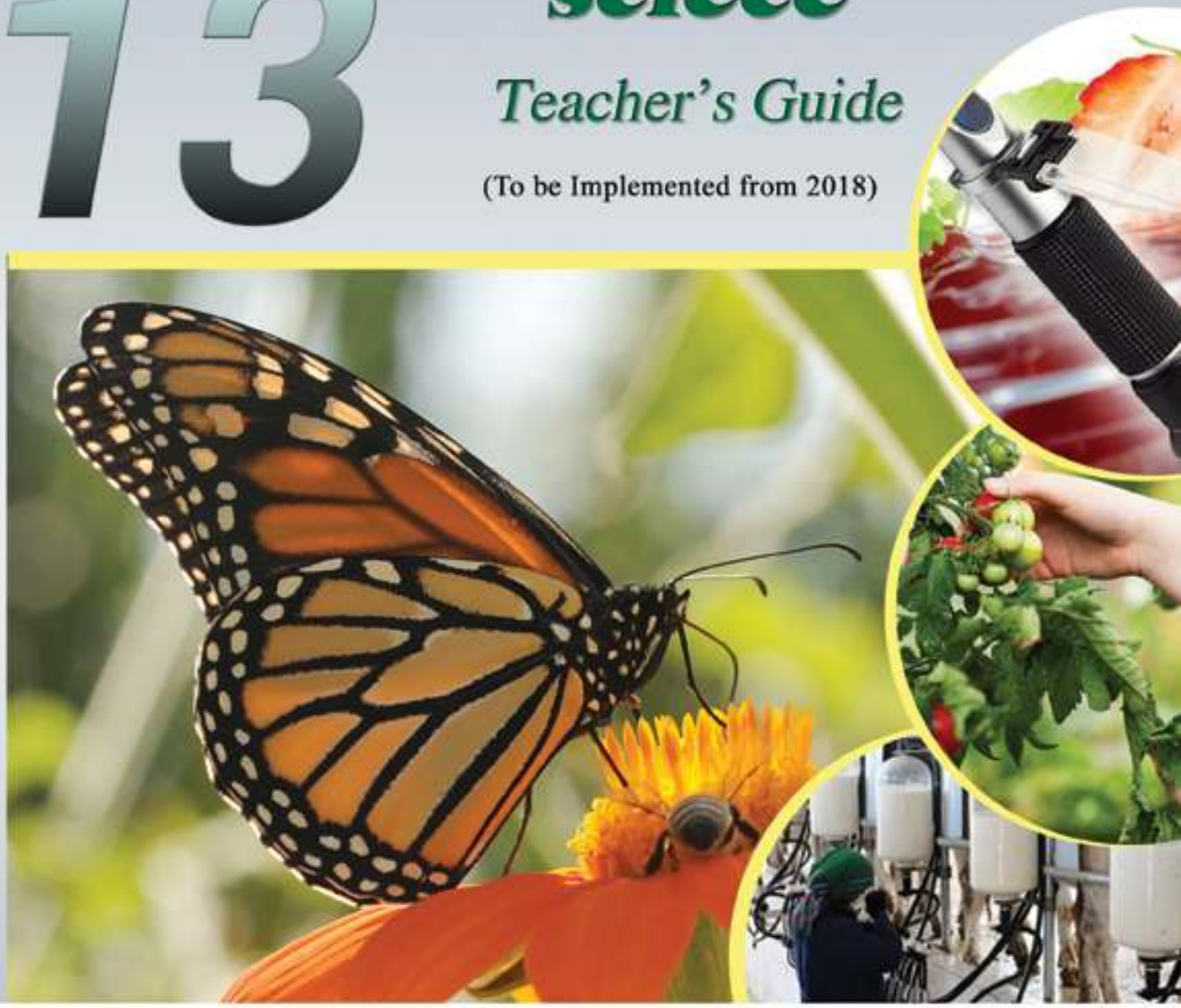
Grade 13

Agricultural sciece

Teacher's Guide

(To be Implemented from 2018)



Department of technical Education
Faculty of Science and Technology
NIE
Sri Lanka
www.nie.lk

General Certificate of Education (Advance Level)

Grade 13

Agricultural Science

Teachers' Guide

(To be implemented from 2018)

Department of Technology Education
Faculty of Science and Technology
National Institute of Education
Sri Lanka
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Agricultural Science

Grade 13
Teachers Guide

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Director General's Message

With the primary objective of realizing the National Educational Goals recommended by the National Education Commission, the then prevalent content based curriculum was modernized,and the first phase of the new competency based curriculum was introduced to the eight year curriculum cycle of the primary and secondary education in Sri Lanka in the year 2007.

The second phase of the curriculum cycle thus initiated was introduced to the education systemin the year 2015 as a result of a curriculum rationalization process based on research findings and various proposals made by stakeholders.

Within this rationalization process the concepts of vertical and horizontal integration have been employed in order to build up competencies of students, from foundation level to higher levels, and to avoid repetition of subject content in various subjects respectively and furthermore, to develop a curriculum that is implementable and student friendly.

The new Teachers' Guides have been introduced with the aim of providing the teachers with necessary guidance for planning lessons, engaging students effectively in the learning teaching process, and to make Teachers' Guides help teachers to be more effective within theclassroom. Further, the present Teachers' Guides have given the necessary freedom for the teachers to select quality inputs and activities in order to improve student competencies. Since the Teachers' Guides do not place greater emphasis on the subject content prescribed for the relevant grades, it is very much necessary to use these guides along with the textbooks compiled by the Educational Publications Department if, the Guides are to be made more effective.

The primary objective of this rationalized new curriculum, the new Teachers' Guides, and the new prescribed texts is to transform the student population into a human resource equiped with the skills and competencies required for the world of work, through embarking upon a pattern of education which is more student centered and activity based.

I wish to make use of this opportunity to thank and express my appreciation to the members of the Council and the Academic Affairs Board of the NIE, the resource persons who contributed to the compile these Teachers' Guides and other parties for their dedication in this matter.

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Instructions for the use of the Teacher's guide

With this Teacher's Guide prepared for grade-13 Agriculture,it has been endeavoured to provide proposed instruction to the teacher to prepare for the lesson before going to the classroom and build up the lesson in the classroom.

Accordingly, we expect that it may assist to build up the lesson in the classroom acquiring prior undrstanding about the learning aids, equipment and materials necessary for the lesson thereby helping to build up the lesson in the classroom.

However, instruction given here are just only a guide for the teacher and it is not expected for them to use it in the same way.The teachers with creative ability may present the lesson innovatively so as to build up the competencies mentioned in the curriculum ,in the students.As it is more suitable to build the lesson according to the teacher's creativity, experiences, students' potentials and facilities available in the school we would like to inform that the teacher has the absolute freedom to plan lessons.

Table of Content

1.0 Introduction

This Teacher's Guide has been prepared in relation to the Agriculture Science syllabus which will be implemented for the grade 12 from year 2017. Specially, when studying agricultural science as an applied and technical subject, it has face to the technological changes that take place day to day. Along with the advancement of science, new specimens come to be used very soon in place of the present breeds of animals, seed varieties, weedicides and insecticides etc. Accordingly, the teacher should use the things that are being daily used in place of examples and specimens provided in this Teacher's Instruction Manual.

The subject matter such as soil health, underground water, recharging, seed health, foods adulteration, ripening of fruits which had not been included before have been newly included in this syllabus in order to give the students the competencies on timely important subject matter.

When implementing the instructions given by this Teacher's Guide, an assessment should be made by the teacher to ensure whether the learning outcomes given for every competency level is achieved. In this approach, the teacher should prepare in advance, materials necessary for students' presentations in the form of quality inputs.

It is your responsibility to improve the practical skills of students by arranging a necessary background to carry out the practical exercise mentioned here. A teacher with qualifications mentioned in the syllabus should be deployed for the purpose of teaching AgriculturalScience. In the instances where a teacher with such qualifications is not available, a teacher with a Diploma in Agriculture can be involved for this purpose.

Even though it is not mentioned in the Teachers' Guide that how a particular competency is actualized, the teacher has the complete right to use any suitable methodology for the learning- teaching process. Similarly, it is my pleasure to inform you that your critical views regarding this publication may be useful for further development of the subject.

2.0 Common National Goals

The national system of education should assist individuals and groups to achieve major national goals that are relevant to the individual and society.

Over the years major education reports and documents in Sri Lanka have set goals that sought to meet individual and national needs. In the light of the weaknesses manifest in contemporary educational structures and processes, the National Education Commission has identified the following set of goals to be achieved through education within the conceptual framework of sustainable human development.

I. Nation building and the establishment of a Sri Lankan identity through the promotion of national cohesion, national integrity, national unity, harmony and peace, and recognizing cultural diversity in Sri Lanka's plural society within a concept of respect for human dignity.

II. Recognizing and conserving the best elements of the nation's heritage while responding to the challenges of a changing world.

III. Creating and supporting an environment imbued with the norms of social justice and a democratic way of life that promotes respect for human rights, awareness of duties and obligations, and a deep and abiding concern for one another.

IV. Promoting the mental and physical well-being of individuals and a sustainable life style based on respect for human values.

V. Developing creativity, initiative, critical thinking, responsibility, accountability and other positive elements of a well-integrated and balance personality.

VI. Human resource development by educating for productive work that enhances the quality of life of the individual and the nation and contributes to the economic development of Sri Lanka.

VII. Preparing individuals to adapt to and manage change, and to develop capacity to cope with complex and unforeseen situations in a rapidly changing world.

VIII. Fostering attitudes and skills that will contribute to securing an honourable place in the international community, based on justice, equality and mutual respect.

3.0 Common National Competencies

The following Basic Competencies developed through education will contribute to achieving the above National Goals.

(I) Competencies in Communication

Competencies in Communication are based on four subsets; Literacy, Numeracy, Graphics and IT proficiency.

Literacy	:	Listen attentively, speak clearly, read for meaning, write accurately and lucidly and communicate ideas effectively.
Numeracy	:	Use numbers for things, space and time, count, calculate and measure systematically.
Graphics	:	Make sense of line and form, express and record details, instructions and ideas with line form and colour.
IT proficienc	:	Computer literacy and the use of information and communication technologies (ICT) in learning, in the work environment and in personal life.

(II) Competencies relating to Personality Development

- Generic skills such as creativity, divergent thinking, initiative, decision making, problem solving, critical and analytical thinking, team work, inter-personal relations, discovering and exploring;
- Values such as integrity, tolerance and respect for human dignity;
- Emotional intelligence.

(III) Competencies relating to the Environment

These competencies relate to the environment: social, biological and physical.

Social Environment	:	Awareness of the national heritage, sensitivity and skills linked to being members of a plural society, concern for distributive justice, social relationships, personal conduct, general and legal conventions, rights, responsibilities, duties and obligations.

Biological Environment : Awareness, sensitivity and skills linked to the living world, people and the ecosystem, the trees, forests, seas, water, air and life- plant, animal and human life.

Physical Environment : Awareness, sensitivity and skills linked to space, energy, fuels, matter, materials and their links with human living, food, clothing, shelter, health, comfort, respiration, sleep, relaxation, rest, wastes and excretion.

Included here are skills in using tools and technologies for learning working and living.

(IV) Competencies relating to Preparation for the World of Work

Employment related skills to maximize their potential and to enhance their capacity

- To contribute to economic development,
- To discover their vocational interests and aptitudes,
- To choose a job that suits their abilities, and
- To engage in a rewarding and sustainable livelihood.

(V) Competencies relating to Religion and Ethics

Assimilating and internalizing values, so that individuals may function in a manner consistent with the ethical, moral and religious modes of conduct in everyday living, selecting that which is most appropriate.

(VI) Competencies in Play and the Use of Leisure

Pleasure, joy, emotions and such human experiences as expressed through aesthetics, literature, play, sports and athletics, leisure pursuits and other creative modes of living.

(VII) Competencies relating to "learning to learn"

Empowering individuals to learn independently and to be sensitive and successful in responding to and managing change through a transformative process, in a rapidly changing, complex and interdependent world.

Suggestions for a national policy framework for general education in Sri Lanka - National Education Commission (December, 2003)

4.0 Objectives of the syllabus

- To explore the potential for available resources sustainably in Agriculture.
- To identify and create entrepreneurship opportunities in Agriculture.
- To plan eco-friendly Agricultural activities.
- To identify and use new advancements of Agro technology.
- To adapt to the changes successfully which occur in locally and export oriented Agriculture.
- To develop the confidence needed to face challenging agricultural problems.
- To create desire to do a self-employment or an employment related to Agricultural field.
- To use the knowledge and skills of Agriculture for a healthy and environmentally sustainable life style.
- To develop enthusiasm on Agricultural activities for spending leisure time productively.
- To focus on the conservation of environment and bio-diversity in Sri Lanka.
- To explore for new technological and business opportunities in Agriculture.

5.0 Suggested number of periods for each competency

Competency	No. of periods
1. Plans the effective pest management practices to ensure successful crop production.	53
2. Plans quality food consumption patterns for the healthy life.	36
3. Innvestigates pre and postharvest techniques for the high quality harvest.	22
4. Plans methologies of animal husbandry to ensure high qualitative and quantitative yield.	69
5. Exhibits readinets to apply principles of economics to improve the productivity in agricultural enterprises.	42
6. Exhibits readiness to engage in the sustainable agriculture.	12
7. Investigates stratergies to minimize health problems and exhibits readiness of engage in sustainable agriculture.	07
8. Exhibits readiness to plan to overcome challenges faced in agriculture.	09
Total	250

Term	Competencies and competency levels for Grades 13
First Term	From first competency to third competency (21 competency levels)
Second Term	From forth competency to fifth competency (30 competency levels)
Third Term	From sixth competency to eighth competency (07 competency levels)

General Certificate of Education (A/L)

Grade 13

Agricultural Science

Syllabus

(To be implemented from 2018)

Department of Technical Education
Faculty of Science and Technology
National Institute of Education
Sri Lanka
www.nie.lk

Competency	Competency Level	Subject Content	Learning Outcomes	Duration
1. Plans to implement pest management practices for successful crop production	1.1 Investigates the effect of pests on crop production while classifying pests	• Pests • Introduction • Classification • Animal pests • Weeds • Pathogenic micro-organisms • Impact on crop cultivation	• Defines pests. • Classifies pests with examples. • Explains effects of pests on crop cultivation.	02
	1.2 Classifies animal pests and inquires into the damages caused by them.	• Animal pests • Invertebrates • Insects • Mouth parts • Biting and chewing • Punching and sucking • Rasping and sucking • Mites • Molluscus • Vertebrates • Birds • Rodents • Mammals • Damages done to crops	• Classifies animal pests with examples. • Identifies and labels typical mouth parts of insects. • Decides on the mouth parts based on the damages caused to crops. • States differences between insects and mites. • Indicates damages caused by animal pests with examples.	06
	1.3 Inquires about the pest insects that belong to different orders important in agriculture.	• Insect orders harmful to agriculture • Orthoptera • Isoptera • Hemiptera • Homoptera • Thysanoptera • Coleoptera • Diptera • Lepidoptera • Impact on crops	• Names different insect orders to which pests mostly attacking the crops belong. • Indicates characteristics of different insect orders using specimens. • Indicates how insects belonging to different orders damage crops. • Identifies insects belonging to various orders damaging crops and makes a collection of them.	06

Competency	Competency Level	Subject Content	Learning Outcomes	Duration

	1.4 Inquires into the types of weed found in agricultural fields.	• Weed
		  • Introduction
		  • Classification
		  • According to life span
		  • According to morphological features
		  • According to habitat
		• Impact on agricultural activities
		• Invasive species
		  • Introduction
		  • Adaptation for survival
		  • Impact on agricultural activities
			• Classifies weeds according to different criteria.
			• Describes special adaptations found in alien and invasive weeds.
			• Describes the influence of weeds in agriculture.
			• Prepares a collecction of weeds according to different criteria.
				04

	1.5 Classifies causative agents of plant diseases and inquires into diseases caused by them.	• Plant diseases
		  • Introduction
		• Casual agents
		  • Classification
		  • Bacteria
		  • Fungi
		  • Virus
		  • Phytoplasma
		  • Nematodes
		• Common plant diseases
		• Pathways of disease transmission
		  • by vectors
		  • by soil
		  • by water
		  • by air
		  • by equipment
		  • by planting materials
			• Classifies causative agents of plant diseases.
			• States examples for plant diseases caused by different causative agents.
			• States comon symptoms manifested due to different causative agents of diseases.
			• Identifies plant diseases by observing infected plant parts.
			• Identifies plant parasitic bacteria,fungi and nematodes.
				08

Competency	Competency Level	Subject Content	Learning Outcomes	Duration

	1.6 Plans to implement successful pest management by observing pest population levels.	• Pest population density
		  • Introduction
		  • Factors affecting
		  • Determination of pest population density
		• Pest population levels
		  • Economic Damage (ED)
		  • Economic Injury Level (EIL)
		  • Economic Threshold Level (ETL)
		  • Epidemic Level
			• Explains population density.
			• Describes factors affecting pest population density.
			• Determines the pest population density in the field.
			• Descripest population density levels using graphs.
				03

	1.7 Plans appropriate methods to manage pests.	• Pest management
		  • Introduction
		  • Principles
		  • Prevention
		  • Control
		• Pest management methods
		  • Mechanical and Physical
		  • Agronomic
		  • Biological
		  • Legislative
		  • Chemical
		• Integrated Pest Management (IPM)
		  • Introduction
		  • Importance
		  • Methodology
			• States principles of pest management.
			• Classifies pest management methods with examples.
			• Controls pests in the field by different methods.
			• Explains integrated pest management.
			• Desccribes the importance of integrated pest management.
			• Explains the process of integrated pest management.
				05

Competency	Competency Level	Subject Content	Learning Outcomes	Duration

	1.8 Inquires into suitable pesticides for pest control.	• Pesticides
		  • Introduction
		  • Classification
		  • Insecticides
		  • Classification
		  • According to the physical nature
		  • According to mode of action
		  • Based on chemical nature
		  • Organic
		  • Inorganic
		  • According to origin
		  • Natural
		  • Synthetic
		  • Weedicides
		  • Classification
		  • According to selectivity
		  • According to mode of action
		  • According to stage of application
		  • Fungicides
		  • Based on chemical nature
		  • Nematodicides
		• Toxicity of pesticides (LD 50)
		  • Introduction
		  • Toxicity levels
		• Problems that arise when using pesticides and minimizing these problems
			• Classifies pesticides under different criteria giving examples.
			• Defines the toxicity of pesticide.
			• States toxicity level according to the state of poison.
			• Describes problems related to the usage of pesticides and strategies that help to minimize those problems.
				08

Competency	Competency Level	Subject Content	Learning Outcomes	Duration
	1.9 Plans mathods of applying pesticide following safety practices.	• Application of pesticides • Methods of application • Foliar application • Mixing with soil • Baits • Injecting • Dipping and coating • Safety measures to be followed • Before application • During application • After application	• Describes pesticide applica tion methods with examples. • States safety measures that should be followed during pesticide application.	03
	1.10 Uses and maintains correctly the equipment used in pest control.	• Equipment used in pesticide application • Classification • Based on the nature of chemicals • Liquid chemical sprayers • Dust / granule sprayers • Fumigators • Based on the amount of liquid applying • High volume sprayers • Low volume sprayers • Micro volume sprayers • Based on the internal mode of action • Piston type • Centrifugal type • Operation and maintenance	• States the criteria relevant to the classification of equipments used in pesticide application. • Assembles the parts of liquid sprayers. • Draws and lebels the parts of liquid and dust sprayers. • Describes the action of a piston type sprayers. • Identifies problems in the equipment used in pesticide application and applies remedial measures.	08

Competency	Competency Level	Subject Content	Learning Outcomes	Duration
2. Plans quality food consumption practices for a healthy wellbeing.	2.1 Investigates constituents that should be included in food in order to reduce nutritional deficiencies.	• Human nutrition • Introduction • Nutrient constituents and their importance • Macro nutrients • Micro nutrients • Other important constituents • Water • Fiber • Food pyramid • Body Mass Index (BMI)	• Names nutrient constituents in a food. • Indicates the importance of various nutrient constituents in human nutrition. • States examples for micro and macro nutrients. • States the functions of non- nutrient constituents which are important in human nutrition. • Describes the manner of selecting suitable food for meals using the food pyramid. • Explains the way of mitigating nutritional complications through the Body Mass Index (BMI).	02
	2.2 Inquires into precautionary measures for nutritional problems.	• Nutritional problems in Sri Lanka and related remedial measures • Malnutrition • Under nourishment • Protein - calorie mal-nutrition • Vitamin & mineral deficiencies • Vitamin A • Iron • Iodine • Zinc • Over nutrition	• Explains problems associated with improper nutrition. • Names the major nutritional problems in Sri Lanka. • Suggests measure for the reduction of nutritional problems. • Selects food to minimize nutritional problems.	02

Competency	Competency Level	Subject Content	Learning Outcomes	Duration
	2.3 Investigates into the factors affecting food spoilage.	• Food spoilage • Introduction • Factors affecting • Physical • Biological • Chemical	• Names factors affecting food spoilage. • Describes how physical factors affect food spoilge. • Describes how biological factors bring about food spoilage. • Describes the way in which chemical factors affect food spoilage. • Identifies spoilt food.	03
	2.4 Plans ways for food preservation following preservation principles.	• Food preservation • Introduction • Importance • Principles • Inhibition • Inactivation • Methods • Physical methods • Low temperature • Refrigeration • Freezing • Thermal preservation • Sterilization • Pasteurization • Blanching • Dehydration • Concentration • Irradiation • Chemical methods • Smoking • Adding preservatives • Bio-chemical methods • Fermentation • combined methods	• States the importance of food preservation. • States the principles of food preservation. • Suggests preservation methods based on the food type. • Experiments on food preservation methods.	16

Competency	Competency Level	Subject Content	Learning Outcomes	Duration
	2.5 Inquires into new trends in food processing.	• New trends • Food diversification • Value addition • Enrichment • Fortification • Minimal processing	• Describes food diversification with examples. • Describes the value addition of foods and enrichment with examples. • Conducts minimum food processing. • Processes diversified food suitable for domestic consumption.	07
	2.6 Inquires into the food standards that control food quality.	• Food hygiene and quality control • Importance • Standards • System standards • Goods standards	• Explains the importance of maintaining food safety. • Describes the importance of quality control in food. • Presents information on important standards in the food industry.	02
	2.7 Plans appropriate methods for food packaging and labelling.	• Food packaging • Introduction • Importance • Materials used • Food labelling • Introduction • Importance • Factors to be considered	• Defines food packaging . • States the importance of food packaging. • Names the materials used for food packaging. • Selects packaging materials suitable for particular food types. • Describes the importance of food labelling. • Designs a suitable lable for a food item.	04

Competency	Competency Level	Subject Content	Learning Outcomes	Duration

3. Investigates post harvest techniques for a high yield.	3.1 Investigates into information regarding maturity of crop yields.	• Maturity of crop harvest
		  • Introduction
		  • Factors determined
		  • Physical
		  • Chemical
		  • Time
		• Maturity index
		  • Introduction
		  • Methods of determining
		  • Visual inspection
		  • According to calendar dates
		  • By measuring acidity
			• Explains the maturity of crop yields and its importance.
			• Describes factors that determine the maturity of crop yields.
			• Defines the crop maturity index.
			• Indicates the methods to determine maturity index
			• Determines the time of harvesting using the maturity index.
				06

	3.2 Investigates facts about the process of fruit ripening.	• Ripening of fruits
		  • Introduction
		• Classification of fruits according to ripening process
		  • Climacteric
		  • Non - climacteric
		• Artificial ripening
		  • Importance
		  • Ripening agents
		  • Methods
		  • Traditional
		  • Modern
			• Introduces the fruit ripening process.
			• Categorizes fruits based on the ripening process.
			• Explains the importance of artificial fruit ripening.
			• Explains the fruit ripening methods.
			• Experiments on ripening fruits safely.
				06

Competency	Competency Level	Subject Content	Learning Outcomes	Duration

	3.3 Inquires into causes of post harvest losses.	• Post harvest losses
		  • Introduction
		  • Different instances of post harvest losses
		  • Harvesting
		  • Collecting
		  • Cleaning
		  • Grading
		  • Storage
		  • Transporting
		  • Packaging
		  • Marketing
		• Reasons
		  • Pre-harvesting factors
		  • Physiological/ Bioligical
		  • Ethylene production
		  • Growth and Development
		  • Transpiration
		  • Environmental factors
		  • Temperature
		  • Relative humidity
		  • Composition of air
		  • Physical factors
		  • Injuries
		• Problems arising
			• Classifies the crop harvests based on preservation .
			• Describes instances of post harvest losses .
			• Explaing how the nature of the crops is important for preserving crops.
			• Describes the pre harvest factors that cause post harvest losses.
			• Decribes reasons for post harvest losses.
			• Describes the problems that arise due to post harvest losses.
				06

Competency	Competency Level	Subject Content	Learning Outcomes	Duration

	3.4 Identify instances of post harvest losses and plans to reduce them.	• Post harvest technology
		  • Introduction
		  • Importance
		• Minimising post harvest losses
		  • Instances
		  • Harvesting
		  • Collecting
		  • Cleaning
		  • Grading
		  • Storage
		  • Transporting
		  • Packaging
		  • Marketing
			• Defines post harvest technology.
			• Describes the importance of post harvest technology.
			• Explains the ways to reduce harvest lossses in each stage.
			• Attempts to minimize post harvest losses.
				04

4. Contemplates methods to obtain high quality in higher quantities products form farm animals.	4.1 Inquires into problems and potentials of developing animal husbandry Sri Lanka.	• Farm animals
		  • Introduction
		  • Importance
		  • Potential for the development
		• Zones of animal husbandry
		  • Classification
		  • Importance
			• Explains the importance of animal husbandry.
			• Marks in a map of Sri Lanka zones where farm animals are being reared .
			• Explains problems and potentials for animal husbandry in Sri Lanka.
				02

	4.2 Inquires into the ways to minimize unfavourable effects of weather conditions in animal husbandry.	• Impact of adverse climatic factors
		  • Temperature
		  • Temperature zones
		  • Rainfall
		  • Wind
		• Minimisation of adverse impact
			• Describes the impact of climatic conditions on the livestock production.
			• Explains the temperature zones that are importance in animal husbandry using a diagram .
			• Analyses the reactions and adaptations of animals for the harmful climatic conditions.
			• States the ways to reduce harmful impacts while increasing and improving livestock production.
				02

Competency	Competency Level	Subject Content	Learning Outcomes	Duration
	4.3 States the importance of various components in food in animal nutrition.	• Animal nutrition • Importance • Main feed components and their importance • Protein • Carbohydrates • Lipid • Vitamins • Minerals • Other constituents • Water • Additives	• States the importance of animal nutrition. • States nutrients contained in animal foods. • Describes the importance of each nutrient.	02
	4.4 Investigates animal feeds.	• Farm animal feed • Introductions • Classification • Roughage • Wet • Dry • Concentrates • Plant based • Animal based	• Categorizes animal feeds with examples . • Compares the differences between roughages and concentrates. • States the feature of roughages and concentrates.	02
	4.5 Inquires into pasture conservation methods for the nourishment of farm animals.	• Roughage conservation • Introduction • Importance • Methods • Hay production • Silage production	• States the importance of pasture conservation. • Describes the hay and silage processing principles. • Experiments on pasture conservation methods.	03

Competency	Competency Level	Subject Content	Learning Outcomes	Duration

	4.6 Describes the structure and functioning of the digestive system of farm animals.	• Digestive system
		  • Introduction
		  • Structure and physiology
		  • Ruminant
		  • Non-ruminant
			• Draws and names the parts of the digestive systems of a cow and a poultry.
			• Explains the structure of the digestive systems of a cow and poultry through the diagrams.
			• Explain the action of the digestive system of a cow and poultry
				06

	4.7 Plans rearing systems of cattle while selecting suitable cattle breeds.	• Cattle breeds
		  • External features
		  • Suitable breeds for different agro-eco logical zones.
		  • Cattle rearing methods
		  • Extensive
		  • Semi-intensive
		  • Intensive
		• Cattle sheds
		  • Importance
		  • Types
			• Compares physical features of various cattle breeds.
			• Selects suitable cattle breeds for animal husbandry zones in Sri Lanka.
			• Describes rearing systems of cattle.
			• Describe the type of cattle houses.
			• Explains the importance of cattle houses.
				04

	4.8 Exhibits the readiness to follow the appropriate practices of handling calves.	• Management practices of calves
		  • Growth stages and husbandry practices.
		  • Until first two weeks
		  • Until weaning
		  • Special management practices
			• Explains the importance of calf rearing.
			• Distinguishes the growth stages of calves.
			• Explains rearing systems fol lowed for infant calves after birth.
			• Describes the weaning process.
			• Decribes special rearing systems followed for calves.
				03

Competency	Competency Level	Subject Content	Learning Outcomes	Duration
	4.9 Investigates the ways to impregnate dairy cattle successfully.	• The reproductive system of a cow • Structure • Function • Heat cycle • Introduction • Stages • Affecting hormones • Getting a cow pregnant • Insemination	• Draws the structure of the reproductive system of a cow and names its parts. • Describes the structure of a cow's reproductive system and it's functioning. • Describes the oestrous cycle. • States the hormones that affect the oestrous cycle. • Lists the heat signs of cows. • Describes the method of impregnating cows.	04
	4.10 Inquires into the rearing methods of pregnant cows.	• Management practices of pregnant cows • Feeding • Paturition of a cow.	• Describes the manner of providing food for pregnant cows. • Lists parturition symptoms of pregnant cows. • Describes how cow and the place are prepared for parturition.	02
	4.11 Inquires into methods for improving animals to increase production.	• Breeding of farm animals • Introduction • Importance • Methods • Natural • Controlled • Selection • Inbreeding • Cross breeding	• States the importance of livestock breeding. • Describes methods of livestock breeding.	04

Competency	Competency Level	Subject Content	Learning Outcomes	Duration
	4.12 Plans conditions required to maintain the quality of milk.	• Milk • Introduction • Gross composition • Factors affecting on the composition of milk	• Describes composition of milk. • States the factors affecting the composition of milk.	02
	4.13 Examines the structure and functioning of the mammary system of a dairy cow.	• Mammary system of a cow • Introduction • Structure • Function • Secretion • Milk let down • Factors affecting on milk yield	• Describes the mammary system of a cow using a diagram. • Explains the functioning of the mammary system of a cow. • Explains the processes of milk secretion and milk let down. • Analyses factors affecting the milk harvest.	04
	4.14 Inquires into how quality milk is obtained from cows.	• Hygienic milking • Importance • Procedure • Methods • By hands • By machines • Production of quality milk • Introduction • Importance • Identification	• States the importance of safe milking. • Describes the method followed in safe milking. • Describes causes for the deterioration in milk quality. • Selects quality milk by following various techniques.	05

Competency	Competency Level	Subject Content	Learning Outcomes	Duration
	4.15 Identifies various cattle diseases and plans measures to control them.	• Farm animal diseases • Introduction • Importance • Cattle diseases • Classification • Iinfectious diseases • Bacterial diseases • Mastitis • Hemorrhagic septicemia • Brucellosis • Viral diseases • Foot and mouth disease • Protozoa diseases • Tick fever • Non infectious diseases • Milk fever • Bloating • Animal health management	• Classifies cattle diseases. • Presents information about major cattle diseases. • Identifies cattle diseases according to symptoms. • Describes steps that should be taken to manage cattle diseases. • Describes non-communicable diseases contracted by cattle. • States the importance of animal health management.	04
	4.16 Inquires into poultry rearing systems and houses.	• Poultry management • Breeds and hybrids • Rearing methods • Extensive • Semi intensive • Intensive • Super intensive	• States suitable poultry breeds for rearing. • Describes poultry rearing systems. • Presents information about poultry houses.	05

Competency	Competency Level	Subject Content	Learning Outcomes	Duration
	4.17 Inquires into suitable chick management methods.	• Rearing of chicks • Management of day-old chicks • Brooding • Natural method • Artificial method • Immunization schedule	• Describes the method of day old chick- brooding. • Describes the method of chick management.	02
	4.18 Inquires into suitable management methods for growing hens.	• Grower management • Providing shelters • Providing feed and water • Other management practices	• Defines growing hens. • Describes the ways of providing food for the animals. • Indicates the ways of culling and beak trimming.	02
	4.19 Plans management methods for layers.	• Management of layers • Providing shelters • Providing water and feed • Other management practices • Light control	• Lists the features of a hen laying a large number of eggs. • Explains the manner of pre paring houses for layers. • Describes the method of providing food for layers. • Explains the method of managing environmental factors according to the layers' requirements.	02

Competency	Competency Level	Subject Content	Learning Outcomes	Duration
	4.20 Inquires into the quality of eggs and incubation.	• Eggs • Structure • Gross composition and nutritional value • Determination of the quality of eggs • External • Internal • Hatching • Introduction • Methods • Natural • Artificial	• Describes the structure of an egg using a diagram. • States the composition and the nutritional value of an egg. • Describes egg incubation methods. • Determines the quality of eggs.	04
	4.21 Exhibits preparedness for the rearing broilers.	• Broiler management • Types of shelters • Provision of feed and water • Other management practices	• States suitable types of houses for rearing broilers. • Examines the ways of providing food and water for broilers. • Describes provision of light and temperature for broilers and prevention of their diseases.	02
	4.22 Plans methods for poultry disease management.	• Poultry diseases • Bacterial diseases • Salmonellosis • Viral diseases • Raniket • Gambora • Bird flue • Protozoa • Coccidiosis • Management of diseases	• Presents information about major poultry diseases. • Identifies poultry diseass according to the symptoms. • Describes measures that should be implemented for poultry disease management.	04

Competency	Competency Level	Subject Content	Learning Outcomes	Duration

5. Exhibits readiness for using economic principles to increase the productivity of agricultural businesses.	5.1 Inquires into proper management of the factors of production.	• Agricultural economics
		  • Introduction
		  • Importance
		  • Factors of production
		  • Land
		  • Labour
		  • Capital
		  • Entrepreneurship
			• Defines agricultural economics.
			• Identifies factors of production and states their special features.
			• Describes the way of managing factors of production efficiently in the production process.
				03

	5.2 Makes decisions based on the nature of demand in agricultural businesses	• Utility
		  • Introduction
		• Consumer demand
		  • Introduction
		  • Theory of demand
		  • Demand table
		  • Demand curves
		  • Factors affecting on demand
		  • Shifting of demand curves
		• Nature of demand for agricultural products and services
			• Defines utility.
			• Defines consumer demand.
			• Names factors affecting demand.
			• Explains the relationship between the price and demand of a good.
			• Draws the demand curve according to the determinants of demand.
			• Explains the nature of demand for agricultural goods.
				06

Competency	Competency Level	Subject Content	Learning Outcomes	Duration
	5.3 Plans to make decisions based on the nature of supply in agricultural businesses.	• Market supply • Introduction • Theory of supply • Supply table • Supply curves • Factors affecting supply • Shifting of supply curves • Nature of supply for agricultural goods	• Defines market supply. • Names factors affecting the supply of a product. • Explains the relationship be tween the supply and the price of a product. • Draws supply curves according to the supply schedule. • States reasons for shifts of the supply cure. • Illustrates the shift of supply curves according to the determinants of supply. • Describes the nature of the supply of agricultural products.	06
	5.4 Contemplates to make decisions in agricultural businesses while inquiring into market conditions.	• Determination of the price based on the demand and supply • Market equilibrium • Nature of agricultural market • Factors affecting the market equilibrium • State intervention • Subsidies • Taxes • Price controls • Structure of market • Perfectly competition • Monopoly • Oligopoly	• Defines market equilibrium. • States the features of a market in equilibrium. • Describes the way the market equilibrium changes according to factors such as subsidies, Taxes and price ceiling. • Categorizes market structures according to different features.	06

Competency	Competency Level	Subject Content	Learning Outcomes	Duration

	5.5 Exhibits the preparation to reduce the cost in agricultural businesses.	• Types of cost of production
		  • Fixed cost
		  • Variable cost
		  • Total cost
		  • Average cost
		  • Marginal cost
			• Defines production cost.
			• Draws cost curves.
			• States the least production cost through cost curves.
				04

	5.6 Examines how to engage in production to maximize profits in agricultural activities.	• Production relationships of the agricultural goods
		  • Factor - Product relationship
		  • production curves
		  • Total production
		  • Average production
		  • Marginal production
		  • Production zones
		  • Factor - Factor relationship
		  • Isoquant curve
		  • Product - Product relationship
		  • Production possibility curve
			• Calculates average production and marginal production in factor-product relationship.
			• Indicates the efficient production zone using product curves.
			• Illustrates the efficient factor combinations through equal product curves.
			• Illustrates efficient output combinations through a production possibilities curve.
				08

	5.7 Inquires into employment opportunities for a small scale agricultural business	• Opportunities for Agribusiness
		  • Business enviornment
		  • Business ethics
		  • Preparing a business plan for an agri business
		  • Importance
		  • Components of a business plan
		  • Preparing agri business plan
		  • Organization
		  • Direction
		  • Control
			• Explains the business environment of small scale agricultural businesses.
			• Lists required resources for maintaining a business productively.
			• Describes external and innernal ethics related to businesses.
			• Prepares a business plan for a business.
				04

Competency	Competency Level	Subject Content	Learning Outcomes	Duration
	5.8 Inquires into the contribution of the value chain analysis for planning and assessment of the agricultural production process.	• Value chain analysis • Introduction • Importance • Organisation structure • Actor chain • Activity chain • Marketing • Supportive services • Assessing the efficiency of stage in value chain analysis	• Defines the value chain and supply chain and explain their difference. • Explains the organizational structure, activities, workers, support services and functions of the value chain process through examples. • Describes the steps of the agricultural production marketing process. • Defines the value chain analysis process and explains its importance, advantages and evaluation of its efficient steps. • Explains how the effectiveness of the agricultural economic process affects the value chain analysis process.	05
6. Exhibits the readiness for engaging in sustainable agriculture.	6.1 Inquires into the need and aims of sustainable agriculture.	• Sustainable agriculture • Introduction • Necessity • Objectives • Features • Environmental principles • Process • Benefits	• Defines sustainability and sustainable agriculture. • Describes the need of sustainable agriculture and its main objectives. • Describes the features of sustainable agriculture. • Explains the environmental principles crucial for sustainable agriculture. • Describes the advantages of sustainable agriculture.	04

Competency	Competency Level	Subject Content	Learning Outcomes	Duration
	6.2 Inquires into the methods for engaging in sustainable agriculture with optimum resource management.	• Sustainable resources management • Introduction • Resources • Methodologies • Cropping systems • Rainfed cultivation • Conservative agriculture • Kandyan forest garden • Agroforestry • Organic farming • Bio-dynamic farming • Integrated farming • Cropping patterns • Multiple cropping • Mix cropping • Inter cropping • Relay cropping • Crop rotation	• Defines sustainable resource management. • Describes environment-friendly farming techniques through diagrams. • States advantages and disavantages of each farming technique. • Describes the contribution of various farming techniques for sustainability in agriculture. • Illustrates environment-friendly cultivation patterns using diagrams. • Lists advantages and disadvantages of each crop pattern. • Describes the contribution of diverse cropping patterns for sustainable agriculture.	08

Competency	Competency Level	Subject Content	Learning Outcomes	Duration

7. Identifying hazards and health problems that would occur in agriculture and inquiring of action that would be taken to minimize them.	7.1 Inquires hazards.	• Hazards
		  • Physical
		  • Dehydration
		  • Noices and vibrations
		  • Dust
		  • Accidents
		  • Due to agricultural equipment
		  • Serpant bite
		  • Insect bite
		  • Poison ingestion
		  • Agro chemicals
		• Minimisation of hazzards
			• Describes physical hazards that occur in agriculture.
			• Identifies accidents that could occur in agriculture.
			• Suggests plans to reduce agricultural hazards.
				03

	7.2 Investigates physical and mental problems that occur in agriculture.	• Health problems
		  • Zoonotic diseases
		  • Brucellosis
		  • Tuberculosis
		  • Leptospirosis
		  • Mental problems
		  • Stress
		  • Undesirable environmental conditions
		  • Legal problems
		  • Financial problems
		• Minimizing health problems
			• Collects information about zoonotic diseases that occur when engaging in agriculture.
			• Describes mental problems that arise in engaging in agriculture.
			• Describes measures that could be followed to mitigate health problems that arise when engaging in agriculture.
				04

Competency	Competency Level	Subject Content	Learning Outcomes	Duration
8. Exhibits the preparation for contemplating required measures to conquer challenges faced in agriculture.	8.1 Prepares measures to mitigate the effects on agriculture caused by climate change.	• Climate change • Introduction • Reasons for occurance • Impact on Agriculture • Temperature fluctuation • Rainfall fluctuation • Mitigation the impact	• Explains reasons for climate changes . • Describes the impact of climate changes on the agricultural sector. • Suggests methods to mitigate the effects caused by climate changes.	05
	8.2 Contemplates measures to protect pollinators in agriculture.	• Pollinating agents • Introduction • Importance • Reasons for shortage • Ways to protect pollinating agents	• Describes the importance of pollinators in agriculture. • Describes the reasons for the scarcity of pollinators. • Suggests techniques that could be used to protect pollinators.	02
	8.3 Contemplates to evade challenges related to the technology used in agriculture.	• Technology related challenges • Introduction • Seed monopoly • Genetically modofied food • Shortage of resources • Minimisation of negative impact	• Describes challenges related to technology in agriculture. • Suggests measures to mitigate the impact of challenges related to technology.	02

Competency 1 : Plans to implement pest management practices for successful crop production.

Competency level 1.1: Investigates the effect of pests on crop production while classifying pests.

Number of periods : 02

Learning outcomes :
- Defines a pest.
- Classifies pests with examples.
- Explains effects of pests on crop cultivation.

Instructions for planning the lesson :

- Start the lesson by presenting a few pest-damaged crops to the class or by any other suitable approach.
- Assist students to define "pests".
  - Any organism or a group of orgamisms which economically damages a human being, an animal reared by a human being, a crop cultivation, and stored product or any other asset is defined as a pest.
- Inquire students for examples of pests found in agricultural lands.
- Using that, guide students to classify pests found in agricultural lands into the following groups:
  - Animal pest
  - Weeds
  - Pathogenic micro-organisms
- Lead a discussion about the damages caused by pests on crop cultivation.
  Ex:
  - Acting as vectors of diseases
  - Damaging stored materials and reducing quality
- Direct students to build up an introduction for a weed.
  - Plants which hinder the existence of a crop by competing with it for plant nutrients, water, space and light are referred to as weeds.
  - Any plant which grows in an unwanted place is called a weed.
  - A plant which apparently has to be removed at any time from the field is called a weed.
- Lead students to gather information about adverse impacts of weeds on crop cultivation.
  Ex:
  - Decrease in the harvest due to suppression in growth because of the competition for light, space and nutrients
  - Reduction in the yield quality
- Let the students list the damages caused by pathogenic micro-organisms.
  Ex :
  - Causing diseases in crops
  - Disturbing physiological processes of plants
- Discuss reasons for pest attacks.
  Ex :
  - Denying organisms which bring about natural equlibrium their habitats due to removal of natural plant cover for agricultural purposes
  - Death of natural enemies in the field due to reduction in biodiversity
  - Cultivation of monocrop or only few crops in an agricultural land
  - Cultivating the same crop repeatedly
  - Distancing from cultivating traditional crops

Key words :

- Pests

Quality inputs:

- Different crop parts damaged by pests and videos showing the effects of pests on crops.

Instructions for assessment and evaluation :

Draw attention to the following facts:

- Introducing pests
- Classifying pests
- Describing the effects of pests on crop cultivation

Competancy level 1.2 : Classifies animal pests and inquires into the damages caused by them.

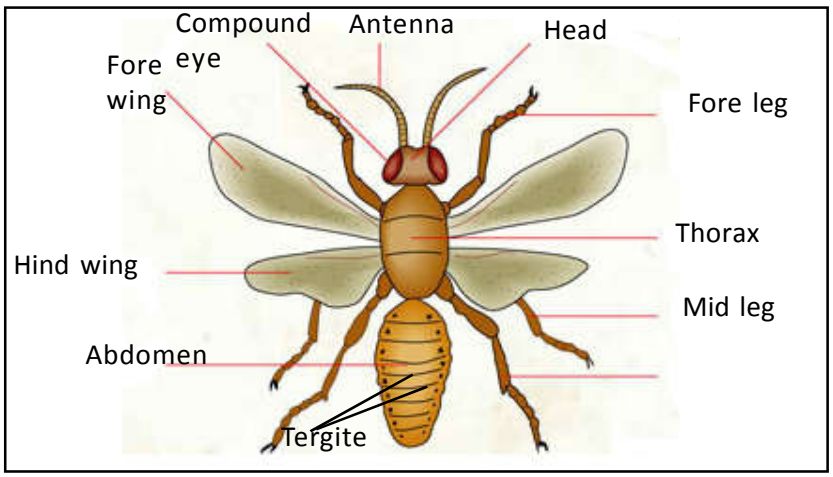
Number of periods : 06

Learning outcomes :
- Classifies animal pests with examples.
- Identifies and labels typical mouth parts of insects.
- Decides on the mouth parts based on the damages caused in crops.
- States differences between insects and mites.
- Indicates damages caused by animal pests with examples.

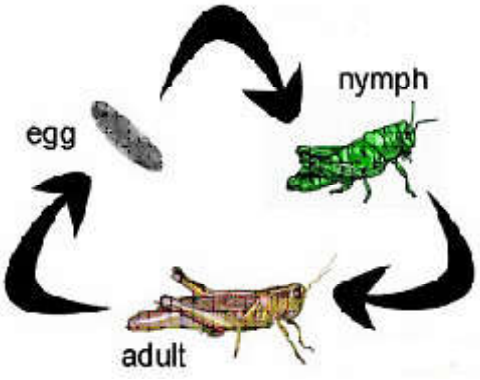
Instructions for planning the lesson :

- Present a list of animal pests to the class and get the comments on that from the students.
- Guide the students to divide those pests into two groups, vertebrates and invertebrates.
- Ask students to classify invertebrates further based on their external characteristics.
  - Insects
  - Mites
  - Mollusks
- Discuss the common characteristics found in insects.

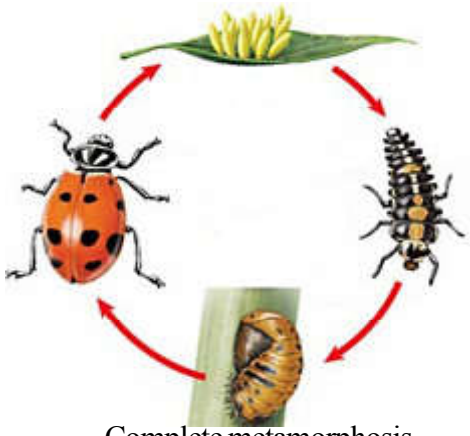
  Ex :
  - Metamorphosis
  - Body composed of three parts
  - Mouth parts with mandibles



- Discuss different metamorphosis types of insects with examples.
  - Incomplete metamorphosis
  - Complete metamorphosis



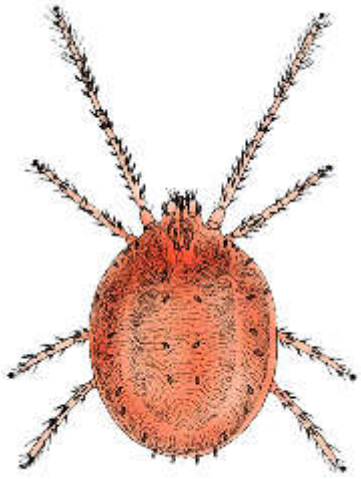
Incomplete metamorphosis



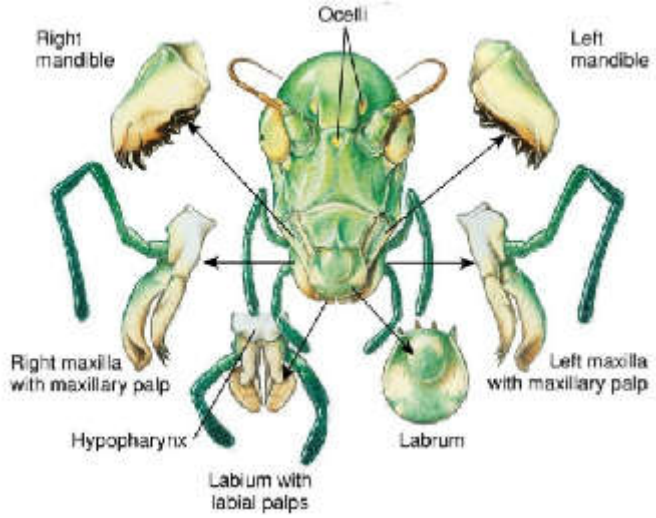
Complete metamorphosis

- Help the students to identify differences between insects and mites by external features.

Insects	Mites
Similarities	
1. Exoskeleton present	Exoskeleton present
2. Jointed appendages	Jointed appendages
3. Moulting occurs	Moulting occurs
Differences	
1. Body consists of three parts (head, thorax, abdomen)	Body consists of two parts (cephalothorax, abdomen)
2. Three pairs of legs	Four pairs of legs
3. Mouth parts with mandibles	Mandibles absent(mouth parts contain glossa , paraglossa)
4. Most of them have wings.	Do not have wings
5. Antenne present	Antanne absent



- Present the typical insect mouth parts using either a diagrame or a video clip.



- Give students an oppotunity to identify and name the mouth parts of an insect by observing prepared slides through the microscope.
- Guide students to list out functions of each mouth part.
  Ex : • Mandibles - chewing and biting of food
  • Maxillae - grabing food
- Confirm through discussion that different mouth parts have modified into different structures.
  Ex: Mandibles modified into stylets
- Emphasize that nature of the pest damage changes according to the nature of the mouth parts.
- Accordingly insect pests can be grouped as follows.
  - Biting and chewing type
  - Piercing and sucking type
  - Rasping and sucking type
- Give an oppotunity to the students to identify and name these three type of mouth parts using diagrams.
- Provide to students true specimens of plants damaged by bitting and chewing mouth parts and let them list the nature of damages.
  Ex : • Eating or cutting leaves
  • Eating flowers and fruits
  • Boring the stem and eating inner parts
  • Eating shoots and seedlings
- Provide to students true specimens of plants , damaged by piercing and sucking mouth parts and let them list the nature of the damage.
  Ex: • Edge of the leaf rolling downward
  • Black or brown spots on fruits
  • Sooty mould fungi growing on the dorsal side of the leaf
- Provide students with true specimens of plants, damaged by rasping and sucking mouthparts and let them list the nature of the damage.
  Ex: • Rasping only the leaf surface
- Discuss the adverse effects caused by insects pests.
  Ex : • Loss of photosynthetic area due to eating or cutting leaves
  • Acting as vectors of diseases
- Instruct students to explore relevant information and complete the following table.

Type of mouth parts	Examples for the pest	Crops damaged and the nature of the damageand

- Give instructions to students to gather information about non insect animal pests and to fill the following table.

Non insect animal pest	Examples	Crops damaged and the nature of the damage
Vertebrates		
Invertebrates		

Key words :

- Vertebrates
- Invertebrates
- Mouth parts of insects

Quality inputs :

- Slides of insect mouth parts
- Videos related to pests and pest damages

Instructions for evaluation and assessing:

Pay attention to the following facts.

- Identifying typical mouth parts of insects
- Determining the mouth part type based on the damage to the crop
- Explaining differences bettween mites and insects
- Explaining damages caused to the crops by animal pests

Competency level 1.3 : Inquires about the pest insects that belong to different orders important in agriculture

Number of periods : 06

Learning outcomes :
- Names different insect orders to which pests mostly attacking the crops belong.
- Indicates characteristics of different insect orders using specimens.
- Indicates how insects belonging to different orders damage crops.
- Identifies insects belonging to various orders damaging crops and makes a collection of them.

Instructions for planning the lesson :

- Present the class, a collection of insects belonging to diffrent orders.
- Give students an opportunity to identify those insects using previous knowledge. Introduce the lesson showing that those insects belong to different orders.
  - Orthoptera
  - Isoptera
  - Hemiptera
  - Homoptera
  - Thysanoptera
  - Coleoptera
  - Diptera
  - Lepidoptera
- Lead a discussion about characteristics of insects belonging to various orders using videos, true specimens, and diagrams.
  - Orthoptera - Pair of fore wings thikened uniformely to form tegmina
  - Isoptera - Absence of wings; live in colonies.
  - Hemiptera - 2/3 of the fore wing is leathery while the tip is membraneous
  - Homoptera - Fore wings uniformly thickned
  - Thysanoptera - Front and hind wings slender, rod like, with dense fringes of long hairs.
  - Coleoptera - Front wings are hard (elytra) and serve as covers for the hind wings.
  - Diptera - Hind wings reduced and modified into halteres.
  - Lepidoptera - Wings are coloured and covered with scales.
- Guide students to identify insects belonging to different orders.
- Guide students to prepare a collection of insects by identifying insects of different orders seen in crop fields.
- Give instructions to complete the following table by exploring relevant information.

Insect order	Meta-mormophosis type	Type of mouth parts	Examples	Crops damaged and nature of the damage

Key Words :

- Insect orders
- Metamorphosis

Qualitative inputs :

- A collection of specimens of insects belonging to different insect orders (insect box)
- Videos, true specimens and diagrams that idicate different insect orders

Instructions for the lesson preparation :

Pay attention to the following facts :

- Naming main insect orders which damage crop cultivations.
- Stating characteristics of different insect orders.
- Naming different insect species belonging to different insect orders.
- Explaining crop damages caused by different insect orders.
- Preparing an insect collection.

Competency level 1.4: Inquires into the types of weeds found in agricultural fields.

Number of periods : 04

Learning outcomes :
- Classifies weeds according to different criteria.
- Describes special adaptations found in alien and invasive weeds.
- Describes the influence of weeds in agriculture.
- Prepares a collecction of weeds according to different criteria.

Instructions for planning the lesson:

- Show weed specimens plucked from the garden to the class and start the lesson asking about their features.
- Show that weeds can be classified according to various criteria.
  - According to the life span
  - According to the habitat
  - According to the morphological features
- Discuss how to classify weeds according to their length of the life span with examples.
  - Annual weeds - Weeds which complete vegetative and reproductive growth within one year or even less than one year
    Ex: Monarakudumbiya (*Vernonia cinerea*), Kuppameniya (*Acalipha indica*), Kadupahara (*Emilia sonchifolia*), Girapala (*Commelina benghalensis*)
  - Perennial weeds - Takes more than one year to complete the life cycle
    Ex : Gandapana (*Lantana camara*), Kalanduru (*Cyperus rotundus*)
- Discuss how to classify weeds according to their habitats with examples.
  - Terrestrial - Ex: Kuppameniya, Monarakudumbiya
  - Semi aquatic- Ex: Walkarabu, Bajiri, Thunessa, Thunhiriya, Maruk, Kokmota
  - Aquatic- Ex: Salvina, Hydrilla, Japanjabara
- Discuss how to classify weeds according to their morphological features with examples.
  - Broad leaves- Ex: Pitawakka, Diyasiyambala
  - Grasses- Ex: Plants that belong to family Poaceae
  - Sedges - Ex: Plants that belong to family Cyperaceae
- Introduce alien and invasive plants to students and assist them to give examples.
  - An alien invasive plant is a one which has its origin in an ecosystem of a certain country and settles in a similar ecosystem of another country causing damage to it.
- Give students an oppotunity to present reasons for spreading invasive plants in this country.
  Ex :
  - Using as ornamental plants
  - Using in agriculture work and foresty
  - Through the tourists
  - By attaching and being carried

- Discuss adaptations made by alien and invasive plants for their survival.
  Ex :
  - Ability to perrenate
  - Producing large number of seeds at a time
  - Having efficient seed dispersion methods
  - Ability to withstand unfavorable conditions and resisting diseases and pests
- Direct students to find information about adverse impacts due to alien and invasive plants under the following topics.
  Ex :
  - Agricultural impact
  - Environmental impact
  - Economical impact
- Guide students to make a collection of weeds composed of different group of weeds classified according to different criteria.

Key words :

- Weeds
- Classification of weeds
- Invasive weeds

Qualitative inputs :

- Video clips related to weeds
- True speciments of weeds

Instructions for assessment and evaluation:

Pay attention to the following facts:

- Defining weeds
- Classifying weeds based on different criteria
- Introducing alien and invasive weeds
- Describing characteristics of alien and invasive weeds
- Making a collection of weeds

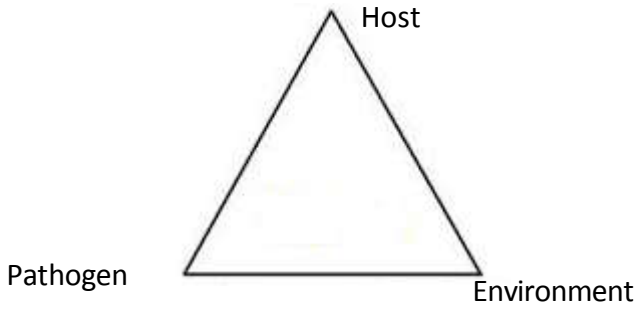
Competency level 1.5 : Classifies causative agents of plant diseases and inquires into diseases caused by them.

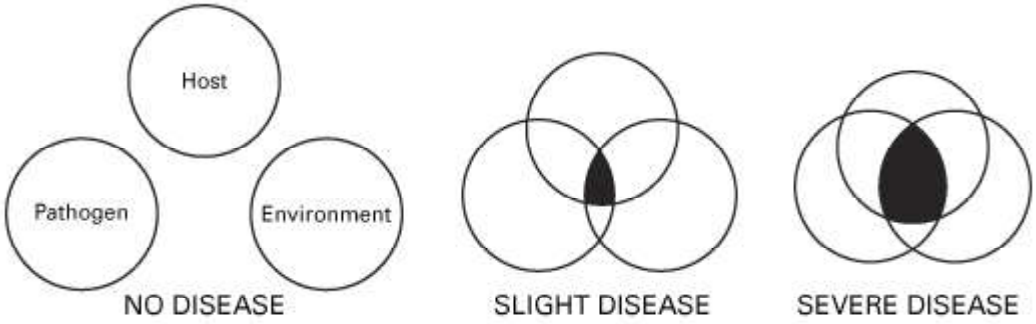
Number of periods : 08

Learning outcomes :
- Classifies causative agents of plant diseases.
- States examples for plant diseases caused by different causative agents.
- States comon symptoms manifested due to different causative agents of diseases.
- Identifies plant diseases by observing infected plant parts.
- Identifies plant parasitic bacteria,fungi and nematodes.

Instructions for plannring the lesson :
- Present true plant specimens affected by diseases to the class and start the lesson.
- Guide students to build a definition for "a plant disease"
  - A deviation of a plant or a part of a plant from normalcy due to a particular factor is called 'a plant disease.'
- Show that physical and physiological changes due to plant disease causative factors are called 'disease symptoms.'

  Ex :
  - Wilting of plants
  - Growth retardation
- Indicate that there should be three factors to cause a disease, by using the disease triangle.





- Ask the students about causes for plant diseases.
- By eliciting students' ideas show them that causing factors of plant diseases could be grouped as follows:
  - Abiotic factors - Ex : Physiological disorders due to dificiencies in nutrients, nutrient poisoning and damages in aerial and soil environments.
  - Biotic factors - Ex : Bacteria, fungi, viruses, phytoplasma, nematoda
- Point out that biotic factors such as bacteria, fungi, viruses, phytoplasma, nematoda are also called causal agents.
- Discuss common symptoms caused by different causal agents.
  Ex :
  - Bacteria - soft rot, knots, leaf spots
  - Fungi - localized spots, cancers, rotting ,wilting
  - Viruses- necrotic lesions, ring spot, mosaic, leaf curl
  - Phytoplasma - reduced size of fruits and leaves
  - Nematodes- wilting of plant
- Guide students to prepae a leaflet on common plant diseass caused by the above causal agents.
- Guide students to identify plant diseases by observing infected plant parts.
- Introduce to students new technological methods used to identify virus disease
  (e.g. PCR - polymerase Chain Reaction, ELIZA)
- Guide students to identify plant parasitic bacteria,fungi and nematodes.
- Lead a discussion with students about the the ways of spreading plant diseases.
  - By vectors
  - By water
  - By air
  - By equipment
  - By planting material

Key words :

- Plant disesases
- Disease causative agents
- Disease triangle

Quality inputs :

- True specimens of infected plants
- A diagram of the disease triangle

Instructions for assessment and evaluation :

Pay attention to the following facts;

- Defining plant diseases
- Naming common plant diseases
- Naming causal agents of plant diseases
- Explaining common symptoms of different plant diseases
- Explaining the disease triangle
- Describing the modes of plant disease spreading

Competency level 1.6: Plans to implement successful pest management by observing pest population levels.

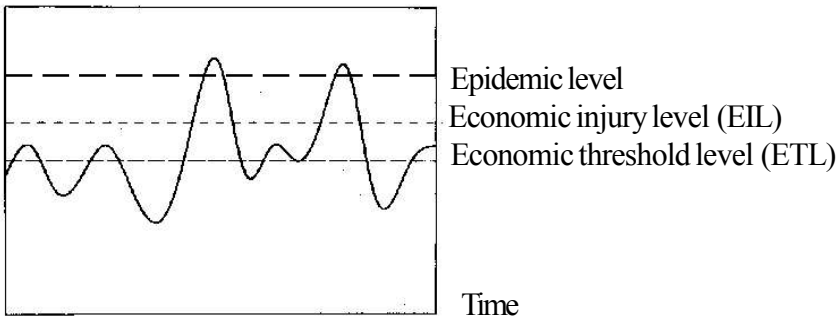
Number of periods : 03

Learning outcomes :
- Explains population density.
- Describes factors affecting pest population density.
- Determines the pest population density in the field.
- Describes pest population density levels using graphs.

Instructions for planning the lesson :

- Get students to the school home garden and give an opportunity to identify pest species. Ask students to count pest individuals in different blocks.
- Start the lesson by emphasizing that the knowledge in population density in pest management is very important.
  - Number of individuals of a species living in a unit area is called population density.
- Discuss different factors affecting the population density.

  Ex :
  - Food
  - Climatic factors
  - Natural enemies
  - Habitat
- Indicate that decision making in pest management is based on the population density.
- Discuss the hypothetical population level used as the limit when identifying the level of pest according to population density.



Hypothetical graph for pest density variation

- Convince students that there is a population balance in the natural environment and in an agricultural environment the harmful organism porpulation can increases setting in pestilence.
- Explain to the students about economic damage on crops.
  - When the expenditure for pest control exceeds the income from the harvest of a crop, it is called an exonomic damage.
  - When the population of an organism reachers a level that leads to economic damage, that organism is referred to as a pest.

- Indicate that the minimum pest population density that can economically damage a crop/cultivation is called Economic Injury Level (EIL).
- Show that at the economic injury level, loss due to the pest is equal to the cost of pest control.
- Explain to the students about economic threshold level. .
  - The pest population density level at which pest management methods should be started to prevent a certain pest population from reaching the economic injury level is defined as the Economic Threshold Level.(ETL)
- Explain to the students that to prevent reaching economic injury levels, pest population density should be controlled below the ETL.
- Indicate that when the pest population level increases beyond the economic injury level, it is called "Epidermic Level".
- Accentuate that it is very difficult to control pests at the epidermic level.
- Lead a discussion with students about factors that lead to the epidermic level.

  Ex :
  - An entrance of a new insect species from one environment to a new environment
  - Emergence of tolorent strains of pests due to mutations.
  - Because of high fertilizer usage, plant tissues get soft and watery and increases the organisms which depend on that plant.
  - High yielding varieties showing less resistance against the pests.
- Let the students detect pest population densities in different blocks in the school home garden using the quadrat.

Key words:

- Pest population density
- Economic injury
- Pest population level

Quality inputs

- Videos or diagrams depicting pest population levels

Instructions for assessment and evaluation :

Pay attention to the following facts;

- Defining pest population density
- Describing factors affecting pest population density
- Determining pest population density in a field
- Explaining pest density levels with diagram

Competency level 1.7: Plans appropriate methods to manage pests.

Numberof periods : 05

Learning outcomes :
- States principles of pest management.
- Classifies pest management methods with examples.
- Controls pests in the field by different methods.
- Explains integrated pest management.
- Desccribes the importance of integrated pest management.
- Explains the process of integrated pest management.

Instructions for planning the lesson :

- Start the lesson by reffering to different pest management methods.
- Give opportunity to students to define pest management.
  - Keeping the pest population density below the economic injury level.
- Discuss with students the principles of pest management.
  Ex :
  - Preventing entry of the pest to the field.
  - Controlling or minimizing the current pest population density in the field.
- Indicate that pest management methods can be classified as follows:
  - Physical and mechanical methods
  - Cultural methods
  - Bio-chemical methods
  - Legislative methods
- Convince students that in physical and mechanical methods of pest management, physical energy sources such as sunlight and heat or mechanical methods are used.
- Lead a discussion about physical and mechanical methods used in animal pest managemnt.
  Ex::
  - Hand picking of pests
  - Dragging of brushes
  - Using barriers (application of gum)
  - Setting traps
    - Light traps
    - Sound traps
  - Using covers
  - Using vibrating equipment
  - Using hand nets
- Lead a discussion on physical and mechanical methods used in disease management
  Ex::
  - Removal of infected plants
  - Removal of infected plant parts
  - Removal of crop debris from the field
  - Removal of infected soil or burning of soil

- Explain about physical and mechanical methods used in weed management.
  - Hand picking
  - Removal of aerial part of plants
  - Mulching
  - Exposing soil to solar radiation
  - Mammoting
  - Burning
  - Flooding
- Emphasize that pest control by improving or changing all the processes from the installation of the crop in the field to harvesting is called 'agronomical pest management.'
- Lead a discussion about different methods agronomic practices.

  Ex :
  - Crop rotation
  - Timing cultivation and harvesting
  - Selecting most appropriate crops
  - Using proper land preperation methods
  - Crop sanitation
  - Sterilization of soil
  - Water management
  - Removal of alternative vector plants
  - Using balanced fertilizers
  - Cultivating trap crops
  - Cultivation of resistant varieties
  - Mixed cropping
  - Cultivation of intercrops
  - Cultivation of cover crops
  - Maintaining proper spacing in planting
- Emphasize that pest management by using another organism is called biological pest management.
- Indicate that organisms used in biological pest management are called "biological control agents".
- Discuss about the group of organisms that can be used as biological control agents.
  - Parasites
  - Predators
  - Pathogens
- Explain about the three main stages of biological pest management.
  - Controlling of pest by using biological control agents
  - Breeding and releasing of biological control agents to the field
  - Conservation of biological control agents
- Lead a discussion with students about factors that are considered in biological agent selection.

  Ex :
  - Should be species specific
  - Should be free from other parasites and predators
  - Having a high reproductive potential
  - Not causing damage to the cultivated crops
- Guide the students to suggest methods to control animal pests,weeds and diseases by biological control
- Direct students to list advantages and disadvantages of biological methods

- Explain to the students that insect pests can be managed by using hormones also.
  - Preventing pests becoming sexually matured
  - Making the pest infertile or deformed
- Explain that hormones are used to control insect pests in the case of biochemical pest management and here the hormones affecting physiological activities of pests are important.

  Ex:
  - Moulting hormones
  - Juvenile hormones
- Here, combinations of above hormones are used.
- Assist students to comment on " legislative pest management".
- Managing pests following legislations according to the" act of plant quarantine and conservation" is legislative pest management.
- Conduct a discussion on the use of legislative methods in pest management. Discuss about weeds, plant diseases and animal pests with examples.
  - External quarantine
  - Internal quarantine
- Let the students introduce "chemical pest management".
  - Managing pests using chemicals which interfere with physiological activities is called chemical pest management.
- Assist the students to build up a definition for integrated pest management.
  - Keeping the pest population density below the economic thresholed level by using a combination of appropriate pest management methods simultaniously while applying of chemicals is called" integrated pest management"
- Direct students to search information about the benefits of integrated pest management.

  Ex :
  - Minimizing emergence of orgamisums resistant to agrochemicals
  - Reducing the damages to beneficial organisms
  - Reducing the cost of pest control
  - Maintaining environmental equilibrium
  - Reducing environmental pollution caused by pesticides

Key words:

- Pest management
- Pest management methods

Quality inputs:

- Videos related to different pest management methods
- Equipment used to control pest

Instructions for assessment and evaluation :

Pay attention to the following.

- Explainning principles of pest managemnt
- Classifying pest management methods with examples
- Introducing integrated pest management methods
- Describing the importance of integrated pest management

Competency level 12.8 : Inquires into suitable pesticides for pest control.

Numbers of periods : 08

Learning outcomes :
- Classifies pesticides under different criteria giving examples.
- Defines the toxicity of pesticide.
- States toxicity level according to the state of poison.
- Describes problems related to the usage of pesticides and strategies that help to minimize those problems..

Instructions for planning the lesson :
- Start the lesson by presenting labels of pesticides that can be used to different pest groups.
- Direct students to definge pesticides.
  - Chemicals which are used in agriculture to control damage of crops and crop related products are called pesticides.
- Direct students to classify pesticides into different groups:
  - Insecticides
  - Weedicides
  - Fungicides
- Point out that insecticides can be categorized according to different criteria.
  - According to the physical nature
  - According to the mode of action
  - According to the chemical nature
- Categorize pesticides according to the physical nature and direct students to present exapmles.
  - Dust Ex: Actalic
  - Granules - Ex: Diacinone
  - Emulsifiers - Ex: Endosulphane 35 Ec
  - Fumigant - Ex : Phosphine
- Categorize insecticides according to their mode of action and let the students present examples.
  - Stomach poison - Ex : Rat bites
  - Contact poison - Ex: Corboril
  - Systemic poison - Ex: Methoate
  - Respiratory poison - Ex: Methyl bromide
- Let the students classsify pesticides according to their chemical nature and present examples.
  - Organochlorines - Ex: Endosulphone
  - Organophosphate Ex: Dimethoate
  - Carbomate- Ex: Carboril
  - Pyratharoids - Ex: Alethrinea
- Point out that weedicides are catergorized as follows:
  - According to the selectivity
  - According to the mode of action
  - According to the time of application
- According to the chemical composition the pesticides

- Direct students to classify weedicides based on selectivity.
  - Non selective weedicides - Ex: Dinitrophenol
  - Selective weedicides - Ex: 2, 4 Dichlorophenoxy acetic acid (2 - 4 , D)
- Direct students to classify weedicides according to the time of application and give examples.
  - Contact weedicides Ex: Pentachlorophenate
  - Systermic weedicides - Ex: M.C.P. A.
- Direct the students to to classify weedicides according to their time of application giving examples.
  - Pre emergency weedicides - Ex: Atracinea
  - Post emergency weedicides - Ex: Paraquete
- Direct students to classify weedicides based on their active chemicals with examples.
  - Fungicides that carry copper
- Fungicides that consist of sulphur
  - Organic fungicides
- Direct students to define toxicity (LD_{50}) in insecticides.
  - Chemical dosage which is required to destroy 50% of the pest population is called the lethal dosage (Chemical requirement in mg per one kg of body weight).
- Explain how to classify pesticides based on the LD_{50} value of the chemicals.
  - Extremely toxic
  - Highly toxic
  - Averagely toxic
  - Mildly toxic
- Point out that there is a colour band in the pesticide label according to the toxicity level as recomended by the World Health Organization.
  - Highly toxic pesticides are grouped as 1 A and 1B category and the colour band is red .
  - In moderate toxic pesticides colour band is yellow in colour.
  - Low toxicity pesticides labels have a blue band.
  - In pesticides of very low toxicity, the colour band is green or white in colour.

Key words :

- Pesticides
- Toxicity

Quality inputs :

- Videos indicating different pesticides

Instructions on assessment and evaluation:

Pay attention to the following facts ;

- Classifying pesticides with examples under different criteria
- Defining toxicity of pesticides
- Stating the toxicity level according to concentration

Competency level 1.9 : Plans mathods of applying pesticide following safety practices.

Number of periods : 03

Learning outcomes :
- Describes pesticide application methods with examples.
- States safety measures that should be followed during pesticide application.

Instructions for planning the lesson:

- Start the lesson by presenting a video or a diagram on pesticide application and eliciting comments on that.
- Ask the students about methods of pesticide application.
  - Foliar application
  - Mixing with soil
  - Spraying
  - Baits
  - Dipping
  - Coating
- Conduct a discussion about the methods of pesticide application with examples.
  - Foliar application- Weedicide
  - Mixing with soil - Fungicides
  - Spraying - Insecticides
  - Baiting - Insecticides
  - Dipping - Insecticides
  - Coating - Fungicicdes
- Direct students to present safety measures that should be practiced before applying pesticides.
  - Wearing safety clothes- Masks , gloves , headgear
  - Reading the label properly and following the instructions given
  - Selecting the correct spraying machine
  - Checking the machine and assuring whether it works properly
  - Preaparation of the pesticide mixture at the correct dilution by using proper measuring equipment
  - Acquiring assistance from another person
  - Using a stick to mix pesticides
  - Using the appropraite nozel type in spray machines
- Initiate a discussion with students about safety measures to be practiced when applying pesticides.
  - Applying either in morning or evening under clear sky / refraining from applying pesticide under heavy winds or heavy sunlight
  - Applying pesticides perpendicular to the wind direction
  - Refraining from heavy meals, smoking or chewing beetle
  - Avoiding mouth blowing during nozzle blockages and using a thin fibre and cleaning the nozzle by washing with water
  - Refraining from wiping sweat off the face during pesticide application.

- Make students aware about safety measures that should be followed after pesticide appplication.
  - Crushing the empty containers of pesticides and burying deep in the soil
  - Cleanning the equipment after application by washing and collecting that water into a separate pit without letting it into a water body.
  - Cleanning the body as well as clothes worn with soap.
  - If eyes have got contaminated with pesticides by accident, cleaning the eyes with pure water several times.Refraining from touching the eyes with the hand.
  - Going to the hospital with the label of the pesticide if symptoms like headache,vomiting or dizziness appear during or after the application of the pesticide.

Key words :

- Pesticides
- Toxicity

Quality inputs

- Videos indicating diverse pesticides

Instructions for assessment and evaluation ;

Pay attention to the following facts:

- Describing methods of pesticide application with examples.
- Stating safety methods that could be implemented as precautions in pesticide application.

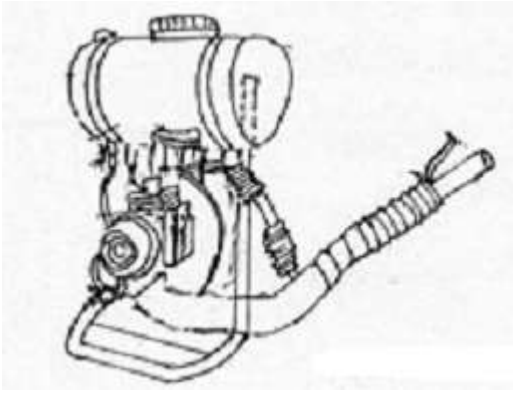
Competency level 1.10 : Uses and maintains correctly the equipment used in pest control.

Number of periods : 08

Learning outcomes :
- States the criteria relevant to the classification of equipments used in pesticide application.
- Assembles the parts of liquid sprayers.
- Draws and lebels the parts of liquid and dust sprayers.
- Describes the action of a piston type sprayers.
- Identifies problems in the equipment used in pesticide application and applies remedial measures.

Instructions for planning the lesson:

- Start the lesson by presenting samples, diagrams or videos of various equipment used to apply pesticides and inquiring into them.
- Tell students that those instruments can be catergorized according to various criteria.
  - According to the physical nature of the chemical
  - According to the amount of liquid used
  - According to the internal activity
- Assist the students to categorize instruments used for pesticide appliction according to the physical nature of the chemical .
  - Dust sprayers
  - Granule sprayers
  - Liquid sprayers
  - Fumigaters
- Direct the students to categorize instruments used for pesticide application according to the amount of liquid used.
  - Low volume sprayers
  - High volume sprayers
  - Ultra low volume instruments
- Direct the students to categorize instrument used for pesticide application according to the internal activity.
  - piston type liquid sprayers
  - power sprayers
- Direct students to draw and name the parts of a liquid sprayer.



dust sprayer

A piston type sprayer

- Direct the students to describe the process in a piston type sprayer.
- Guide the students to assemble the parts of liquid sprayers.
- Conduct a discussion on ultra volume type sprayers.
  - The efficiency of this instrument varies according to the nature of the nozzle used for spraying liquids and according to the person who sprays.
  - The discharge rate is high.
  - The diameter of the drops of liquid sprayed is large.
- Conduct a discussion on low volume instruments.
  - Low discharge rate
  - Small diameter of drops of liquid sprayed
- Direct the students to search information about ultra low volume instruments.
  - Uses a very small quantity of water
  - Used for sprinkler irrigation as they produce very small droplets only.
  - High discharge rate, the ability to be used for a big area and abitlity to receive quick results form pesticides are advantages.
  - Direct the students to describe the process in a power sprayer.
    - Fill in the sprayer tank with chemicals and close the lid tight.
    - Next, fill in the fuel tank with petrol and lubricant oil in 25:1 ratio properly mixed and then close the lid tight.
    - Next, activate the smalll engine of the equipment.
    - The fan disc produces wind currents. They are directed to a big, flexible hose. An extra smaller tube conveys a wind current into the tank containing chemicales.(This wind current stirs the content in the tank and exerts a pressure).
    - By changing the position of the throttle lever the speed of the engine could be increased or decreased and accordingly the wind currents produced by the fan also fluctuates.
    - Moreover, the amount of chemicals flowing out of the tank can be reduced or increased by changing the position of the shuttle lever.
    - Accordingly, the liquid flowing from the chemical tank is directed to the mouth of the tube through a thin tube and a trigger valve.

- Conduct a discussion about the defects in sprayers and ssolutions for those defects.
- Guide the students to fill in the following table .

Defect	Cause	Solutions

Key words:

- Equipment of pesticide application

Quality inputs

- Real samples or diagrams or videos of various instruments of pesticide application.

Instructions on assessment and evaluation :

Pay attention to the following facts :

- Stating the criteria related to the categorization of pesticide appllication instruments.
- Assembling parts of liquid sprayers
- Drawing and naming the parts of liquid and powder sprayers
- Describing the process of a piston type sprayer
- Identifying defects of instruments used for pesticide application and finding solutions.

Competency 2 : Plans quality food consumption practices for a healthy wellbeing.

Competency level 2.1 : Investigates constituents that should be included in food in order to reduce nutritional deficiencies.

Number of periods : 02

Learning outcomes :
- Names nutrient constituents in a food.
- Indicates the importance of various nutrient constituents in human nutrition.
- States examples for micro and macro nutrients.
- States the functions of non-nutrient constituents which are important in human nutrition.
- Describes the manner of selecting suitable food for meals using the food pyramid.
- Explains the way of mitigating nutritional complications through the Body Mass Index (BMI).

Instructions for planning the lesson :

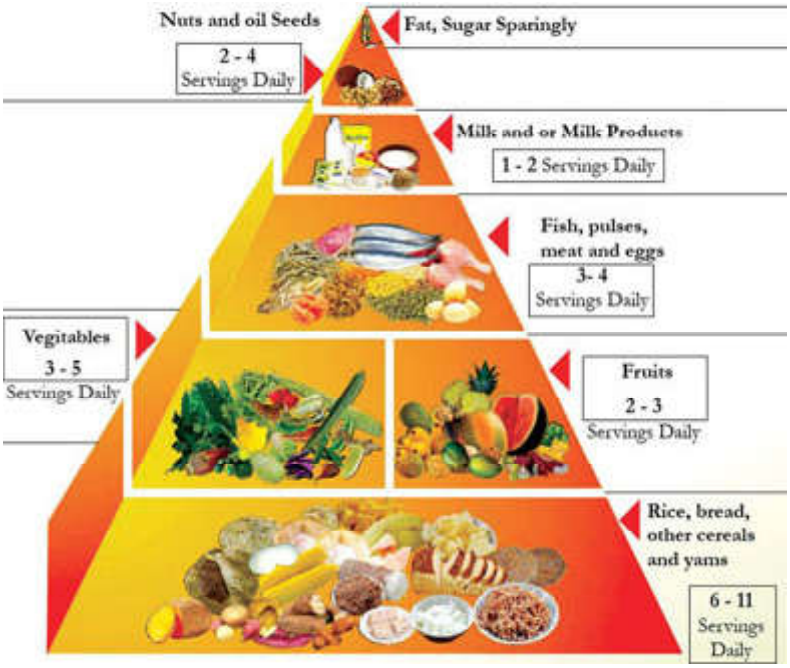
- Start the lesson by presenting pictures or a poster that indicates various food types.
- Emphasize that food is crucial for a healthy wellbeing. Point out that the body receives nutrition by food.
  - A food is a plant or animal product which contributes to a person's growth of his body, to maintain his physiological functions while sustaining immunity within the body by providing energy which contains one,a few or all nutrients.
- Show that acquiring sufficient food in order to maintain and sustain body growth and social activity corresponding to the environment in which one lives is called human nutrition.
- Point out that there are various nutrients in foods.
  - Nutrients are the constituents obtained by the body from food.
- Let the students name nutrients in a food.
  - Carbohydrates
  - Proteins
  - Lipids
  - Minerals
  - Vitamins
- Let the students categorize them as carbohydrates, monosaccharides, disaccharides, and polysaccharides and provide examples for them.
- Reinforce through examples, the fact that, various functions are carried out by carbohydrates in the body.

  Ex: • The main function of carbohydrates is supplying energy to the body. It provides the daily calorie requirement.
- Explain through discussions that the daily calorie requirement of a person varies according to various factors.

  Ex: gender, age, activity

- Direct the students to collect information about food rich in high carbohydrate levels.
- Ask the students about the the chemical composition of proteins.
- Introduce the biological value of proteins.
  - This is defined as the ability to sustain essential amino acids in a certain protein.
- Conduct a discussion about the functions of proteins.
  Ex:
  - For the growth of body cells
  - For repairing work out cells and tissues.
  - For the production of haemoglobin and antibodies
- Point out that fats and oils that could be seen in the nature are classified as lipids.
- Inquire the students about the difference between oils and fats.
  - Lipids which exist as liquids at room temperature are called oils while those that exist as solids at room temperature are called fats.
- Inquire the students about the chemical composition of lipids.
  - Lipids are made of carbon, hydrogen and oxygen.
- Discuss the function of lipids.
  Ex:
  - Production of cholesterol in the body
  - Acting as an energy substrate in the body
- Point out that vitamins are nutrient required for the human nutrition in very small quantities.
- Conduct a discussion on the functions of vitamins.
- Point out that some vitamins are soluble in water while some vitamins are soluble in fats.
- Guide the students to categorize vitamins based on the solubility in fats and water.
- Conduct a discussion on the functions of vitamins.
  Ex:
  - Acting as co-enzymes in the metabolism of other nutrients and energy production .
  - Acting as catalysts in metabolic reactions.
- Point out that minerals are inorganic elements and that about 6% of the human body are minerals.
- Point out that minerals can be divided into two categories according to the daily requirement of man.
  - Main elements which are minerals required in large quantities
  - Micro elements which are minerals required in small quantities
- Conduct a discussion on the functions of minerals.
  Ex:
  - To maintain the acid-base balance in the body
  - Being compornent of the body's hormones and enzymes
  - Supporting the body's water balance
- Guide the students to name the above nutrients as micro and macro nutrients and to provide examples.
  Ex:
  - Macro nutrients - carbohydrates, proteins, fats , lipids
  - Micro nutrients - minerals and vitamins
- Let the students explore the fuctions of other constituents which are not nutrients but are crucial in human nutrition.
  Ex:
  - water, fibre

- Support the students to collect information about the food pyramid.



- Introduce the balanced diet and assist the students to use the food pyramid to select suitable food for meals through the food pyramid.
- Introduced the Body Mass Index and help the students to search information about ways to mitigate nutritional deficiencies .

Key words :

- Human nutrition
- Food nutrients
- Body Mass Index - BMI

Quality inputs

- Posters that indicate main nutrients and food that include those nutrients
- A diagram of the food pyramid
- BMI tables
- RDI table (Daily nutritional requirement table)

Instructions for assessment and evaluation :

Pay attention to the following facts:

- Defining human nutrition
- Describing nutrients and their functions
- Selecting suitable food for a balanced diet through the food pyramid
- Explaining the way of mitigating nutritional deficiencies through the Body Mass Index

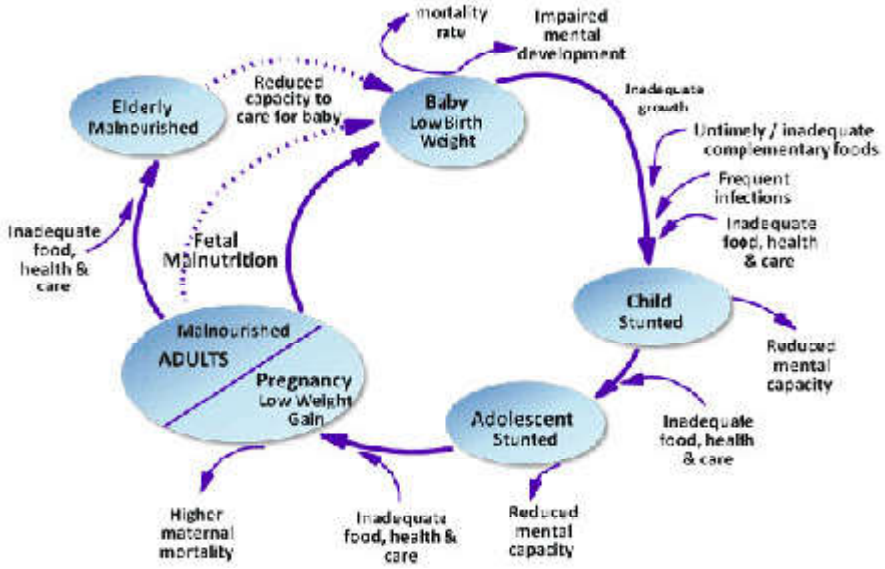
Competency level 2.2: Inquires into precautionary measures for nutritional problems.

Nuber of periods : 02

Learning outcomes :
- Explains problems associated with improper nutrition.
- Names the major nutritional problems in Sri Lanka.
- Suggests measure for the reduction of nutritional problems.
- Selects food to minimize nutritional problems.

Instructions for planning the lesson:

- Start the lesson by presenting illustrations, diagrams, pictures or newspaper articles and posters depicting malnutrition and overnutrition.
- Direct the students to present an introduction for "improper nutrition".
- Exlplain the fact that malnutrition and overnutrition are the aspects of improper nutrition.
- Question the students about the reasons for improper nutrition.
- Discuss the fact that malnutrition is the detrimental condition resulted when a person doesn't recieve one nutrient or all the nutrients in sufficient quantities.
- Ask the students about reasons for malnutrition.
  Ex:
  - Inadequacy of food in sufficient quantities
  - Diseases in the digestive system
  - Disturbances for proper absorption of nutrients even though there is a sufficient amount of food supplied
  - Frequent infections
- Discuss the malnutrition cycle with the students.



- Ask the students about the major nutritional deficiencies in Sri Lanka. Guide them to collect information about those deficiencies.
  Ex:
  - Protein calorie malnutrition
  - Vitamin and mineral deficiencies
  - Vitamin A deficiency
  - Deficiency of iron, iodine and zinc

- Guide the students to collect information about those nutritional deficiencies.

Nutritional deficiency	Reasons for the deficiency	Symptoms	Treatments

- Introduce overnutrition as a long term consequence of overconsumption of food.
- Point out that obesity is a result of overnutrition.
- Inquire the students about the health problems caused by obesity and direct them to collect information about them.

  Ex:
  - Diabetes
  - Cardiovascular diseases
  - Respiratory defects
  - Problems in sleeping
  - Formation of stones in the gall bladder
  - Complecations in the pregnancy period
  - Artharitis
  - Cancers
  - Back pains
  - Depression
  - Changes in the menstrual cycle
- Get the students to suggest precautionary measures for nutritional problems.

  Ex :
  - Changing the food pattern
  - Engaging in exercises
- Show that this risk can be overcome by measures such as maintaining one`s weight and height appropriate for the age through correct nutrition and physical exercise (maintaining a Body Mass Index less than or equal to 25).
- Let the students present ideas about selecting food to minimize nutritional problems.

Key words :

- Malnutrition
- Nutrient deficiencies

Quality inputs;

- Posters, pictures or paintings that illustrate nutritional problems in Sri Lanka
- Posters that illustrate vitamin and mineral deficiencies
- Leaflets that include instructions to overcome nutritional problems (Ministry of Health)

Instructions for assessment and evaluation :

Pay attention to the following facts:

- Introducing malnutrition and overnutrition
- Stating major nutritional deficiencies in Sri Lanka
- Identifying symptoms of vitamin A and mineral deficiencies
- Presenting precautionary measures to overcome nutritional problems
- Suggesting ideas about selecting food to arrest nutritional problems

Competency level 2.3: Investigates into the factors affecting food spoilage.

Number of periods : 03

Learning outcomes :
- Names factors affecting food spoilage.
- Describes how physical factors affect food spoilge.
- Describes how biological factors bring about food spoilage.
- Describes the way in which chemical factors affect food spoilage.
- Identifies spoilt food.

Instructions for planning the lesson :

- Present some spoilt food samples to the class for the students to examine. Let them recognize differences among them.
- Let the students identify the features of a spoilt food though it.
  Ex:
  - Change in colour
  - Loss of attractive nature : vegetables, fruits
  - Becoming slimy or sticky Ex: texture
  - Change in odour : production of gases like ammonia, hydrogen sulphide
  - Change in taste : rancidity , sourness
- Point out the fact that food spoilage is the degradation of a particular food to the point of being that it is unpleasent for consumption and harmful for health.
- Ask the students about the various factors affecting food spoilage.
  Ex:
  - Physical factors
  - Biological factors
  - Chemical factors
- Let the students present facts about the way food spoilage occurs through physical factors such as temperature, moisture, mechanical damages and adulterants.
  Ex:
  - High temperature causes protein denaturation, destruction of vitamins, breakdown of emulsions and drying due to evaporation of water.
  - A change in colour occurs in many fruits and vegetables due to the breakage of tissues under a low temperature.Ex; Peels of ripe banana blacken when stored in refrigerators.
  - There are two types of water in a food.
    - Water that is tightly bonded with chemicals (bonded water)
    - Water that is loosely bonded (free water)

    Water that is loosely bonded with a food is called "water activity" (a_w). Free water serves as the medium for the chemical reactions that occur in food. It is this water which can be obtained by micro-organisms. The highest value of water activity is 1 and the life span of a food could be increased by plummeting it to a lower degree.
  - The moisture in the exterior (storage place) speeds up microbial activities on some food types.
  - Fruits such as mango and papaw that had been subjected to machanical damages get spoilt quickly due to entry of microbes and also during storage they may be damaged by insects and other pests.
  - Food spoilage occurs when adulterants such as dust and hair get mixed with food.

- Discuss how various chemical factors that cause food spoilage.

  Ex:
  - pH value-Often acidic food is spoilt by fungi. Other food types are spoilt by bacteria . Food is also spoilt due to enzyme action at a pH suitable for enzymatic reactions.
  - Enzymatic browning
  - Rancidity
    - Oxidative rancidity
    - Hydrolytic rancidity
  - Fermentation
  - Browning
    - Enzymatic browning
    - Non-enzymatic browning
      - Maillard reaction
      - Caramelization

- Give students the opportunity to explain how biological factors spoil food.
  Ex: Bio-chemical factors-Enzymes
  Insects, rodents and microrganisms
- Discuss that carbohydrates,proteins and fats, the major components of food undergo various chemical changes due to enzymatic action resulting in the production of various compounds which change the taste,smell and colour of food.
- Discuss the factors that speed up food spoilage caused by microrganisms.
  - Physical factors - temperature, air,relative humidity in the place of storage.
  - Internal factors - pH value, moisture content, nutrients, reduction potential.Factors connected with the food
- Help the students to engage in practical activities to identify food spoilage.

Key words

- Food spoilage
- Water activity

Quality inputs

- Spoilt and unspoilt food samples

Instructions for assessment and evaluation :

Pay attention to the following facts:

- Stating factors affecting food spoilage
- Describing how physical factors affect food spoilage
- Describing how biological and chemical factors affect food spoilage
- Identifying spoilt food

Competency level 2.4: Plans ways for food preservation following preservation principles.

Number of periods : 16

Learning outcomes :
- States the importance of food preservation.
- States the principles of food preservation.
- Suggests preservation methods based on the food type.
- Experiments on food preservation methods.

Instructions for planning the lesson:

- Start the lesson by presenting some preserved food types.
- Guide the students to understand food preservation through it.
  - Maintaining the nature, nutrition, texture, taste, and appearence of the food as much as possible while controlling factors affecting food spoilage and avoiding wastage is called food preservation.
- Let the students present their ideas on the importance of food preservation.

  Ex:
  - The ability to preserve food that have a high nutritional value but with a high tendency for quick spoilage (food such as milk, fish ,meat ,vegetables ,fruits)
  - The ability to use the yield of plants for consumption throughout the year even though the yield can be obtained only during a particular season
  - Reducing wastage by preserving the surplus production
  - Abitily to produce instant foods or food with different flavours
  - Ability to change the appearance of food Ex: corn flakes
  - The ease in the storage due to reduction in weight and volume
  - Ability to increase the nutritional value
  - Ability to prepare food according to nutritional needs
- Explain food preservation pricniples.
  - Inhibition
  - Inactivation/destruction
- Explain that one or more of the above mentioned principles are used in food preservation.
- Conduct a discussion about food preservation methods and the principles used in each of those method.

  Ex:

Principle	Preservation method	Examples
Inhibition	Reducing water activation	Drying and salting
	Reducing the pH value	Fermentation and addition of acid
	Addition of preservatives	Concentration
	Use of low temperatures	Freezing and defreezing
Inactivation/ Destruction	Heat treatment	Pateurization and sterilization
	Irradiation	

- Point out that blanching is a pre treatment done before preserving food.

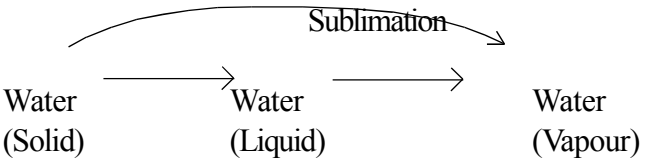
- Ask the students about the instances of using blanching.
  Ex: In preservation methods such as drying vegetables and fruits, canning and defreezing
- Discuss the blanching principle with the students.
  - Deactivating the natural enzymes in food
  - Destroying the microrganisms on the surface the food
  - Removing the air among food particles.
  - Reducing the volume of the food
- Discuss the methods of blanching.
  - Hot water blanching
    - Point out that here the food is kept in hot water (100 ^{0}C temperature) for a few minutes until the enzymes are deactivated.
  - Steam blanching
    - The food is exposed to steam for about 1 minute.
    - Point out that the colour of the vegetables can be retained by treating with a 0.1% SMS (sodium metabisulphate) solution
  - Microwave blanching
    - Point out that the food is kept in a microwave oven for about 1 minute.
- Tell the students that blanching could also be done using chemicals but is not very popular.
- Guide the students to experiment on the blanching process.
- Ask the students about the food preservation methods.
- Point out that food preservation can be categorized as mentioned below while eliciting their ideas.
  - Physical methods
  - Chemical methods
  - Biochemical methods
- Discuss physical food preservation methods with the students.
  - Heat preservation.
    - Emphasize that microrganisms, their spores and unfavourable enzymatic reactions are controlled by heat.
    - Give students the opportunity to name heat preservation methods.
      - Sterilization
      - Pasteurization
- Discuss how food is preserved by each method.
  - Sterilization
    - Highlight that food is subjected to a higher temperature than the temperature favourable for micro-organisms and that all micro-organisms could be destroyed together with their spores.
    - Discuss how this preservation method is used to produce sterilized milk.
      - Pouring into bottles
      - Bottle cap sealing
      - Heating milk fo 15 minutes under a temperature of 121^{0}C and a pressure of 6.8 kg per 6.5 cm with the aid of a sterilization machine.
    - Point out that the taste of food could be changed by the volatile sulphur compounds because a temperature over 100 ^{0}C is used and the colour could be changed by the browning reactions.

- Pasteurization
  - State that a lower temperature in comparison to sterilization is used in this method.
    - HTST - High Temperature Short Time
      72 ^{0}C , 15 seconds
    - LTLT - Low Temperature Long Time
      63 ^{0}C , 30 minutes
    - Instant method
      80 ^{0}C, 1-2 seconds
  - Emphasize that the pasteurized food should be stored under a temperature lower than 10 ^{0}C.
  - Guide the students to pasteurize food.
- Ask the students about low temperature food preservation methods.
  - Chilling
  - Freezing
  - Freeze drying
- Discuss about the principles of freezing and defreezing.
  - This lowers the water activity. Moreover, a tranformation of active water to inactive water is expected in defreezing.
  - This maintains a lower temperature in a particular space than that of the environment.
- Point out that a temperature of 0-15 ^{0}C should be maintained when freezing.
- Discuss about the way the food is stored in a refrigerator.
- Emphasize that in defreezing a certain food is kept under a lower temperature (-18 ^{0}C) than the freezing point of the food.
- Direct the students to define the defreezing point as the temperature at which the first ice cube could be seen.
- Let the students find freezing points of various food items.

Food	Moisture %	Defreezing point
Vegetables	78 - 92	-0.8 - 2.8
Fruits	87 - 95	-0.9 - 2.7
Meat	55 - 70	-1.7 - 2.2
Fish	65 - 81	-0.6 - 2.0
Milk	87	-0.5
Eggs	74	-0.5

- Discuss the main defreezing methods:
  - Fast freezing
  - Slow freezing
- Elaborate that in slow freezing large ice crystals are formed inside the food damaging the inner structure causing drip. This removes micronutrients. In fast freezing a large number of smaller ice crystals are formed, so the quality of food is retained.
- Discuss the impact of defreezing.
  - Nutritional impact- Ex: Oxidation of fats/lipids in food decreases and the impact is minimal.

- Impact on microrganisms- Ex: Ceases the microbial activity of many microbes.
- Educate the students about pre defreezing steps
  - Control of enzymatic activity
  - Preventing oxidation
- Point out that enzymatic activity could be controlled by blanching vegetables bfore defreezing.
- Point out that airtight packaging could be used to prevent oxidation.
- Discuss the principles of freeze drying.



- In normal food drying, water in food is removed as water vapour. But here, water in the solid state is removed using a special instrument (vaccuum) in the form of steam. This is called sublimation.
- Point out that food dried by this method is expensive and it is only used for products like strawberry in Sri Lanka.
- Ask students about examples for food types which are preserved by freeze drying.
  Ex: Meat and fish products
- Discuss with students the principle of preservation by drying.
  - This inhibits microbial activity by lowering the water activity (a^w).
- Point out that the drying processs can mainly be done in two ways:
  - Drying in natural sunlight
  - Drying under controlled conditions using artificial methods
    - Mechanical
    - Microwave
- State that removal of water in food using sunlight is called natural drying.
- State that food preservation is effected by exposing food to natural sunlight or using a solar drier.

Sun drying

Solar drier

- Ask the students about examples for foods which are preserved using natural sunlight.
  Ex: fish, jack seeds , vegetables
- Discuss the steps that need to be followed for drying vegetables.
  - Selection of vegetables
  - Cleaning/washing
  - Peeling
  - Slicing
  - Blanching
  - Drying using a drier
- Guide the students to dry some vegetable types after preparing a solar drier.
- Point out that mechanical drying is drying food using artificial methods under controlled conditions using driers.
- Ask the students about examples for various driers.
  Ex: Spray driers - Used to dry solid food

- Discuss the method of producing milk powder by spray drying.
  - Sending milk along a milk pipe under a high pressure
  - Spraying milk from the nozzles at the pipe end. This pipe opens into a chamber. Here, water in milk is evaporated by sending a hot air blast.
  - When tiny drops of milk come into contact with the wall of the chamber ,water is evaporated forming dry milk powder. It settles on the base of the chamber.
  - The milk powder is collected from the vessel at the base.
- Point out that when food products are immersed in a concentrated solution, the water in the food moves to the solution, while the subtances in the solution move into the food. This lowers the water activity . This is called osmotic dehydration.
- Point out that microrganisms which settle on food also get destroyed being dehrydrated by exosmosis.
- Guide the students to practically engage in preserving fruits by immersing them in a concentrated sugar solution.
- Discuss preserving of food by radiations.
- State that radiations inhibit microbial activity and sterilizes food. This is called cold sterilization/ irradiation.
- Ask the students about examples for food preserved by irradiation.
  Ex: fresh vegetables and fruits, eggs, crustacians, prawns, lobsters

- Ask the students about chemical food preservation methods.
  - Addition of preservatives
  - Smoking
- Point out that food preservation could be effected using food preservatives.
- Point out that inhibition of microbial activity and microbial growth using permitted chemicals , is the main principle here.
- Guide the students to list preservatives used for food preservation.
- Guide the students to categorize food preservatives as follows:
  - Accoding to the source
    - Natural - Ex: salt, honey, Garcinia
    - Artificial- Ex: bensoate, nitrite, sorbate
  - According to the activity
    - Antioxidants- Ex: ascorbic acid, citic acid, BHA, BHT
    - Antibiotics-Ex: bensoate, nitrite, sorbate
- Point out that smoking is a traditional food preservation method.
- Point out that this preservation methods had been used by ancient people to preserve meat.
- Indicate that tar, phenols and aldehydes contained in smoke deposit on food forming a protective layer which prevents microbial action.The phenolic compunds act as disinfectants and antioxidants controllling rancidity.
- Point out that some chemicals in smoke are carcinogens.This harmful situation could be mitigated by maintaining smoke at a temperature of 150 ^{0}C.
- Point out that using favourable microrganisms for food preservation is known as biological food preservation.
- Indicate physical and chemical changes in food brought about by beneficial micro-organisms deny other micro-orgnanisms the conditions essentials for existence.
- Point out that fermentation is a chemical change catalysed by enzymes.
- Emphasize that fermentation is a biochemical preservation method.
- Point out that the colour, texture and flavour are changed during fermentation.
- Discuss the main types of fermentation.
  - Lactic acid fermentation
  - Alcohol fermentation
  - Acetic acid fermentation
- Explain the principle of lactic acid fermentation.
  - Lactose → Lactic acid
  - This creates an unsuitable pH value for the growth of microrganisms.
  - Guide the students to make yoghurt and drinking yoghurt.
- Explain the principle of alcohol fermentation.

  Simple sugar → Ethanol
- Ask the students about the acetic acid fermentation.
  - Carbohydrates get converted into acetic acid under aerobic conditions.

- Guide the students to produce vinegar by fermenting alcohol.
- Point out that perserving food by combining several preservation methods is called "combined food preservation".
- Ask the students about examples for combined food preservation.
  Storing food under a low temperature after sterilizing using intense heat.

Key words :

- Food preservation
- Principles of food preservation
- Methods of food preservation

Qualitaty inputs :

- A few preserved food types
- Equipment required for the production of preserved food

Instructions for assessment and evaluation:

Pay attention to the following facts:

- Explaining the objectives of food preservation
- Describing principles and methods of food preservtion
- Suggesting methods of food preservation suitable for each type of foods
- Experimenting on certain food preservation methods

Competency level 2.5: Inquires into new trends in food processing.

Number of periods : 07

Learning outcomes :
- Describes food diversification with examples.
- Describes the value addition of foods and enrichment with examples.
- Conducts minimum food processing.
- Processes diversified food suitable for domestic consumption.

Instructions for planning the lesson:

- Present some processed food samples to the class.
  Ex: Dried fish/Sprats
  Tomato sauce/Jam
  Mango jam/Cordial
- Start the lesson by asking the students about the processing of those food items.
- Let the students present an introduction for food diversification through it.
  - Presenting a food in different forms conforming to consumer preference so that it is easier for consumption is called food diversification.
- Let the students give examples for diversified foods.
  Ex: rice- rice flour, rice flour noodles, hopper flour, string hoppers
  mango- jam, cordial, pickles, slices
- Let the students present their ideas on the importance of food diversification.
  Ex: The ability to increase the market demand and share by diversifying food and producing them in diverse ways as the consumer taste always varies.
  - Ability to reduce wastage of food.
  - Increase in the nutritional value of food by adding nutrients that are not included in the food.
- Point out that the value addition is producing a more valuable product by changing the physical nature of the material.
- Ask the students to give examples of value added products.
  Ex: rice - rice flour
  meat - seasoned meat
- Point out that the addition of nutrients that get completely destroyed during the production process is called enrichment.
- Convince that it is the replacement of the removed nutrients that occurs in enrichment and not an addition of more nutrients.
- Ask the students for examples for enrichment.
  Ex: Adding vitamins externally in order to replace the vitamins destroyed (Ex: vitamin A and D) during the production of milk powder.
- Increasing the nutritional value of food by adding nutrients externally even though those nutrients that were initially present or not present in the food is known as fortification.
- Ask the students to give examples for fortification.
  Ex: Adding calcium externally during milk production, adding iodine to salt
- Ask students the reasons why people nowadays are tempted to buy processed food largely. Discuss about the sanitary safety of those foods.

- Indicate that as additives are added and nutrients are lost during processing and excessive treatment of food, a doubt has emerged among people regarding the hygienic safety of them.
- Ask the students about alternative ways of food processing that can be adopted instead of those methods.
  - Minimum food processing
- Point out that minimum food processing is presenting products to the market without changing their original nature completely but subjecting them to minimum processsing such as washing, peeling and slicing.
- As for examples of foods that are subjected to minimum processing.
  - Ex: vegetables, fruits, pulse seeds,meat and milk
- Discuss the advantages and disadvantages of using new trends for food processing.

  Advantages
  - Increasing market demand
  - Reducing food wastage
  - Increasing the lifetime of foods
  - Ability to adjust the nutritional value according to the need
  - Ability to gain a higher market price than for the raw materials

  Disadvantages
  - Possibiltity of the changing nutritional composition and nutritional profile of the initial material.
  - Some techniques and chemicals used in food diversification becomes a threat to hygeine.
  - Emergence of serious health problems due to lack of suitable packaging and storing facilities.

Key words:

- New trends in food processing

Quality inputs :

- A few processed foods
- Instruments and materials required for practical activities

Instructions for assessment and evaluation:

Pay attention to the following facts;

- Describing new trends in food processing
- Experimenting on new trends in food processing

Competency level 2.6 : Inquires into the food standards that control food quality.

Number of periods : 02

Learning outcomes :
- Explains the importance of maintaining food safety.
- Describes the importance of quality control in food.
- Presents information on important standards in the food industry.

Instructions for planning the lesson:

- Present some food packets with and without the logo standards. Start the lesson by asking the students about the type they select in the market.
- Based on students' opinions, draw the idea that any food is not fully safe for consumption.
- Emphasize that one should be vigilant about the safety of a food in order to reduce risks caused by food on health.
- Let the students present ideas on the signinficance of food safety.
  Ex:
  - Preventing food poisoning and allergies
  - To prevent food born illnesses
  - Reducing health risks caused by excessive consumption of food
  - To prevent long term diseases such as neurological disorders and cancer
- Ensure that the below mentioned facts should be considered in the food consumptionn of a human being.
  Ex :
  - Fulfilling daily nutritional requirements through food consumption.
  - Maintaninng the sense-perceptive characteristics such as colour, odour, taste and texture at a level acceptable to the consumer.
  - Lack of harmful chemicals or other waste materials.
  - Not falling prey to diseases or infections through food consumption
- Based on the above, let the students present ideas on the quality of a food.
  - Food quality is maintaining characterisitcs of a particular food at a level acceptable to the consumer.
  - State that the colour, taste, odour and nutrients of a certain food are known as its unique features.
- Point out that the features of a certain food may change due to various reasons (physical, chemical) and that it is crucial to select foods of certain quality.
- Let the students present ideas on the importance of the quality control of foods.
  Ex:
  - Giving an opportunity for the consumer to select hygeinic food with sufficient nutritional value
  - Ensuring consumer trust
  - The reduction of risks caused by microrganisms, chemicals and physical factors in a food product
    Ex: The maximum amount of ecoli bacteria in yoghurt should be one colony in 1 g
  - Reduction of food spoilage
  - Avoiding addition of harmful substances into foods during the production process
  - Ability to identify instances like food adulteration during the production process

- Point out that there are food standards to ensure food quality.
  - Standards indicate the minimum values of the ingredients that should be present in a food to make it suitable for consumption and the maximum values of adulterants which make it unsuitable for consumption.
- Let the students present ideas on the significance of food standards in the food industry. Pay attention to the following facts.

  Ex:
  - Protecting the consumer (nutrition and health)
  - Ability of the consumer to protect himself/herself
  - Ability to receive benefits for the producer due to the high demand for standardized products
  - Ensuring the identity, high standard and safety of a food
  - Ability to use the money spent on illnesses on some other task
  - Increase in productivity of a firm by turning out products with a high standard
  - Ability to increase foreign exchange through exporting high quality food products
  - Making a healthy population
  - Reduction of food spoilage
- Guide the students to investigate important standards in the food industry.
- Point out that standards can be divided into two categories, system standards and good standards, through examples.

  Ex:
  - System standards (Quality protection systems)
    - HACCP - Hazard Analysis Critical Control Point
    - GMP -Good Manufacturing Practices
    - GAP- Good Agricultural Practices
  - Product standards
    - SLS
    - ISO
- Guide the students to make a poster or a booklet which includes information on each system standard.
  - HACCP
    - A methodical system created to ensure food safety
    - Managing risks that arise in a food industry
    - Ensuring consumer trust
    - Successful marketing and promotion within the competitive market
  - GMP
    - Discuss the fact that this management system is crucial to certify that the factory fulfills all needs in order to ensure proper safety in food production and to produce food of high quality.
    - Point out that it also certifies that all production processes are carried out safely starting from the raw materials to the end product.
  - GAP
    - Indicate that these system standards are introduced to prevent the entry of adulterants from the farmland to the factory which is presumable however carefully the physical and chemical changes in food are controlled in the production process.

- Discuss the activities done in this process.
  Ex:
  - Selecting a land for planting
  - Selecting planting materials
  - Following environment-friendly pest control methods
  - Irrigation
  - Sanitation of the field
  - Post harvest techniques
- Point out that SLS is a national level certificate presented by the Institute of Sri Lankan Standards (SLS) after examning the standard of the finished product.
- Explain the fact that each product has its standards and information on them could be obtained from the Institute of Standards.
- Guide the students to note down the relevant standards after compiling a collection of SLS logos while examining them.
- Let the students present their ideas on using the SLS logo as a product standard.
  Ex:
  - The necessity of this logo for certain products
  - It protects the quality and safety of the good while ensuring consumer protection.
- Guide the students to collect information about the necessary requirements to get the national standard certificate from the Sri Lanka Standards.
  - The service or production should conforms to the relevant standard.
  - The implementation of he mangament system that certifies quality within the relevant instituition.
  - Conceding to disburse 0.05% of the annual income to the Institute of Sri Lanka Standards.
- Point out that the product standard (ISO) is an international standard certificate.
- Emphasize that the international standards which are formulated for easy exchange of goods and services among countries are maintained by the relevant countries.
- Guide the students to make a collection of logos that include foods with the ISO standard.

Key words :

- Food safety
- Quality control
- Standards

Quality inputs :

- Illustrations, videos or diagrams indicating ISO, SLS standardized food packages, safe and unsafe foods
- Flow charts of HACCP, GMP, GAP processes
- Posters/leaflets on ISO, SLS

Instructions for asessment and evaluation:

Pay attention to the following facts:

- Defining food safety, standards and quality control
- Explaining the importance of ensuring food safety
- Describing the significance of quality control in food
- Presenting information about important standards in the food industry

Competency level 2.7: Plans appropriate methods for food packaging and labelling.

Number of periods : 04

Learning outcomes :
- Defines food packaging .
- States the importance of food packaging.
- Names the materials used for food packaging.
- Selects packaging materials suitable for particular food types.
- Describes the importance of food labelling.
- Designs a suitable lable for a food items.

Instructions for planning the lesson:

- Start the lesson by presenting samples of packaged and non packaged food, or videos of them or by any other suitable approach.
- Elicit students' ideas on the safety of those food samples.Conduct the discussion as to highlight the need of food packaging.
- Let the students define food packaging.
- Guide the students to describe packaging as a means of handling a product protecting its quality in the light of science, art and technology from the stage of its production to consumption with minimum cost while providing information appealingly.
- Point out the fact that food packaging could simply be defined as, presenting a food product enveloped in a wrapper or placing in a container to the customer.
- Guide the students to make a list while discussing the importance of food packaging.
  Ex:
  - Protecting the quality of the food from the point of production to the point of consumption
  - Minimizing post-harvest losses
  - Facilitating the customer and saving his time
  - Acting as a barrier for the exchange of substances between the micro environment of the food and the external environment
  - Being a communication medium to present essential information
- Introduce packaging materials and help the students to make a list of packaging materials. Guide the students to investigate into the features of each packaging material.
  Ex:
  - The characteristics of glass, metal, plastic, alumiminium foil paper, cardboard, wood and laminated materials
  - Cost and availability
  - The factors which contribute to safety
  - Ability to withstand conditions faced during the production in supply
  - Ease of usage and manipulation
  - The impact on the environment during production and disposal
  - Tendency to get mixed with the food during reactions with the packaging material
  - The ability to reuse or to recycle
  - Transparency
  - Ability to maintain the physical form

- Instruct the students to select suitable packaging materials for each food and present information about them to the class or to make a booklet on them.
- Get the students to examine a food label and present an explanation about it while inquiring into food labelling.
- Surface through a discussion the fact that labelling means inclusion of a label in the food package with the aim of providing correct understanding about the food item to the customer.
- Discuss the importancce of food labelling.
  Ex:
  - Facilitating the consumer to gauge the suitability
  - Providing the opportunity to compare one product with another
  - Providng information on the nutritional value and the way of usage and the factors to be considered in storage.
- Direct the students to investigate facts in the labels provided.
- Direct the students to inquire into information included in a food label.
  Ex:
  - The common name of production
  - Market name of production
  - Producer's name and address
  - Registration number
  - Net weight/volume
  - Ingredients (In descending order)
  - Maximum market price
  - Lack of preservatives
  - Manufacturing date and expiry date
  - Batch number
- Guide the students to make a suitable label for a selected food correctly. Advise them about the facts that should be included in the label.
  Ex:
  - Facts that need to be included in the main frame of a package
  - The way of expression and the letter size (Expiry date- DD/MM/YY)
  - Special conditions Ex: The special label for the irradiated food.
- Discuss the rules and regulations related to food labelling. Pay attention to rules and regulations related to the food.

Key words :

- Food packaging
- Packaging material
- Food labelling

Quality inputs

- 1980 No.26 Food Act (Orders about packaging and labelling)
- Gazettes 2005-2010
- Model of a properly prepared food label
- A collection of various packaging materials

Instructions for assessment and evaluation:
Pay attention to the following facts:

- Introducing food packaging and labelling
- Stating the importance of food packaging
- Identifying different packaging materials
- Selecting suitable packaging materials for food types
- Designing a label for a food type

Competency 3 : Investigates post harvest techniques for a high yield.

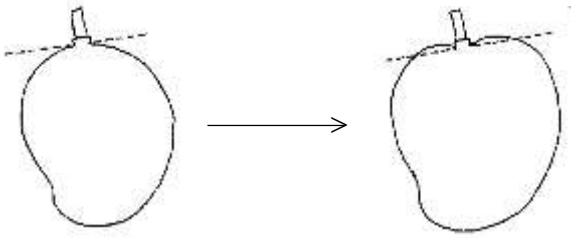
Competency level 3.1 : Investigates into information regarding maturity of crop yields.

Number of periods : 06

Learning outcomes :
- Explains the maturity of crop yields and its importance.
- Describes factors that determine the maturity of crop yields.
- Defines the crop maturity index.
- Indicates the methods to determine the maturity index.
- Determines the time of harvesting using the maturity index.

Instructions for planning the lesson:

- Use a suitable approach to explain crop yield maturity.
  Ex:
  - Presenting pictures and videos of various crop yields
  - Presenting pictures and videos of harvesting yields
  - Exhibiting scenes of examining maturity by new technological methods (hardness-firmness)
  - Traditional methods used to examine crop maturity
    Ex: Stabbing the jack fruit with a knife when harvesting jack yields
    Tapping pumpkins and listening to the peculiar sound
- Let the students define crop maturity.
  Crop yield maturity is the time when a plant completes its physical growth or the time when it has grown into a useful product or to an extent that conforms to customer's needs.
- Let the students present facts about the importance of being acquainted with the maturity of crops.
  Ex:
  - Sensory and nutritional quality
  - Obtainng fresh products
  - Adequate shelf-life
  - Facilitating market
- Direct the students to collect information on the factors that determine crop maturity.
  - Physical- specific gravity, weight, length, roughness or smoothness, colour of the skin
  - Chemical- amount of acid, pH value, amount of oil
  - Time
  - Physiological- respiratory rate, amount of ethylene produced
- Help the students to present a definition of the Crop Maturity Index.
- Direct the students to investigates the techniques that determine crop maturity index.
- Offer the students opportunities to identify crop maturity through various methods.
  - Visual method - Ex: round nature of bananas, raising of the shoulders of mangoes



- According to the number of calendar days- counting days/weeks after flowering bloom
  Ex: Counting the number of weeks since th day that the first bunch of bananas (ambul) appear
  Local market - 13 weeks
  Foreign market - 12 weeks
- Measuring the maturity index
  - Firmness value - Firmness meter is used to examine the roughness or smoothness of the fruit.
  - Brix meter (Refractometer)- The brix meter is used to measure the maturity index .It examines hardness/ softness of the fruit.

- According to the colour

- Specific gravity - Ex: Mature mango fruits sink in water while raw fruits float.
- Size - The size of bananas can be measured using a vernier caliper.

Key words :

- Harvesting maturity
- Crop maturity index

Quality inputs

- Videos indicating harvests and crop harvesting
- Real samples indicating diverse maturity states of various crops
- Inputs required for practicals
  - Brix meter
  - Firmness meter
- Fruits of different maturity stages

Instructions for assessment and evaluation:

Pay attention to the following facts:

- Defining crop maturity
- Explainng the importance of determining crop harvesting maturity
- Defining the Crop Maturity Index
- Testing and naming ways that determine crop maturity indices

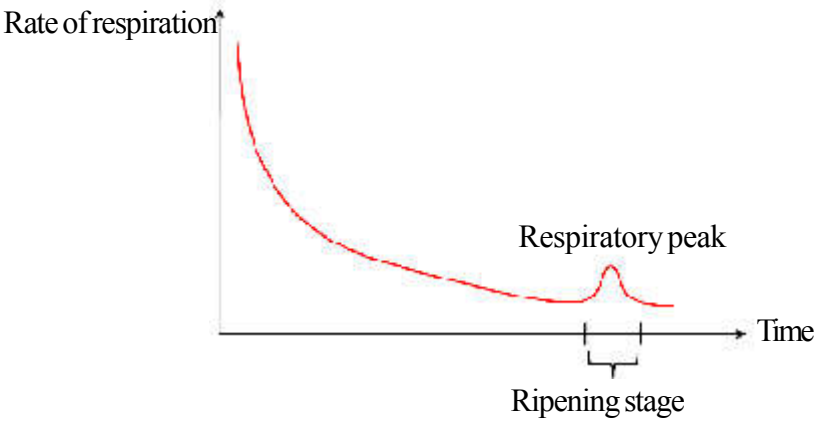
Competancy level 3.2: Investigates facts about the process of fruit ripening.

Number of periods : 06

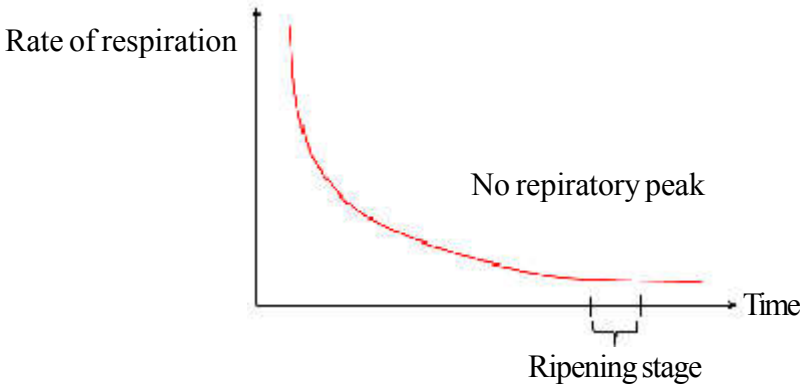
Learning outcomes :
- Introduces the fruit ripening process.
- Categorizes fruits based on the ripening process.
- Explains the importance of artificial fruit ripening.
- Explains the fruit ripening methods.
- Experiments on ripening fruits safely.

Instruction for planning the lesson:

- Ask the students about an occasion where fruits ripen naturally and about an occasion where fruits are ripened artificially.
  Ex: smoking of bananas/ mixing billin leaves
- Let the students identify fruit ripening in this way.
- Give the opprtunity to collect information about the fruit ripening process and to present them.
- Explain the categorization of fruits based on the ripening process.
  - Climacteric fruits
    - Fruits that show the highest repiratory rate during ageing and ripening belong to this category Fruits with starch reserves)
      Ex: apple, pears, mangoes, bananas



- Non climacteric fruits
- Fruits that do not show the highest repiratory rate during ageing and ripening.
  (Fruits with non reserves)
  Ex: pineapple, strawberry, citrus, grapes, cherry, dragonfruit



- Elicit student's ideas on the need of artificial fruit ripening.
  Ex:
  - To supply according to the market demand
  - To prevent wastage
- Help the students to collect information about ripening agents used for artificial fruiit ripening.
  Ex: ethrel, calcium carbide
- Give an opprtunity to collect facts about the traditional and modern techniques/ways used for artificial fruit ripening and present them.
  - Traditional- Ex: smoking
  - Artificial Ex: using ethrel
- Let the students try out fruit ripening methods.
- Discuss the importance of safe fruit ripening. Instruct the students to keep records on them.

Key words:

- Fruit ripening
- Climacteric fruits
- Non-climacteric fruits

Quality inputs:

- Relevant pictures, video tapes
- Mature mangoes or bananas

Instructions for assessment and evaluation:

Pay attention to the following facts:

- Defining the fruit ripening process
- Categorizing fruits according to the ripening process
- Explainng the fruit ripening process
- Explaining the need of fruit ripening
- Trying out artificial fruit ripening
- Explaining the importance of safe fruit ripening

Competency Level 3.3 : Inquires into causes of post harvest losses

Number of periods : 06

Learning outcome :
- Classifies the crop harvests based on preservation .
- Describes instances of post harvest losses .
- Explains how the nature of the crops is important for preserving crops.
- Describes the pre harvest factors that cause post harvest losses.
- Decribes reasons for post harvest losses.
- Describes the problems that arise due to post harvest losses.

Instrusctions for planning the lesson:

- Start the lesson by presenting some pictures that illustrate wasted crops in a farm or a market.
- Show that the nature of crops does affect crop wastage.
- Point out that crops can be categorized as durable crops and perishable crops baseed on the nature of the crop.
- Ask students about the differences between these harvests.
- Give the opportunity to present facts about the impact of the nature of the harvest on preserving the harvest.
- Let the students define post harvest losses.
  - The loss of harvest from the point of harvesting to the point of receiving by the customers is known as the post harvest losses.
- Guide the students to collect information about the causes for post harvest losses. Pay attention to the facts mentioned below:
  - Pre-harvest factors
  - Physiological or biological functions
    - Ethylene production
    - Growth and development
    - Respiration
    - Transpiration
- Help the students to collect information on pre- harvest factors which encompass stages from selection of crops to harvesting.

  Ex :
  - Objectives of the cultivation
  - Irrigation
  - Selecting suitable planting materials according to the area
  - Manuring
  - Selecting quality planting materials
  - Pests and diseases
  - Previously cultivated crop
  - Using agro chemicals
  - Climatic factors
  - Trainning and prunning

- Guide the students to collect information on the climatic factors , physiologiical/biological damages that affect post harvest losses. Pay attention to the below mentioned facts.
  - Temperature
  - Relative humirdty
  - Composition of the air
- Direct the students to collect facts about the physical factors that impact post harvest losses and to present those to the class.

  Ex: ; • Injuries
  - Bruises
- Discuss the problems that arise due to post harvest losses.

  Ex: • Reduction of the quantity and nutritional value of crops
  - Loss of resources due to crop wastage
  - Reduction of food security
  - Emergence of economic and psychological problems

Key words :

- Durable crops
- Perishable crops
- Post harvest losses

Quality inputs

- Real samples and pictures indicating post harvest losses

Instructions for assessment and evaluation :

Pay attention to the following facts:

- Categorizing harvest based on the ways of preservation
- Definng pre harvest and post harvest
- Explaining pre harvest factors
- Describing environmental factors that affect post harvest losses
- Explaining physiological and biological activities that affect post harvest losses
- Naming the physical factors that affect post harvest losses

Competency level 3.4 : Identify instances of post harvest losses and plans to reduce them.

Number of periods : 04

Learning outcomes :
- Defines post harvest technology.
- Describes the importance of post harvest technology.
- Explains the ways to reduce harvest lossses in each stage.
- Attempts to minimize post harvest losses.

Instructions for planning the lesson:

- Start the lesson by reminding the instances of harvest losses after harvesting.
- Ask the students to suggest measures to reduce these harvest losses.
- Assist the students to present a definition for post harvest technology through it.
  - Post harvest technology is all that technical and technological measures employed to minimize quantitative and qualitative losses in harvest from the stage of harvesting to consumption while protecting and improving when possible the quality of the harvest.
- Give an opportunity to present information about the importance of post harvest technology.
- Conduct a discussion about the situations in which post harvst losses can occur and the ways by which those losses can be minimized.
  - During harvesting
  - During harvest collection
  - During harvest cleaning
  - During harvest grading
  - During harvest storing
  - During packaging
  - During marketing
- Let the students present facts about the ways in which post harvest losses occur and suggestions to prevent those losses through post harvest technology.

Key words :

- Post harvest technology
- Handling of harvest

Quality Inputs

- Diagrams/videos/real samples indicating various stages of post harvest losses
- Statistics/ illustrating amounts of post harvest losses

Instructions for assessment and evaluation:

Pay attention to the following facts:

- Introducing post harvest loss and post harvest technology
- Describing the importance of post harvest technoogy
- Naming the stages of post harvest losses
- Describing reasons for post harvest losses that occur in each stage
- Suggesting techniques that should be implemented in order to minimize post harvest losses in each stage

Competency level 4 : Contemplates methods to obtain high quality parameters in higher quantities form farm animals.

Competency level 4.1 : Inquires into problems and potentials of developing animal husbandry in Sri Lanka.

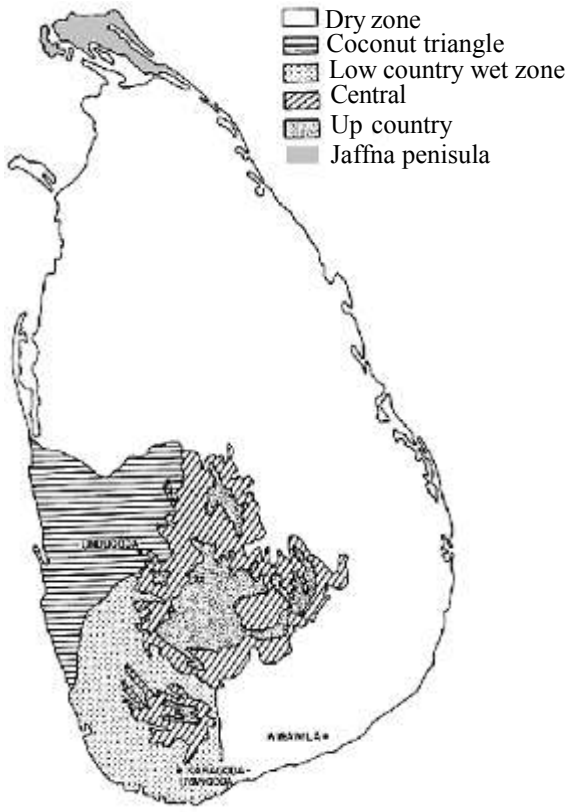
Number of periods : 02

Learning outcomes :
- Explains the importance of animal husbandry.
- Marks in a map of Sri Lanka zones where farm animals are being reared .
- Explains problems and potentials for animal husbandry in Sri Lanka.

Instructions for planning the lesson:

- Present pictures or videos indicating farm animals .Start the lesson by inquiring into the products obtained by those animals.
- Point out that farm animals are animals reared in a farm to obtain various products.
- Ask the students about the farm animals that are being reared in farms in Sri Lanka at present.
  Ex: Animals such as cattles, hens, goats, pigs are being reared while sheep, rabbits, ducks and turkeys are reared in small scale.
- Help the students to investigate information on the following related to animal husbandry in Sri Lanka.
  - The animal population in Sri Lanka at present.
  - The average monthly quantity of animal products / animal production
  - Listing various animal products
  - Nutrients contained in various animal products / per capita consumption of milk, meat and eggs
  - Quantity of imported animal products in the past few years
- Instruct the students to prepare a list on the importance of animal husbandry through the above facts and through discussions.
  Ex:
  - Ability to use as source of protein
  - Ensuring food safety
  - Reducing unemployment
  - Supply of raw materials to industries
  - Contributing to production of energy
  - Ability to use marginal lands
- Instruct the students to collect information about potentials for animal husbandry in Sri Lanka.
  Ex:
  - The existence of animals that can withstand the local environmental conditions
  - Ability to use marginal lands in villu for animal husbandry
  - Ability to use by- products in sugar industry, fat and oil industry and other industries as well as by-products of crops
  - The market, extension service and government sponsorship
  - The contribution of the private sector towards animal husbandry
- Direct the students to collect information about the problems that could arise in the animal husbandry industry.
  Ex:
  - The dearth of qualitative animal foods
  - Scarcity of high productive farm animal breeds
  - Impact of climatic changes
    - The contribution towards climatic changes
    - Impact on environmental pollution
    - Hardships in marketing certain animal products

- Direct the students to mark the Animal husbandry zones in a map of Sri Lanka.



- Guide the students to investigate into farm animals suitable for different animal husbandry zones.
- Discuss how farm animals are distributed throughout Sri Lanka in the animal husbandry zones.

Key words :

- Farm animals
- Animal husbandry zones in Sri Lanka

Quality inputs :

- CDs/Posters indicating farm animals
- A map that illustrates agro-ecological zones in Sri Lanka
- Graphs/tables that include farm animal population and export -import data

Instructions for assessment and evaluation:

Pay attention to the followig facts:

- Identifying farm animals in Sri Lanka
- Explaining the importance of animal husbandry
- Describing the potnentials and obstacles for animal husbandry
- Illustrating the animal husbandry zones in Sri Lanka and elaborating the spread of animals in these zones.

Competency level 4.2: Inquires into the ways to minimize unflavourable effects of weather conditions in animal husbandry

Number of periods: 02

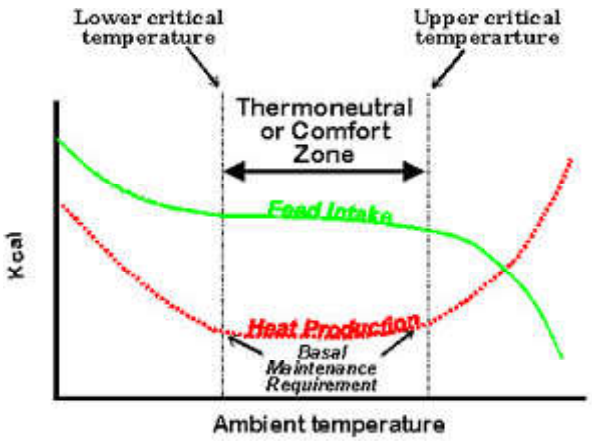
Learning outcomes :
- Describes the impact of climatic conditions on the livestock production.
- Explains the temperature zones that are importance in animal husbandry using a diagram .
- Analyses the reactions and adaptations of animals for the harmful climatic conditions.
- States the ways to reduce harmful impacts while increasing and improving livestock production.

Instructions for planning the lesson:

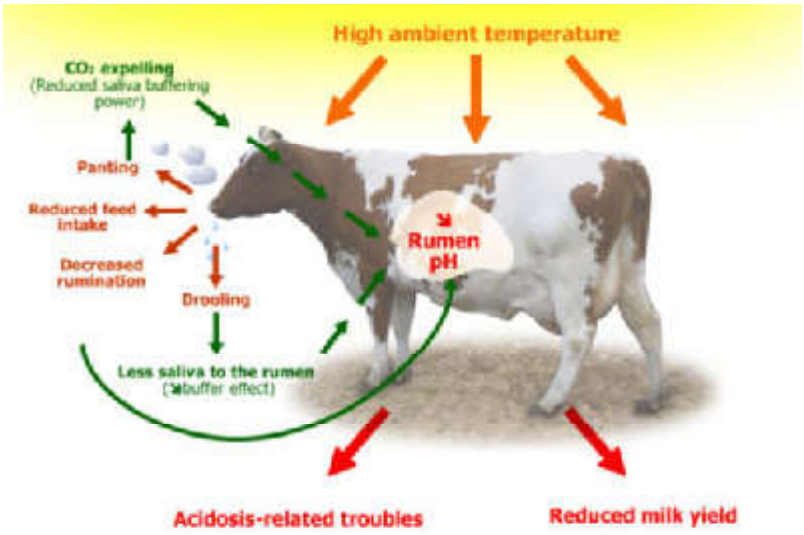
- Start the lesson by inquiring into the milk production of a Fresian cow who had been growing in a cold environment and that of a Fresian cow who had been brought up in a hot environment, or by any other suitable means.
- Point out the fact that the level of production of an animal is determined by the genetic potential and by the environment it lives in.

Phenotype = Genotype + Environment

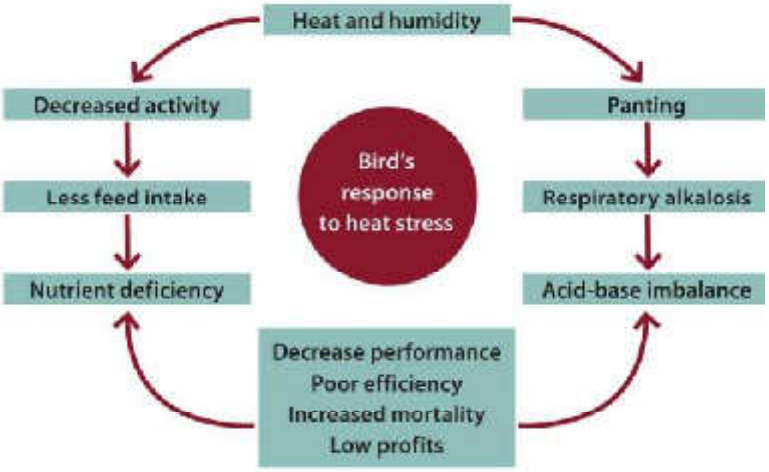
- Point out that due to this, the environment that the animals live in affects the livestock production.
- Point out that higher production could be obtained by farm animals under favourable climatic conditions.
  - Temperature and humidity
  - Rainfall
  - Light
  - Wind
- Ask students about the climatic conditions that affect animal production.
- Temperature
  - Point out that farm animals have a limit in torelating the temperature, that if the temperature exceeds or gets under that limit ,it harmfully affects the physiological activities of the animal and hence the production.
  - Discuss those limitations using a diagram.



- Discuss the harmful impact on livestock production when the temperature increases.
  - Cattle
    - Fertility decreases.
    - Oestrus period of cattle decreases and heat signs do not appear.
    - The desire for sexual activities (Libido) of cattle gets reduced while the quality of sperms drops.
    - Milk production in European cattle decreases.



    - In Poultry
      - Egg production and the mass of eggs decrease
      - Quality of eggs decreases
        Ex: Thinning of the egg shells



- Discuss the harmful impact on the livestock production when the light duration gets shortened.
  Ex:
  - When the day time lengthenes, hens sexually mature fast. If sexual maturity is stimulated and if eggs are laid early the egg production / egg size decreases.
- Discuss the harmful impact of high rainfall on the livestock production.
  Ex:
  - The food intake duration of cattle and poultry that are reared under the free-range system, decreases. This causes decrease in production.
  - Diseases spread fast
    Ex: Worm diseases

- Discuss the detrimental effects on the livestock production when there is a high wind situation.
  Ex: • The spread of diseases increases. Vulnerability of animals to disease increases. So the production decreases.
- Elicit students' ideas on the responses of animals to unfavourable climatic conditions.
  Ex:

Reactions under high temperatures	Reactions under low temperatures/frigid situation
Behaviour	
Going in search of cool places	Going in search of warm places
Decrease in movement /activity of the animals	Decrease in movement
Getting distanced of animals	Animals clustering together
Prostrating (To increase the surface area of the skin)	Sleeping with their bodies curled up
Physical reactions	
Expansion of blood vessels	Contraction of blood vessels
Sweating	Expansion of fur/wings
Panting	Shivering
Increase in saliva secretion	Increase in heat production by the combusting of fat
Reduced activity of the sympathetic nervous system	Increase in th activity of the sympathetic nervous system
Becoming less active	Becoming more active
Morphological characteristics	
Decreased fur growth	Increased fur growth
Increased blood vessels on the surface of the skin	Increased in the hypodermal fat layer
Increased length in body parts Ex: legs , hump and flap	
Increased amount of fur and sweat glands	

- Let the students suggest methods and techniques to increase animal /livestock production while reducing unfavourable effects.
  - Providing shelter
  - Keeping sources of water cool
  - Providing light artificially
  - Constructing houses that provide proper ventilation
  - Providing qualitative foods with high nutritional value
  - Use of cooling methods Ex: spraying water, use of cooling pads

Key words :

- Thermal zones

Qualitaty inputs :

- Temperature zone graph
- Newspapers and magazines

Instructions for assessment and evaluation:

Pay attention to the following facts:

- Stating the factors affecting livestock production
- Explaining the climograph crucial in livestock production
- Examining the reactions of animals under unfavourable climatic conditions
- Indicating methods to increase livestock production while reducing unfavourable effects

Competency level 4.3 : States the importance of various components in food in animal nutrition.

Number of periods : 02

Learning outcomes :
- States the importance of animal nutrition.
- States nutrients contained in animal foods.
- Describes the importance of each nutrient.

Instructions for planning the lesson::

- Present some animal food types to the class. Start the lesson by letting the students identify those food types.
- Point out that animal food is imperative in order to provide nutrition to farm animals.
- Explain through discussions, the fact that animal nutrition is the supply of nutrients according to bodily needs of animals.
- Point out that the production of farm animals could be surged by proper nutrition.
- Ask the studnts about the nutrients that should be included in animal foods.
  - Proteins
  - Fats
  - Carbohydrates
  - Vitamins
  - Minerals
- Guide the students to ivestigate about each nutrient. Pay attention to the following facts:
  - The importance of the nutrient
  - Examples for foods that contain the nutrient
- Explain through discussions, that water and additives should be included in a food even though they are not nutrients and explain their importance through a discussion.

  Ex:
  - Water -
    - To chew and swallow food
    - For the digestion and absorption,to transport absorbed materials
    - For excretion
    - To control the body temperature
    - For processes like milk production
  - Additives - There are five types of additives.
    - Nutritional additives - Ex: Microelements, Amino acids
    - Technical additives Ex: Bonding agents
    - Taste/attractive additives Ex: Flavours, Colourings
    - Biotechnical additives Ex:Enzymes, Probiotics
    - Medicinal additives - Ex: Antibiotics, Coccidiostates

Key words:

- Animal nutrition
- Nutrients

Quality inputs :

- Books that include facts about nutrients
- Tables, magazines that include facts on feeds

Instructions for assessment and evaluation:

Pay attention to the following facts:

- Defining animal nutrition
- Stating the significane of animal nutrition
- Stating nutrients in animal foods
- Describing the most important fucntions of nutrients
- Explaining the functions of additives and water

Competency 4.4 : Investigates about animal feeds.

Number of periods : 02

Learning outcomes :
- Categorizes animal feeds with examples .
- Compares the differences between roughages and concentrates.
- States the features of roughages and concentrates.

Instructions for planninging the lesson:
- Present grass, legumes, silage, cereals, poonac, fish powder samples or any other feed samples and let the students identify the them.
- Instruct the students to categorize those animal feeds.
- Point out that animal feeds can be divided into two main categories as follows:
  - Roughages
  - Concentrates
- Point out the fact that foods of plant origin with relatively low content of proteins and fat and contain which include more than 18 % crude fiber with cellulose are defined as roughage.
- Let the students prepare a definition for concentrates.
  - Foods that contain more of easily digestable nutrients, with crude fiber below 18% are called concentrates.
- Let the students present examples for roughages and concentrates.
- Discuss the way in which the students' examples could be further categorized.

Key words :
- Animal feeds
- Roughages

Qualitaty inputs
- Any animal feed that is available in the area Ex: Grass, legumes, silage, cereals, poonac, fish meal

Instructions for assessment and evaluation:

Pay attention to the following facts:
- Classifying animal feeds
- Identifying differences between roughages and concentrates
- Stating the features of roughages and concentrates
- Providing examples for roughages and concentrates

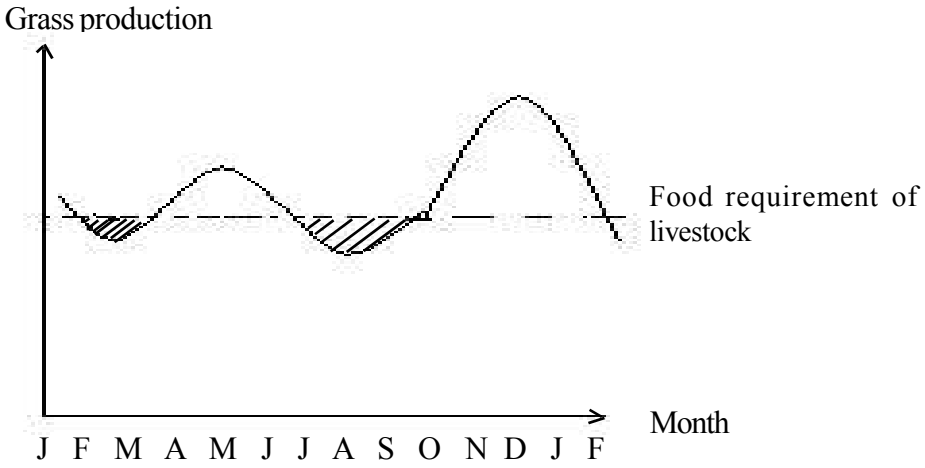
Competency level 4.5 : Inquires into pasture conservation methods for the nourishment of farm animals

Number of periods : 03

Learning outcomes :
- States the importance of pasture conservation.
- Describes the hay and silage processing principles.
- Experiments on pasture conservation methods.

Instructions for planning the lesson::

- Start the lesson by presenting the following graph to the class and by inquiring about it. Point out that the grass production in Sri Lanka does not remain uniform throughout the year, but the animals' food requirements remains the same throughout the year. In addition, show that the scarcity of grasses in the dry season is a major factor that limits the animal husbandry of ruminents.



- Show that pasture conservation is crucial during excessive grass growing periods.
- Inquire the students about methods of pasture conservation.
  - Hay production
  - Silage production
  - Leaf/grass meal production
- Point out that pasture which is dried and stored without completely removing the green colour is called "hay".
- Point out the fact that the pasture and fodder obtained by subjecting pasture or a legume with a medium water percentage (40-45%) or to fermentation under a controlled conditions is known as silage.
- Guide the students to investigate hay and silage production. Pay attention to the following :
  - Hay and silage production principles
  - The production process
  - Advantages and disadvantages
  - Support students to experiment on methods of hay and silage preparation as pasture conservation methods.

K**ey words** :

- Pasture conservation
- Hay
- Silage

Qualitaty inputs

- Leaflets, books that contain facts on pasture conservation
- CDs that include vedios on the preparation of hay and silage

Instructions for assessment and evaluation:

Pay attention to the following facts:

- Describing the importance of pasture conservation
- Describing the principles of hay and silage preparation
- Experimenting on hay and silage preparation methods

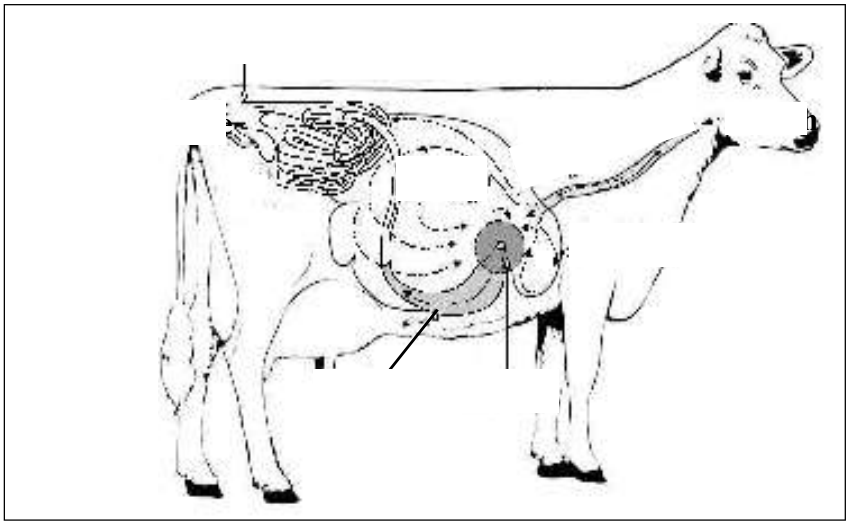
Competency level 4.6 : Describes the structure and functioning of the digestive system of farm animals.

Number of periods : 06

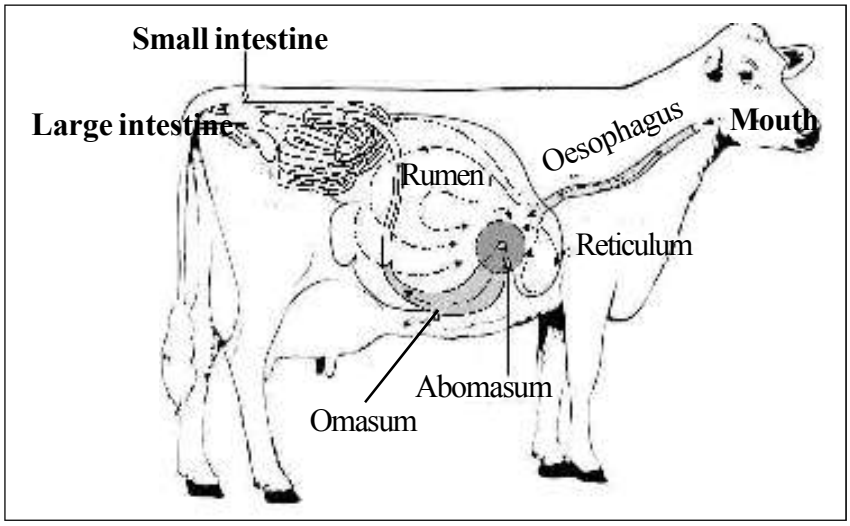
Learning outcomes:
- Draws and names the parts of digestive systems of a cow and a poultry.
- Explains the structure of the digestive systems of a cow and a poultry through the diagrams.
- Explains the action of the digestive system of a cow and a poultry

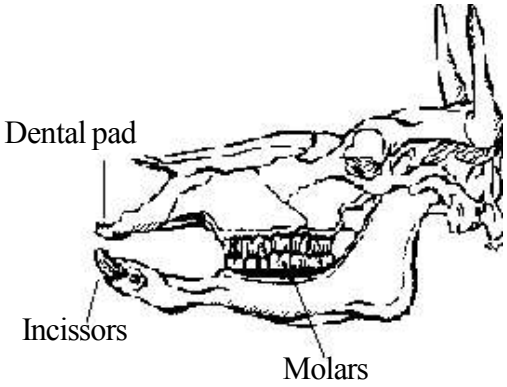
Instructions for planning the lesson:

- Present diagrams of the digestive systems of a cow and a poultry and let in the students examine them. Start the lesson by letting the students compare the two digestiv systems.
- Point out that the digestive system of every farm animal is a tubular shaped structure that includes muscles and glands.
- Point out that that the main functions of this are intake of food, grinding, digestion, absorption and the removal of unwanted matter from the body.
- Point out that several organs in the digestive system can vary based on animal types and types of foods they consume.
- Point out that the digestive systems of farm animals can be divided into two types:
  - Ruminant digestive system Ex: Digestive systems of a cow and a goat
  - Simple digestive system Ex: Digestive systems of a poultry and a pig
- Let the students define ruminants.
  - Mammals who completely depend on plant based food and who have a complex stomach are known Ruminants.
  - Food materials of ruminants are mainly foods with high content of crude fibres. It is taken into use of the host after digesting crude fibres with cellulose by the aid of micro-organisms in their digestive systems.
- Let the students identify the main parts of a the digestive system of a cow as a ruminant animal by providing them an unlabeled diagram of a cow's digestive system.
  Mouth, phyrnyx, oesaphagus, complex stomach, small intestine, large intestine

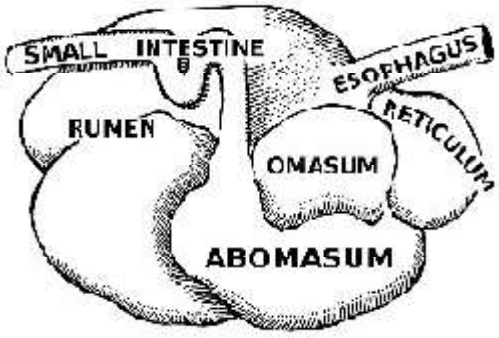


- Discuss about the stucture of the digestive system using a diagram or a video.





Ex:
- Mouth
  - Ability to move in a wide range and having the lower and upper jaws.
  - Immovable lips made of thick muscles.
  - The tongue becomes rough while supporting to grab, chew, mix and to swallow food.
  - Dental structure of a cow
    Milk teeth - (0/4 Incissors, 0/0 Canines 3/3 Pre-molars, 0/0 Molars) x 2 = 20
    Permanent teeth - (0/4 Incissors, 0/0Canines, 3/3Pre-molars, 3/3Molars) x 2 = 32
  - The upper jaw does not contain incissors while the gum in this area is thickened and formes the dental pad. Salivary glands are present. Canines are absent.
- Pharnyx
  - A commom opening for food transportaion and food moves on to the oesophagus due to muscle activity.
- Stomach
  - A complex stomach can be divided into four parts:
    - Rumen
    - Reticulum
    - Abomasum
    - Omasum

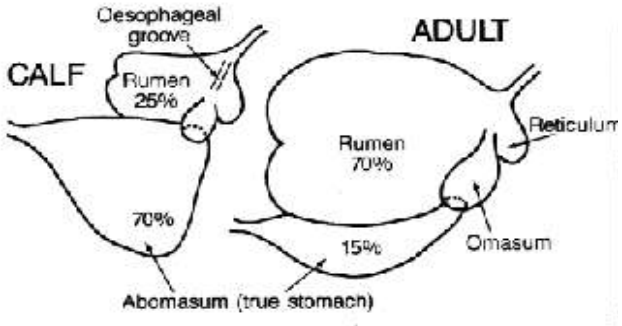


- Rumen- Finger like projections like wool in a towel called "papillae" exist on the inner wall.The surface area is increased by these. There are no glands which produce digestive enzymes of any type.
- Reticulum - The smallest part in the complex stomach partially separated from the rumen.Papillae absent in the inner wall while haxagonal shaped structures are present. Resembles a beehive.The reticulum is situated near the heart and is separated from the diaphragm. Enzymes are not secreted. Acts as a filter. Has the ability to regulate food to the rumen.The oesoparangeal groove is situated in between the rumen and the reticulum and the milk sucked by the calves could be sent to the omasum directly.

- Omasum - A round structure placed close to the liver.It opens into the reticulum from one side and to the abomasum from the other side. Muscular leaves like pages of a book are present on the inside.It has a very high ability to absorb nutrients and water from the rumen fluid.

- Abomasum-An elliptical sack opened to the omasum from one side and is open to the duodenum from the other side.The stomach glands secrete enzymes like Pepsin and Renin and acids like HCl. The wall often secretes mucus.

- Present pictures of the complex stomach of an adult cow and that of a calf. Let the students compare those pictures.
  Ex: The rumen and the reticulum of calves are less developed while the omasum is relatively the biggest part in the complex stomach.

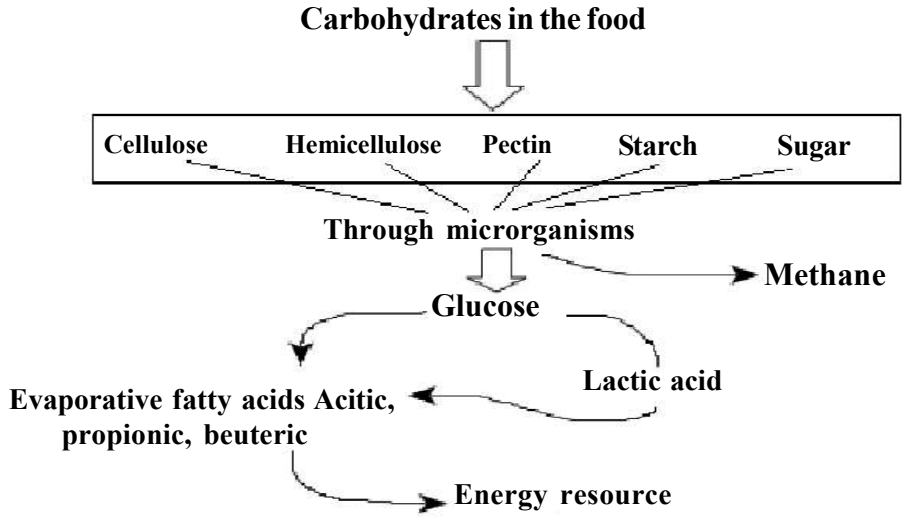


  - Small intestine
    - Begins from the prosterier end of the omasum.
    - It has three main parts.
      - Duodenum
      - Jejunum
      - Ileum
    - The duodenum is "U" shaped while pancreatic duct and the duct of the gall bladder open into it.
    - The wall of the small intestine has glands and the surface area is increased by the presence of villi.
  - Large intestine
    - Mainly consist of the caecum, spiral colon and the rectum.
    - The cow's caecum is relatively small. It is a sac closed at one end. Micro-organisms are present in it.Undigested materials and other nutrients are digested.
    - The rectum which is the terminal part of the large intestine ends in the anus.
  - In addition, organs such as the liver, pancreas,gall bladder are also present in the digestive system.
- Discuss the action of the digestive system of a cow using illustrations and videos.
- Point out that the digestion process of a cow occurs in three main stages:
  - Mechanical digestion
  - Microrganism digestion
  - Enzymatic digestion

- Point out that the main food digestion processs can be divided into five steps:
  - Food grinding
  - Mixing with saliva
  - Rheumatic process
  - Digestion
  - Absorption
- Assist the studnts to present the functions of each part in the digestive system.

  Ex:
  - Mouth- Grinding/mechanical digestion
  - Phyrnyx - conducting food to the oesophagus
  - Rumen and reticulum- Subjects food to a microbial fermentation
  - Abomasum - Desorption of water and minerals in food
  - Omasum- Chemical digestion
  - Small intestine- Chemical digestion and absorption of digested materials
  - Large intestine -Desorption of water in food
- Let the students present how the digestion of the main nutrients in food occurs in each part of the digestive system by a flow chart or by any other means.

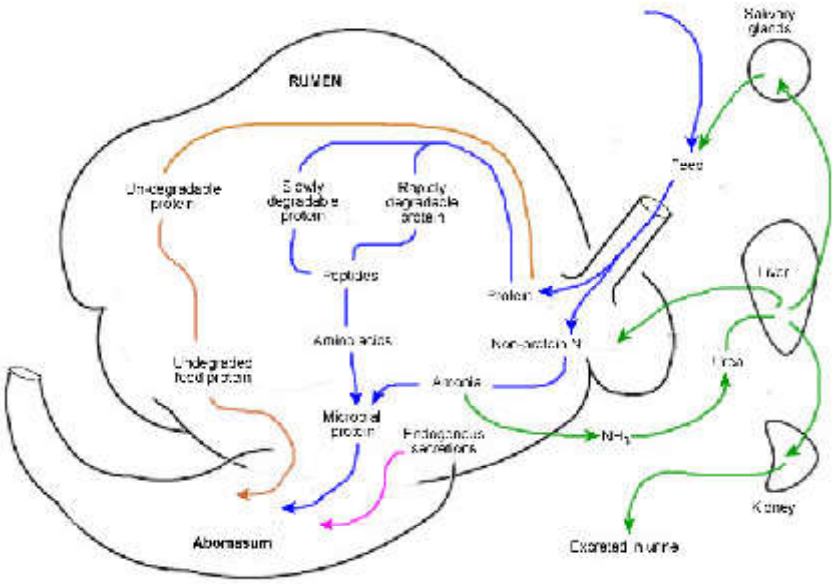
  Ex:
  - In the rumen- Microbial digestion
    - Carbohydrate digestion
      - Rumen bacteria digest cellulose in the mechanically ground food as described be low secreting extracellular enzymes.



- Protein digestion

  Rumen bacteria produce their own proteins using the proteins in food. But the dying bactria pass into the abomasum in which pepsin produced by the cow's body digests proteins stored in the bacterial cells and converts them into amino acids. They are later absorbed by the cow's small intestine.
- Digestion of non-protein nitrogenous substances

  Among non-protein nitrogeneous substances amines, amides and amino acid are present in natural foods in considerable quantities. Non protien nitrogen compounds such as urea,biuret,ammonium salts are mainly used for ruminant rations.Bacteria convert NPN compounds in cow's food into amino acids and proteins. Finally ,after the death of bacteria the cow gets those proteins



- Chemical digestion in the omasum, duodenum and the small intestine

- The enzymatic digestion of the cow occurs in the following manner in the omasum, duodenum and small intestine.
  - In the omasum
    Proteins → Peptides
    Milk → Milk clotting
  - In the duodenum
    Gall bladder and pancreatic juice mix with food.The digestion occurs as follows by its enzymes:
    Proteins → Peptides
    Peptides → Amino acids
    Starch → Maltose
    Lipids → Glycerol + Fatty acids
  - In the small intestine
    Peptides → Amino acids
    Maltose → Glucose
    Sucrose → Glucose
- Discuss the absorption process of the digested foods of ruminants.
  Ex:
  - Fatty acids produced during the ruminant process are absorped through the ruminant wall.
  - Glucose and amino acids are absorbed into the blood stream by the villi.
  - Minerals are absorbed by the small intestine wall.

Key words :

- Digestive system
- Ruminants
- Process of digestion

Quality inputs

- CDs, posters or wallpapers depicting the digestive system of a cow
- True specimens of the digestive system of a cow

Instructions for assessment and evaluation:

Pay attention to the following facts:

- Drawing diagrams of the digestive system of a cow and naming its parts
- Describing the structure of the digestive system of a cow
- Explaining the functions of each part in the digestive system
- Describing the manner in which digestion occurs in each part of the digestive system

Competency level 4.7 : Plans rearing systems of cattle while selecting suitable cattle breeds

Number of Periods : 04

Learning outcomes :
- Compares physical features of various cattle breeds
- Selects suitable cattle breeds for animal husbandry zones in Sri lanka
- Describes rearing systems of cattle
- Describe the type of cattle houses
- Explains the importance of cattle houses

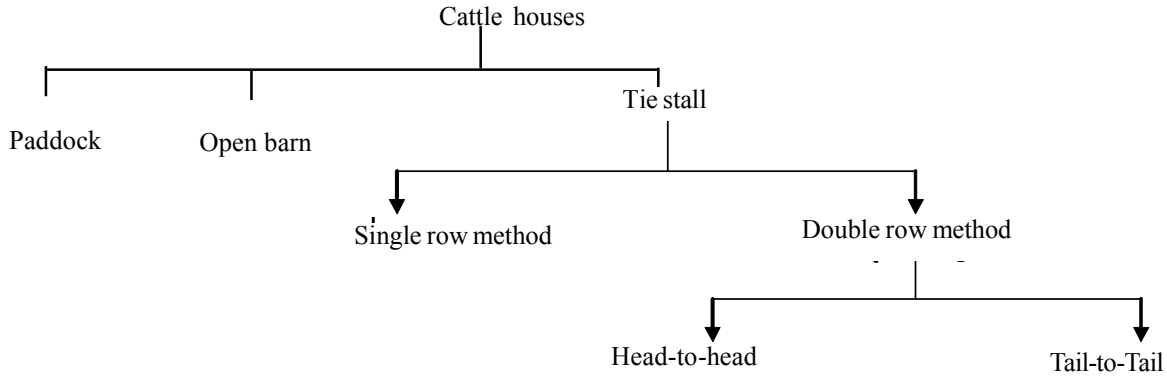
Instructions for planning the lesson :

- Present diagrams or videos on dairy cattle breeds and buffalo cattle breeds of Indian origin and of European origin.
- Start the lesson by letting the students identify those cattle breeds.
- Point out that dariry cattle can be divided into three main groups.
- Show that dairy cattle and buffalo cattle are reared in Sri Lanka.
- Dairy cattle of Indian origin
- Dairy cattle of European origin
- Local dairy cattle
- Give the opportunity to compare the disparities between dairy cattle of Indian origin and dairy cattle of European origin.Make use of pictures,videos and illustrations.

Indian (Bos indicus)	**European (B*os taurus*)**
• Can tolerate to the high temperatures	Cannot tolerate to high temperatures
• Body Relatively small	Body relatively bigger
• The hump is well grown	Hump is small
• Well grown navel flap and dewlap	Not well grown
• Back of the body is round shaped	Back of the body is not round
• More sweat glands in unit area of the skin	Less sweat glands in a unit area of the skin
• Skin is leathely and movable	Skin is firmly attached to the body
• Resistant to tick fever and external parasites	Not resistant
• Bulls are suitable to carry weights	Not suitable
• Low milk production	High milk production
• Short fur	Long hairs
• High fat percentage in milk	Relatively low
• High ability of food digestion	Relatively low

- Guide the students to identify dairy cattle of Indian origin and dairy cattle of European origin.
  Ex: European cattle - Fresian
  Irieshire
  Jersey
  Indian cattle - Red sindhi
  Sahiwal

- Guide the students to list external features and special features of each breed . Pay attention on the following facts:
  - Body colour
  - Purpose of rearing Ex: For meat, for milk production.other
  - Amount of products delivered
  - Zones in which they are reared
  - Body weight
- Point out that Australian Milking Zebu-AMZ and Australian Fresian Sahiwal-AFS are produced by crossing the breeds Sahiwal and Sindhi of Indian origin with Jersey of European origin.
- Point out that AMZ is mostly reared in central and southern wet zones, in dry zone and the coconut triangle.
- Dicuss the special features of local dairy cattle.
  Ex:
  - A cattle breed with a small body size
  - These animals are robust. Grows very well even without a rearing system.
  - Body colour is either black or red.White spots can be seen.
  - A mature male animal weighs about 273 kg while a mature female animal weighs about 182 kg. 628 L of milk could be obtained in one lactation.
  - Used to obtain milk and meat, for ploughing and to carry weights.
- Guide the students to identify the buffalo cattle breeds reared in Sri Lanka.
  - Murrah
  - Surti
  - Nili Ravi
  - Local breeds
- Let the students compare the features of each breed.
- Ask the students about major rearing systems of cattle in Sri lanka.
  - Free-range
  - Semi intensive
  - Intensive
- Guide the students to compare each rearing system. Emphasize the following facts:
  - Animal husbandry zones where it is practiced
  - Advantages and disadvantages
- Indicate that in the intensive method, cattle are reared in permanent cattle house and the animals are fed in the houses themselves.



- Guide the students to investigate into the categories of cattle houses
  - Discuss the importance of providing houses for cattle.
    Ex:
    - To protect the animals from unfavourable climatic conditions like heat, cold and wind
    - To protect the animals from thieves or any external threats.
    - To provide sufficient food and water
    - To methodically and cleanly perform functions such as milking
    - To facilitate waste management

Key words

- Cattle breeds
- Rearing systems of cattle
- Cattle houses

Quality inputs:

- CDs and posters with Indian and European cattle breeds
- Videos, magazines and books indicating facts on rearing systems of animals
- Diagrams of cattle houses

Instructions for assessment and evalution :

Pay attention to the following facts:

- Comparing physical features of various cattle breeds
- Selecting suitable rearing systems for agro climatic zones in Sri Lanka
- Stating the change in quality and quantity of products under each rearing system
- Naming suitable cattle breeds for ecological zones in Sri Lanka
- Describing rearing systems of cattle
- Explaining the importance of cattle houses

Competency level 4.8: Exhibits the readiness to follow the appropriate practices of handling calves.

Number of periods : 03

Learning outcomes :
- Explains the importance of calf rearing.
- Distinguishes the growth stages of calves.
- Explains rearing systems followed for infant calves after birth.
- Describes the weaning process.
- Decribes special rearing systems followed for calves.

Instructions for planning the lesson :

- Start the lesson by presenting the saying "The calf today is a dairy cow tomorrow" with a picture of a calf to the class.
- Emphasize through discussions that the animals aged one year since their birth are known as "calves".
- Discuss the importance of correct and systematic calf rearing.
  Ex:
  - Ability to reduce death rates during the first two weeks after birth
  - Ability to obtain healthy dairy cattle who reach sexual maturity with a suitable weight.
  - Acquiring strong dairy cattle with longevity
  - Acquiring well grown dairy cattle who can consume a large quantity of roughages and have a capacious body capacity
  - Ability to impregnate early (obtaining offsprings at the ages of 2-2.5 years due to reaching sexual maturity at the right time)
  - Obtaining high quality products
- Discuss the various growth stages of a calf:
  - Neonatal
  - Early stages up to 3 weeks of birth
  - From 3 weeks of birth up to weanning (aged 8-12 weeks)
  - Animals weaned after 12 weeks (up to 6 months)
- Discuss the rearing activities implemented in each growth stage and about the importance in following them.
  Ex:
  - Rearing activties conducted at the moment of birth
  - Removing respiratory difficulties- Removing mucus in the nostrils
    Allowing the mother to lick
  - Cleaning the calf - making to sneeze by inserting something into its nose
  - Easing respiration by rubbing the animal with hay or a dry cloth
  - Cutting the placenta with a sterilized pair of scissors and applying an antiseptic like tincture iodine.
  - Measuring the birth weight and noting it down.
  - Checking for other abnormalties.
  - Allowing to suckle 1/2 an hour after birth.
    - Liquid produced during the first 4-5 days after parturition is called "colostrum".

- Discuss about the differences between colostrum and normal cow milk.

Colostrum	Milk
• Light yellow in colour	White in colour
• Highly concentrated	Low concentrated
• Contains more proteins	Relatively low protein percentage
• Realatively low percentage of lactose	High percentage of lactose
• Low fat percentage	Relatively high fat percentage
• Contains the antibody immunoglobuline	Does not contain
• Has laxative effect	No laxative effect
• High content of vitamins and minerals	Relatively low

Constituents	Colostrum %	Milk %
Water	72.72	87.92
Fats	3.37	3.49
Proteins	19.65	3.28
Lactose	2.48	4.46
Minerals	1.78	0.75
Non protein Nitrogen	23.91	8.59

- Discuss the importance of providing colostrum.

  Ex:
  - Provides nutrition for calves.
  - Provides immunity protecting calves from diseases.
  - The laxative effect helps defeacation for the first time.
  - Ease of digestion and absorption due to the small size of fat globules.
  - Discuss the techniques that can be followed if the calf would be unable to gain colostrum due to reasons such as the death of its mother.

- Preparing colostrum
  - Indicate the method of preparing colostrum artificially.

    Ingredients

    6 egg whites
    3/4 L milk
    1/4 L clean water
    1 teaspoonful of cod liver oil
    1 teaspoonful of caster oil
    1/2 g antibiotics

    The liquid prepared by mixing the above ingredients should be provided in a quantity of 3-4kg a day for an European calf and 2-3kg for a day for an Iindian calf for about a week.

- Discuss the manner one should follow in order to obtain a healthy calf with a correct weight by nourishing them from birth till the age of weaning.
  - Daily milk requirement - During first month milk should be provided in a quantitiy of 10% of the calf's body weight (3 kg of fresh milk per day).
    - It is gradually reduced till weaning.
  - Accustoming to milk feeding - Acclimatizing to drink naturally or by a bucket
  - Providing 100-200 g of roughages, rations and concentrates by 2 weeks.
  - Providing clean water unlimitedly throughout the day
- Discuss the qualities essential for an animal to be weaned.

  Ex :
  - The weight of the animal should be twice its birth weight (10-12 weeks).
  - By this age more than 7 kg of fresh roughage and concentrates should be supplied. Also about 10g of mineral supplements should be provided per day.
- Provision of houses
  - Discuss the problems that could arise when the mother cow starts to live with other animals in the herd and the importance of providing houses to calves.

    Ex:
    - When the calves suck more milk the produce is lowerd.This situation can be evaded by providing houses separately.
    - It prevents calves licking one another when they are reared in the group method.This prevents formation of fur balls in the rumen.
- Discuss the facts to be considered when providing houses for calves.
  - Providing single cages at the first stage and putting them into common cages later.
  - The place should be dry, clean, free of strong winds and should have a peaceful atmosphere.
  - Space that should be provided at various stages

    For infant calves- 75x150 cm - approximately 1.5 m^2 for 1 animal

    At 2 months - common cages and 1.5 m^2 for 1 animal

    - 6-8 animals in one cage

    At 3 months - 2.88 m^2 per animal

    - 6-8 animals in one cage

A cage

- Ask the students about the practices that should be followed when maintaining herds of calves
  - Tagging
  - Tatooing
  - Castration
  - Ringing - nose ring and rosen rope application
- Discuss the need of the following rearing systems in addition to the above ones:
  - Ensuring health and safety
  - Keeping records

Key words:

- Growth stages of calves
- Weaning
- Parturition
- Neonatal

Quality inputs

- Diagrams indicating growth stages of calves
- Diagrams of cattle houses

Instructions for assessment and evaluation :

Pay attention to the following facts:

- Explaining the importance of calf rearing
- Identifying growth stages of calves
- Explaining the rearing systems implemented on infant cattle after parturition
- Explaining the methods of weaning
- Describing calf rearing systems

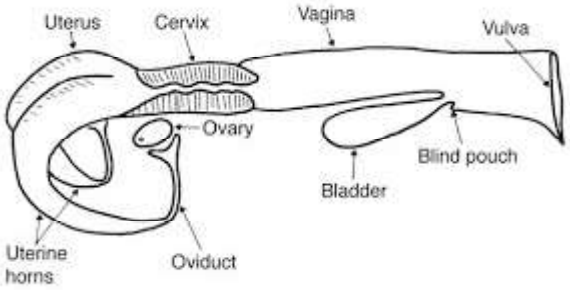
Competency 4.9 : Investigates the ways to impregnate dairy cattle successfully

Number of periods : 04

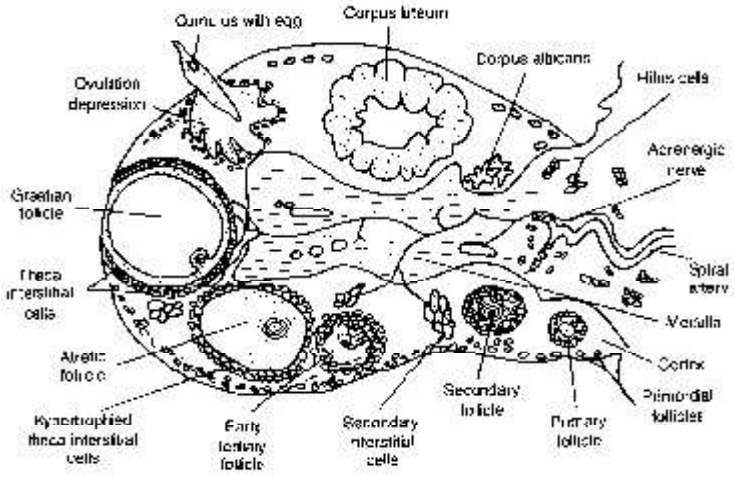
Learning outcomes :
- Draws the structure of the reproductive system of a cow and names its parts
- Describes the structure of a cow's reproductive system and it's functioning.
- Describes the oestrous cycle.
- States the hormones that affect the oestrous cycle.
- Lists the heat signs of cows.
- Describes the method of impregnating cows.

Instructions for planning the lesson:

- Present pictures indicating growth stages of a dairy cow (Ex: infantal stage, weaning stage, growth stage/heifers, matured stage)
- Start the lesson by inquiring into the growth stage of a dairy cow suitable for impregnation.
- Point out the fact that generally a cow reaches sexual maturity, in 12-14 months.
- State that cows which have reached sexual maturity are suitable for impregnation.
- Indicate the fact that a cow could be used for sexual reproduction when it reaches 2/3rd of its matured weight and reaching this age is called sexual maturity.
- Emphasize at that stage the growth of the reproductive system and the growth of the cow have reached an expedient level.
- Point out that it is important to have an understanding about the reproductive system of the cow for impregnation.
- Show the structure of the reproductive system of a cow with the aid of a diagram.



- Guide the students to draw the diagram of the reproductive system and to name its parts.
- Discuss about the structure of each part and their functions.
  - Ovary- Production of ova and sexual hormones



- Fallopian tubes - Ovum fertilization, secretion of mucus during parturition and when reaching the oestous
- Uterus - Implantation of the embryo providing nourishment and protection for the embryo
- Vagina - Depositing sperms during sexual intercourse, acting as a birth canal during parturition
- Vulva - Secretion of mucus

- Point out that one should be concerned about the oestrous cycle and heat signs when impregnating a sexually matured dairy cow.
- Inquire into the students knowledge on the oestrous cylce.
  - In cows which have reached puberty. ovulation occurs once in 21 days. Nearing ovulation oestrogen hormone level in the blood increases and heat signs appear. These heat signs are the physical and behavioural changes displayed with the increase in the oestrogen concentration in blood and they reflect desire for sexual reproduction.This stage in which heat signs appear is called the oestrous.
  - Heat signs reappear 21 days after one oestrous. Since it is periodic it is known as the oestrous cycle.The oestrous cycle is the interval bertween the beginning of one oestrous and the beginning of the other oestrous.
  - Point out that the oestrous cycle is mainly controlled by the internally secreted sexual hormones.
  - Discuss the major hormones that regulate the oestrous cycle and the organs / structures which secrete them.

    1. Follicle stimulation hormone - FSH (Secreted by the interior lobe of the pituitary gland)
    2. Luteinizing hormone- LH (Secreted by the interior lobe of the pituitary gland)
    3. Oestrogen - (Secreted by the developing graffian follicle)
    4. Progesterone - (Secreted by the corpus luteum)

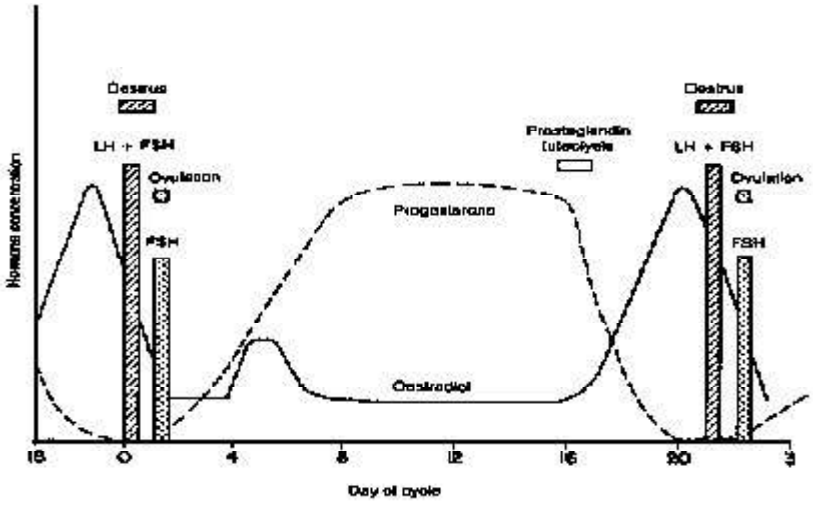
  - Point out that during the oestrus cycle a lot of physical changes in the uterus,vagina and ovary occur due to the impact of these hormones and that the oestrous cycle can be divided into four stages according to those changes:

1.	Pro-oestrous	2-3 days
2.	Oestrous	18 hours
3.	Met-oestrous	3-4 days
4.	Die-oestrous	12-13 days
		21 days

- Guide the students to introduce each stage and, to present facts about the changes that occur in the reproducive system and about the action of hormones in those stages.

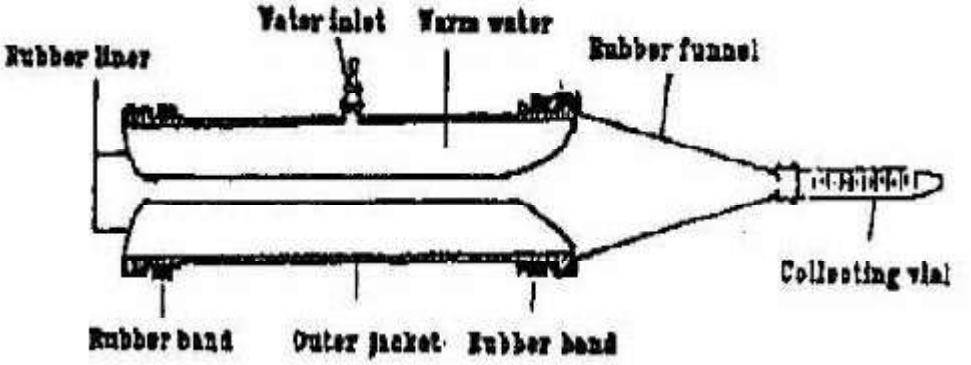
  Ex:
  - Pro-oestrous - The stage before the beginning of oestrous
  - Hormonal activity
  - The growth of follicles begin with the effect of the FSH hormone on the ovaries during this period.
  - Changes taking place
    - Thickning of the mucus layer which acts as an interior liming to the uterus
    - Enlargement of the muscle fibres in the walls of the uterus
    - Secretion of mucus from the cervix
    - Reddening of the vagina

- Oestrous- The time which female animals show desire for sexual intercourse. Cows shows heat sings during this stage.
  Ex:
  - Allowing sexual intercourse / homosexual behaviour
  - Uneasiness
  - Repetitive screams, frquent urination
  - Enlargement of external sexual organs
  - Reddening of the vagina and secretion of mucus from the vagina
  - Raising the tail frequently
  - Getting isolated from other animals
  - Hormonal activity :
    - Oestrogen secretion from the graffian follicle gradually increases. When the oestrogen reaches a certain level, the FSH level in blood decreases, while the LH level increases. Ovum is released in this stage (ovulation).
- Met Oestrous- The stage in which oestrous ends is known as met oestrous.The physical and behavioural changes occcured with the oestrous subsides during this stage and return to the normal state.
  - The progesterone hormone secreted by the corpus luteum formed after ovulation, prevents animal's subjection to heat.
  - Ensuring the fixing of the embryo, nourishing embryo and growth of the memmory glands are the other functions of the corpus luteum.The amount of oestrogen produced by the ovary decreases during this stage.
- Die oestrous- This is the end of the oestrous cycle. It is the interval between the end of the oestrous to the beginning of the next oestrous cycle.
  - When the ovum fertilization does not occur, the growth of the corpus luteum stops and it gradually gets reduced.This causes the progesterone level to decrease.
  - With that, the pituitary gland secretes the FSH hormone which stimulates, follicle growth, starting another oestrous cycle.
  - Die Oestrous occurs only when impregnation does not occur.



Effect of hormones on the oestrus cycle

- Point out that the most convenient time to inseminate a cow is 12-18 hours after the oestrous begins.
  Ex: • Animals showing heat signs in the morning hours should be inseminated in the evening of the same day.
  • Animals showing heat signs in the evening hours should be inseminated next morning the following day.
- Point out that inseminating 6 hours befor the oestrous period or 18 hours after showing heat signs causes a low pregnancy rate.
- Point out that cattle insemination could be carried out in two methods:
  • Natural insemination
  • Artificial insemination
- Introduce each method.
  • Natural insemination- Getting to a bull to sexually intercourse with a cow which shows heat signs.
  • Artificial insemination - Depositing the semen produced by a selected stud bull with advanced features through certain techniques after examining it. The semen is deposited in the vagina (the end of the cervix) of a cow which shows heat signs.
- Discuss the steps of artificial insemination.
  • Sperm collection
  Ex: • An artificial vagina is used for this process.
  • It is made according to the natural features of the vagina of a live dairy cow, namely: warmth,pressure and smoothness.



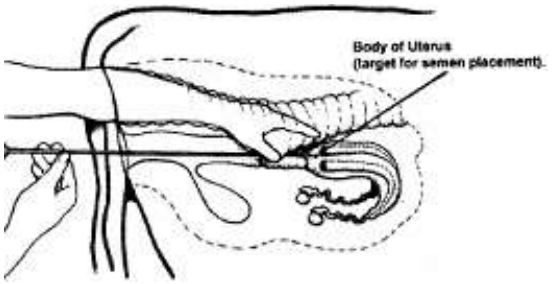
  • Assessment of sperm
  • Sperm samples are subjected to visual and microscopic observation.
  • Visual observations- sperm colour, viscosity, volume, pH
  • Microscopic observations- sperm mobility sperm concentration,abnormal sperm percentage, dead and live sperm percentage and bacteria infections etc.
  • Dilution and addition of preservatives
  • Ask the students about the importance of sperm dilution.
  • The ability to process a large number of samples from one sample obtained from one secretion.
  • To avoid destruction of sperms produced from the reproductive system of a bull after secreting semen to the external environment, due to lack of nutrients and a suitable environment to live in.

- Ask the students about the substances that can be used to make dilution media for sperms.

Ex: Egg yolk citrate (Egg yolk and 2.9 % sodium citrate medium)
Egg yolk phosphate
Milk media

- Discuss the essential features of a diluted medium.
  Ex:
  - An osmotic pressure favourable for sperms
  - Non toxic for sperms
  - Controlling the pH value in the medium

- Freezing and storage
  - Point out that if the sperms are not used immediately after dilution they should be stored.
  - Sperms are freezed or de-freezed depending on the time period in which they are used.
  - Point out that sperms are kept in the refrigerator at a temperature of 4 ^{0}C after putting them into semen straws .Point out that the viability of sperms of this type rapidly slackens and should be used within 3-4 days. Sperms made this way are called "chillled semen".
  - Point out that the defreezing method is used when storing sperms for a long period of time.
  - Point out that sperms can be stored using liquid nitrogen at -196 ^{0}C
  - Discuss the method of sperm de-freezing.
    - The semen straws are stored in a refrigerator for 5-16 hours to bring the temperature to 4-5 ^{0}C .Then the semen straws are staked in a rack and exposed to liquid nitrogen vapour (-80 ^{0}C)Then it is kept in a liquid nitrogen container.
    - Glycerol is added to the diluted solution. It prevents the adverse effects of freezing .
    - 0.5 ml-1ml plastic tubes are used to store semen. Their size varies with the species.The straws should be labelled with numbers or any other marks before filling in semen to them.
- Sperm transportation
  - Point out that strong containers that can maintain low temperatures should be used in sperm transportation..
  - Point out that damages caused to defreezed sperms transportation could be avoided by using containers with liquid nitrogen .
- Insemination of cattle
  - Point out that the recto-vaginal method is used in the insemination of cattle.
  - Discuss how the recto-vaginal method is performed.



Recto-vaginal method

- First the external sexual organs of the animal on oestrous should be cleaned and dried.
    - One hand is entered into the anus and the cervix situated at the inner end of the vagina is touched.
    - After that, the sperms are deposited on the cervix by entering the pippette containing sperms by the other hand.
    - Underscore the fact that the service of a professional versed in inseminating animals is required for this.

- Discuss the advantages and disadvantages of artificial insemination.

  Advantages

  Ex:
    - Ability to use animals of advanced hereditary characteristics for breeding.
    - Ability to use the animal's sperms in foreign countries even after its death for insemination by defreezing the sperms.
    - Ability to reduce the spread of sexually transmitted diseases.
    - Ability to obtain a large number of calves from one stud bull.
    - Ability to use an animal for breeding even if it is disabled and has good features.
    - Ability to evade dangers that could be caused by stud bulls.

  Disadvantages

  Ex:
    - Animals with an unsuitable heridity could be widely used for artificial insemination when there's no proper selection method.
    - Producers might not be able to select an animal suitable for their requirements.
    - In-breeding could be increased due to the use of a small number of animals.
    - A large amount of capital and proper organization is required to provide aftificial insemination services.
    - Professional technicians are essential .

Key words :

- Reproductive system of a cow
- Oestrous cycle
- Heat signs
- Artificial insemination

Qualitative inputs

- Posters or illustrations on the structure of the reproductive system of a cow , oestrous cycle and equipment used for artificial insemination
- Videos on the artificial insemination method

Instructions for assessment and evaluation:

Pay attention to the following facts.

- Identifying parts of the structure of the reproductive system of a cow
- Describing the oestrous cycle and heat signs.
- Describing the effect of hormones on the oestrous cycle
- Describing the method of heifer impregnation

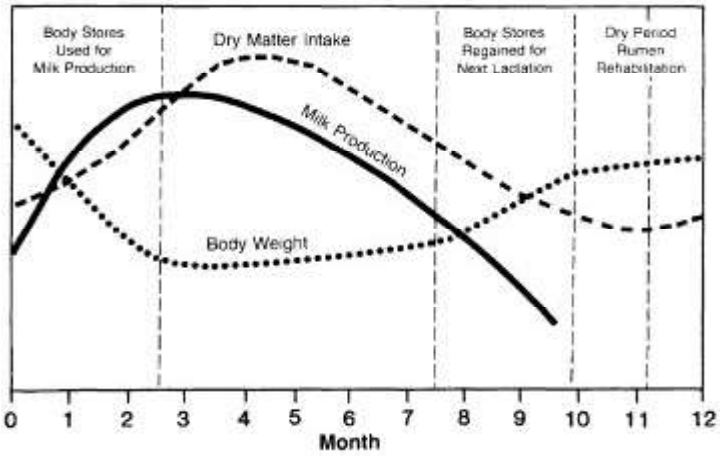
Competency level 4.10 : Inquires into the rearing methods of pregnant cows.

Number of periods : 02

Learning outcomes :
- Describes the manner of providing food for pregnant cows.
- Lists parturition symptoms of pregnant cows.
- Describes how cow and the place are prepared for parturition.

Instructions for planning the lesson:

- Start the lesson by presenting pictures or videos on pregnant cows.
- Point out that cows which do not show heat signs 21-42 days after insemination are known as "pregnant cows".
- Point out that the gestation period of a dairy cow is 274 ± 10 days.
- Explain the importance of paying a attention to the dairy cows during their gestation period.
  Ex:
  - To avoid slipping and congestion of cows in cattle houses and grasslands.
  - To prevent infections from other animals.
- Discuss how pregnant cows are nourished correctly.
  - Ask the students about the importance of nourishing pregnant cows properly .
    Ex:
    - To provide nutrition for their growth, sustenance, embryonic growth and for milk production.
  - Point out that nutritional needs of pregnant cows reaches the climax due to the rapid growth of the embryo during the last 2 months of the gestation period.
  - Point out that the required nutrition should be provided in order to obtain a high yield of milk during the period of lactation.
  - Emphasize the fact that nutritional mineral mixture should be suppliedand is important for the extra requirement of calcium, phospherous, magnesium and micronutrients.
  - Point out that nutritional needs of pregnant cows could be obtained from nutrient charts.
  - Point out that drying should be done two months prior to parturition.
  - Ask students about of importance of drying.
    - It makes possible the storing of nutrients essential for the growing embryo and the next lactation period and also the repair of worn out tissues in the udder.At this time grass should be provided while concentrates should be provided 10% more than the usual quantity. Watr should be provided in sufficient quantity less.



- State that the gestation period is 280 days and at the end of those 280 days, the pregnant cow gives birth to a calf. This is called parturition.
- Emphasize the fact that from parturition symptoms it can be identified that the pregnent cow is about to give birth to the calf.
- Let the students list parturition symptoms of a pregnant cow.
  Ex:
  - Enlargement of the udder which is filled with milk
  - Secretion of milk as drops when the udder is squeezed by fingertips
  - Slight enlargement of the vagina and secretion of mucus
  - Restlessness.
  - Intermittent standing and lying.
  - Discharge of a bag filled with liquid through the vagina when parturition nears
  - Curling up its back , raising its tail
- Discuss the manner of preparing the dairy cow for parturition.
  Ex:
  - Isolating from other animals a few days before parturition.
  - Repairing damages on the floor
  - Providing clean water to drink
  - Washing the backside and the udder of the cow with soap
- Discuss the way of preparing a place for parturition.
  Ex:
  - Spreading hay on the ground and making a lining
  - Removing stones/rocks on the ground
- Discuss about the steps that must be followed during parturition.
  Ex:
  - Checking if the calf has come out by 2 hours after the rupture of the water bag
  - Seeking instructions of a veteinerarian if it delays
  - Removing the placenta to prevent the cow from eating it
  - Providing a bit of grass afterwards
  - Vaccinating dairy cows who show mineral deficiency, according to the advice of a veterirarian

Key words :

- Gestation period
- Parturition

Quality inputs :

- Pictures/videos on pregnant cows and parturition
- Nutitient charts - approved recipes.

Instructions of assessment and evaluation:

Pay attention to the following facts:

- Stating the importance of being highly concerned about the pregnant cows during the gestation period.
- Stating the parturition symptoms of a pregnant cow
- Describing the method of preparing a pregnant cow for parturition
- Indicating how the place is prepared for parturition
- Indicating what is done at the time of parturition

Comepetency level 4.11 : Inquires into methods for improving animals to increase production.

Number of periods : 04

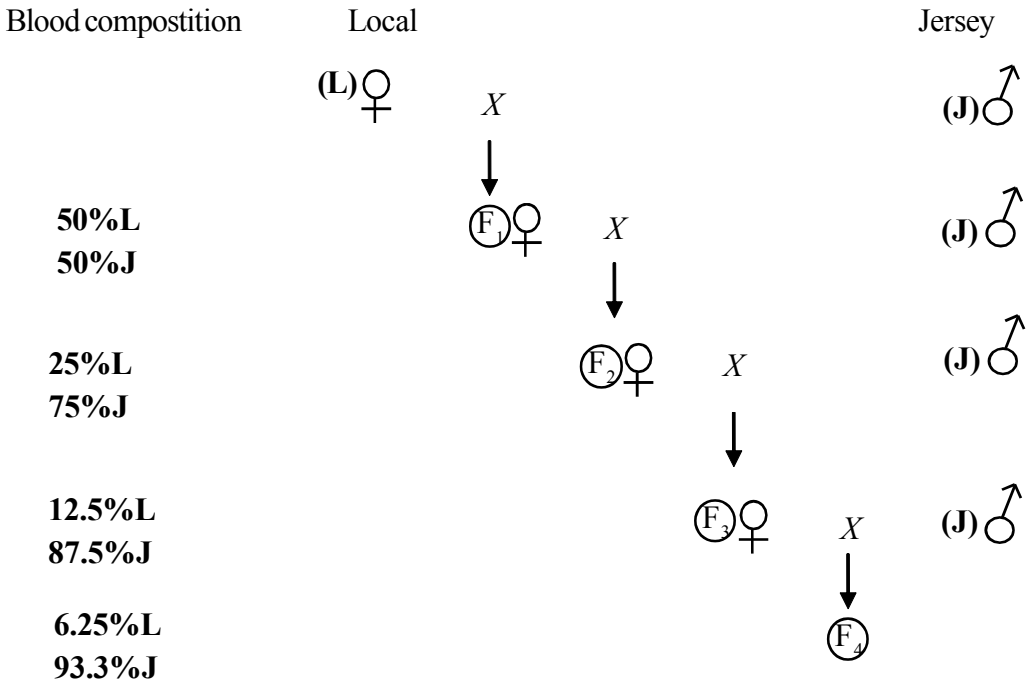
Learning outcomes :
- States the importance of livestock breeding.
- Describes methods of livestock breeding.

Instructions for planning the lesson:

- Present a chart indicating the quantities of animal products imported to Sri Lanka during the past Point out that according to the chart, the animal products produced in Sri Lanka are insufficient.
- Show that environmental factors as well as genetic factors should be improved in order to improve animal products.
- Explain that improving genetic factors to increase animal production is called animal breeding.
- Discuss the importance of animal breeding.
  Ex :
  - Maintaining the animal industry as profitable business.
  - Incrasing production by improving genetic characteristics of animals
  - Supplying animal products according to the rising demand
- Introduce the methods used for animal breeding:
  - Natural
  - Controlled
- Point out that it is difficult to obtain offspring that would provide a high production by insemination of animals under natural conditions.
- Discuss the fact that breeding under a controlled conditions could result in more productive calves.
- Inquire into the methods used for animal breeding.
  - In- breeding
  - Cross- breeding
- State that inbreeding is breeding among animals with close kinship. Animals with one or common ancestor in a generation are called inbred animals.
  - Direct the students to list the changes that occur due to degeneration of characteristics casused by inbreeding.
    Ex :
    - Decrease in production
    - Suppression of growth
    - Decrease in fertility
    - Decrease in immunity
    - Decrease in birth weight
    - Reduction in the body size of the animal
- Ask the students about the instances where in- breeding is used.
  Ex:
  - To establish important economic features of animals in a certain population uniformly.
  - To idenify and cull animals of inequality or those with unsuitable genes .
- Define cross-breeding. Point out that it is the process of obtaining offsprings by interbreeding two breeds of animals showing genetic differences.
- Discuss the objectives of cross- breeding.
  - Introducing a favourable gene from another animal type into a particular animal population.
  - Creating hybrid vigour.

- Discuss the processes followed when introducing favourable genes in to an animal population.
  - Cross-breeding for improving features
    - This is done if only one feature of an animal type appears feeble . It is implemented to . improve that particular feature.That feeble feature of those animals could be removed by crossing them with male animals in which that particular feature is strong .The existing animal type is maintained as it is.
  - Improving up to an advanced animal type
    - Here, the objective is to improve a breed to the level of a specific animal type which shows a high production .All male animals in the population are removed and are replaced by other selected male animals for breeding.
    - The resulting F1 hybrid animal are bred preventing inbreeding with the selected male. In six generations an animal which has 98.3% of the blood of the superior type can be obtained.

      Ex: Improving local cows with the Jersey type



  - Breeding for new animal breeds
    - This method is used to produce a new animal breeds when a particular animal breed in a certain area is incompatible to its geographical conditions.The essential features here are the adaptation of the new breed to the environmental conditions, and the high productivity.Therefore, selection should be done when getting parents for this.

Ex: The process implemented in producing the Sunandani cow breed

Brown Swiss	Indian cattle	Brown Swiss blood
		50%
		75%
		50% (Sunandani)

- Guide the students to investigate cattle breeds produced by this method.

  Ex : Jersey x Sindhi or Sahiwal ⟶ AMZ (Australian Milking Zebu)

  Fresian x Sahiwal ⟶ AFZ (Australian Freisian Sahiwal)

- Define hybrid vigour.
  - The main objective of animal breeding is the establishment of parental feature in the offspring. Hybrid animals show high heterozygous features while showing a high production of their parents. Various biological notions have been forwarded as reasons for this while the increase in production of the offspring generation is known as the hybrid impact.
    This hybrid impact does not solely affect quantitative features such as milk production and egg production but also affect the viability of animals. This concept is called "hybrid vigour".
- Accentuate that hybrid vigour will not be transmitted from one generation to another and that the production of the next generation obtained by interbreeding the hybrid animals could be decreased.
- Ask the reason for this.
  - It is because of the decrease in heterozygous nature due to gene segregation. Therefore, hybrid vigour is an impact solely existant in the first hybrid generation.
- Guide the students to explore information on alternative hybridization and rotational cross breeding used to upgrade cows .
- Inquire into the cattle breeds recommended for various agro-climatic zones for cross breeding.

Agro-climatic zones	Approved cattle breeds for cross breeding
Dry zone Up country Low country wet zone	

- Discuss the problems confronted in cross-breeding.
  - The need of two or more animal breeds
  - The necessity of a broad organization and the complexity of management
- Point out that selection should be done when choosing animals for breeding.

- Show that in selection, suitable parents are selected to produce the next generation of an animal population.
- Indicate the fact that here, the animals which show unsuitable hereditary characteristics in a certain animal population are removed from the group and only the animals who show essential characteristics of breeder are used as parents to produce the next generation.
- Discuss the methods that could be used to obtain information about animal selection.
  - Production reports
  - Pedigree records
  - Reproductive test

Key words :

- Selection
- In- breeding
- Cross- breeding
- Hybrid vigour

Quality inputs:

- A chart illustrating the amount of animal products imported to Sri Lanka during the past few years

Instructions for assessment and evaluation:

Pay attention to the following facts:

- Introducing animal breeding
- Stating the importance of animal breeding
- Describing cross breeding
- Stating the manner in which the blood percentage of animals change during cross- breeding
- Stating the processes of alternative hybridization and rotational hybridization

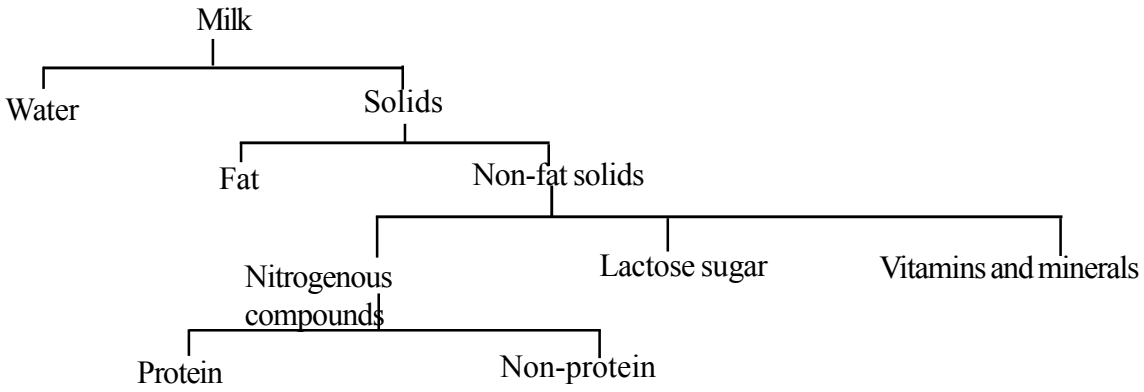
Competency level 4.12 : Plans conditions required to maintain the quality of milk

Number of periods : 02

Learning outcomes :
- Describes the composition of milk.
- States the factors affecting the composition of milk.

Instructions for planning the lesson:

- Present a milk sample to the class.
- Start the lesson by letting the students examine the colour, odour and viscosity of milk.
- Thereby elicite an introduction for milk.
  - Milk is a highly nutritional liquid with a delicate taste produced in the mother's mammory glands of mammals for the nourishment of the neonate after giving birth to it.
- Ask the students about nutrients contained in milk.
- Let the students categorize those nutrients.



- Discuss special features in milk.
- Water - 88% water is present in high fat fresh milk.
  - Proteins -Kesine is the main protein present in milk. It is approximately 80% of overall proteins. In addition, it contains whey proteins, lacto albumin , lacto globuline, beta lacto globulin.
  - Fat - High fat milk consists of approximately 3% of fat. There is 0.35% of cholesterol in fat while this level in milk is about 0.014%. About 25% of Cis 9.18.1 fatty acids are contained in milk. Fats in milk occur as small globules. Fat in milk is formed by triglycerides of saturated fatty acids.
  - Carbohydrate - Lactose is the main carbohydrate in milk. It is called milk sugar.
  - Vitamins - A precursor of vitamins-Carotine, provides its characteristic yellow colour. Milk is an important source of A and B vitamins.
  - Minerals - Milk is rich in calcium. It also contains iodine,magnesium and zinc as micro-elements.

- Let the students compare the milk of various farm animal breeds using a chart.

Animal species.	Water %	Lactose %	Protein %	Fat %	Mineral %
Cattle	87.92	4.46	5.28	3.49	0.75
Goat	82.00	4.27	3.52	4.25	0.86
Sheep	80.71	4.81	5.23	7.90	0.90
Buffalo	82.76	5.48	3.60	7.38	0.78
Human	87.43	6.98	1.63	3.75	0.21

- Let the students compare the composition of milk in various farm animal breeds of cattle.

Breed	Fat %	Protein %	Lactose %	Mineral %	Non-fat solid%	Total solids %
Red Sindhi	4.90	3.42	4.91	0.70	8.76	13.66
Zahiwal	4.55	3.33	5.04	0.68	8.82	13.37
Jercy	5.37	3.73	4.93	0.70	9.54	14.91
Freician	3.40	3.13	4.86	0.69	8.86	12.26
Hybrid	4.50	3.37	4.92	0.67	8.63	13.13

- Discuss the factors affecting the change in milk composition.
  - Animal species and breed
  - Milking stage
  - Food provided
  - Number of milking times
  - Diseases associated with the udder
  - Milking method
  - Weather and climatic condition

Key words :

- Milk
- Composition of milk

Qualitative inputs

- A sample of cow's milk
- Charts that indicate the milk composition of milk in various animal types

Instructions for assessment and evaluation:

Pay attention to the following facts:

- Introducing milk
- Categorizing nutrients contained in milk
- Introducing the composition of milk of various cattlle breeds and farm animal types
- Stating the factors affecting composition of milk

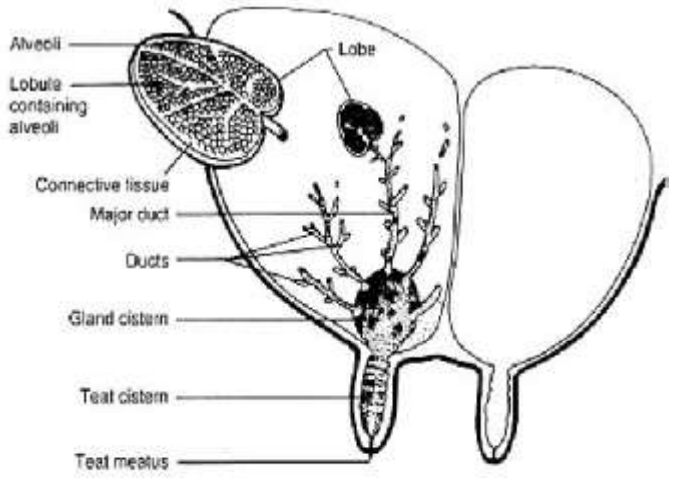
Competency level 4.13 : Examines the structure and functioning of the mammary system of a dairy cow.

Number of periods : 04

Learning outcomes :
- Describes the mammary system of a cow using a diagram.
- Explains the functioning of the mammary system of a cow.
- Explains the processes of milk secretion and milk let-down.
- Analyses factors affecting the milk harvest.

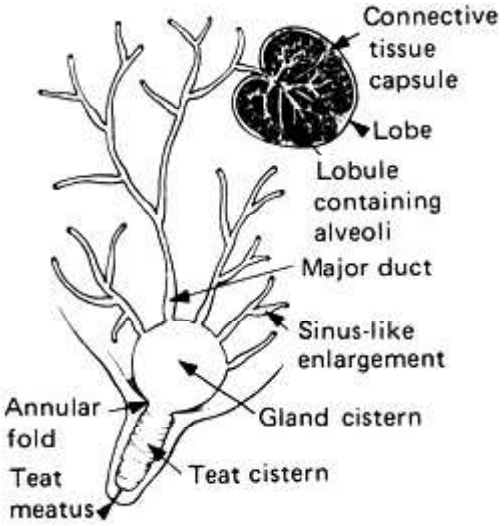
Instructions for planning the lesson:

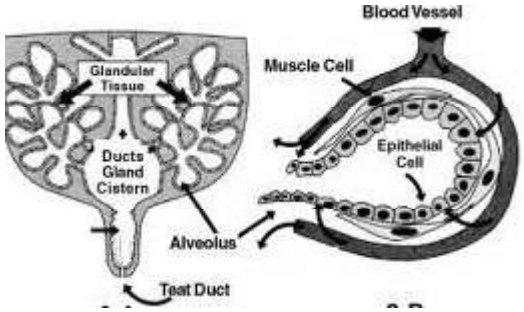
- Present two pictures of a dairy cow which produces milk and of a dairy cow which does not produce milk. Let the students compare those two pictures. Start the lesson by drawing attention to the difference between their udders.
- Point out that the milk needed for the nourishment of the calf is produced in the mammary system of the dairy cow.
- Discuss the rough structure of the mammary system using a diagram.



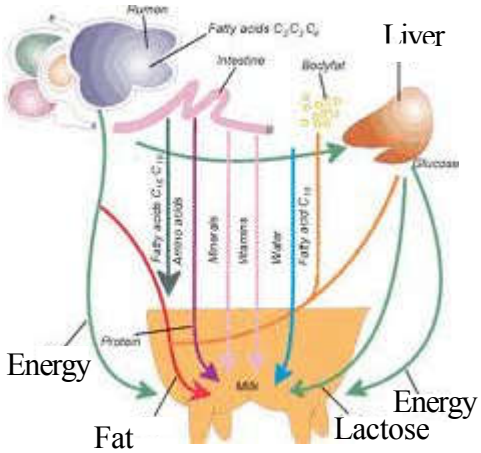
- Let the students sketch the structure of the mammary system and label its parts.
- Pay attention to the following facts when discussing the mammary system:
  - The mammary system is a modification of sweat glands.
  - The udder consists of four completely separated parts : anterior, posterior, right and left.
  - The anterioir half has 40% and the posterior half has 60% production capacity.
  - The udder consists of one teat for each part and the mammary glands are connected to them.
  - The function of the mammary gland is secretion and storage of milk.
  - These glandular tissues are interconnected by connecting tissues.
  - A mammary gland consists of lot of lobules and each lobule contains lot of alveoli made of milk cells.
  - The alveoli are the basic functioning units.
  - A myoepithelium is present in each alveolar gland.
  - This secretes milk to the alveolar cavity.
  - Essential nutrients for milk production are provided by the proper blood circulation connected to the alveolar glands.

- The milk flowing from the alveoli reaches the branched ducts through the fine glandular structures in the alveoli and those ducts are connected to larger ducts.
- Those ducts finally open to the gland cistern (the space for milk storage).
- The gland cistern opens into the teat cistern in the teat and then to the exterior through the streak canal.
- A few moments after milking a muscular tissue at the end of the furrow closes.



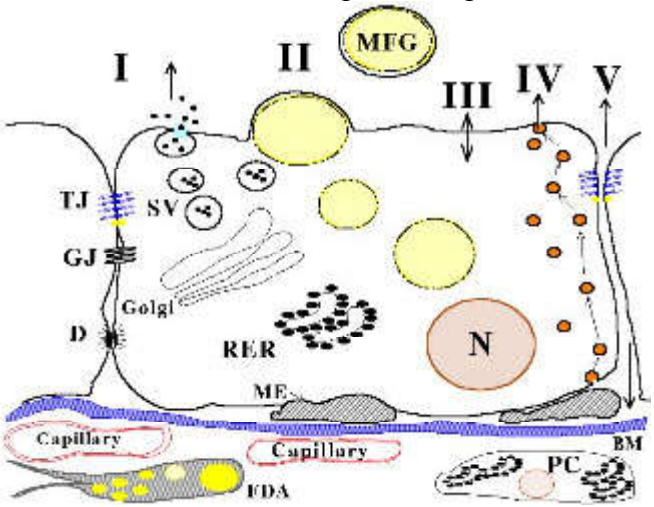


- Discuss the functioning of the mammary system. Make use of diagrams and videos for this.
- Discuss the functioning of the mammary system under the following topics:
  - Milk secretion
  - Milk let down
- Discuss how milk is secreted.
  - The end products of digestion absorbed to the blood stream in the digestive system of the cow (glucose, fatty acids, amino acids,vitamins, minerals) are carried to the walls of the alveolar glands in the udder.



Milk secretion

- The myoepithelium secretes milk using the nutrients so carried.
- In myoepithelial cells small fat globules are formed by the aggregation of fatty acids. These small globules then unite form large fat globules which are emptied into the alveolar cavity through the plasma membrane of the myoepithelial cells. Similarly milk containing proteins, lactose, sugar, vitamins, minerals and fats is secreted into the alveolar cavity.
- This is defined as milk secretion and it is a persistent process.



- Point out that with milk scretion, the pressure in the alveolar glands increases and then milk secretion stops.
- Therefore, this pressure would be reduced by decreasing the interval between milking or by accomodating the calf to suck the milk. This brings about secretion of milk again.
- Ask the students about the hormone crucial for milk secretion.
- It is LTH (Luteotroph hormone) or prolactin.
- Describe milk let-down.
  - It is the release of milk into the cavities of alveolar glands due to their contraction caused by a suitable external stimulation and then into the gland cistern and teat cistern.
- Show that milk letdown is a neuro-endocrine process. It is controlled by the cenral nervous system and a hormone connected with it.
- Describe the process of milk let down using the following flow chart:

Receiving a suitable external stimulation

↓

Hypothalamus receives the stimulation

↓

Sending a nerve impulse to the posterior pituitary

↓

Producing oxcytocin hormone

↓

The hormone moves into the alveolar glands through blood

↓

Myoepithelium around alveoli contracts

↓

Alveoli are squeezed and the milk is secreted through the duct

↓

Milk enters into the gland cistern

↓

Milk reaching into the teat cistern

- Discuss the infuence of hormones on the functioning of the mammary system.
  Ex : Oxytocin - Affects milk let-down
  Thyroxin - Increases the blood supply to the mammary system and increases the nutrient amount.
  Oestrogen, Progesterone } Contributes to the growth of the mammary gland
  Prolactin - Stimulates milk secretion
- Discuss the factors affecting milk harvest.
  - Animal breed and type
  - Health of the animals
  - Age of the animal
  - Lactating stage
  - Maintenance in the dry season

Key words :

- Mammary system
- Milk secretion
- Milk let-down

Quality inputs

- A picture of a dairy cow who produces milk and a picture of a dairy cow who does not produce milk.
- Photos or videos that indicate the functioning of the mammary system of a dairy cow.

Instructions for assessment and evaluation :

Pay attention to the following facts:

- Drawing and naming the rough structure of the mammary system
- Describing the functioning of the mammary system
- Indicating the process of milk secretion through a flow chart
- Describing the factors affecting the milk harvest

Competency level 4.14 : Inquires into how quality milk is obtained from cows.

Number of periods : 04

Learning outcomes :
- States the importance of safe milking.
- Describes the method followed in safe milking.
- Describes causes for the deterioration in milk quality.
- Selects quality milk by following various techniques.

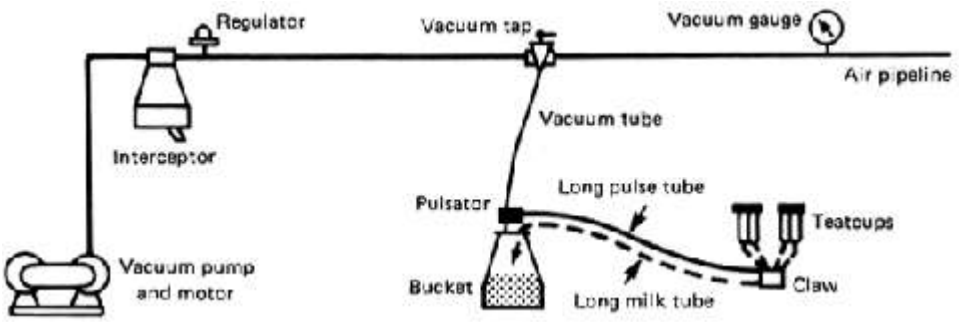
Instructions for planning the lesson:

- Start the lesson by presenting diagrams or a video on ways of milking and by inquiring into it.
- Introduce milking through it.
  - Taking out milk in the teat cistern through the teat meatus is called milking.
- Point out that there are two main ways of milking.
  - Hand milking
  - Machine milking
- Discuss various methods of hand milking

Full hand milking Stripping Knuckling

- Discuss machine milking methods.
  - Mobile milking machine
  - Combined milking machine

Mobile milking machine



Combined milking machine

- Let the students compare advantages and disadvantages of hand milking and machine milking.
  Ex: Milk could be quickly and efficiently taken out by the machine milking method in comparison to the hand milking method.
- Point out that the following steps need to be followed in order to obtain quality milk:
  - Wash the udder and teats with clean water and wipe them with a clean piece of cloth to remove water drops falling from the teats.
  - Milk away the first milk drops coming from each teat and subject the milk next obtained to the strip-cup test.
  - Milking into already cleaned containers.
  - Use the full hand method when milking by the hand milking method and remove the last milk drops by the stripping method.
  - After the milking process, sink the teats in an antiseptic (teat dripping).
- Discuss the importance of safe milking.
  Ex:
  - Ability to obtain milk of good quality
  - To prevent addition of adulterants from outside
  - To get a high price for milk
- Discuss the process followed in safe milking under the following.
  - Cleanliness of the dairy cow
  - Cleanliness of the cattle shed
  - Cleanliness of the milker
  - Cleanliness of the containers used for milking and collection
- Discuss causes for the lowering of the quality of milk.
  Ex:
  - Not maintaining the required sanitary conditions during milking
  - Addition of various substances to milk by the producers
    Ex: water, milk powder, wheat flour, coconut milk, salt
- Direct the students to determine the quality of milk through the following tests:
  - Measuring the fat percentage in milk- Gerber method
  - Measuring the specific gravity - Lactometer method
  - Determining the non-fat solids percentage in milk
- Direct the students to test the presence of the following substances in milk.
  - Water
  - Salt
  - Wheat flour
  - Sugar or coconut milk
  - Formalin
  - Salicylic acid
  - Non-fat milk
- Instruct the students to select high quality milk while following different methods.

Key words :

- Milking
- Quality of milk

Quality inputs :

- Dairy milk samples
- Pipettes
- Centrifuge
- Lock key
- Amyl alcohol
- Beutrometer
- Rubber stoppers
- Sulphuric acid
- Lactometer
- Measuring cylinder
- Thermometer
- 10% Potassium dichromate
- Iodine
- Ceramic containers
- Ferric chloride
- Ether
- Citric acid
- Silver nitrate
- Glycerine
- Concentrated hydrochloric acid
- Dolica molibo phosphoric acid
- Phenolpthelin

Instructions for assessment and evaluation :

Pay attention to the following facts:

- Introducing milking
- Describing the process of safe milking
- Stating the main methods of milking
- Descrbing hand milking
- Stating reasons for the deterioration in quality in milk
- Identifying good quality milk

Competency level 4.15 : Identifies various cattle diseases and plans measures to control them.

Number of periods : 04

Learning outcomes :
- Classifies cattle diseases.
- Presents information about major cattle diseases.
- Identifies cattle diseases according to symptoms.
- Describes steps that should be taken to manage cattle diseases.
- Describes non-communicable diseases contracted by cattle.
- States the importance of animal health management.

Instructions for planning the lesson :

- Start the lesson by asking the students about their experiences of the externally observable symptoms of sick animals.
- Derive the definition of a "disease" through it.

  A disease is a diversion from the normalcy of an animal. That means, it is a change in a particular organ/part, structure or the usual functioning in the body or a deviation from normal physical health.
- Discuss the impact of unfavourable health conditions on farm animals.

  Ex :
  - Reduction of growth and production
  - Debilitation of reproductive efficiency
- Ask the students about cattle dseases.
- Let the students classify these diseases.
  - Communicable diseases.
    - Bacterial diseases - Mastitis
      - Haemorrhagic septicaemia
      - Brucellosis
    - Viral diseases - Foot and mouth disease
    - Protozoal diseases - Tick fever
  - Non-communicable diseases - Milk fever
    - Stomach bloating
- Guide the students to investigate into the causal agent, disease symptoms and controlling methods of the diseases mentioned above.
- Direct the students to include that information in the following table:

Disease	Causal agent	Symptoms	Treatments and controllong strategies
Communicable • • •			
Non-communicable • •			

- Discuss the importance of animal health management.
  Ex :
  - Reduction of the number of animals who die due to diseases
  - Ability to ensure the high standard in animal products
  - Increasing in the quality of animal products
  - Decreasing in the cost for medecines
  - Ability to prevent the transmission of diseases from the infected animal to human beings
  - Ability to use lands,labour and capital effectively
  - Ability to increase profits

Key words :

- Cattle diseases
- Animal health management

Quality Inputs

- Internet, magazines

Instructions for assessment and evaluation:

Pay attention to the following facts :

- Stating the impact of unfavourable health conditions on farm animals
- Stating the importance of animal health management
- Categorizing cattle diseases
- Describing cattle diseases and stating management methods

Competency 4.16: Inquires into poultry rearing systems and houses

Number of periods : 05

Learning outcomes :
- States suitable poultry breeds for rearing.
- Describes poultry rearing systems.
- Presents information about poultry houses.

Instructions for planning the lesson :

- Present diagrams or videos of different poultry breeds.
- Start the lesson by letting the students identify these poultry breeds.
- Point out that poultry rearing is implemented as an industry in Sri Lanka.
- Discuss reasons why farmers incline towards poultry rearing in Sri Lanka.
  Ex :
  - Increase in demand for meat and eggs
  - Ability to acquire products within a short period
  - Ability to rear a large number of animals in a smalll space
  - Ease in management
- Point out that poultry breeds can be divided into groups based on the purpose of rearing as follows:
  - For eggs - White leghorn
  - For meat - Brahma, Kochin
  - Dual type - RIR, Australorp
  - Supplementary - Indian game
- Let the students compare the differences among these poultry breeds. Use pictures, photos and videos of poultry breeds for this purpose.
  Ex: Feather colour, mature body weight, egg production
- Point out that commercial breeds have been produced among these breeds for meat and egg production.
- Emphasize that in Sri Lanka these breeds are used more commercially.
- Point out that with the advancement in technology, these breeeds have been introduced with the objective of obtaining a high production.
- Ask the students about examples for breeds reared in Sri Lanka.
  - Hens laying brown eggs
    Ex: Golden comet, Hisex brown, Shavor 579, Loman brown, Highline brown
  - Hens laying white eggs
    Ex: Shever 288, Highsex white, Highline white
  - Broiler
    Ex: Cob spp, Hubbard, Hybro, Loman, Shaver, Sarbro
- Indicate that with the advancement of genetic engineering , broiler types have been produced which reach maximum growth in about 35 days.
- Point out that although there are differences in the commercial names based on companies, similar features are seen in most of the breeds.
- Ask the students about the main poultry rearing systems in Sri Lanka.
  - Free-range
  - Semi-intensive
  - Intensive
- Guide the students to carry out a comparison among the systems. Derive the following facts:
  - A animal rearing zones
  - Advantages and disadvantages

- Indicate the fact that permanent poultry houses are provided in rearing poultry by intensive and ultra-intensive systems.
- Guide the students to investigate the permanent poultry house types.
  - Deep litter system
  - Slattered floor system
  - Cage system
- Instruct the students to present facts about each system comparatively.
  Ex: Method of preparation, advantages and disadvantages
- Discuss the importancce of providing poultry houses.
  Ex:
  - Protecting the animals preventing exposure to high winds, rain, sunlight or any other unfavourable climatic condition
  - Protecting anmals from external attacks or enemies
  - To provide sufficient food and water systematically
  - To acquire high quality products and a contingent free of diseases

Key words :

- Poultry management
- Poultry breeds
- Poultry houses

Quality inputs :

- Photos, pictures and videos of poultry breeds
- A video or a picture of poultry rearing systems
- Pictures of various type of poultry houses

Instructions for assessment and evaluation:

Pay attention to the folowing facts :

- Stating the importance of poultry management
- Categorizing poultry based on their functions with examples
- Naming poutry breeds
- Stating different methods of poultry rearing and their advantages and disadvantages
- Describing the importance of providing poultry houses

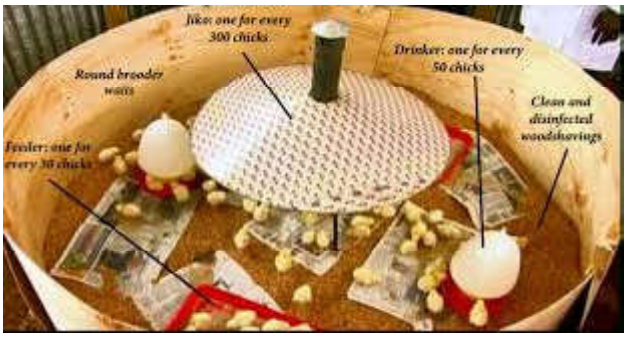
Competency level 4.17 : Inquires into suitable chick management methods.

Number of periods : 02

Learning outcomes :
- Describes the method of day old chick- brooding.
- Describes the method of chick management.

Instructions for planning the lesson::

- Present a picture that indicates a mother hen brooding eggs to depict the way it is done. Start the lesson by inquiring into the reasons to do so.
- Point out that fertile egg incubation could be conducted naturally using a hen or using an artificial incubator and the fact that a matured chick could be obtained from the egg 21 days after incubation.
- Indicate that this chick who comes out of the egg is called a "day-old chick".
- Inquire the students about criteria that must be considered in rearing day-old chicks.
  Ex:
  - Being healthy and active chicks
  - Having bright eyes
  - Being free of disabilities/abnormalities
  - Having a uniform growth
  - Normal body weight should be 35-40 g
- Inquire the students about methods of chick-brooding.
  - Natural method
  - Artificial method
- Point out that brooding of the chick who comes out of the egg is known as the natural chick management method.
- Discuss the features that should be possessed by a hen suitable for this method.
  Ex: Having a normal size body having features suitable for incubation
- Discuss the advantages and disadvantages of the natural method.
  Advantages - Ex: Low cost
  Disadvantages - Ex: Unsuitable for a large-scale poultry farm
- Point out that a brooder is used in the artificial method.



- Ask the students about environmental factors that must be considered in managing chicks reared in a brooder.
  Ex: Temperature, light, gusts of wind
  - Discuss the ways to control these conditions.
  - Discuss the ways of sterilizing the brooder, supplying water and food and maintaining the litter.
  - Discuss the importance of brooding chicks in the brooder.
  Ex: The ability to protect their health status
  - Discuss the way of brooding the chicks for the period of 2-4 weeks after their time inside the brooder (up to 8 weeks). Pay attention to the following facts:
    - Recommended immunity programme:

Age	Immunization
At birth	Marex vaccine
3 weeks	First Ranikhet vaccine
6 weeks	First vaccine for ckicken pox
7 weeks	Begining of giving vermicides
13 weeks	Second dose of vermicides
14 weeks	Second Ranikhet vaccine

- Shortening the beak
  - Carried out in 5-10 days or 4-6 weeks.
  - The importance of trimming the beak Ex: To prevent cannibalism
  - A beak trimmer is used for this purpose.

  - Providing a vitamin solution with water mixed with glucose to reduce pain, on the day prior to the day of shortening the beak.
  - Animal culling
    - Weak animals are isolated
    - Advantages - Ex: Reduces food wastage
  - Provision of feed
  - Ration of chicks
    - Protein - 18%
    - Metabolizable energy - 2 900 kcal/kg
  - Food should be provided unlimitedly.

Key words :

- Chick brooding
- Day-old chicks

Quality inputs

- A picture of a hen and a group of chicks
- Videos indicating the states of selection of chicks and incubation of eggs

Instructions for assessment and evaluation:

Pay attention to the following facts :

- Stating the two methods of brooding day-old chicks
- Stating main steps followed in brooding chicks by the natural method
- Stating the main steps followed in brooding chick by the artificial method
- Stating ways of quality control in the brooder
- Stating the advantages and disadvantages of broooding chicks in the brooder
- Stating the immunity programme of chicks
- Describing the method of rearing animals after the chick brooding period

Competency level 4.18 : Inquires into suitable management methods for growing hens.

Number of periods : 02

Learning outcomes :
- Defines growing hens.
- Describes the ways of providing food for the animals.
- Indicates the ways of culling and beak cutting.

Instructions for preparing the lesson:

- Let the students observe a picture or watch a video of a poultry house of growing hens. Start the lesson by asking students about the growth stages of hens and about poultry houses.
- Point out that hens aged 8-18 weeks reared with the intention of getting eggs are called "grower hens".
- Inquire about houses that could be provided for grower hens.The deep litter system is often used for them.
- Discuss the spatial needs and foods that should be provided in the houses based on the deep litter system.

  Ex: Space required by an animal (a hen) - 0.12 m^2
  Animals/m^2 - 8.3
  Oval shaped food bowls - 6.4 cm/animal
  Round shaped containers - 3.8 cm/ animal
- Discuss the nutrient composition of the ration that is provided to the growing hens.

  Protein 13-15%
  Fiber < 8%
  Energy 2 750 kcal
- Conduct a discussion on the method of supplying rations for the hens
  - Providing food in a way that reduces competetion.
  - Providing food within limites
  - Introducing food rations systematically and introducing a grower mass ration method.
  - Filling r 1/3rd of the food container with food
  - Being cautious about the cleanliness of food materials and of the containers.
- Ask the students about the spatial requirements for water containers.

  Oval shaped water containers - 1.9 cm/ animal
  Round shaped water containers - 1.3 cm/ animal
- Discuss the method of providing water for grower hens.
  - Use of automated or non-automated water containers
  - Cleaning the water containers once a day
  - Providing clean water twice a day
- Discuss the other management methods.
  - Animal culling
  - Shortening of beaks - in 08-12 weeks or
    - in 18 weeks (depends on the requirement)
- Maintaining nutrition of animals , immunization and safety of houses properly

Key words

- Growers

Quality inputs

- A picture or a video of a house of grower hens

Instructions for assessment and evaluation :

Pay attention to the following facts:

- Defining grower hens
- Being concerned about the space requirements of hens
- Stating the spatial requirements for food and water containers
- Stating the other requirments of animals

Competency Level 4.19 : Plans management methods for layers.

Number of periods : 02

Learning outcomes :
- Lists the features of a hen laying a large number of eggs.
- Explains the manner of preparing houses for layers.
- Describes the method of providing food for layers.
- Explains the method of managing environmental factors according to the layers' requirements.

Instrustions for planning the lesson:

- Present a picture or a video that indicates layers and egg cages in a poultry house. Start the lesson by inquiring into the laying stage of hens.
- Point out that sexual maturity occurs at the age of 18 weeks and that egg laying begins at the age of 18-21 weeks. Emphasize that this first stage is called pullets.
- Let the students list features of a hen that lays a higher number of eggs.
  Ex:
  - Having an average body size
  - Having food conversion efficiency
  - Not tempted for egg brooding
  - Laying eggs in a short period
- Let the students comparatively present the observable differences between hens who give a high yield and a hens who lay less number of eggs.

Organ	**High egg producers**	**Low egg producer**
Comb		
Eyes		
Beak		
Feathers		
Feather dropping		
Part from breast bone to Pelvic bone		
Skin		
Vent		
Toes in leg		
Bust		
Stomach		

- Point out that the deep litter system is mostly used for layers.
- Discuss the facts that should be considered when preparing houses for the deep litter system.
  Ex:
  - Being aware of mitigating the stress induced when transferring hens to new houses
  - Careful handling of the animals
  - Transferring the animals in the morning

- Maintaining the cleanliness of the houses
  Fixing egg cages before egg laying (when the hens are 14-16 weeks of age).
  An egg cage must be 45 cm long and 30 cm wide while the height of the opening of the box should be 20 cm and the height of the entire box should be 45cm.
- Putting a 5cm thick bed of hay, chaff or sow dust.
- Washing, cleaning and sterilizing the egg cages before installing them in the houses.
- Keeping a door that can be closed to prevent animals from entering the egg cages at night and defecating in them.

- Ask the students about the space requirements of layers the deep litter system houses.
  Ex: For soft breeds - 0.16 m^2 per bird
  For heavy breeds - 0.19 m^2 per bird
- Discuss the space requirements of food and water containers.

	Light breeds	Heavy breeds
Oval shaped feeders	10 cm / animal	12 cm / animal
Round shaped feeders	4.9 cm / animal	5.8 cm / animal

	Light breeds	Heavy breeds
Oval shaped water containers	2.5 cm / animal	3.5 cm / animal
Round shaped water containers	1.5 cm / animal	2.0 cm / animal

- Discuss facts that should be considered when providing food for layers.
  Ex:
  - Providing the food ration of the layers when the egg production reaches 5%
    Protein - 14-16%
    Fiber - 7-9 %
    Energy - 2800 k cal/kg
  - Conducting the transeferring of food systematically
    At the first growth stage the hens should be acclimatized to 75% of food and 25% of layer mash for 2 days, a mixture of 50% each of layer mash and grower mash for 2 days ,75% of layer mash and 25% of grower mash for 2 days and finally completely acclimatizing for layer mashes.
  - Providing adequate food to the hen containing calcium
    Ex: Sea shells, limestone

Stage	Calcium requiremnt for one animal (g)
Before laying eggs	2
First stage of egg laying	5
End stage of egg laying	10

- Discuss the consequence caused by calcium deficiency in food ration in animals.
  Ex:
  - Bone deformities
  - Thinning of egg shells
  - Egg picking and cannabalism
  - Decrease in egg production.

- Let the students state the environmental factors that should be considered in layer management.
  - Light
  - Temperature
  - Humidity
- Inquire into the prior knowledge on the impact of those factors on egg production.
- Guide the students to calculate the egg production efficiency of a hen.

  Ex : Number of hens - 100
  Number of eggs laid - 80
  Quantity of food provided - 12 kg
  Price of 1kg of food - Rs. 40.00
  Total egg production - 80/100 = 80%
  Feed Conversion Ratio - FCR = 12 000 g/ 78
  = 150 g of food per egg

  $\frac{12 \times 40}{80}$ = Rs. 6.00

Key words :

- Layers
- Layer management

Quality inputs

- A picture or a video of layers and egg cages in a poultry house

Instructions for assessment and evaluation:

Pay attention to the following points:

- Stating features of a hen who lays a large number of eggs
- Stating the facts that should be considered when preparing houses for layers
- Stating the space requirements of layers
- Stating space requirements of food and water containers
- Stating facts that should be considered when providing food for layers
- Stating consequences of calcium deficiency

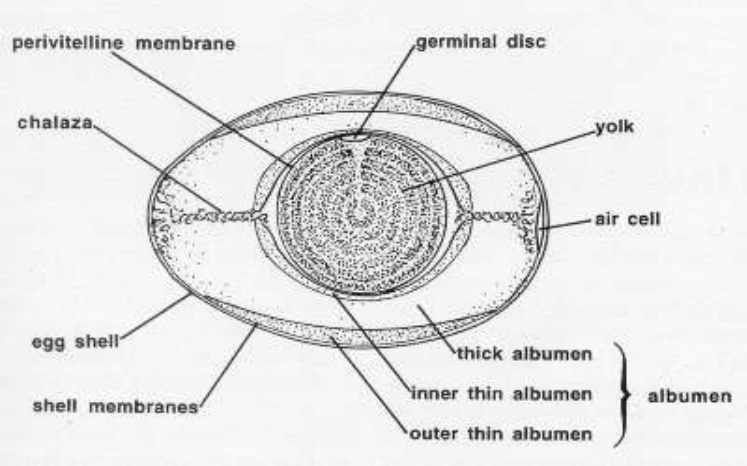
Competency level 4.20 : Inquires about the quality of eggs and about incubation

Number of periods : 04

Learning outcomes :
- Describes the structure of an egg using a diagram.
- States the composition and the nutritional value of an egg.
- Describes egg incubation methods.
- Determines the quality of ggs.

Instructions for planning the lesson:

- Take an egg, break it and present it to the class. Start the lesson by letting the students identify its parts.
- Present a diagram that indicate the structure of a typical egg and let the students identify its parts.



- Let the students draw the structure of an egg.
- Discuss the functions of each part of the egg.

  Ex:
  - Cuticle - Functions as a mechanical barrier.
  - Egg shell - Protects the egg, maintains its shape and is important for the exchange of gases
  - Inner and outer shell membranes - Prevents entery of micro-organisms into the egg.
  - Air cell - Exchange of gases
  - Albumin (Egg white) - Protects the egg yolk from shock, act as an antiseptic and provides nutrition for the growing embryo.
  - Egg yolk - Providing nutrition to the growing embryo
  - Germinal disk - Growth of the embryo
- Discuss the composition and nutritional value of a hen's egg.

	Whole egg	Shell-less egg	Albumen	Egg yolk
Water	69.9%	77.0%	88.4%	48.4%
Protein	11.2%	12.4%	10.6%	17.0%
Fat	8.5%	9.4%	-	32.5%
Carbohydrates	0.3%	0.3%	0.4%	0.2%
Minerals	10.1%	0.9%	0.6%	1.8%

- Introduce egg incubation.
  - The process of obtaining chicks out of fertile eggs by maintaining essential conditions for the embryo growth is called egg incubation. Chicks are born 21 days after incubation.
- Let the students name the two main methods of egg incubation.
  - Natural method
  - Artificial method
- Point out that using a hen for egg incubation is the natural method.
- Discuss the factors that should be considered in the natural method under the following topics:
  - Selecting the brooding hen

    Ex :
    - Having a healthy, strong body
    - Having a medium size body with lot of feathers
    - Having reached the brooding condition
    - Free from external parasites (ticks, flees)
    - Dual purpose breeds such as RIR, Light sussex, Austrelop are suitable for this.
  - Preparing a place for brooding.

    Ex:
    - The place for incubation should be a bit dark, with a quiet environment. It should be cool and free from rain and wind.
    - Preparing egg cages for egg incubation - boxes made of wooden strips or planks, cane baskets etc.
    - Spreading the cages with dry sow dust, straw or chaft after sterilizing the cages.
  - Introducing eggs to the hens.

    Ex:
    - Selecting the hen with brooding features and introducing some normal eggs to it at night.
    - Introducing the selected eggs for incubation at night if the hen broods them.
    - Letting the brooding hen come out twise a day and letting the hen stay outside for 15 minutes or less.
- Discuss the advantages and disadvantages of the natural egg incubation method.

  Advantages

  Ex:
  - High efficiency in egg brooding.
  - Low cost and simple

  Disadvantages

  Ex:
  - Difficulty in using a large number of eggs (12-15 eggs are used at a time)
  - Reduction of the hen's production period as 21 days are required for incubation.
  - The possibility of transmitting diseases and parasitic attacks to the chicks.
- Point out that egg incubators are used in artificial egg incubation.
- Discuss the steps that must be followed for egg incubation inside incubators, under the following topics:
  - Keeping incubators levelled.
  - Fumigating before use - For this a substance such as formaldehyde can be used.
  - Temperature control

    Ex:
    - There should be a temperature of 37.8- 39.3 ^{0}C for egg incubation (when there are no fans). When air is artificially provided, a temperature of 37.5- 37.8 ^{0}C would be suffice.
    - The eggs are transferred to the part where chicks are born, 18 days after keeping eggs in a large egg incubator. In that part a temperature is maintained 0.5- 1^{0}C or less.
    - When egg incubation and the birth of chicks occur in the same part, the temperaure of it must be 37.8 ^{0}C .

- Humidity control
  Ex: • Humidity should be increased as 40-50% in the first week, 50-60% in the second week, and 60- 65% in the third week.When 1/3rd of the eggs are hatched, humidity should be 75% and when 2/3rd of chicks come out it should be reduced to 65% .
- Ventilation control
  Ex: • Clean air should be provided sufficiently to the growing embryo during this period.
- Storing of the eggs - Keep the blunt end downward in the trays.
- Turning of eggs
  Ex: • Egg turning needs to be done daiily from the 3rd day after the beginning of incubation.
  • Egg turning must be done 4-6 times in the first stage . After that, turning 2-3 times per day for 17 days would be sufficient.

- Discuss the advantages and disadvantages of artificial egg incubation.
  Advantages
  Ex: • Ability to incubate a large number of eggs at a time.
  • No impact on the production period of the hen.
  Disadvantages
  Ex: • Maintaining temperature, humidity control, egg turning are carried out using electrical energy. The incubation is hampered if there is a power faliure.
- Discuss the unfavourable effects resulting from the lack of quality control in egg incubators.
  Ex: • If there is a high humidity near the chick's birth , it would result in a weak chick. If a low humidity is maintained during the incubation period, small chicks with weak bone development would be born.
  • When the temperature increases during the incubation period, although time taken for the hatching is less, the rate of production of chicks would be low. (The chick sticks to the the egg shell and dies).
- Emphasize that it is crucial to select good quality eggs when selecting eggs for incubation.
- Point out that internal and external features of eggs should be examined when determining the quality of eggs.
  - External features of eggs suitable for incubation.
    Ex : • Cleanliness of the egg shell
    • Shape of the eggs
    • Mass of the eggs
    • Nature of the egg shell
    • Colour of the egg shell
- Point out that the internal features of the eggs suitable for incubation could be tested by the Candlin instrument.
- Point out that eggs unsuitable for incubation are removed after testing the eggs by the Candling instrument.
  Ex: • Egg is opaque and light is not visible from outside
  • Cracks, blood stains and pieces of meat on the egg shell
  • Presence of two egg yolks and the egg yolk is shifted to one side
  • Egg white is discoloured
  • Having a large air cavity
- Guide the students to examine internal features of eggs using the Candling instrument.

Key words :

- Structure of an egg
- Egg incubation
- Quality of eggs

Quality inputs

- A picture of an egg's structure
- A few eggs

Instructions for assessment and evaluation:

Pay attention to the following facts:

- Describing the egg structure using a diagram
- Stating the composition and the nutritional value of an egg
- Describing and presenting egg incubation methods
- Determining the quality of eggs

Competency Level 4.21 : Exhibits preparedness for the rearing broilers.

Number of periods : 02

Learning outcomes :
- States suitable types of houses for rearing broilers.
- Examines the ways of providing food and water for broilers.
- Describes provision of light and temperature for broilers and prevention of their diseases.

Instructions for planning the lesson:

- Present two pictures of a poultry type reared for meat and of a broiler sample and let the students identify them. Start the lesson by surfacing the fact that broilers are the types that are mostly reared for meat at present.
- Define broilers.
  The strains produced for meat by crossing two poultry types to effect maximum growth in a short period like 35 days are called "broilers".
  Ex:
  - Cornish x Plymath rock
  - Sussex x RIR
- Although the features of broilers are similar, let the students prepare a list of names of broilers reared in Sri Lanka.
  Ex:
  - Indian runner
  - Wencob
  - Hybro
  - Habbard
- Point out that there is a difference in the commercial names according to the companies, and as the features of the animals are often similar , the benefits are also similar.
- Ask the students about the methods of rearing broilers.
  - Deep litter system
  - Slattered floor method
  - Battery cage method
- Discuss about the space that sould be provided according to the age of animals.

Age	Space requirement (m^2)
1-4 days	0.03
7-14 days	0.05
14-42 days	0.09

- Discuss the problems that would arise due to lack of sufficient space.
  Ex :
  - Contracting diseases due to the lack of proper ventilation
  - Fall off in cleanliness
  - Increase in the spread of diseases
  - Emergence of bad odour
  - Competition for food and water
  - Decrease in meat production

- Discuss problems caused by the excessive space inside houses.
  Ex: Decrease in meat production with the decrease in food conversion efficiency ratio due to increased movement of the animals
- Point out that the quantity of food required to produce 1kg of the live weight of an animal is called the "Food conversion ratio".

$$\text{Food conversion ratio} = \frac{\text{Total feed consumed by one animal (kg)}}{\text{Live weight of the animal (kg)}}$$

- Point out that a value lower than 1.8 of the food conversion ratio is suitable for broilers.
- Point out that it is important to provide a high nutrition to broilers as they show a quick growth.
- It is required to supply the broiler starter from the first day to the 4th week and the broiler finisher from the end of the 4th week ' ad- libitum'.
- Guide the students to compare the nutritional composition between the broiler starter and the broiler finisher.

	ME (Cal/kg)	Protein %	Fiber %	Fat %	Calcium %	Phospho-rus %
Starter ration	3000 - 3200	22	≤ 6	< 8	1	0.8
Finisher ration	3000 - 3200	18-20	$\leqslant 6$	8	1	0.7

- Point out that food prepared for broilers are available in the market in different types.
  Ex: Powedered type, Cubical type, Cylindrical
- Discuss the importance of providing the animals with cubical and cylindrical food compared to the powdered type.
  Ex:
  - Ability to reduce food wastage
  - Ability to reduce diseases related to lungs
- Point out that different types of containers are used to provide food for broilers.
  Ex: Oval containers, Round containers
- Point out that the space that should be provided for the animals food containers changes with their growth stage.
  Oval containers- 10-15 cm / for one bird
  Round food containers - 10-15 cm / for one bird
- Emphasize that automated food containers also could be used to provide food.
- Point out that clean, fresh water should be provided to broilers and that various types of water containers are used for this purpose.
  - Normal type containers
  - Automated type
- Point out that the space in one water container sufficient for one animal is 24 cm.
- As animals are highly fatigued in the first three days , about four tea spoonfuls of glucose added to 1L of boiled and cooled water should be given. Vitamins and minerals can also be given with water.
- Point out that the water containers should be cleaned once a day and that water should be renewed every day.

- Point out that it is important to provide light so that animals can consume food both day and night.
- Point out that a high light intensity should be provided in the first 14 days and that it should be reduced to a low intensity afterwards.
- State that incandescent bulbs or fluorescent bulbs could be used for this purpose.
- Discuss how temperature is maintained for broilers. Point out that a day-old broiler should be provided with a temperature of about 35 ^{0}C at the beginning and this temperature should be lowered to the room temperature later, gradually.
- Point out that the brooder time is two weeks.
- Discuss the facts that should be considered when selecting a litter for poultry houses.
  - The litter should be free of chemicals and other harmful substances.
  - Should be free from excessive dust or powder.
- Discuss the way of managing the litter.
  Ex: • Setting a layer of chaff to a height of 5-10 cm
  • Preventing excessive granulation
- Ask the students about diseases that could be caught by broilers.
- Discuss the immunity implemented to provide vaccinations to prevent Gamboro and Ranikhet diseases.

Diseases	Age for vaccine	Type of vaccination	Method of vaccination
Mareks	day 1	Mareks	Neck/ Under the wing
Ranikhet	2-3 weeks	Hithher B1(live)	Mixing with drinking water
Gamboro	day 7,14 and 21	Live Intermediate	Mixing with drinking water As eye drops
Newcastle	day 1 day 9-14	ND	Mixing with drinking water As eye drops

Key words :

- Rearing of broilers
- Broilers

Quality inputs

- A poster on broilers or a picture of a meat shop

Instructions on assessment and evaluation:

Pay attention to the following facts:

- Defining broilers
- Indicating houses suitable for rearing of broilers
- Examining the manner of providing food and water for broilers
- Describing the method of providing light, and temperature and preventing diseases

Competency level 4.22 : Plans methods for poultry disease management.

Number of periods : 04

Learning outcomes :
- Presents information about major poultry diseases.
- Identifies poultry diseass according to the symptoms.
- Describes measures that should be implemented for poultry disease management.

Instructions for planning the lesson:

- Let the students observe a picture or a video that indicates ill and healthy poultry.
- Ponit out that various diseases that could be caught by animals by showing the differences indicated in those pictures.
- Inquire the students about poultry diseases.
- Let the students categorize those diseases.
  - Communicable diseases
    - Bacterial diseases - Salamonellosis
    - Viral diseases
      - Gamboro
      - Chicken pox
      - Ranikhet
      - Bird fever
    - Protozoa diseases - Cockcidiosis
    - Worm diseases
      - Tape worm diseases
      - Round worm disease
  - Non-communicable diseases - Curly toe paralysis
    - Cannibalism
- Guide the students to investigate into the causal agent, disease symptoms and management methods.
- Direct the students to fill in those information in the following table.

Disease	Causal agent	Disease symptoms	Treatments and management
Communicable • • •			
Non-communicable •			

- Discuss about the methods of managing poultry diseases.
  Ex:
  - Maintaing the health saftety of the farm
  - Vaccinating at the right time
  - Treating the sick animals
  - Removing sick animals

Key words:

- Poultry diseases

Quality inputs

- Pictures of sick and healthy poultry

Instructions for assessment and evaluation :

Pay attention to the folllowing facts:

- Stating the causal agents of poultry diseases
- Stating the causal agent, symtoms and management methods of the salmonellosis disease
- Describing the causal agents, symptoms and management methods of viral diseases of poultry
- Describing the causal agents, symptoms and management methods of cocidiosis disease and worm diseases caught by poultry
- Presenting facts about non-communicable poultry diseases
- Describing methods followed for disease management

Competency 5 : Exhibits readiness for using economic principles to increase the productivity of agricultural businesses.

Competency level 5.1 : Inquires into proper management of the factors of production.

Number of periods : 03

Learning outcomes :
- Introduces agricultural economics.
- Identifies factors of production and states their special features.
- Describes the way of managing factors of production efficiently in the production process.

Instructions for planning the lesson:

- Ask the students about various businesses related to the agricultural industry. Instruct students to list them. Emphasize that knowledge about economics is essential to obtain the maximum profit from those businesses.
- Introduce Agricultural Economics.
  - Agricultural economics is a monetary analysis of products that could be obtained based on plants and animals.
- Discuss the importance of agricultural economics.
  Ex:
  - The agricultural industry has turned into a business sectorr based on profit.
  - It has to fulfill unlimited human wants with limited available resources.
- Point out that agricultural products can be divided into two groups as goods and services.
- Present an agricultural product or another hen to the students and prepare a list on materials required to make it.
- Point out that anything used here for the production process is considered a factor of production.
- Point out that the factors of production listed above could be divided into four categories based on their nature:
  - Land
  - Labour
  - Capital
  - Entrepreneurship
- Introduce the factor of production called "land".
  - All the natural resources gifted by nature such as minerals, water, oceans, forests and climatic factors on earth belong to the factor of "land".
- Discuss the special features of the factor "land".
  Ex :
  - It is a natural resource
  - The supplies are mostly steady
  - Cannot be used in isolation
  - Immovable
  - Heterogeneous
- Discuss the ways of increasing the productivity of land.
  Ex:
  - Using for a suitable production process based on the condition of the land.
  - Using techniques such as irrigation methods, soil conservation methods or application of are tificial fertilizers.
  - Developing the land by methods like reclamation .

- Define labour.
  - The physical or mental effort spent for the production of a good or a service is labour.
- Discuss the special features of the labour factor.
  Ex :
  - A movable factor
  - Heterogeneous
  - Inability to be separated from the labourer
  - A factor that needs training
  - Subjected to regional specialization.
- Discuss how labour productivity can be increased.
  Ex :
  - Providing higher wages for skilled labour
  - Initiating labour intensive industries in countries where labour is readily available.
  - Determining the number of labour units required for the production process and engaging labourers according to it.
- Define capital.
  - Goods and equipments made by man for future production is capital.
- Discuss the features of capital.
  Ex :
  - A man-made production
  - Productivity
  - Long-term
  - Subjected to depreciation
  - Ability to be used for a number of production processes
  - Discuss methods to increase the productivity of capital.

  Ex :
  - Planning properly the production process
  - Managing well the factors labour, land and entrepreneurship
  - Efficient management of machines, equipment and buildings
  - Persuading people to save.
- Define entrepreneurship.
  - Initiating businesses with a profit motive and managing production resources optimally for it, is called entrepreneurship.
- Discuss features of entrepreneurship.
  Ex:
  - Making decisions on production properly
  - Using factors of production
  - Producing new goods and services and viewing market opprtunities
  - Desire to use new technology
  - Bearing responsibilities and ability to take risks
- Discuss the ways to increase productivity of entrepreneurship.
  Ex:
  - Giving the opportunity to acquire knowledge of the production process by giving opportunities to participate in in-service programs, seminars and foreign jobs.
  - Improving one's knowledge himself by reading magazines and newspapers.
  - Providing facilities to study other production processes similar to that of self.
- Emphasize that the productivity of agricultural businesses could be increased through proper management of the four factors of production.

Key words :

- Agricultural economics
- Factors of production

Quality inputs

- Lists and pictures indicating employment opportunities related to agriculture.

Instructions for assessment and evaluation:

Pay attention to the following facts:

- Stating the importance of agricultural economics
- Stating the four factors of production
- Stating the features of each factor
- Stating methods to increase productivity of each factor

Competency 5.2 : Makes decisions based on the nature of demand in agricultural businesses

Number of periods : 06

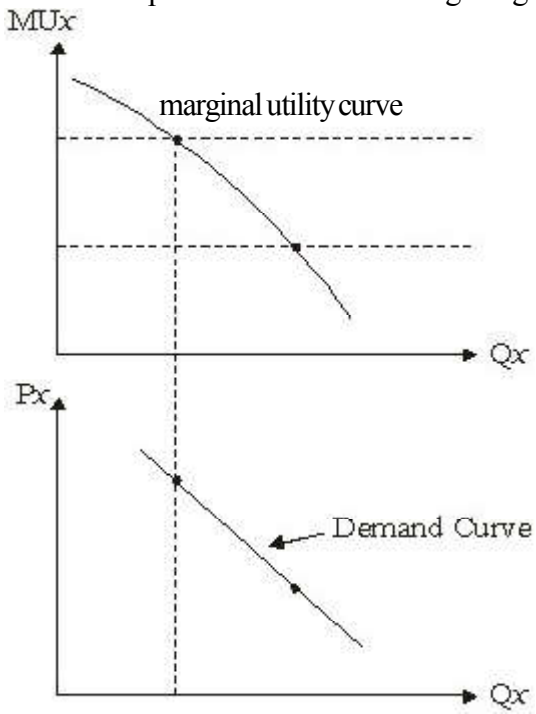
Learning outcomes :
- Intoduces utility.
- Defines consumer demand.
- Names factors affecting demand.
- Explains the relationship between the price and demand of a good.
- Draws the demand curve according to the determinants of demand.
- Explains the nature of demand for agricultural goods.

Instructions for planning the lesson :

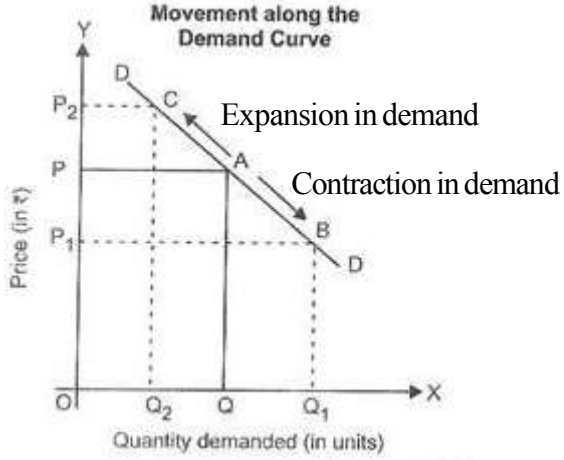
- Start the lesson by inquiring into the reactions of a person under hot sun suffering from thirsty when he gets a cool cup of water or by using any other type of approach.
- Define utility.
  - The ability to fulfill a certain want/need or the degre of satisfaction is utility. This is measured by the unit "util ".
  - Define Total Utility (TU) and Marginal Utility (MU).
    - The total satisfaction obtained by the consumption of a good or a service is known as "Total Utility".
  - When consuming a certain good or a service , the satisfaction obtained by each extra unit declines gradually. This is Marginal Utility.
- Introduce consumer demand.
  - The ability and desire of consumers to buy goods and services under respective prices is consumer demand.
- Discuss the requirements for fulfillment of "demand".
  Ex:
  - Consumer utility.
  - Consumer's purchasing power.
  - Preparedness to purchase goods.
- Present a chart that indicates prices of a certain consumer good and the degree of demanded for the good under respective prices.

Market price for rice (Rs)	Quantity demanded for rice (kg)
50	1100
55	1000
60	900
65	800
70	700
75	600
80	500
85	400
90	300
95	200
100	100

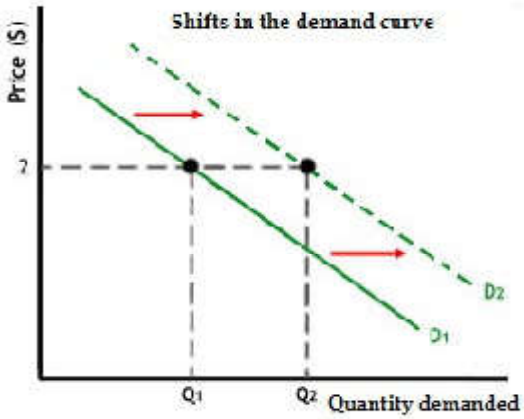
- Discuss the impact of the following on the demand of a good.
  - Price of a good (P)
  - Prices of supplements and complements ($P_{\wedge n-1\&}$)
  - Consumer income (Y)
  - Consumer taste (T)
  - Future price expectation (P_e)
  - Soicial status (R)
  - Government policies (P)
  - Climatic condition
  - Publicity (P)
  - Religious and cultural causes
- Describe the demand schedule.
  - A schedule based on the goods which consumers are prepared to buy when only the price of the product in consideration changes while all other determinants affecting demand are held constant is called a demand schedule.
- Introduce the demand function.
  - The mathematical illustration of the relationship between the determinants of demand and the quantity of that product in demand is called the demand function.
    $Qd_x = f(P_x, P_{(n-1),} Y, T, P_C, R)$
    Qd_x = Quantity in demand of the product in consideration
- Point out that demand is a function of price when all other factors affecting demand (except the price of the product in consideration) are held constant.
- Introduce the demand curve.
  - The geometrical curve that illustrates the relationship between the market price of a certain good at a particular peiod of time and the quantity in demand when all other factors affecting demand are held constant is the demand curve.
- Let the students build up the demand curve using the demand schedule given above.
- Discuss the relationship between the diminishing marginal utility curve and the demand curve.



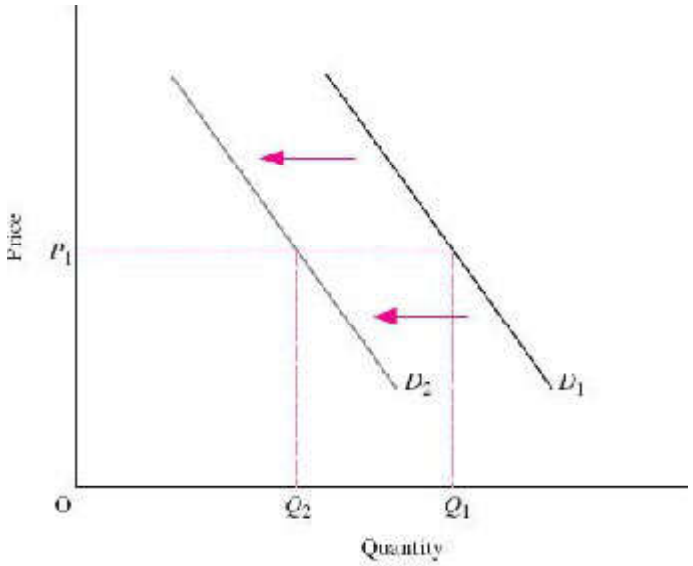
- Discuss the shift of demand curves.
- Explain the fact that the demand curve is subjected to contraction and expansion according to the change in price of the product.
  - When the demand curve remains unchanged, it moves along the curve increasing and decreasing quantity in demand according to the price of the product.



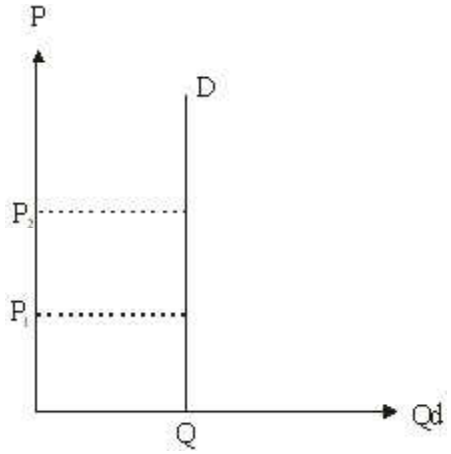
- Discuss the shifting of the demand curve to the the right or to the left due to changes in other factors affecting demand except the price.
- Discuss causes for a the shift of the demand curve to the right.
  - Increase in prices of substitutes
  - Decrease in prices of complements
  - Increase in consumer's income
  - Increase in consumer's taste
  - Expecting an increase in the future price of the product



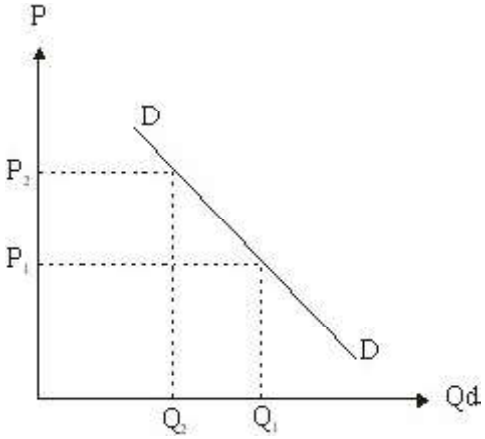
- Discuss a instances of leftward shift of the demand curve.
  - Decrease in prices of substitues
  - Increase in prices of complements
  - Decrease in consumer's taste in income
  - Expecting a decrease in future price of the product



- Discuss the the nature of demand of agricultural products.
  - Most of the agricultural products are essential goods.Therefore, the quantity demanded for these products remains unchanged irrespective of the percentage change in their prices.



  - Or else, the change in quantity demanded would be less than that of the price.



Key words :

- Utility
- Demand
- Demand curve

Quality inputs

- A demand schedule

Instructions for assessment and evaluation :

Pay attention to the following facts :

- Defining utility, total utility and marginal utility
- Listing dterminants of demand
- Introducing the demand shedule, demand function and the demand curve
- Stating reasons for the leftward and rightward shifts of the demand curve
- Stating the nature of demand for agricultural products

Competency level 5.3 : Plans to make decisions based on the nature of supply in agricultural businesses.

Number of periods : 06

Learning outcomes :
- Defines market supply.
- Names factors affecting the supply of a product.
- Explains the relationship between the supply and the price of a product.
- Draws supply curves according to the supply schedule.
- States reasons for shifts of the supply cure.
- Illustrates the shift of supply curves according to the determinants of supply.
- Describes the nature of the supply of agricultural products.

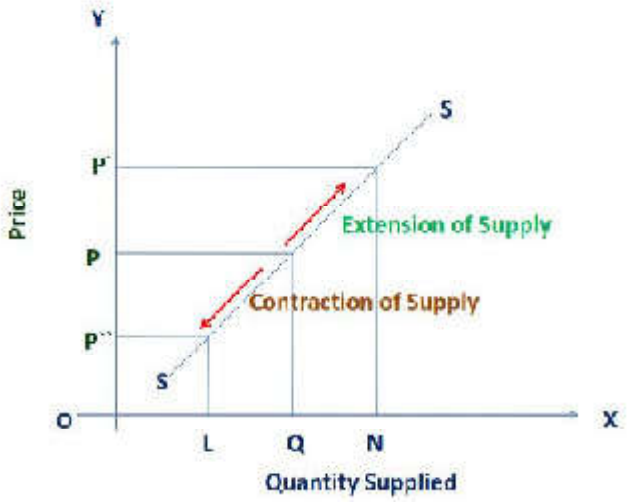
Instructions for preparing :

- Start the lesson using a suitable method.
- Introduce market supply.
  - The quantity of products provided to the market for sale in a particular period of time is the market supply of that product.
  - The collection of that product provided to a certain market by the suppliers is the market supply.
- Introduce the law of supply.
  - The supply of a product increases with the increase in its price while its supply decreases when price decreases.
- Introduce the supply schedule.
  - The table illustrating of the quantity of the product provided to the market by the supplier under various prices is the supply schedule.
    Ex: The supply schedule for tomatoes.

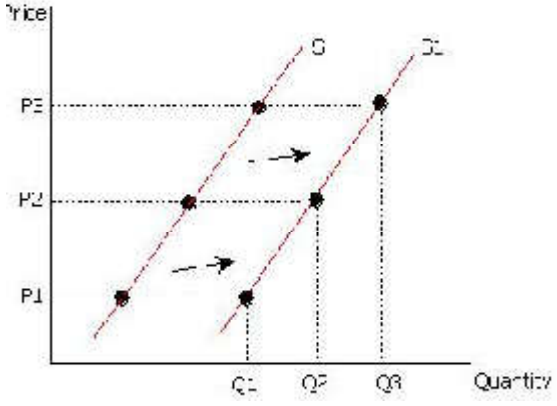
Price of 1kg (Rs.)	Quantity supplied (kg)
50	2500
75	2800
100	3100
125	3400
150	3700
200	4000
225	4300
250	4600
275	4900
300	5200

- Define the supply curve.
  - It is the graph which indicates the relationship between the price and the quantity of supply.
- Direct the students to draw the supply curve using the above supply schedule.

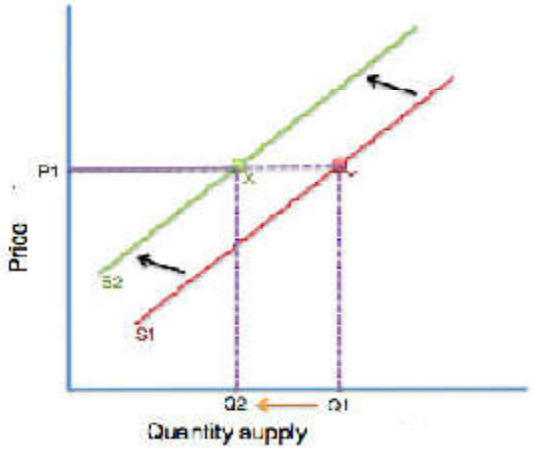
- Define the supply function.
  - The mathematical illustration of the relationship between the determinants of supply and the quantity suppplied of the product is the supply function. (to the market)
    $Q_S = f(P_x, P_S, C, Y, T, E, A)$
- Direct the students to list factors affecting supply. Discuss how these factors impact supply.
  - Price of the product (P_x)
  - Price of substitues (P_S)
  - Production cost (C)
  - Producer's income (Y)
  - Production technology (T)
  - Production goals (A)
  - Production expectations (E)
- Direct the students to draw the supply curve using the above supply schedule.
- Explain the way the supply curve contracts and expands when the price of the product changes.



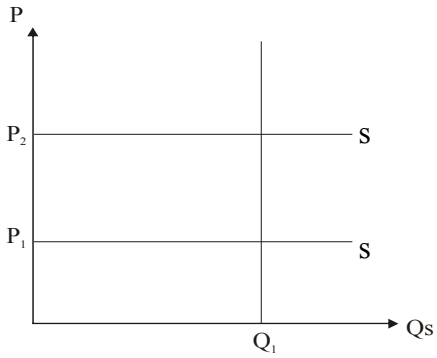
- Point out that the changes in all other determinants of supply except the price of the product cause shifts of the supply curve.
- Discuss reasons for a rightward shift of the supply curve.
  - Decrease in prices of the factors of production
  - Using advanced technology for production
  - Presence of a favourable climate for agricultural products.
  - Provision of subsidies



- Discuss reasons for a leftward shift of the supply curve.
  - Increase in prices of the factors of production
  - Degradation of the technology used in the production process
  - Presence of unfavourable climatic conditions such as droughts and floods
  - Taxes imposed on production



- Discuss the nature of the supply of agricultural products.
  - Explain the fact that products cannot be instantly changed according to the changes in prices as agricultural products depend on climatic factors. Point out that the quantity supplied is not changed according to the change in price (Quantity supplied is not responsive to the change in price).



Key words :

- Supply
- Supply curve

.Quality inputs

- Supply schedule

Instructions for assessment and evaluation:

Pay attention to the following facts:

- Defining market supply
- Defining the law of supply, supply schedule and the supply curve
- Naming the determinants of supply
- Illustrating shifts of the supply curve
- Illustrating the nature of the supply of agricultural products

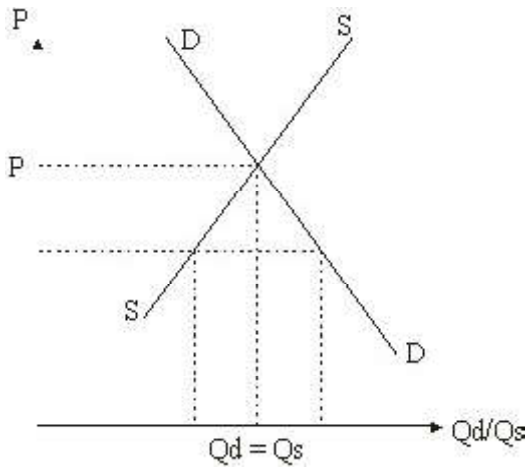
Competency 5.4 : Contemplates to make decisions in agricultural businesses while inquiring into market conditions.

Number of periods : 06

Learning outcomes :
- Defines market equilibrium.
- States the features of a market in equilibrium.
- Describes the way the market equilibrium changes according to factors such as subsidies, taxes and price ceiling.
- Categorizes market structures according to different features.

Instructions for planning the lesson:

- Inquire into places where the household products for daily consumption are purchased. Start the lesson by surfacing "market" through the students' answers.
- Introduce the market.
  - Any situation that accomodates an exchange relationship between producers and consumers when exchanging goods and services is a market.
- Define market equilibrium.
  - The instance where both the market quantity demanded of a particular good and the quantity supplied of that good are equal under a certain price is called "Competitive market equilibrium".
- Point out that the price agreed by both the supplier and the consumer in a market in equilibrium is called the equilibrium price.
- Point out that Qd = Qs in that equilibrium price.



- Discuss the features of a market in equilibrium.
  Ex:
  - The demanded price should be equal to the supplied price.
  - The quantity demanded and quantity supplied should be equal.
  - There cannot be an excess demand or excess supply.
  - The excess demand and excess supply should be zero.
- Point out that market equilibrium could be illustrated by the following methods :
  - Mathematical illustration - Through the demand and supply equations
  - Numerical illustration - Through a demand and supply sheet
  - Geometrical illustration- Through demand and supply curves

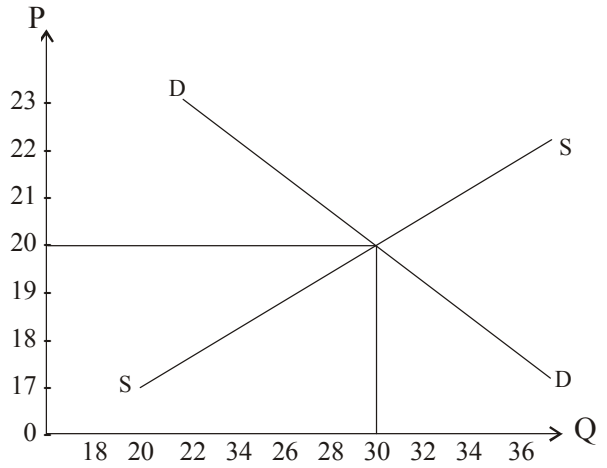
- Point out the way to illustrate market equilibrium by the demand function and the supply function.
  Ex: Demand function $Qd_x = 70 - 2P_x$
  Supply function $Qs_x = 4P_x - 50$
  - In an equilibrium situation, the quantity demanded and quantity supplied of the product are equal.
    Accordingly, $Qd_x = Qs_x$
    $70 - 2P_x = 4P_x - 50$
    $70 + 50 = 4P_x + 2P_x$
    $120 = 6P_x$
    $120/6 = P_x$
    $20 = P_x$
    This is the product's equilibrium price.
    Quantity demanded of the product P_x at the the price of Rs 20,
    $Qd_x = 70 - 2P_x$
    $= 70 - 2x20$
    $= 30$ units
  - Quantity demanded is equal to quantity supplied in a market in equilibrium. Accordingly when the price of the product is Rs 20, the equilibrium quantity is 30 units.
- Explain how to construct the above concept.
- Discuss how to determine equilibrium quantity and price using the demand and supply schedules.

Ex:

Price (Rs.)	Quantity of demand (kg)	Quantity of supply (kg)	Quantity of overdemand (kg)	Quantity of oversupply (kg)
17	36	18	18	-18
18	34	22	12	-12
19	32	26	06	-6
20	30	30	0	0
21	28	34	-6	6
22	26	38	-12	12
23	24	42	-18	18

According to the above schedule, equilibrium price is Rs 20 and equilibrium quantity is 30 kg.

- Discuss how to determine equilibrium price and quantity using the demand and supply curves.



According to the above diagram DD is the demand curve and SS is the supply curve . Equilibrium is illustrated at the point of intersection of the demand and supply curves. .According to this, the equilibrium price is Rs. 20 and the equilibrium quantity is 30 kg.

- Discuss causes for the changes in market equilibrium.
  - Decrease or increase in demand when supply is held constant.
  - Decrease or increase in supply when the demand is held constant.
  - Changes in both demand and supply.
- Point out the changes in the equilibrium prices and equilibrium quantity in the above instances using demand and supply curves.
- Intoduce about the change in market equilibrium by the provision or removal of subsidies, taxes or controlled price through graphs.
- Point out that there are various market structures.
  - Perfectly competetive market
  - Monopoly market
  - Monopolistically competetive market
  - Oligopolistic market
- Introduce the perfectly competitive market.
  - A perfectly competitive market is characterized by a large number of buyers (consumers) and suppliers (producers) as well as companies that sell homogenous products and services.
- Discuss the features of a perfectly competitive market.

  Ex:
  - Presence of a large number of buyers and sellers
  - Homogeneous products
  - Free entry and exit
  - Lack of law limits
  - Operating under an assigned price
- Introduce the monopoly market.
  - The market structure where there's only a single producer even though with the presence of a large number of buyers for a certain product, is called the monopoly market.
- Discuss the features of a monopoly market.

  Ex:
  - Presence of only one producer
  - Absence of free entry and exit (Barriers to entry and exit)
  - Absence of substitues
  - Lack of competition in the market and existence of advertising the product
  - Continuity of high profit making
  - Price maker (The buyer has to buy according to the price decided by the producer)
- Define the monopolistically competitive market.
  - The market structure with a large number of buyers and sellers relative to the monopoly with a variation of products is called the monopolistically competetive market.
- Discuss the features of a monopolistically competetive market.

  Ex :
  - Presence of a large number of products relative to that of a monopoly market
  - Barriers to entry and exit
  - Variation of products
  - Presence of advertising for selling
  - Slight variation in price due to variation
- Define oligopolistic market.
  - The market structure with a large number of buyers and less number of sellers in which products could either be homogeneous or heterogeneous is the oligopolistic market.

- Discuss the features of an oligopolistic firm.
  Ex:
  - Presence of only a few producers
  - Presence of a large number of buyers
  - Free entry and exit
  - Heterogeneity of products
  - Presence of advertising
  - Mutual dependance among the suppliers
  - Presence of quantitative profits continiously
- Discuss the agricultural market's status in Sri Lanka.
  Ex:
  - Vegetable market - A monopolistically competitive market could be seen.
  - Basmathi rice market - Oligopoly market
  - The market changes according to the nature of the product and according to the number of buyers and suppliers.

Key words :

- Market
- Market equilibrium
- Market models
- Monopolistic competition
- Oligopoly

Quality inputs

- A picture or a video of a market

Instructions for assesment and evaluation:

Pay attention to the following facts:

- Illustrating market equilibrium
- Stating the features of a market in equilibrium
- Indicating the ways of presenting market equilibrium
- Indicating how the market equilibrium changes
- Defining various market structures and their features separately
- Indicating the condition of the agricultural market in Sri Lanka

Competency level 5.5 : Exhibits the preparation to reduce the cost in agricultural businesses.

Number of periods : 04

Learning outcomes :
- Defines production cost.
- Draws cost curves.
- States the least production cost through cost curves.

Instructions to plan the lesson:
- Start the lesson by emphasizing that money should be allocated for the production of a certain product and that allocated money is called the cost.
- Point out that a cost is a money allocation implemented with the expectation of obtaining profits.
- Point out that the expenses spent on the factors of production in a production process to produce goods and services is called the production cost.
- Instruct the students to list the production cost of various agricultural production processes.
  Ex: Fertilizer, agro-chemicals, labour in a paddy plantation
- Point out that there are two types of production cost.
  - Short-term products -Short run production cost
  - Long term production- Long run production cost
- Emphasize that only the short-term production cost is considered here.
- Point out that the short run production cost is of a few types:
  - Total fixed cost-TFC
    - The monetary value of expenses that cannot be changed in a company within a short period of time is called the total fixed cost.The producer should bear this fixed cost whether he produces or does not produce a product.
      Ex: Buildings, cost on plant and machinery, machine depreciation, insuarance costs
  - Total variable cost - TVC
    - The total monetary value of expenses that are spent on production and that can be changed in a short period of time is called total variable cost.
      Ex: Cost spent on raw materials and labour
  - Total Cost -*TC*
    - The sum of both total fixed cost spent on the production of a certain set of products and the total variable cost is called the total cost.

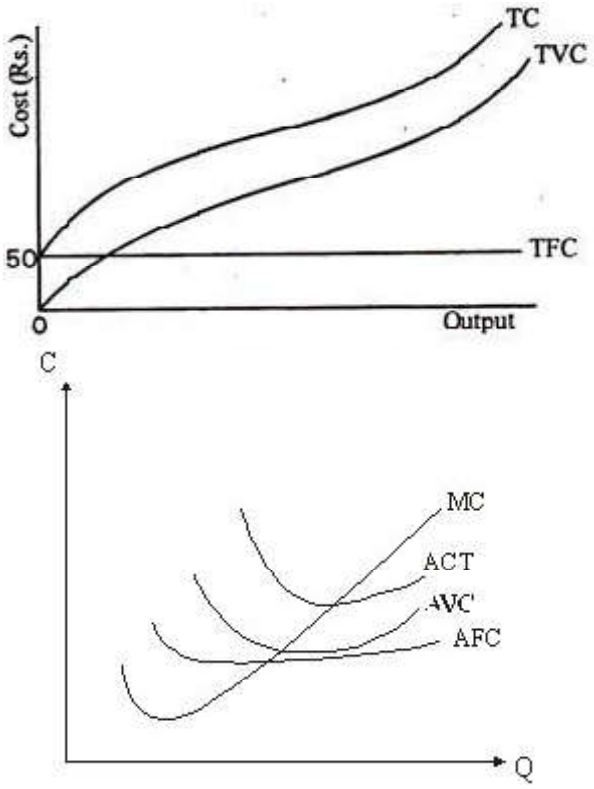
      $$TC = TFC + TVC$$

  - Average Variable Cost - AVC
    Average variable cost can be obtained by dividing the total variable cost by the number of production units. The expenses spent on a variable factor for one unit of production is the average variable cost.
  - Average fixed cost -AFC
    The expenses spent on the fixed factor for one unit of production is the average fixed cost. AFC, or the expense for a unit decreases with the number of production units.
  - Average total cost - ATC
    The expense spent for total cost spent on one unit of production is the Average Total Cost.
  - Marginal cost
    Marginal cost increases when the production quantity is increased by unit. Accordingly, the additional cost that has to be spent for each additional unit is the marginal cost.

- Guide the students to complete the table given below.

1	2	3	4	5	6	7	8
product Units	TFC Rs.	TVC Rs.	AFC Rs. 2 ÷ 1	AVC Rs. 3 ÷ 1	TC Rs. 2 + 3	AC Rs. 6 ÷ 1	MC Rs.
1	20	10					
2	20	20					
3	20	25					
4	20	28					
5	20	30					
6	20	52					
7	20	85					
8	20	120					
9	20	230					
10	20	410					

- Guide the students to draw cost curves using it. Discuss the reasons for the shapes of those curves.



Key words :

- Production cost
- Production curves

Quality inputs

- Product curves

Instructions for assessment and evaluation:

Pay attention to the following facts:

- Defining production cost
- Drawing cost curves
- Illustrating production cost through cost curvess

Competency level 5.6 : Examines how to engage in production to maximize profits in agricultural activities.

Number of periods: 08

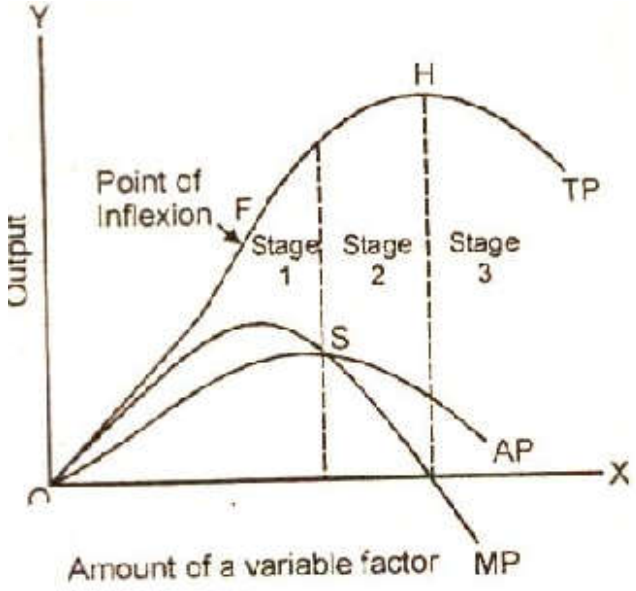
Learning outcomes :
- Calculates average production and marginal production in factor-product relationship.
- Indicates the efficient production zone using product curves.
- Illustrates the efficient factor combinations through equal product curves.
- Illustrates efficient output combinations through a production possibilities curve.

Instructions to plan the lesson :
- Make the students aware about the relationships that exist in agricultural production.
  - Factor-product relationship
  - Factor-factor relationship
  - Product-product relationship
- Explain that the relationship between one variable factor and one product is displayed by the factor product relationship.
  $y = f(x_1, x_2 ..... x_n)$
- Present a table to show the change of production according to the inputs.

Land	Input (No. of urea bags (10kg)	T.P.	A.P.	M.P.
1	0	0		
1	1	3		
1	2	8		
1	3	12		
1	4	15		
1	5	17		
1	6	17		
1	7	16		
1	8	13		

- Guide the students to define total product, average product and marginal product.
- Guide the students to fill the average product and marginal product columns in the above table.
- Help the students to illustrate graphically the changes of the total production, average production and the marginal production according to the amount of inputs.
- Point out through the graph that the total product increases at a greater rate when the amount of fertilizer is increased keeping all the other variables offering the yield constant.
- Show that the total production, average production as well as the marginal production have been increased during this period.
- Point out that when the amount of fertilizer is persistently increased, the marginal production and the average production decrease while the total production increases at a decreasing rate.
- Conduct a discussion about the reason for the gradual drop in productionn after an increase.

- Point out that the total production increases until the variable factors reach the optimum level with the fixed factors and that the total production decreases afterwards how large is the increase in variable factors.
- Emphasize that the cause for the decrease in the total production is the negative value of the marginal production.
- Explain through the above example the law of diminishing marginal returns presented by economists, on the short run production.
- In a production process involving several inputs, the total product increases in a production process of a few inputs when some inputs are held constant and only one input is increased. But when that input is increased after one stage,the marginal production which is the quantity newly added to the total product when an input is increased by one unit, gradually decreases. Therefore the total production increases at an increasing rate and then increases at a decreasing rate.
- Discuss the stages of the production function.



- Point out that the first production stage is the stage from zero upto the stage where the marginal production equals the average production (MP=AP) and that during this stage, the total production increases at an increasing rate and then increases at a decreasing rate.
- Explain that diminihing returns appear at the fisrt stage itself.
- Explain that the fisrst production stage is determined when the marginal production becomes equal to the maximum level of the average product.
- Conduct a discussion to explain reasons as to why the producer does not remain in this zone.
- Emphasize that in the second stage, the total production reaches its maximum and that although AP and MP decrease, both take positive values.
- Point out that increasing inputs beyond this zone is not productive.
- Guide the students to comprehend the fact that it is in this stage that the producer operates because it is in this stage that the variable factors used match well with the fixed factor and the production reaches its optimum level.
- In the third stage, the total production and average production decrease while the marginal production takes a negative value and it is called the negative value stage.
- Point out that the producer should not come up to this stage as he receives a low profit for each variable factor, he puts in.

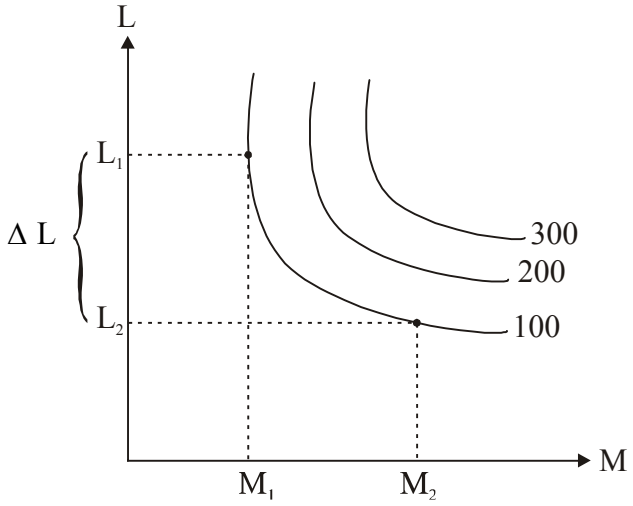
- Assert that the production would decrease if variable factors are further added in amounts unwieldy for fixed factors.
- Point out that the marginal revenue is the increase in revenue with the increase in one variable factor and that it could be obtaiined by multiplying the marginal production by the price of one product unit.

Marginal revenue (MR) = Marginal production(MP) x Price of one production unit

- Point out that the marginal cost is equal to the marginal revenue at the optimum input level of a product unit.

Marginal cost (MC) = Marginal revenue (MR)

- Point out that the manner of managing one's fixed and variable factors in the factor-factor relationship by a producer in order to maximize profits could be explained by Iso-quant product curves and Iso-cost curves.
- Explain that the Iso-product curve is the line drawn joining the points that represent diverse combinations by which equal production level could be acquired.

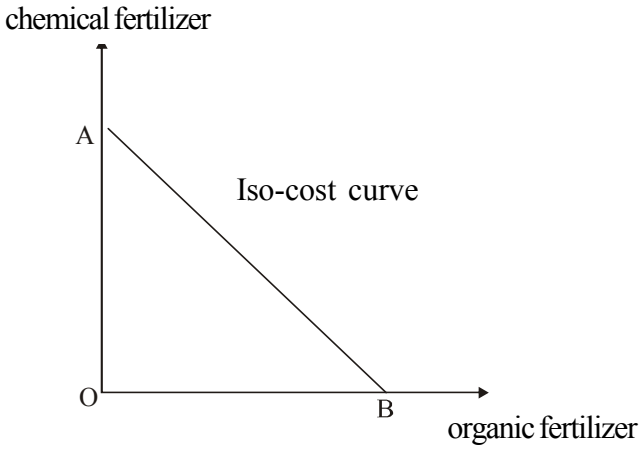


- Explain that, any point on the Isoquant product curve provides the same product and that those points depict diverse combinations used to obtain an equal production.
- Point out that when distancing from the origin, the production values in Isoquant product curves would increase.
- Point out that the slope of the Isoquant product curve depicts the ability to substitue two production factors and that it is called the marginal rate of technical substituition (MRTS).

Marginal rate of technical substituition (MRTS)	=	$\frac{\Delta L}{\Delta M}$

- Emphasize that the producer's Isoquant cost curve is important in determining the product equilibrium.

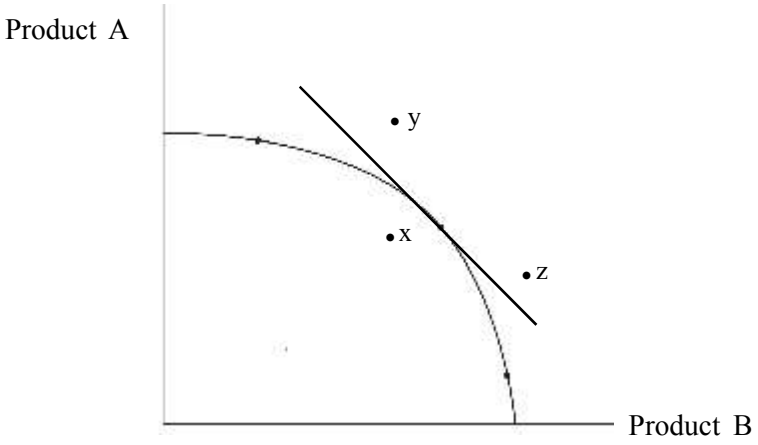
- Explain that any point on an Iso cost curve depicts the factor quantity that could be obtained by increasing the total cost.
- Emphasize that the price ratio is indicated by the slope of the iso-cost curve.



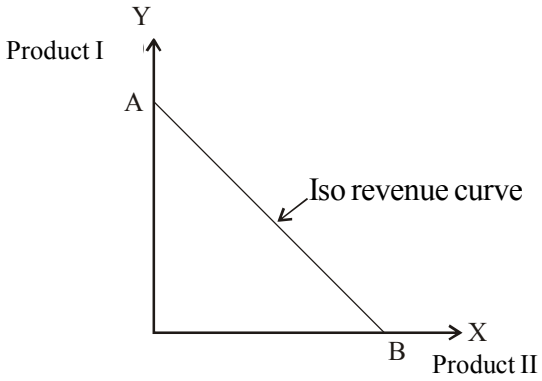
- Explain how the stage of optimum profit is determined by an isoquant product curve.
- The profit reaches its maximum at the point of intersection of the isoquant product curve and the iso cost curve lines. This point also shows the optimum possible output combination.

Marginal rate of technical substituition = Price ratio between factors $\frac{DA}{DB} = \frac{P_B}{P_A}$

- Conduct a discussion about the product-product relationship.
- Discuss about the way the producer selects the optimum mix through the product-product relationships obtained by investing one's productiong resources.
- Explain that if the producer's factor inputs could produce two products under the existing techniques, the curve that illustrates the optimum product mix is called the "production possibilities curve".

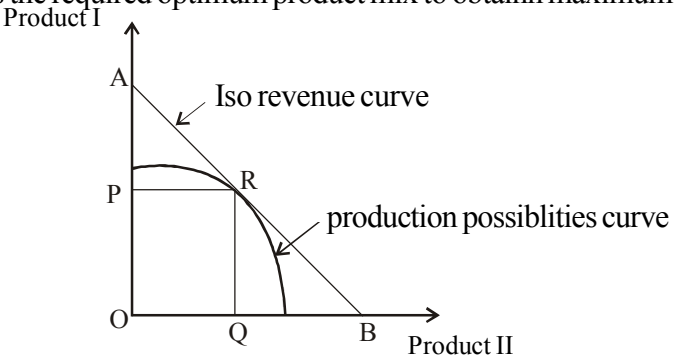


- Conduct a discussion about the reason for the real producer to select the "x" product mix in order to maximize profits under a low cost and for the selection of "y " and "z" points.
- Let the students design the Iso cost curve. Explain that the product quantity which could be produced under fixed costs by a certain factor mix is depicted by the production possibilities curve.



X - Carrot
Y - Beat

- Emphasize that the point of intersection of the two curves Iso revenue curve and the production possiblities curve represents the required optimum product mix to obtainn maximum profits.



- Explain that the point R shows the optimum product mix and that the producer can obtain maximum by growing OP amount of vegetable A and OQ amount of vegetable B.

Key words

- Factor - Factor Relationship
- Factor - Product Relationship
- Product - Product Relationship

Quality inputs

- Product curves

Instructions for assessment and evaluation:

Pay attention to the following facts:

- Defining total production, average production and marginal production
- Calculating average production and marginal production in a factor-factor relationship
- Explaining stages of a product curve
- Indicating the optimum production zone through product curves
- Illustrating optimum factor mix through isoquant product curves
- Illustrating the optimum product mix through the production possibilities curve

Competency level 5.7 : Inquires into employment opportunities for a small scale agricultural business

Periods : 04

Learning outcomes :
- Explains the business environment of small scale agricultural businesses.
- Lists required resources for maintaining a business productively.
- Describes external and innernal ethics related to businesses.
- Prepares a business plan for a business.

Instructions for planning the lesson:

- Start the lesson by giving the opportunity for the students to provide examples for various agricultural businesses.
- Guide the students to introduce agricultural businesses.
  A business designed to supply agricultural goods and services is called an agricultural business.
  - Assist the students to name the factors affecting a small scale business.
    - Business environment
    - Business resources
    - Business ethics
- Explain that all the forces affecting the external and internal affairs of small scale businesses are called the business environment.
- Point out that the environment related to the business environment can be divided into two main categories as internal and external.
- Point out that the internal environment of small scale agricultural businesses is employees who conduct the bussiness, consumers and planners.
- Emphasize that inorder to maintain the internal environment of an agricultural business, its stakeholders should work with commitment.
- Discuss situations in which the owner and managers should make correct decisions,
  - in recruiting employees
  - in assigning work to the employees
  - in their supervision and monitoring
  - in paying wages
  - in welfare
- Discuss with students about the stakeholders belonging to the external enviroment of a bussiness.
  - Natural environment
  - Economic environment
  - Community environment
  - Global environment
  - Political and legal environtment
  - Social and cultural environtment
  - Technical environment
- Emphasize that the natural resources used as factors/inputs in the business belong to the natural environment. Explain that factors such as availability of natural resources and climatic conditions, topographical conditions in the particular area etc. affect this factor.
  Ex: Business should be established in closer areas to obtain raw materials.
- Discuss the problems that would emerge here.
  Ex: Scarcity and depreciation of natural resources

- Point out that the impact of the political and legal environment for businesses is determined by factors such as government imposed taxes and government policies.
- Discuss the factors affecting the social and cultural environment of a bussiness.
  Ex : Social customs, traditions, poverty, cultural beliefs, literacy rate, life expectancy, values
- Discuss the fact that the social structure and social values create a considerable impact on businesses, through examples.
  Ex: Consumers showing their interest in the product quality when the literacy rate increases, Is increase in demand for clothes and garments in the market during festive seasons.
- The impact is created according to the community environment, population, population density and population growth rate and that thedemand for goods and services changes due to the impact of thses factors.
  Ex: Demand for infant food is high if there is a high infant percentage in the population. Labour intensive products could be produced in those areas whare there is a high population density due to the possibility of acquiring more labour.
- Point out that it is important to identify the impact of the technological development on businesses and to adapt to those impacts.
  Ex: Automating supply of food instead of keeping food and water bowls in houses to suppply food and water when rearing animals in closed huoses in animal husbandry.
- Emphasize that the business should be adjusted according to the impact of the global environment as the world has become a global village due to expansion of information and communication technology.
  Ex: When floriculture is undertaken for exports, flowers should be prepared for exportation according to the requirements of the country to which they are exported and its standards.
- Help the students to define business resources. Business resources are the human, monetary, physical and knowledge factors required for a business process.
- Let the students name business resources.
  Ex: Labour, money/capital, machinery techniques, inputs, market, expertise
- Accentuate the fact that to start a business ways to obtain capital to start a business need to be investigated and that the immensity of business depends on the capital.
- Discuss the fact that loans could be obtained to hire capital and the available opportunities for it.
- Explain that the service of people who have acquired theoritical and practical knowledge about the relevant business needs to be procurred in obtaining labour and that they should be made aware about the goals and objectives of the business.
- Explain that the salary level/wage rates should be decided beforehand when recruiting labourers to the business and that one should be aware of the relevant rules and regulations about employing labourers for service.
- Explain the fact that in a small business extra labourers should be employed after obtaining labour from the family members.
- Stress that one needs to be concerned about inputs and facilities required for a business, the methods that could be used to acquire those and the legal impacts related to them.
- Ask the students about the 3 business organization systems:
  - Individual businesses
  - Cooperative businesses
  - Established businesses
- Point out that small scale agricultural businesses among these systems could be carried out as individual businesses as well as cooperative businesses.

- Explain that one should be well concerned whether the goods and services produced have an available market as the goods and services produced, shall be presented to the market.
- Explain the fact that it is essential to have entrepreneurial charachteristics required to start and maintain a business.
- Inquire the students about main business management techniques:
  - Capital intensive techniques
  - Labour intensive techniques
- Explain the fact that the technique in which more capital (to use machines) and less labour is used for production is called the capital intensive method.
- Convince students that the labour intensive technique is more suitable for a country like Sri Lanka where labour is abundant.
- Guide the students to introduce social ethics.
  - The collection of ethical/moral responsibilities connected with a business is ethics and these are different from government regulations.
- Point out that these ethics can be divided into two groups:
  - Internal ethics
  - External ethics
- Ask about examples for internal ethics from the students.

  Ex:
  - The behaviour of employees and managers in small scale businesses, speech, honesty in transactions, helping the clients, avoiding ill-treating people, heartily welcoming the client, rendering to the client's needs on time.
  - Avoiding improper use of money.
  - Commitment for the progress of the business
- Make studnets understand that external ethics are ethics related to outer stakeholders engaged in the business.

  Ex: Avoiding sneaking of production secrets
- Point out that a businessman/businesswoman should be attentive towards society and that it is called social responsibility.
- Inquire the students about examples for social responsibilities.

  Ex: • Proper disposal of the business's waste matter
- Guide the students to define an agricultural business plan.
  - It is a written design which evaluates and examines the stability of economic development and business expertise with the future expectations of the agricultural business.
- Conduct a discussion with the students about the importance of preparing a business plan for agricultural businesses.

  Ex:
  - To analyse related information by paying attention to one's goals
  - To deal with banks and providers of loans investors and consultant institutions.
  - To discover the weak points caused by omission during the planing process of the agricultural business
- Discuss the components of an agricultural business plan.
  - The cover, executive summary and contents.
  - The cover, exective summary, and contents need to be correctly and attractively prepared and the required information should be included on the cover. The entire plan should be simply and comprehensively presented in the executive summary.
- "Business plan" should be mentioned on the cover page and the following information should be included in it:

- Name and the business name
- Logo
- Adress
- Telephone number
- Fax number
- E-mail address
- Date

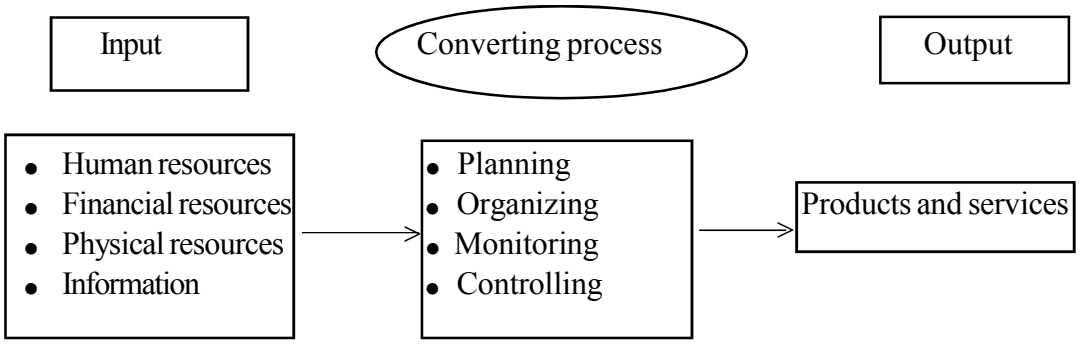
- The executive summary should present a gist of facts given in the plan. Its special features are:
  - Should consist 1-3 pages and should only contain the important facts of the rest of the plan.
  - Should include basic features of business concepts, financial requirements, the present status of the business, the status of the business at its beginning, the main owners and people, future victories.
  - Every page should be numbered while those page numbers and main and sub topics should be included in the contents.
- Business description
  - Business description is the business's vision. It should include information related to the producer, good or service provided, the market to which it is supplied, opinions of the businessman and his capacity.
- Market or industry analysis
  - Descriptions on the targetted clients on one's production and the number of clients that could be expected in the future should be given here.
- Production plan
  - The present status of the business and the future capacities should be included, beginning with a short summary about other businesses competing with the business in consideration.
- Competition
  - A short description about the primary competitors should be presented stating their strengths and weaknesses with strengths and weaknesses of self and with ways of facing a competant atmosphere with the goods and services delivered by the agricultural business of self.
- Selling plan and estimated sales

  This should include
  - Information on the extent of the market, market surveys, targets and results, customers and marketing strategies.
  - Techniques that would be used by producers to persuade consumers to purchase goods and services in the business should be presented through the marketing plan.
  - Three crucial aspects in selling and marketing namely the strategy, mode of selling and the method of advertising and promotion.
- Development plan
  - The selling plan and estimated sales should be based on the benefits of the production or service, clients, the immensity of the market and on the competition.
  - Reasons and methods implemented in order to increase the requirements of the client as well as the number of clients should be included here.
  - Product pricing techniques, distribution techniques, steps that should be taken for advertising and strategies to retain consumers should be mentioned.
  - Descriptions on state of the production and plans for the completion of its development, should be included.
  - Descriptions on product development, place of expenditure, labour requirements and technology should be included.

- The good or service development should be presented and described as a plan while considering all the expenses that need to be spent to plan the production and for the production.
- Approvals that should be obtained for the products of the production plan, licence and regulations that needs to be fulfiilled and the standards that should be acquired must be included.

- Labour requirements/human resource plan
  - The labour requirements / human resource plan should include details about the management team, labour requirement to start and maintain the business, essential skills and powers and responsibilities of the various management levels.
- Expenses and capital requirement/monetary plan
  - Should prepare 3 prototype forms for operational expenditure, capital requirement and cost.
- Management plan
  - It should include details of the group engaging in the management section or the group that expects to engage and the way of achieving the final vicotory.
  - The organizational structure management levels, ways of assigning authorities and responsibilities and communication methods should be described.
- Ask the students about the risks that could arise by the mistakes related to the agricultural business made by agricultural businessmen.

  Ex:
  - over paying salaries to employees.
  - under estimating expenditure
  - under estimating sales
  - working without getting to know the clients
- Guide the students to prepare a project plan for an agricultural business.
- Guide the students to define "management" under agricultural business management.
  - Management is utilising all available resources, planning, effective and efficent monitoring and controlling an organization to realize its aims.
- Point out that the managemnt process is a process that converts factors into products.
- Explain that this includes four processes namely planning organizing conducting and controlling.



- Point out that planning is deciding the objectives of a firm in the management process and determining the strategies and course of action required to fulfill those objectives.
- Explain that planning is establishing a strong connection among employees, resources, fuctions and responsibilities cordinating them properly in order to achieve the targets of an institution efficiently and effectively.
- Discuss the five basic steps of organization.
  - Identifying the tasks that need to be implemented and creating division of labour
  - Creating the organizational structure
  - Distribution of resources
  - Coordination
  - Creating standards

- Explain that monitoring is the guidance and persuasion towards the human resources and other resources of an institution in order to achieve its goals.
- Describe the fact that leadership, communication and motivation are required for a successful conduct of a business.
- Convince students that control is examining whether the plan drawn up to achieve the aims of an agricultural business is properly implemented, identifying deviations if any and taking suitable course of action to rectify them.
- Show the students that a proper controlling process is essential for the progress of a well planned and organized institution.

Key words :

- Business plan

Quality inputs

- Models of an agricultural business plan

Instructions for assessment and evaluation:

Pay attention to the following factors:

- Definng agricultural businesses
- Explaining the environment of small scale agricultural businesses
- Describing required resources to maintain a business productively
- Explaining internal and external ethics related to businesses
- Preparing a business plan for an agricultural business
- Explaining steps of agricultural business management

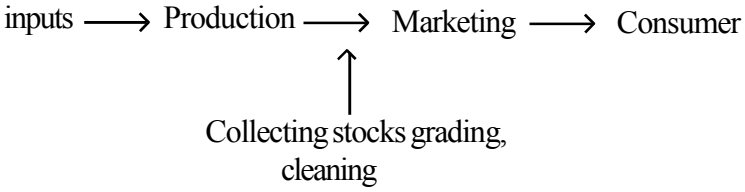
Competency level 5.8 : Inquires into the contribution of the value chain analysis for planning and assessment of the agricultural production process

Number of periods : 05

Learning outcomes:
- Defines the value chain and supply chain and explains their difference.
- Explains the organizational structure, activities, workers, support services and functions of the value chain process through examples.
- Describes the steps of the agricultural production marketing process.
- Defines the value chain analysis process and explains its importance, advantages and evaluation of its efficient steps.
- Explains how the effectiveness of the agricultural economic process affects the value chain analysis process.

Instructions for planning the lesson :

- Present a diagram which illustrates the process form the cultivation of the agricultural crop to the reception of the product by the consumer.



- Start the lesson by accentuating that this process takes place in a certain sequence.
- Show that the aim of a business is to start every step of the production process with raw materials and deliver a maximum quality good to the consumer with minimum expenditure.
- Let the students peresent their ideas about the way the produced product would be sent to the consumer.
  - Direct marketing
    Products ⟶ consumer
    There is no supply chain here.
- Indicate that supply chain is the delivery to the consumer for ultimate use in the same form obtained from the producer without value addition.
  Ex : Providing vegetables obtained from the producer as they were to the consumer
  Providing paddy obtained from the producer to the consumer without processing.
- Point out that some other products are provided to the consumers adding a certain value after obtaining the products from the producer. This is called the value chain.
- Inquire about examples for this situation from the students.
  Ex:
  - Grading vegetables procurred by suppliers.
  - Cleaning paddy obtained from suppliers, converting to rice and then delivring to consumers.
  - Providing fresh milk to the consumer after freezing and convering to other products.
- Guide the students to present a definition for the value chain.
  - It is the interrelated process that includes the production of a product or service using essential inputs with the help of other services and facilities and delivering it to the customer.
- Give opportunity to present ideas as to highlight the difference between the value chain and the supply chain.

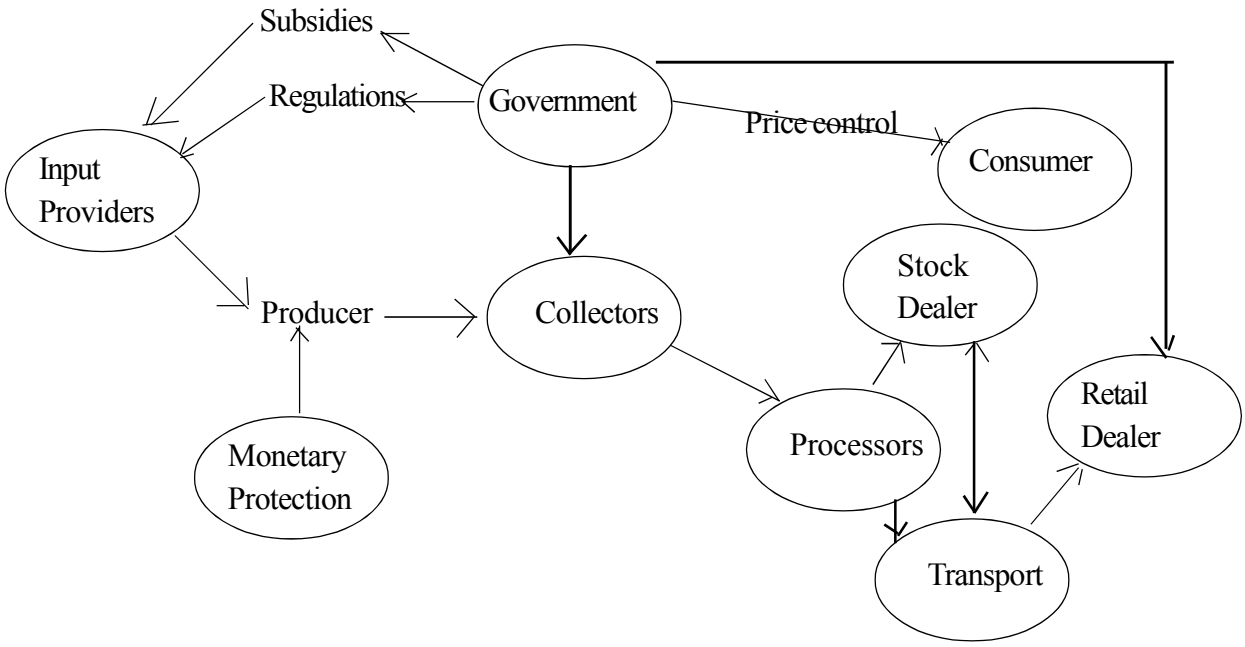
- Emphasize the fact that the value chain is important as a process that helps deliver a high quality good to the consumer by adding value to raw materials used in a business through various activities.
- Discuss the fact that the steps followed to improve the quality of a product add values to that product and let the students present examples for it.

  Ex: Rice from which sand and stones removed.
- Let the students present their ideas on the expectation of a production firm through value addition.

  Ex:
  - Providing the benefit of the competition to the firm
  - Providing high wages for everyone in the market chain
  - Creating a value for one's product
  - Provision of a quality product to the consumer
- Guide the students to present facts that are important for a successful value chain process. Pay attention to the facts mentioned below:
  - Identifying market opportunities and presenting market oriented products based on them.

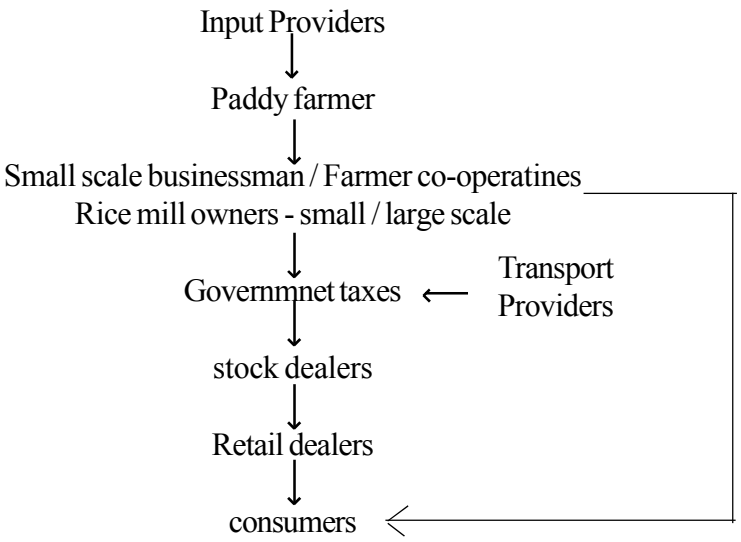
    Ex:
    - Some super markets in Sri Lanka produce products according to market requirements.
    - Information about the price and quality symbols.
    - Information about the price is important for the producer while information about the quality is crucial for the consumer. Information could be obtained from the television, radio and newspapers.

Value chain process

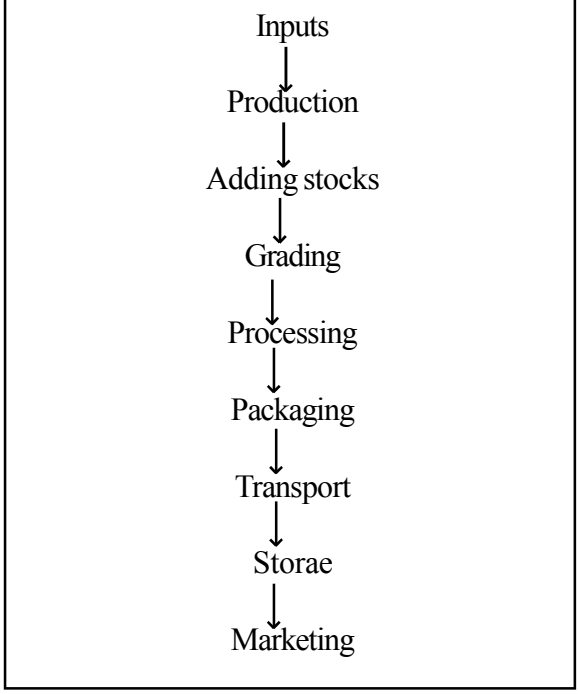


- Let the students present the value chain organization structure with the help of a flow chart. Pay attention to the following points:
  - Functioners' chain
  - Function chain
  - Support services

Functioner's chain



Function Chain



Support Services

Input providers

Financial assistance

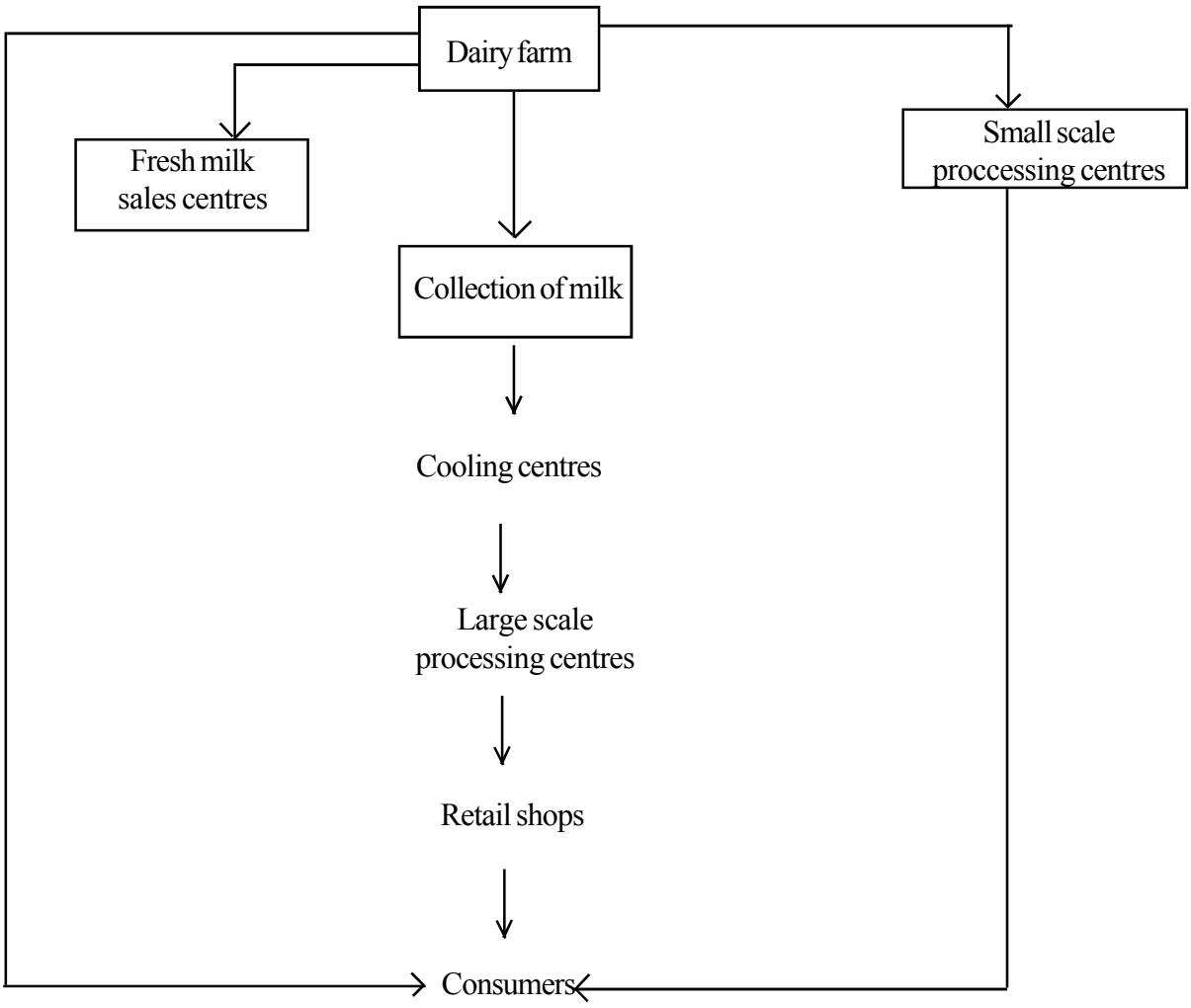
Insurance

Transprot services

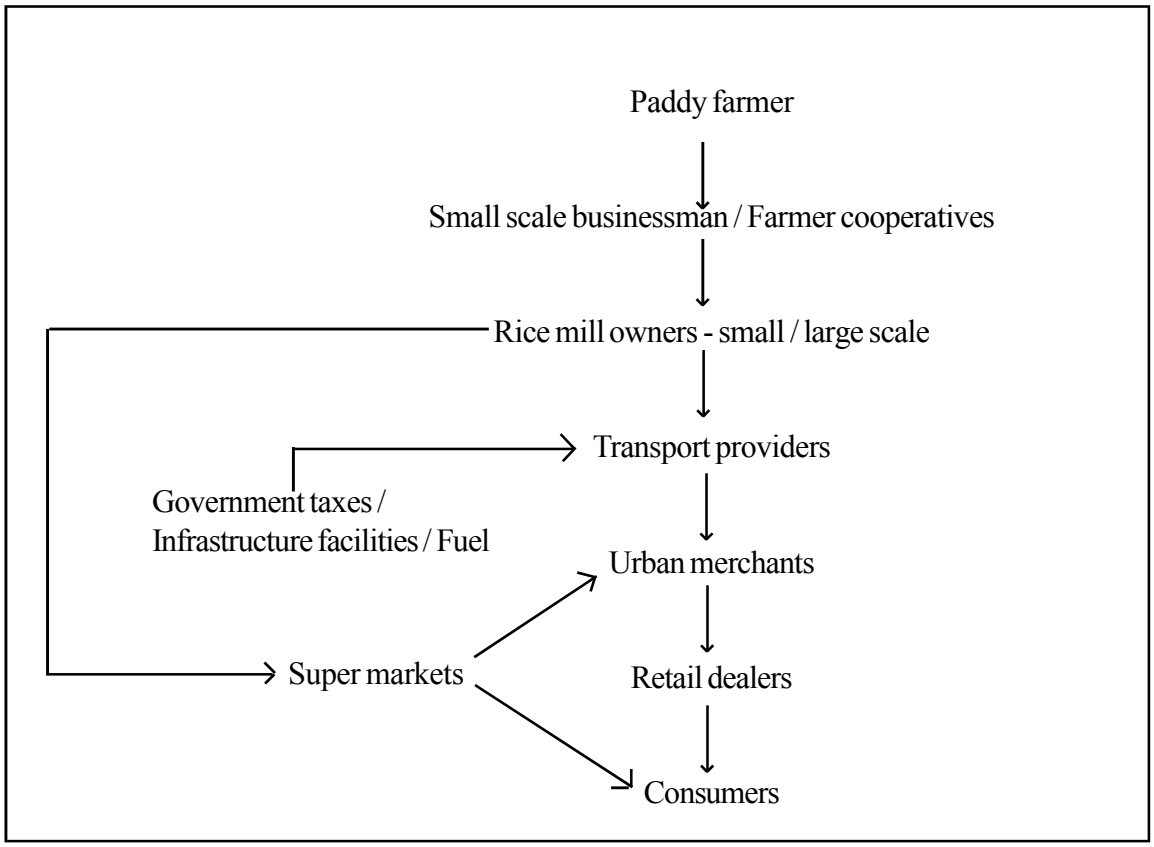
Technical Services

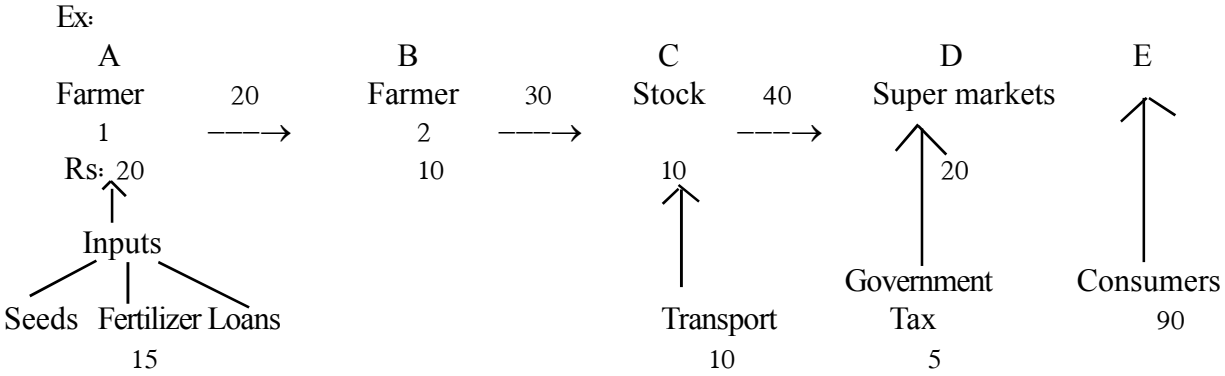
Regulations

Field of Dairy Industry



- Let the students gather and present information about the tasks carried out in each stage of the value addition carried out in the value chain and function chain. Pay attention to the following facts:
  - Steps of the production process
  - Changes in quality in each step
  - Method to increase efficiency in each step
- Assist the students to collect facts about agricultural product marketing. Pay attention to the following aspects:
  - Defining agricultural product marketing
  - Special features of agricultural product marketing
  - Marketing steps (Executing the marketing process in the value chain)
  - Agricultural marketing activities (exchange, physical tasks, facilities)
  - Increasing marketing efficiency
- Guide the students to collect information about the support services and their functions within the value chain.





- The price of the product is decided according to the value added to the production unit in each step of the entire process. Accordingly, the sum of the values added from A to E is 20+10+10+20. But there is an addition for transport, factors, government taxes at other stages (15+10+5). The sum of the values added becoming equal to the amount spent by the consumer (Rs. 90) is a feature of a successful value chain.

- Let the students define the value chain analysis process.
- Help the students explain the need for assessing the analysis efficiency steps in value chain.
- Emphasize the following facts:
  - That all processes implemented in each step in the value chain analysis process should be identified by the firm.
  - That the value addition in each step should be apparent and that it should be possible to determine quantitatively the value addition in each step.
  - That a cost is added in each step and that the cost is important in determiinig the price.

- Let the students present their ideas on decisions that could be made by assessing the efficiency stage.
  Ex: Removing sectors that need to be removed.
  Identifying sectors that need improvement and improving those sectors further.
- Giude the students to search information on the importance of the value chain analysis process, profits and limitations.
  Ex:
  - Saving the production cost
  - Increasing the production capacity
  - Acquisition of profits with a low cost by the producer through the product for a longer period.
  - Properly identifying information about price and quantity signals and transmitting them smoothly.
  - Identifying situations of efficiency and inefficiency of an economic manager.
  - Producing products sufficiently without scarcity coordinating market demand and market supply.
  - Identifying and analyzing inefficient stages and coming to relevant decisions.
  - Decrease in the cost of distribution.

Key words

- Supply chain
- Value chain analysis
- Function chain
- Agricultural market

Quality inputs

- A diagram that indicates the stages from the cultivation of the agricultural crop to the reception of the product by the consumer.

Instructions for assessment and evaluation:

Pay attention to the following facts:

- Defining the value chain and the supply chain
- Defining the value chain analysis
- Explaining the value chain analysis process
- Stating the importance of the value chain analysis and its end
- Explaining how the value chain analysis affects the productivity of an agricultural economic process.

Competency 6 : Exhibits the readiness for engaging in sustainable agriculture.

Competency level 6.1 : Inquires into the need and aims of sustainable agriculture.

Number of periods : 04

Learning outcomes :
- Defines sustainability and sustainable agriculture.
- Describes the need of sustainable agriculture and its main objectives.
- Describes the features of sustainable agriculture.
- Explains the environmental principles crucial for sustainable agriculture.
- Describes the advantages of sustainable agriculture.

Istructions for planning the lesson:

- Instruct the students to list the problems related to agriculture faced by society at present and reasons for those problems.

Problem	Reasons
Decline in soil fertility	• Reduction in soil fertility • Excessive use of nutrients • Increase in salinity and alkalinity • Decrease in soil organic matter • Soil erosion
Reduction in arable lands	• Development activities-construction of houses • Soil degradation
Low production	• Reduction in plant growth • Increase in pest attacks • Scarcity of nutrients
Increase in the cost of plantation	• Increase in prices of agro-chemicals and fertilizers and labour cost.
Drop in pollinators Extinction of beings (flora and fauna)	• Development activities, use of land for agricultural activities, use of pesticides, use of weedicides
Health problems (Kidney diseases, cancer)	• Water pollution, improper use of agro-chemicals

- Point out that at present, the absence of features that had been built-in the local agricultural industry in the past is the reason for these problems. Guide the students to define sustainability accordingly.
  Sustainability-Long term existence
  The ability to maintain a certain process or production continuously is called sustainability.
- Point out that this impacts entire society in addition to the agricultural sector as many issues affecting life are connected with agriculture.
- Point out that factors such as resource degradation, overconsumption and resource scarcity would unfavourably affect the agricultural sector in the future.
- Present the note mentioned below :
  Resources $\xrightarrow{\text{maximum use}}$ Maximum production
  Resources $\xrightarrow{\text{optimal use}}$ Optimum production
- Point out the problems generated by reaching the maximum production in the agricultural undustry due to the maximum utilization of resources and point out the need of optimum production.

- Emphasize that agricultural inputs should be utilized in a way that could be taken into future use in order to continue production of foods required for the increasing population in the country itself.
- Accentutate that, accordingly, agriculture must be sustainable.
- Point out that the ability to maintain the production at an average level uniformly by conserving farm resources and by optimally maintaining external factors causes sustainability of agriculture.
- Emphasize that, in addition, sustainable agriculture has been defined by the World Food and Agricultural Organization as follows:
  FAO definition- Sustainable agriculture
  A specified management system improving and expediting the health, biodiversity, biological cycles and processes in an agricultural environment stystem using bioscientific and machanical techniques.
- Guide the students to collect information about the objectives and the need of sustainable agriculture.
  - Main objectives
    Ex :
    - Protecting environmental health
    - Ability to maintain economic profitability
    - Maintaining socio-economic equality
  - Need
    Ex :
    - Conservation of natural resources used in agriculture
    - Maintaining soil safety
    - Conservation of water and soil
    - Reducing/minimizing environmental pollution
    - Improving people's health income and social status
    - Ensuring food safety and food hygiene
    - Conserving natural resources for future use
- Explain that an agricultural environment system which fulfills wants and needs of human beings in long tem is considered sustainable and let the students identify features of such an agricultural system. Pay attention to the following facts. Explain that sustainable agriculture is not organinc farming.
  - Being envioronment-friendly.
    Conserving the quantitative and qualitative nature of natural resources (conservation of soil,water and biodiversity) - i.e, protecting and maintaining entire agricultural environment system (humans, animals, crops, soil organisms, natural biological processes.)
  - Economic profitability
    - The farmers must be satisfied with the products produced by the agricultural production process
    - The labour cost and investment expenditure should tally with the income.
    - Resources conservation and risk factor managment should be taken into consideration in addition to the increase in production.
  - Social justice/equity
    - Accomodating the need to utilize resources to fulfill the needs of everyone in soiciety, accomodating the need to obtain technological and market opportunities by all transactors equally
  - Human factors
    - Protecting all beings considering man, plants and animals are important and making influence to create sustainability of an environmental system through activities and interactions and viable organizations.
    - The need for the protection and nature of social,cultural and positive integration.

- Ability for adaptation
  - The ability of society to adapt to capricious situations.
    Ex: Changing government policies
    Population growth
    Increasing market demand
- Discuss the environmental principles based on which sustainable agriculture is based.
  Ex:
  - Creating favourable conditions for plant growth and sustainability.
  - Maintaining the viability of soil through activating soil microbial activities, by adding organic matter.
  - Maintaining soil nutrient availability and the nutrient balance.
  - Nitrogen fixation, using soil nutrients in the deep layers, improving the recycling process, adding nutrients when nutrients are diminshed.
  - Reducing the loss of resources caused by sunlight and wind
  - Management of the micro environment, use of biological methods to prevent soil erosion
  - Mitigating the damage caused by diseases/pests, integrated pest control, pest control through natural biological control (natural enemies, preventive and protective remedies)
  - Bio diversity improvement and conservation.
  - Use of genetic resources balancing appropriately the symbiotic activities and interactions between plants and animals. Ex. integrated farming, mixed crop cultivation, multiple crop cultivation
- Let the students suggest methods that could be followed in order to fulfill the main objectives of sustainable agriculture.
  - Agricultural and natural resources
  - Plant and animal production activities
  - Economic and social activities
- Discuss strategies related to agricultural activities and natural resources.
  - Water
    - Irrigation and utilization
    - Water conservation and utilization of water storage structures
    - Providing subsidies when selecting drought-resistant and salinity-resistant crops
    - Utilization of micro-irrigation systems (to protect the quality of water)
    - Crop control to reduce water loss
- Soil
  - Providing a sufficient amount of water, maintaining soil air, nutrients and buffering action.
  - Maintaining the viability of soil by soil temperature control
  - Being free of poisonous substances (heavy metals,e -wastes)
  - Maintaining physical and chemical factors of soil conducive for plant growth.
- Discuss plant production techniques.
  Ex: Selecting the land suitable for plantation and selecting special varieties
  - A sustainable sytem would be established by following preventive techniques primarily.
    Ex:
    - Use of crops resistant to pests and diseases
    - Choosing plants suitable for the land and drought-resistant and salinity-resistant plants
    - Searching the history of the climate, topography
  - Plant system diversification
    - Reducing the risk by following multiple cropping methods as against monocropping, adapting to the price fluctuation connceted with demand and supply.

- Soil management
  - Explaining that soil health is the foundation of sustainable agriculture.
  - Disease and pest-resistant plants/crops could be obtained by growing healthy and strong crops.

    Techniques :
    - Growing cover crops
    - Use of organic fertilizer (compost, green manure)
    - Minimizing land preparation (zero tillage)
    - Avoiding vehicle movemet on wet soil.
    - Mulching
    - Adding organic materials often
  - Use of input efficiency
    - Use of traditional farming inputs
    - Use of inputs that could be gained by natural, renewable and farming techniques
    - Avoiding use of chemical inputs.
  - Life style and aims of farmers
    - Contemplating management decisions in a way that would not affect the lives and environment of farmers.

    Ex: Introducing modern technology to farmers conveniently in suitable situations.
- Discuss techniques that could be used in livestock production.
  - Properly planning activities related to animal husbandry.
  - Food, health, breeding, nutrition, production and marketing activities
- Discuss techniques that could be followed in economic and social sectors.
  - Introducing policies in order to create socio-economic equality, economic profitability and environmental health.
  - Reducing the use of chemicals, educating and encouraging farmers for economizing scarce rsources
  - Pereparing suitable government policies in obtainng employee labour.
- Inquire students' ideas about the advantages of sustainable agriculture.

  Ex:
  - Environment resource conservation
  - Incliming to use resources sustainably
  - Implementing cultivation activities while conserving soil and water
  - Getting used to little inputs and inputs obtained from the farm itself.
  - Ensuring food hygiene and safety
  - Developing attitudes for protecting environment

Key words
- Sustainability
- Sustainable agriculture

Quality inputs
- Publications, books, information from internet and posters about sustainable agriculture

Instructions on assessment and evaluation:

Pay attention to the following facts:
- Explaining the need for sustainable agriculture.
- Defining sustainable agriculture
- Explaining principles based on sustainable agriculture
- Suggesting techniques for sustainable agriculture

Competency level 6.2 : Inquires into the methods for engaging in sustainable agriculture with optimum resource management

Number of periods: 08

Learning outcomes :
- Defines resource and sustainable resource management.
- Describes environment-friendly farming techniques through diagrams.
- States advantages and disavantages of each farming technique.
- Describes the contribution of various farming techniques for sustainability in agriculture.
- Illustrates environment-friendly cultivation patterns using diagrams.
- Lists advantages and disadvantages of each crop pattern.
- Describes the contribution of diverse cropping patterns for susstainable agriculture.

Instructions for planning the lesson :
- Present pictures or videos that indicate various cropping methods and ways of engaging in agricultural activities while utilizing natural resources such as sunlight, soil and water.
- Start the lesson by surfacing the idea "resource".
- Direct the students to present a definition for a "resource".
  - A resource is something with an economic value which can be used to get done a certain task successfully. It can also be defined as an in/out that contributes to deliver a product.
- Ask the students about circumstances in which resources are used for productive activities.
  Water- cropping purposes, animal husbandry
  Sunlight - Photosynthesis $\longrightarrow$ Plant food production
  Solar panels $\longrightarrow$ Electricity
- Inquire how resources are utilized in sustainable agriculture. Guide the students to present a definition for sustainable resource management.
  - Utilization of resources in business activities of agriculture or in social activities following sustainable measures so that those resources could be used at present as well as in the future is called sustainable resource management.
  - In sustainability every memebr in the sysytem supplies profits to the sytem through more than one activity.
- Advise the students to search information about methods to be followed in order to engage in sustainable agriculture.
  Ex: - Farming methods
  - Cropping patterns
- Define farming methods.
  A man-made agricultural system which carries out agricultural activities while managing all the tasks.
- Guide the students to collect information about cropping patterns that maintain sustainability in an agricultural environment system and correspond to its principles. Pay attention to the following cropping patterns:
  - Rainfed cultivation
  - Conservation farming
    - Up country home crop
    - Agro forest crop
  - Organic farming
  - Biodynamic farming

- Instruct the students to search information about the facts mentioned below when investigating about the above farming techniques.
  - Defining the farming technique
  - Presenting through diagrams
  - Principles
  - Methods followed in cultivation
  - Advantages and disadvantages
  - How sustainability is ensured
- Let the students present a definition for rainfed cultivation.
- Surface through discussions about the fact that, rainfed cultivation is chena cultivation restricted to one place.
  - It is a farming technique effected using only rain water which is mostly carried out in the dry zone. Rainfed cultivation is mostly undertaken in areas of 500-1500 mm of annual rainfall where the expected rainfall is less than 25%.
- Discuss the various stages of a rainfed cultivation.
  - Deforestation
  - Burning
  - Erection of the fence
  - Sowing
  - Harvesting
- Guide the students to present in a table the months in which various steps of rainfed cultivation are carried out and the processs executed in each stage.

Process	Month started	Month ended
1. Deforestation	July/First week of August	First week of September
2. Burning of forests	Final week of August	Last week of September
3. Erecting of fences	September	Third week of October
4. Land preparation	From the first week of September	From final week of October to last week of November
5. Sowing/seedling planting	Third week of October	First week of November and December
6. Harvesting	Till the mid of December, January and March	Last week of March

- Ask students about the crops cultivated in rainfed cultivation.
  Short term crops - kurakkan, maize, dry land paddy
  Main crops in the yala season - sesame
- Inquire into students' ideas on the advantages and disadvantages of this farming technique.
  - Advantages
    - Less capital required.
    - Use of less inputs
    - Use of local resources
    - The uncertainity and risk are low due to crop diversification
    - Irrigation is not required due to the sole utilization of rain.
  - Disadvantages
    - High risk and uncertainty due to unpredictable rainfall
    - Formation of crusts on the soil surface
    - Lessening of ground water recharge

- Define Conservative farming.
  - Engaging in agricultural activities in a way that protects the soil, water, nutrients and bio-diversity in a particular place is called "conservative farming".
- Let the students present facts on techniques that can be followed for the conservation of soil,water, nutrients and bio-diversity in this farming technique.
  - Techniques followed for soil conservation.
    Ex:
    - Selecting the land according to the categorization of land utilization.
    - Land preparation according to the place.
    - Use of reduced land prparation methods for lands with high gradient slopes which are susceptible to soil erosion.
    - Setting stone/soil bunds and terraces to prevent soil erosion.
    - Cultivating crops according to contours
    - Constructing trenches to control drains
    - Mulching
    - Taking action to increase seeping
  - Techniques followed for water conservation
    Ex:
    - Setting windbrakes
    - Increasing infiltration through land preparation
    - Organic mulching
  - Techniques followed for nutrient conservation
    Ex:
    - Methodical land preparation
    - Adding organic matter
    - Minimizing removal of nutrients from soil
    - Recycling removal of nutrients through cropping patterns
    - Adding crop residues
    - Improving recycling processes-Compost
  - Techniques followed for bio-diversity conservation.
    Ex:
    - Use of biological soil conservation methods
    - Cultivating cover crops
    - Preparing bio-fences
    - Following integrated pest control practices
    - Following multiple cropping ; mixed cropping
  - Discuss the advantages and disadvantages of conservative farming.

    Advantages

    Ex:
    - Reduction of soil erosion-due to the increase in water absorption through the soil cover.
    - Nutrient conservation
    - Fixation of nitrogen using legumes
    - Weed management and reduction of water evaporation through mulching.
    - Reduction of risk and uncertainty through crop diversification
    - Minimization of production cost due to low cost input utilization
    - Protection of biodiversity

    Disadvantages

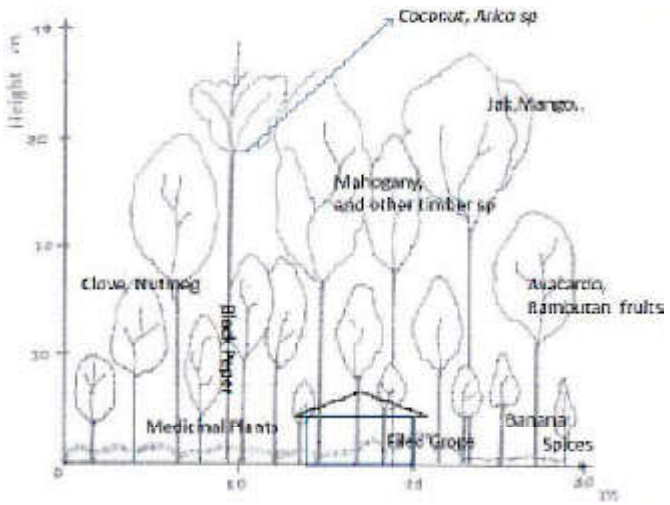
    Ex:
    - Environment pollution and increase in cost due to the use of weedicides in the use of zero and minimum land preparation methods.
- Instruct the students to present facts about the contribution of conservative farming for the sustainability of agriculture.

  Ex:
  - Conservation of nutrients, soil, water and biodiversity
  - Reducing environment pollution
  - Fixation of nitrogen in soil

- Point out that there are different sub systems in conservative farming.

  Ex: Alley cropping
  Multilayer cropping system
  Agro forestry cultivation
  Up country forest gardens
  Crop residue mulching system

- Instruct the students to gather information about the following cropping techniques among the above subsystems.
  - Up country forest gardens
  - Agro forestry cultivation
- Present diagrams or videos that illustrate up country/ home gardening. Assist the students to present a definition while discussing the features of that farming technique.
  - A multi-layered cropping system abundant in the Kandy district in Sri Lanka (mid country and intermediate zones)
- Discuss the features of this farming technique.
  - Based on perennial crops
  - Presense of high crop diversity and a complex structure
- Consists of crops cultivated for economically important products such as fruits, timber and fuel (Ex; avacado, papaw, gliricedia, clove, jak, banana, tea, lemon, orange, vegetables, spices, rubber, mango,rambutan, arecanut, cocoa, kithul, breadfruit, coffee, pepper)



  - It provides specific environmental services in addition to economical advantages

  Ex: Biodiversity conservation, sustenance of water catchment area and land
  - A mixture of agro forestry cultivation
  - The procured products are varied
  - Less chance to become unsussessfull economically
  - Often cultivated for family needs and selling
  - Crops for animal food are grown in sloping lands
  - Undergrowth is methodically grown so that it can withstand intense sunlight and rainfall

- Ask students about advantages and disadvantages of upcountry cultivation
  Advantages
  Ex:
    - Recieving a high income
    - Supply of food, timber and firewood
    - High plant diversification, protection of gene pool
    - Fufilment of nutritional requirements of the family
    - Providing habitats for rearing animals

  Diadvantages
  Ex:
    - Inability to be implemented on a large scale (often cultivated to fulfil family requirements and the rest is sold.)
- Let the students present their ideas about how up country crop cultivation conforms to the sustainable agriculture.
  Ex:
    - Cultivating grass in the land with slopes to avoid soil erosion
    - Growing suitable crops after establishing a proper drainage system in marshy lands
    - Systematizing undergrowth cultivation in a way that tolerates high intensity sunlight and rainfall
- Present pictures of videos of an agro-forestry. Inquire specialty of this cropping stystem in comparison with other systems . Guide the students to present a definition through the discussion.
  - A proper management system with varied biological combinations which utilizes the land economically and agriculturally productively and with sustainability and which aloso has the capability to safeguard the equilibrium of a forest.
- Guide the students to prepare a list of constituents present in agro-forestry.
  - Crops
    - Perennial crops, annual crops, grass
    - Timber, firewood, crops for fuel
  - Animal husbandry
- Let the students present ideas about the function of agro-forestry.
  - Maintaining the balance of natural cycles.
    Ex: Carbon and nitrogen cycles
  - Minimizing soil erosion
  - Protecting the environmental equilibrium
  - Providing food and habitats for animals
  - Mainintaining the biological equilibrium
  - Underground water conservation
  - Increase in soil fertility due to the addition of organic materials.
  - Cycling of soil nutrients
  - Environmental temperature control
  - Providing favourable conditions for soil organisms
  - Ability to obtain timber and fuel
  - Efficient utilization of the aerial environment
- Ask the sudents about causes for the instability of agro-forestry.
  Ex:
    - Subjected to diseases and pests
    - Susceptible to climatic changes
    - Use of chemical fertilizer and soil erosion
    - Destruction of biodiversity
    - Use of expensive inputs

- Let the students present ideas about the way agro-forestry conforms to sustainable agriculture.
  Ex:
  - Using less amount of inputs (fertilizer)
  - Lessening management activities
  - Cultivating crops protecting natural forests as much as possible (reduction of soil erosion)
  - Cultivating crops with stratification
- Remind the students of a place where organic farming is done and present a picture or a video of such a place. Introduce organic farming through it.
  - Simply define organic farming as farming without using artificial chemicals.
- Point out that organic farming leads to sustainability by increasing soil fertility and biodiversity and minimizing the use of chemicals.
- Point out through discussions, the need of organic farming as a solution to problematic conditions such as the degradation of the soil structure with the depletion of organic matter in soil, weakening of soil aeration, decrease in nutrients, removal of artificial fertilizer and pollution of the environment by their deposition in reservoirs and swollowing up by food chains and food webs.
- Guide the students to collect the following information about organic farming.
  - Products produced by organic farming and exported by Sri Lanka
    Ex: cashew, tea, pepper, cloves, nutmeg, coconut, copra, pepper, cardamon
- Introduce IFOAMC (International Federation for Organic Agriculture Movements) as the institution involved in organic farming.
- Let the students present a definition for organic farming.
  - FAO definition
    - A perfect and specified production management system which sustainably maintains biodiversity, expediting bilogical processes and soil biological processes using cultural, biological and mechanical methods in a farm.
  - USDA definition
    - A farming system implemented by avoiding or limited use of artificial inputs such as artificial feretilizer, pesticides, hormones, food additivies and employing crop rotation, crop residues, animal fertilizer, off-form organic waste, mineral grade rock additives and mobility of nutrients and biosystem and plant protection methods.
- Discuss the main objectives of organic farming.
  - Maintaining viability of soil
  - Protecting soil health
- Point out the fact that here, the required nutrients are released to the crops through crop rotation, crop residues, farmyard manure, green manure of legumes, farm's organic waste, bio-fertilizer, useful micro-organisms as well as through biological and mechanical methods while accomplishing the objectives aforesaid.
- Ask the features of organic agriculture.
  - Organic farming is an integrated nature-friendly farming technique.
  - This improves environmental system health, biodiversity, biological cycles and soil micro-organism activities.
  - This involves improvement of biological processes and maintainence of organic matter, protection of long term soil fertility and safe use of machinery.
  - Brings about nutrient availability through microbial processes.
  - Maintains fixation of biological nitrogen recycling of organic matter, nitrogen recycling and self-sufficiency of nitrogen.
  - Weed and pest control is brought about by crop rotation, natural enemies, predators and parasites.
  - Solving problems related to animal husbandry sector through animal health, breeding methods and livestock distribution.

- Conducting activities in a way that minimally affects environment, wildlife conservation and natural habitats.
- Using organic matter instead of artifical input (compost, nitrogen fixation, cover crops)
- Not using artificial pesticide (using biological/physical methods)
- Following preventive methods instead of following artificial veterinary methods.
- Not using genetically modified types and using mixed farming techniques, crop diversification and integrated farming techniques combined with livestock.

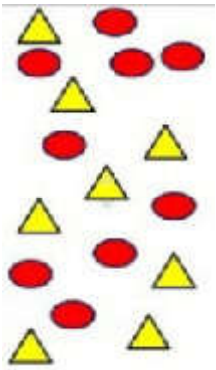
- Guide the students to gather information about the principles on which organic farming is based.
  - Health
  - Ecology
  - Fairness
  - Care
- Health
  - Organic farming plays a greater concern for the health of the environment, soil, environment system, animals and man.
  - Health is not only being free from diseases but also maintaining physical, mental, social and economic wellbeing and immunity.
  - Health is instrumental for the congruity of a bio-system.
  - Considers that individual health and environmental health are inseparable.
    Ex: Obtaining healthy crops from a healthy soil.
  - Since earth is considered a single unit, organic farming attempts to maintain sustainably, the health of soil, plants, thermometry and improvement of health.
    Ex: The use of pesticides is harmful for man as well as soil organisms
  - The health of man as well as of animals is safeguarded when obtaining healthy crops from a healthy soil.
  - Improvements in cultivation, processing, distribution and consumption should be done safeguarding health.
- Ecological principles
  - Organic farming is based on the live environment system and natural cycles and is important for their stability. Accordingly, production depends on environmental processes and recycling processes. Organic farming should tally with local conditions, environment, cropping pattern, cropping and scale. Maintainence of materials and energy sources and environment's quality should be obtained by reuse of input, recycling and efficient management. This also causes resource conservation.
  - In organic farming environment equilibrium should be established by sustaining heriditary and agricultural diversification, creating habitats for animals and by planning the farm.
    Ex; Crops-Soil
    Farm environment - Animals
    Aquatic environment - Fish

- Principles about equity
  - The fulfilment of social and environmental justice is expected through this.
    Ex; Everybody in society should receive healthy food. A good relationship should be made between the common environment and its beings and should gain its trust. Humane relationships shoud be built among the farmers,l abourers, processors, distributors and consumers connected with organic farming.

  Production quality and sufficient amount of food and other products should be targated and environmental and social resources should be managed and consumed while reserving for the future generation.
- Care
  - The safety of all generations should be ensured. Safeguarding health and protection of present and future wellbeing should be effected with resposibility while managing resposibility and prevention properly. Apecial attention should be paid when selecting suitable technology, management and development.

- Dicuss that the following points must be considered when moving towards organic farming.
  - Necessity of subjecting the cultivating land to organic management
  - Protecting the biodiversity and stability of the former environment system
  - Managing, prevention and responsibility in order to safeguard the wellbeing and health of the environment for the present and future generations.
  - Use of alternative sources for nutrition .
  - Adopting crop rotation, crop residue management, organic fertilizer and biologocal inpts
  - Pest control through biological control and physical methods
- Instruct the students to prepare a list on measures that should be included in organic farming.
  - Cropping at the right time
  - Fertilizing soil
    - Use of crop rsidues, use of organic fertilizer, crop rotation, multiple croppong and excessive land preparation.
    - Covering soil
    - Temperature control-covering soil
    - Maintaining natural cycles
    - Increasing gene diversification, use of renewable resources, refraining from using pesticides
  - Efficient water management
  - Biological pest management
  - Use of organically derived insecticides
  - Maintaining soil health
  - Increasing gene diversity
- Guide the students to frame a definition for bio-dynamic farming.
  Bio-life
  Dynamic-energy
- Bio-dynamic farming can be explained as an agricultural science implemented using knowledge about nature's principles and cosmic energy to maintain soil health and equilibrium.
  - In this method, a farm is considered a live system while it is believed that earth is a living body . It contributes to provide nutrition essential for humans and development maintaining relationship between the environment and healthy soil.

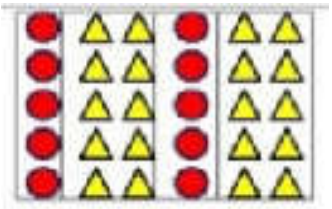
- Discuss special features of bio-dynamic farming.
  - Bieng an alternative farming techniques similar to organic farming
  - Soil is considered the main constituent.
  - As artificial fertilizers debris obtaining cosmic energy, an unpollutant land is selected.
  - Being a process which fulfills the wellbeing of the environment system, uplifts living standards of animals including humans and provides nutrition, it is carried out with local technology and organic farming.
  - Process which follows spiritual techniques and rituals for the farm's sustainabiity and self-sufficiency (A technique that depends on cosmic and earthly energy)
- Instruct the students to explore facts about principles of bio-dynamic farming.
  - Crop diversification - The pest problem could be maximized through crop diversification maintaining natural setting.
  - Animal diversification - The increase in animal diversification aids soil health mainteinance, control of diseases and pests and helps to produce compost using animal faeces.
  - Homeopathic solutions - These solutions are prepared from animal faeces, plant and materials and minerals. These solutions are sprayed in soil treatments.
  - Life forces - Crops are cultivated, paying attention to how various forms of energy affecting earth have their impact on plant growth.
- Guide the students to prepare a list of various methods used in bio-dynamic farming.
  - Not using chemical fertilizers and insecticides and instead, making use of natural means and bionutrients (bacteria, fungi, mycorrhiza, actinomycetes)
  - Use of bilological practices such as compost, green manure, crop rotation, inter-cultivation, mixed crop cultivation and trapping plant cultivation.
  - Conducting agricultural activities with the help of a bio-dynamic calendar.
  - Controlling pests by birds, parasites and natural enemies.
  - Believing that using chemical materials forestall cosmic energy.
- Present diagrams, pictures, videos and photographs of varoius cropping patterns. Inquire about them. Guide the students to frame a definition for cropping patterns from them.
  - The order of cultivating crops on a land is the cropping pattern.
- Inquire the students about cropping patterns. Point out that cropping patterns can be divided into two main categories.
  - Mono-cropping
  - Multiple cropping
- Point out that only one crop is cultivated in mono-cropping.
- Ask students to give examples for mono-cropping.
  - Paddy cultivation
  - Tea cultivation
- Define multiple cropping and make students aware about the following multiple cropping methods.
  - Cultivating two or more crops in the same field in the similar period in the same year is multiple cropping.
- Let the students name various multiple cropping methods.
  - Mixed cropping
  - Intercropping
  - Relay cropping
  - Crop rotation



- Let the students present a definition for mixed croppping.
  - Cultivating in a manner of aquiring the best use of a land with similar concern for annual, biannual and perennial crops without creating competetion is called mixed cropping.
  - There should be two or more types of crops and often, the crops should be of same age.
- Ask the students about situations where mixed cropping is used.
  Ex: Rainfed cultivation, up country homegardens, agro-foresty.
- Discuss the crops used in mixed cropping and the way of establishment.
  Ex: banana, brinjals, chillie

- Discuss facts that should be considered when selecting crops for a mixed crop.
  Ex:
  - Being plants that are suitable for the climatic conditions of that area.
  - Cultivating crops with drougt resistant features in low rainfall periods in the dry zone
  - The space occupied in the aerial environment
- Discuss advantages and disadvantages of mixed cropping.
  Advantages
  Ex:
  - Obtaining incomes throughout the year
  - Reduction of risk and uncertainty
  - Getting employment opportunities throughout the year.
  - Recycling of nutrients
  - Controlling weeds
  - Ability to use crop residues of one crop as organic fertilizer for the other crop.
  - Preventing formation of hard pans on soil.
  - Reducing soil erosion
  - Making the best use of land
  - Conservation of the environment and protecting biodiversity

  Disadvantages
  Ex:
  - Restlessness or being busy
  - Difficulty in using machinery
  - Encountering problems in irrigation
  - Requirment of high income
  - Requirement of proper knowledge and training
  - Difficulty in prescribing fertilizers
  - Difficulty in planting
- Let the students present facts about the contribution of mixed cropping towards the sustainability of agriculture.
  Ex:
  - Optimum utilization of plant nutrients for obtaining nutrients from various layers due to cutivating many crops collectively.
  - Soil conservation affected by covering due to difference in growth patterns in different crops.
- Present pictures or videos of an intercrop.
- Point out that cultivating another short term crop or several crops in the same cultivation land together with the main crop without inducing competition between the plants is called intercropping.
- Ask the students about examples for plants that are used in intercropping.
  Ex:
  - When the main crop is coconut; pineapple, papaw, banana are cultivated as intercrops.
  - When rubber is the main crop; legumes, banana, passion fruit, pineapple, yams, ginger, coffee, cocoa are cultivated as intercrops.



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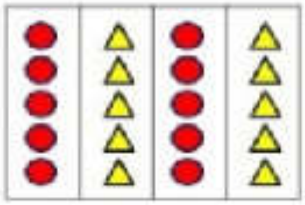


- Inquire the students about crop establishment in intercropping.

  Ex: • When the main crop is coconut,.the intercrops are cultivated approximatly two metres away from the tree.This minimizes the competetion between the intercrop and the coconut tree. Considering the amount of light required by the intercrops, intercrops can be cultivated when the coconut tree is aged less than five years and when its age is more than 25 years.
- Guide the students to prepare a list of advantages and disadvantages of intercropiing.

  Advantages

  Ex : • Making the best use of resources
  - Increase in the harvest of a unit area
  - Control of pests

  Diadvantages

  Ex : • The farmer should have a proper knowledge about crop selection
  - Difficulty in post-cultivation care
  - Problems emerging in harvesting
  - Increase in the capital required
  - Difficulty in mechanization
  - Increased need of irrigation due to large number of crops growing per unit area
- Let the students describe how intercropping ensures sustainability in agriculture.

  Ex: Conserving soil water due to soil covering
- Introduce crop rotation.
- Cultivating a few selected crops methodically in same land, changing from one season to another is called "crop rotation".
- Ask students about the need for crop rotation.
  - When one crop is grown in a field continuously, the land becomes deficient in nutrients due to the absorption of the same nutrient (nutrient imbalance)
  - The roots grow to the same depth, nutrients from that area only are absorbed. This needs to be prevented.
  - To avoid persistent diseases and pest population.
- Name crop categories suitable for crop rotation, discuss the order in growing each crop category and the importance of those catgories.

  Ex: Cereal crops ....Legume crops..... Yam crops....Vegetables

A	B
D	C

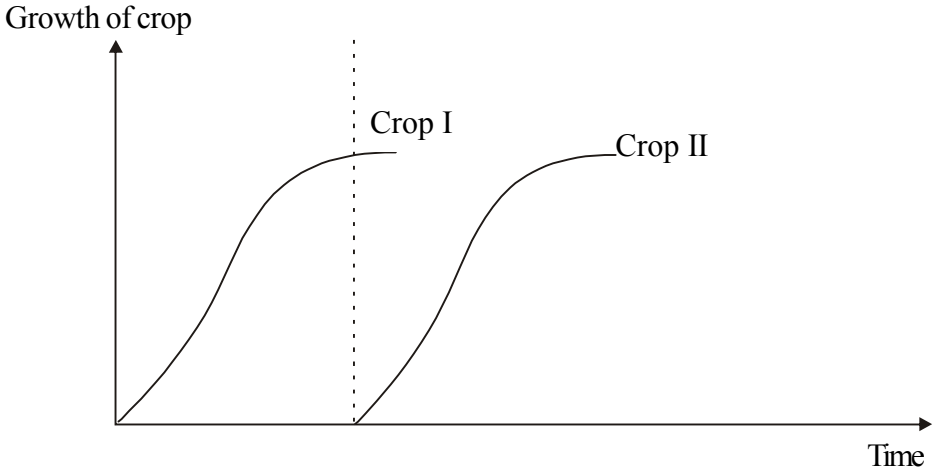
D	A
C	B

C	D
B	A

B	C
A	D

A - Cereal crops B - Legume crops C - Yam crops D - Vegetables

- Discuss facts that should be considered when selecting crops for crop rotation.
  Ex:
  - Climatic factors
  - Growth pattern of the crop
  - The depth to which the root system grows
  - Impact on soil ntrients
  - Age of the crop
  - Common diseases and pests for each crop
- Define relay cropping.
  Relay cropping is growing another crop in the same area when the growing stage of the previous crop terminates and reaches the reproductive stage minimizing competition between crops.



- Ask the students about the advantages and disadvantages of relay cropping and list them.
  - Advantages
    Ex;
    - Ability to make the best use of resouces
    - Increase in the number of crops cultivated per year
    - Control of pests and diseases
  - Disadvantages
    Ex;
    - The need of awarness and knowledge about crop requirements and the nature of the land
    - Having to work according to plan
    - Need to cultivate crops at exact times
    - Problems emerging in harvesting
- Guide the students to expain how relay cropping contributes to the sustainability of agriculture.
- Introduce crop rotation.
  - Crop rotation is growing in the same land several selected crops having the same growth pattern season-wise.
  - Let the students present advantages and disadvatages of crop rotation
  - Advantages
    Ex;
    - Increase in organic matter in soil
    - Control of weeds
    - Reducing the risk and uncertinty of the farmer
  - Disadvantages
    Ex;
    - Need of knowledge for crop selection
    - Need of different inputs due to different crops

- Let the students explain the contribution of crop rotation to the sustainability of agriculture.
- Guide the students to maintain a field in a 5X5 m^2 land area using the principle connected with the above farming techniques.

Key words

- Sustainable management of resources
- Farming systems
- Cropping patterns

.Quality Inputs;

- Pictures or videos indicating the manner of engaging in agricultural activities utilizing natural resourses such as sunlight, soil and water
- Pictures indicating different farming systems

Instuctions for assessment and evaluation

Pay attention to the following facts

- Defining sustainable management of resources
- Describing environmental friendly farming systems
- Explaining farming systems and cropping patterns through diagrams
- Describing the impact of farming systems and cropping patterns on the sustsinabliliy of agricuture

Competency 7 : Identifying hazards that would occur in agriculture and inquires into course of action that would be taken to minimize them.

Competency level 7.1: Investigates into probable disasters that would occur in agriculture.

Number of periods : 03

Learning outcomes :
- Describes physical hazards that would occur in agriculture.
- Identifies accidents that would occur in agriculture.
- Suggests plans to minimize hazards and accidents that would occur in agriculture.

Instructions for plannning the lesson:

- Start the lesson by presenting a video or a picture indicating accidents and hazards that could occur in agriculture.
- Define a hazard.
  - Anything that has the potential to cause harm to a person is a hazard.
- Direct the students to investigate the situations leading to hazards in agriculture.
- Conduct a discussion about reasons for the increase in hazards in the field of agriculture.
  Ex:
  - Agricultural entrepreneurs have to face various climatic conditions
  - Abundant use of chemicals in animal husbandry and in crop cultivation
  - Use of agricultural machinery
- Let the students name physical hazards.
  - Excessive noise and vibrations
  - Dehydration
  - Dust
- Ask the students about machines that produce excessive noise and vibrations.
  Ex:
  - Tractors
  - Lawn mowers
  - Cereal driers
  - Sawing machines
- Conduct a discussion about reasons for the generation of excessive noise in machines.
  Ex :
  - When operating imbalanced, broken or loose machine parts
  - When lubricants are not used
- Make the students aware about noise-induced hearing loss.
  - Temporary threshold shift- Auditory organs get hurt and temporarily non receptive when exposed to an intensive sound.
  - Permanent threshold shift- Hearing cannot be brought back to normal/be rtrieved when exposed to an intensive sound.

- Conduct a discussion about unfavourable effects of intensive sounds.
  Ex :
  - Emergence of hypertension
  - Emergence of hyperacidity
  - Emergence of palpitations
  - Hinders sleep and rest
- Explain the impact of high vibrations on man's health.
  Ex:
  - Head arm vibration syndrome. causes numbering of fingers, paling and pain.
  - Fatigue, agitation, headache and back pain occur as the entire body is subjected to shock.
- Conduct a discussion about the effects of serving in places of high temperature.
  Ex :
  - Dehydration
  - Emergence of rashes
  - Heat cramps
  - Heat exhaustion, vertigo, faint, excessive fatigue, unclear vision, sweating, wet skin
  - Heat stroke- colour blindness, twitching, disorientation, mania
- Direct the students to name dusts that cause harm to farmers in agriculture.
  - Cotton dust
  - Endotoxin
  - Cereal powder
  - Bagassiosis
  - Saw dust
- Discuss the effects of inhaling dusts by man.
  Ex -
  - Fibrosis in lungs
  - Allergies
- Conduct a discussion with students about the effects of dehydration on man.
  Ex –
  - Low thinking ability and attention due to lowering of brain activity
  - Fatigue and high rate of heart beat due to lowering of metabolic activity'
  - Wrinkling drying and discolouring of the skin
- Direct the students to name accidents that could occur in agiculture.
  - In using agricultural equipment
  - Snake bites
  - Insect bites
- Conduct a discussion about accidents that could occur when using agricultural instruments.
  Ex:
  - Cuts from equipments
  - Electrical shocks
- Inquire about snake bites in agricultural sector.
  - 85% of snake bites occur in Sri Lanka during direct or indirect involvement in agriculture.
    Ex: Weeding, harvestig, and preparation, sanitation of the field
- Explain to the students about the major seasons and situations in which snakes could be seen.
  Ex:
  - Snakes could mostly be seen in the monsoon rain seson.
  - Snake activities would be stimulated with the rain and excessive humidity.
  - Snakes can be often seen near tea cultivations,near fields
  - Snakes come to eat mice lingering near fields.
  - Snake habitats are highly possible when there is a thick ground cover cultivation and it is probable that they ccannot be seen.
- Direct the students to name ways by which toxics are absorbed to the body.
  Ex::
  - Through respiration
  - Through skin contact
  - Through food (with beetle)

- Support the students to name the commonly used agro-chemicals.
  - Insecticides
  - Weedicides
  - Fungicides
  - Chemical fertilizer
- Support the students to categorize agro-chemicals according to their effects.
  - Local toxicity
  - Systemic toxicity - Poisoning occurs at another place away from the place of poisons contact with the body
  - Acute toxicity- Poisons just as it is exposed to the chemical
  - Chronic toxiciy - A collective damage occurs in a certain system.Takes a long time to discover the disease.
- Conduct a discussion about the unfavourable effects of agro-chemicals.

  Ex:
  - Kidney diseases could emerge due to pesticides with chemicals such as mercury, cadmium, chlorofam
  - Respiratory diseases-occur through amonium chemicals
  - Skin diseases
  - Diseases related to the blood circulatory system
  - Cardiovascular diseases
  - Nervous disorders
  - Cancer
  - Diseases in the reproductive system
- Discuss measures that could be taken in agriculture to mitigate dehydration.

  Ex: Wearing protective clothes,washing the body repeatedly when working under a high temperature.
- Conduct a discussion on steps that could be taken to mitigate hazards caused by sounds and vibrations of intensive machinery.

  Ex:
  - Setting lubricants to the machines
  - Renewing broken, loose machine parts
  - Slow functioning of big machine.This lowers its sound.
  - The shock caused by the functioning of the machine on the cement floor is prevented by fixing vibration isolation pads to the feet of the sound producing machines.
  - Sound proof materials attached in walls and the ceiling can prevent sound pollution.
  - Wearing protective clothes and the use of personal protective equipment
- Discuss steps that could be taken to reduce accidents that occcur when using agricultural instruments.

  Ex :
  - Proper maintainece of all instruments and operating them according to the instructions of their manufacturers.
  - Using protective clothes and protective equipments when operating instruments. Hair should be tied in order to avoid clothe parts getting into contact with the instruments.
  - The area and roads where the instruments are used should not be slippery and should be clean.

- Ask the students about measures that should be followed when setting pesticides to the field to prevent poisoning.
  Ex:
  - Read the label and follow its instructions.
  - Selecting the correct sprayer.
  - Testing whether the instrument does operate before using.
  - Proper preparation of the pesticide mixture by using suitable measuring instruments.
  - Using a protective clothe kit in utilization,wearing mouth covers, hand gloves
  - Getting the support of another person when using highly poisonous pesticides
  - Applying pesticides on a day with a clear sky in the morning or evening
  - Keeping it to the perpendicular to the wind direction
  - Avoiding taking food when spraying
  - Avoiding mouth blowing when the nozzle gets stuck
  - Avoiding wiping sweat in the midst of spraying
- Make the students aware about measures that should be taken after spraying pesticides.
  Ex:
  - Deeply burying empty pesticide containers in a way that they cannot be reused
  - Avoid addition of pesticides in instruments to reservoirs
  - Bathing after removing the clothes worn at the moment of spraying
  - If pesticides get in contact with the eyes accidentally,washing with clean water and getting treatments from a doctor.
  - Going to a doctor with the packaging,if headache, vomiting,fainting, or any bodily discomfort is experienced at the moment of spraying or afterwards.

Key words

- Physical hazards

Quality inputs

- Videos indicating hazards and accidents that could occur in agriculture.

Instructions for assessment and evaluation:

Pay attention on th following facts

- Defining hazards
- Describing physical hazards that could occur in agriculture
- Describing hazards that could occur in agriculture
- Describing measures that should be implemented to avoid hazards and accidents in agriculture

Competency level 7.2: Investigates into physical and mental problems that occur in agriculture.

Number of periods: 04

Learning outcomes :
- Collects information about zoonotic diseases that occur when engaing in agriculture.
- Describes about mental problems that arise in engaging in agriculture.
- Describes measures that could be followed to mitigate health problems that arise when engaging in agriculture.

Instructions for preparing the lesson:

- Start the leson by presenting a picture or a video that indicates health problems that occur when engaging in agriculture.
- Guide the students to categorize those health problems.
  - Zoonotic diseases
  - Mental disorders
- Support the students to name frequent zoonotic diseases related to agriculture.
  - Brucellosis
  - Tuberculosis
  - Leptospirosis
- Direct the students to investigate into brucellosis disease.
  - A disease created by the bacterium named Brucella and is a disease transmittable to man.
  - There are various strains in this bacterium. Some strains could be seen in the cow while some strains could also be seen in pigs, dogs, sheep and in goats.
    - *B.abrotus* - in cows
    - *B.suis* - in pigs
    - *B.melitensis* - could be seen in goats and in sheep
  - This bacteria is transmitted from perosn to person.
  - Brucella bacteria could enter the body through cuts in the skin, food or drinks contaminated by the bacteria.
    Ex: Milk that has not been pasteurized, uncooked meat or rarely through air.
    - Symptoms of the Brucellosis disease.
      - Decrease in appetite
      - Back pain
      - Shivering
      - Languidness
      - Stomach pain
      - Ligament pain
      - Fluctuating fever
      - Decrease in body weight

- Guide the students to investigate into tuberculosis.
  - Animals are prone to this disease through the bacterium named *Mycobacterium bovis*.
    Ex: Cows and buffaloes
  - Cows and buffaloes act as vectors to this disease.
  - Bovine tuberculosis occurs when the bacterium infects the respiratory system of those animals.Healthy animals are affected through the respiratory system secretions, faeces and milk.
  - This bacterium is transmitted to humans through cows and buffaloes.
  - The micro-organism enters the body through unpasteurized milk and through consuming dairy products,through drops secreted from sneezes, during respiration and through broken wounds (injuries).
  - Disease symptoms
    - Fever
    - Heart pain
    - Cough
- Direct the students to investigate about rate fever (Leptospirosis).
  Ex:
    - Caused by the bacteria named "*Leptospira interrogans*"
    - Infection occurs when the bacteria enter the human body when the water or soil mixed with rat urine comes into contact with eyes, nose, mouth and injuries.
  - Symptoms of Leptospirosis
    - Headache
    - Muscle pain
    - Fever
    - Flowing of blood from lungs in extreme situations
- Ask the students about mental problems that could emerge when engaging in agriculture.
  - Stress
- Define stress.
  - Stress is a physical reaction a threat to one's life.
- Ask the students about reasons for the emergence of stress in agricultural industry.
  Ex:
    - Damaging of crops due to climatic conditions that cannot be prefigured.
    - Damages to expensive machinery
    - Decrease in market demand
    - Debilitation of the overall status
- Point out the fact that although the stress occuring is similar, the reactions of different people are varied.
- Educate the students about symptoms of stress.
  Ex:
    - Change in sleeping patterns
    - Decrease in body weight
    - Fatigue
    - Restlessness
    - Headache
    - High blood pressure
    - Dismantling of family relationships

- Conduct a discussion on legal matters related to agricullture.
  Ex:
  - Problems about ownership
    - Legal problems about LRC rental lands
  - Matters on development businesses
  - Matters pertainng to insuarance
  - Matters realted to farmers not receiving subsidies even though they pay taxes to the government
  - Legal matters related to water distribution
  - Matters of its standard when purchasing agro-chemicals
  - Legal matters related to standard of inputs
  - Legal matters related to marketing
  - Legal matters related to quality
  - Legal matters related to subsidies
  - Legal matters related to the export market barriers
- Direct the students to gather information about economical matters related to agriculture.
  - Emergence of unfavourable environmental conditions,incapability to pay loans.
  - Lack of required capital to establish a small scale industry.
- Make students aware about measures that could be taken to mitigate the Brucellosis disease.
  Ex:
  - Avoiding use of uncooked meat and non-pasteurized milk, cheese made out of non-pasteurized milk and icecream.
  - Wearing gloves and protective clothes when handling animals
  - Covering as to prevent entering into the body through scars or wounds of animals.
  - Wearing protective clothes when supporting parturition of animals.
  - Providing vaccinations that control Brucellosis disease
- Discuss techniques that can be used to prevent transmission of rat fever to humans.
  Ex:
  - Wearing protective shoes when walking in fields
  - Using techniques to prevent spread of rats
  - Providing antibiotics as treatments
- Conduct a discusssion on measures that should be taken to prevent stress.
  Ex:
  - Obtaining required assistance for problem solution
  - Exercising-Exercise for 30 minutes
  - Avoiding drinks that consist caffeine
  - Engaging in activities like walking, hobbies, meditation
  - Reading books
- Make the students aware about ways to mitigate legal problems.
  Ex:
  - Obtaining legal instructions to take measures for the relevant matter.
- Make the students aware on ways to mitigate legal problems.
  Ex:
  - Obtaining legal instructions to take measures for the relevant matter.

Key words

- Zoonotic diseases

Quality inputs

- A picture or a video that indicates health problems arised with engaging in agriculture

Instructions for assessment and evaluation:

Pay attention to the following facts:

- Describing zoonotic diseases that occur in agriculture
- Describing mental problems that occur when engaing in agriculture
- Explaining measures that could be taken in order to mitigate mental problems that arise when engaging in agriculture
- Suggesting required techniques to solve the economic and legal problems that occur in agriculture

Competency 8: Exhibits readiness for contemplating required measures to overcome challenges faced in agriculture.

Competency level 8.1 : Prepares measures to mitigate the effects on agriculture caused by climate changes

Number of periods : 05

Learning outcomes :
- Explains reasons for climate change.
- Describes the impact of climate changes on the agricultural sector.
- Suggests methods to mitigate the effects caused by climate change.

Instructions for preparing the lesson:
- Inquire into the students knowledge about the rainfall pattern in Sri Lanka.Start the lesson by pointing out that natural disasters affect it.
- Let the students define natural disasters.
- Point out that there are various definitions for natural disasters.Present the definition of the IPCC (Inter Governmental Panel on Climate Change) to the students.
  - Long term (a decade or more) and considerable changes in the usual weather and its changes are called climatic changes.These changes can occur due to the man made, long term changes in natural constituents or land consumption.
- Let the students investigate and examine tables,graphs about the world's temperature and rainfall (for years) through the internt. Assist the students to realize the existence of natural disasters through it.
- Guide the students to collect information about reasons for climate changes.
- Conduct a discussion to ensure the contribution of man's activities towards climate change.
- Emphasize the fact that the main reason for climate change is the increase in global temperature through the enhanced green house effect.
- Prove through relevant data, tables and graphs, the way green house gases affect green house phenomena, and the way green house gases have increased due to human activities.
- Point out that the enhanced green house effect is an essential component for the sustenance of the earth.
- Let the students prepare and present a list of causes for climate changes.
  Ex:
  - Burning of fossil fuels
  - Forest destruction
  - Urbanization
  - Addition of urban waste
  - Increase in green house gases such as carbon dioxide,CH_4,N_2O and CFC due to activities like agriculture.
- Point out through discussions that increase in global temperature and imbalance of the water cycle occur due to the above reasons.
- Elicit students' ideas on the impact of the above climatic changes on the agricultural sector.
  Ex: Climatic conditions like drough, flash floods, high intensity rain, the sky weighed with clouds persistently
- Help the students to investigate facts about the impact of rainfall instabilities on the agricultural sector.
  Ex: Dilapidation of production activities due to threats to the main cropping seasons

- Prove the fact that rainfall instabilities occur as a consequence of climate changes using relevant tables and graphs.
- Explain that instabilities such as long term drought periods, random rain periods,intensive rains,not receiving rain in sufficient amounts at certain times, could be observed.
- If not, instruct the students to gather a relevatent data collection.
  Ex:
  - Soil erosion, decrease in water capacity due to deposition of silt in reservoirs
  - Removal of fertile soil
  - Perpetual floods
  - Scarcity of irrigated water
  - Crops subjected to drought situations
  - Reduction of water deposits in soil
  - Increase in diseases and pests
  - Effects on grass and livestock production in the animal husbandry sector
  - Emergence of diseases and pests in farm animals
  - Decrease in crop harvest and livestock production in the animal husbandry sector
  - Emergence of diseases and pests in farm animals
  - Decrease in crop harvest and liestock production due to these reasons
- Let the students present suggestions to mitigate impacts of climate changes on the agricultural sector.
  Ex:
  - Efficient farm water management (micro-irrigation systems,reservoirs, canals rehabilitation, cleaning unclean waterband using later)
  - Provision of crop in agroecological zone level.
  - Introducing new varieties suitable for the environment.
  - Introducing short term crop varieties,salinity resistant varieties,drought resistant varieties, diease and pest resistant varieties and temperature resistant varieties.
  - Implementing tree planting programs
  - Following environment-friendly farming systems
  - Increasing fertilizer efficiency
  - Utilizing renewable energy (wind mills, oceanic waves) for farm's energy.

Key words
- Climate changes
- Green house effect
- Global warming

Quality inputs
- Posters,books and magazines that indicate climate changes

Instructions for assessment and evaluation:

Pay attention to the following points:
- Defining climate changes
- Stating reasons for climate changes
- Explainng the green house effect
- Describing the impact of climate changes on the agricultural sector
- Suggesting methods to mitigate the effects of climate changes on the agricultural sector

Competency level 8.2 : Contemplates measures to protect pollinators in agriculture.

Number of periods : 02

Learning outcomes :
- Describes the importance of pollinators in agriculture.
- Describes the reasons for the scarcity of pollinators.
- Suggests techniques that could be used to protect pollinators.

Instructions for preparing the lesson:

- Start the lesson by asking strudents about pollination which causes fruiting in crops.
- Let the students name pollinators.
  - Live pollinators - Ex: insects
  - Non-live pollinators - Ex: wind, water
- Guide the students to prepare a list of live pollinators that contribute towards pollination.
  Ex: bees, bumble bees, butterflies
- Discuss the importance of pollinators in agriculture.
  Ex: Fruiting by pollination
- Discuss reasons for the scarcity of pollinators.
  Ex:
  - Environmental pollution
  - Use of insecticides/pesticides
  - Destruction of natural habitats of beings
  - Urbanization
  - Scarcity of foods for insects
- Let the students suggest methods that could be implemented to protect live pollinators.
  Ex:
  - Creating habitats for pollinators
    Ex: Flower gardens, forest gardens
  - Use of environment-friendly pest control methods
  - Use of environment-friendly farming systems and cropping patterns

Key words :

- Pollination
- Pollinator

Instructions for assessment and evaluation:

Pay attention to the following facts:

- Stating the importanc of pollinators in agriculture
- Naming pollinators
- Describing reasons for the destruction of pollinators
- Suggesting techniques to protect pollinators

Competency level 8.3 : Contemplates to overcome challenges related to the technology used in agriculture

Periods : 02

Learning outcomes :
- Describes challenges related to technology in agriculture.
- Suggests measures to mitigate the impact of challenges related to technology.

Instructions for the planning lesson :
- Present pictures and videos that illuustrate situations where technology is being utilized for agricultural activities in developed countries. Start the lesson by letting the students implment a comparison among situations that technology has been used in agricultural activities in Sri lanka.
- Point out that Sri Lanka has faced various challenges pertaining to technology.
- Guide the students to investigate challenges that agriculture is facing at present:
  - Seed monopoly
  - Gene modified food
  - Scaricity of resources required for agriculture
  - Protection of local crops
  - Seed monopoly
- Point out that seed production, distribution and marketing by entirely getting the planting matrials as the seed production process under one person or a group is seed monopoly.
- Point out that multinational companies have inclined for this purpose.
- Inquire reasons for considering imported seeds as planting materials by farmers.
  Ex:
  - Ease
  - Acquiring a large harvets
  - Attractiveness (in harvests)
- Let the students present their ideas about the unfavourable effects that could occur due to seed monoply and use of these imported seeds.
  Ex:
  - Extinction of genetic resources due to letting go of using local crop seeds.
  - The plants to be cultivated in the future in one country should be decided according to the decisions of multinational companies
  - High prices
  - Difficulties in purchasing in certain areas
  - Genetically modifies foods
- Point out that genetically modified foods are food prepared from beings produced by changing genetic materials.
- Ask for examples for genetically modified foods.
  Ex:
  - Weedicide and insecticide resistant soyabeans,maize,canola
  - Nutritional rice (golden rice)
- Discuss unfavourable effects of using genetically modifies foods
  Ex:
  - Problems in ensuring health safety
    Ex:
    - The chemical composition and those mixtures are not ensured to be safe for human health.
    - Resistant to antibiotics

- Discuss about challenges due to lack of resources for agriculture.
  - Protection of local crops
    - Point out that some local crops are being extincted at present due to the use of technology.
      Ex:
      - Extinction of local varieties due to hybridization and use of imported seeds.
        Ex : local snakeguards, pumpkins
      - Way of acquiring seeds/plants for cropping
- Inquire the tudents about reasons for the above circumstances.
  Ex:
  - Supply of food required by the increasing population.
  - People reach optimum production and not the maximum production.
- Let the students suggest measures that could be followed to conquer each challenge related to technology faced by the country.
  - Techniques that could be followed to overcome unfavourable circumstances due to seed monopoly.
  - Self-seed production.
    - Use of self-seed production to fulfillll the need of planting materials for cropping. This lets one to produce seeds of one's requirement and preferance.
  - Techniques that could be followed to overcome unfavourable circumstances due to the use of genetically modified food.
  - Suggested solutions through technology for challenges espoused by scarcity of resources required in agriculture.
    Ex:
    - Utilizing agricultural resources,increasing efficiency.
    - Reaching optimum production by using competetive agricultural inputs sutainably
    - Following mthods of engaging in a productive agriculture while protecting water and soil.
      Ex:
      - Following Precision agriculture methods
      - A farm management concept implementing variation observation in the field or between the fields while assessing and using information technology to respond those circumstances while efficiently using resources.Required methods are implemented by GIS computers.The harvest is increased by observing crop and soil status through the use of senses and machines and implementing the required treatments.
      - This allows an optimum production in comparison to the inputs while conserving resources.
  - Suggested solutions to protect lllocal crops.
    Ex:
    - A certain crop grows productively only in its endemic environment.It is important to maintain local crop varieties persistently.
    - Protecting biodiversity.
    - Ability to acquire an optimum production by providing optimum environmental conditions.

Key words

- Technology related challenges in agriculture
- Precision agriculture

Qualitative inputs

- Pictures or videos that illustrate circumstances that technology has been used in developed countries for agricultural activites.

Instructions for assessment and evaluation:

Pay attention to the following facts:

- Describing technology related challenges in agriculture.
- Presenting suggestions to mitigate the impact of technology related challenges on agriculture.