harvesting and nutrient preservation

Aim

To avoid destroying the nutrient value of plant organs during harvest.

What you need

i. Vegetable leaves: cabbage, lettuce, spinach, *sukuma wiki* (collard greens), broccoli, cauliflower, or any other edible green vegetables.
ii. Tubers: carrots, cassava, Irish potatoes, sweet potatoes or yams.
iii. Bulb: onions.
iv. Fruits: bean pods, maize cobs, rice, millet, sorghum or groundnuts

Note

Carry out the activities on one type of plant food material listed but you can use any other type which is readily available.

What to do

Using one kind of plant material from a set of plant organs (either i, ii, or iii) carry out one of the following procedures that applies to the set you have chosen:

a. **Picking edible vegetative leaves as shown in *fig. 3.2a.***

Fig. 3.2a: Examples of leafy vegetables.

Study them and identify similar plants grown in your community. Use them to carry out this activity.

- Make a choice of the vegetable leaves.
- Get a banana leaf, tie one end to make a bag like pack.
- Between 11am-3pm, pick the mature vegetable leaves and put them in the banana leaf.
- Wash the vegetable leaves with water one by one to ensure that they are well cleaned but do not dry them in the sun.
- Chop the vegetable leaves, wrap them in a clean banana leaf and steam for 10-20 minutes or until tender. Do not leave the vegetables to steam for a long time as this destroys the nutrient content.
- Serve together with other foods.
- Dry raw vegetable leaves in the sun and make a powder that can be served with meals.
- Carry out a food test on the raw, steamed, and dried vegetable leaves.
- Choose the best form of serving the vegetable leaves with meals and the best way of selling them to the community.

Fig. 3.2b shows plant organs that provide food to other organisms. Identify the organs and state their food value to human beings.

Fig. 3.2a: Examples of leafy vegetables.

Study them and identify similar plants grown in your community. Use them to carry out this activity.

b. **Prepare preserved food materials from a suitable plant tuber or fruit.**
   - When plants are mature, harvest the tubers or fruits for example as shown in ***fig. 3.2b.***
   - Dry the tubers or fruits in suitable surroundings and conditions.
   - Make powders out of the tubers or fruits and prepare meals or sell the powder properly packed with instructions on how to prepare a meal with them.

- Avoid leaving the plant food materials exposed to contaminants. e.g. open sacks, placing them on soil surfaces to dry or keeping in moist areas. This will prevent food poisoning from moulds or contamination.
- Sell raw tubers or fruits to the community and train them on how to harvest plant materials and preserve nutrients without contamination.
- Carry out food tests on the raw, cooked and dried tubers or fruits.
- Choose the best form of serving the tubers or fruits with meals and sell to the community.

Explanatory note

Food materials are made in vegetable leaves in the form of starch, which is converted to other forms of food nutrients in the plant. These are translocated to other parts of the plant where they are required or for storage, i.e. in stem tubers, root tubers, bulbs, or fruits and seeds. Most of these plant storage organs provide food materials to animals, including humans, but the process of availing the food to animals may destroy the plant food nutrients, therefore it needs care.

Expected results

Explain your choice of form of serving the plant food materials.

Show the importance of preventing food poisoning and contamination to animals, including humans.

Conclusion

Demonstrate the best time for harvest and the best procedure for preserving plant food nutrients.

Evaluation

Fig. 3.2c: Various plant food materials ready for sale.

Comment on the method of handling or presentation of materials to the market.

Follow-up activity:

- Prepare a plot of land and grow one or two types of food crops, for sale to the community in various forms, such as raw, cooked or preserved.
- Find out how other animals obtain food materials from plant organs and food nutrient preservation procedures in your community.

Activity 3.2.4 Growing crops and trees

Aim

To show the significant roles that plant nutrition plays in other organisms.

What you need

Seedlings of tree plants like jackfruits, mangoes, pine, eucalyptus, banana suckers, seedlings of ornamental plants, water and watering can.

Note

The plant seedlings to be used should be healthy.

Watering of the growing plants should be during the morning hours and in the evening.

What to do

- Choose one type of plant from the above list for planting.
- Identify a suitable area either at home or school for growing your choice of plant.
- Prepare the land for planting the crops or trees.
- Get suitable plant seedlings from a nursery bed.
- Plant the seedlings with recommended spacing to allow proper growth and development of the crops/trees.
- If it is a dry season, keep watering the plant until they develop a root system to depend entirely on soil moisture.
- Check regularly for any pathogen/pest, diseases and threat.
- Carry out a field visit in a nearby forest and grassland area or an animal farm and a crop garden/banana plantation.

Note: The weather conditions of areas in terms of the temperatures and aeration (smell/speed and body feeling of atmospheric air) of the surroundings.

- From your field study, predict the weather conditions of your surroundings at home or school. Is there any notable difference expected between the present and in future when your plants grow? Give reasons for your answer. Study ***fig.3.2d.*** *Outline the causes of* *the differences and how the plant population can be increased and maintained in these habitats, respectively.*

Explanatory note

Apart from providing food nutrients to other organisms, plants through the process of photosynthesis have other significant roles of:

i. utilising carbon dioxide gas in the atmospheric air, therefore reducing air pollution and preventing global warming and the greenhouse effect.
ii. Providing oxygen gas used in the aerobic respiration of organisms including human beings. This ensures the survival of organisms, through a stable energy production required for physiological processes.

In the context of development, the two roles of plant photosynthesis affect the climate and the populations of other organisms either positively or negatively. For example, in Uganda **climate variability** (fluctuations in weather elements' patterns e.g. temperatures/rainfall) and **climate change** (frequencies or levels of weather elements e.g. high temperatures/heavy rains) have been noted and plants are the major agents of these climatic facts associated with photosynthesis.

Expected results

Show the value of growth of plants or seedlings in your community to other organisms apart from being a food source.
Establish the role of photosynthesising plants in a water body and land habitats, to other organisms and biogeocycles.

Conclusion

Demonstrate the procedures for maintaining crops and trees for economic development and a sustainable climate.

Evaluation

Show how photosynthesising plants are vital in preventing the accumulation of carbon dioxide and how they are an essential source of oxygen for respiration.

Follow-up activity

Develop a crop or tree planting project for economic development and sustainable weather conditions in your community.

Observe and identify the effects of any one of the following activities on plant growth and weather changes in your community:

i. Industrial fumes released in the atmospheric air or water.
ii. Transporting vehicle discharges on the road.
iii. Construction of buildings and roads.
iv. Farming and related agricultural activities.
v. Charcoal and timber.

Provide recommendations to your community to avoid any further impact and prevent future adverse effects on the environment. Practise growing plants at the right time.

Activity 3.2.5 Deficiencies affecting photosynthesis

Aim

To identify the factors affecting the photosynthesis process in plants.

What you need

Banana plantation, cassava/bean plants/tomatoes garden

Note

Study the crop gardens in two separate seasons for example ***fig. 3.2e***.

Prepare to grow crops at different times of the year and seasons.

What to do

- Identify a crop garden in an area nearby or prepare a crop garden at home/school.
- Record the calendar time/dates and season or weather conditions of the surroundings.
- Observe and note the growth and development rate and appearance of the crops.
- Identify any disease or infection symptoms on the plant organs.
- Observe and identify the quality of the soil type in which the crops are grown.
- Note any external factor that is likely to interfere with the photosynthesis process indirectly, such as the rainfall pattern of the area, the percentage crop cover, weeds, among others. Determine how they influence the photosynthesis process of crops.
- Carry out ways of preventing the influence of the external factors' on the photosynthesis process of the crops.

Explanatory note

Photosynthesis is affected mainly by inadequate supply of the raw materials required for the process (water and carbon dioxide amounts present in the surroundings of plants), and conditions required for the process that is light. Other factors influencing photosynthesis are:

i. Soil fertility/mineral nutrients from soils to provide the elements or compounds required for photosynthetic tissue development.
ii. Enzymes in photosynthetic cells to ensure photosynthesis reactions occur and pathogens that destroy photosynthesising tissues or deplete mineral nutrients in tissues, causing deficiencies.

Observe and identify symptoms that indicate malfunctioning of the plant's photosynthesis process and thus affect growth and development, and yields.

Expected results

Explain the various internal and external factors that affect the photosynthesis process in plants. Indicate symptoms, causes, and prevention strategies that you may use to protect crops and improve yields.

Conclusion

Demonstrate the significance of taking care of crops in the garden, like mulching/irrigation in the dry season, maintenance of water resources, weeding, avoiding plant competition, right spacing of crops, etc.

Evaluation

Show various procedures for crop garden maintenance that promote an efficient photosynthesis process in plants to provide high quality yields.

Follow-up activity

Demonstrate strategies to community farmers which ensure an efficient photosynthesis process occurs in plants, thus preventing food shortage due to drought or poor soils.

Activity 3.2.6 Using plant photosynthetic pigments to enrich food products

Aim

To show the value of photosynthetic pigments to animals.

What you need

2 kgs of fresh carrot root, mortar and pestle, a wooden table of 1m by 2 m covered with a translucent plastic sheet to form a cage or an oven.

Note

- Make sure the setting is protected from moisture or dust and any other kind of contamination.
- Pack in air tight packages.

What to do

- Obtain 2 kg of carrot roots.
- Slice or dice pieces of 1ml thick carrot fruit.
- Dry the pieces in a cage covered with a translucent polythene bag to filter sunlight energy and heat.
- Leave for 7 days to dry and pound to form a powder.
- Mix the powder produced with fruit juices and any other food material.
- Pack in suitable materials and sell.

Explanatory note

Carotenoid pigments, for example beta carotene and xanthophylls, give roots, leaves or fruits their red, orange, yellow, or brown colour to roots, leaves, fruits, e.g. carrot roots, ripe tomatoes, orange, sweet potato etc which yield **vitamin A** after digestion by animals. It imparts antioxidant properties to animals and to plants; it is a photosynthetic pigment.

Expected results

Attractive food colour used to enrich food products with vitamin A source.

Reduce malnutrition and earn a living by selling the powders to improve food products.

Conclusion

The pigments in plant organs are not only used by the plant photosynthesis process especially during dry seasons but are also of health and economic value to humans.

Evaluation

Demonstrate the preparation of other products of value from photosynthetic plant pigments.

Follow-up activity

Extract the chlorophyll pigments from the common green vegetables or edible algae to be used to boost blood levels in anaemic people. Work with an experienced person.

3.3 Nutrition in Animals

Inquiry question: *Different animals show distinct processes of nutrition. Explain the importance of maintaining a normal nutrition process in mammals.*

Background information

While plants can make their own organic complex food compounds from simple materials, animals must be supplied with these complex compounds in the form of food materials ingested. The food materials are required to provide nutrients, which are essential for the physiological activities of the body that promote life processes.

After taking in/ingestion of food materials major processes sequentially follow: digestion (converting the complex nutrient compounds into simple absorbable forms), absorption of nutrients in simple form followed by assimilation, where nutrients are utilised by the body while the undigested materials are removed from the body in the process of egestion. These processes in the animal's body provide economically important activities that require practising in everyday life.

You should be able to:

- *show the importance of nutrition in animals and in other organisms.*
- *observe and identify malnutrition symptoms in mammals.*
- *identify and provide essential food materials to animals to improve health.*
- *process and supply food materials to animals, including people.*
- *preserve food materials for future use by animals.*
- *prepare useful products from materials egested by animals.*

Activity 3.3 .1 Nutrient deficiency diseases and prevention

Aim

To observe and identify causes of malnutrition in mammals using human beings.

What you need

Pawpaw, orange, pineapple, cabbage, broccoli, cauliflower, cassava, onion, sweet potato, milk, chicken, and fish. Food test reagents and equipment.

Note

You can choose any other list of foods, but make sure fruits, green vegetables, plant tubers and animal products are represented.
Use the school laboratory to carry out food tests.

What to do

- Collect a sample of all the food materials listed above in a raw form and label the materials.
- From each food material, prepare an extract and carry out the conventional food tests.
- Record the nutrient value of each food material confirmed from the above tests in table 3.3a below:

Food materials	Food test results	Role of the nutrient (s) to the human
Fruits		
Vegetables		
Tubers		
Animal products		

Table 3.3a: A summary table of food materials.

Group the above list of materials as indicated in the table and rewrite the table, filling in the gaps.

Suggest other food nutrients that are provided by the food materials listed above.

- State the type of food materials you can provide or recommend to patients with bleeding gum, marasmus, kwashiorkor, or any other deficiency disease in humans.
- Describe the prevention of various deficiency diseases in humans and train the community on how to maintain health through nutrition.

Explanatory note

Various human diseases are directly related to the type of food materials eaten and these are the common deficiency diseases while others are indirectly related to the food materials eaten. Such diseases are caused by other factors such as malfunctioning of body organs, e.g. the heart, pancreas, liver or the body hormonal glands, e.g. thyroid, ovary/testis, which are related to feeding habits and food materials. Common examples of such diseases include: diabetes, goitre, fibroids, digestive upsets, some heart diseases, etc.

Proper nutrition in humans is vital for proper functioning /maintainance of organs of the body and repair of body tissues through the use of nutrients and better feeding practises.

For example, the following food materials are known to be helpful in improving body health and also protection;

i. Cassava tubers are suitable for some diabetes, cardio-vascular diseases, the large intestine functioning, etc;
ii. Pawpaw and mangoes relieve indigestion, improve eyesight, etc.
iii. Fish ensures the proper functioning of the pancreas, thyroid glands, etc.
iv. Onion ensures the proper functioning of the thyroid, brain cells, etc.

Visit nutritionists and health resource persons to get a detailed explanation of the value of nutrients to health.

Expected results

Observe and identify the feeding habits of human beings that affect their body health, and carry out recommended strategies for improving health through nutrition.

Conclusion

Prepare a suitable menu for various patients with chronic diseases indirectly related to nutrition.

Evaluation

Identify nutrient deficiency diseases that are common in your community and recommend health improvement measures through talks or adult learning programmes.

Follow-up activity

Carry out a study on poultry birds and domestic animals' nutrition deficiencies. Identify the deficiencies, and suggest remedies and prevention procedures to be provided to farmers.

Activity 3. 3. 2 Preparing food material

Aim

To prepare the required types of food materials essential for children between the ages of six months and two years.

What you need

Heat source, food materials in any of the sets listed below;

i. 3 tablespoons soya powder, 1 teaspoon fish powder and 3 tablespoons maize flour, 1000ml of water.
ii. 1 Onion, 2 carrot, an egg or 500ml milk.
iii. 500ml Milk, an egg, and 2 tablespoons of sugar

iv. 1 medium melon and 1 medium pawpaw or a banana, passion fruit, guava, pineapple, mango and an orange

Note

Ensure the food materials are well processed to avoid contamination and transmission of infectious opportunistic microorganisms. On the pack for sale indicate the procedure of making ready food, to guide the user.

What to do

- Choose one set of the above food materials.
- Collect the selected set of food materials' samples.
- For set i. measure the recommended amounts or proportions and place them in a bowl or container.
- Using a suitable clean container, mix the food materials thoroughly as powders and pack for sale or add water and simmer for 10-15 minutes or until ready to be served as porridge.
- For set ii. prepare a soup by chopping the onion and carrots, and then add egg or milk. Simmer for 10-15 minutes or until tender/soft.
- For set iii. make a custard pudding, by simmering the milk, egg, and sugar for 3-5 minutes.
- For set iv. mash and mix the melon with pawpaw or banana to make a fruit drink. Or make juice from passion fruit, pineapple, orange or mango. Serve in a glass or put in bottles for sale.
- Supply to the community as foods that maintain and improve health.

Explanatory note

These food materials may be served as an enhancement to help the babies of HIV-positive mothers, as part of the weaning process or to feed sick babies. Relative amounts or proportions of food materials are recommended to provide the right quantities and quality of food nutrients to animals. Different age, sex, and energy demands in animals determine the kinds of food material to be consumed to maintain body health and to promote efficient physiological mechanisms.

Expected results

Set up a recommended feeding programme for individuals of varying age, work or sex and health status, using food materials. Display prepared foods to be served as meals to individuals of various health statuses at a cost.

Conclusion

Show suitable procedures for preparing meals with right food material ratios.

Evaluation

Demonstrate food ratio procedures used to prepare a standard meal for babies of varying status. Work with Home Economics Department/a nutritionist/a resource person.

Follow-up activity

- A field study visit to a nearby animal farm feeds supplier or factory or resource person, to demonstrate the procedures used to prepare suitable food material ratios for domestic animals. Mix and pack the required types and ratios of the food materials essential for domestic animals, including humans, for sale.
- Intercrop elephant grass with crops for cattle and domestic use, or blackjack and cabbage to provide feeds to poultry and green herbal tea for human consumption.

Activity 3.3.3 Egestion products

Aim

To utilise egested materials of the animal nutrition process to produce useful products.

What you need

Faeces/dung of domestic animals e.g. cattle, goats and poultry.

Note

Identify a garden or farmland or prepare a garden with food crops e.g. a banana plantation or commercial trees like pine or eucalyptus, etc.

Protect the pits from disturbance by animals.

Some animal-egested materials may contain microorganisms that are parasitic or pathogenic. Ensure that you protect your body e.g. through the use of gloves and gum-boots. Dry and burn the suspected dung.

The crops in plots should be the same species of plants. Similar conditions of the soil types should be ensured.

What to do

Divide the land into two plots. Do not place animal-egested materials in the first plot. Place the egested materials in the second plot as follows;

i. Select the garden or farmland and dig pits of 0.5meters deep that are well spaced, within 5metres space apart.
ii. Study the growth and development of crops in both plots.
iii. Collect the animals' dung (egested materials) as shown in ***fig.3.3c.***
iv. Then fill the pits with dung and cover them with soil to allow the materials to decompose and provide manure to the crops.

Fig 3.3c: Cattle dung which can be used in banana plantation for manure.

- The manure forms part of topsoils and also provide soil nutrient compounds that maintain soil fertility.
- Dig deep pits and put in animal dung collected from nearby areas, then cover with soil or plant materials.
- Supply the product to the community as manure to improve soil fertility.

Explanatory note

Animal-egested materials are useful economically because they improve soil fertility that is essential for improving crop yields. This method also improves the quality of top-soil in areas where the soils are not suitable for the cultivation of crops. Together with the Agriculture Department and your teacher, establish a method that is more sustainable in developing soil manure from egested materials. Discuss what happens to the human egested materials in sewage plants or in the nearby soak pits where they are deposited.

If a school or a home lacks a soak pit to deposit the animal-egested including humans' waste materials, draw up an action plan to provide one. Work with a resource person and community leader.

Expected results

Explain the economic and health-related issues of egested material products. Relate the value of using animal-egested materials in top-soil formation and economic development.

Conclusion

Demonstrate the use of animal-egested materials in improving saprophytic nutrition in microorganisms.

Evaluation

Show the role of products from animal-egested materials in soil fertility, by observing garden crop yields in plots with manure and those without manure.

Follow-up activity

Visit resource persons nearby or the Chemistry Department, to establish and carry out procedures for using domestic animal dung to produce biogas, commercial soil fertilizers, pesticides or insecticides and herbicides.
Discover the use of cattle dung as a preservative for crafts and models or dry goats' dung smoking near the poultry or goat shelter.

Activity 3.3.4Sources of nutrients for animals

Aim

To carry out food tests on animal feeds to show the nutrient value of food materials.

What you need

Flavours, heat, saucepans, serving dishes, knife, vegetable oil/ butter/ margarine/ghee, milk, water, eggs, food test reagents

i. Sweet potato leaves, onions, tomatoes, groundnut paste, soya flour
ii. Cassava flour, sweet potato flour, raw bananas

iii. Oranges, pawpaw, mangoes, pineapple, passion fruits
iv. Millet flour, rice flour, maize grains, bean seeds/peas

Note
Wash in warm water to remove the anti nutrient materials.

What to do

- Carry out the conventional food test procedures on one set of the food materials provided above.
- Prepare dishes of the set you have chosen and carry out a food test on the final food product to be served.
- Compare the nutrient value of the set of foods and that of the cooked product.

Note: Preparation of the dishes will depend on your individual meal preparation skill or creativity. For example:
Prepare a sweet potato dish using set i. of food materials: i.e. 1kg leaves, 2 medium onions, 4 medium tomatoes, flavours, water.

- Clean the food materials thoroughly to remove all dirt.
- Shred the leaves finely, chop the onions and tomatoes to small pieces and place all the food materials in a dish, then add flavours and stir to ensure a uniform mix of materials.
- Heat vegetable cooking oil/butter/ margarine/ghee, in a frying pan and add the food mixture, fry for 5-10 minutes or until tender and soft to eat.
- Serve with the main course.
- Or
- Add 200 ml of water or soya flour or roast-groundnut paste with water or use 200 ml of milk/2 eggs.
- Cook for 5 minutes and serve as a sauce or soup.

Fig. 3.3d: Examples of food materials in sets ii, iii, and iv.

Set out the procedure for preparing these foods.

Explanatory note

During the preparation of meals, the preservation of nutrients in food material is a challenge. You should be able to recommend the best way of preparing food without losing much of the nutrients in the food and to improve the nutritional value of food and body health.

Expected results

Together with a resource person, train your classmates and the community in the value of using the right procedure for food preparation by relating it to the source of nutrients and preservation.

Conclusion

Demonstrate procedures of food product preparation at a cost or sell the food product to the community.

Evaluation

Show the value of the nutrient source of food materials, by preparing and serving suitable food products to the community (meal for sale) or to your family.

Follow-up activity

Carry out food tests on preserved animal feeds such as salted fish, smoked fish, roasted meat/chicken, packed maize flour/ posho.

You should also test any other food material that is commonly used in your home or community.

Activity 3.3.5 Digestion

Aim

To explain the value of proper feeds in mammals.

What you need

Carnivores, e.g. a dog; herbivores or ruminants such as cattle, goats; or rodents such as rabbits; omnivores, e.g. human beings; poultry

Common types of food materials used in your home or community.

Note

Ensure the animals, including the human beings, are provided with the suitable and preferred types of food.

What to do

- Identify one group of domestic animals according to their feeding specialisation (either a carnivore/herbivore/omnivore) that is common in a nearby area. (Include humans with special feeding preferences such as vegetarians or non-vegetarians).
- Observe and identify the types of food materials they prefer as feeds.
- Record the source of the food materials, i.e. plant products/animal products/mixed plant and animal products.

- Note the animals' behaviours during and after feeding, and the amount of time they spend feeding using a 24 hour clock. (i.e. morning, mid-day, mid afternoon, late afternoon, evening or at night, etc.).
- Study this process for a period of 60 days.
- Recommend the right type of food material for the group of animals you chose.
- Provide the preferred food materials to the animals in your community by designing a mini-project to supply the feeds.

Explanatory note

Get involved in identifying suitable food materials and times of feeding. Observe the characteristic behaviours related to animal feeding to guide proper digestion and other physiological processes such as growth and development, and the health conditions of animals.

For example, the value of time of feeding is important: in humans, the last main course meal of the day should be before 8.00 pm; dogs feed any time during the 24-hour cycle; birds prefer feeding from early in the morning (6.00am) to evening (6.00pm), and at night with lights on. Cattle prefer feeding from 7.00am-12.00pm and usually rest between 1.00-3.00pm then feed again up to 6.00pm; goats prefer feeding between 10.00am-6.00pm. Suggest reasons for feeding time in relation to the digestion processes.

Expected results

Show the differences between types of food materials eaten by the animals you have studied and yourself.

Explain the reason(s) for the distinguishing factors, e.g. time of feeding, behaviours in the course of feeding, between the study animals and yourself. Nocturnal animals actively feed at night or in the dark and have well developed chemoreceptors to be able to smell food materials in the dark but have poor sight during daytime. State any other reason why nocturnal animals behave that way.

Conclusion

Demonstrate suitable procedures for feeding domestic animals in the community or your home.

Evaluation

Keep or rear domestic animals in your home or school or community. Using information from your study and knowledge of animals' digestion processes, provide suitable feeds to domestic animals.

Follow-up activity

Carry out a field study by visiting animal feeds preparation factories or animal-rearing farms in the nearby areas. Study and compare settings with those shown in ***fig. 3.3d.***

Fig 3.3 d: Goats

3.4 Nutrition in Lower Organisms

Inquiry question: *Identify the common lower organisms found in the nearby habitats.*

Background information

Most of the lower organisms carry out saprophytic nutrition by extracting nutrients from dead organic materials (food materials) through the process of decomposition.

Saprophytes secrete enzymes into the tissues of the substrate (food materials), which digest the complex insoluble materials into simple soluble compounds, i.e. external digestion resulting in a process which causes decay or rotting of the dead organic plant or animal material. Note that even herbivores and carnivores where digestion is internal, extracellular digestion occurs in the gut cavity.

You should be able to:

- *demonstrate saprophytic nutrition in common mushrooms.*
- *observe and identify decomposition of organic matter.*
- *prevent food spoilage.*
- *control growth of microorganisms.*

Activity 3.4.1 Growing mushrooms

Aim

To demonstrate the saprophytic nutrition process in growing mushrooms.

What you need

Cotton cake (coffee husks/maize cob/wood shavings)

saucepans, water, basin, nylon bags, polythene bags (*kaveera*), mushroom spores, pieces of wood, spirit, razor blade, safety pin

Note

- Avoid perfumes and perfumed substances; these interfere with the growth of mushrooms.
- Ensure that the pan is clean before cooking the cotton cake.
- Sterilise using disinfectants, like Jik or spirit, all equipment to be used.
- The incubation room should be dark.
- Transferring to another room should be done in the evening.

What to do

- Prepare a saucepan and put in water, place the pieces of wood and cover these with a folded nylon bag.
- Soak the cotton cake overnight.
- Spread another nylon bag open as in the course of steaming food.
- Remove the cotton cake from the water, put it in the prepared pan and cover.
- Heat over fire, bring to the boil and allow to simmer (88oC) for 3 hours. This is done to destroy microorganisms.
- Leave it to cool overnight.
- Wash the basin and other equipment to be used and sterilise them with Jik/spirit.
- Remove the mushroom spores from the bottle using a metallic rod.
- Place the cotton cake in the basin and mix the spores.
- Put the cakes in the polythene bags, press firmly and spread more spores on top.
- Tie the polythene and tighten firmly.
- Prick holes in the sides of the polythene with a safety pin.
- Cut the bottom corners and the bottom centre of the polythene with a razor blade.
- Prepare a dark place where you can hang the polythene with the mixture and close the door for incubation.
- Check after 2 - 2½ weeks. Knock the polythene to ensure that it is hard.
- Transfer to another room on other racks.
- Cut large holes round the polythene to expose the mixture.
- Water in the morning daily or 3 to 4 times per day during a hot season.
- Leave for 2 – 4 days for the mushrooms to come up.
- Harvest and sell for use as food.

Explanatory note

An example of saprophytic nutrition takes place in mushrooms, a group of fungi. Some mushrooms are eaten by humans and the part that is eaten is the reproductive structure which produces spores while the rest of the fungus lives below the surface of the soil in rotting wood or dung in contact with the food supply. Mushrooms have medicinal characteristics. They also contain minerals and vitamins.

Expected results

Explain the changes that occur to the spores.

Explain the importance of the following:

- Sterilising the equipment.
- Boiling the cotton cake.
- Providing openings on the polythene bag.
- Incubation done in the dark room.

Conclusion

Show how saprophytic nutrition in mushrooms is of economic value to humans.

Evaluation

- Explain the change in colour of the cotton cakes.
- Demonstrate what happens to spores after 18 days.

Follow-up activity

- Identify other materials that can be used to grow mushrooms.
- Grow mushrooms for home consumption and for sale.

Activity 3.4.2 Causes of food spoilage

Aim

To identify the micro organisms that carry out saprophytic nutrition.

What you need

Boiled milk, spoilt milk, unboiled milk, or samples of spoilt food, scalpel and needle, agar/nutrient medium/culture plates, knife, hand lens, microscope, glass slide, disinfectant (saline, Jik or spirit)

Note

Do not use products that harbour infectious microorganisms like dead animals.

Protect your body parts and avoid inhaling the spores from spoilt foods by protecting the nose.

What to do

- Collect samples of the milk (boiled, spoilt, unboiled).
- Using the school laboratory equipment, identify microorganisms in the samples of milk collected.
- Make dilutions of each sample of milk by adding 5mls of milk in 200mls of distilled and sterilised water.
- Prepare the culture plates in uniform-sized Petri dishes.
- Place a drop of liquor on the culture plate.
- Incubate at room temperature for a period of 24 hours to allow microbes to grow.
- Prepare the microscope study slides of the identified cultures of the milk samples.
- Put the glass slide under the microscope and focus to get enlarged images. Microorganisms such as fungi and bacteria may be seen if food is spoilt.
- Observe and record the colour of the microorganisms seen on the culture plates and under the microscope.
- Use these colours to identify the sample of milk with saprophytic organisms that spoil milk.

Other spoilt food materials may be used such as rotting oranges, bananas, bread, etc and follow the procedures below:

- Bring the suspected spoilt food material to the laboratory.
- Scrap off a thin layer of food and spread it on a drop of water on a glass slide.
- Put the glass slide under the microscope and focus to get enlarged images. Microorganisms such as fungi and bacteria may be seen if food is spoilt.
- Observe and record the colour of the microorganisms.
- Use these colours to identify spoilt food materials in future.
- Advise the community on the quality of good food and spoilt foods using the smell, physical appearance and colour of food materials.

Explanatory note

Presence of microorganisms in spoilt food samples is an indication of the decomposition process (saprophytism) causing food to decay. In cooked foods or raw foods, usually such saprophytic microorganisms are absent because the conditions of these foods do not favour development of decomposers. *State these conditions and how food spoilage can be prevented.*

Expected results

Show various ways of observing and identifying food spoilage to avoid food poisoning.

Supply high quality foods to your community and train your family members/classmates on how to avoid food decay.

Conclusion

Demonstrate procedures of supplying food materials of high nutrient value and avoid feeding on decomposing materials of low nutrient value.

Evaluation

Explain reasons why the decayed food materials have low nutritive value and how you can ensure food materials do not get rotten.

Follow-up activity

Carry out a study on microorganism cultures using preserved foods and explain the presence of these organisms on preserved foods.

Collect organic wastes to reduce environmental pollution and degrade it into manure used in improving soil fertility. Prepare manure to show the role of decomposition in soil formation and improve soil fertility. Also check ***Activity 2.2.1 in Chapter 2 –SOIL.***

Activity 3.4.3 Controlling microbial growth

Aim

To apply heat as a method of controlling microbial growth.

What you need

500g fruit (e.g. mango/pineapple/apple, etc)

250g sugar

500ml water

Saucepan with a cover

Jars with fitting lids

Note

Use fresh and good quality fruits.

Seal the jars immediately after heat treatment.

What to do

- Wash and peel the fruits, remove any cores and cut into even-sized pieces.
- Dissolve the sugar into the water in a pan and boil for 3 minutes, to make syrup.

- Pack the fruits into clean damp jars and fill to the top with the cooled syrup.
- Place the jars in a pan on a thick cloth with water up to the necks of the jars.
- Put the lids tightly on the jars and slowly raise the temperature to simmering point (88oC). Cook for about 5 – 30 minutes depending on the fruit.
- Tightly screw on the lids immediately.
- Store in a cool dry place and sell as packed fruits.

Explanatory note

Heat treatment works on the principle that microorganisms (saprophytes) are destroyed to prevent the decay of fruits. Also enzymes in fruits are inactivated and denatured at high temperatures to prevent the degeneration of fruits' nutrients. This can be applied in the preservation of the fruits together with canning, which helps to prevent the entry of microorganisms that cause decomposition.

Expected results

Explain the significance of simmering the fruits at high temperatures. Show the role of the sugar syrup in the preservation of fruits.

Conclusion

Demonstrate ways of preventing the decay of preserved fruits by making jam. Pack and sell to your community.

Evaluation

Show the importance of refrigeration, salting and smoking in preventing saprophytic nutrition in microorganisms. Use fresh fish and meat as food materials.

Follow-up activity

Using the same procedure, treat other fruits and vegetables for home consumption and for sale.

Demonstrate the procedures of controlling teeth decay by showing causes of decay and how to control microbial growth.

Chapter 4: TRANSPORT IN PLANTS AND ANIMALS

Introduction

The movement of materials within the body tissues or between tissues in multicellular organisms like high plants and animals occurs in transport systems. In unicellular or low plants and animals, such movement is by the transport mechanisms of molecules within a transport medium by diffusion, osmosis, active transport and mass flow, among others.

In multicellular animals, the medium of transport is blood, while in plants, it is water in which the materials are dissolved and transported. In case of diseases such as diarrhoea, dysentery, malaria, etc, the animal body may undergo dehydration. This causes serious effects on the body's physiological process, which can lead to death. Just like dehydration in animals, in plants wilting or excess water loss results, especially during dry seasons or inadequate water supply or absorption by conducting tissues.
Animals and plants have specialised cells or tissues performing special functions of the transport systems apart from transporting materials.

Discuss the role of protection and support of the body structure, by the transport systems in animals and plants.
The major significance of these systems to the body has been greatly applied to economic development, for example by animal health service providers, in the construction industry using plant materials and in environmental protection.

Requisite knowledge

- *The cell structure and tissues*
- *Structure of transport systems in animals and plants*
- *Composition of blood*
- *Blood transfusion*
- *Immunity and immunisation*
- *Effect of HIV on immunity*
- *Transpiration*
- *Translocation*
- *Transport mechanisms in cells (diffusion, osmosis, active transport)*

Outline of Major Concepts

1.1 **Transport in Animals**

1.2 **Transport in Plants**

1.1 Transport in Animals

Inquiry question: *Of what use is a transport system in animals?*

Background information

Transport involves the movement of materials from one part of the organism to another. In animals, it is basically the circulatory system. The system consists of the heart and blood vessels. Blood flow through the system is maintained by the heart, skeletal muscles, valves, and inspiratory movements. The heart is myogenic. Blood transports dissolved substances such as respiratory gases, water, food materials, etc.

In case of diseases such as malaria, diarrhoea and others, the body may lose blood together with water, leading to dehydration. This causes serious effects including dizziness and even death. This condition can be corrected by administering dalose.

You should be able to:

- *observe symptoms, identify causes and prevent dehydration.*
- *identify diseases related to the transport system functions.*
- *explain the effects of blood levels in human beings.*
- *explain simple ways of using vasoconstriction and vasodilation.*

Activity 4.1.1Prepare oral rehydration solution

Aim

To provide oral rehydration solution to patients

What you need

Clean cup, salt, sugar, drinking water, spoons, dehydrated patient.

Note

Use clean and sterilised appliances and boiled water.
Emphasise hygiene in the preparation of the mixture.
The mixture should be used within 48 hours.

What to do

- Put half a litre of drinking water in a clean container.
- Add 4 tablespoons of sugar and 1 teaspoon of salt for adults.

Or

- Put ½ litre of drinking water in a clean container.
- Add 2 tablespoons of sugar and ¼ teaspoon of salt for children above 2 years.
- Stir the mixture with a clean spoon to form a uniform mixture.
- Keep the mixture covered. This drink is known as a dalose. Pack and sell to patients.
- Let the patient take ½ litre daily for five days by drinking a little portion at a time.

Explanatory note

Oral rehydration mixtures are used to boost the amount of water lost from the body due to dehydration. Dehydration is a condition developed in patients that have experienced illness, leading to low water amounts in blood fluid. Rehydration helps to add water to the body so that transport of materials in the body is efficient.

Expected results

Observe and identify signs of a dehydrated patient.

Explain the effects of administering dalose to the patient.

Conclusion

Press any soft part of the hand of the adult patient using a finger or lift part of the stomach skin in children and release it. Observe the depressions formed on the body. On the basis of this, explain the differences between a normal and a dehydrated individual.

Evaluation

Relate the effects of dehydration to the role of the human transport system and body health.

Compare this mixture and the commercial product provided in the health centres.

Follow up activity

Discover plant food materials in the form of vegetables and fruits that are used in protecting the body from dehydration.

Grow and sell such food products to patients to boost rehydration.

Activity 4.1.2 Investigating the effect of exercise on the pulse rate

Aim

To demonstrate the effect of exercise on the pulse rate.

What you need

2 individuals, stop watch, graph paper, pen, paper

Note

Weak or poor health individuals should not get involved in exercises without consulting medical practitioner.

Do not use the heart area to identify a pulse.

What to do

- Form a group of two individuals of the same age range and work in pairs.
- Then use your fingers to identify a pulse at the wrist as shown in ***fig.4.0b.*** or in the neck area.

Fig. 4.0b: A human determining pulse rates.

Determine the rate of wrist pulse or neck pulse by counting the pulses per 60 seconds/1 minute.

- Then calculate the heart rate by multiplying the pulse rate by 10.
- Measure your partner's resting pulse rate before he/she exercising in a sitting position.
- Let your partner exercise the body for one minute (e.g. carry out press-ups or jogging on the spot). Measure the pulse rate immediately after the one-minute exercise is over.
- Continue to monitor your partner's rate every minute, until the pulse rate has returned to the resting level or become stable/ constant once again.
- Follow the above procedure too and determine your pulse rate. Record your results in a Table 4.1c.

Time (minute)	*1*	*2*	*3*	*4*	*5*
Number of pulse counted					

Table 4.1c is to be filled in to indicate pulse rates at rest and after exercise.

Plot bar-graphs showing the rate of pulse of your partner and your response to exercise, using the same axes.

- State the known standard pulse rate of a human being, the normal pulse rate of your partner and yours. Explain the difference between the standard, normal and after exercise pulse rates.

Explanatory note

Changes in the pulse rates are noted because of varying flow of blood and rate of heart beat. For blood to flow, the heart beats through the contraction and relaxing of ventricles and auricles (indicated by a pulse). The amount of blood flowing via blood vessels is determined by the heartbeat, environmental conditions, the state of one's health and the extent to which blood vessels are constricted or dilated in addition to other factors.

Describe the causes of this variation in the pulse rate during body exercise and at rest.

Train individuals to determine pulse rates and carry out exercises through sports for healthy body maintenance.

Expected results

Explain the significance of a normal pulse rate in human beings, by comparing it to the standard pulse rate and the adjusted pulse rate during exercise.

Show the flow of blood through the heart to other body parts.

Conclusion

Explain the health role of carrying out daily exercises by relating it to the functions of the transport system in humans.

Follow-up activity

Collect data from friends on the pulse rate, compare the fitness of your members and advise accordingly.

Form a sports club or association in your community for the purpose of engaging in exercises/sports activities/games. Or form a health club that runs training exercises for the less fit individuals e.g. the diabetic/hypertension patients, pregnant women, etc.

Activity 4.1.3 Signs of common heart diseases

Aim

To identify body behaviours of an individual with common candiovascular diseases.

What you need

The heart of a domestic mammal (cattle, goat), patient with heart disease

Note

Use the fresh heart of a domestic mammal but not from dangerous or unsuitable animals such as dogs, cats and humans.

What to do

- Visit health centres to study the symptoms of heart disease in patients of varying age groups.
- Record the findings and causes whether acquired or inborn.
- Make an inquiry from a health worker as to whether the patient requires treatment by surgery or just drugs or exercise or whether it is a chronic case.
- Collect a heart organ from a registered and authorised slaughter house for domestic animals.
- Study the organ and identify the external features, draw and label.
- Cut a longitudinal section of the heart and name the observed parts. Draw and label one section of the heart organ.
- On your diagram, indicate by arrows the direction of blood flow.
- Show how this heart is adapted to its function.
- Cut part of the ventricles or part of the blood vessels observed. Study the level of destruction in the heart from a slaughter house and predict the extent of interference on flow of blood that may be caused

if it happens in the human being naturally.

- Sensitise the members of your class, family, and community using your findings to the symptoms, causes, care and protective measures.

Explanatory note

Some heart problems are a result of poor development of the young while in the mother's womb or hereditary such as having small blood vessels. Heart diseases may also be acquired through fat deposit layers within the vessels making the lumen small. Heart failure may be due to the swelling of the muscular walls of the heart or failure of the valves to close and open rhythmically. This is what leads to collapse and sometimes death.

Carry out regular body exercises to prevent development of some heart diseases and eat a proper diet such as feeding on liver, cassava products, and ripe bananas as shown in ***fig.4.1e.***

Fig. 4.1e: The ripe banana fruit type as one of the suitable measures for heart disease protection.

Do not over eat the bananas on the assumption that it is a treatment or cure! Get suckers of this banana species and grow them at home and sell the fruit for health improvement and economic development.

Expected results

Show the procedures for taking care of heart disease patients.

Conclusion

Demonstrate ways of protecting the body from heart failure or developing heart diseases.

Evaluation

Show the relationship between body exercises and functioning of the circulatory system.

Follow-up activity

Develop an action plan to set up a health exercise or fitness association to reduce heart problems in your community.

Activity 4.1.4 Reducing blood flow by vasoconstriction

Aim

To demonstrate the function of the animal transport system in temperature regulation.

What you need

Iced water, clean piece of cloth, needle, steriliser, soap

Note

Use sterilised needles

- Ensure that you do not share the needle used for pricking.
- Clean the finger with a cotton piece soaked in spirit.

This activity is suitable for minor injuries only as first aid. For major injuries seek medical services from a resource person.

What to do

- Wash your hands with soap.
- Immerse your right forefinger in iced water for 1 minute.
- Prick the tip of the forefinger with a sharp sterilised needle.
- Then immerse your left forefinger in warm water for 1 minute.
- Prick the tip of your left forefinger with a sterilised needle.
- Observe the amount of blood released; use a plaster to cover the finger.

Explanatory note

Demonstration for vasoconstriction of blood vessels using iced water on fingers shows the effect of cold conditions or low temperatures of the surroundings on animals. This is a physiological process of the body that maintains body temperature in humans by reducing the volume of blood flow in skin surface blood vessels. In this way, heat loss to the surroundings is prevented through a reduction in the volume of blood flow at the skin surface. This is used by indigenous scientists in the community to reduce blood loss, for example reduce blood flow by vasoconstriction.

i.To prevent excessive bleeding during circumcision

- Immerse the body of a circumcision novice in a cold stream before the foreskin is cut.
- Apply ice cubes wrapped in a clean piece of cloth.

ii.To stop nose-bleeding

- Wrap ice cubes in a clean piece of cloth or small towel.
- Apply to the face around the nose until bleeding stops.

Expected results

Explain causes of the difference in the amount of blood oozing out of the two fingers. Show what would happen if a vasodilated blood vessel is cut.

Conclusion

Describe the effect of vasodilation and vasoconstriction of blood vessels as a mechanism in reducing bleeding.

Evaluation

Demonstrate how you can apply vasoconstriction to reduce bleeding.

When would the principle of vasodilatation and constriction be applied?

Follow-up activity

Suppose a friend has had a minor accident by cutting a finger or a hand, or hit a finger with a car or classroom door. How would you help him or her to reduce excessive loss of blood or to ensure normal flow of blood in the finger blood vessels?

1.2 Transport in Plants

Inquiry question:

Study Table. 4.2a below which shows the flow of materials in a plant.

Using arrows, show the energy flow, nutrients and water movement in the plant parts indicated in the table.

<table>
<tr><td colspan="2">Light source</td></tr>
<tr><td colspan="2">Leaf cell</td></tr>
<tr><td>Xylem stem</td><td>Phloem stem</td></tr>
<tr><td>Xylem root</td><td>Phloem root</td></tr>
<tr><td colspan="2">Root hair cell</td></tr>
<tr><td colspan="2">Soil water source</td></tr>
</table>

Explain the processes involved in the circulation of materials from one part of the plant tissue to another.

Background information

The conducting tissues in plants are the xylem which transports water and dissolved mineral salts, and the phloem which transports photosynthetic products. Transport of these materials occurs through the processes of diffusion, osmosis, active transport, mass flow and translocation. The transpiration process indirectly supports transport of materials in plants especially with the help of the transpiration steaming mechanism. Water is transported to the top of leaves through a water column created by the natural forces of cohesion and adhesion, providing the ability of tissues to transport water from the roots, where it is absorbed from soil by root hairs. The pressure generated in the leaves due to water absorption is also promoted, following massive photosynthesis which is important for causing a mass flow of organic nutrients down the phloem, then to the food storage organs.

Explain the significance of the above processes in the development of plants and their role in the environment.

You should be able to:

- *use the structural features of conducting tissues in plants to develop construction materials.*
- *demonstrate the effect of plant transpiration on rain formation and water resource quality.*
- *show the relationship between conducting tissues and food storage organs in plants.*

Activity 4.2.1 Drying wood (log) for making firewood or building poles.

Aim

Demonstrate the role of transpiration in preparing dry wood materials that are used for commercial development.

What you need

Woody plants preferably trees and a panga

Note

Do not clear the vegetation or leave the land bare.
Woody plants must be mature and of the same size.

What to do

- Cut down two identical woody plants of the same size and age.
- Remove all the branches and leaves from one of them.
- Leave the second intact.
- Allow the two to dry for a week or two.
- In which of the two arrangements do the stem pieces dry first?

Explanatory note

Explain the differences in the degree of dryness in the woody plants.

Air flows through the plant tissue spaces between the pieces readily, removing moisture lost by the pieces, thus quickening the drying process. Prepare dried woody plant stems for the community firewood and poles market.

Fig. 4.2a: Stems of woody eucalyptus plants that are used to make firewood and poles ready for sale.

Suggest a suitable method of storage that ensures the wood is dried further.

Expected results

Relate factors affecting the rate of transpiration and dryness of wood.

Explain the difference in the degree of dryness in the stems piled together and those separated.

Conclusion

What is the effect of leaves and branches on the preparation of wood for firewood or building poles?

Evaluation

Explain the role of leaves and branches in the rate of transpiration and drying up of wood.

Follow-up activity

Cut down a branch of a tree at home and practise the fast method of drying firewood for sale.

Activity 4.2.2 Preparation of wood for timber

Aim

Demonstrate the preparation of wood for timber.

What you need

Mature wood, timber

Note

Use mature wood of the same size.

What to do

- Split the stem into pieces.
- Place 4-6 pieces parallel to one another on the ground.
- Place 4-6 pieces across the first pieces.
- Alternate the direction faced by pieces until a height that can be supported is attained.
- Set up a control in which all the pieces are simply heaped in one pile.

Explanatory note

What is the difference in moisture content between the timbers produced in the above activity and that in the control activity suggested?

Fig. 4.2b: Timber for sale.

Explain the effect of placing planks of timber parallel to each other without pieces separating them.

Expected results

Explanation of the factors affecting the rate of transpiration.

Evaluation

What is the effect of the surface area on the rate of evaporation and drying of timber?

Follow-up activity

Practise fast methods of drying firewood in your homes.

Visit a carpentry workshop and find out the different ways of drying timber and the quality of timber produced.

Develop a programme with resource persons and acquire skills of using timber for economic development.

Activity 4.2.3 Killing weeds

Aim

To demonstrate the role of transpiration in weed control.

What you need

10 herbaceous weeds.

Note

Use fresh herbaceous plants with many leaves

What to do

- Remove 10 herbaceous weeds from a garden, e.g. blackjack.
- Remove the leaves from 5 of them and leave the other five intact.
- Remove all soil from roots.
- Spread the two lots separately on the ground for a few hours.
- *In which of the 10 herbaceous woody plants does drying occur first?*

Explanatory note

Transpiration occurs in leaves and other aerial parts of a plant. Evaporation of large quantities of water results in wilting or drying of weed plants. In this case lack of leaves does not promote the evaporation or transpiration stream forces developed in the xylem, resulting in a reduced quantity of transported water in tissues and low water absorption by the roots.

What is the effect of removing leaves from herbaceous plant?
What causes the difference in the rate of drying up of the experimental and control herbs?

Expected results

The leaves allow transpiration, hence faster drying.
Find out the role of leaves in the transpiration process of plants.
Compare the rate of drying of herbaceous and woody plants, and use this

technique in weed control in your community.

Conclusion

Explain the effect of leaves on the rate of transpiration and drying of weed plants.

Evaluation

Demonstrate the effect of removing leaves from a weed plant. Pick weeds from flower beds or crop gardens at an early stage. *Explain why this is done early and not at mature stage of the weed plants.*

Follow-up activity

Practise fast and effective methods of killing weeds in the flower gardens and crop fields.

Remove leaves from weeds in your home garden to kill the weeds.

Chapter 5: GASEOUS EXCHANGE AND RESPIRATION

Introduction

When nutrients are absorbed in cells, the metabolic process converts the nutrient chemical compounds into energy following a biochemical system set in living cells. This energy is stored as potential energy in body tissues and released when required by the body's biological processes. This is known as respiration, and is supported by the gaseous exchange process, and nutrition. The energy is formed through the breakdown of food components like glucose in cell tissue respiration and utilised by the body's physiological processes, e.g. growth, movement, reproduction, etc. The carbon dioxide released during the respiration is removed from the cells and body through gaseous exchange mechanisms since it is toxic at high concentration. However, in plants the carbon dioxide released is used in the process of photosynthesis in which food and oxygen are produced. These products of photosynthesis are of economic importance in the environment and to other organisms.

Requisite knowledge

- *Photosynthesis*
- *Nutrition*
- *Basic cell structure and function*
- *Importance of carbon dioxide and oxygen*

Outline of Major Concepts

5.1 Gaseous Exchange

5.2 Aerobic Respiration

5.3 Anaerobic Respiration

5.1 Gaseous Exchange

Inquiry question: *Apart from saving life, relate the gaseous exchange process to everyday activities in the environment.*

Background information

Fig 5.1a: An illustration of students using air.

What value of gaseous exchange to the lives of organisms is indicated?

In man, the medium of gaseous exchange is air and respiratory organs are the lungs located in the thoracic cavity. A number of movements occur during inspiration (breathing in) and expiration (breathing out). Oxygen is transported as oxyhaemoglobin in the blood throughout the body, while carbon dioxide is transported as bicarbonate ions through the blood medium to the alveoli in the lungs.

Trace the gaseous exchange system path in mammals and compare it to that of a fish.

During severe accidents like electric shock, drowning, poisoning, etc., one may become unconscious and fail to breathe. This can lead to damage of the brain cells due to lack of oxygen in the body tissues. Mouth-to-mouth resuscitation/kiss of life/artificial respiration can be provided as immediate first aid to restart breathing and provide sufficient amounts of oxygen supply to the cells as shown in ***fig.5.1a.***

In everyday life, natural activities that maintain a balanced atmospheric air mixture in terms of optimum percentages exist. These are demonstrated in the form of biochemical cycles, like the oxygen, carbon dioxide, water and nitrogen cycles, among others.
Establish such activities and relate them to economic development of the nearby community.

You should be able to:

- *explain the value of the relationship between gaseous exchange in plants and other organisms.*
- *show the role of the gaseous exchange process in environmental protection and improving standards of living.*
- *use the techniques of gaseous exchange to save life and maintain good health.*

Activity 5.1.1 Kiss of life

Fig.5.1a: A dummy patient

Aim

To demonstrate artificial respiration using a dummy patient.

What you need

Mat or piece of cloth, dummy patient

Note

- The rescuer must be free from airborne diseases like influenza, cold, tuberculosis, etc.
- Put a clean piece of cloth over the patient's mouth before placing your mouth over his / hers to avoid transmission of infections.

What to do

- Lay the dummy patient on the back as shown in fig.5.1a.
- Follow the steps illustrated in ***fig.5.1b.***

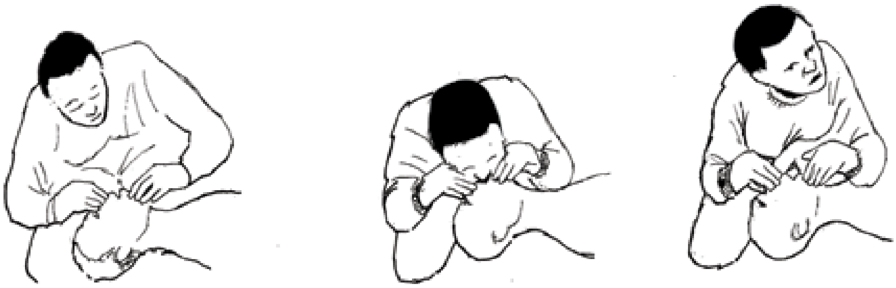


Fig. 5.1b: An illustration of kiss of life .

Pull the head back (to keep the passage open) and put a clean piece of cloth over the mouth.

- Close the patient's nose using your fingers.
- Take a deep breath and then place your mouth on that of the patient to cover it completely and breathe out into the patient's lungs as you watch the patient's chest rising.
- Then remove the mouth and allow the patient's chest to fall or gently press it.
- Repeat the steps above until the patient begins to breathe by himself/herself.
- Take the patient to hospital.

Explanatory note

This activity is useful in saving life in case an individual collapses owing to lack of sufficient air. However, care must be taken in case of asthma, sickle cell, diabetes, or heart disease patients. In such cases, seek the services of a health professional immediately.

Explain the value of mouth resuscitation of a patient during the kiss of life.

Expected results

Relate the sequence of events occurring during gaseous exchange in man to the above activity. Develop a demonstration model that may be used to educate the nearby community on this first aid technique.

Conclusion

Explain the role of artificial respiration to a patient. Practise health conditions for which you can apply artificial respiration as first aid.

Follow-up activity

Explain any other type of first aid which can be administered to a patient in case of a gaseous exchange difficulty in humans.
Visit a neighbouring hospital and request a specialised person to demonstrate to you the use of a resuscitator. Explain the operation of the machine and if possible practise using it at a health centre.

Activity 5.1.2 Events that occur during breathing in humans

Aim

To explain the actions that occur in life which are influenced by gaseous exchange.

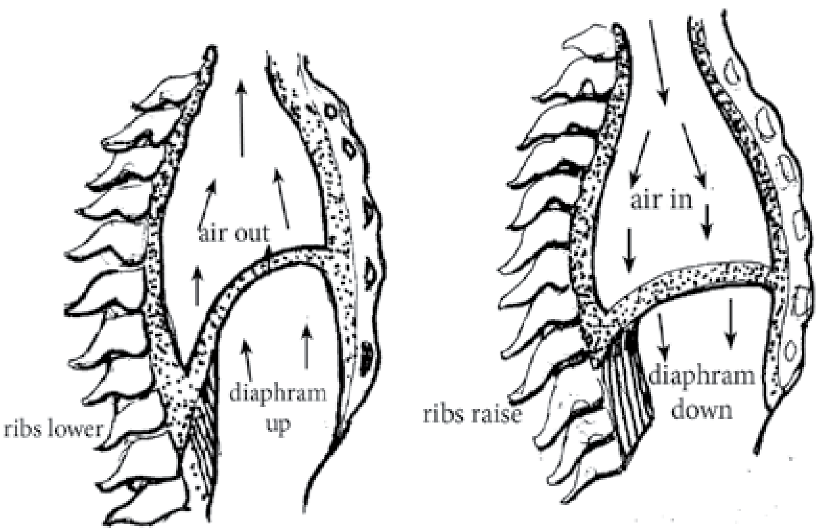


Fig.5.1b: The inspiration and expiration processes in mammals.

Study the diagrams and describe the changes that occur in the thoracic region

What you need

Water, Lime water, test tube, plastic bottle, small basin, 2 balloons, 2 transparent plastic/polythene sheets, transparent ball pen cover or a straw, a string, rubber band, tape measure, students in pairs

Note

Ensure the hygiene of the material chosen.
Both students should not have health problems or if any, use first aid service from a trained person.

What to do

- Pair up (2 students).
- Breathe in (inspiration) and breathe out (expiration).
- Count the number of breaths per minute of each other while **a.** sitting **b.** standing **c.** after exercise (jogging).

Using table 5.1b: fill in the results and compare the number of breaths per minute.

Activity	*Sitting*	*Standing*	*After exercise*
Student A			
Student B			

Using a tape measure, take chest measurements of each other, as you breathe in and out deeply. Take several measurements of each other's chest. Record the measurements.

- Compare the rates of breathing in a normal person in different weather conditions. Determine if there is any variation and cause. If there is need for medical attention, advise the person to visit a medical centre.

Other activities related to breathing

1. In pairs, move around different urban and rural areas. Breathe in the air to identify air that is polluted, e.g. choking air, bad scent, etc. Investigate the cause of the air condition identified and record the area and condition of air. Recommend how the community can improve the air conditions in their area for improved health.
2. Put lime water in a test tube and blow into it. Note differences in the lime water colour before and after blowing into it.
3. Fill a plastic bottle with water, e.g. mineral water bottle. Invert it in a small basin of water. Insert a straw/plastic tube as shown in ***Fig.5.1c*** below. Breathe out gently into the straw or tube or blow air into the bottle. Note the volume of water in the bottle when breathing gently and when you blow.

- *Compare the results.*
- *Explain how the breathing system of a human being works in a swimming activity.*
- *Describe the effects of drowning in water on the breathing system of humans. Suggest the first aid procedures that may be used to save life.*
- *Develop a programme with community leaders on sensitising the nearby community members using water bodies on how to save someone who is drowning.*

Fig 5.1c: The effect of breathing into a straw. It relates to how swimmers breathe under water.

4. Using a knife, cut off the bottom of the plastic bottle and replace it with a transparent plastic or polythene sheet. Tie tightly using a string or rubber band. Insert a balloon through the top of the bottle as shown in Fig. 5.1d. Pull the sheet down and note the effect on the size of the balloon, then release the sheet and note again.

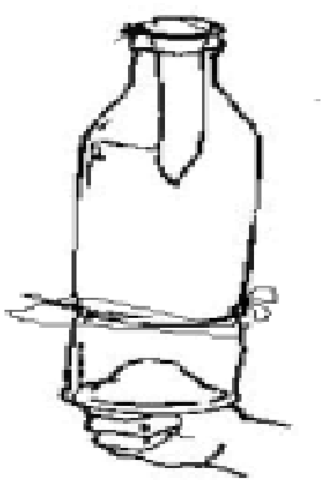


Fig 5.1d: A model bottle illustrating inspiration and expiration.

Copy and draw a labelled diagram indicating the parts representing the organs used in gaseous exchange.

This is demonstrated on a drowning individual when the chest is pressed up and down to pump out water from the breathing system. Relate activity 3 with the first aid provided. Using specialised personnel, sensitise the fishermen on how breathing occurs and how this relates to the first aid.

Explanatory note

- Describe the differences in chest size/volume during breathing in and breathing out.
- Note the changes of the lime water when air is blown into the water, and why lime water and not ordinary water is used.
- The simple model represents the parts involved in gaseous exchange in humans. Name the items used in the demonstration by relating them to the gaseous exchange organs.

Expected results

Identify the pair of students.

Explain the differences in the number of breaths of a person.

1. Note environment of the places visited, e.g. market, latrine, clinic, garage, hotel, restaurant, garden, kraal, etc. and make a list of the areas with polluted air.
2. The volume of water in the bottle is replaced by the air breathed out. Therefore, the volume of water replaced is equal to the volume of air breathed out and this represents the lung capacity. What is lung capacity?

Conclusion

The events observed in 1-4 above describe the process of gaseous exchange in humans. *Suggest other animals that have a similar mechanism of gaseous exchange and outline the sequence of events.*

Evaluation

Relate the model to a real-life situation and determine the factors that affect breathing rate in patients.

Follow-up activity

Find out how to assist newborn babies by providing first aid in gaseous exchange in case of a breathing setback.

5.1.2 Activity on fishing

Aim

To protect immature fish from suffocating when trapped.

What you need

Fishnets of suitable size, a collecting container.

Note

Work with experienced fishermen to identify the mature and immature fish.

What to do

- Set the trap net in a suitable water body near your home.
- Leave for 24 hours to allow fish to be caught.
- Identify the fish caught and save the immature fish by placing them back into the water immediately.
- Monitor the fishing behaviour of fishermen and advise them on how to care for the immature fish, through ensuring the use of water by the gill system. Also the mature fish may be packed in containers with sufficient air supply but not water. *Explain the importance of this air supplied.*
- Inform the fishermen and fishmongers of the suitable standards to be observed instead of resorting to killing the immature fish or using poison to kill the mature fish for sale. *Give the advice to fish mongers on how to pack the fish.*

Explanatory note

When the fish are exposed to air in the atmosphere the gill gaseous exchange system is adversely affected. The filaments stick together, reducing the surface area thus losing the ability to absorb air effectively. Gaseous exchange cannot take place efficiently. This kills the fish irrespective of age. *Demonstrate how you would save the immature fish from suffocating after trapping and putting them back in water bodies.*

Expected results

Use of suitable standards in fishing without poisoning the fish to contaminate the product.

Provide procedures for selecting suitable size and age of fish for sell and save the immature fish.

Conclusion

Continuous supply of fish as a result of saving the immature fish to sustain the business.

Evaluation

Demonstrate the economic importance of the gill gaseous exchange system in fishing.

Follow-up activity

Develop a fish farm in a nearby area to ensure a sustainable supply of fish.

5.2 Aerobic Respiration

Inquiry question

*Suggest the effects of the types of gas involved in the activity illustrated in **fig.5.2a.***

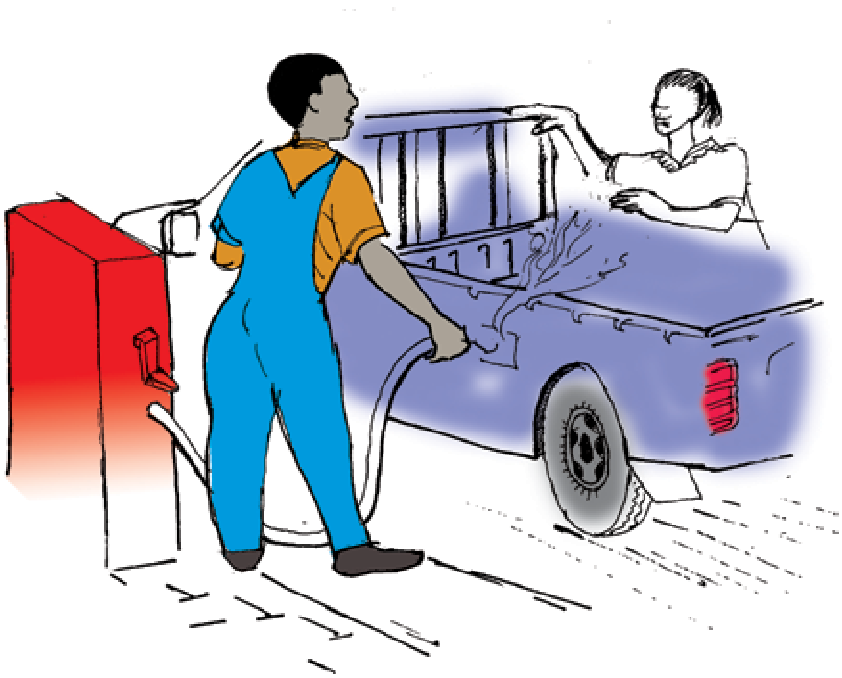


Fig. 5.2a: Illustration of a car refuelling at a fuel station.

- *What are the functions of respiratory gases in organisms?*

Background information

Aerobic respiration in living cells involves the breakdown of organic compounds (e.g. glucose) into carbon dioxide, water and energy.

This uses oxygen;

Glucose + Oxygen enzymes Carbon dioxide + water + energy.

$\mathbf{C_6H_{12}O_2 + O_2}$ enzymes $\mathbf{CO_2 + H_2O + 2880KJ.}$

You should be able to:

- Describe the different types of respiration.
- Explain the role of the respiration process in organisms.
- Discuss the factors affecting respiration.

- Explain how living organisms obtain energy.
- Explain the extent to which man utilises the process of respiration in daily life.

Activity 5.2.1 Body exercise

Aim

To show the effect of lactic acid in the muscles of humans

What you need

- Twenty students or your classmates.
- Games field or compound at home.

Note

Make sure you are in good health and not hungry.

What to do

- Move to the games field or compound.
- Make straight lines with an equal number of students.
- Raise the left arm on to your head.
- Form your right hand into a first clench and unclench the fist in front of you while moving the right arm forward and backwards) for 15-30 minutes.
- Describe the feeling in your arms during the 15-30 minute period of the exercise.
- How do your arms feel after the 15-30 minute exercise?

Explanatory note

Explain the feeling in your arms during and after the 15-30 minutes exercise.

Expected results

Explain the experience of the exercise by referring to the idea of accumulated lactic acid in the muscles of the arms and the reduced amount after the vigorous exercise.

Conclusion

Carry out the exercise vigorously with your legs. When you can no longer continue, rest by lying down flat on your back, rest the arms on your lap and notice how the body muscles feel.

Evaluation

Explain the events that may occur in gaseous exchange system during and after a running race.

Set up an exercise health club or first aid service centre near a sports field in your community to train and provide health exercises.

Follow-up activity

- Participate in the school athletics competition to be organised next year or term.
- Carry out a survey on adults carrying out exercises to find out the reasons why they are exercising, whether for health /medical purposes or simply to keep fit.

Activity 5.2.2 The build-up of lactic acid in muscles

Aim

To investigate the formation of lactic acid in your hand muscle.

What you need

Groups of two individuals/pairs, weight of reasonable size, desk, stopwatch

Note

Do not use excessive size weight.

What to do

- Form a group of 2 individuals.
- learner I: Take the weight in one hand with lower arm flat on the surface of the bench or desk and wait to be instructed to start lifting.
- learner II: Instruct pupil I to lift the weight and at the same time start the stop watch.
- learner I: Lift the weight regularly from the desk to your shoulder and back down again, taking about 1 second for each movement.
- Repeat those steps, till you feel the hand aching.
- Collect data from the whole class while taking note of the time taken for each individual to feel pain.
- Tabulate your results in a suitable table.
- Then plot a graph of the number of lifts vs. time.

Explanatory note

- What changes have you experienced after 5, 10, 20 and 30 minutes?
- At what concentration is the active substance in the muscle at the end of exercise (from the graph)?
- What was the highest concentration of the active substance in the muscle reached (from graph)?
- When was the highest concentration of the active substance in the muscle reached (from graph)?
- By how much did the active substance in the muscle increase during the period of exercise (from graph)?

Expected results

- Explanation of events which occur during anaerobic respiration in animals.
- Explanation of the physiological changes which occur during repeated lifting of the weight.

Conclusion

What is the effect of anaerobic respiration in animals?

Evaluation

What is the biological significance of the rate at which one feels pain when exercising when compared with someone who does not exercise?

Follow-up activity

Carry out regular exercises to find out how they affect your physical fitness and health.

Compare the physical fitness of your friend who does not carry out physical activities with those who do so regularly and advise.

5.3 Anaerobic Respiration

Inquiry question: *Describe the processes influencing your daily life that are supported by anaerobic respiration.*

Background information

In animals and some bacteria, anaerobic respiration produces lactic acid, while in plants, some fungi and bacteria form alcohol through fermentation process. This process has been economically utilised in industries to produce food items, such as making yoghurt, cheese, alcohol and bread. However, various communities have basic ways of food production by fermentation process. Suggest improvement techniques suitable for the methods.

Anaerobic respiration involves the breakdown of organic compounds without using of oxygen. Less energy is produced than in aerobic respiration. Other products depend on the organism, for example, yeast, plants and some bacteria produce alcohol in the form of ethanol and carbon dioxide while animals and some bacteria produce lactic acid.

i.e. **Glucose Enzymes Ethanol + Carbon dioxide+ energy (in plants**)

This fermentation process in organisms is utilised by man in the industrial process of brewing beer, bread making, and producing vinegar and producing biogas.

Glucose Enzymes Lactic acid + energy (in animals)

$$C_6H_{12}O_6 \quad \text{Enzymes} \quad 2C_3H_6O_3 + 150KJ$$

In humans anaerobic respiration occurs for a few seconds during strenuous exercises when the muscles require extra energy. This is because we cannot breathe fast enough to obtain the extra oxygen required to obtain the extra energy. So the muscles respire anaerobically to produce energy and lactic acid, thus acquiring oxygen debt.
Lactic acid produced by bacteria through anaerobic respiration can be put to maximum use by humans, e.g. in the making of yoghurt, butter, etc. It is also called lactic-fermentation.

$$C_6H_{12}O_6 \qquad 2C_2H_5OH + 2CO_2 + 210KJ$$

You should be able to:

- *make food products using fermentation process.*
- *identify first aid activities in daily life that utilise anaerobic respiration .*

Activity 5.3.1Making bread

Aim Demonstrate anaerobic respiration of yeast cells in making bread.

What you need

15g Yeast, 3 tablespoons of sugar, 2.5 teacups of water, 6.5 teacups of wheat flour/barley, 1 tablespoon of salt, polythene, baking tin or trays, 3 tablespoons of margarine (fat), flavouring, oven and mixing bowl.

Note

Provide a warm environment while carrying out the procedure.
Use clean containers and clean hands when kneading the dough.

What to do

- In a mixing bowl, mix flour with margarine (fat), yeast and water to form dough.
- Then add flavouring and knead the dough repeatedly until elastic and smooth.
- Lightly oil a large mixing bowl. Place the dough in the bowl and turn it to coat with oil.
- Cover the bowl and dough with polythene (black) or foil or a damp cloth. Place this in a warm place for 1 hour to allow the dough rise to double its size.
- Deflate the dough and turn it out on a lightly floured flat surface.
- Divide the dough into 2 equal pieces and shape each into a loaf.
- Place each shaped dough in a greased baking tin or make medium-size dough into moulds and shape, then place pieces on a greased baking tray.
- Cover the tins/tray with a damp tea towel/cloth for about 40 minutes to let the dough rise.
- Preheat oven to 220^0C /425^0F.
- Transfer the bread to a hot oven and bake for 30 minutes. (Start with a high oven temperature for a short time), then reduce the temperature to 190^0C/375^0F and bake until bread turns brown.
- Remove the bread from the oven and turn it onto a plate.
- What changes occur to the dough during:
  (i) Kneading?
  (ii) Proving/leavening, i.e. incubation?
  (iii) Baking?

Explanatory note

During fermentation, the carbon dioxide gas given off raises the dough, and the alcohol adds flavour to the bread. Show how these two products (carbon dioxide and alcohol) are obtained in the process of baking bread.

Expected results

- Explain what causes air spaces in the bread during kneading.
- What causes the rise in volume of the bread during proving to form a spongy texture?
- Explain the importance of kneading, proving/and incubation.
- What happens to the ethanol in the bread finally?

Conclusion

- What is the role of yeast cells in bread making?
- What is the purpose of keeping the dough in a warm environment?
- Why is it necessary to bake at a high oven temperature initially?

Evaluation

Demonstrate the baking of bread without the use of yeast and other ways by which anaerobic respiration may be used by humans.

Follow-up activity

Show the role of anaerobic digesters in sewage treatment. Visit any nearby sewage plant to get more information.

Activity 5.3.2 Fermenting fruit juice to make wine

Aim

To demonstrate fermentation of fruit juice to make alcohol.

What you need

1 litre metallic/plastic containers, water, fruits, e.g. pawpaw, mango, orange, pineapple, etc., thermometer, needle

Note

Minimise the entry of oxygen as much as possible and allow outlet for a gas.
Banana, grapes and apple fruit may be used.
Add yeast cells and sulphur dioxide if available.

What to do

- Crush the fruit, squeeze out the juice and mix in a container.
- Store the mixture in a warm place (at room temperature about 25oC) and leave it for a week for fermentation to occur.
- Leave the product to settle and decant.
- Sell in suitable packages.

Explanatory note

- What is the purpose of adding sulphur dioxide during the process?
- Explain the role of yeast cells.
- What causes the changes observed in the mixture?
- Why is the mixture kept in a warm environment?

Expected results

- What is the taste of the product?
- Is there any evolution of a gas?
- Is there any change in temperature?

Conclusion

What are the products of fermenting mixed fruit juice?

Evaluation

Explain the role of fermentation in the brewing industry.

Follow-up activity

Identify the fruits in your home area and make wine.

Fig.5.3b: Pieces of pawpaw in a glass jar.

Place similar fruit pieces in a jar and keep them at room temperature. Note what happens to the pawpaw fruit pieces.

Activity 5.3.3 Fermenting millet grains to produce alcohol

Aim

To demonstrate of fermentation of sugar.

What you need

Millet or maize flour, 5-10 jerricans, water, incubator (e.g. blanket, thick cloth), pot

Note

- Minimise oxygen as much as possible.
- Incubate the mixture in a warm place.

What to do

- Get millet seeds and soak in water for three days in a jerrycan.
- On the third day, remove some of the millet and dry on a clean surface in the sun.

- Let the other half continue germinating till all radicles and plumules are fully seen, and then dry it.
- Grind the paste remaining in a jerry can and cover tightly.
- After 5-7 days, get the paste and bake it until it is dark-brown and dry.
- Grind the other germinated millet to make flour (yeast flour).
- Put the dried/baked paste in a pot and mix with water, add ½ kg of flour (yeast).
- Leave for one day.

Explanatory note

- What is the purpose of soaking the millet?
- What role is played by the germinated millet?
- Is there any gas produced?
- Is there any change in temperature?

Expected results

Events occur during fermentation.
What is the taste of the mixture?
Are there any bubbles given off?

Conclusion

What are the products of fermented millet seeds?

Evaluation

What other carbohydrate substrates produce alcohol?
What other sources can provide the enzyme that is involved in fermentation?

Follow-up activity

Find out names of as many locally made alcoholic drinks, other carbohydrate substrates/materials and procedures used in your locality, to produce alcohol. Study ***fig.5.3c*** below and propose the stage of fermentation shown and why it is important.

Fig.5.3c: Illustration of a method used locally to make alcoholic drinks.

Activity 5.3.4 Making yoghurt from milk

Aim

To demonstrate the preparation of yogurt.

What you need

1 litre milk (skimmed/unskimmed), 125 g of sugar, 20 g of starch, heat source, saucepan, bacteria starter (*Lactobacilli bulgaricus/Streptococcus thermophilus*).

Note

Bacteria starter may be obtained from commercial yoghurts or sour milk.

What to do

- Mix the milk with sugar and starch in a saucepan.
- Boil the mixture for 15 to 30 minutes at a fairly high temperature and homogenise to improve texture.
- Cool the mixture to body temperature.
- Add 2 teaspoons of the starter bacteria and stir thoroughly.
- Pour mixture in a tightly covered container and incubate at warm temperatures (37-400 C) for 4 to 12 hours.
- Cool and add flavours.
- Serve or sell in suitable packs.
- Store in a refrigerator or at 2-5 degrees Celcius.

Explanatory note

The milk is heated at high temperatures to remove air (Oxygen), making the milk conditions suitable for the growth of anaerobic bacteria. These produce lactic acid and acetaldehyde, giving the characteristic flavour to yogurt.

Expected results

Explain the importance of incubating the mixture at 35-37^0 C temperature.

Evaluation

Describe the effects of heat and incubation on milk, showing the role of these temperature conditions in the development of the starter bacteria.

Follow-up activities Prepare cheese, ghee and butter through the fermentation process from milk. Use starter bacteria to respire anaerobically. Outline the processes of fermentation used in the preservation of food products.

Activity 5.3.5 Biogas fermenters

Aim

To demonstrate the production of biogas

What you need

Animal dung e.g. Cow dung, or organic materials e.g. Grass, a 20 litter jerrycan or metal can with a tap, 2-3 m long rubber tubing of 2-3 cm diameter.,

Note

Use fresh dung or organic materials.
The can should be airtight.
The rubber tubing should fit tightly onto the tap to avoid air outlet.
Provide room temperature or optimum temperature ranges for anaerobic respiration.
In case the gas does not evolve, add 20g of lime or ash from animal bones.

What to do

- Mix the cow dung with water in a ratio of 1:1 to make a slimy substance.
- Place the mixture in the can and cover it tightly, turn off the tap of the can.
- Fix the rubber tubing onto the tap.
- Allow the mixture to standard for 2 days to ensure that fermentation occurs.
- Connect the rubber tubing to a lamp or burner (stove or gas cooker).
- Turn on the tap to let out the gas, for use in lighting or cooking.

Explanatory note

The rumen of ruminant animals are known to have natural gas production systems for methane, hydrogen sulphide and ammonia gas. This is a complex fermentation system involving many different anaerobic microorganisms in the digestive system. The cow is an example of a ruminant.

In case of organic substances like grass, when they are chopped, the microorganism decomposers cause decay either aerobically or anaerobically. When placed in a can where the oxygen gas content is low, the microorganisms respire anaerobically and emit biogas.

Expected results

Biogas production using a very low technology scale is used in homes or communities to supplement other fuel sources. However, anaerobic conditions are utilised through the decomposition process of domestic organic refuse to keep the environment clean. Explain other values of anaerobic respiration in your day-to-day activities.

Conclusion

Establish a mini-biogas production plant at your home and use it to provide light or to cook.

Train the nearby community to set-up a simple technology of biogas production.

Evaluation

Demonstrate the production of bio fuel gases with the help of the Chemistry Department or technical personnel.

Follow-up activity

Visit large-scale biogas production plants and establish how organic waste is biodegraded to yield large quantities of gas mixtures.

Activity 5.3.6Making millet beer (*malwa* or *ajon*)

Aim

To demonstrate local production of alcohol.

What you need

5 kg of millet seeds, water, grinding stone or machine, open jerrycan/a hole dug in the ground, firewood, yeast, drying space/mat/ cleaned flat ground, pot/drum

Note

Prevent mould growth on millet to avoid toxin contamination.

What to do

- Get 5 kg of any millet seeds and soak in water for three days to activate the sugars (hydrolise starch). The millet should be in a heap or in a jerrycan.
- On the third day remove 4 kg and dry on a mat or clean surface in the sun.
- Let the other 1 kg continue germinating till all radicles and plumules are fully developed. This provides the opportunity for yeast to multiply and produce more sugar hydrolyine. After this, dry the millet.
- Grind the other 4 kg and mix with water to make a paste.
- Put this paste in a hole in the ground or in an open jerrycan and cover tightly not to allow air in.
- After 5-7 days, get the paste and roast/bake it till it is dark-brown and dry well.
- Grind the remaining 1kg of millet to make flour.
- Put the dried paste in a pot, mix with water and add ½ kg of millet flour with yeast.
- Leave for one day. The mixture will start bubbling and sweetening.
- On the second day add ½ kg of yeast flour and add water and mix to the desired thickness.
- On the third day it is ready for drinking; and after 5 days it turns sour.
- Pack in suitable containers and sell.

Explanatory note

The yeast is an anaerobic organism utilising the carbohydrates in the millet. Through the process of fermentation the alcohol is released. Explain the cause of bubbling of the mixture during the above procedure.

Expected results

Explain the importance of roasting and drying the millet paste.

Show the importance of using a portion of raw millet and yeast mixture in the alcohol preparation.

Conclusion

Provide an alcohol millet drink produced locally that is safe to drink. Explain the cause of the change in the taste of the drink from sweet to sour with time.

Evaluation

Demonstrate suitable packaging and distribution of the alcohol.

Set standards of preparation and supply to adults only.

Follow-up activities

Demonstrate preparation of drinks from millet using fermentation.

Chapter 6: HOMEOSTASIS AND EXCRETION

Introduction

Body cells carry out various physiological activities that support the normal functioning of the systems and the stability of processes, fluid composition, and conditions of the body. These are internal body mechanisms involved in regulating changes and maintaining a balanced internal environment, known as homeostasis. This is linked to excretion, which involves removal of waste products, leading to a normal and stable internal body environment. The mechanisms involved in maintaining an ideal stable internal environment of the body lead to survival and economic benefits of organisms.

Requisite knowledge

- *Movement of materials in cells and tissues and transport in organisms.*
- *Gaseous exchange and respiration.*

Outline of Major Concepts

6.1 Excretion in Plants

6.2 Excretion in Animals

6.3 Homeostasis

1.1 Excretion in Plants

Inquiry question: *Excretory products from plants are known to be less harmful to organisms, including the plants themselves. Using examples of plant excretory products, explain the processes that support this statement.*

Background Information

To maintain a relatively constant internal environment, removal of waste products of the metabolic processes from the body is vital. In the case of plants, this is done without a specialised system but such products are stored in various tissues of plant organs. Also some metabolic processes use by-products of similar physiological processes as raw materials within the plant. This reduces the accumulation of waste.

In the environment, plant excretory products are naturally recycled to provide useful development to plants and other organisms. For example, the carbon dioxide cycle and the water cycle. *Show how excretory products from plants are important for the sustainability of the environment and for development*.

Some plant organs that store excretory products have been utilised by humans as food or medicine and in the production of other commercial products. For example, flowers, leaves, fruits, stems, and roots are used in industrial and agricultural processes by humans.

You should be able to

- *produce simple useful products from plant organs that store excretory products.*
- *identify the effects of the role of plant excretory products in environmental degradation, by relating the natural biogeo cycles to the excretion process in plants.*

Activity 6.1.1 Preparation of dyes from coloured organs

Aim

To produce simple products from fruits

What you need

- mortar and Pestle, Glass rod, wood rod, Bottles, Test tubes, Ethanol (98%) or propanone or 250mls of crude waragi, Plant organs: *Jambula* fruits, red cabbage, coloured flowers, etc.

Note

Preparation of the dye depends on the use of the dye and plant organ.

What to do

- Pick, for example, the coloured flowers and pluck off the petals.
- Crush the petals in a mortar with a pestle.
- Add ethanol/propanone/crude waragi to the mortar and stir with the glass rod/wooden rod/ pestle.
- Decant/filter the mixture to obtain a clear-coloured mixture which is the dye prepared.
- Pour the dye in a clean bottle.
- Different flower extracts can also be mixed to get varying dyes.
- Use the dyes as food colours, hair, nail/cloth dye and sell.

Explanatory note

Plants with coloured organs such as flowers, fruits, stems and leaves contain compounds known as anthocyanins which are used in forming dyes. The colours are determined by a chemical compound that forms some waste products and therefore provide characteristic colour shades to plant organs. List the various excretory products that are found in plants, and state their role in plants and other organisms.

Expected results

Indicate a suitable method of packaging the dyes for sale or for use at home.

Conclusion

Prepare different dyes for various purposes in your daily life.

Evaluation

Explain the importance of using alcohol in the process of extracting the dyes.

Follow-up activities

Use different flowers and plant organs to make a variety of dyes and market the dyes.

Activity 6.1.2 Preparation of cough mixture locally

Aim To show the use of plant excretory products in plant organs.

What you need

Saucepan, glass rod/wooden rod, burner/stove, packing bottles, knife, lemon fruits, ginger, honey, mango tree bark and leaves, Water 250mls

Note

Follow the National Drug Authority policies.

Use resource personnel from a herbal research centre for more ingredients, guidance on measurements and packaging of the mixture before selling.

Avoid mixing too many different organs as this may cause toxicity instead of treatment.

What to do

- Cut fresh/green lemon fruits or ginger into small parts.
- Place the cut parts in a saucepan.
- Add the cut pieces of mango bark/mango leaves to the saucepan.
- Measure distilled/rain/tap clean water to the saucepan.
- Heat on the burner/stove to boil till most of the water has evaporated.
- Allow to cool, add honey, stir and cover with net/cover.
- Leave the mixture to cool.
- Filter the mixture and measure the required volumes and package in bottles.

Explanatory note

The concentration of excretory products in plant organs consists of organic chemical compounds which have an antibiotic effect and is therefore used in treatment. Most of these are non-nitrogen compounds that are less toxic to plants. However, to other organisms the concentration of the product determines the toxicity level that is used as a measure in treatment, and this varies according to age and species.

Expected results

- Explain the effects of excretory products on the treatment of a cough in humans.
- Encourage people suffering from cough to use the mixture, but if the cough persists after 3 days of taking the mixture, ask them to seek medical treatment from health centres.

Conclusion

Ensure the cough mixture produced is not contaminated during the process and that it is properly packed for supply and ready for use.

Evaluation

Demonstrate the production procedures for a cough mixture suitable for different age groups.

Identify suitable plant organs used in the production and outline recommendations.

Follow-up activity

Get various plant organs used in herbal medicine production and practise production with training from specialised or professional personnel.

Demonstrate activities that promote carbon dioxide pollution reduction. Show how the water cycle may be maintained.

1.2 Excretion in Animals

Inquiry question: *Animals remove waste from their bodies in different forms such as urine and sweat. How can animal waste be turned into wealth?*

Background Information

The waste products of metabolism must be removed from the body as soon as they are formed, because they can hinder the physiological processes in body cells.

This also helps the body to remain healthy. Waste products produced during metabolism need to be removed from the body tissues/cells. Animal waste products include excess water, excess salts, carbon dioxide and nitrogenous wastes which include ammonia, urea and uric acid.

The urinary system removes water, salts and urea from blood in the form of urine, which contains traces of ammonia and uric acid. This process involves kidneys carrying out ultra-filtration and selective reabsorption. Poor disposal of urine can contaminate the environment and spread diseases such as Bilharzia, coliforms, and other waterborne diseases. This happens if infected animal urine joins the water cycle through soil water drainage or goes direct into water resources.

Proper disposal of animal urine is very important in keeping a clean and healthy environment. Though harmful and toxic, excretory products can be put to maximum use by people, e.g. as fertilisers and in the production of biogas.. Urine is rich in nitrogen compounds and can be turned into fertiliser to increase crops yield.

You should be able to:

- *explain the need for proper disposal of urine.*
- *explain how urine can be turned into fertiliser.*
- *demonstrate that yields are higher in a garden where fertiliser from urine has been applied than where it has not.*
- *promote proper disposal of urine and other waste.*

Activity 6.2.1 Preparation of urine fertiliser

Aim

To demonstrate the preparation and application of fertiliser from urine.

What you need

Jerrican, urine, ash, red pepper or tobacco, water.

Note

Do not use urine as fertiliser before complete decomposition.
Use gloves or polythene paper when handling the urine.

What to do

- Collect animal urine.
- Pour it in a jerrycan, add ash, tobacco or red pepper.
- Leave the mixture for at least 2 weeks to allow decomposition.
- Dilute the mixture with 2 cups of water or in a ratio of 1:4.
- Transfer to the garden and pour the urine fertiliser a slight distance away from the plant but not directly on the plant it is intended to benefit.
- Set a control by not applying the urine fertiliser to some plants.
- What do you observe in the mixture after 2 weeks in terms of temperature, evolution of a gas, and uniformity of the mixture?
- Compare the appearance of the plants before and after applying the fertiliser.
- Provide fertilisers to other farmers and sensitise them on how to keep soils fertile by using animal waste.

Explanatory note

- Describe the compounds responsible for the changes observed in plants.
- Show the purpose of adding ash and red pepper to the mixture.

Expected results

Explain the process used in the production of fertilisers using animal urine.

Conclusion

what compounds in urine are important in the production of fertiliser.
Establish a continuous programme of supplying fertilisers to farmers in your community.

Evaluation

Identify the plant deficiency that would be corrected by applying urine fertiliser?

Follow-up activity

Collect the urine of domestic animals from homes or farms, (**see activity 6.2.2)**, leave it to decompose for 2 weeks and use it to produce fertilisers to maintain soil fertility and get high crop yields.

Activity 6.2.2 Disposal of urine in the community (follow-up activity)

Aim

To promote proper disposal of urine.

What you need

Resource person, classmates, friends.

Note

Get permission from the local authority to visit homes if the information is to be collected by students.

What to do

- Form groups of 4 – 6 students.
- Prepare a questionnaire to fill when collecting information.

- Visit homes and find out how animal urine (e.g. of cattle, goats, pigs) and human urine are disposed of.
- Note the effects of urine disposal on the environment, e.g. smell, insect infestation, etc.
- Discuss group results in plenary and compile a report (on how urine is disposed of, and the effect of poor urine disposal on the environment, animals and the people in the community).
- Display the report on both the class noticeboard and school noticeboard and give a copy of the report to the LC I Chairperson for discussion and action at community level.
- Ask the LC I Chairperson to invite a resource person to a community meeting to talk about proper disposal of urine.

Expected results

Explain the benefits of proper waste disposal and the dangers of poor waste disposal.

Evaluation

Identify the poor methods of waste disposal common in your community.

Recommend measures to improve waste disposal (through community awareness).

Follow-up activity

Together with the community, the school administration and management, develop a sustainable programme on urine disposal and economic utilisation.

Activity 6.2.3 Using waste products to improve yields

Aim

To improve crop yields by maintaining soil fertility.

What you need

Large tin/bucket/jerrycan or any suitable container, animal urine (goats/

pigs/cattle/human), water, ash, hot pepper

Note

- This activity is similar to activity 6.2.1 but you should be able to apply the fertiliser on community farms by following activity 6.2.3 and to use it as part of the community programme on waste management.
- Ferment urine before applying it to the garden.
- Handle chili/hot pepper carefully if it is to be added.

What to do

- Collect urine, measure/note its volume and put it in a container.
- Allow the urine to ferment for about 14 days.
- Add water to the fermented urine to make a solution in a ratio of 1urine: 4 water.
- You may add ash to increase potassium in the nitrate-rich fertiliser.
- You may add hot pepper to the fertiliser to kill pests if it is to be applied to banana plantations.
- Apply fertiliser to a vegetable garden A and set up a garden B with no fertiliser added.
- After 3 weeks, compare the yields from treated and untreated gardens.
- Practise at home and transfer the preparation procedure sensitisation to the community.

Explanatory notes

Fermentation changes nitrogenous waste into nitrates. Ash and pepper add value to the fertiliser by increasing nutrients and killing pests, respectively.

Expected results

Students produce fertiliser and improve yield.
Clean healthy environment.

Conclusion

Use waste in the home to improve yields and the standard of living, sensitise the community about the possibility of changing waste into wealth.

Evaluation

It is possible to keep the environment healthy and clean, and at the same time improve yields without spending money.

Follow-up activity

Grow vegetables or other crops, make and apply fertiliser.
Sell fertilisers produced to get income.
Invite the resource person to speak to community members about using animal urine and other waste products.
Practise production and liquefaction of biogas to form fuel, e.g. paraffin from waste products.

6.3 Homeostasis

Inquiry question: *Why is homeostasis a must in the lives of organisms?*

Background Information

Temperature regulation is a homeostatic process whereby all the activities the body uses to maintain a constant temperature are caused by either heat gain or loss. Temperature must be kept at optimum level to favour efficient enzyme action.
In humans, the following processes take place during overheating of the body, i.e. sweating, relaxing of erector pili muscles, and decrease in metabolic rate and vasodilation. These lead to heat reduction in the body. For example, during vasodilation, the blood capillaries near the skin surface dilate to

allow more blood to flow near the surface so that more heat is lost from the body by convection or radiation into the air. However, during over-cooling vasoconstriction occurs and blood capillaries near the skin surface narrow down/constrict /contract so that blood supply to the skin surface is reduced and less heat is lost to the surroundings. Vasoconstriction and vasodilation are applied to control the loss of blood during an accident, injury or surgery, etc.

Sweating cools the body by reducing excess heat but it is also used in the osmoregulation process of the body in case of excess water and salts which is released by humans through body exercises. Other organisms have adapted to certain habitats and conditions to carry out osmoregulation for survival. This has been used by humans to determine the habits of organisms and their distribution for economic purposes.

Chemical compounds like hormones and enzymes in body fluids also influence the stability of internal environments e.g. sugars and salts are essential in determining the osmotic pressure of the tissues of living organisms, including blood pressure in humans. Such chemical compound effects cause economic disruption which affects development. For example, in humans, the sugar balance influences health, food production, quality and utilistion (feeding).

You should be able to:

- *identify simple symptoms in humans indicating hormonal deficiencies.*
- *show the importance of osmoregulation.*
- *demonstrate the effects of water source quality on organisms.*

Activity 6.3.1 Regulation of sugar levels in blood

Aim

To show the effects of the diet on blood sugar in human beings.

What you need

Charts, stationery materials to develop fliers, pamphlets.

Note

Work with specialised personnel in the treatment of diabetis in humans.

What to do

Develop a handout on diabetis with a specialised person indicating:

i. symptoms
ii. causes
iii. recommendations related to prevention and health improvement.

Use this handout to:

i. develop literature on charts
ii. sensitise the community using a health club, as a school community service activity.

Explanatory note

Blood sugar imbalances are a homeostatic key factor that needs to be explained to the community at all levels to ensure improved health of members. This may be achieved through sensitisation of the community on acquired malfunctioning of the pancreas, liver, or poor feeding habits.

Expected results

Form an interest club to provide sensitisation on diabetes. Suggest the target age group to sensitise and demonstrate how this will be done depending on your community structure.

Conclusion

Explain ways of protecting the body from diabetes by addressing the community on the need for health protection and improvement on the related sugar imbalances.

Evaluation

Demonstrate the activities of the club set up with the school.

Follow-up activity

Recommend simple activities like body exercises and diet that help in maintaining the blood sugar levels.

Activity 6.3.2 Temperature regulation

Aim

To show the extent of temperature regulation as a homeostatic function.

What you need

Ice water, clean piece of cloth, needle, steriliser, soap.

Note

Use sterilised needles.

What to do

- Wash your hands with soap.
- Immerse the forefinger of your right hand in iced water for 1 minute.
- Prick the tip of the finger with a sharp sterilised needle as shown in ***fig.6.3a.***

Fig. 6.3a: A healthy worker pricking a finger of a patient.

Suggest reasons why the finger is first cleaned with cotton dipped in methylated spirit.

- Then immerse the fore finger of your left hand in warm water for 1 minute (control).
- Prick the finger tip with a sterilised needle.

Explanatory note

Explain what happens to the blood flow when iced water is applied to a fingertip before pricking.

Explain what causes the difference in the amount of blood oozing out of the 2 fingers.

Expected results

Demonstrate the control of blood loss by vasoconstriction and vasodilation.

Conclusion

What is the effect of vasodilation and vasoconstriction on blood flow?

Evaluation

Under what health conditions would you apply vasoconstriction and vasodilation?

Follow-up activity

- Develop a report on how health workers reduce loss of blood during injury or any other form of accident.
- Demonstrate how you can help a friend who has injured a vein on a finger or toe to reduce excessive loss of blood.
- Demonstrate how you can help a friend from losing blood due to nose-bleeding.

Activity 6.3.3 Preparation of a detoxificant

Aim

To demonstrate detoxification as a homeostatic function.

What you need

Source of heat, ginger, garlic tubers, lemon fruits, honey, sieve, plastic bowl/container, mortar and pestle

Note

Use sterilised bowl/container.

The ginger, lemons and garlic plant parts to be used need to be cleaned. Suggest reasons why these are first cleaned in saline water.

What to do

- Wash your hands with soap.
- Immerse the ginger, lemon and garlic in saline water for 2 minutes.
- Using a mortar and pestle, crush 3 pieces of ginger and 3 cloves of large garlic, respectively.
- Then squeeze the 3 lemon fruits and mix the juice with the ginger

and garlic in the bowl/container.

- Add 750ml of water to the mixture, boil and cool.
- Add 125ml of honey to the cooled mixture.
- Decant the mixture.
- Pack the juice for sale in a bottle and dry the residues to be reused as powdered spices for sauce.
- Take one table spoonful of juice for one week.

Follow-up activity

Develop a report on how health workers reduce loss of blood during injury or any other form of accident.

Demonstrate how you can help a friend who has injured a vein on a finger or toe to reduce excessive loss of blood.

Demonstrate how you can help a friend from losing blood due to nose-bleeding.

Chapter 7: COORDINATION IN PLANTS AND ANIMALS

Introduction

Responses in plants and animals are used in the communication between the external and internal environments to ensure physiological efficiency of organisms. Through this process, organisms are adapted to living in certain kinds of environment and develop structures and ways of life related to particular needs for survival. The ability of organisms to survive has been translated into economic development by human beings and some of the ways are evident in your daily life. Among these are the responses of plants and the beauty of the surroundings, protection of life, improvement of species through natural selection and response.

Requisite knowledge

- *Diversity of organisms*
- *Homeostasis*

Outline of major concepts

7.1 Response in Plants

7.2 Chemical Coordination in Vertebrates

7.3 Response in Animals and Behaviour

7.4 Receptor Organs in Mammals

1.1 **Response in Plants**

Inquiry question: *Plants release scents at night, e.g. the night rose, which repel insects like mosquitoes, rather than attracting bees. Explain the benefits of such a response to the community.*

Background information

Plants respond to stimuli in their environments. For example, plant shoots grow towards light, plant roots grow towards gravity and water, plant shoots grow away from gravity and creeping plants grow along walls while climbing plants grow around supports. These plant responses, known as tropisms, are controlled by growth hormones called auxins.

Auxins stimulate and inhibit growth of plant parts in different concentrations. For example, growth in shoots is stimulated by a higher concentration of auxins than that for growth in the roots.

Auxins also bring about apical dominance. Lateral bud growth is inhibited in the presence of the shoot tips. The terminal bud produces and releases hormones/auxins that move downwards and have the effect of inhibiting the growth of the lateral buds. Hence there is no branching. When the terminal buds are removed by pruning, the lateral buds are released from apical dominance.

Application of a weak solution of auxin to a cutting from a woody stem causes roots to develop more quickly than they otherwise would. This knowledge can be applied in horticulture to give services and to generate income.

You should be able to:

- *explain the effect of auxins on plant growth and responses.*
- *demonstrate the effect of pruning, e.g. on crops, vegetables, hedges and other ornamental plants.*
- *use the knowledge to offer services like beautifying compounds.*
- *generate funds by producing and selling services, increasing yields e.g. of vegetables, tea, and selling cuttings.*

Activity 7.1.1 Beautifying homes

Aim

To apply tropisms to horticulture.

What you need

Creeping plant seeds or seedlings; climbing plant seeds or seedlings; walls, e.g. retaining walls; support plants, e.g. trees

Note

Use ornamental creeping plants and/or climbing plants which are not poisonous to people or their animals.
Provide suitable conditions for growth, e.g. fertile soil, moisture.

What to do

- Get suitable seeds from shops or the community.
- Plant seeds/seedlings/cuttings of an ornamental creeping plant in fertile soil along a wall.
- Or plant seeds/seedlings/cuttings of an ornamental climbing plant in fertile soil near a support (tree, hedge, etc).
- Water the young plant whenever necessary.

Explanatory note

The creeping and climbing plants will sense the presence of the walls and other supports and grow along or around them (i.e. positive haptotropism or thigmotropism).

Expected results

The creeper will grow along the wall, thus beautifying it. The climber will grow around the support thus beautifying the home.
*Study **fig.7.1a** and explain the type of growth response shown by the plant.*

Fig.7.1a: Ceeping plants used in fence decoration

Conclusion

Grow creepers and climbing plants to beautify your home and generate income.

Evaluation

Can you identify the qualities of suitable plants for making the compound beautiful?

Follow-up activity

Demonstrate economic development activities using chemotropism by plants.

Activity 7.1.2 Apical dominance and horticulture

Aim

To grow short bushy plants for more beauty and higher yields.

What you need

Growing plants, e.g. hedge or tea cuttings, vegetables e.g. Amaranthus seeds, ornamental plants e.g. Bougainvillea cuttings, garden scissors/knife/panga.

Note

Start pruning plants when they are young and repeat periodically.
Get seedlings.

What to do

- Plant hedge/tea/vegetable/ornamental plants in gardens.
- Remove the apical/terminal bud of the young plant before it exceeds 30 cm.
- Regularly prune the plant by cutting off the tops of the branches that grow on the plant thus removing the terminal buds of the branches.
- Prune in such a way as to determine the height and increase beauty of the plants in hedges and the shape of ornamental plants such as bougainvillea and yield in tea and vegetables.

Explanatory note

Branching occurs owing to the absence of the apical bud, resulting in a bushier plant. This is due to lateral buds taking over the function of the terminal bud and growing faster.

Expected results

The plants will stop growing tall and straight and branch to make thick, bushier plants.

Evaluation

- How does pruning lead to increase in yield in plants like tea and Amaranthus?
- Can you suggest with reasons the best time to start pruning hedge plants, vegetables, ornamental plants or tea?

Follow-up activity

Grow hedge plants or compound plants as shown in ***Fig. 7.1b*** around your home or school compound and demonstrate plant response through pruning.

Fig.7.1b: Pruned compound plants providing beauty as hedge plants.

Identify the plants and grow similar plants in a nearby compound. Or provide a community service in the form of maintenance of such plants.

Activity 7.1.3 Helping cuttings to 'take'

Aim

To stimulate roots to grow from stem cuttings.

What you need

Stem cuttings, rooting medium, substance, water, bucket, or other suitable container, fertile soil.

Note

- Stem cuttings should be made from a short stem that has no flower on it.
- Cut off some of the leaves before you plant the cutting.
- Provide fertile soil.

What to do

- Prepare cuttings of the desired plant.
- Dip one end of the cuttings into the rooting medium (a substance containing auxin).
- Plant the cuttings.
- Observe how long it takes for the cuttings to 'take'.
- Repeat the procedure using untreated cuttings.
- Compare the time it takes for treated and untreated cuttings to 'take'.

Explanatory note

Rooting medium contains auxin. The auxin quickens mitosis and cell elongation at the cut end that is dipped in the rooting medium.

Expected results

- What plants/cuttings started growing first?
- How does the development of roots affect growth?
- How does the use of rooting medium lead to generating money?

Conclusion

Describe/state the role of auxins in the 'taking', in stem cuttings.

Evaluation

Demonstrate the effect of rooting medium on cuttings from different plants.

Follow-up activity

Set up cuttings of hedge plants and ornamental plants for sale.
Work out the cost of production and the sale price.
Plant some in your home and sell others.

1.2 Chemical Coordination in Vertebrates

Inquiry question: *The endocrine glands secrete hormones in the form of chemical compounds to regulate and promote physiological processes. Show how hormones and the growth of humans are related.*

Background Information

Hormones are released in the body as chemicals in the form of proteins, amino acids, amines and steroids, among other compounds. These are used in the coordination of metabolic activities, either independently or antagonistically.
For example, the thyroxine hormone produced by the thyroid gland regulates the metabolic rate. This is important in energy release in that it influences oxygen consumption and utilisation in the body.
When there is excessive activity of the thyroid glands, cells utilise higher oxygen amounts, above the normal consumption, and in the case of low thyroid hormone levels, oxygen use in cells is reduced. Both conditions

affect optimum energy release by the body, requiring homeostatic feedback to get normal concentration levels of the thyroid hormone. Other hormones affecting energy production are growth hormones and insulin. These influence glucose utilisation in the body, which is controlled to stabilise blood glucose levels.

The antideuretic hormone (ADH) is useful in kidney reabsorbtion processes and the sex hormones are important for sexual development. These are some of the hormones that determine chemical communication in the body.

The major economic role is to ensure a healthy body, proper growth indicators, and to avoid starvation of organisms either as a result of malfunctioning of the homeostasis mechanisms and associated organs or food shortage in the community.

You should be able to:

- *identify simple symptoms of hormonal malfunctioning in the body.*
- *demonstrate the recommendations that may protect the body and reduce the effects of hormonal deficiencies.*

Activity 7.2.1 Hormones and growth

Aim

To show human growth responses influenced by hormones.

What you need

Individuals with growth abnormality, charts, videotapes or CDs.

Note

Work with health personnel and community leaders.

What to do

- Develop a programme with your teacher to visit health centres that are involved in growth and development-related problems, e.g. Mulago Hospital's Mwana Mugimu Unit dealing with nutrition and development issues.

- Identify the hormonal defects related to growth.
- Using the above material aids, write a documentary with the Language and Biology Departments citing hormonal defects in humans.
- Present or sell the documentary produced as a film or information to the community.

Explanatory note

Explain the symptoms of common hormonal diseases identified.

Expected results

Develop information on human growth defects caused by hormonal deficiencies by compiling a visual or written document.

Conclusion

Disseminate the documentary either in the form of a video or a handout or other form of literature.

Evaluation

Write a handout or magazine indicating hormonal defects, causes, symptoms and possible remedies that may be practised by the community.

Follow-up activity

Provide simple education talks to the community regarding hormonal responses and growth in humans.

1.3 Response in Animals and Behaviour

Inquiry question: *Discuss the various sounds made by animals at different times or periods of the year, and relate their behaviour with the sound.*

Background Information

Young birds, e.g. the young of chickens need external sources of warmth because their feathers are not yet well developed. The hen protects them under its body, thus providing a warmer surrounding. During the breeding season, different animals behave differently. For example during the wet season, male toads move into water bodies and make a croaking sound to signal to females to move to the water too, so that the eggs laid are fertilised.

You should be able to:

Identify and explain behaviour of domestic animals in various surroundings.

Activity 7.3.1 The relationship between the hen and chicks

Aim

To show the behaviour and response of chicks during the growing period.

What you need

Poultry, heat source, poultry birds (2 hens and 1 cock).

Note

The hens used should be able to lay fertile eggs.

Provide warmth to growing chicks.

Provide conditions that prevent growth of disease causing organisms.

What to do

- Rear local hens and allow them to lay eggs.
- Prepare the hatching place where the eggs are temporarily kept.
- Let the hens incubate the eggs and study their behaviour during the 21 days.
- When the chicks hatch, observe their behaviour in relation to the hen.
- Keep the area warm throughout the chicks' growing period.

Keep the poultry rooms warm. Design the clay pot or mud oven heat source, within the poultry area, to provide the moderate warmth in the room that is *required by young birds. Also provide conditions that prevent the growth of infectious disease causing organisms.*

- Set a control demonstration by using a poultry area without the warm conditions or place the chicks without the hen for the growth period.
- Compare the two settings by studying the behaviour of the chicks and their growth/ development rate.
- Sell the mature birds and ensure there is continuity of the poultry birds reproducing.

Explanatory note

After hatching, the chicks have not fully developed the feathers. Therefore, they need warmth from the hen or an external heat source. Identify the chicks' behaviour within the first two weeks after hatching, then after one month.

Expected results

State and explain what happens to the young birds during the period of growth.

Conclusion

Make sure the growing birds are taken care of by the hen to reduce the rate of death. Explain why warmth is necessary in a poultry unit.

Evaluation

Demonstrate ways of keeping optimum warmth in the poultry house and caring for the poultry birds, including hygiene and feeding.

Follow-up activity

Develop a larger poultry unit containing several hens and cocks.
Identify the behaviour of cocks towards each other and provide solutions that will help promote economic development.

*Use **fig.7.3a** to identify the hens and cocks shown.*
Rear poultry birds similar to those you have identified for sale and food.

Fig. 7.3a: Poultry birds.

7.3.2 Breeding behaviour among domestic animals

Aim

To identify signs of the breeding season in domestic animals.

What you need

Female and male domestic animals, e.g. pigs, goats, cattle or local poultry birds

Note

Work with experienced personnel in rearing the domestic animals.

What to do

- Choose one example of the domestic animals common in the nearby area or in your community from the above list (pigs /goats/cattle/ poultry birds).
- Get young domestic animals, e.g. piglets, chicks, or calves.

- Rear a male and two females of the chosen domestic animals at your home until a mature age.
- At the reproductive age, study the behaviour of the animals and identify signs that indicate maturity and note them for future reference.
- Ensure that the animals breed at the right age and period.
- Allow the animals to reproduce in case fertilisation takes place and sell off the young animals to the community.
- Sensitise the community on the breeding behaviour of animals to ensure the welfare of animals, for economic development.

Explanatory note

Response and behaviour is a result of either internal or external stimuli. The type of behaviour /response determines the physical activity displayed or ways demonstrated by animals. *Explain various stimuli that influence breeding behaviour in domestic animals.*

Expected results

Explain the importance of the breeding behaviour of the domestic animals you have reared.

Conclusion

Relate the female and male breeding season behaviour to age and type of domestic animal.

Evaluation

Make a list of breeding season behaviour or signs that you have identified.

Follow-up activity

Identify the breeding behaviour of other domestic animals, including cats and dogs, and set up a similar activity so as to sell the animals.

Chapter 8: LOCOMOTION

Introduction

Over the years, you have noted body injuries occurring during various sports or games including swimming. Body parts that have been commonly injured are used in promoting movements in animals. For example, sprains occur in mammals including humans.

What happens during sprains? How are the animals with sprains treated? In order to come up with answers, find out the function of ligaments and where they are located in the animal's body. An example you may consider is that at old age, humans tend to feel pain in joints a condition known as Osteoarthritis.

Requisite knowledge

- *Types of skeleton and their functions*
- *Types of tissues*
- *Support in organisms*

Outline of major concepts

8.1 Locomotion in Mammals

8.2 Locomotion in Insects, Birds and Fish

8.1 Locomotion in Mammals

Inquiry question: *How many members of your class jog every day and why do they jog?*

Background Information

Think about the shape of your body without bones!. Within the body of mammals, different types of bones and joints exist that ensures flexible movements of the animal. The tissues form part of the antagonistic muscles and regulate action of the skeleton.

Discuss the various functions of a skeleton including how a correct posture for the body is maintained and its importance during body exercises and rest.

You should be able to:

- *Identify the type of bones in your body.*
- *State the function of each type of bone in the body of mammals.*
- *Explain the importance of joints, ligaments, tendons and muscles in the humans.*

Activity 8.1.1 What shape is your body?

Aim

To find out why many injuries occur early on in a sports activity.

What you need

20 classmates, a space for playing/ a playing field, a first aid kit

Note

Work out a training program with your game/sports teacher, preferably during the sports period.

What to do

- Together with the sports / games teacher or a health worker, name and prepare physical items that should form a first aid kit to be used during a sports activity.
- Practise how to provide the first aid to a dislocation and pulled muscle.
- Identify the 20 classmates according to similar range of age, weight and height.

- Together with the game/sports teacher, carry out activities that involve exercising the body parts including running.
- Note the progress of each classmate over a period of one month.
- If any classmate is injured in the process, provide first aid with the help of the teacher.

Explanatory note

Due to lack of regular exercise of the body or practise of sports/ game activities, the ligaments tear badly at a joint causing a dislocation or muscle pull. *Illustrate parts of your body that have joints.*

Expected results

Describe using examples the role of bones in shaping your body.
Explain the function of ligaments in maintaining the shape of the body.

Conclusion

Discuss with your classmates how you can prevent injuries during sports/ games activities.

Evaluation

What is a dislocation?
What is a pulled muscle?
Explain the cause of injuries (if any) got by your classmates.

Follow-up-activity

During sports /games bone fractures occur. Suggest ways of providing first aids to injured classmates.

Activity 8.1.2 First aid for the forearm fracture

Aim

To practise the steps followed in proving a first aid to a fracture.

What you need

1flat wooden board (of 10cm in width, 30cm in length and 2.0cm thick), 4 wooden strips /stick (of 2.0cm in width, 30cm in length and 2.0cm thick), 5 strings of 40cm long made from sisal or piece of cloth, a triangular bandage or a ½ meter piece of cloth and a safety pin

Note

Work out a training program with your game/sports teacher. Preferably during the sports period. Use a dummy/model arm to practise.

What to do

- Stretch out the strings on a flat surface or object that is raised off the ground.
- Place the flat wooden board on top of the strings.
- Then place the dummy/ model arm (it is assumed to be a fractured forearm) on top of the board.
- Place the wooden strips over this "fracture" or dummy arm. Make sure you have one strip on each side of the injured part.
- Tie the strings around the board, arm and strips tightly.
- Use the triangular bandage or cloth to keep the arm in position by wrapping it over the injured arm and the shoulder of the uninjured arm.

Explanatory note

Fractures are broken bones. For example, fractures may occur as a result of accidents on a playing field or slippery surface.

Expected results

Practise the above steps with your classmates.

Explain the importance of using the wooden board and strips.

Conclusion

Discuss with your classmates how you can prevent fractures during sports/ games activities.

Evaluation

Find out which sport could cause fractures of: ankle, collar bone and arm.
Name the bones broken and suggest the first aid that may be provided.
If possible, extend this service to a nearby community.

Follow-up-activity

Find out the first aid provided in case of a fracture occurring at the leg bone and collar bone.

Chapter 9: GROWTH AND DEVELOPMENT

Introduction

Growth is a permanent increase in size during the course of development. It is a result of cell divisions, cell enlargement and assimilation. Development on the other hand is the progressive change that occurs in an organism from its early lifetime to later stages in life. It is a result of cell specialisation/ differentiation to form tissues. Growth goes on throughout the body in animals but in plants it occurs in specialised areas called meristems. Primary meristems are found at the tips of roots and stems and are called apical meristems. In the stem they are protected by the leaf primordial and in the root by the root cap. Growth resulting from them results in increase in length and the branching of roots and stems and is called primary growth.

Growth in girth is by the cambium, which adds to the secondary xylem and the phloem. In many plants, there is also the cork cambium, which gives rise to the secondary cortex and corky cells/bark. Cambium is also known as secondary meristem.

Requisite knowledge

- *Cell division*
- *Cell enlargement*
- *Cell specialization*
- *Diversity of living things*
- *Economic importance of arthropods*
- *Nutrition*
- *Reproduction*

Outline of major concepts

- *Growth and Development in Animals*
- *Growth and Development in Plants*

9.1 Growth and Development in Animals

Inquiry question: *Identify arthropods in your community that have a major economic importance.*

Demonstrate an activity that may benefit the community in terms of improvement of living standards.

Background Information

The application of growth and development in animals is easily explained using arthropods in our day-to-day experiences. The type of growth in arthropods is called intermittent growth. This is because in many insects, growth goes on in stages. The exoskeleton limits growth, so growth occurs only around the time of moulting. The metamorphosis processes (changing from one form to another) is indicated as egg, larva, pupa/ nymph, and adult stage. These stages form the life cycle of an arthropod e.g. insects, ticks, which provide economic activities to humans.

You should be able to:

- *describe the life cycles of organisms and the conditions under which they are promoted, e.g. insects and ticks.*
- *make beehives and proper harvesting and treatment of honey.*
- *carry out proper growth and treatment of silkworms and silk (work with a resource person).*

Activity 9.1.1: Collecting the honey bees wax

Aim

To demonstrate production of wax by promoting growth of honeybees.

What you need

2 beehives of 150cm x 80cm, flower garden and support tree.

Note

Identify a place with few animal and human activities to avoid distracting the bees.

The study area should have enough water source for the bees, e.g. near a swamp.

What to do

- **See activity 1.6.1.**
- When the honey is ripe for harvesting, remove both the wax and honey.
- Separate the honey and wax, and place these products in suitable containers for further processing.
- Mould the wax into candle sticks by placing a thread within the centre of the mould.
- Sell the candles.

Explanatory note

Growth of honeybees takes place in the beehive where bees form honeycombs made of wax, which form cells where honey is collected.

Growth of the bees

Bees undergo complete metamorphosis during growth, and the castes make products that are of economic benefit.

Expected results

Identify the different stages of growth and development of bees that make the wax and honey.

Conclusion

State the value of rearing bees to the community.

Evaluation

Demonstrate ways of improving the wax product for the market and set up a similar activity at home or school for continued production.

Follow-up activity

Extract the honey and pack for sale.
Use wax to make candles with mosquito repellant properties.
Grow silkworms.
Study the growth and development stages of common vectors and pests and demonstrate methods of controlling them to promote improved standards of living in your community.

9.2 Growth and Development in Plants

Inquiry question

Explain factors that prevent proper growth and development of crops in your community or at home. Suggest ways that may be used by farmers in the nearby area to improve crop production.

Background Information

In flowering plants, growth starts with a process called germination, following a period of dormancy in response to suitable environmental conditions.
Germination is a process known as hypogeal in some seeds and epigeal in others. Seeds do not normally germinate immediately after ripening, they have a stage called seed dormancy. Seed dormancy is caused by several factors and it can also be broken in many ways. Apart from a seed being viable and ready to germinate, the external environmental conditions must be met in order for seeds to germinate.

You should be able to:

- *explain conditions required to promote crop growth and development.*
- *demonstrate ways of improving crop production, and sustain food production and supply.*
- *describe different methods of plant growth and development.*
- *identify causes of seed dormancy and describe methods of breaking dormancy.*

Activity 9.2.1 Growing plants from vegetative parts

Aim

To demonstrate growth and development of plants using vegetative parts.

What you need

Cuttings of cassava stems, a well prepared garden or area.

Note

Use suitable vegetative parts, e.g. should have growing buds at the nodes on stems.

Work with the Agriculture Department or an experienced person.

What to do

- In a well prepared garden or area, grow cassava plants by:
  - digging rows of shallow depressions in the prepared area.
  - placing each piece of stem into one of the shallow depressions.
  - covering the stem pieces with soil.
  - leaving the plants to grow for about 6 months – 1 year and harvesting the cassava root tubers for sale.

Fig.9.2a: cassava root tubers.

Harvest similar roots from your garden and make other products out of the roots, e.g. cassava flour to make food or pancakes.

Explanatory note

The growing points on cassava stem cuttings are at the nodes. These develop into a whole plant that is of economic value, if taken care of well.

Expected results

The mature plants provide root tubers that can be used as food in your home or for sale to improve your standards of living.

Conclusion

Continue developing a cassava garden to obtain food products for your community.

Evaluation

Demonstrate methods of food processing using the vegetative parts of the cassava plants you have grown.

Follow-up activity

Carry out a similar activity using sweet potato vines grown in mounds of soil. From the following list of crops (onion bulbs, carrot roots, corms of yams, suckers of banana /pineapple), choose one that is common in your community and use it for the plant growth and development activity, to promote nutritional health and economic development in your home.

9.2.2 Crop improvement through growth and development of plants

Aim

To demonstrate the grafting method of improving crops through growth and development.

What you need

Orange fruit seeds or seedlings or plants, well prepared garden or growing area

Note

Using good qualities of plants, show the standard of crop improvement. Therefore, choose qualities basing on the parent plants, e.g. nature of fruits, disease-resistant features etc.

For the stock, plant the seeds to seedling level or choose a young plant and for the scion plant use a mature plant.

The cut parts of the stock plant (the growing plant to be improved) and the scion plant (the plant to be used to improve or one with the good qualities) should be slanting in the opposite direction.

What to do

- Allow the stock plant to grow up to a height of 40-60cm from the ground level.
- Cut a slanting twig from the scion plant.
- Cut off about 20cm of the stem part of the stock plant, slanting in the opposite direction as the slanting twig of the scion plant.

- Fit the slanting twig plant parts onto the cut surface of the growing stock plant.
- Bind the plant parts or surfaces firmly using a tape/raffia thread/polythene strips.
- Smear the cut surface joint formed with wax to prevent evaporation /drying and protect the cut parts from microbial infections, or cover with a transparent polythene bag to reduce transpiration.
- Water the plant and provide enough shade throughout the growing period until mature.
- After two weeks, remove the polythene when the scion starts growing.
- Remove the tape or raffia thread or polythene strip when growth has occurred.

Explanatory note

Fixing the cut plant parts allows vascular tissues of the stock and scion plant to fit together. This ensures the cambium tissues of both will promote growth, therefore, promoting improvement of qualities in the stock plant.

Expected results

Insert the tapering twig of the scion plants into stock plants and set an orange plant garden. Determine the period taken by the orange plants to grow and develop, and provide fruits for sale.

Conclusion

Ensure improved quality of orange plant fruit and sustain supply to the community through developing a farm.

Evaluation

Demonstrate the differences in qualities and rate of growth between the stock plant and the improved variety and scion plant. Study ***Fig.9.2d.***

Identify fruits in your community that are similar to the varieties shown, but different from your improved orange plant fruits.

Fig.9.2d: Examples of varieties of orange fruit.

Follow-up activity

Carry out grafting activity on the following: mango, avocado, passion and lemon fruit plants, at home.

Demonstrate how the budding method is used in improving crops through growth and development. Work with experienced personnel to set up a garden of ornamental plants for sale or improving compound beauty through budding.

Chapter 10: REPRODUCTION IN ORGANISMS

Introduction

Reproduction is a life process in which new individual organisms are produced. It is a fundamental feature of all known living things, as each individual organism exists as the result of reproduction. The known methods of reproduction in organisms are broadly grouped into sexual and asexual reproduction.

In asexual reproduction, an individual can reproduce without involvement with another individual of that species. Sexual reproduction usually involves two individuals, male and female of same species. For instance, most plants are capable of vegetative reproduction (using plant organs/ parts without involving seeds or spores) but can also reproduce sexually. Forms of asexual reproduction include parthonegenesis, fragmentation and spore formation that involves only mitosis. Parthenogenesis (from the Greek words **parthenos**, meaning "virgin", and **genesis**, meaning "creation") is the growth and development of an egg or female gamete into an embryo without fertilisation. Parthenogenesis occurs naturally in some species, including lower plants, invertebrates e.g. water fleas, aphids, some bees and parasitic wasps, and vertebrates e.g. some reptiles and fish such as shark. It is sometimes also used to describe reproduction modes in hermaphroditic species which can self-fertilise.

Sexual reproduction is a biological process by which organisms create new individuals that have a combination of genetic material contributed from a male and a female member of the species. Each of the two parent organisms contributes half of the offspring's genetic makeup by creating haploid gametes. Most organisms form two different types of gametes. These are an-isogamous species, where the two sexes are referred to as male (producing sperm or microspores) and female (producing ova or megaspores).

In isogamous species, the gametes are similar or identical in form, but may have separable properties and then may be given different names. Most animals (including humans) and plants reproduce sexually. Sexually reproducing organisms have two alternative forms of a gene for every trait (called alleles). Offspring inherit one allele for each trait from each parent, thereby ensuring that offspring have a combination of both parents' genes. Allogamy is a term used in the field of biological reproduction to describe the fertilisation of an ovum/egg from a female with the spermatozoa of a male.

Self-fertilisation (also known as autogamy) occurs in hermaphroditic organisms where the two gametes fused in fertilisation come from the same individual. This is not common in higher organisms but occur in lower organisms like protozoa through the conjugation process.

The reproduction process is vital in daily life to add numbers, improve and maintain varieties, and create new species. This ensures economic and sustainable development within a community. For example, plant reproduction ensures food supply, prevents food shortage and malnutrition, and promotes a healthy body.

Requisite knowledge

- Growth and development in organisms
- Significance of the endocrine system
- Cell specialisation
- Diversity of living things

Outline of major concept

- *Reproduction in Lower Organisms*
- *Asexual Reproduction in Plants*
- *Sexual Reproduction in Plants*
- *Sexual Reproduction in Animals*

10.1 Reproduction in lower organisms

Inquiry question: *Show the role of the reproduction process in health and nutrition improvement of humans.*

Background information

Asexual reproduction is the process by which an organism creates a genetically similar or identical copy of itself without the contribution of genetic material from another individual. Bacteria divide asexually via binary fission; viruses take control of host cells to produce more viruses; hydras and yeasts are able to reproduce by budding and algae by fragmentation. Most of these organisms do not have different sexes, and they are capable of 'splitting' themselves into two or more individuals. However, some 'asexual' species, like algae, hydra and jellyfish, may also reproduce sexually. Their forms of reproduction have significance for economic development such as ensuring food production and prevention of sewage accumulation which may lead to pollution.

You should be able to:

- *identify processes of reproduction in lower organisms.*
- *grow and develop economically important organisms.*
- *use the lower organisms to provide food to humans and other animals.*

Activity 10.1.1 Fragmentation in algae

Aim

To show reproduction in other organisms.

What you need

Filament of a *Spirogyra* species, an aquarium/pond

Note

Ensure that the water in the aquarium/pond is clear and not contaminated with algal bloom.

Provide light and allow air to circulate in the water.

What to do

- Set up a pond or an aquarium with optimum conditions of light and air.
- Place a filament of the *Spirogyra* algae into the pond or aquarium.
- After 7 days, observe the amount of *Spirogyra* algae filaments in the water.
- Collect the *Spirogyra* filaments.
- Pack and supply them as feeds for fish or to industries involved in bio-fuel production.

Explanatory note

Spirogyra is an example of algae. Explain the causes of increased *Spirogyra* filaments in water.

Expected results

Discuss the process of reproduction of a *Spirogyra* filament.

Conclusion

Fragmentation is a reproductive process used by algae to multiply their numbers. *Spirogyra* filaments break up and the pieces develop into new filaments.

Evaluation

Multiplication of *Spirogyra* filaments is useful to supply food to fish but also they have disadvantages. Identify water bodies in your community that have *Spirogyra* growing in them

Follow-up activity

Identify edible filamentous algae for human consumption. Grow them for sale.

Budding by yeast in bread.

Decomposition and food spoilage.

10.2 Asexual Reproduction in Plants

Inquiry question

Plants reproduce to ensure that there is increase in numbers and to perpetuate its own self by reproducing offsprings. Through this process, plants are prevented from extinction and older/damaged plants are replaced. Explain the methods used by a nearby community to prevent extinction.

Background Information

Asexual reproduction refers to new organisms arising from a single parent without fertilisation taking place. For example, some parts of a plant have the ability to grow into new plants; such parts are the vegetative structures. This type of reproduction is an example of asexual reproduction and is known as vegetative propagation. Vegetative propagation involves:

(i) **Natural methods:** New plants grow that occur by means of: (a) Leaves, e.g. *Brophyllum.*

Fig.10.2: Buds growing on a leaf that develops into a new plant.

(b) roots, e.g. tubers of sweet potato (pomea batatas) and carrot roots

(c) stem, e.g. cassava *Manihot esculenta,* Sweet potato stems, Irish potato (*Solanum tuberosum),*sugar cane, etc.

(ii) **Artificial methods:** Where new plants are grown from portions of the vegetative body of an older plant by humans. These include cuttings, layering, grafting of stems or buds and marcotting.

You should be able to:

- Identify types of asexual reproduction in plants.
- Demonstrate asexual reproduction forms that occur in plants to promote crop improvement.

Activity 10.2.1 Vegetative propagation using cuttings

Aim

To grow new plants from the parent plant stem tuber.

What you need

Sprouting Irish potato tubes, a knife, a well prepared garden or soil in a basin.

Note

Use well drained fertile soil.

Irrigate the plants

Sterilise the knife to be used.

What to do

- Using a sterilised knife, cut several portions of the Irish potato stem tuber (each part must have a bud) as in Fig. 10.2a below

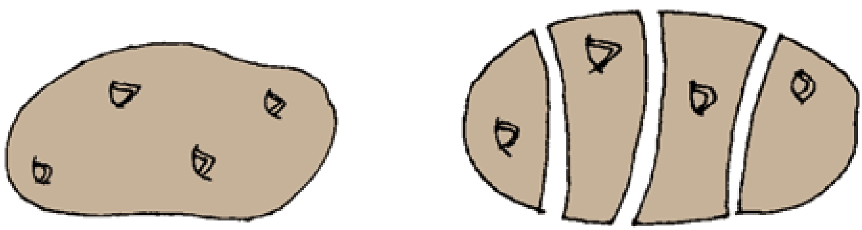


Fig. 10.2a: An illustration of irish potato tuber

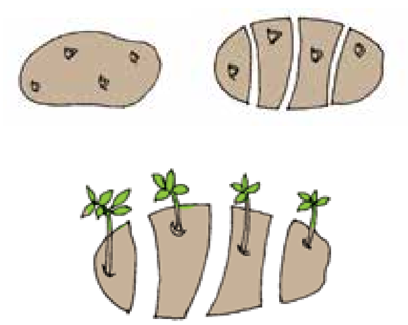
Ensure that the Irish potato is not infected by fungi or moulds. Keep it in a moist environment in order to develop the buds develop before the Irish potato is used as a specimen. You may use other suitable plant parts in case you do not get Irish potatoe

- Plant parts separately in soil (label A).
- Repeat 1-2 using parts of Irish potato without buds (label B).
- Water the plants regularly.
- Write down observations within 2 weeks.

Explanatory note

- From which part of the tuber do new plants grow?
- What features indicate that a new plant has grown?

Expected results



Figs. 10.2b: An Irish potato cutting developing new plants

- 'The Irish potato tuber is a stem structure'. From your observations of the external features, give reasons to confirm the above statement.
- Which part of Irish potato grows into new plants?
- Uproot the tuber pieces and carefully examine and draw the features observed in the figures labelled **A** and **B** respectively.

Conclusion

Explain the differences observed in the tuber parts labelled **A** and **B.**

Evaluation

Study Fig. 10.2c below, then pick an Irish potato similar to the one shown and draw and label the parts you have identified.

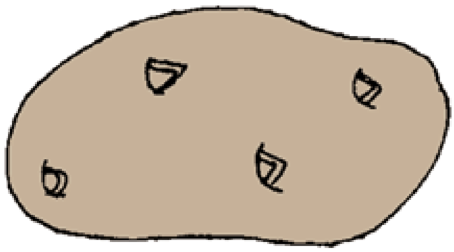


Fig. 10.2c

- Outline the importance of the Irish potato tuber to the:
  a. plant   b. humans
- Grow large numbers of plants from the cutting of cassava, sugarcane, sweet potatoes and rose flower plants, in a well prepared garden.

Follow-up activity

Use a similar technique to show vegetative propagation using cassava stems. Visit to an agricultural farm to discover other simple methods of vegetative propagation and practise them at home.

Activity 10.2.2 Quick flowering of plants

Aim

To demonstrate artificial propagation in promoting early flowering and fruiting of plants.

What you need

Suckers of bananas, a well prepared garden or area.

Note

Choose mature banana suckers and young seedlings of the banana plant.
Make clear rows of holes spaced by 2m.

What to do

- Using a hoe, dig holes of 1m deep and 2m wide in a well prepared garden or area.
- Leave the holes for 7 days and add manure to the soil.
- After 3 days, collect banana suckers from a plantation in the community.
- Dip the suckers in herbicides or cattle / goat urine to protect the plants from infections that may be caused by soil pathogens.
- Plant the suckers in the holes and cover with soil completely if they are seedlings or if suckers are bigger cover with soil to ¼ of the plant level.
- If it is a dry season, water daily and mulch the garden to reduce excess evaporation of soil water.
- Compare the rate of growth of the banana sucker seedlings and the bigger /older suckers, by comparing the time taken for the bananas to sprout and develop at least 4 banana leaves.
- Determine the flowering and fruiting period.
- Take care of the growing plants until the fruits mature and harvest for food and sale to the community.

Explanatory note

Vegetative propagation encourages a short life cycle of plant growth. As a result, the time taken to mature and fruit in flowering plants is shorter when older plant parts are used in the reproduction process than when seedlings or seeds are used.

Expected results

Explain why it is important for plants to have a shorter life cycle.

Conclusion

Ensure the suckers of banana plants are used in the reproduction process to provide food and promote the economic development of the community.

Evaluation

Demonstrate the advantages of artificial propagation using the banana plants grown in your home and community.

Follow-up activity

- Demonstrate the layering method to reproduce Bougainvillea plants used as ornamental plants or hedge plants.
- Practise artificial propagation by growing large numbers of plants from the vegetative parts of pineapples, sugarcane, sweet potatoes and rose flower plants, in a well prepared garden and sell the products.

10.3 Sexual Reproduction in Plants

Inquiry question: *Identify varieties of flowers, stating their uses to other organisms, e.g. humans, insects.*

Background Information

Higher plants are angiosperms and gymnosperms. Angiosperms are plants that produce seeds which are enclosed in fruits while gymnosperms produce naked seeds. Angiosperms are classified into monocotyledons and dicotyledons. These basically have flowers which are sexual organs.

The flower has two major parts:

(a) Non-essential parts (calyx, corolla)
(b) Essential parts (androecium and gynoecium)

The androecium consists of stamens which in turn consist of filaments and anthers which produce pollen grains containing the male nuclei/ gametes. The gynoecium (pistil) consists of carpels each of which consists of a stigma, style and ovary. The ovary contains ovules each of which contains a female nucleus. Pollination is the transfer of pollen grains from an anther to the stigma of a flower of the same species.
In the sexual reproduction of plants, fruits and seeds are produced. These are economically important as a food source to other organisms i.e. they provide nutrients in the form of proteins, carbohydrates, vitamins and mineral salts. Vitamin C is known to be a detoxicant of the body, in addition to providing a strong matrix of bones and teeth, skin health, etc. *Draw a table for other vitamins and mineral salts.*

You should be able to:

- *demonstrate the role of pollination in the fruit and seed formation in plants.*
- *show the value of fruits and seeds in health improvement and economic development of humans.*
- *improve the standard of living in the nearby community through growing and developing various flowering plants to provide fruits, seeds and juice for sale.*

Activity 10.3.1 Importance of Pollination

Fig.10.3: A bee on a sunflower.

Suggest the benefits of such living things being together as shown.

Aim

To demonstrate the importance of pollination in the reproduction of flowering plants.

What you need

Bean seeds, two boxes filled with soil, polythene bags, water

Note

Seeds must be viable.

Soil should be well drained and fertile.

What to do

- Plant bean seeds in two separate boxes A and B filled with soil.
- Keep watering them at regular intervals (twice a week).
- As soon as flowers start forming, cover the plants in box B with perforated transparent polythene bags.
- When the fruits are ripe, harvest them.

Explanatory note

What are the causes of the differences between the pods in A and B.

Expected results

- Describe the appearance of the fruits from the plants in box A and box B.
- Open the fruits and describe the seeds in A and B.
- Discuss the differences in bean plant pods grown in A and B.

Conclusion

What condition would you avail to plants for them to bear viable seeds?

Evaluation

Demonstrate the importance of a flower in the pollination process.

Follow-up activity

Identify other causes of poor yields in plants and show why some fail to fruit.

Activity 10.3.2 The role of flower structures

Aim

To show the economic value parts of a flower.

What you need

Water, sugar, salt, saucepan, heat source, calyces of hibiscus plant as shown in ***fig.10.3a*** and *Hibiscus sabdariffa* (Rosella) plant

Fig.10.3a: An example of a Hibiscus plant species.

Rosella fruits are harvested fresh, and their calyces are made into a drink rich in vitamin C and anthocyanins.

Dried rosella calyces can be obtained in two ways. One way is by harvesting the fruits fresh, decoring them, and then drying the calyces. Decoring means removal of a seed capsule from the fruit using a simple hand tool to obtain its calyx, as shown in ***fig.10.3 c*** below.

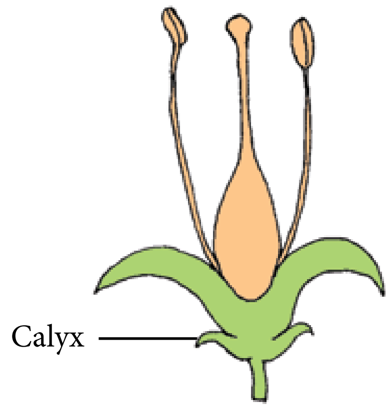


Fig. 10.3c: Illustration of the calyx removed

The other way is by leaving the fruits to dry on the plants to some extent, harvesting the partially dried fruits, drying them further if necessary, and then separating the calyces from the capsules.

Note

With the help of the teacher or an expert, identify the right species of Hibiscus plant that is able to fruit, since some do not fruit. For example, the Hibiscus plant used in compounds ***(Fig. 10.3 d)*** is not suitable for this activity as it does not fruit. Use the one shown in ***Fig.10.3 e*** instead.

Fig.10.3d: Hibiscus plant similar to a Rosella plant.

Fig.10.3e: Rosella plant similar to a Hibiscus plant

What to do

- Boil 5 litres of water.
- Measure 2 mugs of calyces (dried calyx).
- Add the calyces when the water is at 100 degrees or at boiling point.
- Let it boil for just 1 to 2 minutes (do not boil for long as you will destroy the nutrients).
- From fire, immediately sieve and put in either a glass container or a white jerrycan but a glass container is advisable.
- Add 1 tablespoon of sugar, 1 teaspoon of lemon juice and a small pinch of common salt and any flavour of your choice.
- Drink when cold or pack in suitable containers and sell in your community as a rosella drink. Ensure high standards of hygiene.

Explanatory note

Flowers are known to form fruits and seeds after pollination and fertilisation processes which are edible to animals, including humans. While the other parts like petals and sepals dry and fall off the plant, these dried parts are known to be of economic and medicinal value. For example, the rosella flower parts are widely used to make products at home which improve health standards, nutrition and lead to economic development.

Expected results

Identify the flower parts of a rosella plant and demonstrate the role they play in other organisms. For example, the rosella drink is a home-made nutritious and health drink obtained from the sepals or calyx of flowers.

Conclusion

Establish the importance of flower parts to the plant and to other organisms.

Evaluation

Demonstrate the use of flower parts other than seed and fruit production in everyday life.

Follow-up activity

Grow the rosella plants at home and use leaves to prepare leafy greens and sweet herbal tea from leaves, or wines and food colour from petals.

Show the extraction of oils and lotions from rosella seeds to treat cracks on the feet, boils and sores.

Demonstrate the preparation of jam from rosella fruits.

Grow flowering plants that produce flowers which you can use to decorate your house, sell to florists, export, etc.

Activity 10.3.3 The value of fruits and seeds

Aim

To identify the economic value of a variety of fruits and seeds.

What you need

Fig.10.3d: Various fruits obtained from flowering plants.

Study them and identify the fruits that are common in your home.

Note

use the above illustration and relate it to economic activities in the neighbouring area.

What to do

- Name the fruits identified in ***Fig. 10.3d*** using the English/local name.
- From the list you have developed above collect five different types by studying their structure.
- Practise the economic benefits in a nearby area by:
  I. Showing the role of seeds in the growth and development of crop plants.
  II. Or Growing and developing flowering plants to obtain fruits and seeds for sell or to use as food.
  III. Relating the nutritional benefits obtained from fruits and seeds by extracting food materials, e.g. fruit juice and seed oils, for sale from the flowering plants.

Explanatory note

Apart from promoting growth and development in plants, the fruits and seeds developed by flowering plants have economic importance to other organisms, including humans. These include nutrition and health improvement if they are of the right quality and are obtained in the right quantities. At the same time, fruits and seeds are a source of income when sold to improve standards of living.

Expected results

Grow and develop flowering plants to provide fruits and seeds to sell.

Improve personal health by feeding on fruits and seeds to reduce food deficiency diseases in the community.

Conclusion

Utilise the fruits and seeds to promote nutritional standards and health in the nearby community.

Evaluation

Demonstrate the value of fruits and seeds in promoting economic and health standards at low cost.

Follow-up activity

Extract perfumes, oils or jam from flowers, fruits or seeds for sale.

Use seed plants in the purification of water. Place Moringa plant seeds in containers of drinking water for at least 3 hours before the water is drunk.

Demonstrate the process of preserving edible fruits and seeds as a means of sustaining food security, health and development.

10.4 Sexual Reproduction in Animals

Inquiry question: *Write a list of animals indicating their gestation period. Outline animals that are threatened or those that are about to be extinct and give the reasons why.*

Background Information

Reproduction is the giving rise to new viable offspring by the parents. In animals, especially mammals, reproduction is sexual, in which gametes from parents fuse together to form a zygote that develops into an embryo (foetus) which in turn grows and develops into a new individual.

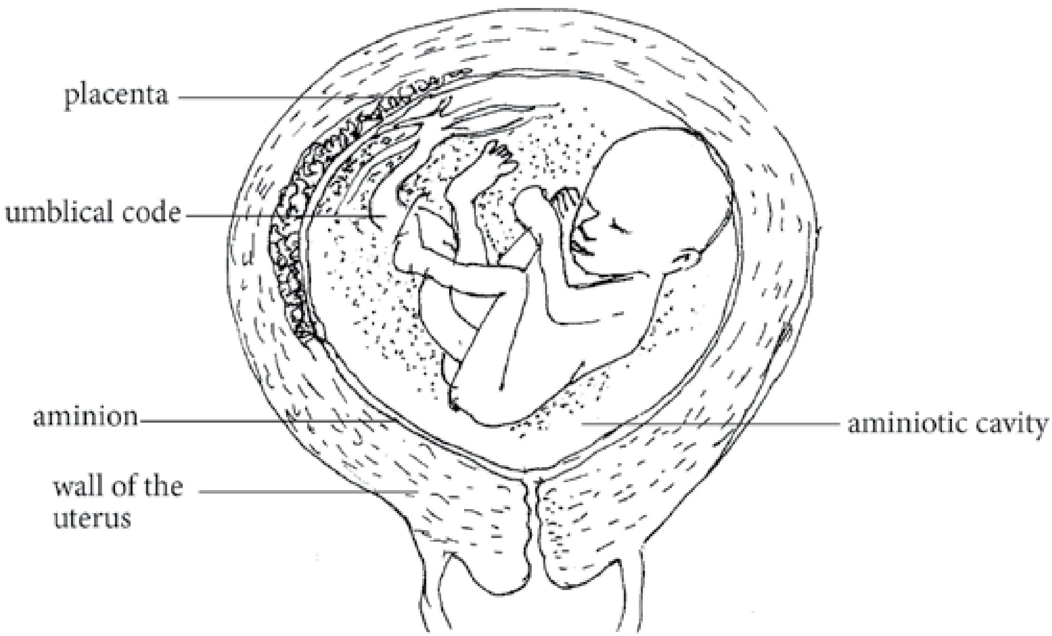


Figure 10.4a: An illustration of a developing Feutus in the womb

Reproductive health and fertility in animals is an example of an economic development issue addressed through family planning, adolescent development and Sexually transmitted diseases (STDs) programmes. These are related to biological facts, especially in humans, such as:

- Structure and function of mammalian reproductive organs.
- Events of the menstrual cycle.
- Process of fertilisation.
- Development of the foetus.
- Birth and parental care.
- Methods of birth control.

- Sexual hormonal influences and development during adolescence.
- STDs e.g. HIV

You should be able to:

- *display reproductive system organs in domestic animals and compare them with illustrations of the human reproductive system.*
- *explain the internal fertilisation mechanisms.*
- *Identify ways of caring for the young and positive influence adolescent behaviour.*
- *describe methods of birth control, giving the advantages and disadvantages of each.*
- *explain sexual hormone influence on adolescent development and behaviour.*
- *identify symptoms, causes, prevention of STDs and care of STD patients.*

Activity 10.4.1 Female and male reproductive organs in a mammal

Aim

To describe the female and male reproductive systems in a mammal.

What you need

Dissected mammals displaying male 'A' and female 'B' reproductive systems (use rabbits, rats)

Hand lens

Dissection guides

Note

Work with your teacher to display the reproductive system of a small mammal.

Avoid damaging the organs in the displays.

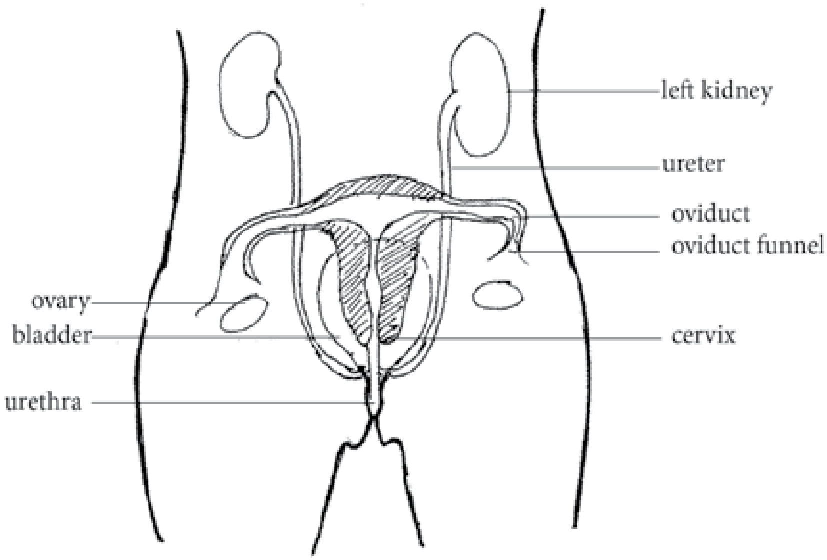
What to do

- You are provided with dissected mammals A and B.
- Examine them using a hand lens.
- Trace the reproductive system in each with the help of pictures in the dissection guide.
- Compare the system in the display with those in the guide.
- Make simple drawings of the reproductive system of dissected mammals A and B. Label them and state the magnification.
- Complete the table below using the identified and labelled organs above.

Organ	*Shape*		*Functions*	
	A	*B*	*A*	*B*

Explanatory note

- Describe the arrangement of the male and female reproductive systems in the mammal using a well labelled diagram of the male and female reproductive systems of the dissected mammals.
- Compare your drawings with the human reproductive system shown in ***Fig. 10.4c*.**



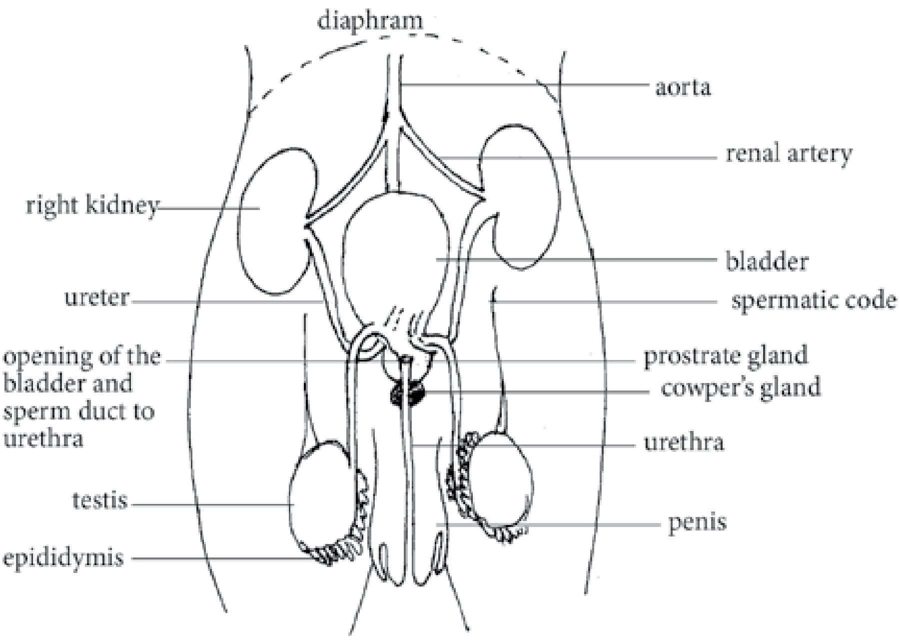


Fig. 10.4c: Illustration of the human male and female reproductive systems.

Expected results

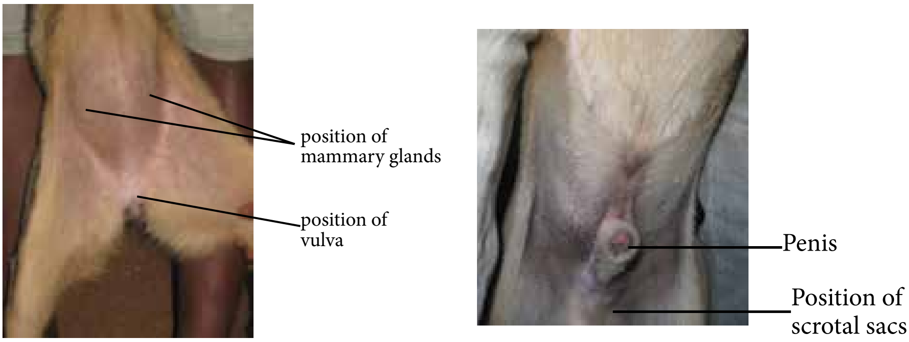


Fig. 10.4d: The external reproductive features of male and female animals.

Study them and write down the differences between the two.

Relate the observed organs to those found in humans, indicating the differences in the external structural features.

Conclusion

Describe the mechanism by which animals produce their offspring and sustain their life on earth.

Evaluation

Show the significance of cell division in the reproduction of animals.

Follow-up activity

Make a survey on how to care for the mammalian reproductive organs in order to maintain good hygiene and avoid diseases.

Visit medical personnel to assist in identifying diseases and causes that affect the human reproductive system, and establish ways of preventing such diseases.

Activity 10.4.2 Reproductive health

Aim

To identify events of the menstrual cycle.

What you need

An illustration of the general menstrual cycle, strong thread or raffia, 31 beads (5 red beads, 2 white beads and 24 blue beads).

Note

Work with an experienced person to develop an accurate menstrual cycle chart.

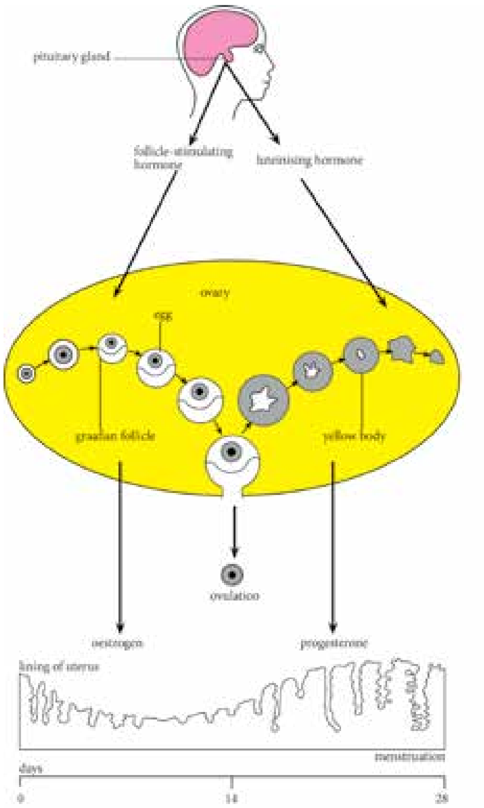


Figure 10.4e: The general menstrual cycle.

What to do

- *Draw a general menstrual cycle on a chart or manila paper.*
- Explain the cycle you have drawn to your classmates through discussion groups.
- Make any necessary improvements to your illustration and

accuracy in the presentation of events.

- Use the chart you have drawn to make a chain of beads that represent the days of the menstrual cycle events.
- Use the colours of beads to differentiate the days into menstrual days (red beads), ovulation (white beads) and other days (blue beads).
- Sell these chain beads to women in the community to enable them to develop a personal menstrual cycle.

Explanatory note

- The female body and reproductive system respond to hormones that regulate the menstrual cycle. Mention these hormones and their role in the body.
- Identify the events of each day of the monthly menstrual cycle together with a group of 15-20 women and teenagers in the community or at school.
- The length of the cycle varies in different women but the range is 21-32 days per cycle.

Expected results

Demonstrate a sensitisation programme on the use of chain beads in indicating the events of the menstrual cycle.

Conclusion

Show the precautions to be taken during the events of the menstrual cycle by the indication of beads.

Evaluation

Explain the value of the menstrual cycle in women and teenagers.

Follow-up activity

Explain the value of birth control to the community by providing information on how to access suitable methods of birth control at health centres.

Working with community groups, demonstrate ways of protecting families and adolescents or humans generally from sexually transmitted diseases (STDs, including HIV).

Chapter 11: GENETICS AND ENVOLUTION

INTRODUCTION

Genetics is the study of how organisms resemble their parents and show variations as a result of inheritance. The heritable material of organisms is in the nucleus in the form of DNA (RNA in some viruses). The uniqueness of individuals, plants or animals is determined by the proteins the DNA contains and by its genes.

Variations that exist in members of each species are caused by differences in DNA. A look around enables one to see different varieties /types of cassava, maize, potatoes, cattle, pigs, dogs, chickens, among other organisms. Within each variety, the differences are due to conditions in which they live.

Some characteristics are desirable while others are not. Inbreeding maintains the characteristics from one generation to another. Crossbreeding, on the other hand, increases variations among offspring.

From time immemorial, communities have practised crossbreeding by selecting male and female domestic animals of good quality. Service by superior bulls, cocks, he-goats, boars, etc. have been sought at village level. At national level, plant and animal breeding is done at research institutes or through NGOs. These institutes release good products to the market and these products are used for community development.

Requisite knowledge

- *Cell structure*
- *Cell division*

- *Reproduction*
- *Growth and development*

Outline of major concepts

1.1 **Mitosis and Meiosis**

1.2 **Genetics**

1.3 **Evolution and Variation**

11.2 Genetics

Inquiry question: *The study of how characteristics are passed on from one generation to the next is known as heredity. This was demonstrated by Mendel through the use of features of the garden pea as shown in* ***Fig.11.2 a.***

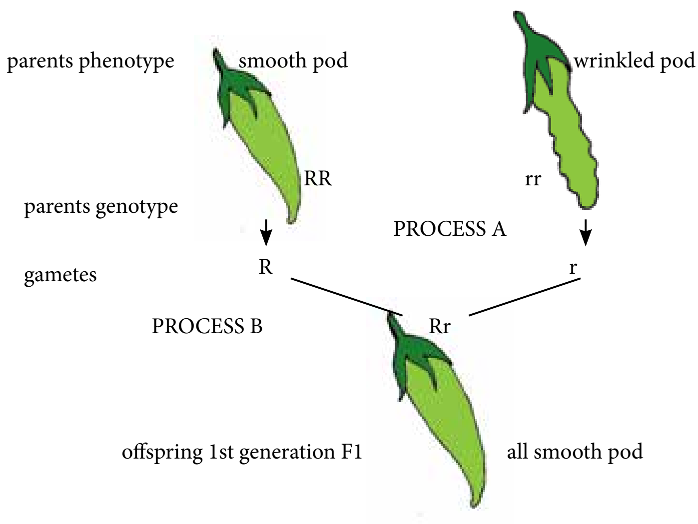


Fig 11.2 a: An assumed RR gene for a smooth pod and rr gene for a wrinkled pod and each gamete in the smooth garden pea has R while the wrinkled garden pea has r.

Define R and r and show how the seed pea cells obtain R or r. Then study the figure below and explain the processes A and B involved.

Mendel crossbred a variety of peas with contrasting features of smooth and wrinkled seed coats, using varieties of garden peas by fertilising the ovules of one with pollen grains from the other. After the seeds were planted and allowed to grow, the seeds of the offspring were examined and all were smooth.

The offspring **F1** were later planted and allowed to grow without cross-pollination (i.e. were self-pollinated) by preventing visits from insects. About three-quarters of the second-generation **F2** were smooth and a quarter were wrinkled, as indicated in ***Fig.11.2b.***

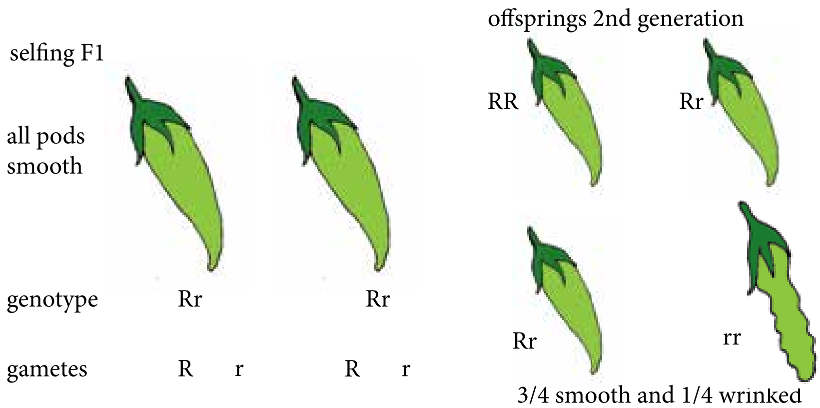


Fig.11.2b illustrates a self-pollinated F1 pea pod, a product of the 1st generation. Explain how the ratio 3:1 is obtained for F2.

Background Information

Genetics is the study of heredity and variation in organisms. This explains the uniqueness of organisms determined by the proteins and genes in their cells.

Genes play an important role in determining the characteristics of organisms, which result in improved qualities, e.g. yields and characters.

Hybridisation is the process involving the crossing of two closely related organisms which differ in some way but produce offspring called hybrids with more desirable qualities than either of the parents. An offspring inherits the characteristics of the parents passed on in gametes at fertilisation. That is why an offspring develops family resemblances in features like facial appearance and skin colour with their parents, grandparents or other close relatives. However, there are recessive genes that determine hidden traits but may be passed on from the male and female parent to their offspring at fertilisation, and physically revealed in an offspring. For example albinism, haemophilia and colour blindness are common traits in humans, which parents should be aware are inherited by the child from both mother and father. Another trait is sickle cell anaemia controlled by a co-dominant gene. The parents are known as carriers and appear to be physically normal.

Other features and characters in organisms appear because of dominant alleles, sex linkage, sex limitation, co-dominance and a sex-influenced gene phenomenon. These are facts that are not reversible and have economic implications but related health issues are addressed by medical personnel.

You should be able to:

- *describe how some unique traits in humans are acquired .*
- *demonstrate the role of genes in the life of an organism*.
- *render a service to the community by creating awareness about the fact that animal and plant breeding should not be left to chance.*
- *give examples of sources of seeds and young animals of good quality.*

Activity 11.2.1 Rearing Poultry Birds

Aim

To demonstrate the role of genetics in improving the characteristics of poultry birds through hybrids.

What you need

A poultry building (150cm x 150cm). *Use pieces of wood, nails, a sheet of hard polythene or grass*

Local female birds (hens)

1 exotic cock (male bird)

Water (drink)
Feeds (food)

Note
Keep the poultry unit clean.
Always provide feed and clean water.
The hen birds should be mature enough to start laying eggs and should not have mated with any cock before the activity.
Isolate the birds to be used in your study for 2 weeks before you start the study.
Immunize the birds following the vaccination schedule.

What to do

- Construct a poultry house and make it ready for the birds.
- Put the local hens together with the exotic cock.
- Feed them over a period of time (two months) until they start laying eggs.
- Allow the local hens to incubate the eggs. Each hen should be provided with approximately 10 eggs until they hatch (21 days).
- Feed the chicks in a separate room and let them grow.
- Identify dead birds at a young stage and note the symptoms on each.
- Use experienced personnel to provide vaccines and treatments.

Explanatory note
Genetics is the study of how organisms resemble their parents and show variations as a result of inheritance. The heritable material of organisms is in the nucleus in the form of DNA (RNA in some viruses). The uniqueness of individuals, plants or animals is determined by the proteins they contain and by their genes.
Explain the factors that bring about the differences in the characteristics of the parents and their offspring.

Expected results

Find out how the characteristics of the offsprings compare with those of the parents in terms of: size, colour, and resistance to disease.

Conclusion

State the effect of crossing an exotic and a local bird?

Evaluation

- Explain the differences between the parent stock and the off spring obtained as a result of crossbreeding of local and exotic birds.
- Determine the cause of poultry bird mortality.

Follow-up activity

Allow the offspring to grow and make conclusive explanations on each of the following characteristics:

- Egg yield
- Growth rate
- Dropping rate

Apply the same skills to cross varieties of maize, beans and cattle, goats and cats.

11.3 Evolution and Variation

Inquiry question: *Useful plants and animals vary in many ways. Explain what people can do to improve the varieties of crops they grow and the varieties of animals they keep.*

Background Information

New species arise from pre-existing species as a result of modification through adaptation or formation of varieties. This occurs through a sequence of changes or succession from generation to generation and from simple forms to complex forms. Evolution is a study that attempts to explain the origin of life and the relationships between living things that exist in the universe. This is done by defining theories of life (ask your teacher or read a reference Biology book to describe these theories). This explains how new species developed from the pre-existing species, and it should help you to relate the day-to-day life processes that cause present-day evolution and economic development.

Desirable traits in plants and animals can be obtained by natural or artificial selection. These are mechanisms causing present-day evolution. For example, humans practise selection and controlled breeding in plants and animals. This is called artificial selection, e.g. through practising selection by rearing and breeding cows that have the ability to yield more milk. This applies to other animals like pigs, goats and poultry birds, among others, through selection based on what is termed as good qualities. Likewise, plants like cassava, sweet potatoes, *matooke*, beans, peas, pumpkin, maize, pineapples, passion fruit, oranges and vegetables like cabbage, carrots and tomatoes can be artificially selected on the basis of qualities such as size, yield, growth rate and pest resistance. This is done to improve the yield quality and quantity, and to conserve the good features of the original species, while at the same time promoting the formation of new varieties. Hybrids of most available passion fruits, bananas, etc. are a result of selective breeding by humans. Present-day varieties have been selected for better quality (green evolution) in terms of size, growth rate, yield and pest or disease resistance and this has promoted economic development.

You should be able to:

- *describe the process of present-day evolution in selected plants and animals.*
- *identify variations among the plants and animals reared by your community.*
- *show the importance of keeping plants and animals with good qualities such as high yield, resistance to disease etc.*

Activity 11.3.1 Selecting improved crop varieties by artificial selection

Aim

To demonstrate artificial selection in crops grown on a nearby farm.

What you need

Varieties of selected plant, e.g. bean, maize, groundnut, tomato, cabbage, passion fruit, orange

Note

If there is no crop farm or garden nearby, grow and develop a type of crop plant of your preference at home or school on a small scale.

What to do

- Choose one type of fruit or vegetable crop plant from the above list of materials.
- Identify two varieties of the crop plant chosen and study the differences and similarities in their qualities or characteristic features, on the basis of human preference and community values.
- Show how this human preference (artificial selection) affects the abundance and distribution of the crop varieties in the community.
- Demonstrate how the two varieties are utilised in promoting nutrition. Sell them off to the community.
- Ensure continuous supply of the best variety by growing and supplying the chosen crop plant to the community.

Explanatory note

- Establish which variety is the original type and which is the new type of the crop plant, and indicate their economic values to the community:
- Identify the most common varieties and how they were introduced into the area.

- How are the new varieties better than the original varieties?
- State any problems associated with the new breed and suggest ways of overcoming these problems for economic development.

Expected results

- Explanation of the characteristics of the original varieties and the new varieties.
- Improved supply of crop varieties basing on community need / demand.

Conclusion

Demonstrate the importance of artificial selection in crop plant breeding.

Evaluation

- Explain the role of artificial selection in present-day evolution.
- Using a flow diagram, make a display of your chosen crop plant history by stating the trends and changes undergone by each variety.

Follow-up activity

Visit an agricultural / animal research station and find out how improvement of plants and animals is done.

Practise ways of breeding varieties of crops and domestic animals for sale.

Activity 11.3.2 Ensuring quality by farmers

Aim

To create awareness among people in order to ensure high yield of good quality in animals and plants.

What you need

Script of a play, skit, song, charts, and resource person.

Note

- The plants and animals included in the information must be relevant to the community.
- Songs/drama/charts etc. must respect the culture of the recipients.
- Together with the teacher, select suitable materials and develop the songs/drama/charts.
- Work with the English Department and the Drama/Music Club to develop the script and theme to be used.

What to do

Identify the items/ cattle or goats or maize or millet or cassava or sweet potatoes or fruits and vegetables, that are readily available in the nearby community. Use these as materials in the procedure below.

What to do

- Identify the crop grown and animals reared in the community.
- Identify the good and poor qualities of those plants and animals.
- Grow or rear the identified materials if possible and study the quality in relation to what is available in nearby community. Or
- Select the medium of communication to use (play, music, resource person, charts).
- Produce the product (play/skit/talk) to use for communication.
- Invite a resource person to give a short talk.
- Organise an awareness activity together with the local authority (date, time, programme, and venue) on the quality of products.
- Carry out the awareness-creation activity leading to variety selection and improvement of crops and animals.

Explanatory note

The activity links what you learn in class with what the community knows about the desirable qualities in their crops and domestic animals. It also encourages them to acquire quality 'seeds' from plant and animal breeders.

Demonstrate how the creation of varieties of living things leads to present-day evolution.

Expected results

Explain the external appearance of the plants and animals that are of good quality. Show the role of community members in the selection of good qualities when rearing animals and growing crops.

Conclusion

Explain the artificial selection concept to members of the community using the prior activities practised by humans in the nearby areas. For example seeking out a bull or he-goat during the breeding period of the animals to ensure good quality/variety.

Obtain information from the community about the qualities that they think are desirable/good or undesirable/bad.

Find out how they ensure continuity of the good qualities.

Evaluation

Demonstrate the methods used in quality improvement of the varieties of crops grown and animals reared in the community.

Follow-up activity

Develop a demonstration garden using one type of crop to show varieties and evolution trends in plants.

Rear domestic animals at home and carry out crossbreeding in order to get a specific variety that is commonly sought by the community nearby.

Chapter 12:
INTERRELATIONSHIPS

Introduction

Interrelationships are explained in the study of ecology, which is the study of the interaction of organisms and their environment. Components of ecology are factors that influence the population distribution and abundance of organisms. These factors are grouped into:

i. Biotic factors which refer to associations and/or inter-relationships between living things.

ii. Abiotic factors which refer to physical factors or non-living elements of the environment that affect the inter-relationships between organisms in a community. An environment is the condition(s) which exists in a habitat. A community refers to all forms/species living in a habitat. A habitant is the particular place in an ecosystem where organisms live and get food and shelter and reproduce.

An ecosystem is part of the universe where organisms interact within the physical features of the environment. It forms a natural self-sustaining unit of associations formed by organisms.

Requisite knowledge

- *Diversity of living things*
- *Soil*
- *Nutrition*
- *Respiration and gaseous exchange*
- *Growth and development*
- *Reproduction*
- *Genetics and variations*

Outline of major concepts

- *Food Chains and Webs*

- *Changes in Population*
- *Associations in Organisms*
- *Human and Natural Environment*

12.1 Food Chains and Webs

Inquiry question: *Explain the different ways by which organisms obtain food and state examples of food types showing how organisms depend on each other in your community.*

Background Information

Food chains and webs are illustrations representing the feeding behaviour of organisms in a natural habitat. They indicate how organisms acquire the nutrients or show what is eaten or being eaten in a habitat.

You should be able to:

- *Make illustrations of the feeding behaviour of organisms in your community.*
- *Explain the causes and effects of food shortage in your community.*

Activity 12.1.1 Identify types of food material

Aim

To demonstrate feeding relationships in higher animals.

What you need

A carnivore, e.g. a dog; a herbivore or ruminant, e.g. cow, goat; or a rodent, e.g. a rabbit; an omnivore, e.g. a human being, a poultry bird

A common type of food material used in your home or community areas

Note

Ensure the animals, including the human beings, are provided with the suitable and preferred type of food.

What to do

- Identify one group of domestic animals according to their feeding specialisation (either a carnivore/herbivore/omnivore) that is common in your community. (Include humans with special feeding preferences such as vegetarians or non-vegetarians.)
- Observe and identify the type of food materials they prefer as feeds.
- Record the source of the food materials, i.e. either plant products/ animal products/mixed plant and animal products.
- Note the animals' behaviours during and after feeding, and the time of feeding using the 24-hour clock (i.e. morning, midday, mid-afternoon, late afternoon, evening or at night, etc.).
- Study this process for a period of 60 days /2 months.
- Recommend the type of food materials suitable for the group of animals you chose.
- Provide the preferred food materials to the animals in your community by designing a mini-project to supply the feeds.

Explanatory note

Get involved in identifying suitable food materials and time of feeding and observe the characteristic behaviours related to animal feeding to guide proper digestion and other physiological processes, such as growth and development, and health issues of animals.

For example, time of feeding has an important value: in humans the last main meal of the day should be before 8.00 p.m.; dogs feed any time of the 24.00-hour day; birds prefer feeding between 6.00 a.m. and 6.00 p.m. and at night with lights on; cattle prefer feeding between 7.00 a.m. and 12.00 p.m. and usually rest between 1.00 and 3.00pm then feed again up to 6.00p.m.; and goats prefer feeding between 10.00am and 6.00p.m. Suggest reasons for feeding time in relation to digestion process.

Expected results

- Show the differences in type of food materials eaten by the animals you have studied and yourself.
- Explain the reason(s) for the distinguishing factors, e.g. time of feeding and behaviours in feeding between the study animals and yourself. For instance, nocturnal animals actively feed at night or in the dark and have a well developed chemoreceptor to be able to smell food materials in the dark but have poor sight during the day time. *State any other reason why nocturnal animals behave that way*.

Conclusion

Demonstrate suitable procedures of feeding domestic animals in the community or your home.

Explain the value of proper digestion processes by comparing the systems in mammals.

Evaluation

Keep or rear domestic animals in your home or school or community. Using information from your study and knowledge of animals' digestion processes, provide suitable feeds to domestic animals.

Follow up activity

Carry out a field study by visiting animal feed factories or animal-rearing farms in the community or nearby areas, to find out how domestic animals are fed.

Activity 12.1.2 Effects of feeding relationships on development

Aim

To demonstrate the impact of feeding relationships among organisms in a habitat.

What you need

Tilapia / catfish, fish pond or an aquarium, fish meal mash, or aquatic weeds (*Spirogyra*), worms/ mosquito larva.

Note

Determine the rate of reproduction and mortality by establishing the number of fish present per month.

Work with experienced personnel to set up an aquarium or fish pond.

What to do

- Identify the type of fish to be reared from the above list.
- Set up an aquarium or a fish pond at home or at school.
- Prepare a monthly feeding timetable using the above alternative fish food types.
- Study the behaviour of the fish in terms of food type preference, body size gained, rate of reproduction and mortality of fish during the period of feeding on a specific food type.
- Sell the mature fish of suitable size to the community.
- Place all the different types of food above in the fish pond and establish how the organisms (weed, fish, worms, and mosquito) relate with each other.

Explanatory note

The feeding preference of fish thus reared will promote development in terms of income generation, nutrition and improved health or vector control through biological techniques. The feeding relationships of organisms are used in biological control activities to control pests and vectors in the community. Show the sequence of feeding established by the organisms in the above study.

Expected results

Explain how the organisms in the above activity relate with each other, and show their impact on fish numbers.

Conclusion

Demonstrate the value of rearing fish at home or in your community.

Evaluation

Study ***Fig.12.1b*** and identify the major differences between the tilapia type and the typical tilapia found in your community, which is shown in ***Fig.12.1c*** below. Give reasons for your answer.

Fig. 12.1c: A typical tilapia

Follow-up activity

Explain the role of fish feeding on mosquitoes or mosquito larva in a natural habitat.

Suggest how this activity can improve health standards and demonstrate a biological control method to reduce common vectors and pests in your community. An example is the biological control method used by insects when they feed on weeds in aquatic bodies or in crop gardens. Another example is the application of chemicals to seeds such as beans to prevent rotting caused by fungi or being eaten by weevils during storage.

12.2 Changes in Population

Inquiry question: *Growth in microbial population makes food go bad. Explain how control of microbial growth conserves food and leads to food security.*

Background Information

Changes in population are best illustrated in bacteria and fungi which are saprophytic, obtaining nutrients from plants or animal products, which are also human food, e.g. fish, meat, cassava, beans, milk, etc. Microbial populations increase rapidly in favourable conditions. Conditions can therefore be made unfavourable in order to reduce the rate of multiplication of the microorganisms. This phenomenon is utilised in food preservation and quality control, through ensuring that the methods used to control microbial growth are able to preserve the good qualities of the food and do not harm the people who consume it.

Commonly used food preservation methods include refrigeration, sun-drying, smoking, salting, canning, and bottling.

Some methods involve the addition of preservatives, although some of the preservatives have side effects. Therefore, the use of natural methods to regulate the microbial population is vital in economic development.

You should be able to:

- *explain the importance of preserving food.*

- *distinguish between good and contaminated food.*
- *select the best methods of preserving the different types of food.*
- *explain the advantages and disadvantages of the different methods of food preservation.*

Activity 12.2.1 Preservation of green vegetables

Aim

To prepare vegetables for storage and control of microbial growth.

What you need

Vegetables (e,g. leaves of cocoyams, *ggobe* (Luganda)/*boo* (Acholi/Lango)/ *eboo* (Ateso), means of cooking/fire, saucepan or some flat clean surface for drying.

(See activities 3.1.3 and 3.4.3).

Note

- Pick the vegetables between 11.00a.m. and 4:00p.m. from an identified garden.
- Do not soak the fresh vegetables to ensure that the water-soluble vitamins are not lost.
- Store dry vegetables in dry, airtight containers.
- Cook briefly in boiling salty water for vegetables that need pre-cooking.
- Find out from the teacher or community members whether the vegetables need pre-cooking.

What to do

- Collect the leaves of the vegetables.
- Wash the vegetables clean.
- Cook the vegetables that need pre-cooking briefly (this applies to some vegetables).
- Dry the vegetables on a clean surface.
- Store the dry vegetables in airtight containers.
- Sell to the community to ensure continuous supply and improve nutrition standards in homes and prevent deficiency diseases due to lack of nutrients in vegetables.
- Identify suitable conditions of preparation and storage to prevent microbial contamination.
- Set up a control by storing the fresh vegetables and note the rate of spoilage.

Explanatory note

Drying removes water, thus reducing the moisture content and slowing the chemical reactions in the food substrate. This prevents the growth and multiplication of microorganisms therefore, controlling population growth. Hence the dried vegetables retain their nature and good qualities.

The dry food is rehydrated during the cooking process, e.g. some vegetables are pounded to powder form, while others are chopped into smaller pieces or pre-cooked in salty water, especially the older leaves and added to sauces such as groundnut sauce.

Explain the difference in the storage period and microbial growth between dried and fresh vegetables.

Expected results

- Dried vegetables are kept in airtight containers for preservation and sale.
- Vegetables are available whenever required, even in seasons of scarcity or poor growth.

- Develop an activity to continuously supply vegetables to the community to sustain improved health and economic gain.

Conclusion

Use of good methods of food preservation keeps food good and available even during the dry seasons. *How does preservation of these foodstuffs impact on the availability of food?* Relate the above activity to food preservation of cereals shown in ***Fig. 12.2a***.

Fig.12.2a: Packed seeds on the market.

Identify the ways that have been used to prevent microbial growth on food items on sale.

Evaluation

Visit a nearby market with food items similar to those in ***fig.12.2a*** on sale. Identify the problems of storage conditions that may promote food spoilage and contamination through microbial growth in the market visited.

Identify other methods that preserve food and recommend the methods suitable for different foodstuffs. Explain how these methods contribute to food security in a community.

Follow-up activity

Find out how food items are preserved in your community.

Carry out procedures to preserve other foods, e.g. cassava, meat, fish, potatoes, fruits, mushrooms, etc.

Prepare a dish using the preserved foods at home.

Carry out a survey on the factors influencing population changes in plants and animals, including humans, in Uganda.

12.4 Human and Natural Environments

Inquiry question: *Identify features of biotic factors in a nearby community by listing organisms which:*

- *you consider to be human food.*
- *cause diseases in you/people.*
- *compete with you/people for natural resources.*
- *provide shelter to you/people.*
- *are hosts of your /human parasites.*
- *pollinate flowers and carry out seed and fruit dispersal.*
- *are predators*
- *are organisms which protect you/people from predators.*

Background Information

The economic importance of human activities and natural resources in the environment exploits features of the environment, causing changes that occur in habitats and how other organisms interact with humans, e.g. in the form of energy flow, recycling of matter, and aspects of natural resource conservation.

Discuss the effects of abiotic and biotic ecological factors on ecosystems. Through a survey of your community, identify human activities that impact on natural resources e.g. on climate, water resources, soil and vegetation including food crops and recommend ways of reversing any negative effects.

List the habitats, communities and ecosystems in your region. Ask your teacher/parent to arrange a visit to a nearby forest, grassland or river/lake/pond/shore/well and note their characteristics in terms of biotic and abiotic features. Fill in the table below.

Area visited	*Biotic features*	*Abiotic features*

Show how the standards of living can be improved in areas visited by comparing the relationships between the biotic, abiotic and human activities in the areas visited.

You should be able to:

- *explain the role of human activities in natural resource sustainability.*
- *identify ways of using natural resources without causing environmental damage.*
- *show the human role in natural resource conservation and the prevention of pollution.*

Activity 12.4.1 Managing Agricultural Wastes

Aim

To remove farm residues and wastes.

What you need

Animal and crop organic wastes, a tank of about 500mls with a tap.

Note

Sort the residues into organic materials and inorganic materials.

What to do

- Set up a residue collection tank for organic materials only and a pit for inorganic materials
- Cover the organic tank tightly and turn off the tap. Leave to stand for 3-5 days depending on the volume of wastes placed in.
- After some time, manure is formed to be used to improve soil fertility and provide biogas (see activity 5.3.5).
- Meanwhile sell the inorganic materials in the pit to recycling industries.
- Ensure that the area surrounding the farm is free of residues and wastes.
- Work with community leaders and interest groups to manage the residues and wastes from farm animals and crops near your home or school.

Explanatory note

The farm residues and wastes may cause environmental pollution. They also cause a high risk of invasion by pests, vector and disease causing organisms to farm animals and crops.

To avoid biodegradation, and to eradicate pest and vector breeding areas or avoid attacks by diseases, humans should ensure that residue and waste management is appropriate.

Expected results

Demonstrate a suitable standard of managing farm residues and wastes in a farm area. Relate this activity to the biogas production to scale up the gas supply, while at the same time keeping the environment clean.

Conclusion

Propose farm area environment management standards set with the community leaders to promote health standards on farms and its surroundings.

Evaluation

- Relate the effects of agricultural residues and wastes to the health of organisms and the environment. Demonstrate suitable standards of waste management in your home and community.
- Visit a rubbish collection point near a farm and residential area. Study it and identify ways that may assist in the management of rubbish in this area.

Follow-up activity

Demonstrate the role of burnt organic materials such as salts or food softeners in homes.

Visit factories which collect organic wastes to reduce environmental pollution and degrade it into fuel (paraffin, petrol, etc.) in order to study the procedures OR supply the rubbish to the factories and study techniques used to extract fuels.

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