

AGRICULTURE
TEACHERS' GUIDE
GRADE 12



2023

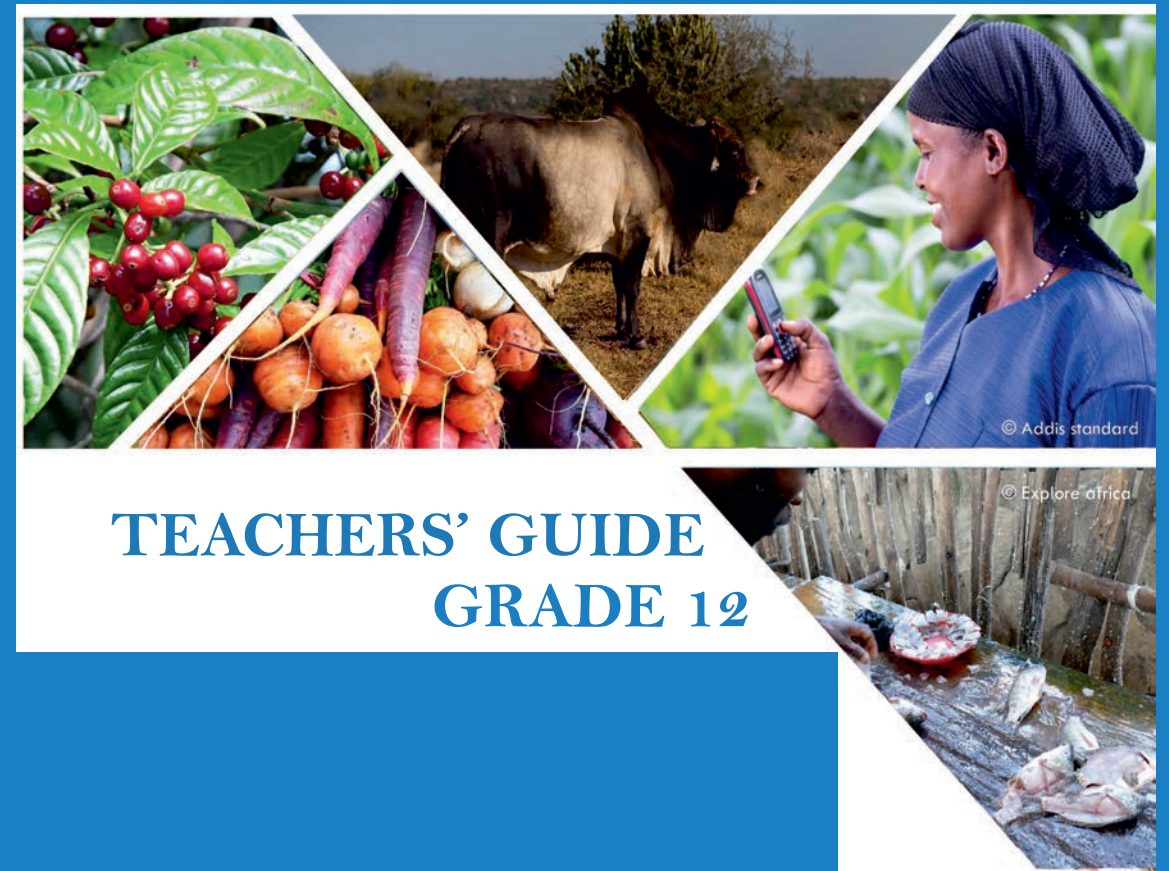
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Writers:

Yohannes Batiso (MSc), Hawassa University
Haile Welearegay (PhD), Hawassa University

Editors:

Bimrew Asmare (PhD) (Content Editor)
Fetene Regassa (PhD) (Curriculum and Instruction Editor)
Tamene Kitila (PhD) (Language Editor)

Illustrator

Yonas Azene (MSc)

Designer:

Ephrem Alamrew (MSc)

Reviewers:

Taye Tolemariam (Professor, PhD)
Teramage Tesfaye (PhD)

Evaluators:

Daniel Taddesse (PhD)
Serawit Handiso (PhD)



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General Introduction

This teacher's guide is intended to help teachers of agriculture in grade 12 in planning, organizing, delivering activities of the content, and assessing the students. The grade 12 agriculture Students Textbook has been designed to provide textual material covering **crop production and management** (vegetable crop production and management, fruit crops production and management, root and tuber crops production and management, and coffee, tea, and spices production and management), **livestock production and management** (such as beef cattle production and management, sheep and goat production and management, camel production and management, poultry production and management, aquaculture, apiculture), **natural resources management** (such as nursery and plantation technology, basics of agro-forestry systems and practices and soil and water conservation), **agricultural technology** (such as introduction to plant biotechnology and ICT in Agriculture) and **nutrition-sensitive agriculture** (gender and human nutrition, safe food production, and postharvest handling).

Within these general objectives, this teacher guide aims to assist teachers in the design and application of various teaching-learning methods, strategies, and learning support materials that teachers may alternatively use in their teaching-learning activity. This teacher's guide also supports teachers' efforts to guide students through the activities and assessment schemes to develop the competencies indicated in each unit to the level required.

General Information for the Teacher

The General Education Curriculum Framework requires the employment of participatory teaching and learning approaches in which learners are at the center of the process. Accordingly, the student's textbook and this teacher's guide are based on a student-centered learning approach. Active teaching-learning methodology, as an aspect of the student-centered learning approach, is used as a strategy in the textbook. You are advised to use this strategy to facilitate students' learning. Active learning encourages students to take more responsibility for their own learning.

Student-centered learning does not sideline or diminish the role of teachers. Instead, it seeks to use teachers' expertise in different ways to increase student engagement. Teachers serve as facilitators and guides for student decision-making and skills-building. As a facilitator, your goal is to help students develop their abilities to independently acquire knowledge and skills and to absorb the subject matter. This teachers' guide is to support teachers, not to stifle their creativity and innovation in using various teaching strategies. This guide must be used flexibly depending on the level of understanding and composition of learners, and teaching-learning circumstances in the locality, school, and classroom setting.

This teacher's guide is intended to structure unit –by-unit in line with the textbook. For each unit, the competencies to be developed are indicated as a focal point of the entire teaching-learning process. Each unit in the teacher's guide follows the structure below.

Unit Overview- summarizes the contents of the unit.

The teaching Learning Process: : Presents the lesson's core activity, including instructions for setting up and presenting each lesson topic and every activity, in sequence. It includes sub-sections such as:

- **Suggested Teaching Methods:** for each topic, particular teaching methods are suggested. The teaching methods may vary depending on the lesson objectives, the composition of students, contents, and activities.
- **Suggested Learning Support Materials:** for each topic, particular teaching methods are suggested. The teaching methods may vary depending on the lesson objectives, the composition of students, contents, and activities.

Lesson Preparation: teaching is a three-phase activity: preparation, delivery, and assessment. Lesson preparation is the first phase in which you get ready for teaching before coming to the classroom. It involves planning for a lesson and selecting appropriate methods, materials, classroom activities, and assessments in advance.

Lesson presentation: in this activity, the lesson is presented to the class as a whole. Usually, this task is performed by the teacher but can be performed by a guest speaker or assigned students.

Evaluation and follow-up: this activity consists of continuous assessment during class time, supplemented with further evaluations before and/or after class. Direct observation, quizzes, tests, homework, mid-semester examinations, and final examinations could be used as assessment tools.

You should provide immediate feedback after the evaluation as a learning tool for the students. Based on the result, you can arrange other mechanisms to address those who performed less well such as providing additional exercises to raise them to the level required.

Student-centered learning considers learning as taking place in a constructive interaction between the students, subject matter (textbook), support materials, and teachers. As a teacher that facilitates student learning, your role in the process is immense. When you use the suggested teaching methods, strategies, and learning support materials, do not consider the suggestions as mandatory instructions that you must adhere to. Thus, please consider this teacher's guide as support material, assisting you and expanding your perspective, not as a substitute for the creative and innovative teaching strategies you may develop in the process.

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Unit 1 Vegetable Crops Production and Management

Total Periods Allotted: 7

Unit Introduction

In this unit, the students will learn about the importance, production, problems, and prospects of vegetable production in Ethiopia. They will also learn about factors affecting vegetable production, classification of vegetables, vegetable production systems, and principles of vegetable production.

Unit Learning Outcomes

At the end of this unit, students will be able to:

- explain vegetable crops production, importance, problems, and prospects of vegetable crops production
- list environmental factors influencing vegetable crops production
- state the classifications of vegetable crops, types of vegetable crops production system, and principles of vegetable crops
- apply the principles of vegetable crops management

Main Contents

- 1.1 Importance, problems, and prospects of vegetable crop production in Ethiopia
- 1.2 Environmental factors that influence vegetable crop production
- 1.3 Classifications of vegetable crops
- 1.4 Types of vegetable crop production System
- 1.5 Principles of vegetable crops management

1.1 Importance, problems, and prospects of vegetable crop production in Ethiopia

Competencies

Period Allotted: 2

At the end of this lesson, the students will be able to:

- discuss the importance, problems, and prospect of vegetable crops production in Ethiopia

Contents

- Importance, problems, and prospects of vegetable crop production in Ethiopia

Overview

In this unit topic the students will learn importance, problems, and prospects of vegetable crop production in Ethiopia.

Teaching-learning Process

Instructional materials

- Pictures/photographs that show the importance, problems, and prospects of vegetable crop production in Ethiopia.

Suggested Teaching Methods

Use active learning methods you think will fit the nature of the lesson, the students' composition (i.e., fast, medium, slow learners), and students with special needs (physical, visual and hearing impairment). You can choose and use from the following teaching methods.

- Brainstorming Questioning
- Group discussion
- Demonstration
- lecture

Pre-lesson Preparation

Get the necessary teaching aids and teaching material ready. If none are available in your school, try to prepare your pictures, and photographs

with your students in the pedagogical center. Read related literature for more ideas that will help you prepare notes and activities.

Presentation of the Lesson

Introduction to the lesson - Introduce the students to vegetable crops production by telling them what the learning outcomes are, ask them also brainstorming questions. This will help you find out the students' background knowledge of the topic.

Body of the lesson

Once the lesson has been introduced; you can explain what vegetable crops are in terms of their properties, giving them examples of the various vegetables commonly used

- let the students discuss the major differences between grain crops and vegetable crops
- list the major benefits of vegetables (nutritional and economic)
- explain the opportunities for vegetable production in Ethiopia. Opportunities include diversity of climate, ample water resources, availability of labor and suitable government policy, etc.
- mention the constraints in the area. For example, the proportion of land allocated for vegetables is low. The major reasons for this are low input use, lack of knowledge about proper production and management methods of vegetables, etc.

Stabilization

Give a summary of the following topics:

- nutritional and economic roles of vegetable production
- favorable conditions for vegetable production in Ethiopia
- a major factors that constrain vegetable production in the country

Assessment

You can give students tasks like

- What are vegetable crops?
- List the benefits of vegetable crops for producers and consumers.
- Explain the opportunities for vegetable production in Ethiopia.
- Discuss the constraints of vegetable production in Ethiopia.

1.2 Environmental factors influencing vegetable production

Competencies

Period Allotted: 2

At the end of this lesson, the students will be able to:

- identify environmental factors that influence vegetable crops production

Contents

- Environmental factors that influence vegetable production

Overview

In this section, students will learn about the major environmental factors that affect vegetable production. Temperature, water, light, and the fertility status of the soils are some of the examples.

Understanding environmental factors that affect vegetable production enables the producers to easily identify the kind of environmental stress the vegetables are facing and to solve the problems before the vegetable is damaged.

Teaching-learning Process

Instructional materials

- Photographs, videos that show vegetable crop influenced by environmental factors in Ethiopia – e.g. picture of a different vegetable crops, etc.

Suggested Teaching Methods

- Brainstorming Questioning
- Group discussion

- Demonstration
- lecture

Pre-lesson Preparation

Get the necessary teaching aids and teaching material ready. If none are available in your school, try to prepare your maps, pictures, and photographs with your students in the pedagogical center. Read related literature for more ideas that will help you prepare notes and activities

Presentation of the Lesson

Introduction to the lesson - Introduce students to environmental factors that affect vegetable production by asking them brainstorming questions. This will help you to find out the students background knowledge.

Body of the lesson Start the lesson by- revising the previous lesson and telling the students the objectives of the lesson for the day -

- listing the major environmental variables that affect vegetable crop production
- letting the students discuss possible effects of these variables on vegetable production (i.e., for example, explain how temperature/ water/light/soil affects vegetable production.)
- explain the mechanism by which temperature or altitude and water affect vegetable crops (e.g., photosynthesis, respiration, heat stress, water stress, cold stress, etc.)
- pointing out how light affects photosynthesis and the shift between vegetative and reproductive growth of vegetables
- finally, explain the effects of humidity, soils, and biotic factors on vegetable production

Stabilization

Give a summary of the following topics:

- effects of temperature, altitude, light, water, etc. on vegetable production and vegetable crop selection
- the effects of soils and biotic factors on vegetable production and

vegetable crop selection.

Assessment

For assessment, you may give students tasks like

- how do altitude, temperature, and water affect vegetable production? Give examples of the effects.
- how do soils and insects/weeds affect?
- vegetable production in Ethiopia?

1.3. Classification of Vegetable Crops

Period Allotted: 1

Competencies

At the end of this lesson, the students will be able to:

- categorize vegetable crops based on the criteria of classification

Contents

- Classification of vegetable crops

Overview

In this section, the students will learn about the major classifications of vegetable crops. Classification of vegetables is primarily based on the edible parts (leaf, root, flower, immature and mature fruits), temperature requirement (warm versus cool season), and growth habits (annuals, biennials, and perennial). It is important to understand the classification systems for better management of vegetable production.

Teaching-learning Process

Instructional materials

- Pictures/photographs that show different types of vegetable

Suggested Teaching Methods

Use active learning methods you think will fit the nature of the lesson, the students' composition (i.e., fast, medium, slow learners) and students with special needs (physical, visual and hearing impairment). You can choose and use from the following teaching.

- Brainstorming questions:
- Questioning
- Demonstration
- lecture
- Group discussion

Pre-lesson Preparations

Get the necessary teaching aids and teaching material ready. If none are available in your school, try to prepare your maps, pictures, and photographs with your students in the pedagogical center. Read related literature for more ideas that will help you prepare notes and activities

Presentation of the Lesson

Introduction to the lesson - Introduce students to the classification of vegetable crops by asking the brainstorming questions

Body of the lesson

Start your presentation by:

- explaining the basis of vegetables classification
- letting the students discuss the vegetables that they commonly consume following the different classifications
- explain that knowing the different classifications is vital because vegetables in the same category are expected to have similar management requirements

Stabilization

Give a summary of the major criteria in classifying vegetables and the importance of classification.

Assessment

Assess the students using these tasks

- List common vegetables classified as warm season and cool season crops. Explain their differences

Agriculture Grade 12

- Name vegetables whose flowers are consumed as food.

Answer to activity 1.1

Mark (X) in the correct column to show the vegetable crop you observed

Vegetable crop	Annual	Biennial	Perennial	Leafy	Flower	Fruit (mature, immature)

1.4. Types of vegetable production systems

Period Allotted: 1

Competencies

At the end of this lesson, the students will be able to:

- list the types of vegetable crops production systems

Contents

- Types of vegetable production systems

Overview

In this section, students will learn about the major types of vegetable crops production systems.

Teaching-learning Process

Instructional materials

Use the following teaching aids:

- Pictures/photographs, videos that show different types of vegetable production systems

Suggested Teaching Methods

Use active learning methods you think will fit the nature of the lesson, the students' composition (i.e., fast, medium, slow learners) and students with

special needs (physical, visual and hearing impairment). You can choose and use from the following teaching:

- Brainstorming questions: Ask questions to know what prior knowledge they may have.
- Questioning
- Demonstration
- lecture
- Group discussion

Pre-lesson Preparations

Get the necessary teaching aids and teaching material ready. If none are available in your school, try to prepare your maps, pictures, and photographs with your students in the pedagogical center. Read related literature for more ideas that will help you prepare notes and activities

Presentation of the Lesson

Introduction to the lesson -Introduce students to vegetable crop production systems based on their responses to the question in 1.1

Body of the lesson

Present the lesson by:

- explaining that vegetable production systems are classified based on the manner and purpose of production and the level of input use.
- telling them that wild vegetables gathering requires just collecting naturally growing edible vegetables with no management whatsoever
- explaining that vegetable production in a mixture with grain crops and home gardens is principally aimed at home consumption and involves low input use.
- Commercial production is a large scale production aimed at sale of vegetables. Commercial production involves inputs and technology use

Stabilization

Give a brief summary of the following topics:

- the major types of vegetable production systems and their characteristics
- the advantages of these production systems

Assessment

Use these tasks for assessment

- What major vegetable production systems are common in your locality?

Answers to activity1.2

Use the following table to help students report their findings. Amounts reported can be rough estimates.

Vegetable crop	Consumption per person per day (grams)	Consumption per person per week (grams)

1.5 Principles of vegetable crops management

Competencies

Period Allotted: 1

At the end of this lesson, the students will be able to:

- explain the principles of vegetable crops management

Contents

- Principles of Vegetable Crops a Management

Overview

In this section, the students will learn about the major principles in vegetable

crops management. The principles include all the activities starting from site selection, selection of planting material, management of water and integrated crop management.

Teaching-learning Process

Instructional materials

- The suggested instructional materials are pictures/photographs that show the different managed vegetable crop. You can find them in the students textbook

Suggested Teaching Methods

Use active learning methods you think will fit the nature of the lesson, the students' composition (i.e., fast, medium, slow learners), and students with special needs (physical, visual and hearing impairment). You can choose and use from the following teaching methods.

- Brainstorming Questioning
- Group discussion
- Demonstration
- lecture

Pre-lesson Preparations

Try to use resources available in your school; try to prepare your maps, pictures, and photographs with your students in the pedagogical center. Read related literature for more ideas that will help you prepare notes and activities

Presentation of the Lesson

Introduction to the lesson - Introduce students to principles of vegetable crop production by asking brainstorming questions

Body of the lesson Present the lesson through an explanation of what vegetable production involves (i.e., Careful planning and implementation across all stages - from site selection to crop and water management.)

- an explanation of the major considerations during site selection (i.e., crop selection, water and vegetable crops management.)

Stabilization

- give a brief summary of the major principles of vegetable crops production and how they relate to the success of vegetable production

Assessment

For assessment, you can give students tasks like

- how do site selection and selection of planting material affect vegetable production?
- what are the major considerations during management of water in vegetable crops production?

4.6 Answer to Key to rev

Part I: Matching

1. E 2. C 3. A 4. B 5. D

Par III. Multiple Choices

1. D 2. D 3. D 4. A 5. C 6. C 7. E

Part III: Short Answers

1. The major vegetable production systems are gathering wild vegetables, production of vegetables mixed with grain crops, home gardens and commercial vegetable production. In Ethiopia, home gardens and vegetable production mixed with grain crops are common. Commercial vegetable production has also become a growing activity.
2. The major principles of vegetable production involve careful site selection, selection of planting material, appropriate water management practices and integrated crop management
3. Altitude of an area is closely related to temperature and rainfall amount. An increase in altitude increases the rainfall amount and decreases the temperature. So, based on the temperature and water requirement, altitude influences the types of vegetables that can be grown in an area and the yield levels.

4. Integrated crop management includes practices like crop rotation, use of organic fertilizers and minimizing nutrient losses to the environment. Crop rotation helps to break disease cycles and reduce dependence on chemical to control crop pests and diseases. Organic fertilization improves soils and, if nutrients coming from these fertilizers are accounted for, it can reduce mineral (inorganic) fertilizer use and over fertilization.
5. Inadequate knowledge of improved methods of production and marketing, low consumption of vegetables, and a high cost of production inputs are among the major constraints. Production inputs include fertilizers, improved seeds and pesticides. Poor management of vegetables, small size of vegetable processing facilities, poor soil fertility, pests, drought, postharvest losses, high price of fuel for pumping water for irrigation are also important constraints to be considered.

To solve these problems, among other things, the government needs:

- to promote research, training and extension services on improved production and management of vegetables,
- promote further nutritional and health benefits of vegetables
- promote investment on vegetable production
- promote and assist producers with the use of small scale irrigation
- promote training of producers on soil fertility management

Check List

Check the student's performance according to the given competencies, against the questions in the checklist for the unit. Put a tick (✓) mark against each task to show whether they are achieved to the competencies of the unit. Students could complete the checklist themselves or you can make your own assessment.

Can you:

		Yes	No
	Understand what are vegetable crops, their uses, the methods used to produce and manage them, and problems associated with their production and management.		
	develop positive attitudes towards the production of vegetable crops, principles of vegetable crops management and different types of vegetable crops production systems		

Unit Assessment

Students' performance has to be assessed continuously over the whole unit. You can determine whether the student has achieved the minimum required level of competence by comparing their performances against the specified level of competencies.

A student working at the minimum requirement level will be able to

- explain vegetable crops production, importance, problems and prospect of vegetable crops production,
- list environmental factors that influence vegetable crops production,
- state the classifications of vegetable crops, types of vegetable crops production system and principles of vegetable crops and
- apply the principles of vegetable crops management.

Students working above the minimum requirement level should be praised and their achievement recognized. They should be encouraged to continue working hard and not become self-satisfied.

Students working below the minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson time during the breaks or at the end of the day.

Unit 2

Fruit Crops Production and Management

Total Periods Allotted: 7

Unit Introduction

In this unit, the students will learn about prospects of fruit production in Ethiopia and its constraints. They will also learn about the classification, production principles, methods of fruit propagation and establishment and management of nurseries and orchards.

Unit Learning Outcomes

At the end of this unit, students will be able to:

- define common terms used in fruit production
- list the importance, problems and prospect of fruit crops production in Ethiopia
- classify fruit crops
- explain principles and techniques of fruit propagation
- describe the importance of planning and establishing fruit crops nursery site and management of orchards

Main Contents

- 2.1 Definition of some common terms
- 2.2 Importance, problems and prospect of fruit crops production in Ethiopia
- 2.3 Classifications of fruit crops
- 2.4 Principles and techniques of fruit propagation
- 2.5 Establishing a nursery
- 2.6 Management of orchards
- 2.7 Factors influencing the quality of fruit crops during harvest and post-harvest
- 2.8 Floriculture and Landscaping

2.1 Definition of some common terms

Periods Allotted: 0.5

Competencies

At the end of this lesson, the students will be able to:

- define some common terms related to fruit production
- differentiate fruits from vegetables

Contents

- Definition some common terms in fruit production

Overview

In this section, students will learn some basic terms in fruit production.

Teaching-learning Process

Instructional materials

- The suggested instructional materials are pictures/photographs that fruit crops. You can find them in the students textbook

Suggested Teaching Methods

Use active learning methods you think will fit the nature of the lesson, the students' composition (i.e., fast, medium, slow learners), and students with special needs (physical, visual and hearing impairment). You can choose and use from the following teaching methods.

- Brainstorming Questioning
- Group discussion
- Demonstration
- lecture

Pre-lesson Preparations

Try to use available in your school; try to prepare your maps, pictures, and photographs with your students in the pedagogical center. Read related literature for more ideas that will help you prepare notes and activities

Presentation of the Lesson

Introduction to the lesson

Introduce students to common terms in fruit production by asking them to

define fruits, for example.

Body of the lesson

Present the lesson by

- explaining fruits (their definition, properties and how they differ from other crop types).
- defining other terms used in fruit production

Stabilization

Give a summary of fruits and how they differ from other crop types

Assessment and Follow up

You can give the students tasks like

- How do you differentiate fruits from vegetables?

2.2 Importance, problems and prospects of fruit crops production in Ethiopia

Competencies

Periods Allotted: 1.0

At the end of this lesson, the students will be able to:

- list the importance, problems and prospect of fruit crops production in Ethiopia

Contents

- Importance, problems and prospect of fruit crops production in Ethiopia

Overview

In this section, students will learn about the importance, major problems and constraints of fruit production in Ethiopia. They will learn about the economic and nutritional importance of fruits. Constraints facing fruit production and the opportunities that encourage fruit production in the country will also be covered.

Teaching-learning Process

Instructional materials

- The suggested instructional materials are pictures/photographs that

fruit crops. You can find them in the students textbook

Suggested Teaching Methods

Use active learning methods you think will fit the nature of the lesson, the students' composition (i.e., fast, medium, slow learners), and students with special needs (physical, visual and hearing impairment). You can choose and use from the following teaching methods.

- Brainstorming Questioning
- Group discussion
- Demonstration
- lecture

Pre-lesson Preparations

Try to use available in your school; try to prepare your maps, pictures, and photographs with your students in the pedagogical center. Read related literature for more ideas that will help you prepare notes and activities

Presentation of the Lesson

Introduction to the lesson - ntroduce students to importance, constraints and prospects of fruit production by asking some brainstorming questions

Body of the lesson Present the lesson by:

- explaining the nutritional and economic roles of fruits
- discussing the major constraints of fruit production in Ethiopia
- pointing out the trends in fruit production, for example, there is an increase in the volume of production land allocated for fruit production) and recognition of their health and nutritional benefits

Stabilization

Give a summary of the general importance, problems and trends in fruit production in Ethiopia.

Assessment and follow-up

For assessment, give the students tasks:

- What nutritional benefits can we get from fruits that we cannot get from grain crops?
- What are the major opportunities for fruit production in Ethiopia?
- What more can be done to boost fruit production in Ethiopia?

2.3 Classification of fruit crops

Periods Allotted: 1

Competencies

At the end of this lesson, the students will be able to:

- classify the major fruit crops

Contents

- Classification of fruit crops

Overview

In this section, the students will learn about classification of fruit crops into different categories based on plant structure, temperature requirement, and ripening and plant characteristics.

Teaching-learning Process

Instructional materials

- The suggested instructional materials are different pictures/ photographs that show different types of fruit crops. You can find them in the students textbook

Suggested Teaching Methods

Use active learning methods you think will fit the nature of the lesson, the students' composition (i.e., fast, medium, slow learners), and students with special needs (physical, visual and hearing impairment). You can choose and use from the following teaching methods.

- Brainstorming
- Questioning
- Group discussion
- Demonstration
- lecture

Pre-lesson Preparations

Try to use available in your school; try to prepare your maps, pictures, and photographs with your students in the pedagogical center. Read related literature for more ideas that will help you prepare notes and activities

Presentation of the Lesson

Introduction to the lesson - Introduce students to the classification of fruit crops by asking them the types of fruits they know

Body of the lesson

Present the lesson by:

- explaining fruit classification based on plant structure and ask them to name examples of each types
- tell them about fruit classification based on temperature requirement and its importance in fruit production and management
- explain fruit crops classification based on ripening and plant characteristics and ask them to name examples from each categories

Stabilization

Give them a summary of the general types of fruit classification and their importance in production and management

Assessment

For assessment, you can give students tasks like:

- name warm and cool season fruits that grown in your surroundings?
- What fruit crops do you have in your surroundings based on plant characteristics?
- What is the benefit of knowing such a classification of fruits?
- You may use interviews and reporting for assessment

Answer to activity 2.2

Students can fill the following Table to answer **activity 3.2**

Fruit	Simple fruit	Aggregate fruit	Multiple fruit	Tree fruit	Small fruit

Fruits	Consumption per person per week (grams)

2.4 Principles and Techniques of Fruit Propagation**Competencies****Periods Allotted: 1**

At the end of this lesson, students will be able to:

- compare principles and techniques of fruit propagation

Contents

- Principles and techniques of fruit propagation

Overview

In this section, students will learn about the major principles and different techniques of fruit propagation.

Teaching-learning Process**Instructional materials**

- use pictures/photographs that show principles and techniques and principles of fruit crops propagation. You can find them in the students textbook

Suggested Teaching Methods

Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach.

- Brainstorming questions.
- Questioning
- Demonstration
- lecture
- Group discussion

Pre-lesson Preparations

Try to use available in your school; try to prepare your maps, pictures, and photographs with your students in the pedagogical center. Read related literature for more ideas that will help you prepare notes and activities

Presentation of the Lesson

Introduction to the lesson -Introduce students to the principles and techniques of fruit propagation by asking brainstorming questions

Body of the lesson. Taking students' background understanding into consideration, present the lesson by:

- explaining the different types of fruit propagation (sexual, asexual propagations), giving them examples of fruit crops propagated by each propagation method
- describe the advantages and disadvantages of the major propagation methods
- Point out the different techniques of asexual (vegetative) propagation

Stabilization

Give a summary of

- the two major types of fruit propagation
- major advantages and disadvantages of fruit propagation

Assessment and Follow up

For assessment purpose, you can give students tasks like:

- What are the most common fruits grown in your surroundings? How are these fruits propagated?

- What is grafting? What are the major principles that should be followed during grafting?

2.5 Establishing a fruit nursery

Periods Allotted: 1

Competencies

At the end of this lesson, the students will be able to:

- describe the major principles of nursery establishment

Contents

- Establishing a fruit nursery

Overview

In this section, the students will learn about the major principles of fruit nursery establishment.

Teaching-learning Process

Instructional materials

- The suggested instructional materials are pictures/photographs that show the establishing a fruit crops nursery. You can find them in the students textbook

Suggested Teaching Methods

Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach.

- Brainstorming questions.
- Questioning
- Demonstration
- lecture
- Group discussion

Pre-lesson Preparations

Try to use available in your school; try to prepare your maps, pictures, and photographs with your students in the pedagogical center. Read related literature for more ideas that will help you prepare notes and activities

Presentation of the Lesson

Introduction to the lesson - Introduce students to the principles and techniques of fruit propagation. Do this by asking questions about what nursery is and what considerations are made during establishing nurseries.

Body of the lesson

Present the lesson by:

- explaining the meaning of nurseries and why they are needed. (The major objective in nurseries is to provide young seedlings. Suitable conditions are required for germination and further growth until plants become strong enough to be transferred to the main growth field.)
- talk about the major considerations during establishing nurseries including site selection (location, topography, soil conditions, water availability), planting material (selection, planting and management)

Stabilization

Give a summary of the following points

- nursery and the need for nursery establishment
- principles to be followed during nursery establishment

Assessment

For assessment, you can give students tasks like:

- What is the effect of climate and soil type on nursery establishment and management?
- Why is the location of the nursery establishment important

Answers to activity 2.4

- students should visit a nearby nursery site (if available) and list the types of fruit seedlings being established at the nursery
- students should also report the types of management at the nursery including source of seed (planting material), irrigation method and source, fertilization (growth media), transplanting (method and stage of transplanting) and other relevant information

2.6 Management of orchards

Periods Allotted: 1

Competencies

At the end of this lesson, the students will be able to:

- list the major considerations during orchard management

Contents

- Management of Orchards

Overview

In this section, the students will learn about the major considerations in orchard management. Important considerations include site selection, land preparation, planting distance (plant population), soil and climate conditions and irrigation management.

Teaching-learning Process

Instructional materials

- The suggested instructional materials are pictures/photographs that show the management of orchards
- You can find them in the students textbook

Suggested Teaching Methods

Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach.

- Brainstorming questions.
- Questioning
- Demonstration
- lecture
- Group discussion

Pre-lesson Preparations

Try to use available in your school; try to prepare your maps, pictures, and photographs with your students in the pedagogical center. Read related literature for more ideas that will help you prepare notes and activities

Presentation of the Lesson

Introduction to the lesson– Introduce the students to the management of orchards by asking questions like what are orchards. What are the major issues that need consideration during orchard management?

Body of the lesson:

Present this topic through

- defining orchard-explain important factors in orchard management including site selection (soil, climate, resource availability).
- describe the process of planting t fruits (seedlings) including land preparation, planting distance (spacing), irrigation management.

Stabilization

Give a summary of

- major factors in orchard management
- the relationship between these factors and the success of an orchard

Assessment

For assessment, you can give students tasks like:

- how does the quality of soil influence orchard establishment and management?

2.7 Factors Influencing the Quality of Fruits during Harvest and Post-harvest

Periods Allotted: 1

Competencies

At the end of this lesson, the students will be able to:

- elaborate factors considered in harvesting and postharvest handling of fruits

Contents

- Factors influencing the quality of fruits during harvest and post-harvest

Overview

In this section, the students will learn about the major factors that influence the quality of fruits during harvest including time and stage of harvest and methods used during harvest. Students will also learn about the major practices of fruit handling after harvest (post-harvest). Post-harvest factors extend from precooking immediately after harvest to sorting, packaging, storing and transportation. All of these affect the quality of fruit crops.

Teaching-learning Process

Instructional materials

- Use pictures/photographs of the factors that influence the harvesting and post-harvesting of the fruit crops by different factors.

Suggested Teaching Methods

Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach.

- Brainstorming questions.
- Questioning
- Demonstration
- lecture
- Group discussion

Pre-lesson Preparations

Try to use available in your school; try to prepare your maps, pictures, and photographs with your students in the pedagogical center. Read related literature for more ideas that will help you prepare notes and activities

Presentation of the Lesson

Introduction to the lesson - Introduce students to factors affecting harvest and post-harvest quality of fruits. Ask questions like ‘What are the criteria to harvest a fruit crop? What major issues need consideration during fruit harvest? What types of precautions are needed after harvest to maintain the quality of fruits?’

Body of the lesson: Start the lesson by

- explaining the major considerations needed to harvest fruit crops (stage and time of harvest, method of harvest) and how these affect quality of the fruits
- describing the major factors that need consideration after harvesting fruits crops (e.g., pre-cooling immediately after harvest, sorting and grading, packaging storage and transportation).
- giving examples of how each process affects fruit quality at harvest and post-harvest generally fruits with high respiration rates have a shorter postharvest life temperature management is used to control respiration rate (pre-cooling, cold storage)

Stabilization: Give a summary on

- describe the major factors that affect harvest quality of fruits
- explain the factors that need consideration after harvesting fruit crops to keep their quality

Assessment

For assessment, you can give students tasks like:

- What are the major fruits grown in your surroundings?
- How is the decision to harvest fruits made?
- What precautions are made after harvesting these fruits?

2.8. Floriculture

Periods Allotted: 1

Competencies

At the end of this lesson, the students will be able to:

- describe the concepts, importance of floriculture

Contents

- Floriculture

Overview

In this section, the students will learn about the concepts of floriculture, its importance and opportunities to produce floriculture in Ethiopia.

Teaching-learning Process

Instructional materials

- The suggested instructional materials are pictures/photographs that show the floriculture. You can find them in the students textbook

Suggested Teaching Methods

Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach.

- Brainstorming questions.
- Questioning
- Demonstration
- lecture
- Group discussion

Pre-lesson Preparations

Try to use available in your school; try to prepare your maps, pictures, and photographs with your students in the pedagogical center. Read related literature for more ideas that will help you prepare notes and activities

Presentation of the Lesson

Introduction to the lesson - Introduce students to the floriculture and landscaping. Do this by asking questions about what floriculture

Body of the lesson

Present the lesson by:

- explaining the meaning of floriculture and why they are needed.
- Suitable conditions are required for floriculture production in Ethiopia

Stabilization

Give a summary of the following points

- Floriculture production and their importance
- principles to be followed during floriculture establishment

Assessment

For assessment, you can give students tasks like:

- What are the importance and opportunities floriculture production in Ethiopia?

Answer to Review Exercise

Part I. Definition of for terms

Asexual propagation: is a vegetative reproduction or propagation where fertilization is not involved in the production of the crop.

Chilling injury is the time of exposure to cool, nonfreezing temperatures during winter. This allows normal bud break and development to take place the following spring.

Chilling requirement of a fruit is the minimum period of cold weather after which a fruit-bearing tree fruit-bearing tree will blossom.

Multiple fruit: A type of fruit that develops from the ovaries of many flowers growing in a cluster or that are fused together into a larger fruit. Examples of multiple fruits are pineapple and mulberry. Each section of a pineapple was an individual fruit from an individual flower, and fused to become a pineapple.

A fruit tree is a tree which bears fruit that is consumed or used by animals and humans — all trees that are flowering plants produce fruit, which are the ripened ovaries and flowers containing one or more seeds.

Orchard: a farm land allocated for growing fruit crops

A type of fruit that develops from a single or compound ovary with only one pistil (of a single flower). Simple fruits are either fleshy or dry. E.g. berries, drupes, etc.

Fruit crop: is a perennial, edible plant cultivated for its true botanical fruit or products derived there from.

Fruit set: refers to the persistence and development of an ovary after flowering.

Part II. Multiple choice

1. E 2. D 3. D 4. A 5. D 6. D 7. D 8. D 9. E 10. G

Part III. Short answers

1. Establishment of nurseries requires proper site selection (topography, climate, soil condition, risk of flooding and wind erosion, resource availability and absence of shade), planting systems and management are all important things. Orchard establishment also requires proper site selection in terms of climate, topography, soil conditions, planting systems (plant population, species and variety selection), irrigation and fertilization management are all vital
soils with good fertility status support good growth of fruits and better yields compared to poor soils that need a lot of fertilizer addition and other inputs to get good fruit productivity.
2. Grafting is the joining of parts of plants together in such a way that they unite and continue to grow as a single plant. The plant part that becomes the upper portion or top of the new plant (canopy) is called the scion and the part which becomes the lower portion is the stock or root stock.
3. Procedures during grafting:
 - Selection of proper varieties of both scion and rootstock
 - Cambial regions of scions and stock must be in intimate contact for successful grafting
 - Cut surfaces should be held tightly for proper healing and flow of water and nutrients by covering the graft area with wax or tape or some moist material
 - Proper care must be given to the graft until the stock and scion unite
 - Shoots from the stock must be removed to stop their competition for resources like nutrients and water with the scion
 - The grafting knife should be sharp
4. The stock and scion should be compatible,
 - they have to be closely related species
 - both should be healthy, strong and free from pests.

- For harvest of fruit crops, stage and time of harvest and method of harvesting are important
- For post-harvest handling of fruits, pre-cooling, sorting, packing, storage and transportation all need careful consideration.

Check List

Check the student's performance according to the given competencies, against the questions in the checklist for the unit. Put a tick (✓) mark against each task to show whether they are able to perform at the competencies of the unit. The students are expected to reply, saying 'Yes' or 'No'. Or, you can make your own assessment to check whether or not the competencies are met.

Can you:

		Yes	No
	Understand what are fruit crops, their importance, the methods used to produce and manage them, and problems associated with their production and management.		
	develop positive attitudes towards the production of fruit crops, principles and technique of fruit crops propagation, establishment of nursery and management of orchards.....?		

Unit Assessment

Students' performance has to be assessed continuously over the whole unit. You can determine whether the student has achieved the minimum required level of competence by comparing their performances against the specified level of competencies.

A student working at the minimum requirement level will be able to:

- define common terms used in fruit production,
- list the importance, problems and prospect of fruit crops production in Ethiopia,
- classify fruit crops, explain principles and techniques of fruit propagation and
- describe the importance of planning and establishing fruit crops

nursery site and management of orchards.

Students working above the minimum requirement level should be praised and their achievement recognized. They should be encouraged to continue working hard and not to become self-satisfied.

Students working below the minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson time during the breaks or at the end of the day.

Unit 3

Root and Tuber Crops Production and Management

Total period allotted: 5

Unit Introduction

In this unit, the students will learn about roots and tuber crops production and the management

Unit Learning Outcomes

At the end of this unit, your students will be able to:

- define related terms, talk about the importance, problems, and prospects of root and tuber crops production
- classify roots and tuber crops
- identify management and protection methods used in the production of roots and tuber crops
- explain factors considered during harvesting and post-harvest handling of root and tuber crops

Main Contents

1. Introduction
 - 3.1. Definition of Terms
 - 3.2. Classification of Roots and Tuber Crops
 - 3.3. Importance of Roots and Tuber Crops
 - 3.4. Prospects of Roots and Tuber Crops Production in Ethiopia
 - 3.5. Problems of Roots and Tuber Crops Production in Ethiopia
 - 3.6. Roots and Tuber Crops Management and Protection
 - 3.7. Harvesting and Post-Harvest Handling of Roots and Tuber Crops

3.1. Definition of Terms

Lesson Objectives

Period allotted: 1/2

At the end of this lesson, the students will be able to:

- define roots, tubers, roots, and tuber crops

Contents

- Definition of Terms

Overview

In this lesson, the students will learn about the meaning and types of roots and tuber crops. Roots and tubers are plants with edible modified roots.

Teaching-Learning Process

Instructional materials

- Pictures of roots and tuber crops

Suggested Teaching Methods

Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach.

- brainstorming questions
- Demonstrations
- Group discussion
- Explanation
- Lecture

Pre-Lesson Preparation

- Before you begin teaching the lesson, get the teaching aids and teaching materials needed for the lesson ready

Presentation of the Lesson

Introduction to the lesson

- You can introduce the lesson in any way you think fits the topic and the students you are teaching. One way to introduce a topic is by raising questions that are relevant to the students' background knowledge.

You may begin the lesson by asking questions such as:

- What are root and tuber crops?
- Do you know who defined the terms 'roots' and 'tubers' for the first time in history?

Body of the lesson

- Following the responses of your students, try to give a general definition of root and tubers crops. Remember to mention both the ancient and the modern definitions of root and tuber crops.
- Explain why it is difficult to have a single and simple definition of root and tuber crops.

Summary

Give a summary of

- The meaning of root and tubers crops given by different scholars
- The definition of roots and tuber crops especially the most convenient and scientific definition of root and tubers crops

Assessment and Follow-Up

Assessment

At the end of the lesson, make sure that your students have understood the essential concepts of the lesson by asking questions and giving them tasks like the following ones.

- What are roots and tuber crops?
- Explain the relationship between root and tuber crops.

Follow up

- Check the students' understanding of the lesson by giving them exercises to do independently or in a group

Remember to grade and rate the students' activities, participation, and quiz results.

Answer Activity 3.1

- Roots and tubers are plants with edible modified roots. Answers to this question need explanations to enable the students to identify useful roots and tuber crops.

3.2. Classification of Roots and Tuber crops

Period allotted: 1/2

Lesson Objectives

At the end of the lesson, the students will be able to:

- Classify root and tuber crops

Contents

- Classification of roots and tuber crops

Overview

In this lesson, the students will learn about the classification of roots and tuber crops. Roots and tuber crops have different classifications based on different criteria. For instance, FAO classifies roots and tuber crops based on their use. It defines roots and tubers as plants yielding starchy roots, tubers, rhizomes, corms, and stems.

Teaching-learning Process

Instructional Material

Use the following teaching aids:

- Pictures/photographs that show the classification of root and tuber crops – e.g. picture of a potato, cassava, etc.

Suggested Teaching Methods

Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach.

- Brainstorming questions
- Demonstrations

- Group discussion
- Explanation
- Lecture

Pre-lesson Preparation

Get the necessary teaching aids and teaching material ready. If none are available in your school, try to prepare your maps, pictures, and photographs with your students in the pedagogical center. Read related literature for more ideas that will help you prepare notes and activities

Presentation of the Lesson

Introduction to the lesson

- Introduce students to the objectives of the lesson and to the classification of root crops and tuber crops.
- Brainstorm students on the classification of roots and tuber crops this helps you assess whether they have related background information.
- Ask them to tell you the different types of roots and tuber crops they know

Body of the lesson

- Present the lesson by explaining how roots and tubers can be classified.
- Have the students describe the classification of roots and tuber crops based on the areas of interest.
- Have the students discuss in groups the types of roots and tuber crops. Allow the students to present their work before you give them explanations.

Stabilization

Give a summary of the following points.

- Why roots and tubers are classified into different types
- How the FAO classifies roots and tuber crops

Assessment and Follow up

Evaluation

To check if the expected competencies are achieved, ask the students questions about the lesson they have learned. You can ask them the following questions, for example:

- Explain how roots and tuber crops can be classified.
- What types of roots and tuber crops do you know?

You can also give them a quiz or a test,

Follow up

Start your presentation by

- explaining how roots and tubers can be classified.
- explaining the classification of roots and tuber crops, including its areas of interest.
- having the students describe the classification of roots and tuber crops based on the areas of interest.
- getting the students discuss in groups types of roots and tuber crops and why classifying roots and tuber crops is needed.

Answer to Activities 3.2

- FAO classified roots and tuber crops into seven primary crops. Potatoes, sweet potatoes, cassava, Taro (Cocoyam), are examples.

3.3. Importance of Roots and Tuber Crops in Ethiopia

Lesson objectives

Period allotted: 1/2

At the end of this lesson, the students will be able to:

- list the importance of roots and tuber crops in Ethiopia

Contents

- Importance of Root and Tuber Crops

Overview

In this lesson, the students will learn about the importance of roots and tuber crops in Ethiopia. Give students different examples of the importance of roots and tuber crops in Ethiopia. Both, i.e., roots and tuber crops, play significant roles as food and nutritional security for farmers and other parts of communities in Ethiopia.

Instructional materials

use such materials as textbook pictures, posters, etc.

Suggested Teaching Methods

Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach.

- Brainstorming questions
- Questioning
- Group discussion
- Demonstration

Pre-lesson Preparation

Get the teaching aids and teaching material ready. If none are available in your school, prepare maps, pictures, and photographs in the pedagogical center.

- Read related literature in the school's library
- Prepare notes and activities.

Presentation of the Lesson

Introduction to the lesson

- Introduce the students to what they are going to learn (importance of root and tuber crops in Ethiopia).
- Brainstorm students about the importance of roots and tuber crops in Ethiopia; this helps you assess your students' background.

Body of the lesson

- Present the lesson by explaining the importance of roots and tuber

crops in Ethiopia.

Stabilization

Give a summary of the following point:

- The contributions of roots and tuber crops to the food and nutritional security and the economy of a given society.

Assessment and Follow up

Assessment

To check whether the students have achieved the expected competencies, ask them questions about the lesson you taught them that day. For example, you ask them to explain the importance of roots and tuber crops.

Follow up

- Assign each group the task of making a library study on the importance of root and tuber crops
- Summarize the contributions of root and tuber crops to the food and nutritional security and the economy for a given society.
- Use a quiz or a test

Answer to Activity 3.3

- Roots and tuber crops such as cassava, potato, sweet potato, beetroots, carrots, yam, etc. have different importance. They are the largest source of carbohydrates; some provide vitamins and are sources of nutrients. They also help farmers to generate income. This means farmers can sell the products and improve their food security and livelihood.

3.4. Prospect of roots and tuber crops production in ethiopia

Period allotted: 1/2

Lesson Objective

At the end of this lesson, the students will be able to:

- describe prospects of roots and tuber crops production in Ethiopia

Content

- Prospect of Roots and Tuber Crops Production in Ethiopia

Overview

In this lesson, the students will learn about the prospects of roots and tuber crops in Ethiopia.

Suggested Teaching-learning Process

Instructional Materials

Instructional materials are any material you may use that supports students to clearly understand concepts, skills, and the lesson.

Suggested Teaching Methods

Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach.

- Brainstorming
- Demonstration
- Group discussion
- Lecture

Pre-lesson Preparation

- Design the most appropriate teaching method.
- Read relevant literature to give the students adequate information.
- Prepare notes, activities, and exercises.

Presentation of the Lesson

Introduction to the lesson

- Introduce the topic briefly using brainstorming questions. Brainstorming questions help you understand the students' background knowledge related to the lesson

Body of the lesson

Explain the prospects of roots and tuber crops production in Ethiopia.

Stabilization

- Give them a summary of the prospects of roots and tuber crops production in Ethiopia

Assessment and Follow up

Assessment

Check the students' understanding of the lesson by giving them activities to do individually.

- Ask them about the prospects of roots and tuber crops production in Ethiopia

Follow up

- To help the students learn further, give them reading assignments; ask them to read on the prospect of roots and tuber crops production in Ethiopia.
- Record the students' results right after you have assessed their activities. Do this whether the activities are oral or written.

3.5. Problems of roots and tuber crops production in Ethiopia

Lesson objective

Period allotted: 1

At the end of this lesson, the students will be able to:

- list problems of root and tuber crops production in Ethiopia

Content

- Problems of roots and tuber crops production in Ethiopia

Overview

In this lesson, the students will learn about problems of root and tuber crops production in Ethiopia.

Teaching-Learning Process

You can use any material that can support the students to understand the lesson.

Suggested Teaching Methods

Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach.

- Brainstorming Questioning
- Group discussion
- Demonstration
- lecture

Pre-Lesson Preparation

- Get the necessary teaching aids and teaching materials ready.

Presentation of the Lesson

Introduction to the lesson

You can present the lesson in any way you see fits the topic and the group you teach.

You can begin the lesson by asking a question such as:

- What problems of roots and tuber crops production do you know in your place of living?

Body of the lesson

Start your discussion by briefly explaining the problems of roots and tuber crops production in Ethiopia.

Stabilization

- Summarize the problem of roots and tuber crops production in Ethiopia

Assessment and Follow up

Assessment

Check your students' understanding of the lesson by asking them the following questions.

- Explain how policy constraints affect root and tuber crops production in Ethiopia?
- Analyze the effects of poor access on the important inputs, diseases and pests on roots and tuber crops production in Ethiopia.

Follow up

Guide the students to discuss the problems of roots and tuber crops production in Ethiopia

Answer to Activity

Activity 3.5

- ✓ There are a number of problems affect root and tuber crops production. Among them poor access to improved seed and pesticide, unforeseen climatic conditions, weed, diseases and pest problems are the major ones. The policy of Ethiopia did not give attention for these crops rather the policy so far has focused mainly on cereals. As a result of that there was the problem in providing improved seed, chemical fertilizers, and extension services for small-scale and resource-poor farmers

Activity 3.6

- ✓ You are advised to facilitate the discussions among the students on the Root, and Tuber Crops Production and Management issues
- ✓ The factors that determine the selection of production sites of root and tuber crops.
- ✓ Land preparation methods implemented for the production of root and tuber crops.
- ✓ Comparing and evaluating the prepared production field

After completing this activity, students are expected to prepare practical reports which will be submitted a week later. Evaluate the students based on the following points:

- ✓ Active participation of the students during the practical session
- ✓ The originality and quality of the reports submitted
- ✓ The quality of the field prepared

3.6. Root and Tuber Crops Management and Protection

Period allotted: 1

Lesson Objective

At the end of this lesson, the students will be able to:

- explain different managements and protection methods of roots and tuber crops

Contents

- Roots and tuber crops management and protection

Overview

In this lesson, the students will learn about roots and tuber crops management and protection. Management practices include irrigation, fertilization, pest management, soil type and the status of its fertility.

Teaching-learning Processes

Instructional Materials

- photographs
- pictures

Suggested Teaching Methods

Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach.

- Brainstorming, group discussion, demonstrations, etc.

Pre-lesson Preparation

- Get the teaching aids and teaching materials ready in advance of the lesson
- Inform students of the lesson for the day and encourage them to present ideas and concepts.

Presentation of the Lesson

Introduction of the lesson

You may start the lesson by asking questions like the following:

- What are different management practices of roots and tuber crops?
- How do farmers in your environment manage roots and tuber crops?

Body of the lesson

- Give a brief description of roots and tuber crops management and protection.

Stabilization

- Give a summary of roots and tuber crops management and protection

Assessment and Follow up

Assessment

- Check whether students have understood the lesson by giving them

quizzes.

- Encourage them to explain how temperature affects root and tuber crops.

Follow up

Ask your students to discuss the following in groups:

- How to protect root and tuber crops from the pest.
- The importance of protecting mechanical damage of roots and tuber crops

3.7. Harvesting and Post-Harvest Handling of Roots and Tuber Crops

Lesson Objectives

Period allotted: 1

At the end of this lesson, the students will be able to:

- explain factors considered during harvesting and post-harvest handling of roots and tuber crops production

Contents

Harvesting and post-harvest handling of roots and tuber crops

Overview

In this lesson, the students will learn about harvesting and post-harvest handling of roots and tuber crops.

Teaching-learning Processes

Instructional Materials

Photographs, pictures of roots and tuber crops can be used as instructional materials

Suggested Teaching Methods

Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach.

- Brainstorming questioning
- Group discussion

- Demonstration
- lecture

Pre-lesson Preparation

- Get ready the teaching aids and teaching materials you need for the lesson.
- Collect as much information on the above topics as possible from additional references.

Presentation of the Lesson

Introduction of the lesson

You may start the lesson by asking questions like the following:

- Why is post-harvest handling needed for roots and tuber crops?
- What are the most commonly used post-harvest handling methods of roots and tuber crops in your environment?

Body of the lesson

- Demonstrate how harvesting and post-harvest handling of roots and tuber crops can be carried out.

Assessment and Follow up

Assessment

- Check whether or not students have understood the lesson by giving them quizzes, tests, class work, etc.
- After evaluating the class work, grade their achievements

Follow up

Ask your students to discuss in groups the following:

- Harvesting and post-harvest handling of roots and tuber crops.
- Let them present their group findings.

Answer to Activity 3.6

The factors considered during harvesting and post-harvest are management and protection activities. These include land preparation, irrigation,

protecting mechanical damage, proper packaging and handling. Controlling temperature of sprouting, protecting pest, etc. are also important factors to be considered.

Answers to the Review Exercise

1. False 2. True 3. False

Answer for Choice questions

1. E 2. E 3. D

1. Cassava, potato, sweet potato, beetroots, yam, etc.
2. The similarities between roots and tuber crops are that both roots and tuber crops are crops grown for their enlarged and edible roots. The other similarities between them are that they both yield starchy roots, tubers, rhizomes, corms, and stems. They are the largest sources of energy. Examples are beetroots, carrot, parsnip and cassava. Tuber crops are crops with swollen underground stems and roots. Potatoes, sweet potatoes, and yams are edible tuber crops. The difference between root and tuber crops is that they have a compact root, often enlarged storage organ with hairy stems that develop from root tissue whereas tuber crops are crops with swollen underground stems.
3. The importance of roots and tuber crops are that they provide vitamins, carbohydrates, and other nutrients. They fill food gaps that might exist until the harvest of major crops provides additional income for farmers. Additional income helps farmers to improve their livelihood. Additional income can also help farmers buy animal feed and various industrial applications.
4. Roots and tuber crops have different economic importance for farmers and others who are engaged in their production. The activity also creates employment opportunities; it generates income and enhances food security.
5. The major problems that roots and tuber crops can face are poor access to important inputs, diseases and pest problems, policy-related

problems, socio-economic problems, and technical constraints

6. Different management and protection methods of root and tuber crops are land preparation, weeding, providing water, protecting mechanical damage, packaging, handling, protecting temperature, etc.
7. Factors needed to consider during harvesting and post-harvest handling of root and tuber crops production are socio-economic factors that prevail in the areas of production and marketing, external factors such as insects, rodents, and molds, the losses of roots and tubers, etc.

Checklist

Check the students' performance according to the given competencies. Refers to the questions under the checklist for every unit. Put a tick (✓) mark against each task to see whether they can perform in the competencies of each unit.

Can you:

		Yes	No
	understand what root and tuber crops are, their uses, the methods used to produce and manage them, and problems associated with their production and management?		
	develop positive attitudes towards the production of root and tuber crops, and apply the methods used in the production and management of root and tuber crops?		

Unit Assessment

Students' performance has to be assessed continuously over the whole unit. You can determine whether the student has achieved the minimum required level of competence by comparing their performances against the specified level of competencies.

A student working at the minimum requirement level will be able to

- define common terms used in the unit
- classify root and tuber crops

- explain the importance of root and tubers crops
- elaborate what factors considered during harvesting and post-harvest handling of root and tuber crops production
- analyze different management and protection methods used in the production of root and tuber crops
- assess the constraints in the production of root and tuber crops production in Ethiopia and suggest solutions to increase productivity
- give values to the production and management of root and tuber crops
- produce and manage some of the root and tuber crops in their school and/or home garden

Students working above the minimum requirement level should be praised and their achievement recognized. They should be encouraged to continue working hard and not become self-satisfied.

Students working below the minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson time during the breaks or at the end of the day.

Unit 4

Coffee, Tea And Spices Production and Management

Total period allotted: 16

Unit Introduction

In this unit, the students will learn about the history, origin, production status, and economic importance of coffee, tea, and spices.

Unit Learning Outcomes

At the end of this unit, your students will be able to:

- describe history, origin and economic importance of coffee and tea
- identify ecological requirements of coffee requirements and practices of coffee and tea propagation techniques, harvesting, and processing
- differentiate the ecological and soil requirements for and production
- explain the various cultural operations needed to establish coffee and tea plantations
- explain the processes involved in the production and management of coffee and tea from seed to cup
- participate wholeheartedly in production and management of coffee and tea
- develop important skills required in the processes of producing coffee and tea

Main Contents

4. Coffee, tea, and spices production and management
 - 4.1. History, origin, production status, and economic importance of coffee, tea, and spices
 - 4.2. Ecological and soil requirements for coffee, tea, and spices production
 - 4.3. Propagation, nursery establishment, and management of coffee, tea, and spices seedling
 - 4.4. Field establishment and management practices for coffee, tea, and spices
 - 4.5. Harvesting and processing of coffee, tea, and spices

4.1. History, origin, production status, and economic importance of coffee, tea, and spices

Period allotted: 3.5

Lesson objectives

At the end of this lesson, the students will be able to:

- describe the history, origin, and economic importance of coffee, tea, and spices

Contents

- History, origin, production status, and economic importance of coffee, tea, and spices

Overview

In this lesson, the students will learn about the history, origin, production status, and economic importance of coffee, tea, and spices. First, they will learn the history and origin of coffee, tea, and spices. Then there will be a discussion of the production status and economic importance of coffee.

Teaching-learning Processes

Instructional materials

Instructional materials are any materials you use that support the students to understand the lesson. These include images, picture, photographs, etc. about coffee, tea and spices.

Suggested Teaching Methods

Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach.

- Brainstorming questions
- Questioning
- Group discussion
- Presentation

Pre-lesson Preparation

- Get the necessary teaching aids and teaching materials ready in advance of the lesson day.

Presentation of the Lesson

Introduction of the lesson

You can start the lesson by posing questions like the following:

- What are the production statuses of coffee, tea and spices?
- What type of coffee species is most widely produced in Ethiopia?

Body of the lesson

Start the presentation by explaining the production status of coffee.

Stabilization

Give a summary of the following topics.

- The production status of coffee production in Ethiopia
- Factors considered during coffee production

Assessment and Follow-up

Assessment

- Organize your students in groups and encourage them to discuss the production status of coffee, tea and spices in Ethiopia.
- Use a quiz, class work or a test to assess the students' performance

Follow up

- Check the students' understanding of the lesson by giving them tasks to do independently.

Make sure to grade and rate the students' activities, levels of participation and quiz results.

An answer to Activity 4.1,

- Wild Coffee originated in Kaffa and the domesticated coffee plant is said to have been from Harar and the native population is thought to be derived from Ethiopia. Tea originated in southwest China as a medicinal drink, most likely in the Yunnan region during the Shang dynasty. The origin of spices has been known to date back to the ancient times in Egypt as recorded in the Bible as valuable trade items. The use of spices moved from Egypt through the Middle East and spread to the Mediterranean and Europe.

An answer to Activity 4.2.

- The economic importance of coffee, spices and tea is that they are sources of foreign currency for countries that produce them abundantly. Tea makes a significant contribution to food security, as the income from tea covers food import bills. Coffee represents the sole economic income for more than 25 million families. It accounts for the lion's share of Ethiopian export earnings and plays an important role in the economy and livelihoods for rural population.
- The most important spices in Ethiopia in terms of their economic value are pepper, ginger, korarima, etc.

4.2. Ecological and soil requirements for coffee, tea and spices production

Period allotted: 3

Lesson Objectives

At the end of this lesson, the students will be able to:

- Mention ideal ecological and soil requirements for coffee, tea and spices production

Content

- Ecological and soil requirements for coffee production

Overview

In this lesson, the students will learn about the ecological and soil requirements for coffee, tea and spices production. The productivity and longevity of coffee, tea and spices plantation depends upon the environmental conditions and management.

Teaching-learning Processes

Instructional Materials

Instructional materials are any material you may use that support students to clearly understand concepts, skills and the lesson.

Suggested Teaching Methods

Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach.

- Brainstorming questions
- Questioning
- Group discussion
- Presentation

Pre-Lesson Preparation

Before you begin teaching the lesson, get the teaching aids and teaching materials suggested above ready.

Forward planning: read the contents on ecological and soil requirements for coffee production

Presentation of the Lesson

Introduction of the lesson

You can start the lesson by posing the question below:

- What is the ecological and soil requirement of coffee, tea and spices production?

You can use your own method of presenting the lesson, but make sure the method fits the topic and the group of students you are teaching. One way to introduce a topic is by raising questions that are relevant to the students' background.

Body of the lesson

- Help your students get the main points in the ecological and soil requirements of coffee, tea and spices production

Stabilization

- Give a summary of the ecological and soil requirements of coffee, tea and spices production

Assessment and Follow up

Assessment

Check the students' understanding of the lesson by giving them the activity below.

- Explain the ecological and soil requirements for coffee production

Follow up

- Give library work to each group on the ecological and soil requirements of coffee production

Make sure to record the students' results right after you have evaluated their performances.

Answers to Activity 4.2

Coffee and tea have different ecological and soil requirements.

I. COFFEE

- Temperature: C. Arabica 18-24°C, C. ; Canephora requires 24-26°C,
- Rain fall : C. Arabica 1524-2286 mm and C. Robusta grows at 1016-2540 mm
- Soil type: fertile, well-aerated, free-draining, and slightly acidic soil with a pH range

II. TEA

- Temperature: 21°C to 29°C is ideal for the production of tea,
- Rainfall: Moderate-to-high rainfall or 1200 mm and above, and
- Soil type: volcanic origin. The best soil type for tea production is pH is 4.5 – 5.5.

4.3. Propagation, nursery establishment and management of coffee and tea seedling

Period allotted: 2

Lesson Objective

At the end of this lesson, the students will be able to:

- describe the most commonly used methods of propagation, nursery establishment and management of coffee and tea seedling

Content

- Propagation, nursery establishment and management of coffee and tea seedling

Overview

In this lesson, the students will learn about propagation, nursery establishment and management of coffee and tea seedling.

Teaching-Learning Process

Instructional Materials

Use any material you think supports the students to understand the lesson.
Use photography/pictures in students textbook

Suggested Teaching Methods

Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach.

- Brainstorming
- Questioning

- Group discussion
- Demonstration
- Lecture

Pre-Lesson Preparation

- Before you begin teaching the lesson, get the teaching aids and teaching materials suggested above ready. Read the contents on propagation, nursery establishment and management of coffee and tea seedling
- Read related literature.
- Prepare notes and activities.

Presentation of the Lesson

Introduction to the lesson

You can start the lesson by asking questions like the following:

- What is propagation?
- Why do we propagate coffee, tea and spices?
- How can we establish coffee, tea and spices seedling?

Body of the lesson

Start your discussion by describing propagation, nursery establishment and management of coffee, tea and spices seedling.

Stabilization

Give them a summary of the propagation, nursery establishment and management of coffee, tea and spices seedling.

Assessment and Follow up

Assessment

Check whether or not the students have understood the lesson by giving them quizzes and class activities. Encourage them to answer the following question in their groups or independently.

- What method of coffee and tea propagation is the most important and why?
- Why is the propagation of coffee and tea needed?

Follow up

Guide the students in their discussion of their findings. After evaluating the class work, grade their achievements.

Answers to Activity 4.4.

- The most commonly used methods of coffee propagation are sexual (propagation by seed) and asexual (vegetative propagation).
- Propagation by seed requires careful selection of the mother tree. The first criterion for selection is the year of planting of the mother tree. Steps needed to follow propagation of coffee by seed are seed tree selection, harvesting and processing seed and seedling development.

Answers to Activity 4.5.

- a. **Tea plants** can be raised from seed, cuttings and tissue culture (micro propagation). Tea can be propagated sexually (by seed) or asexually (by vegetative means).
- b. Propagation of tea by seed is sowing the seeds directly in the plantation or by first growing them in seed bags in a nursery
- c. ***Sexual propagation involves*** sowing the seeds directly in the plantation or by first growing them in seed bags in a nursery whereas asexual/vegetative propagation involves clonal propagation. This consists of taking a cutting (i.e. a stem or leaf) from a “mother bush” and growing a tea bush ‘clone’.

4.4. Field establishment and management practices of Coffee, Tea and Spices

Period allotted: 2

Competency

At the end of the lesson, the students will be able to:

- explain the various cultural operations of the established coffee and tea plantations in the field

Content

- Field establishment and management practices for coffee, tea and spices

Overview

In this lesson, the students will learn field establishment and management practices of tea, spices and coffee.

Teaching-learning Processes

Instructional materials

Use images, pictures, photographs of different established field of coffee, tea and spices.

Suggested Teaching Methods

Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach.

- Brainstorming questions
- Questioning
- Demonstration
- Lecture
- Group discussion

Pre-lesson Preparation

- Get the teaching aids and teaching materials ready.

Presentation of the Lesson

Introduction of the lesson

You can start the lesson by asking questions like the following:

- What are field establishment and management practices?
- List major different of field establishment and management practices of coffee and tea?

Body of the lesson

Start the presentation by explaining field establishment and management practices.

Stabilization

Give a summary for the following topics.

- Field establishment and management practices of coffee
- Field establishment and management practices of tea

Assessment and Follow-up

Assessment

- Organize your students into groups and encourage them to discuss field establishment and management practices
- Give them quizzes or class work or both

Follow up

Check your students' understanding by asking questions and giving them class activity. Based on the feedback, check that the objectives of the lesson are met. Make sure that you are always grading and rating the students' activities, levels of their participation and quiz results.

4.5. Harvesting and processing of coffee, tea and spices

Period allotted: 1

Lesson objective

At the end of the lesson, the students will be able to:

- describe harvesting and processing of coffee and tea

Content

- Harvesting and processing of coffee

Overview

In this lesson, the students will learn harvesting and post-harvest handling process of coffee and tea.

Teaching-learning Process

Instructional Materials

- Pictures and photographs

Suggested Teaching Methods

Choose and use some of the following methods to start the lesson:

- Brainstorming questions, group discussion, explanation, presentation, etc.

Pre-lesson Preparation

Get ready the teaching aids and teaching material. If none are available in your school, prepare some in the pedagogical center. Students can help in this regard.

- Read related literature in the school's library to enrich your understanding of the lesson.
- Prepare notes and activities.

Presentation of the Lesson

Introduction to the lesson

- Introduce students to what they are going to learn (i.e., harvesting and processing of *coffee and tea*).
- Brainstorm the students about harvesting and processing of *coffee tea and* spices. This will help you assess whether they have background information about the lesson, i.e., how to harvest and process coffee tea and spices.

Body of the lesson

- Start your presentation by explaining how to harvest and process *coffee, tea and spices*
- *Have* the students describe how to harvest and process coffee, tea and spices.
- Have the students discuss in groups the harvesting and processing of coffee, tea and spices based on their prior related experience

Stabilization

Give a summary of the following points:

- Picking coffee using machine
- Harvesting tea

Which method is better for *coffee picking and tea* harvesting? Why?

Assessment and Follow up

Assessment

To know the level of understanding of the students and whether the expected competencies are achieved, ask the students questions about the topic you have taught. You can ask the student's questions like the following:

- Explain the different methods of coffee, tea and spices processing.

You can also give them a quiz, class work, or a test.

Follow up

Evaluate the students' assignments and grade their achievements.

Give special attention to

- slow-learner students,
- deaf students
- students who have problem on their body parts

Answers to Activity 4.6.

a) There are different methods of coffee harvesting and processing:

Whether by machines or humans, coffee is always harvested by one of the following two methods:

- **Strip picking** – The cherries are stripped off of the branch, either by hand or by machine
 - **Selective picking** – The red cherries are picked and the green ones are left to ripen.
- b) There are different coffee processing methods: dry method, wet method, drying the beans, milling the beans, grading and sorting, exporting the beans, tasting the coffee, etc.
- c) Mechanical methods because it minimizes the production cost.

Answers to Activity 4.7.

- a. Tea can be harvested manually (i.e., by hand) and by mechanical means. Plucking tea by hand is a traditional way of picking tea leaves. Plucking occurs when the tea bush flushes or pushes out new leaf shoots. Mechanical harvesting is the removal of tender, growing shoots from the surface of the bush using a machine.
- b. The mechanical methods are quicker and thus much more economical than the manual methods.

Answers to Review Exercise

PART I

1. C 2.C 3. D 4.E 5.C 6.C 7.A 8.C 9.B 10. E

PART II: ANSWERS TO THE ESSAY QUESTIONS

1. Economic importance: coffee provides or generates income for farmers, foreign currency for a country. Coffee accounts for 25-30 percent of Ethiopia's total export earnings. 5% of GDP is derived from coffee exports.
2. The optimum ecological conditions for coffee production are the presence of tropical climate or temperature i.e. from 18-24 °C where there is no frost. Coffee needs ample sunshine, and plenty of water. It also needs moist, fertile soil, well-drained soil under shade canopy that receives healthy dose of sunshine each day
3. Temperature affects coffee production when it is beyond or above the optimum. It affects the quality and quantity of coffee beans. Temperature affects coffee bean size (coffee bean becomes below the average size).
4. Coffee can be hand-harvested by people to ensure that only the ripe cherries are picked. Hand-picking is hard and laborious task. Whether by machines or humans, coffee is always harvested by one of the following two methods:
 - **Strip picking** – The cherries are stripped off of the branch, either by hand or by machine
 - **Selective picking** – The red cherries are picked and the green ones are left to ripen.
5. The methods in vegetative propagation of coffee are propagation by cutting and by grafting.
6. Nursing the seedlings
7. There are two types of coffee harvesting. Harvesting by hand and by harvesting using a machine. Coffee can be hand-harvested by people to ensure that only the ripe cherries are picked. Whether by machine or

humans, coffee is always harvested through strip picking and selective picking. 18) There are three main types of coffee: Arabica, Robusta and Liberica.

Check List

Check the student's performance according to the given competencies referring to the questions under the checklist for every unit. Put a tick (✓) mark against each task to see whether they are able to perform in the competencies of each unit.

Can you:

		Yes	No
	describe the history, origin, production status and economic importance of coffee tea and spices?		
	explain the most commonly used methods of propagation of coffee, tea and spices?		
	state ecological and soil requirements for coffee, tea and spices production ?		
	explain the various cultural operations needed to establish coffee plantations?		

Unit Assessment

Students' performance has to be assessed continuously over the whole unit. You can determine whether the student has achieved the minimum required level of competence by comparing their performances against the specified level of competencies.

A student working at the minimum requirement level will be able to

- mention history, origin and economic importance of coffee, tea and spices
- identify ecological requirements of coffee, tea and spices requirements and practices coffee, tea and spices propagation techniques, harvesting, and processing
- differentiate the ecological and soil requirements for and production
- explain the various cultural operations needed to establish coffee and

tea plantations

- explain the processes involved in the production and management of coffee and tea from seed to cup
- participate wholeheartedly in production and management of coffee and tea
- develop important skills required in the processes of producing coffee and tea

Students working **above the minimum** requirement level should be praised and their achievement recognized. They should be encouraged to continue working hard and not become self-satisfied.

Students working **below the minimum** requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson time during the breaks or at the end of the day.

Unit 5 Introduction to Plant Biotechnology

Total period allotted: 4

1. Unit Introduction

This unit covers different topics. These include introduction to tissue culture, types of crops produced by tissue culture, benefits of tissue culture, introduction to genetic engineering and application of genetic engineering in crop production.

2. Unit Learning Outcomes

At the end of this unit, the students will able to:

- explain tissue culture and genetic engineering.
- list types of crops produced by tissue culture
- describe the benefits of tissue culture in crop production
- explain the application of genetic engineering in crop production

3. Main Contents

- 5.1. Introduction to tissue culture
- 5.2. Types of crops produced by tissue culture
- 5.3. Benefits of tissue culture
- 5.4. Introduction to genetic engineering
- 5.5. Application of in-crop production

5.1. Introduction to tissue culture

Period allotted: 1/2

Lesson Objective

At the end of this lesson, the students will be able to:

- define tissue culture

Contents

- Introduction to tissue culture

Overview

In this lesson the students will learn about tissue culture.

Teaching-learning Processes

Instructional Materials

Pictures and images of crops developed using tissue culture methods.

Suggested Teaching Methods

Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach.

- Brainstorming Questions
- Group discussion
- Demonstration
- Lecture

Pre-lesson Preparation

- Get the teaching aids and teaching materials photographs, pictures about crops developed by tissue culture ready.

Presentation of the Lesson

Introduction of the lesson

You can present the lesson in a way you see fits the topic and the group you teach. You can begin the lesson by asking questions like

- What is plant tissue culture?
- What are the major plant parts used for tissue culture?

Body of the lesson

Start your discussion by briefly explaining the plant tissue culture.

Stabilization

- Summarize the plant tissue culture and parts of plants used for tissue culture.

Assessment and Follow-up

Assessment

- Organize your students into groups and encourage them to discuss the plant tissue culture.
- Give them a quiz and class work

Follow up

Check your students' understanding of the concepts by asking them questions and giving them class activity. Based on the results, check that the objectives of the lesson are met. If not, determine what is not clearly understood and plan for a remedial activity. You need to provide additional activities that fit the different composition of the students. Make sure that you are always grading and rating the students' activities, levels of participation and quiz results.

5.2. Types of crops produced by tissue culture

Period allotted: 1

Lesson objectives

At the end of this lesson, the students will be able to:

- identify the types of crops produced by tissue culture

Content

- Types of crops produced by tissue culture

Overview

In this lesson, students will learn about the types of crops produced by tissue culture.

Teaching-learning Processes

Instructional Materials

Use picture or photographs of different types of crops that can be produced by tissue culture.

Suggested Teaching Methods

Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach:

- Brainstorming: Asking questions to know what prior knowledge students' may have.
- Questioning
- Demonstrations
- Group discussion:
- Explanation (**lecture**)

Pre-lesson Preparation

- Get the teaching aids and teaching materials ready.

Presentation of the Lesson

Introduction to the lesson

You can start the lesson by asking questions like the following:

- What are the crops produced by tissue culture?
- Have you ever seen crops produced by tissue culture in your environment/school?

Body of the lesson

Start the presentation by explaining the crops produced by tissue culture.

Stabilization

Give a summary of the following topics.

- The types of crops produced by tissue culture
- Different crops produced by tissue culture in their environment or in your school

Assessment and Follow-up

Assessment

- Organize your students in group and encourage them to discuss the types of crops produced by tissue culture.
- give them a quiz and class work

Follow up

Check your students' understanding of the concepts by asking questions and giving them class activity. Based on the feedback, check that the objectives of the lesson are met. If not, determine what is not clear and plan for a remedial activity. You need to provide additional activities that fit the different composition of the students. Make sure that you are always grading and rating the students' activities, levels of participation and quiz results.

Answers to Activity 5.1

- The crops produced by tissue culture are potato, asparagus, acacia species, citrus species, clematis species, coffee Arabica, etc.

5.3. Benefits of tissue culture

Lesson objective

Period allotted: 1/2

At the end of the lesson, the students will be able to:

- describe the benefits of tissue culture

Content

- **Benefits of tissue culture**

Overview

Tissue culture has benefits such as rapid multiplication of genetically uniform plants, regeneration of whole plants from plant cells that have been genetically modified, the production of plants from seeds that otherwise have very low chances of germinating and growing, etc

Pre-lesson Preparation

Get the teaching materials you need ready in advance of the lesson day. If none are available in your school, try to prepare by yourself for some in the pedagogical center.

- Read related literature in the school's library.
- Prepare notes and activities.

Presentation of the Lesson

Introduction to the lesson

- introduce students to benefits of tissue culture

Body of the lesson

- Start your presentation by explaining the benefits of tissue culture

Stabilization

Give a summary of the following points:

- The benefits of tissue culture

Assessment and Follow up

Assessment

Ask the questions like the following:

- Explain the benefits of tissue culture.

You can also give them a quiz, or class work

Follow up

- Give them assignments, quiz, and test

Evaluate the students' assignments and grade their achievements.

Give special attention to

- slow-learner students,
- deaf students
- students who have disabilities

5.4. Introduction to genetic engineering

Period allotted: 1

Competencies

At the end of this lesson, the students will be able to:

- define genetic engineering

Content

- Introduction to genetic engineering

Overview

In this lesson, the students will learn about genetic engineering.

Teaching learning processes

Instructional Materials

- Pictures/ph

Suggested Teaching Methods

Use the following teaching methods as suggested in the general introduction and presentation of the lesson:

- Brainstorming questions, questioning, introduction and explanation, group discussion, presentation.

Pre-lesson preparation

Before you begin teaching the lesson, get pictures that show basic concepts of genetic engineering and other teaching materials.

Presentation of the Lesson

Introduction to the lesson

You may begin the lesson by asking questions like the following:

- What is genetic engineering?
- What is the importance of genetic engineering?

Body of the lesson

Briefly, explain the characteristics of conventional breeding and genetic engineering.

Stabilization

Give a summary of the following topics.

- Genetic engineering
- Conventional breeding and genetic engineering

Assessment and fellow up

Assessment

Ask them to answer the following questions.

- Describe the importance of genetic engineering?
- Explain the concepts of genetic engineering?

Follow up

Check the students' understanding of the lesson by giving them tasks to do independently.

- What are the advantages of genetic engineering over the conventional?

Additional Questions

1. Explain the role of reproductive techniques in genetic engineering.
2. Describe the method used to run the genetic engineering

Answers to Activity 5.2

- a) Methods used to change the pattern in genetic material or information in

a plant, animal or human being in order to produce some desirable traits.

b).

conventional breeding	Genetic engineering
▪ is limited to exchanging genetic material between the same or very closely related species. ▪ has little or no guarantee of any particular gene combination from the millions of crosses generated. ▪ may result in transferring undesirable genes along with the desirable ones. ▪ takes a long time to achieve the desired results.	▪ allows the direct transfer of one or just a few genes, between either closely or distantly related organisms ▪ results in crop or animal improvement in a shorter time compared to the conventional breeding ▪ Allows plants or animals to be modified by removing or switching off particular genes

Answer the additional question

1. Helps to manipulate the gametes and embryos like obtaining a new organism from adult differentiated cells.

2. Artificial reproduction (in-vitro fertilization, embryo transfer, artificial insemination) speeds up genetic improvement.

5.5. Application of genetic engineering in crop production

Period allotted: 1

Competencies

At the end of this lesson, the students will be able to:

- explain the application of genetic engineering in crop production.

Content

- Application of genetic engineering in crop production

Overview

In this lesson, the students will learn about methods of plant breeding, application of genetic engineering to plant breeding.

Teaching-learning Processes

Instructional Materials

- Pictures/Photographs that shows different procedure of genetic engineering.

Suggested teaching methods

- Brainstorming questions, questioning, group discussion, and presentation.

Pre-lesson preparation

Get the instructional materials and teaching material ready. If none are available in your school, prepare your own pictures or photographs with your students in the pedagogical center.

- Read related literature
- Prepare notes and activities.

Presentation of the lesson

Introduction of the lesson

Introduce the students to the topic of the lesson for the day. Do these using brainstorming questions

- Does anyone know what genetic engineering in plants is?
- Explain the role of genetic engineering for plants?

Body of the lesson

Start your presentation by explaining modern breeding in plants and the role of genetic engineering in plants.

Discuss the benefits of genetic engineering in plants.

Stabilization

Give a summary of the following points:

- Methods of plant breeding,
- application of genetic engineering in plants, and
- benefits of genetic engineering in plants.

Assessment and Follow up

Assessment

You can ask the students' questions like the following:

- Explain the role of genetic engineering in plants.

Follow up

Give them library study on the following issues:

- What is the desired gene?

Additional Questions

a . What is the new variety of DNA strand?

Answer to Activity 5.3

The advantages of genetic engineering for crop production is:

- It allows for a faster growth rate
- It can create an extended life.
- Specific traits can be developed.
- New products can be created.
- Greater yields can be produced

The disadvantages of genetic engineering for crop production is:

- The growth of plants through genetic engineering can create less nutritional value.
- Nature is continuously adapting to our genetic engineering efforts

- Pathogens adapt to the new genetic profiles.
- There can be negative side effects that are unexpected
- The amount of diversity developed can be less favorable

Answers to the additional questions

1. The strand that has only the desired gene is transferred to a location in the recipient genome.

Answers to the review exercise

Part I: True or false

1. True 2. True

Part II: Choice

1. D 2.D 3.D 4.D 5.D 6.D

Part III: Answer to the Short Answer Questions

1. Plant tissue culture is the technique of growing plant cells, tissues, and organs on an artificial nutrient medium under aseptic conditions.
2. Asparagus, cucumber, grapevine, banana, alfalfa, citrus, sugarcane, tomato, potato, groundnut, etc.
3. Nutrients, pH medium, adequate temperature, and proper gaseous and, auxins, etc are the components of tissue culture
4. The benefits of tissue culture are rapid multiplication of genetically uniform plants, regeneration of whole plants from plant cells that have been genetically modified, etc.

Check list

Check the student's performance according to the given competencies referring to the questions under the check list for every unit. Put a tick (✓) mark against each task to see whether they are able to perform in the competencies of each unit.

Can you:

	Yes	No
describe what culture means?		
mention types of crops produced by tissue culture?		
explain the benefits of tissue culture?		
define genetic engineering?		
describe the genetic engineering in crop production?		

Unit 6 / Beef Cattle Production and Management

This unit requires approximately 6 periods of teaching time.

Unit Introduction

In this unit, the students will learn about beef cattle production and management. They will get introduced to the known local and exotic beef cattle breeds and selection methods. The unit also familiarizes the students with feed resources for beef cattle and feeding methods. Beef cattle housing, major diseases of beef cattle, and beef cattle control methods are also present in the unit. Furthermore, the processing of the products of meat is also covered in this unit.

Unit Learning Outcomes

At the end of this unit, your students will be able to:

- identify different beef cattle breeds and make proper selection.
- categorize beef cattle breeds and explain selection procedures.
- describe beef cattle housing.
- explain beef cattle feed resources and their feeding methods.
- judge the cattle housing used by beef cattle breeders based on the criteria required.
- list major diseases and parasites of beef cattle and their controlling methods.
- describe the processes involved in the processing and handling of meat.
- show interest in breeding beef cattle.
- promote the production and management of beef cattle in their localities.

Main Contents

- 6.1. Beef cattle breeds and selection
- 6.2. Beef cattle feeds and feeding methods
- 6.3. Beef cattle housing
- 6.4. Major diseases of beef cattle and controlling methods
- 6.5. Meat production and processing

6.1. Beef Cattle Breeds and Methods of their Selection

Period allotted: 1

Competencies

At the end of this lesson, the students will be able to:

- identify different beef cattle breeds and make proper selection
- categorize beef cattle breeds and explain selection procedures.

Contents

- Beef cattle breeds and their selection

Overview

In this lesson, the students will learn about the cattle breeds used for meat production and their selection methods. First, they will learn some potential beef cattle breeds and traits considered for selection. Then there will be a discussion of the term beef and the characteristics associated with the term.

Teaching Learning Process

Suggested instructional materials/media

- Pictures of beef cattle breeds

Suggested Teaching Methods

- Brainstorming questions, Question - answer, gapped lecture, Group discussion, Presentation

Pre-lesson preparation

Before you begin teaching the lesson, it is good to obtain the pictures of different beef cattle breeds and other teaching materials.

Presentation of the lesson

Introduction to the lesson

You might use your own method of presentation in any way you see fits this topic and the group of students you teach. However, the one way of introducing a topic is by raising relevant questions after introducing the specific objectives of the lesson to the students. Questions are motivating

factors that make students curious. Good questions draw the students' attention to the lesson. Therefore, you may begin the lesson by asking questions such as:

What is beef cattle breed?

What are the characteristics of good beef breed?

What are the differences between beef and dairy type of cattle breeds?

What cattle breeds are kept by farmers for meat production locally?

What are the selection methods used for beef cattle breeds?

- Draw the students' attention to the objective of the lesson.
- Introduce the lesson by defining the term beef and beef cattle breed.
- Explain the differences between breeds used for meat production and milk production.
- Introduce the known cattle breed in tropics and temperate climate or areas.
- Introduce the breeds of cattle often used for meat production in Ethiopia.
- Introduce the criteria used to select breeding animals for beef?

You may ask questions such as: what do you think the reasons for the differences between cattle breeds are?

Body of the lesson

Define beef and beef cattle breed.

- Tell them about methods of selecting beef cattle.
- Explain why we do not have specialized beef cattle breeds in Ethiopia.
- Explain beef cattle breed selection criteria and their importance.

Stabilization

Give a summary of the following points:

- The definition of beef and beef cattle breed
- The characteristics of beef breeds
- The selection methods and the criteria considered for beef cattle breeds selection.
- The traits considered in beef cattle breed selection.

Assessment and follow-up

Assessment

At the end of the lesson, make sure that your students have understood the essential concepts of the lesson by asking questions and giving them tasks like the following

1. What is beef and beef cattle breed?
2. What are the beef cattle breeds in tropics and temperate?
3. Explain the difference between beef and dairy type breeds?
4. What are the selection methods for beef cattle breeds?

Follow up

Check the students' understanding of the lesson by giving them some exercise to do independently.

- Write the meaning of beef
- Name the beef cattle breed in tropics (including Ethiopia) and temperate breeds.
- What are the breeds kept for meat production locally?
- Explain the main difference between beef cattle breeds and dairy cattle breeds?
- Explain what beef cattle selection methods are?

Make sure that you are always grading and rating the students' activities, levels of participation and quiz results.

Additional Questions

The temperate beef breeds have been deliberately selected for various purposes and can be easily differentiated with their peculiar features such as body color, length, and shape of a horn, having no hump, and other traits. They are well known for their good beef traits and provide more meat. In the case of tropics, there are a few breeds that are selected and bred for beef purposes. The available breeds are rather selected and bred for centuries to be more adaptive and serve as multi-purpose cattle, not for specialized production. The local breeds for example are expected to give meat, milk, plowing, etc.

Questions are set from these beef cattle breeds notes as follows:

1. What do you mean by specialized beef cattle breeds? Explain briefly by giving examples.
2. How do you understand the multipurpose breeds?
3. Compare local (tropical breeds) and temperate breeds and report their differences?

Answer to Activities

Activity 6.1.

Students may come up with a list of breeds that are known for multipurpose like Boran, Barka, Begait, Fogera, Arado, Horro, Arsi-Bale, etc. If there are no such farms around to visit, alternatively allow the students to watch videos of fattening activities from the internet or from the school library. Use the term “cattle fattening” or open the following search link for the educational video(<https://www.youtube.com/watch?v=L-lviI2VSVY>).

Let them share and discuss their finding with the whole class.

Activity 6.2.

Alongside the given examples of known exotic beef cattle breeds, students may come for a discussion with other specialized breeds and their differences from the internet and different kinds of literature. They may propose known beef cattle breeds by looking at their advantages for crossbreeding with local breeds. The expected characteristics to see in the offspring should be in line with the merits of the chosen exotic breed.

Let them share their answers with the other students in the class.

Activity 6.3.

Fattening farm or butchers shop owners focus on the criteria that suits their interest and on the needs of the market. Beef animals with good performances are selected to be fattened or slaughtered. Good performances could be high meat yield, quality meat, fast growth rate, high feed intake, disease and heat tolerance, foraging ability, etc.

Activity 6.4.

The differences are in color, adaptation, year per head, meat quality, purpose or special ability, etc. Allow the students to use the figures of

exotic and tropical breeds to differentiate the breeds specialized for beef and the tropical (local) ones. Allow the students to share their views with others.

Answer key to the additional questions

1. Breeds that are selected and bred based on specific selection criteria or trait(s) for decades. Those breeds might, for example, be meat type or/and dairy type. They can easily be differentiated from other breeds due to their peculiar features such as body color, length, the shape of a horn. In addition, they have no hump, and other similar traits. Whereas specialized beef cattle is the breed used for meat production and commercialized used beef breeds like Hereford, Angus, Shorthorn, South Devon, etc.
2. Multipurpose breeds are breeds used for different purposes like milk, meat, and plowing at the same time. Farmers use both performances to select breed or individuals as breeding animals.
3. Tropical breeds:
 - refers to cattle found in the tropics.
 - there is no specialized beef cattle breed
 - the available breeds are rather selected and bred for centuries to be more adaptive and serve as multi-purpose cattle, not for specialized production.
 - there are potential beef cattle breeds in tropical environment like Boran, Afrikander, Brahman, Indo-Brazilian etc.

Temperate cattle breed:

- are found in the temperate zones especially in the USA and in Europe.
- are deliberately selected for various purposes.
- can easily be differentiated from other breeds due to their peculiar features.
- are known for their good beef traits.

6.2. Beef Cattle Feeds and Feeding Methods

Period allotted: 1

Competencies

At the end of the lesson, the students will be able to:

- explain beef cattle feed resources and feeding methods

Contents

- Beef cattle feeds and feeding methods

Overview

In this lesson, the students will learn about the various feed resources used for beef cattle breeds in general. They will also learn about feed resources, quality and their feeding level, and different feeding methods of beef cattle.

Teaching-learning process

Suggested Instructional material

Use the following teaching materials:

- Pictures or figures of roughages and concentrates that show the available feed resources
- Tables or charts that show the nutritional merits of some commonly available feed resources for beef cattle.

Suggested teaching methods

Start your lesson by using the following methods:

- Brainstorming questions, question-answer, group discussion, and presentation.

Pre-lesson preparation

- Get ready the instructional materials and teaching material before you begin. If none are available in your school, prepare your own pictures or photographs with your students in the pedagogical center.
- Read related literature in the school's library.

Presentation of the Lesson

Introduction to the lesson

Introduce the students to what they are going to learn (beef cattle feeds and feeding methods).

Make the objectives of the lesson clear.

Brainstorm students about the feed resources used for beef cattle.

You can assess whether they have background information by asking the following questions:

- What are the feed resources used for beef cattle? Why is it important to know about feeds?
- What are the feeding methods and why is the knowledge of nutrients supplied by feeds required?

Body of the lesson

Start your presentation by

- explaining beef cattle feed resources and feeding methods.
- explain types of feeds based on the categories mentioned in the lesson.
- having the students describe the resources and variations over the location and season
- having the students discuss in groups the basics for animals to set nutritional requirements and how it can be developed.
- asking the students to present their opinion before the class.

Stabilization

Give a summary of the following points:

- the feed resources available for beef cattle breeds used by the farmers or cattle fatteners
- the criteria to set the nutritional requirements and
- the feeding methods

Assessment and follow-up

Assessment

To know the level of students' understanding and whether the expected competencies are achieved.

Ask the students questions about the topic you have taught.

You can ask the student's questions like the following:

- Mention beef cattle feed resources available in your area.
- Explain the beef cattle feeding methods you know in your area.

Follow-up

To help your students get more idea on the lesson, you can give them assignments.

Assign each group to do a library or internet study on the following issues:

- Explore the compositional quality of the locally available feedstuffs that you have interviewed and listed for discussion from the activities? Search from different literature or the internet, if any.

Additional questions

Feed resources that are available for beef cattle production vary in terms of quality and feeding level. Unlike the concentrate feeds, roughage feeds are known for being less dense. They are high in fiber and high in crude fiber in a dry state. Legumes are good in protein sources and in fixing nitrogen from the air.

Questions are set from this classification of feeds as follows:

1. What are the major differences between roughage and concentrates?
2. What types of feed resources are categorized under concentrate feeds?
3. What are the comparative advantages of legumes over grasses?

Answer to Activities

Activity 6.5.

Elders or farmers may say hay, grains, straw, and stover corn cobs. Depending on the season they may also mention green feeds like pasture, green chops and other high moisture feed like wet by-products, roots, tubers, cactus, or Enset. In the urban and per/urban areas, due to their proximity and access to agroindustry by-products, they may list feeds like wheat bran, molasses, brewer's grain, beet pulp, malt sprouts.

Answer key to the additional questions

1.

Roughage feeds	Concentrate feeds
- are bulky and less dense - are feeds that are high in fiber and low in total digestible nutrients(TDN) - contain above 18% CF when dry	- are less bulky and dense - are feeds that are low in fiber and high in TDN - contain below 18% CF when dry

2. Grain feeds, supplement feeds and byproduct feeds.

3. Legumes:

- have on their root's nodules containing bacteria that fix nitrogen from the air
- examples include alfalfa, clovers, peanut hay, soya bean hay, etc.

6.3. Beef Cattle Housing

Period allotted: 1

Competencies

At the end of this lesson, the students will be able to:

- describe beef cattle housing

Content

- Beef cattle housing

Overview

In this lesson, the students will learn why housing is necessary for beef cattle. Beef cattle housings vary depending on the place of their location. In this lesson, both the conventional and modern types of beef cattle housing systems will be the focus of the lesson. Then there will be discussion about the housing system and what are the common beef cattle housing characteristics.

Suggested Teaching-Learning Process

Suggested Teaching Aids

Use the following aids in this lesson.

- Photographs/figures

Suggested Teaching Methods

For further information on how to use the suggested methods refer to the general information for the teacher in the Introduction to this guide.

- Brainstorming , demonstration, group discussion , presentation

Pre-Lesson Preparation

Get ready in advance with the instructional materials and teaching materials, such as pictures of different housing designs for beef cattle, and the raw materials used to construct, etc.

Design the most appropriate teaching method.

Read relevant literature to provide students with full information. Prepare notes, activities and exercises.

Presentation of the Lesson

Introduction to the lesson

Introduce the topic briefly with the help of brainstorming. Be sure the students understand the objectives of the lesson.

Conduct a brainstorming session with the students so you can understand their background knowledge about beef cattle housing.

- What type of cattle housing system do you know?
- What is the difference between the traditional housing system and the improved housing designs?

Body of the lesson

Give some examples of the existing beef cattle housing systems.

- a) Give sufficient explanation of why housing is important.
- b) Give sufficient explanation of what we need to address before establishing the farm.
- c) Mention the differences between the traditional and modern beef cattle housing practiced in tropics.

Stabilization

Make the following points clear to your students;

- How proper housing protects beef cattle from the adverse effect of the environment.
- The important issues that need to be considered before establishing beef cattle house.
- The various types of beef cattle housing systems used by farmers and the differences compared to the modern ones.

Assessment and follow up

Assessment

Check the students' understanding of the lesson by giving them activities to do individually such as:

- How does proper housing protect beef cattle from climate stress?
- What important issues need to be considered before establishing beef cattle house?
- What raw materials do farmers used to construct beef cattle houses? In what ways do the houses built by farmers differ from the modern beef cattle houses?

Follow up

To broaden students' knowledge, give the following library assignments to each group.

- Find out the differences and similarities between beef cattle and dairy cattle housing systems.
- Beef cattle housing system depends on the locations of the farm. Explain the housing systems and designs suitable to a tropical environment.

Remember to record the students' results right after you evaluate their activities.

Additional Questions

1. Explain why securing sufficient ventilation in a tropical environment is crucial in beef cattle housing.
2. Take a housing system of small scale fattening farms in your locality and explain what should be done to enhance the performance of the animals.

Answer to Activities

Activity 6.6.

- a. Open overhead shelter with enclosures is the predominant but small and medium scale fattening farms , however, you may see housing with open enclosure.
- b. Students may come up with a list of materials used to construct beef cattle houses in their locality such as wood, corrugated iron sheet, acacia thorn.
- c. Help them discuss the advantages of each housing system identified by students during their visit. Give a summary at the end of the discussion.

Answer Key to the Additional Question

1. Sufficient ventilation allows air circulation within the house. This keeps the heat stress and relative humidity to a minimum.
2. Suggest improvements to the existing housing system, the students can look at what modern beef housing should look like. Space requirements for each animal, the height of the roof, ventilation, feeding and water troughs, and other facilities are major considerations. Students may come with a list of options to improve the existing housing system. Let them discuss and learn from the summary of the group.

6.4. Major Diseases of Beef Cattle and their Controlling Methods

Period allotted: 1

Competencies

At the end of this lesson, students will be able to:

- list the major diseases of beef cattle and methods to control them

Content

- Major diseases of beef cattle and methods of controlling them.

Overview

In this lesson, the students will learn about diseases that commonly affect beef cattle. The infectious and non-infectious diseases can further be divided into viral, bacterial, and protozoal. Beef cattle can also be affected by internal and external parasites. Strategies of disease control in beef cattle.

Teaching-Learning Processes

Suggested Teaching Aids

- Pictures and photographs that show parasites and symptoms of different diseases
- Charts

Suggested Teaching Methods

Conduct your class using the suggested teaching methods

- Brainstorming, demonstration, questioning, group discussion, presentation etc.

Pre-lesson Preparation

Get ready with the instructional materials and teaching materials. Inform the students of the lesson to be discussed and encourage them to sufficiently participate.

Presentation of the Lesson

Introduction to the lesson

Introduce students to the lesson and give emphasis to the major diseases in beef cattle and methods of controlling them. Make the objectives of the lesson clear to the students. Brainstorm the students' to see if their past experiences can be related to the lesson topic. You can begin the lesson by asking probing questions like

- What are the major disease in beef cattle?
- What is an infectious disease?
- What is a parasite?

Notice that these questions are samples; you can reproduce and use them based on the lesson given.

Body of the lesson

Start your discussion by describing briefly what infectious and non-infectious beef cattle disease mean.

- Discuss the viral, bacterial and protozoal diseases by giving examples.
- Explain the disease controlling strategies in beef cattle.
- Encourage the students to discuss the diseases that affects beef cattle in their area.
- Categorize the diseases into infectious and non-infectious. Let the students explain the indigenous knowledge and practices used in the local community to combat animal diseases.

Stabilization

Summarize the following points

- Infectious and non-infectious diseases of beef cattle.
- Viral, bacterial and protozoal beef cattle diseases by giving examples.
- The diseases controlling strategies in beef cattle.

Assessment and Follow-Up

Assessment

Check whether or not the students have understood the lesson by giving them quizzes. Encourage them to answer the following questions in their groups or independently.

- Define the infectious and non-infectious beef cattle diseases
- Define what internal and external parasite is.
- How do you perceive the influence of diseases on the production performance of beef cattle?
- What's meant by controlling strategies of disease? Give examples

Follow up

Inform the students and guide them in discussing the following issues. Check their findings. After evaluating the classwork, grade their achievements. It is recalled that students had enough discussion with farmers in their area

during activity 6.8.

Let the students take one disease which is prevalent in their locality and answer the following questions:

- What are the symptoms of the disease?
- What strategies can be used to control the disease?

Additional Questions

1. Give examples of common viral beef cattle diseases.
2. What are the effects of parasites in beef cattle?

Answer to the Activities

Activity 6.7.

Following the fieldwork, students may come to the whole class with a list of diseases that affects beef cattle in their areas. Categorize and describe the diseases as listed in the activity.

Answer key to the additional questions

1. Viral diseases are rinderpest, Foot and Mouth Disease (FMD), rabies, bovine virus diarrhea, etc.
2. Parasites suck the animal's blood and compete for blood nutrients. This causes a great economic loss to the farm animal owner by reducing the animal's weight, feed intake, and carcass quality.

6.5. Meat production and processing

Period allotted: 1

Competencies

At the end of this lesson, the students will be able to:

- describe meat production and processing

Contents

- Meat production and processing

Overview

In this lesson, the students will learn about meat production and processing.

Meat is produced from livestock, fish, and poultry for domestic and export uses. The majority of beef comes from old oxen, culled cows, and surplus young bulls. Meat production tends to be moderately rising with some fluctuation. Meat processing involves a wide range of treatment methods such as physical, chemical, or biochemical techniques.

Teaching-learning processes

Suggested Instructional Materials

Pictures and charts that show meat products and the processing methods.

Suggested teaching methods

You can conduct your class using the suggested teaching methods

- Brainstorming, demonstration, group discussion, and presentation.

Pre-lesson preparation

Get ready the instructional materials and teaching materials. Inform students of the lesson to be discussed and encourage them to present ideas and concepts.

Presentation of the lesson

Introduction to the lesson

Introduce students to the lesson giving emphasis to the given topics, such as meat production and processing techniques. Make the objectives of the lesson clear to the students. Brainstorm them to know their past experiences regarding the lesson for the day. You can begin the lesson by asking questions like;

- What are the sources of meat production in Ethiopia for the domestic and export market?
- Why does Ethiopia contribute low to the world meat production?
- What is the current Ethiopian per capita meat consumption?
- What are the meat processing techniques?

Notice that these questions are just a few examples samples and you can ask more questions yourself.

Body of the lesson

Start your discussion by describing briefly meat production in Ethiopia and its challenges.

Discuss the per-capital production and the Ethiopian contribution to world meat production.

- Explain meat processing techniques including the traditional processing techniques.
- Explain why it is important to process meat into different forms.

Stabilization

Summarize the following points

- Sources of meat in Ethiopia
- Current status of meat production compared to the existing livestock resources
- Meat processing techniques

Assessment and follow up

Assessment

Check whether or not the students have understood the lesson by giving them quizzes. Encourage them to answer the following questions in their groups or independently.

- List the animals used as sources of meat.
- Explain why Ethiopia contributes little to world meat production.
- What are the meat processing techniques? Give examples.
- Explain why meat processing into different forms is required?

Follow-up

Guide the students in discussing. Check their findings. After evaluating the classwork, grade their achievements. Let the students take some traditionally processed meat and some meat products processed in a modern way. Allow the students to compare the techniques followed to process the products. Think about their storage temperature, and time, additives used,

casings, and estimated shelf life. Then ask students to answer the following questions:

- What differences have you noticed between the products? Answer the question in line with the parameters considered for comparison.
- In both processing methods, what are the principal techniques used to inhibit the growth of microorganisms and consecutive spoilage?

Additional to the Questions

1. What are the differences between modern and traditional meat product processing techniques?

Answers to the Activities

Activity 6.8.

Students may come up with a list of methods for how cattle are slaughtered and meat is processed. Perhaps the information collected by students may include the traditional slaughtering techniques at the small abattoir. Allow them to discuss using the information they have collected.

Activity 6.9.

- a. Students may come with a list of techniques used to preserve meat like smoking, drying, cutting into pieces, cooking, freezing, etc. The shelf life of the products also may vary from few days to months depending on the season and preservation techniques used.
- b. Advantage: to mention some, it could be like to extend shelf life, desirable flavor, and test, diversify products.

Disadvantage: hard to maintain constant quality.

The rest of the questions mentioned under activity 5.8 (c to d) can be used for discussion of the data students have collected under your guidance.

Answers Key to the Additional Questions

1.

- Modern: constant quality, longer shelf life, uniform recipe or

procedure, advanced processing materials.

- Traditional: hard to maintain quality, less shelf life, lacks processing materials.

Answers Key to the Review Questions

Part I

1. False 2. True

Part II

1. C 2. D 3. E 4. D 5. D 6. B 7. E
8. C 9. B

Part III

1. It is characteristics of beef. It can be divided into carcass quality (composition) and carcass Quantity traits.
2.

Viral	Bacterial	Protozoal
<u>Rinderpest</u>	<u>Tuberculosis</u>	<u>trypanosomiasis</u>
<u>bovine virus diarrhea</u>	<u>Blackleg</u>	<u>coccidia</u>

Check list

Check the student's performance according to the given competencies referring to the questions under the checklist for every unit. Put a tick (✓) mark against each task-see whether they are able to perform in the competencies of each unit. The students are expected to respond by saying Yes or No. Then, you can make your own assessment and check whether the competencies are met or not.

Can you:

		yes	No
1.	state the meaning of beef? _____		
2.	define fattening _____		
3.	differentiate beef cattle breeds from dairy type? ____		
4.	explain the traits used to select beef cattle. _____		
5.	list the traits/characteristics of beef cattle? _____		
6.	mention some tropical and temperate breeds used for meat production?__		
7.	determine the feed resources available for beef cattle. _____		
8.	categorize feed resources based on their quality _____		
9.	design a house for beef cattle? _____		
10.	list the issue that need to be considered before establishing beef cattle house? _____		
11.	mention major beef cattle disease and parasites? ____		
12.	Explain controlling strategies of beef cattle disease		
13.	compare the per-capital consumption of Ethiopia with other African countries and world? _____		
14.	mention the physical , chemical and biochemical techniques of meat processing _____		

Unit Assessment

The assessment will be made by comparing students' performance with the specified level of competencies. Besides, the teacher has to recognize the level of performance of each student and provide assistance accordingly, Thus:

Students at the minimum requirement level

A student at a minimum requirement level will be able to;

- state the meaning of beef and fattening mean,
- determine the breeds used for meat production,
- state the differences between beef and dairy type,
- mention the traits of good beef cattle,
- list the criteria used to select beef animals by farmers,
- explain why beef cattle housing is required

- explain the housing systems for beef cattle production
- list the available feed resources for beef cattle and the proper feeding methods,
- explain the controlling strategies of beef cattle,
- describe meat production in Ethiopia,
- explain the major physical, chemical, biochemical meat processing techniques.

Students working above the minimum requirement level

A student working above the minimum requirement level and considered as a higher achiever should be able to:

- compare beef cattle with the dairy type of cattle breeds
- state the typical characteristics of beef cattle
- give examples of roughage and concentrate feeds
- explain why housing is important for production performance,
- explain why Ethiopia is contributing little to the world meat production,
- compare the advantage and disadvantages of traditional meat processing,
- list the benefits of meat processing

Students below the minimum requirement level

Students working below a minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson time during the breaks or at the end of the day.

Students who have not only reached the minimum requirement level but also achieved a little bit more should be supported so that they can attain the higher achiever competencies. Students who fulfill the higher-achiever competencies also need special support to contribute and achieve more.

Unit 7

Sheep and Goat Production and Management

This unit requires approximately 6 periods of teaching time

Unit Introduction

In this unit, the students will learn about sheep and goat production and management. They will be introduced to the known local and exotic sheep and goat breeds and their selection methods. The unit is also familiarizes the students with the feed resources for sheep and goat and their feeding methods, sheep and goat housing systems, a major disease of sheep and goats, and their control methods. Furthermore, meat and milk from sheep and goat product processing is also another area of focus of the unit.

Unit Learning Outcomes

At the end of this unit, your students will be able to:

- classify different sheep and goat breeds and make selections for preferred traits
- describe sheep and goat feed resources and their feeding methods
- identify different types of housing for sheep and goats
- list the major sheep and goat diseases and parasites and the controlling methods
- explain the major products and product processing of sheep and goat
- give values and proper place to sheep and goat breeds

Main Contents

- 7.1. Sheep and goat breeds and selection
- 7.2. Sheep and goat feeds and feeding
- 7.3. Sheep and goat housing
- 7.4. Major diseases of sheep and goat and methods of controlling the diseases
- 7.5. Sheep and goat meat and milk production and processing

7.1. Sheep and goat breeds and methods of their selection

Period allotted: 1

Competencies

At the end of this lesson, the students will be able to:

- classify and characterise different sheep and goat breeds.
- The selection methods and preferred traits for sheep and goat breeds.

Content

- sheep and goat breeds and selection

Overview

In this lesson, the students will learn about the indigenous sheep and goat breeds and their habitats. Important exotic sheep and goat breeds, their distribution, and their purpose are the other areas of focus in this lesson. There will be a session on breed selection in this lesson. Different breeds have different environmental adaptability. Animals which are adapted to cool areas may not be suitable for hot areas. Choosing an appropriate breed with good production performance is an important step in selection.

Teaching learning processes

Suggested Instructional Materials

- Pictures showing local and exotic breeds, diagrams

Suggested Teaching Methods

Use the following teaching methods, as suggested in the general introduction and presentation of the lesson:

- Brainstorming questions, Question-answer, Introduction and demonstration, Group discussion, Presentation.

Pre-lesson preparation

Before you begin teaching the lesson, get pictures of the important sheep and goat breeds of local and exotic, photographs, diagrams, and other teaching materials. The school pedagogical center may provide you with

such pictures.

Forward planning: read the contents on illustrations or pictures in the student's textbook and other related resources to make the necessary preparation. Prepare your plan especially to monitor students when they do the start-up activity. The start-up activity is designed to identify the breeds important to farmers and some exotic breeds used in the breeding programs implemented in sheep and goats by interpolation.

Presentation of the Lesson

Introduction to the lesson

You can use your own method of presenting the lesson, but that way should fit the particular topic and the group you are teaching. However, one way to introduce a topic is by raising relevant questions that motivate the students and makes them curious to learn know more about the topic of the lesson for the day. Therefore, you may begin the lesson by asking questions like the following:

- What are the breeds of sheep and goats found in Ethiopia?
- What are the important exotic sheep and goat breeds and the purposes of keeping them? Why is it important to introduce exotic sheep and goat breeds?
- What are the selection methods and the traits included as selection criteria by farmers?

Body of the lesson

After seeing your students' understanding of local and exotic sheep and goat breeds, present the lesson by explaining indigenous sheep and goat breeds and their distributions. Describe the characteristics of sheep and goat breeds. Discuss the breed selection criteria which enable us to identify the potentials breeds of important traits.

Stabilization

Give students a summary of answers to the following questions:

- What important breeds of sheep and goats are found in Ethiopia?

- What are the known exotic breeds?
- How is breed selection practiced? What are the predominant traits?

Assessment and follow up

Assessment

In order to check whether the students have understood the lesson, ask them to do the following task.

- List the most common indigenous breeds, their characteristics and distribution.
- Describe the selection methods used for sheep and goats.

Follow up

Check the students' understanding of the lesson by giving them some exercise to do independently.

- Are the local breeds more adapted to local conditions than the exotic sheep and goat breed? Why?
- Name some of the sheep and goat breeds found in Ethiopia?
- Explain the main differences between local and exotic sheep and goat breeds.
- Explain the criteria used to select male or female sheep and goats for breeding.

Make sure that you always grading and rating the students' activities, levels of their participation, and quiz results.

Additional Questions

The exotic sheep and goat breeds have been selected for a particular purpose for decades and can be easily differentiated with their peculiar features such as body color, length, and shape of a horn. They are well known for their particular trait and are specialized in meat, milk, wool and sometimes you may find multipurpose breeds. In the indigenous cases, most are selected and bred for many reasons and purposes. The sheep and goat breeds are selected and bred for centuries to be more adaptive and serve as multi-purpose, not for specialized production. The local breeds for

example are expected to give meat, wool, milk, etc. Questions from sheep and goat breeds are noted as follows.

1. What are specialized sheep and goat breeds? Give examples
2. How do you understand multipurpose breeds?

Answer to the Activities

Activity 7.1.

Students may come to class with a list of breeds known for multipurpose in the area. Let them report their finding to the whole class.

Answers to the additional questions

1. Breeds have been selected for a particular purpose for decades and can be easily differentiated with their peculiar features such as body color, length, and shape of a horn. They are well known for their particular trait and are specialized in meat, milk, wool and sometimes you may find multipurpose breeds.
 - Sheep breeds known for their milk production such as Awassi, East friesian, Assaf chios sheep
 - Sheep breeds known for their meat production such as Bonga, dorper, Hampshire down sheep
 - Sheep breeds known for their wool production such as Merino, Corriedale, Romney sheep
 - Goat breeds known for their milk production such as Saanen, Alpine sheep
 - Goat breeds known for their meat production such as Boer, Anglo-Nubian, Alpine goat
 - Goat breeds known for their wool production such as Angora sheep
2. Breeds or animals used for two or more purposes.

7.2. Sheep and goat feeds and feeding

Period allotted: 1

Competencies

At the end of this lesson, students will be able to:

- explain sheep and goat feed resources and feeding methods

Content

- Sheep and goat feeds and feeding

Overview

Sheep and goat feed resources and feeding methods and their feeding habits will be discussed. A summarized list of feed resources across different production systems will be used to make students aware of the effect of the difference between locations. The strategies for ensuring appropriate nutrition of sheep and goats are:

- matching production system to the available feed resources
- efficient use of agro-industrial by-products as sources of feed, and
- encouraging increased intake.

Teaching-learning Processes

Suggested Teaching Aids

You can use the following teaching aids:

- Pictures/Photographs and films that show different feedstuffs and feeding methods.

Suggested teaching methods

Begin the lesson using the following methods:

- Brainstorming questions, Question-answer, Group discussion, Demonstration, Presentation

Pre-lesson preparation

Get the instructional materials and teaching material ready before the

lesson. If none is available in your school, prepare your own maps, pictures, and photographs with your students in the pedagogical center. Read related literature in the school's library for more ideas on the topic. Prepare notes and activities.

Presentation of the lesson

Introduction of the lesson

Introduce the students to what they are going to learn (sheep and goat feed resources and feeding methods). Make clear the objective of the lesson. Brainstorm the students for information about sheep and goat feeds and feeding by asking the following questions:

- Do you know the feed resources for sheep and goats available in your area?
- What are the effect that affects the availability and types of feed resources for sheep and goats?

Body of the lesson

Begin your presentation by:

- explaining feed resources
- explaining feeding methods for sheep and goats, including the nutritional requirement of sheep and goats
- having the students describe the relationship between the farming system and feed resources available for sheep and goats.
- having the students discuss in groups the common feed resources and why it is important to know the resources and their nutritional quality. Students should present their opinions to the class.

Stabilization

Give a summary of the following points:

- What feed resources are available for sheep and goats?
- How and why do the feed resources vary based on production system and locations?
- Why is it important to study the feed resources available?

- What are the nutritional requirements of sheep and goats and their feeding methods?

Assessment and Follow up

Assessment

To the level of understanding of the students and whether the expected competencies are achieved, ask the students questions about the topic you have taught. You can ask the students' questions such as:

- What are the feed resources for sheep and goats?
- Are location and production system important in feed resources availability? And how?
- Explain the categories of feed resources based on their nutritional quality?
- Explain sheep and goats feeding methods?

Follow up

To help your students get more knowledge on the lesson you have taught, you can give them assignments. Assign each group to make a library study of the following issues:

- roughage and concentrate feeds resources
- feeding habits of sheep and goats

Evaluate the students' assignments and grade their achievements. Give special attention to students who are finding the work difficult.

Additional Questions

1. What are the strategies for ensuring appropriate nutrition of sheep and goats?
2. Larger sheep or goats need more feed. Why?

Answer to the Activities

Activity 7.2.

Depending on their proximity to industries, urban, etc., students may have a long list of resources used for sheep and goats. Let them report the

summary of their findings to the whole class.

Answer key to additional questions

1. Align the production system with the feed resources available. Use efficiently the agriculture and industrial by-products feed resources. Knowing the nutritional composition of available feed is important. Encourage and increase intake.
2. Larger animals need more feed in order to maintain their body functions.

7.3. Sheep and goat housing

Period allotted: 1

Competencies

At the end of this lesson, the students will be able to:

- explain sheep and goat housing.

Content

- Sheep and goat housing

Overview

Sheep and goat housing should be light, well ventilated, well-drained, and easily cleaned. The housing can include facilities like feeding and watering troughs, sorting pens, lambing/kidding unit, hospital area, dips/spray races, and foot baths. Various housing designs are available which suit the space and environment requirement.

Suggested teaching learning process

Suggested teaching aids

Use the following aids when you introduce the lesson topic

- Photographs, pictures

Suggested teaching methods

For further information about how to use the suggested methods refer to

the general information for the teacher in the Introduction to this guide.

- Brainstorming, demonstration , group discussion, and presentation

Pre-lesson preparation

Get ready in advance with the instructional materials and teaching materials, such as an ancient map of the world. Choose appropriate teaching method from the above sessions. Read relevant literature to provide students full information. Prepare notes, activities, and exercises.

Presentation of the Lesson

Introduction to the lesson

Introduce the topic briefly with the help of brainstorming. Be sure the students understand the objectives of the lesson. Conduct a brainstorming session with the students; this helps you to understand their background knowledge about sheep and goat housing.

- What type of sheep and goats housing system do you know?
- What is the difference between the traditional housing system and the improved housing designs?

Body of the lesson

Following the response of your students, give examples of the existing sheep and goats housing systems.

- Explain why housing is important.
- Explain the issues to be addressed before establishing the farm.
- Mention the differences between the traditional and modern sheep and goat housing systems used in the tropics

Stabilization

Give your students ideas on the following points

- Importance of housing for sheep and goats
- The important issues that need attention before establishing houses.
- The various types of sheep's and goats' housing systems used by farmers and their differences when compared to the modern ones.

Summarize the main points of each group and individual activities as well as practicals done and questions raised and discussion, etc in this period.

Assessment and follow up

Assessment

Check the students' understanding of the lesson by giving them activities below to do individually:

- How does modern housing protect sheep and goats from climate stress?
- What are the important issues that need attention before establishing sheep's and goats' houses?
- Explain the raw materials farmers use to construct sheep's and goats' houses?
- How do these materials differ from the materials needed to construct modern houses for sheep and goats?
- What are the differences between the two types of housing systems?

Follow up

Give the following library assignments to each group.

- The difference and similarities of sheep and goats housing system.
- Housing system depends on the locations of the farm. Explore more about the housing systems and designs suitable to tropical environments.

Reminder: Make sure that you are always recording the students' results right after you have evaluated their activities - whether the activities have been performed orally or in written form.

Additional Questions

1. Explain why securing sufficient ventilation in a tropical environment is crucial in sheep and goats housing
2. What are the issues to be considered when allotting space and housing for sheep and goats?

Answers to the Activities

Activity 7. 3.

- a. One side open enclosure, and without enclosure would be the common list to expect. Shape the discussion going to be held among the students.

Following their assessment students may come with a list of materials used to construct sheep's and goats' houses in their localities. For example, wood, iron sheet, different plant parts, or plant types that help them to make enclosures for their animals.

- b. to protect from adverse effects of the environment, protect them from predators, enhances the performances of the animals, protect them from disease, to make management easier , etc.

Answers key to the Additional Questions

1. Efficient ventilation is important to reduce the environmental effect on the animals.
2. The type of house we should construct be like permanent confinement or night housing only. Similarly, the space requirement of animals should reflect the age of the animals, whether animals are pregnant and materials available etc will influence the design.

7.4. Major diseases of sheep and goat and their Controlling Methods

Period allotted: 1

Competencies

At the end of this lesson, the students will be able to:

- list the major diseases of sheep and goat and the methods of controlling them.

Content

- Major diseases of sheep and goat and methods of controlling the diseases

Overview

In this lesson, the students will learn about diseases and parasites that commonly affect sheep and goats. There are infectious and non-infectious animal diseases. Animal diseases can further be divided into viral, bacterial, and protozoal. Sheep and goats are also affected by internal and external parasites. Prevention and controlling strategies of diseases are important steps to ensure productivity in sheep and goats.

Teaching-Learning Processes

Suggested Teaching Aids

- Pictures and photographs that shows parasites, symptoms of different disease

Suggested Teaching Methods

- Brainstorming, demonstration, question-answer, group discussion, presentation etc.

Pre-lesson Preparation

Get ready with the instructional materials and teaching materials. Inform students of the lesson to be discussed and encourage them to generate ideas relevant to the topic.

Presentation of the Lesson

Introduction to the lesson

Make the objectives of the lesson clear to the students. Introduce students to the lesson focusing on the given topics, such as major disease in sheep and goats and methods of controlling them. Brainstorm them to know their past experience regarding the lesson topic. You can begin the lesson by asking questions like

- What are the major disease in sheep and goats in your places?
- What are infectious diseases?
- What is a parasite?

Notice that these questions are samples; you can reproduce and use them based on the lesson given.

Body of the lesson

Start your discussion by describing briefly infectious and non-infectious sheep and goat diseases.

- Discuss the viral, bacterial, and protozoal diseases by giving examples.
- Explain the disease controlling strategies in sheep and goats.

Stabilization

Summarize the following points

- Infectious and non-infectious diseases of sheep and goat.
- Viral, bacterial, and protozoal sheep and goat diseases.
- The disease controlling strategies in sheep and goats.

Assessment and Follow Up

Assessment

Check whether or not the students have understood the lesson by giving them quizzes. Encourage them to answer the following questions in their groups or independently.

- Define infectious and non-infectious sheep and goat diseases. Give examples of each. Define internal and external parasite
- What are the influences of diseases on the production performance of sheep and goats?
- What are animal diseases controlling strategies?

Follow up

Inform the students about and guide them in discussing the following issues. Check their findings. After evaluating the classwork, grade their achievements. It is expected that the students had enough discussion with farmers in their area in activity 7.3.

Let the students take one disease which is prevalent in their locality. Let them answer the following questions about the disease:

- What are the symptoms of the diseases
- What are the controlling strategies?

Additional Questions

1. Give examples of the common viral and bacterial sheep and goat diseases.

Answers to Activities

Activity 7.4.

Following the fieldwork, students may come with a list of internal and external parasites that affect sheep and goats in their areas. Let them discuss and share their work with the rest of the class.

Answer key to the additional question

1. Examples of viral diseases: Foot and Mouth Disease (FMD), rift valley fever, etc.

Examples of bacterial diseases: anthrax, sheep box etc.

7.5. Sheep and goat meat and milk production and processing

Competencies

Period allotted: 1

At the end of this lesson, the students will be able to:

- describe sheep and goat meat and milk production and processing techniques.

Contents

- Sheep and goat meat and milk production and processing.

Overview

In this lesson, the students will learn meat and milk production and processing. Meat is the most important product of sheep and goats in tropical countries. Meat is very often used for celebrations. The selection criteria to take into consideration for meat production are fast growth rate, overall appearance, adaptability, and coat color. Unlike goats' milk,

sheep milk production is reported in only a few countries in the tropics for instance in Sudan, Algeria, etc. in case of Ethiopia, there are reports that indicate sheep are not only provide meat but are also being used for milk production. It can successfully be made into cheese, yogurt, butter, ghee, etc. Meat and milk processing involves a wide range of physical and chemical treatment methods such as physical, chemical, or biochemical techniques. Products like Ghee are made from blended sheep's and goat's milk or processed solely in different farming communities.

Teaching learning processes

Suggested Instructional Materials

Pictures and charts that show the meat and milk products and processing methods.

Suggested teaching methods

- Brainstorming, demonstration, group discussion, and presentation.

Pre-lesson preparation

Get instructional materials and teaching materials ready in advance of the lesson period. Inform students of the lesson to be discussed and encourage them to present ideas and concepts early enough.

Presentation of the lesson

Introduction to the lesson

Introduce students to the lesson and give emphasis to the given topics, such as meat production and processing techniques. Make the objectives of the lesson clear. Brainstorm the students' to access their past experiences regarding the lesson topic. You can begin the lesson by asking questions like;

- What are the sources of meat production in Ethiopia for the domestic and export market?
- Why does Ethiopia contribute low to world meat production? Remind the students what they learned in unit 6.
- What are the meat and milk processing techniques?

Notice that these questions are samples and you can ask many questions of their own.

Body of the lesson

Start your discussion by describing briefly meat and milk production in Ethiopia and the status of the activity.

- Discuss the contribution of meat from sheep and goats to farmers.
- Explain meat and milk processing techniques, including the traditional processing techniques.
- Explain why it is important to process meat and milk into different forms. What are the common products produced from goat and sheep milk in your area?

Stabilization

Summarize the following points

- Sources of meat in Ethiopia and the contribution of sheep and goat meat to the national meat production
- Milk products from small ruminants particularly in the pastoral and agro-pastoral community.
- Current status of meat production compared to the existing livestock resources
- Meat processing techniques

Assessment and follow up

Assessment

Check whether or not the students have understood the lesson by giving them quizzes. Encourage them to answer the following questions in their groups or independently.

- List the animals used as sources of meat.
- What is the contribution of sheep and goats to meat production
- What are the most common meat processing techniques? Give examples.
- Explain why processing meat or milk into different forms is required?

Follow up

Inform the students about and guide them in discussing the following issues. Check their findings. After evaluating the class work, grade their achievements.

Let the students take one traditionally processed meat product for example Quanta or smoked, fermented and the other processed products in a modern way like sausage, chops, etc. Allow them to compare the two products processing techniques followed, storage temperature and time, additives used, casings and estimated shelf life. Answer the following questions on the basis of the information given above.

- What differences have you noticed? Answer the question in line with the parameters considered for comparison.
- In both products, what are the techniques used to inhibit the growth of microorganisms and consecutive spoilage.

Additional Questions

1. What is quarantine?

Answer to the Activities

Activities 7.5.

- a. Students may mention a list of products such as meat, milk, skin, wool, etc.
- b. Goats or Sheep's milk has high solids content and is more concentrated in fat and protein. It can successfully be made into cheese, yogurt, butter, and ghee.

Compared to cow's milk, sheep's milk has high solids content and is more concentrated in fat and protein. In the case of goat milk contains less lactose, but its fat content is also much simpler

4.7. Answer to the Additional Questions

1. Quarantine is the isolation of animals that are either infected or suspected of being infected with a disease or diseases.

Answer to the Review Questions

Part I

1. False 2. True

Part II

1. A 2. B 3. D 4. E 5. C 6. F

Part III

1. C 2. D 3. E 4. D 5. D

Part IV

1. Goats prefer to consume a wide variety of feedstuffs. Goats are more selective and browse more, especially under extensive conditions.

Check list

Check the student's performance according to the given competencies referring to the questions under the checklist for every unit. Put a tick (✓) mark against each task to decide whether they are able to perform in the competencies of each unit.

Can you:

		Yes	No
1.	differentiate different breeds of sheep and goat? ____		
2.	name breed selection criteria? _____		
3.	explain the traits used to select? Why they are important? _____		
4.	mention some of indigenous and exotic breeds used for meat or milk production? _____		
5.	determine the feed resources available for sheep and goat? _____		
6.	categorize feed resources based on their quality? ____		
7.	design a house for sheep and goats? _____		
8.	list the issues to be considered before establishing sheep's and goat's house? _____		

		Yes	No
9.	mention major sheep and goat disease and parasites?_____		
10.	explain animal diseases controlling strategies?_____		
11.	explain the contribution of sheep and goat as sources of meat and their role in the community? _		
12.	mention the physical , chemical or biochemical techniques of meat and milk processing?_____		

Unit Assessment

The assessment will be made comparing students' performance with the specified level of competencies. Besides, the teacher has to recognize the level of performance of each student and provide assistance accordingly, Thus:

Students at the minimum requirement level

A student at a minimum requirement level will be able to

- determine the sheep and goat breeds used for several purposes,
- tell the differences between local and exotic breeds or types,
- mention the traits of good meat, wool, or milk producers based on the information given about each breed ,
- list the criteria used to select sheep or goats by farmers,
- explain why sheep and goat housing is required, etc.

Students working above the minimum requirement level

A student working above the minimum requirement level and considered as a higher achiever should be able to:

- compare and contrast local and exotic sheep and goat breeds or types,
- list the typical characteristics of sheep or goat breeds used for example meat, milk,
- give examples of roughage and concentrate feeds for sheep and goats
- why housing is important for production performance
- describe the common housing design in the tropics
- compare the advantage and disadvantages of sheep and goat meat processing, etc.

Students below the minimum requirement level

Students working below a minimum requirement level will require extra

help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson time during the breaks or at the end of the day.

Students who have not only reached the minimum requirement level but also achieved a little bit more should be supported so that they can attain the higher achiever competencies. Students who fulfill the higher-achiever competencies also need special support to contribute and achieve more.

Unit 8 Camel Production and Management

This unit requires approximately 4 periods of teaching time

Unit Introduction

In this unit, the students will learn about camel production and management. They will get introduced to the known breeds and selection methods. The unit also will familiarize the students with the feed resources available for camels and the feeding methods, camel housing, major disease of camels, and methods of their control. Furthermore, the processing of the product of meat and milk is also another area of focus of the unit.

Unit Learning Outcomes

At the end of this unit, your students will be able to:

- recognize different camel breeds and selections
- describe camelfeeds and feeding methods
- differentiate camel housing from other livestock's housing
- state the major diseases of camel and suggest their controlling methods
- explain the techniques used in camel meat and milk production and processing
- describe camel meat and milk production and processing
- promote camel production and management in their locality (in the low land of Ethiopia)
- construct a model house for camel production

Main Contents

- 8.1. Camel breeds and selection
- 8.2. Camel feeds and feeding methods
- 8.3. Camel housing
- 8.4. Major disease of camel and methods of their control
- 8.5. Camel meat and milk production and processing

8.1. Camel Breeds and Selections

Period allotted: 1

Competencies

At the end of this lesson, the students will be able to:

- identify different camel breeds and their selection

Contents

- Camel breeds and selection

Overview

In this lesson, the students will learn about the camel breeds used for work, meat and milk production, and their selection methods. First, they will learn the two types of camels and their characteristics. Some selected bacterianus, dromedary camel breeds, and the traits considered for selection will also be discussed. Then there will be a discussion about the camel housing systems, feeding, and the major disease.

Teaching Learning Process

Suggested Instructional materials

- Pictures of breeds

Suggested Teaching Methods

- Brainstorming questions, Questioning, Demonstration, Group discussion, Presentation

Pre-lesson preparation

Before you begin teaching the lessons get pictures of different breeds and other teaching materials.

Presentation of the lesson

Introduction to the lesson

You might present the lesson in a way you see fits the particular topic and group of students. However, one way to introduce a topic is by raising relevant questions. Questions motivate students and make them curious to

know more about the topic.

- Introduce the lesson by explaining the importance of camel breed.
- Introduce the differences between breeds used for work, meat production, and milk production.
- Introduce the known camel breed in the tropics and temperate.
- Introduce the criteria used to select breeding animals for a camel

Therefore, you may begin the lesson by asking questions such as:

- What is the importance of camels to herders?
- What are the differences between the one-humped and the two-humped types of camels?
- What camel breeds are kept by farmers for work, meat, and milk production locally?
- What methods are used for camel breed selection?

Body of the lesson

- importance of camel to the herders,
- types of camels,
- examples of camel breeds of tropical and temperate
- camel breed selection methods.

Stabilization

Give a summary of the following points:

- The importance of camel to herders.
- characteristics of camel types and the common breeds.
- The selection methods and the criteria considered for camel breeds.
- The traits particularly to be considered for camel breed selection.

Assessment and fellow-up

Assessment

At the end of the lesson, make sure that your students have understood the essential concepts of the lesson by asking them questions. Examples:

- What are the importance of camels?
- What are the camel breeds in the tropics and temperate?

- Explain the difference between one-humped and two-humped types of camel.
- What are the selection methods for camel breeds?

Follow up

Check the students' understanding of the lesson by giving them tasks to do independently.

- List the camel breeds in the tropics (including Ethiopia) and temperate (cold environment) zones.
- What is the purpose of keeping local camel breeds?
- Explain methods of camel breed selection.

Make sure that you are always grading and rating the students' activities, levels of participation, and quiz results.

Additional Questions

1. The one-humped have evolved from the two-humped camel type. Explain where the evolution took place.
2. What are the criteria used to characterize breeds in camel?

Answer to the Activities

Activity 8.1.

Let the students tick and narrate (if any) in the given space of the following table.

	Yes	No	
a. Have you ever seen a camel?	_____	_____	
- In which regions or areas are camels found in Ethiopia?			_____
b. Are there camels in your area?	_____	_____	
- If there are, what are their breed types?			_____

- c. there are officially recognizes 5 breeds of camel in Ethiopia : Somali/Ogaden, Ethiopian Dromedary, Afar, Anti and Borena.

Activity 8.2.

a).

- One-humped and larger camel than bactrian camels
- Possess short, fine, and spacey distributed coat color.
- They have lean tissue, longer limbs, and broad feet.
- Important to the hotter areas of Africa
- Adapted to trapdoor nostrils to protect the entrance of sandstorms into the nasal cavity.

b).

- Body size/appearance, growth rate, color, work performance, and libido are the most important traits to consider in the selection of breeding male camels.
- Age at first calving, growth rate, and milking abilities are the most highly-rated traits in selecting breeding female camels.

c). to identify the best types of camels for improvement of production and productivity in camels.

Answer to the additional Questions

1. The evolution took place in one of the hotter and more arid areas of the central and southern Arabia. The present distribution of dromedaries is in warmer desert areas (India-Mali in West Africa).
2. Type of hump, skull bone, hair growth, adaptation to cold or hot, and coat color.

8.2. Camel Feeds and Feeding Methods, and housing

Period allotted: 1

Competencies

At the end of the lesson, the students will be able to:

- explain camel feed resources and feeding methods
- differentiate camel housing from other livestock housing

Contents

- Camel feeds and feeding methods
- Camel housing

Overview

In this lesson, students will learn about the various feed resources used for camels and the housing of camels. In addition, camel feeding methods (considering the special feeding habits of camel) and why housing of camel is necessary will also be an area of focus in this lesson. Supplementation of camel feed with protein and energy-rich sources is highly recommended to enhance productivity. Similarly, there will be a discussion about the housing system and the common camel housing characteristics.

Teaching-learning process

Suggested Instructional Materials

You can use the following teaching aids:

- Pictures or figures of trees, shrubs and concentrates that show the available feed resources, designs of camel houses.
- Tables that show the nutritional merits of some commonly available feed resources for camels.

Suggested teaching methods

Start your lesson by using the following methods:

- Brainstorming questions, questioning, group discussion, and presentation.

Pre-lesson preparation

Get the instructional materials and teaching material ready before you begin. If none is/are available in your school, try to prepare your own pictures, or photographs with your students in the pedagogical center. Read related literature in the school's library to enrich your thoughts about the topic.

Presentation of the Lesson

Introduction to the lesson

Introduce the students to what they will learn (camel feeds and feeding methods). Be sure that the objectives of the lesson are clear.

- Brainstorm the students about camel feeding.
- What type of camel housing system do you know?

You can assess whether the students have background information or not by asking them the following questions:

- - What are the feed resources used for camel? Why is it important to know about the available feeds?
- - What are the feeding methods and why is knowing the merits of different feedstuffs required?
- - What is the difference between the traditional housing system and the improved housing designs?

Body of the lesson

Begin your presentation by explaining camel feed resources, camel feeding methods and camel housing system.

- Have the students describe the resources and variations over the location and season
- Have the students discuss in groups the basis for animals to set nutritional requirements and how they can be developed.
- Mention the differences between the traditional and modern camel housing practiced in the tropics.

Stabilization

Give a summary of the following points.

- The feed resources available for camels or camel herders.
- Why supplementation is recommended to the working and lactating camels
- What are the feeding methods
- What is the water requirement of camel?
- The important issues that need attention before establishing camel house.
- The various types of housing systems used by herders and the difference compared to the improved ones.

Assessment and follow-up

Assessment

To know the level of understanding of the students and whether the expected competencies are achieved, ask the students questions about the topic you have taught. You can also ask the students questions like the following:

- List common feed resources available
- Explain the feeding methods for camels
- What important issues need attention before establishing a camel house?
- What are the raw materials used, and the types of housing systems used by farmers? List the differences traditional and modern housing systems?

Follow-up

To help your students get more knowledge on the lesson you have taught, you can give them assignments. Assign each group the task of visiting the library or browsing the internet get for information the following issues:

- The main camel feeds resources
- are the feeding habits of camels different from that of other animals?
- What are the optional and the least preferred feed types by camel?
- What are important issues to consider in camels' housing systems?
- The housing system depends on the age of the animal. Explore more

local housing systems and designs that are suitable to different ages of camels.

Evaluate the students' assignments and grade their achievements. Give special attention to weaker students.

Additional questions

1. Female camels are shifted to areas of better feed availability by pastoralists while males are kept around the settlement. Why?
2. Supplementation of feed in the form of mineral salt, or allowing camels to graze on salty grasses and on saline soils is recommended. Why?
3. Explain the main categories of camel housing system on the basis of age of the camel.
4. What are the materials used to construct a camel house?

Answer to the Activities

Activity 8.3.

a.

- Students may come up with lists of feed resources such as plants with thorns, acacia and salt bushes, grasses, cereals, etc.
- Camel is a very versatile and opportunistic animal, they accept a wide range of browse species that are often rejected by other animals.
- Supplementing camels with available protein and energy sources is recommended.

b.

- Camel is resistant to water deprivation. They can stay long without water and lose up to 20 % of their body weight. When they get access, they can drink up to 200 liters in less than half an hour.

Let them summarize their report and explain it to the whole class.

Activity 8.4

- a. to protect camels from adverse effects of environment, predators, diseases, etc.
- b. one side open, roofed but all sides are open with enclosure, etc.

Answer to the Additional Questions

1. Female camel needs better feeds to fulfill their nutritional requirements for milk production and reproduction.
2. Camels have a higher salt requirement than other livestock.
3. Sweeping and closed camel housing system.
4. Wood, pieces of thorn wood, bush plants, etc.

(8.3.,8.4.,8.5.) Camel Products, Major Disease of Camel and their Controlling Methods

Period allotted: 2

Competencies

At the end of this lesson, the students will be able to:

- mention the major diseases of camel and suggest their controlling methods
- explain the techniques used in camel meat and milk production and processing

Content

- Major disease of camel and control methods
- Camel meat and milk production and processing

Overview

In this lesson, the students will learn about diseases that commonly affect camel and meat and milk production and processing. The infectious and non-infectious diseases can further be divided into viral, bacterial, and protozoal. Camels are also victims of internal and external parasites. Meat and milk processing involves physical and chemical treatment methods. This lesson also has major camel diseases and parasites and their methods

of controlling. Examples of products locally and from the modern practices for both camel milk and meat products will be another area of focus in this lesson.

Teaching-Learning Processes

Suggested Teaching Aids

- Pictures and photographs, charts

Suggested Teaching Methods

- Brainstorming, questioning, group discussion, presentation etc.

Pre-lesson Preparation

Get instructional materials and teaching materials ready. Inform the students of the lesson to be discussed and encourage them to contribute ideas.

Presentation of the Lesson

Introduction to the lesson

Introduce students to the lesson and give emphasis to the given topics, such as major camel diseases and methods of controlling them. Make the objectives of the lesson clear. Brainstorm students to access their past experience regarding the lesson topic. You can begin the lesson by asking questions like

- What are the major disease in camel?
- What is infectious disease?
- What is the status of camel meat production in Ethiopia for domestic and export market?
- What are meat and milk processing techniques used for camel products?

Notice that these questions are samples and you can design other similar questions of your own based on the lesson given.

Body of the lesson

Start your discussion by describing briefly camel meat and milk production in Ethiopia and challenges,

- what does infectious' and 'non-infectious' camel disease mean.
- explain meat and milk processing techniques including the traditional processing ones
- explain why it is important to process camel meat and milk in to different forms
- discuss the viral, bacterial and protozoal diseases by giving examples.
- Explain camel disease controlling strategies.

Finally let the students discuss the diseases that affect camels in their area. Let them categorize the diseases as infectious and non-infectious. What indigenous knowledge and practices do the local community members use to combat camel diseases?

Stabilization

Summarize the following points

- Infectious and non-infectious diseases of camel.
- Viral, bacterial and protozoal camel diseases by giving examples.
- Diseases controlling strategies in camel.

Assessment and Follow Up

Assessment

Check whether or not the students have understood the lesson by giving them quizzes. Encourage them to answer the following questions in their groups or independently.

- Define the infectious and non-infectious camel diseases
- What do you think are the influences of diseases on the production performance of camels?
- What's meant by controlling strategies of disease? Give examples
- Explain the role of camel meat and milk production in Ethiopia
- Compare the current status of meat and milk production with that of other livestock
- Existing meat and milk processing techniques

Follow up

Guide the students in discussing the following issues. Check their findings. After evaluating the classwork, grade their achievements. You have to check that students have gained enough information from their interviews from the activities given.

Let the students take one disease which is prevalent in their locality. Answer the following questions about the disease:

- What are the symptoms of the diseases?
- What are the controlling strategies?

Additional Questions

Camel meat compares favorably with the meat of other livestock in carcass yields and quality. With a dressing percentage of about 45- 55%, camels yield a carcass of approximately 200 kg. The quality of meat produced from young animals (5 yrs. or less) is comparable to beef in taste and texture. However, young animals are not slaughtered usually for reasons given. Therefore, camel meat ordinarily availability is usually tough. The demand for fresh camel meat and for camel meat in the blended meat products exists.

1. Give examples of common bacterial camel diseases.
2. Mention two measurements to control camel disease.
3. List at least two African countries that are major producers of camel meat.
4. What are the special advantages of camel meat production over the meat production of other livestock?
5. What dairy products are produced from camel milk in Ethiopia?

Answer to the Activities

Activity 8.4.

Let the students fill in the following table as template and share it with the rest of the students in the class.

Viral disease	Bacterial disease	Parasite

Activity 8.5

Let them discuss their answer with their neighbors and share their experiences regarding consumption, preferences, and product processing of camel meat and milk with the rest of the class.

Answer to the additional question

1. Anthrax, Brucellosis, rickettsiosis, etc.
2. Separate sick animal, Disinfecting, etc.
3. Sudan, Egypt, Somalia, Kenya, etc
4.
 - With dressing percentage of about 45- 55%, camels yield a carcass of approximately 200 kg.
 - The quality of meat produced from young animals (5 yrs. or less) was comparable to beef in taste and texture.
5.
 - “Dhanaan” is produced in the Somali region.
 - “Ititu” is a fermented camel product in Boran zone.

Keep in mind also students may come with different expenses and names of products depending on the location and farming system.

Answer to the Review Questions**Part I**

1. True 2. False

Part II

1. E 2.C 3. E 4.A

Part III

1. Camels are domestic animals that live in deserts or in hot areas of the

tropics including parts of Ethiopia. The camel is considered as a form of productive capital among the herders. It is also their investment capital. The survival strategies of pure pastoralists are very much tied to rearing and preserving the camel. Camel herders derive social capital from the camel. In this case, wealth and prestige are conceptualized in terms of the number of camels one owns.

2. Kraal is an enclosure for cattle or other livestock around the pastoralists' settlement or it is a village surrounded by a fence of thorn-bush branches, it is roughly circular in shape.
3. White camel cheese, camel powder milk, etc.

Check list

Check the student's performance according to the given competencies referring the questions under the check list for every unit. Put a tick (✓) mark against each task whether they are able to perform in the competencies of each unit.

Can you:

		yes	No
1.	differentiate the breeds or types of camel? _____		
2.	explain breed selection criteria? _____		
3.	explain the traits used to select? Why they are important?		
4.	determine the feed resources available for camels?		
5.	discuss feeding habits of camel ? _____		
6.	draw a sketch of a camel's traditional house? _____		
7.	mention major camel diseases and parasites? _____		
8.	explain camel diseases controlling strategies? _____		
9.	explain the meat and milk production and products?		

Unit Assessment

Students' performance has to be assessed continuously over the whole unit. The assessment will be made by comparing students' performance with the specified level of competencies. Besides, the teacher has to recognize the level of performance of each student and provide assistance accordingly, Thus:

Students at the minimum requirement level

A student at a minimum requirement level will be able to

- state the importance of camels to the herders,
- justify the differences between camel types,
- list the criteria used to select male and female camels by herders,
- describe the housing systems of a camel.
- mention the available feed resources for camel and the proper feeding methods
- mention the common camel diseases, and explain the controlling strategies of camel diseases, explain camel meat and milk production in Ethiopia,
- mention the major meat and milk processing and give some examples of the products

Students working above the minimum requirement level

In addition, a student working above the minimum requirement level and considered as a higher achiever should be able to:

- compare camel types and their evolution,
- describe carcass traits and explain the special advantages of a camel
- give examples of roughage and concentrate feeds for a camel
- talk about why nutrients in feed are required by the animals,
- why camel housing is important,
- explain the status of camel meat and milk production in Ethiopia
- list the benefits of meat and milk processing in different forms?

Students below the minimum requirement level

Students working below a minimum requirement level will require extra help if they are to catch up with the rest of the class. Students who have not only reached the minimum requirement level but also achieved a little bit more should be supported so that they can attain the higher achiever competencies. Students who fulfill the higher-achiever competencies also need special support to contribute and achieve more.

Unit 9 Poultry Production and Management

This unit requires approximately 6 periods of teaching time

Unit Introduction

In this unit, the students will learn about poultry production. They will get introduced to local and exotic poultry breeds, breed classification and selection methods. The unit will also make the students familiar with feed resources for poultry, and their feeding methods, poultry housing systems, major poultry diseases, and methods of controlling the diseases.

Unit Learning Outcomes

At the end of this unit, your students will be able to:

- analyse the characteristics of both indigenous and exotic poultry breeds in Ethiopia
- recognize poultry breeds, classification and selection methods
- clarify poultry feed resources and feeding methods
- estimate the feed requirements for different types of poultry breeds
- compare common types of poultry housings
- describe egg incubation and hatchery management
- explain poultry brooding and rearing methods
- describe layers and broiler management
- mention poultry and swine diseases and suggest their controlling methods
- initiate their classmates to engage in poultry production and management

Main Contents

- 9.1. Poultry breeds, classification and methods of selection
- 9.2. Poultry feeds and feeding
- 9.3. Poultry housing
- 9.4. Poultry incubation and hatchery management
- 9.5. Poultry brooding and rearing
- 9.6. Layers management
- 9.7. Major diseases of poultry and controlling methods

9.1. Poultry Breeds, Classification and Selection

Period allotted: 1

Competencies

At the end of this lesson, the students will be able to:

- analyze the characteristics of both indigenous and exotic poultry breeds in Ethiopia
- recognize poultry breeds, classification and selection.

Content

- Poultry breeds, classification and selection

Overview

In this lesson, the students will learn about the indigenous poultry genetic resources, their habitats, and poultry breeds. Important exotic poultry, their distribution, and purpose will also be the focus of the unit. There is a section in the unit that discusses breed selection methods. Different breeds have different environmental adaptability. Animals which are adapted to cool areas may not be suitable for hot areas. Choosing an appropriate breed with good production performance is an important step in poultry breed selection.

Teaching learning processes

Suggested Instructional Materials

- Pictures, diagrams

Suggested Teaching Methods

- Brainstorming, question-answer, field visits, group discussion, presentation.

Pre-lesson preparation

Before you begin teaching the lesson, get pictures of the important poultry breeds of local and exotic and other teaching materials. The biology/agriculture laboratory may have such pictures.

Forward planning: read the contents and the illustrations/pictures in the student's textbook and other related sources to make the necessary

preparation. Prepare your plan especially to monitor students when they do the start-up activity. The start-up activity is designed to identify the breeds important to farmers and some exotic breeds used in the breeding programs implemented in poultry by interpolation.

Presentation of the Lesson

a. Introduction to the lesson

You might use your own method of presenting in any way you see fits this topic and the group of students you teach. However, one way of introducing a topic is by raising relevant questions. Questions are motivating factors that make students curious. Good questions draw the students' attention to the lesson. Therefore, you may begin the lesson by asking questions like the following:

- What breeds of poultry are found in Ethiopia? What are the classifications of poultry breeds/types?
- What are the important exotic poultry breeds and the purpose of keeping them?
- Why is it important to introduce exotic poultry breeds?
- What are the selection methods and the traits included as selection criteria by farmers?

b. Body of the lesson

After checking your students' understanding of the local and exotic poultry breeds, start your presentation by explaining indigenous poultry breeds and their distributions. Tell them the characteristics of some examples of poultry breeds.

Explain why it is important to study the breed resource which enables us to identify the potentials breeds. Explain poultry breed selection criteria and their importance.

c. Stabilization

Give a summary of the following topics:

- The important breeds of poultry found in Ethiopia and their characteristics.

- The characteristics of known exotic poultry breeds.
- The breed selection practices. What are the predominant traits in poultry breeds?

Assessment and follow up

a. Assessment

At the end of the lesson, make sure that your students have understood the essential concepts of the lesson by asking questions and giving them tasks like the following

- List the indigenous breeds, characteristics and their distribution.
- Describe the selection methods followed in poultry.

b. Follow up

Check the students' understanding of the lesson by giving them tasks to do independently.

- Are the local breeds are better adapted to the local environment than the exotic poultry breeds? Why?
- List the poultry breeds found in Ethiopia and exotic breeds?
- Explain the main differences between the local and exotic poultry breeds?
- Explain the criteria used to select breeding male or female in poultry.

Make sure that you are always grading and rating the students' activities, levels of participation, and quiz results.

c. Additional Questions

1. What is meant by specialized poultry breeds? Explain by giving examples.
2. what do you understand is meant by multipurpose breeds?

Answer to Activities

Activity 9.1.

SStudents may come with a list of breeds that are known as multipurpose

in the area. Let them report their findings to the whole class.

Answer to the additional questions

1. Breeds have been selected for particular purposes for decades and can be easily differentiated with their peculiar features such as body color, length, and shape of a horn. They are well known for their particular trait and are specialized in meat, egg and sometimes you may find multipurpose breeds. Layer breeds Bovans Brown and White Leghorn. Babcock is the chicken breed that is used for a fattening purpose.
2. Breeds or animals used for two or more purposes or reasons.

Activity 9.2

Following their visit, students should have a list of opinions from farmers or farm owners. Let them share and compare this with their classmates.

9.2. Poultry feeds and feeding

Period allotted: 1

Competencies

At the end of this lesson, the students will be able to:

- clarify poultry feed resources and feeding methods
- estimate the feed requirements for different types of poultry breeds

Content

- Poultry feeds and feeding

Overview

Poultry feed resources, their feeding methods and their feeding habits will be discussed in the unit. A summarized list of feed resources across different production systems will be used to make students aware of the effects of and the differences between locations. The strategies for ensuring appropriate nutrition of poultry are:

- a. matching production system to the available feed resources

- b. efficient use of agro-industrial by-products as sources of feed, and
- c. encouraging increased intake

Teaching-learning Processes

Suggested Teaching Aids

Use some of the following teaching aids:

- Pictures/Photographs and films that show different feedstuff and feeding methods.

Suggested teaching methods

Start the lesson using some of following methods:

- Brainstorming, questioning, group discussion, field visit, demonstration , presentation

Pre-lesson preparation

Get the instructional materials and teaching material ready before the lesson. If none is available in your school, prepare your own pictures, and photographs with your students in the pedagogical center. Read related literature in the school's library for more ideas on the topic. Prepare notes and activities.

Presentation of the lesson

a. Introduction of the lesson

Introduce the students to what they are going to learn (poultry feeds resources and feeding methods). Make clear the objective of the lesson. Use the brainstorm activity to engage students with poultry feed and feeding.

- Do you know the feedstuff used for poultry?
- What are the factors affect the availability and types of poultry feed resources in your area?

b. Body of the lesson

Start your presentation by explaining poultry feed resources.

- Explain poultry feeding methods, including the nutritional

requirements of poultry and what can be provided by the available feeds.

- Have the students discuss in groups the common feed resources and why it is important to know poultry feed resources and their nutritional quality.

Students should present their opinions to the whole class.

c. Stabilization

Give a summary of the following points:

- Poultry feed resources
- How and why poultry feed resources vary.
- Why we study poultry feed resources
- Nutritional requirements of poultry, and their feeding methods

Assessment and Follow up

a. Assessment

Ask the students questions about the topic you taught. You can ask questions like the following:

- What are feed resources for poultry?
- Why are location and production system important in feed resources availability?
- Explain poultry feeding methods

b. Follow up

Assign each group a library study on the following issues:

- Discuss roughage and concentrate feeds resources.
- Feeding habits of poultry are different from other ruminants. Explain.
- Well-fed poultry are expected to be healthy and produce more. Why?

Evaluate the students' performances and grade their achievements.

c. Additional Questions

1. What are the strategies to ensure appropriate nutrition of poultry?

Answer to the Activities

Activity 9.3.

The students may have a long list of resources that are used for poultry. Let them report and share their summary with the whole class.

Answer to the additional questions

1. Align the production system with the feed resources available.
Use efficiently the agriculture and industrial by-products feed resources.
Encourage increased intake.

9.3. Poultry housing

Period allotted: 1

Competencies

At the end of this lesson, the students will be able to:

- describe common types of poultry housings.

Content

- Poultry housing

Overview

Poultry housing should be light, well ventilated, well-drained, and easily cleaned. The housing can include facilities like feeding and watering, sorting pens, hospital area, dips/spray races, and foot baths. Various housing designs are available which suit the space and environment requirement. In this lesson, both the conventional and modern types of poultry systems will be the focus of the lesson.

Suggested teaching learning process

Suggested teaching aids

Use the following aids:

- Photographs, pictures of poultry housing designs

Suggested teaching methods

For further information on how to use the suggested methods, refer to the general information for the teacher in the Introduction to this guide.

- Brainstorming, demonstration, group discussion, field visit and presentation

Pre-lesson preparation

Get ready in advance the instructional materials and teaching materials. Design the most appropriate teaching method. Read relevant literature to provide students with full information. Prepare notes, activities, and exercises.

Presentation of the Lesson

a. Introduction to the lesson

Introduce the topic briefly with the help of brainstorming. Brainstorm the students to see their background knowledge about poultry housing.

- What type of poultry housing system do you know?
- What is the difference between the traditional housing system and the improved housing designs?

b. Body of the lesson

- Following the responses of your students, give them examples of the existing poultry housing systems.
- Explain why housing is important.
- Explain the determinant issues to be addressed before establishing a farm.
- Mention the differences between the traditional and the modern poultry housing practiced in the tropics.

c). Stabilization

Make the following points clear to the students:

- How proper housing can protect poultry from the adverse effect of the environment.
- The important issues to be addressed before establishing poultry house.

- The various types of housing systems used by farmers and their differences when compared to the modern ones.

Assessment and follow up

a. Assessment

Give them activities to do individually. Examples:

- Why is proper housing required to protect poultry from climate stress?
- What important issues need attention before establishing a poultry house?
- What are the types of traditional housing systems used by farmers?
- What raw materials are used to construct them?
- How different are they from the modern housing?

b. Follow up

Give this library assignment to students to do in groups:

- Housing systems depend on the locations of the farm. Explore more housing systems and designs that are suitable to tropical environments.

Remember to record the students' results right after evaluating their work.

c. Additional Questions

1. Explain why securing sufficient ventilation in a tropical environment is crucial in poultry housing.
2. What issues need to be considered in allotting space in poultry housing?

Answer to the Additional Question

1. Efficient ventilation is important to reduce the environmental effect on the animals.
2. The type of house we construct should be like permanent confinement or night housing only. Similarly, the space requirement of animals according to their age is important, this will influence the design.

9.4. Egg incubation, hatchery management, brooding and rearing chicks

Period allotted: 1

Competencies

At the end of this lesson, the students will be able to:

- describe poultry incubation and hatchery management
- explain poultry brooding and rearing methods

Contents

- Poultry incubation and hatchery management
- Poultry brooding and rearing

Overview

In this lesson, the students will learn poultry incubation and hatchery management, poultry brooding, and rearing. Types of incubation, factors to achieve good production, cleaning, and disinfection of incubator, collection, and storage of eggs are also important lessons in the unit. Then, there will be a discussion of the brooding, methods of brooding chicks, and artificial heat sources.

Teaching learning processes

Suggested Instructional Materials

Pictures that show the incubatory and hatchery.

Suggested teaching methods

Conduct your class using the suggested teaching methods,

- Brainstorming, demonstration, group discussion, and presentation.

Pre-lesson preparation

Get ready with the instructional materials and teaching materials. Inform the students of the lesson to be discussed and encourage them to sufficiently participate.

Presentation of the lesson

a. Introduction to the lesson

Introduce the lesson to the students, giving emphasis to the objectives. Brainstorm them to see their prior knowledge in the area. You can begin the lesson by asking probing questions like

- What is incubation?
- What is required to develop a fertile hen egg into a young chick?
- What is brooding?
- What brooding method do you know?

Notice that these questions are samples and you can reproduce and use them based on the lesson given.

b. Body of the lesson

Start the lesson by describing briefly the following topics:

- poultry incubation, hatchery, brooding chicken, and rearing.
- explain the sources of heat an incubator can have.
- explain why it is important to clean and disinfect the incubator.
- discuss why it is important to collect and immediately store hatching eggs
- list the sources of the heat of brooders.
- describe the natural and artificial methods of brooding.

c. Stabilization

Summarize the following points

- Types of incubation,
- Requirments to develop a fertile hen egg into a young chick,
- Importance of cleaning and disinfecting incubator,
- Importance of collecting and immediately storing hatching eggs,
- Definition of brooding and types of brooding, and
- Natural and artificial methods of brooding.

Assessment and follow up

a. Assessment

Check whether or not the students have understood the lesson by giving them quizzes. Encourage them to answer the following questions in their groups or independently.

- List the possible sources of the heat in an incubator.
- Explain the importance of artificial incubators over natural.
- Mention the possible sources of heat for brooders.
- Explain the importance of artificial brooders over natural

b. Follow up

Let the students discuss natural and artificial incubation methods. Allow them to compare the two methods and answer the following questions.

1. What types of differences have you noticed?
2. In both products, what are the principal techniques used to increase the number of hatched eggs?

c. Additional Questions

1. Explain the importance of ventilation in the incubator.
2. How do we monitor the humidity of the air in the incubator?
3. What is the age range of chicks to manage brood in tropics?

Answer to the Activities

Activity 9.4.

Let the students share findings of the fieldwork in groups.

Answer to the Additional Questions

1. Efficient ventilation is important to make the air in the incubator fresh and remove the stale air.
2. Water should be supplied/placed to humidify or to moisten the air.
3. One-day of age to about four weeks.

9.5. Layers and broilers management

Period allotted: 1

Competencies

At the end of this lesson, the students will be able to:

- describe layers and broiler management

Contents

- Layers and broilers management

Overview

In this lesson, the students will learn layers and broilers management. Laying housing and housing equipment, age of moving to lying house, and broilers management are also other important aspects of this lesson.

Teaching learning processes

Suggested Instructional Materials

Pictures that show the housing designs, broilers and layers

Suggested teaching methods

- Brainstorming, demonstration, group discussion, and presentation.

Pre-lesson preparation

Get the instructional materials and teaching materials ready. Inform the students about the lesson to be discussed and motivate them to sufficiently participate.

Presentation of the lesson

a. Introduction to the lesson

Introduce the lesson to the students, giving emphasis to the objectives of the lesson. Brainstorm the students to see their related prior knowledge. You can begin the lesson by asking probing questions such as:

- What types of management do we need for layers and broilers?

Notice that these questions are samples; you can reproduce and use them as the need arises.

b. Body of the lesson

Start the lesson by describing layers and broilers differences and its implication on their management.

- Explain layers' and broilers' housing and the required equipment and structures.

c. Stabilization

Summarize the following points

- Age at which of hens start laying eggs
- Housing of layers and broilers and housing equipment
- What is the “all in, all out” principle in broilers?

Assessment and Follow up

a. Assessment

Check whether or not the students have understood the lesson by giving them quizzes. Encourage them to answer the following questions in their groups or independently.

- List the equipment required for layers?
- Explain the special care required for “litter”?

b. Follow up

Guide the students in discussing the following issues. Let the students compare the management required for layers and broilers and the equipment required. Allow them to compare the two types of chickens and their management, and answer the following questions on the basis of the information given above.

1. What type of differences have you noticed?
2. In both product types, what are the principal rearing techniques used to increase productivity?

c. Additional Questions

1. What are the types of laying nest?
2. Why is special care required for broilers litter?

Answers to the Additional Questions

1. Individual nest, allow one nest for every 4-5 layers.
Communal nest can be used by 10-15 birds at the same time.
2. The formation of breast blisters can happen due to the caked litter and then downgrading of the carcasses.

(9.6,9.7) Major diseases of poultry and their controlling methods

Period allotted: 1

Competencies

At the end of this lesson, the students will be able to:

- discuss poultry diseases and their controlling methods

Content

- Major diseases of poultry and methods of controlling them

Overview

In this lesson, the students will learn about diseases that commonly affect poultry: infectious and non-infectious diseases. Diseases can further be divided into viral, bacterial, and protozoal. Poultry are also victims of internal and external parasites. Prevention and controlling strategies of diseases are important steps to ensure productivity in poultry

Teaching-Learning Processes

Suggested Instructional Materials

- Pictures and photographs that shows parasites and, symptoms of different diseases
- charts

Suggested Teaching Methods

Conduct your class using the suggested teaching methods

- Brainstorming, questioning, group discussion, presentation etc.

Pre-lesson Preparation

Get the instructional materials and teaching materials ready. Inform students of the lesson to be discussed and encourage them to contribute ideas and concepts.

Presentation of the Lesson

a. Introduction to the lesson

Introduce the students to the lesson – i.e., major poultry diseases and methods of controlling them. Brainstorm the students' past experience regarding the lesson topic. You can ask questions like

- What are the major diseases in poultry?
- What are infectious diseases and parasites?

b. Body of the lesson

Start your discussion by describing briefly what infectious and non-infectious poultry diseases are.

- Discuss the viral, bacterial and protozoal diseases by giving examples.
- Explain diseases controlling strategies in poultry.
- Let the students discuss the diseases that affects poultry in their areas and categorize them as infectious and non-infectious. Encourage them to explain the indigenous knowledge and practices the local community use to combat diseases.

c. Stabilization

Summarize the following points

- Infectious and non-infectious poultry diseases.
- Viral, bacterial and protozoal poultry diseases with examples.
- The strategies used to control the diseases.

Assessment and Follow Up

a. Assessment

Give them quizzes. Encourage them to answer the following questions in their groups or independently.

- Define the infectious and non-infectious poultry diseases by giving examples.
- Define internal and external parasites.
- How do you perceive the influence of diseases on the production performance of poultry?

- What's meant by controlling strategies of disease? Give examples

b. Follow up

The students can be expected to have had enough discussion with farmers in their area in Activity 9.5. Let them take one disease which is prevalent in their locality and answer the following questions:

- What are the symptoms of the diseases?
 - What are the controlling strategies?

c. Additional Questions

1. Give examples of the common viral poultry diseases.

Answer to the Activities

Activity 9.5.

Following the field work, students may have come to class with a long list of internal and external parasites that affect poultry in their areas. Let them discuss and share their ideas with the whole class.

Answer to the additional question

1. Viral poultry disease: Newcastle diseases, infectious bursal diseases, avian coccidiosis, fowl pox, etc.

Answer to the Review Questions

Choose the correct answer

1. B 2. D 3. D 4.E 5. D

Check list

Check the student's performance according to the given competencies, referring to the questions in the check list for every unit. Put a tick (✓) mark against each task to see whether they are able to perform in the competencies of each unit. The students are expected to respond by saying Yes or No. Then, you can make your own assessment and check whether the competencies are met or not.

Can you:

		Yes	No
1.	name different breeds of poultry? _____		
2.	identify poultry breed type based on their utility or economic value? _____		
3.	explain the traits used in poultry breed selection?		
4.	mention some indigenous and exotic breeds used for meat and egg production? _____		
5.	determine the feed resources available for poultry? _____		
6.	categorize feed resources based on their quality? _____		
7.	design a house for poultry ? _____		
8.	list the issues to be considered before establishing poultry house? _____		
9.	explain poultry disease controlling strategies? _____		

Unit Assessment

The assessment will be made by comparing students' performance against the specified level of competencies. Besides, the teacher has to recognize the level of performance of each student and provide assistance accordingly, Thus:

Students at the minimum requirement level

A student at a minimum requirement level will be able to;

- determine poultry breeds used for several purposes,
- justify the differences between local and exotic breeds or types,
- list the criteria used to select poultry breeds by farmers,
- explain why poultry breeds housing is required
- discuss the common housing systems for poultry breeds.
- describe the proper feeding methods
- list the common poultry breed diseases, explain their controlling strategies.

Students working above the minimum requirement level

A student working above the minimum requirement level and considered as a higher achiever should be able to:

- compare and contrast local and exotic poultry breeds or types,
- describe the typical characteristics of poultry breeds used for example meat, egg, etc.?
- give examples of roughage and concentrate feeds for poultry
- explain why housing is important for production performance.
- describe the common housing design in the tropics

Students below the minimum requirement level

Students working below a minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson time during the breaks or at the end of the day.

Students who have not only achieved the minimum requirement level but also achieved a little bit more should be supported so that they can attain the higher achiever competencies. Students who fulfill the higher-achiever competencies also need special support to contribute and achieve more.

Unit 10 / Fishery Production and Management

This unit requires approximately 6 periods of teaching time

Unit Introduction

In this unit, the students will learn about aquaculture. They will be introduced to aquaculture and the known farmed fish species in Ethiopia. The basic anatomy of bony fish, fish feeding and their feeding practices, fish culture, fish rearing, fishing methods will be another aspect of lesson in this unit. The unit also familiarizes the students with the handling of fish and fish products, disease in aquaculture, and indigenous knowledge in fish processing.

Unit Learning Outcomes

At the end of this unit, your students will be able to:

- recognize farmed fish species in Ethiopia
- explain basic anatomy of bony fishers
- describe fish feeds and feeding practices
- examine the fish culture techniques
- explain fish rearing methods
- identify fishing methods
- express the handling of fish and fish products
- list the major disease of fish and control methods
- elaborate the application of indigenous knowledge in fish processing
- give values for indigenous knowledge in fishery management
- practice handling fish and fish products effectively

Main Contents

- 10.1. Basic terms in aquaculture and farmed fish species in Ethiopia
- 10.2. Basic anatomy of bony fishers
- 10.3. Fish feeds and feeding practices
- 10.4. Fish culture techniques
- 10.5. Fish rearing
- 10.6. Fishing methods
- 10.7. Handling fish and fish products
- 10.8. Diseases in aquaculture
- 10.9. Indigenous knowledge in fish processing

10.1. Basic terms in aquaculture, farmed fish species in Ethiopia and basic anatomy of bony fishes

Competencies

Period allotted: 1

At the end of this lesson, the students will be able to:

- recognize farmed fish species in Ethiopia
- explain basic anatomy of bony fishes

Content

- Basic terms in aquaculture and farmed fish species in Ethiopia
- Basic anatomy of bony fishes

Overview

In this lesson, the students will learn about the basic terms in aquaculture, Ethiopian freshwater fauna, farmed fish species, the economically important families of Ethiopian fish, internal and external anatomy of a bony fish.

Teaching learning processes

Suggested Instructional Materials

- Pictures, diagrams

Suggested Teaching Methods

Use the following teaching methods, as suggested in the general introduction and presentation of the lesson:

- Brainstorming questions, questioning, demonstration, group discussion, presentation.

Forward planning: read the contents on illustrations or pictures in the student's textbook and other related resources and to make the necessary preparation. Prepare your plan especially to monitor students when they do the start-up activity. The start-up activity is designed to identify the economically important fish families and the exotic families introduced to Ethiopian waterbodies.

Pre-lesson preparation

Before you begin teaching the lesson get pictures of the important fish families of the local and the exotic breeds, photographs, diagrams, and other teaching materials. The school pedagogical center may provide you with such pictures.

Presentation of the Lesson

a. Introduction to the lesson

You might use your own method of presenting the lesson, but make sure your method fits the topic and the group of students you teach. Ask questions that might probe the students' prior knowledge related to the topic. Questions draw the students' attention to the lesson. Therefore, you may ask questions like the following ones:

- How often do you eat fish? Do you remember the last time you ate fish?
- Do you know what aquaculture is?
- What are the internal and external body parts of bony fish?

b. Body of the lesson

After seeing your students' understanding of basic terms of aquaculture and fish, present the lesson by explaining Ethiopian freshwater fauna and farmed fish family and their distributions. Describe the characteristics of freshwater species.

c. Stabilization

Give a summary of the following topics

- Ethiopian fish fauna (indigenous and exotic)
- The three Ethiopian indigenous freshwater fauna
- Basic anatomy of bony fish.

Assessment and follow up

a. Assessment

Ask the students to perform the following tasks.

- List the three species of tilapia in Ethiopia, their characteristics and distribution.
- Describe the basic anatomy of bony fish.

b. Follow up

Give your students some activities to do independently.

- List the indigenous freshwater fauna.
- Sketch the basic anatomy of fish.

Remember to grade the students' activities, levels of participation and quiz results.

c. Additional Questions

1. How many indigenous and exotic species of fish can be found in Ethiopia?

Answer to the Activities

Activity 10.1 and Activity 10.2

Students may come to class with a list of species known in the available lake or fish market in the area. Let them report their finding to the whole class.

Answer key to the additional questions

1. 153 indigenous and 10 exotic species

10.2. Fish feeds and feeding practices

Period allotted: 1

Competencies

At the end of this lesson, the students will be able to:

- describe fish feeds and feeding practices

Content

- Fish feeds and feeding practices

Overview

Fish feeding mechanisms, habits of fish, trophic categories of fish, feed resources, feeding methods, etc will be among the topics in this section.

Teaching-learning Processes

Suggested Instructional materials

Use the following teaching aids:

- Pictures/Photographs that show different feed stuffs and feeding methods.

Suggested teaching methods

Begin the lesson by using the following methods:

- Brainstorming questions, question-answer, group discussion, demonstration, presentation.

Pre-lesson preparation

Get the instructional materials and teaching material you need for the lesson ready. If none are available in your school, prepare pictures and photographs with your students in the pedagogical center.

- Read related literature in the school's library.
- Prepare notes and activities.

Presentation of the lesson

a. Introduction of the lesson

Introduce the students to what they are going to learn (fish feeds resources and feeding methods). Brainstorm them on fish feeding habits, fish feeds and feeding. You can assess the relevance of their background to the lesson for the day by asking:

- Do you know the feed resources for fish?
- What is food capture in fish?

b. Body of the lesson

- Start your presentation by explaining what feed and feeding is.

- Explain the feeding habit of fish, including feeding styles of fish, and fish food.
- Have the students discuss in groups the common feed resources and why it is important to acquire the knowledge of the basic feeding style and habit, and resources in the water bodies. Encourage the students to participate in the lesson.

c. Stabilization

Give a summary of the following points:

- Foods eaten by fish
- How and why feed resources vary.
- Importance of studying the feed available that is for fish

Assessment and Follow up

a. Assessment

You can ask the students' questions like the following:

- What are the resources in the waterbody or feeds prepared for fish?
- Explain the feeding mechanism of fish.

b. Follow up

Assign each group library work on the following issues:

- Discuss roughage and concentrate feeds resources.
- Feeding habits of fish are different from the feeding habits of other livestock. Why?

Evaluate the students' assignments and grade their achievements.

c. Additional Questions

1. What are the food or feed resources of different categories of fish?
2. Define herbivorous fish and their feed resources.

Answer to the Activities

Activity 10.3.

The students may have a list of resources that are used for fish. Let them

report and share their summarized ideas with the whole class.

Answer to the additional questions

1. Decomposed plants, animal flesh, planktons, flowers, fruits, seeds, leaves, pieces of stem, etc.
2. Fish that feed on plant materials

10.3. Fish culture techniques

Period allotted: 1

Competencies

At the end of this lesson, the students will be able to:

- examine the fish culture techniques

Content

- Fish culture techniques

Overview

In this lesson, the students will learn about: aquaculture techniques, classification of aquaculture system, advantages, and disadvantages of each aquaculture, and fish farming systems.

Suggested teaching learning process

Suggested Instructional Materials

Use the following aids when you introduce the lesson topic:

- Photographs, pictures of different fish culture.

Suggested teaching methods

For further information about how to use the suggested methods refer to the general information for the teacher in the introduction to this guide.

- Brainstorming, demonstration , group discussion, and presentation

Pre-lesson preparation

Get the instructional materials and teaching materials ready in advance

- Design the appropriate teaching method.

- Read relevant literature to get more ideas on the topic.
- Prepare notes, activities and exercises.

Presentation of the Lesson

a. Introduction to the lesson

Introduce the topic briefly using brainstorming. Brainstorming helps you to see the students' background knowledge about fish culture techniques.

- What type of fish culture techniques do you know?
- What criteria are used to classify fish culture?

b. Body of the lesson

Following the students' replies to the brainstorming questions, give them examples of the existing fish culture techniques.

- Give sufficient explanation of why fish culture is important.
- Mention the differences between the fish culture techniques practiced in tropics.

c. Stabilization

Give emphasis to the following points

- Criteria for classification techniques of fish culture
- Important techniques of fish culture under each classification.

Assessment and follow up

a. Assessment

Check the students' understanding of the lesson by giving them activities to do individually such as:

- Explain why fish culture techniques are important.
- What are the differences between monoculture and poly-culture?
- What are fish cultures on the basis of enclosure?

b. Follow up

Give the following library assignments to each group.

- The fish housing systems are classified on the basis of density.

Explore more about the characteristics of fish farming systems on the basis of density in the tropical environments.

Remember to record the students' results after evaluating their performances.

c. Additional Questions

1. Explain the advantages and disadvantages of mono-sex culture.
2. List examples of aquaculture techniques or farming types on the basis of integration.

Answer to the Activity

Activity 10.4

Provide and aware the students with the necessary information/items for safety reason before they go to the fish market/nearby lake.

Let the students share the summary of their group discussion with the whole class.

Answer to the Additional Question

1.

Advantages

- Cultivation practices such as feeding, disease diagnosis and treatment are easier. For example, feeding is easier in raising single species due to uniform feeding habit.
- Typical characteristics of fish can be studied more accurately.

Disadvantages

- Productivity of pond is not fully utilized
- Market supply cannot be fulfilled and is riskier

2.

- Pig and fish farming
- Duck and fish farming
- Horticulture crop and fish farming
- Rice Paddy and fish farming

10.4. Fish rearing management and fishing methods

Competencies

Period allotted: 1

At the end of this lesson, the students will be able to:

- explain fish rearing methods
- identify fishing methods

Contents

- Fish rearing
- Fishing methods

Overview

In this lesson, the students will learn about the hatching, rearing and harvesting or processing, and different fishing methods.

Teaching learning processes

Suggested Instructional Materials

Pictures that show fish rearing and fishing methods.

Suggested teaching methods

- Brainstorming, group discussion, field visit and presentation.

Pre-lesson preparation

Get the instructional materials and teaching materials ready. Inform the students of the lesson to be discussed and encourage them to contribute ideas and concepts related to the lesson.

Presentation of the lesson

a. Introduction to the lesson

Introduce the students to the lesson, giving emphasis to the lesson objectives. Brainstorm the students to access their past experience on the lesson topic. You can begin the lesson by asking probing questions like

- What are the main events in fish rearing?

- What are fishing methods?

Notice that these questions are samples and you can reproduce and use them based on the lessons given.

b. Body of the lesson

Start your presentation by:

- Start your discussion by describing briefly fish rearing and fishing methods.
- Explain some common fishing methods.

c. Stabilization

Summarize the following points:

- Main events of fish rearing
- Fishing methods

Assessment and follow up

a. Assessment

To know the level of students' understanding of the students and whether the expected competencies are achieved. Ask the students questions about the topic you have taught.

You can ask the student's questions like the following:

- List the fish rearing techniques.
- Describe common fishing methods.

b. Follow up

To help your students get more ideas and knowledge about the lesson you have taught, you can give them assignments.

Assign each group the task of making to do a library or internet study on the following issues:

- Explore the common fishing methods?
- What are the components of fish rearing?

c. Additional Questions

- Explain harvesting in the context of fish rearing?
- What are the two major types fishing gears?

Answer to the Activities

Activities 10.5.

Let the students share the summary of their field work with each other.

Answer to the Additional Questions

1. Harvesting refers to selecting fish, moving them to a finishing pond.
2. Passive and active fishing gear

10.5. Handling fish, fish products and local knowledge in fish processing

Period allotted: 1

Competencies

At the end of this lesson, the students will be able to:

- express the handling of fish and fish products
- discuss the application of indigenous knowledge in fish processing

Contents

- Handling fish and fish products
- Indigenous knowledge in fish processing

Overview

In this lesson, the students will learn about handling fish and fish products, and about indigenous knowledge in fish processing. Fish processing involves a wide range of physical and chemical treatment methods.

Teaching learning processes

Suggested Instructional Materials

Use the following aids:

- Pictures and chats that show the fish products and the processing methods.

Suggested teaching methods

You may use some of the teaching methods suggested below.

- Brainstorming, demonstration, group discussion, and presentation.

Pre-lesson preparation

Get the instructional materials and teaching materials ready in advance of the lesson day. Inform students of the lesson to be discussed and encourage them to share ideas and concepts relevant to the lesson with each other.

Read relevant literature to provide students with full information. Prepare notes, activities and exercises.

Presentation of the lesson

a. Introduction to the lesson

Introduce the students to the lesson, giving emphasis to the given topics, such as handling, product processing technique. Brainstorm the students to see if they have relevant prior knowledge regarding the lesson topic. You can ask questions such as:

- Why does fish require proper handling, processing and distribution?
- What are fish processing methods?

Notice that these questions are samples and can be reproduced and used based on the lessons to be taught.

b. Body of the lesson

Start your discussion by describing briefly fish production in Ethiopia and associated challenges. Following that,

- explain fish processing techniques including the traditional

processing techniques. .

- explain why processing fish in different forms is important.
- Indigenous knowledge in fish processing.

c. Stabilization

Summarize the following points

- Fish processing techniques
- Fish products
- Drying techniques of fish processing
- Fish preservation.

Assessment and follow up

a. Assessment

Give them quizzes and check whether or not the students have understood the lesson. Encourage them to answer the following questions in their groups or independently.

- What stages are involved in fish processing?
- What are fish processing techniques? Give examples.
- Explain why fish processing into different form is required.

b. Follow up

Guide the students in their discussion of traditional and commercial techniques of fish production. Consider issues like storage temperature and time, additives used, casings, and estimated shelf life. Answer the following questions on the basis of the information given above.

- What type of difference can be noticed between traditional and commercial fish production? Answer the question in line with the parameters considered for comparison.
- In both products what is the principal techniques used to inhibit growth of microorganisms and consecutive spoilage?

c. Additional Questions

1. Mention at least two local fish products processing techniques.

2. Give examples of fish products that can stay longer.

Answer to the Activities

Activity 10.7

Students may be aware of a wide range of products and handling methods from their experiences. Let them discuss and share their findings with the rest of the class.

Answer Key to the Additional Questions

1. Smoking, drying (quanta), frozen fish, canned fish, etc
2. Frozen fish, cured fish, canned fish, etc.

(10.6,10.7,10.8,10.9) Diseases in Aquaculture

Competencies

Period allotted: 1

At the end of this lesson, the students will be able to:

- list the major disease of fish and methods of controlling them.

Content

- Diseases in aquaculture

Overview

In this lesson, the students will learn about diseases that commonly affect fish - infectious and non-infectious diseases. Diseases can further be divided into viral, bacterial, and water molds (fungi). Fish can also be victims of internal and external parasites. Prevention and controlling strategies of diseases are important steps to ensure productivity in fish.

Teaching-Learning Processes

Suggested Instructional Materials

- Pictures and photographs that shows parasites, symptoms of different disease
- Charts

Suggested Teaching Methods

Conduct your class using the suggested teaching methods

- Brainstorming, questioning, group discussion, presentation etc.

Pre-lesson Preparation

Get ready with the instructional materials and teaching materials ready in advance of the lesson day. Inform the students of the lesson to be discussed and encourage them to sufficiently participate.

Presentation of the Lesson

a. Introduction to the lesson

Introduce students to the lesson through brainstorming. This helps you to see the relevance of the students' prior knowledge to the new lesson. You can begin the lesson by asking questions like

- What are the major disease in fish?
- What are infectious disease and parasites?

b. Body of the lesson

Start your discussion by describing briefly what infectious and non-infectious fish diseases are.

- Discuss viral, bacterial diseases by giving examples.
- Explain disease controlling strategies in fish.
- Let the students discuss the diseases that affect fish in their areas and categorize them as infectious and non-infectious diseases.

c. Stabilization

Summarize the following points

- Infectious and non-infectious fish diseases.
- Viral, bacterial and fungal fish diseases and their examples.
- Diseases controlling strategies in fish.

Assessment and Follow Up

a. Assessment

Check whether or not the students have understood the lesson by giving them quizzes. Encourage them to answer the following questions in their groups or independently.

- What are the influences of diseases on the production performance of fish?
- What are disease controlling strategies? Give examples.

b. Follow up

Encourage the students to choose one disease which is prevalent in their locality and answer the following questions.

- What are the influences of diseases on the production performance of fish?
- What are disease controlling strategies? Give examples.

c. Additional Questions

1. Give example of the common viral and bacterial fish disease.

Answer to the Activities

Activity 10.8.

Following their field assessment and group discussion, students may come with a long list of major diseases of fish in their areas. Let them share their answers with the rest of the class.

Answer key to the additional question

1. Catfish Virus Disease (CCVD), Motile Aeromonad Septicemia (MAS).

Answer Key to the Review Questions

Part I

1. A 2. B 3. D

Part II

4. a). Cooked fish, b). Cured fish, c). Canned fish

5. Look at figure 10.3 in the student's textbook for answers.

Check list

Check the student's performance according to the given competencies. Refer to the questions in the check list for every unit. Put a tick (√) mark against each task to see whether they are able to perform in the competencies of each unit. The students are expected to respond by saying Yes or No. Then, you can make your own assessment and check whether the competencies are met or not.

Can you:

		Yes	No
1.	define the basic term in aquaculture? _____		
2.	differentiate different indigenous and exotic families of fish? _____		
3.	explain the basic anatomy of bony fishers _____		
4.	mention fish feeds and the feeding practices _____		
5.	determine the feed resources available for fish in waterbody _____		
6.	classify fish culture system based on different basis _____		
7.	what are the main events in fish rearing? _____		
8.	what are the methods of fishing? _____		
9.	what are the fish processing stages and fish products? _____		
10.	mention major fish disease? _____		
11.	explain the local knowledge in fish processing _____		

Unit Assessment

The assessment will be made by comparing students' performance with the specified level of competencies. Besides, the teacher has to recognize the level of performance of each student and provide assistance accordingly, Thus:

Students at the minimum requirement level

A student at a minimum requirement level will be able to:

- define basic terms in aquaculture,
- explain the internal and external body parts of fish,
- explain the feed habit of fish and source of feeds in water bodies,
- explain supplementation of fish,
- classify the fish culture techniques,
- explain the main events of fish rearing,
- common methods of fishing,

Student working above the minimum requirement level

A student working above the minimum requirement level and considered as a higher achiever should be able to:

- compare and contrast local and exotic fish families based on their contribution to the economy and community and answer questions like
- what are the typical characteristics of each fish family?
- What are the foods often eaten by fish in water body, and can give examples of aquatic plants, dead body, flowers etc

Students below the minimum requirement level

Students working below a minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson time during the breaks or at the end of the day.

Students who have not only achieved the minimum requirement level but also achieved a little bit more should be supported so that they can attain the higher achiever competencies. Students who fulfill the higher-achiever competencies also need special support to contribute and achieve more

Unit 11 Apiculture

This unit requires approximately 8 periods of teaching time

Unit Introduction

In this unit, the students will learn about apiculture. They will get introduced to apiculture management, bee biology, and behavior, types of honey bee colony, and beekeeping practices in Ethiopia, colony management, and queen rearing are the lessons in this section. In addition, in this lesson, the students will be made familiar with honey bee products and processing, bee diseases, pests and predators, and indigenous knowledge in apiculture.

Unit Learning Outcomes

At the end of this unit, your students will be able to:

- explain the situation of honey bee management in Ethiopia
- recognize bee biology and behavior
- list types and members of honey bee colony and describe their roles in a colony
- identify honey bee management and queen rearing techniques
- describe hive products and processing methods
- mention major diseases, pests, predators of honey bees and their controlling methods
- give values for indigenous knowledge used in apiculture and committed to improve the application
- compare indigenous knowledge against scientific knowledge in apiculture
- give values for indigenous knowledge used in apiculture and committed to improve the application
- prepare modern hives.

Main Contents

- 11.1. Introduction to honey bee management
- 11.2. Bee biology and behavior
- 11.3. Types of honey bee colony
- 11.4. Management of honey bees
- 11.5. Colony management and queen rearing
- 11.6. Hive products and processing
- 11.7. Bee diseases, pests and predators
- 11.8. Indigenous knowledge in apiculture

11.1. Introduction to honey bee management, bee biology and behavior

Period allotted: 1

Competencies

At the end of this lesson, the students will be able to:

- explain the situation of honey bee management in Ethiopia
- recognize bee biology and behaviour

Content

- introduction to honey bee management
- bee biology and behavior

Overview

In this lesson, the students will learn about honey bee management, honey bee biology and behavior.

Teaching learning processes

Suggested Instructional Materials

- Pictures

Suggested Teaching Methods

Use some of the following teaching methods, as suggested in the general introduction and presentation of the lesson:

- Brainstorming questions, questioning, demonstration, group discussion, presentation.

Pre-lesson preparation

Before you begin teaching the lesson, get pictures of the important honeybee biology and behavior, photographs, diagrams, and other relevant teaching materials. The school pedagogical center may provide you with such pictures.

Presentation of the Lesson

a. Introduction to the lesson

You can begin the lesson by asking questions like the following:

- Explain the honey bee management in Ethiopia?
- What is the biology of honey bee and their special behavior?

b. Body of the lesson

Give brief characteristics of some honeybees as a subsector of agriculture in Ethiopia, honey bee biology and behavior.

c. Stabilization

Give a summary for the following topics.

- the role of honey bee to agriculture
- honey bee biology and behavior

Assessment and follow up

a. Assessment

Ask the students to perform the following task.

- Describe the importance of honey in agriculture.

b. Follow up

Check the students understanding of the lesson by giving them tasks to do independently.

- What is the contribution of honey bee to pollination service?
- List the honey bee castes.

Remember to grade and rate the students' activities, levels of participation and quiz results.

c. Additional Questions

1. How many melliferous plants are found in Ethiopia?
2. What is the estimated potential of honey and beeswax production in Ethiopia?

Answer to the Activities

Activity 11.1.

- a. depending on the rains season , honey be can be harvested at least twice a year.
- b. from the significant 53 crops cultivated in Ethiopia, 33 (62.2%) of them are dependent on biological pollinators. contribution to pollination service in agricultural crops is at around 0.815 billion dollars in Ethiopia.

Activity 11.2.

Let the students share the summary of their discussions with the rest of the class.

Answer key to the additional questions

1. There are over 7000 *melliferous* plant species.
2. 500,000 tons of honey and 50,000 tons of beeswax.

11.2. Types of honey bee colony

Period allotted: 1

Competencies

At the end of this lesson, the students will be able to:

- list types of honey bee colony

Content

- Types of honey bee colony

Overview

In this lesson, the students will learn the types of honeybees, member of the bee colony and their roles.

Teaching-learning Processes

Suggested Instructional Materials

- Pictures/Photographs that show different members of the bee colony.

Suggested teaching methods

Start your lesson using the following teaching methods:

- Brainstorming questions, questioning, group discussion, and presentation.

Pre-lesson preparation

Get the instructional materials and teaching material ready. If none is available in your school, prepare your own pictures and photographs with your students in the pedagogical center.

- Read related literature in the school's library.
- Prepare notes and activities.

Presentation of the lesson

a. Introduction of the lesson

Introduce the students to what they will learn. Ask them some brainstorming questions on the types of honeybees they know.

b. Body of the lesson

- Present the lesson by explaining the roles of workers, drones and queen.
- Mention the types of honey bees identified in Ethiopia and their distributions.

c. Stabilization

Give a summary of the following points:

- Types of honey bee colony and their agro ecological distribution.
- Members of the bee colony and their roles.

Assessment and Follow up

a. Assessment

You can ask the students' questions like the following:

- Explain the roles of members of the bee colony.
- Mention the types of honey bee colony.

b. Follow up

Give the students assignments. Assign each group the task of library work. For example, they can be asked to discuss the characteristics of queen bee.

Answer to the Activities

Activity 11.3.

Let individual students discuss their answers with their neighbors.

11.3. Honey bees, colony management and Queen rearing

Period allotted: 2

Competencies

At the end of this lesson, the students will be able to:

- identify honey bee management and queen rearing techniques.

Content

- Management of honey bees
- Colony management and queen rearing

Overview

In this lesson, the students will learn about types of beekeeping practices in Ethiopia, colony inspection, feeding management, and queen rearing.

Suggested teaching learning process

Suggested Instructional Materials

You can use the following teaching aids:

- Photographs, pictures

Suggested teaching methods

For further information about how to use the suggested methods refer to the general information for the teacher in the introduction to this guide. Begin the lesson using the following methods:

- Brainstorming, lecture, group discussion, and presentation

Pre-lesson preparation

Get the instructional materials and teaching materials ready in advance. Read relevant literature to get more ideas on the topic. Prepare notes, activities, and exercises.

Presentation of the Lesson

a. Introduction to the lesson

Introduce the topic using brainstorming questions. Ask students to tell you the types of beekeeping practices they know in their areas.

b. Body of the lesson

Accept students' answers and build yours on that. Give them examples of fish culture techniques.

- Give them sufficient ideas on beekeeping practices in Ethiopia and their characteristics.
- Describe colony management and queen rearing.

c. Stabilization

Give a summary of the following points:

- Types of beekeeping practices in Ethiopia
- Important things for proper bee management practices (i.e., colony inspection, feeding management and movable frame beehives)
- Queen rearing techniques.

Assessment and follow up

a. Assessment

Check the students' understanding by giving them activities to do individually such as:

- Describe a traditional system of bee keeping.
- What are the colony management practices?

b. Follow up

Give the following library work to each group.

- In natural state, what are the scenarios that trigger the production of a new queen?

c. Additional Questions

- Mention some examples of honeybee management practices.
- What are the most common locally available feed types used for colony supplements?

Answer to the Activity

Activities 11.4 and 11.5

Let the students share their findings of the fieldwork with the whole class and discuss the summary of the groups.

Answer to the Additional Questions

1. Swarm control, feeding during dearth periods, stimulating early colony growth, and pest and disease control, etc.
2. Sugar syrup, Shiro (peas and bean flour), barley flour, maize flour, honey, and fafa (supplementary food for infants).

11.4. Hive products and processing

Period allotted: 1

Competencies

At the end of this lesson, the students will be able to:

- describe hive products and processing methods.

Contents

- Hive products and processing

Overview

In this lesson, the students will learn about honey, beeswax, local beverage.

Teaching learning processes

Suggested Instructional Materials

- Pictures

Suggested teaching methods

- Brainstorming, group discussion, lecture, and presentation.

Pre-lesson preparation

Get the instructional materials and teaching materials ready. Inform students of the lesson to be discussed and encourage them to present ideas and concepts.

Presentation of the lesson

a. Introduction to the lesson

You can begin the lesson by asking questions like

- What are hive products?
- What are the hive product processing methods?

b. Body of the lesson

Start your discussion by describing briefly honey bee products. Explain the common hive product processing.

c. Stabilization

Summarize the following points

- honey bee products and their processing techniques.

Assessment and follow up

a. Assessment

Check whether or not the students have understood the lesson by giving them quizzes. Encourage them to answer the following questions in their groups or independently.

- What is tej? And its role in the honey market?

b. Follow up

Guide the students' discussion of the following points.

- What is honey?

- Describe honey products and the products derived from them.

c. Additional Questions

1. Explain why is beeswax collection is not significant?

Answer to the Activities

Activities 11.6.

Let the students share the result of their fieldwork with the whole class.

Answer Key to the Additional Questions

1. Lack of awareness about what to do with it.

11.5. Bee diseases, pests and predators

Period allotted: 1

Competencies

At the end of this lesson, the students will be able to:

- list major diseases, pests, predators of honey bees and their control methods

Contents

- Bee diseases, pests and predators

Overview

In this lesson, the students will learn about the major disease, honeybee pests, and predator birds.

Teaching learning processes

Suggested Instructional Materials

- Pictures

Suggested teaching methods

You can use the teaching methods suggested below.

- Brainstorming, introducing the lesson, demonstration, group discussion, and presentation.

Pre-lesson preparation

Get the instructional materials and teaching materials ready. Inform students of the lesson to be discussed and encourage them to sufficiently participate.

Presentation of the lesson

(a)Introduction to the lesson

You can begin the lesson by asking probing questions like

- What are honey bee diseases?
- Explain the effect of honey bee diseases on the production performance of honey bee and product processing?

a. Body of the lesson

Start your discussion by describing briefly what honey bee diseases are and their effects on production. Explain pests and predators of honey bee and the mechanisms employed to control them.

b. Stabilization

Summarize the following points

- Major honey bee diseases and their effects,
- Pests and predators of honey bee and their controlling mechanisms.

Assessment and follow up

a. Assessment

Check whether or not the students have understood the lesson by giving them quizzes. Encourage them to answer the following questions in their groups or independently.

- What are honey bee diseases?
- Explain the effects of honey bee diseases on production and processing

b. Follow up

- What are the common honey bee pests and predators? And the

controlling mechanisms employed?

c. Additional Questions

1. Mention two common honey bee diseases

Answer to the Activities

Activities 11.7

The students may come with answers from beekeepers in their area. Let them discuss and share their work with the rest of the class.

Answer Key to the Additional Questions

1. Chalk brood, nosematosis, and amoeba

(11.6,11.7,11.8) Indigenous knowledge in apiculture

Competencies

Period allotted: 1

At the end of this lesson, the students will be able to:

- explain the application of indigenous knowledge in apiculture

Content

- Indigenous knowledge in apiculture

Overview

In this lesson, the students will learn traditional honeybee feeding, swarm control, baiting hives management, traditional uses of honey, traditional beehives, and equipment, honey harvesting and processing methods.

Teaching-Learning Processes

Suggested Instructional Materials

- Pictures

Suggested Teaching Methods

Use the teaching methods suggested

- Brainstorming, questioning, group discussion, presentation etc.

Pre-lesson Preparation

Get the instructional materials and teaching materials ready before the lesson. Inform students of the lesson to be discussed and encourage them to sufficiently participate.

Presentation of the Lesson

a. Introduction to the lesson

You can begin the lesson by asking questions like

- What is the main indigenous knowledge in apiculture?

b. Body of the lesson

Start your discussion by describing briefly the indigenous knowledge commonly practiced by local farmers.

c. Stabilization

Summarize the following points

- The traditional knowledge practiced by beekeepers in different parts of Ethiopia.

Assessment and Follow Up

a. Assessment

Give them quizzes. Encourage them to answer the following questions in their groups or independently.

- What are traditional honey bee feeding?

b. Follow up

- Mention the substances or items used to attract scout bees.
- What are the traditional tools and equipments used in the traditional beekeeping system

c. Additional Questions

1. Give two examples of the common traditional knowledge practiced by beekeepers?

Answer key to the additional question

1.

- The farmers may sometimes use honeycomb, body soap, and spray perfume in the inner part of baiting hives to attract scout bees.
- Beekeepers use indicators to control swarming. For example, they identify the sound of the queen during the night.
- Beekeepers provide supplementary feeds like flour of roasted grain of barely as well as that of maize, bean, and pea to strengthen the colony for the next season.

Answer Key to the Review Questions

Part I

1. False 2. True

Part II

3. D 4. B 5. D 6. D

Part III

1. Pollination by honey bees plays an essential role in human nutrition and food security, income in households, and ecosystem services.
2. A queen bee has well developed ovaries and lays all the eggs in the colony.

Check list

Check the student's performance according to the given competencies. Refer to the questions under the check list for every unit. Put a tick (✓) mark against each task to see whether they are able to perform in the competencies of each unit. The students are expected to respond by saying Yes or No. Then, you can make your own assessment and check whether the competencies are met or not.

Can you:

		Yes	No
1.	explain the role of apiculture in the agriculture system?		
2.	recognize bee biology and behavior? _____		
3.	list types of honey bee colony? _____		
4.	List honey bee management and queen rearing techniques? _____		
5.	describe hive products and processing methods? _____		
6.	mention major diseases, pests, predators of honey bees and their control methods? _____		
7.	explain the application of indigenous knowledge in apiculture? _____		

Unit Assessment

Students' performance has to be assessed continuously over the whole unit. The assessment will be made by comparing students' performance with the specified level of competencies. Besides, you have to recognize the level of performance of each student and provide assistance accordingly, Thus:

Students at the minimum requirement level

A student at a minimum requirement level will be able to:

- explain the situation of honey bee management in Ethiopia,
- recognize bee biology and behavior,
- list types of honey bee colony,
- identify honey bee management and queen rearing techniques,
- describe hive products and processing methods,
- mention major diseases, pests, predators of honey bees and their control methods,
- explain the application of indigenous knowledge in apiculture.

Students working above the minimum requirement level

In addition, a student working above the minimum requirement level and considered as a higher achiever should be able to:

- analyze the situation of honey bee subsector in Ethiopia,
- recognize bee social structure and biology differences,

- explain the characteristics of each types of honey bee colony,
- describe the common honey bee management,
- explain the queen rearing techniques,
- describe hive products and processing methods,
- differentiate major diseases, pests, predators of honey bees and their control strategies,
- compare the indigenous knowledge in apiculture with the modern beekeeping practices.

Students below the minimum requirement level

Students working below a minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson time during the breaks or at the end of the day.

Students who have not only achieved the minimum requirement level but also achieved a little bit more should be supported so that they can attain the higher achiever competencies.

Unit 12 Nursery and Plantation Technology

Total Periods Allotted: 3

Unit Introduction

This unit deals with the nursery and plantation technology. It is designed in a way that enables learners to develop basic understanding of the nursery and plantation technology. The unit covers topics like Nursery establishment and management, Design and layout of the nursery producing plants from seeds, Plantation establishment and management

Unit Learning Outcomes

At the end of this unit, the students will able to:

- describe nursery establishment and management.
- show practically how to do nursery site selection, preparation and layout.
- explain how to produce plants from seeds
- demonstrate the plantation establishment and management of nursery

3. Main Contents

- 12.1. Nursery establishment and management
- 12.2. Design and layout of the nursery
- 12.3. Producing plants from seeds
- 12.4. Plantation establishment and management

12.1. Nursery establishment and management

Period allotted: 1

Lesson Objective

At the end of this lesson, the students will be able to:

- demonstrate nursery establishment and management.

Contents

- Nursery establishment and management

Overview

In this lesson, the students will learn about nursery establishment and management. Explain the term nursery establishment and management. Do not limit yourself to the explanation provided in text book.

Teaching-learning Processes

Instructional Materials

Use pictures or photographs of established and managed nursery.

Suggested Teaching Methods

Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach

Brainstorming questions

- Questioning
- lecture
- Demonstrations
- Group discussion

Pre-lesson Preparation

- Get the teaching aids and teaching materials ready.

Presentation of the Lesson

a. Introduction of the lesson

You can start the lesson by asking questions like the following:

- What are the nursery establishment and management methods?
- how farmers in your environment establish and manage the nursery?

b. Body of the lesson

Present the lesson by explaining nursery establishment and management methods.

c. Stabilization

Give a summary for the following topic.

- The nursery establishment and management practices in their environment

Assessment and Follow-up

a. Assessment

- organize your students to group and encourage them to discuss nursery establishment and management
- give the students quiz or class work

b. Follow up

Check your students' understanding of the concepts by asking them questions and giving them class activity. Make sure that you are always grading and rating the students' activities, levels of participation and quiz results.

Answer to activity 12.1

Guide the students to use the following checklist during their field visit

1. Name of the owner of the nursery management site-----
2. Address: Zone: ----- Woreda-----Kebele-----
3. Date of Visit-----
4. Nursery establishment season-----
5. Group of students-----

No.	Name of Crop	Area coverage	Methods used to manage the nursery	Remark

12.2. Design and layout of the nursery

Period allotted: 1/2

Lesson objective

At the end of this lesson, the students will be able to:

- elaborate the importance of site selection, preparation and layout.

Content

- Design and layout of the nursery

Overview

In this lesson, the students will learn about the design and layout of the nursery.

Teaching-learning Processes

Instructional Materials

- Use picture/photography of design and layout of the nursery

Suggested Teaching Methods

- Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach
- Brainstorming:
- Questioning
- Demonstration
- Group discussion
- Lecture

Pre-lesson Preparation

- Get the teaching aids and teaching materials ready.

Presentation of the Lesson

a. Introduction of the lesson

You can start the lesson by posing questions like the following:

- how to design and layout of the nursery?
- how farmers in your locality design and layout of the nursery?

b. Body of the lesson

Start your presentation by explaining the design and layout of the nursery.

c. Stabilization

Give a summary for the following topic.

- Designing and preparing a lay out for the nursery establishment

Evaluation and Follow-up

a. Evaluation

- Organize your students to group and encourage them to discuss design and prepare a lay out for the nursery establishment

b. Follow up

Ask them questions and give them class activity. Based on the feedback, check that the objectives of the lesson are met. If not, determine what is not clear and plan for a remedial activity.

12.3. Producing plants from seeds

Period allotted: 1

Lesson objective

At the end of the lesson, the students will be able to:

- Describe the benefits of tissue culture

Content

- Producing plants from seeds

Overview

In this lesson, the students will learn about the producing plants from seeds.

Pre-lesson Preparation

Get the teaching aids and teaching material needed for the lesson. If none are available in your school, try to prepare by yourself for your students in the pedagogical center.

- Read related literature in the school's library.
- Prepare notes and activities.

Presentation of the Lesson

a. Introduction to the lesson

- Introduce to students how to produce plants from seeds

b. Body of the lesson

- Start your presentation by explaining how to producing plants from seeds

c. Stabilization

Give a summary of the following point:

- Methods for producing plants from seeds

Assessment and Follow up

a. Assessment

To know the level of understanding of the students and whether the expected competencies are achieved, ask the students questions about the topic you taught. You can ask the student's questions like the following:

- Explain how to produce plants from seeds.
- Give quiz, test, class work, etc

b. Follow up

You can give them assignments, quiz, and test. Evaluate the students' assignments and grade their achievements.

Answer to activities 12.3

Producing plants from seed requires a number of steps. Choosing a container, adding quality soil, planting at the proper depth, watering wisely, maintain consistent moisture, etc. are some examples

12.4. Plantation establishment and management

Period allotted: 1/2

Lesson objective

At the end of the lesson, the students will be able to:

- show the plantation establishment and management of nursery

Content

- Plantation establishment and management of nursery

Overview

In this lesson, the students will learn about the plantation establishment and management of nursery.

Pre-lesson Preparation

Get the teaching aids and teaching material needed ready. If none are available in your school, try to prepare by yourself for your students in the pedagogical center.

- Read related literature in the school's library or elsewhere.

- Prepare notes and activities.

Presentation of the Lesson

a. Introduction to the lesson

Introduce to the students how to establish and manage plantation for nursery.

b. Body of the lesson

- Start your presentation by explaining how to establish and manage plantation for nursery

c. Stabilization

Give a summary of the following point:

- What methods are used to establish and manage plantation for nursery?

Assessment and Follow up

a. Assessment

Ask the students questions about the topic you taught. You can ask the student's questions like the following:

- Explain how to establish and manage plantation for nursery.

Give a quiz, test, or class work

b. Follow up

- You can give students assignments, quiz, and test. Evaluate the students' assignments and grade their achievements.

Answers to the Review exercise

Part I. Answer for Choice

1. E 2. D 3. E 4. C

Part II. Short Answer

1. Nurseries are needed because they produces high quality seedlings of the desired species, employing the most cost-effective, and environment friendly and socially practices.
2. Plantations may be established from seedlings, stem cuttings, or direct seeding. Each of these types of plantings must be done during periods of adequate rainfall, and must be protected from weeds and nests.

Check list

Check the student's performance according to the given competencies referring to the questions under the check list for every unit. Put a tick (✓) mark against each task and decide whether they are able to perform in the competencies of each unit.

Can you:

	Yes	No
demonstrate nursery establishment and management.		
elaborate the importance of site selection, preparation and layout.		
discuss producing plants from seeds.		
show plantation establishment of land management of nursery.		

Unit Assessment

Students' performance has to be assessed continuously over the whole unit. You can determine whether the student has achieved the minimum required level of competence by comparing their performances against the specified level of competencies.

A student working at the minimum requirement level will be able to

- define nursery establishment and management.
- Explain nursery site selection, preparation and layout.
- discuss methods of producing plants from seeds

- apply the methods of producing plants from seeds using modern techniques and indigenous knowledge

Students working above the minimum requirement level should be praised and their achievement recognized. They should be encouraged to continue working hard and not become self-satisfied.

Students working below the minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson time during the breaks or at the end of the day.

Unit 13 Basics of Agro-Forestry Systems and Practices

Total Periods Allotted: 6

Unit Introduction

The basic objective of this unit is to familiarize students with the basic concepts of the management of natural resources. As grade 12 students do not have background knowledge about natural resources management, the unit begins by explaining the concepts to familiarize the students with the concepts. The unit includes activities, some to be done individually, some in group, either in the classroom or outside the classroom. You can use the activities as they are or with some modification or adding your own activities depending on the students' composition, school and local conditions.

At the end of the unit, there are review questions to help students reflect on what they have learned in the classroom and outside the classroom. You can add your own review (assessment) questions if necessary

Unit Learning Outcomes

At the end of this unit, the students will be able to:

- define agro-forestry and related terms.
- discuss the significance of agro forestry in the agricultural systems
- mention the types of agro-forestry systems
- explain agro-forestry species, establishment and management methods

Main Contents

- 13.1. Definition of agro-forestry, agro forestry systems, practices and technologies
- 13.2. Significance of agro forestry
- 13.3. Classification of agro forestry systems
- 13.4. Agro forestry species, their establishment and management methods

13.1. Definition of agro-forestry, agro forestry systems, practices and technologies

Lesson Objective

At the end of this lesson, the students will be able to:

- Explain agro- forestry and related terms.

Contents

- Definition of agro-forestry, agro forestry systems, practices and technologies

Overview

In this lesson, the students will learn the definition of agro-forestry, agro forestry systems, practices and technologies. Different working definitions of the terms agro forestry systems, practices and technologies will be among the points to learn in this lessons.

Teaching-learning Processes

Instructional materials

Use photographs and pictures of agroforestry

Suggested Teaching Methods

- Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach.
- Brainstorming questions:.
- Questioning
- Demonstration
- lecture
- Group discussion

Pre-lesson Preparation

- Get the teaching aids and teaching materials ready.

Presentation of the Lesson

a. Introduction of the lesson

You can start the lesson by posing questions like the following:

- What is agro-forestry? Explain agro forestry systems and practices and technologies, etc.?
- What is social forestry, community forestry and farm forestry?

b. Body of the lesson

Start your presentation by explaining agro-forestry, agro forestry systems, practices and technologies

c. Stabilization

Give a summary for the following points.

- Agro-forestry,
- Agro forestry systems practices and technology

Assessment and Follow-up

a. Assessment

- Encourage the students to discuss agro-forestry, agro forestry systems practices and technologies, social forestry, community forestry and farm forestry.
- give quiz, class work for the students

b. Follow up

Check your students' understanding of the concepts by asking questions and giving them class activity. Based on the feedback, check that the objectives of the lesson are met. If not, determine what is not clear and plan for a remedial activity. Make sure that you are always grading and rating the students' activities, levels of participation and quiz results.

Answer for activity 13.1

- a. Agro forestry systems are land management practices in which trees and shrubs are produced on the same land as agricultural crops or livestock.
- b. some agroforestry practices are for example boundary planting; farm woodlots; orchards and tree gardens; tree plantations; shelterbelts; windbreaks; conservation hedges; fodder banks; live fences.

Note: Here the students can answer depending the type of agro forestry system practiced in their environment.

13.2. Significance of Agro Forestry

Period allotted: 1

Lesson Objective

At the end of this lesson, the students will be able to:

- Explain the significance of agro forestry in the agricultural systems

Content

- Significance of agro forestry

Overview

In this lesson, the students will learn about the significance of agro forestry.

Teaching-learning Processes

Teaching-learning processes are the students' interaction with the teacher, with each other, with learning materials and activities.

Suggested Teaching Methods

Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach.

- Brainstorming questions
- Questioning
- Group discussion
- Demonstration

Pre-lesson Preparation

- Get the instructional and teaching materials ready.

Presentation of the Lesson

a. Introduction of the lesson

You can start the lesson by posing question like the following:

- What is the significance of agro forestry?

b. Body of the lesson

Start your presentation by explaining the significance of agro forestry

c. Stabilization

Give a summary for the following topic.

- The significance of agro forestry such as its economic, environmental and social benefits.

Assessment and Follow-up

a. Assessment

- Organize your students in to group and encourage them to discuss the significance of agro forestry.
- Give quiz and class activity for the students

b. Follow up

Check your students' understanding of the concepts by asking questions and giving them class activity. Based on the feedback, check that the objectives of the lesson are met. If not, determine what is not clear and plan for a remedial activity. Make sure that you are always grading and rating the students' activities, levels of participation and quiz results.

Answer for activity 13.2

Silvopastoral systems are those that combine tree growing with the production of livestock. Fodder (browse) is an agricultural term for animal feed, and fodder trees and shrubs are those plants (shoots or sprouts,

especially tender twigs and stems of woody plants

Examples of tree fodder like Wychelm, Aspen, Salix caprea, gray Alder, etc.

13.3. Classification of agro forestry systems

Period allotted: 1

Lesson objective

At the end of this lesson the students will be able to:

- List the types of agro-forestry systems

Content

- Classification of agroforestry systems

Overview

In this lesson, the students will learn about the classification of agro forestry systems.

Instructional materials

Use photographs or pictures of different agroforestry systems

Suggested Teaching Methods

Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach.

- Brainstorming questions.
- Questioning
- Demonstration
- lecture
- Group discussion

Answer or the activity 13.3

Agroforestry system is classified based on the following criteria:

- Function of the system (role and output and outcome of components)
- Agro-ecological zones where the system exists or is adoptable, and
- Socioeconomic scales and management levels of the system

There are three types of agro forestry based on above criteria.

1. Agrisilvicultural systems
2. Silvo pastorals Systems (Tree-Livestock/Animal)
3. Agro-Silvo pastoral system (Tree-Crop-Livestock)

Answer for activity 13.3

Some common methods of agro forestry system classification are:-

- Structure of the system (nature and arrangement of components).
- Function of the system (role and output and outcome of components)
- Agro-ecological zones where the system exists or is adoptable, and
- Socioeconomic scales and management levels of the system based on these criteria,

13.4. Agro forestry species, their establishment and management methods

Lesson Objective

Period allotted: 2

At the end of this lesson the students will be able to:

- Discuss agro-forestry species, establishment and management methods

Content

- Agro-forestry species, establishment and management methods

Overview

In this lesson, the students will learn about Agro-forestry species, establishment and management methods.

Teaching-learning Processes

Instructional materials

Use pictures of agroforestry species.

Suggested Teaching Methods

Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach.

- Brainstorming questions
- Questioning
- Demonstration
- lecture
- Group discussion

Pre-lesson Preparation

Read the text book and other resources on agro-forestry species, establishment and management methods. Select your teaching methods, strategies, support materials and assessment tools before class. Get the teaching aids and teaching materials ready.

Presentation of the Lesson

a. Introduction of the lesson

Introduce to the students agro-forestry species, establishment and management methods.

b. Body of the lesson

Start your presentation by explaining agro-forestry species, establishment and management methods.

c. Stabilization

Give a summary for the following points.

- Agro-forestry species, establishment and management methods. After finishing the presentation, review the key ideas and concepts of the lesson. You can also use pictures to summarize the lesson.

Assessment and Follow-up

a. Evaluation

- Group the students and encourage them to discuss agro-forestry species, establishment and management methods. Give quiz, test and

class work for the students

b. Follow up

Check your students' understanding of the concepts by asking questions and giving them class activity. Based on the feedback, check that the objectives of the lesson are met. If not, determine what is not clear and plan for a remedial activity.

Answers to the unit review exercise

1. C 2. E 3. E 4.A 5.D 6.E 7.B

1. **Agro forestry** is a collective name for land use systems and technologies where woody perennials (trees, shrubs, palms, bamboos, etc.) are deliberately used on the same land management as agricultural crops and animals in same form of spatial arrangement or temporary sequence. Agro forestry systems are land management practices in which trees and shrubs are produced on the same land are as agricultural crops or livestock.
2. It means agroforestry combines trees, crops or livestock to increase diversity, productivity, profitability, and environmental stewardship.
3. The importance of tree fodder and silvopastoral systems is that it controls wind erosion, provides organic matter and nutrients to adjacent crop areas. It hosts insects, birds, snakes, and other animals that help control crop pests.
4. Multipurpose and fodder trees provide food, income, soil improvement and environmental amelioration during the harsh weather.
5. Agro forestry provides a wide range of economic, socio-cultural and environmental benefits
6. a) Aboveground Management Practices
 - The aboveground management practices include pruning, thinning, pollarding, lopping and coppicing.b) Belowground Management
 - Root Pruning

Check list

Check the student's performance according to the given competencies referring to the questions under the check list for every unit. Put a tick (✓) mark against each task to see whether they are able to perform in the competencies of each unit.

Can you:

	Yes	No.
explain agro-forestry and related terms?		
elaborate the significance of agro forestry in the agricultural systems?		
list types of agro-forestry systems?		
discuss agro-forestry species, establishment and management methods?		

Unit Assessment

Students' performance has to be assessed continuously over the whole unit. You can determine whether the student has achieved the minimum required level of competence by comparing their performances against the specified level of competencies.

A student working at the minimum requirement level will be able to

- describe what agro-forestry, agro forestry systems, practices and technologies
- discuss the significance of agro forestry in the agricultural systems
- Analyze the types of agro-forestry systems
- discuss about agro-forestry species, establishment and management methods
- Value the species, establishment and management of agroforestry in their local area

Students working above the minimum requirement level should be praised and their achievement recognized. They should be encouraged to continue working hard and not become self-satisfied.

Students working below the minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson time during the breaks or at the end of the day.

Unit 14 / Soil and Water Conservation

Total Periods Allotted: 5

Unit Introduction

This unit deals with the soil and water conservation. It is designed in a way that enables learners develop basic understanding of the soil and water conservation.

Unit Learning Outcomes

At the end of this unit, learners will be able to:

- describe soil properties.
- elaborate the types of soil erosion
- illustrate the major causes of soil erosion
- know the negative impacts of soil erosion on the environment
- describe the types of soil and water conservation practices
- explain the need of soil and water conservation
- mention types of indigenous knowledge's applicable in Soil and water conservation

Main Contents

- 14.1. Soil properties
- 14.2. Soil erosion
- 14.3. Major causes of soil erosion
- 14.4 Negative impacts of soil erosion
- 14.5. Types of soil and water conservation practices
- 14.6. Need of soil and water conservation
- 14.7. Indigenous Knowledge in Soil and water conservation

14.1. Soil properties

Period allotted: 1/2

Lesson objective

At the end of this lesson, students will be able to:

- Describe soil properties

Contents

- Soil properties

Overview

In this lesson the students will learn soil properties. You are expected to provide explanation about soil properties.

Teaching-learning Processes

Instructional Materials

Use photographs and pictures

Suggested Teaching Methods

Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach.

- Brainstorming questions.
- Questioning
- Demonstration
- lecture
- Group discussion

Pre-lesson Preparation

- Get the teaching aids and teaching materials ready.

Presentation of the Lesson

a. Introduction of the lesson

You can start the lesson by asking questions like the following:

- What are the different types of soil properties?

b. Body of the lesson

After testing your students' understanding about the soil properties, start your presentation by explaining the soil properties.

c. Stabilization

Give a brief summary for the following topics.

- The soil properties and its types

Assessment and Follow-up

a. Assessment

- organize your students into groups and encourage them to discuss soil properties
- give a students a quiz to check their understanding.

b. Follow up

Check your students' understanding of the concepts by asking questions and giving them class activity. Based on the feedback, check that the objectives of the lesson are met. Make sure that you are always grading and rating the students' activities, levels of participation and quiz results..

Answer for Activity14.1

- a. Soil is a mixture that contains minerals, organic matter, and living organisms.
- b. Soil has both physical and chemical properties. The physical properties of soil include all the aspects that we can see and touch such as texture, color, depth, structure, porosity whereas, the chemical properties of soil include cat ion exchange capacity and soil reaction (pH)

14.2. Soil erosion

Period allotted: 1/2

Lesson objective

At the end of this lesson, the students will be able to:

- Explain the types of soil erosion.

Content

- Soil erosion

Overview

In this lesson, students are going to learn about the soil erosion.

Teaching-learning Processes

Instructional Materials

Use pictures or photographs presented in student's textbook

Suggested Teaching Methods

Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach.

- Brainstorming questions.
- Questioning
- Demonstration
- lecture
- Group discussion

Pre-lesson Preparation

- Get the teaching aids and teaching materials ready.

Presentation of the Lesson

a. Introduction of the lesson

You can start the lesson by posing questions like the following:

- What is soil erosion and how it occurs?

b. Body of the lesson

After testing your students' understanding about the soil erosion, start your presentation by explaining the soil erosion.

c. Stabilization

Give a brief summary for the following topics.

- The soil erosion

Assessment and Follow-up

a) Assessment

- organize your students in to group and encourage them to discuss about **soil erosion**

b) Follow up

Check your students' understanding of the concepts by asking questions and giving them class activities. Based on the feedback, check that the objectives of the lesson are met. If not, determine what is not clear and plan for a remedial activity.

Answer for Activity 14.2

- Soil erosion is a gradual process that occurs when the impact of water or wind detaches and removes soil particles, causing the soil to deteriorate. It is caused by heavy rainfall, flooding, high winds, and even mass movements

14.3. Major causes of soil erosion

Period allotted: 1

Lesson objective

At the end of this lesson, the students will be able to:

- Describe the major causes of soil erosion

Content

- Major causes of soil erosion

Overview

In this lesson, students are going to learn about the major causes of soil erosion

Teaching-learning Processes

Instructional Materials

Instructional Materials are any material you may use that support students to clearly understand concepts, skills and understandings of lesson.

4.2 Suggested Teaching Methods

Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach.

- Brainstorming questions.
- Questioning
- Demonstration
- lecture
- Group discussion

Pre-lesson Preparation

- Get the teaching aids and teaching materials ready.

Presentation of the Lesson

a. Introduction of the lesson

You can start the lesson by posing question like the following:

- What are major causes of soil erosion?

b. Body of the lesson

Start your presentation by explaining the soil erosion.

c. Stabilization

Give a brief summary for the following topics.

- The major causes of soil erosion

Assessment and Follow-up

a. Assessment

- organize your students in to group and encourage them to discuss about major causes of soil erosion

b. Follow up

Check your students' understanding of the concepts by asking questions and giving them class activity. Based on the feedback, check that the objectives of the lesson are met. If not, determine what is not clear and plan for a remedial activity.

Answer for the activity 14.3

- a. Soil erosion decreases soil fertility, which can negatively affect crop yields. It also sends soil-laden water downstream, which can create heavy layers of sediment that prevent streams and rivers from flowing smoothly and can eventually lead to flooding answer depends on the students observation and understanding of soil erosion problem in their specific area.

14.4 Negative impacts of soil erosion

Period allotted: 1/2

Lesson objective

At the end of this lesson, the students will be able to:

- Explain the negative impacts of soil erosion on the environment

Content

- Negative impacts of soil erosion

Overview

In this lesson, students are going to learn about the negative impacts of soil erosion.

Teaching-learning Processes

Suggested Instructional Materials

- Use photograph or pictures

Suggested Teaching Methods

Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach.

- Brainstorming questions.
- Questioning
- Demonstration
- lecture
- Group discussion

Pre-lesson Preparation

- Get the teaching aids and teaching materials ready.

Presentation of the Lesson

a. Introduction of the lesson

You can start the lesson by posing question like the following:

- What are negative impacts of soil erosion?

b. Body of the lesson

Start your presentation by explaining the *negative impacts of soil erosion*.

c. Stabilization

Give a brief summary for the following topics.

- The negative impacts of soil erosion

Assessment and Follow-up

a. Assessment

- organize your students in to group and encourage them to discuss about negative impacts of soil erosion

b. Follow up

Check your students' understanding of the concepts by asking questions and giving them class activities. Based on the feedback, check that the objectives of the lesson are met. If not, determine what is not clear and plan for a remedial activity.

Answer for the activity 14.4

- the negative effect of soil erosion is that it decrease rooting depth, soil fertility, organic matter in the soil and plant-available water reserves

14.5. Types of soil and water conservation practices

Period allotted: 1

Lesson Objective

At the end of this lesson, students will be able to:

- Explain the types of soil and water conservation practices

Contents

- Types of soil and water conservation practices

Overview

In this lesson the students will learn the Explain the types of soil and water conservation practices.

Teaching-learning Processes

Suggested Instructional Materials

Use image/pictures or videos of different structure of soil and water conservation

Suggested Teaching Methods

Use active learning methods you think will fit the nature of the lesson, the students' composition (i.e., fast, medium, slow learners) and students with special needs (physical, visual and hearing impairment). You can choose and use from the following teaching

- Brainstorming questions

- Questioning
- Demonstration
- lecture
- Group discussion

Pre-lesson Preparation

- Get the teaching aids and teaching materials ready.

Presentation of the Lesson

a. Introduction of the lesson

You can start the lesson by posing questions like the following:

- What soil and water conservation practices?
- List different types of soil and water conservation practices.

b. Body of the lesson

Start your presentation by explaining the explain the types of soil and water conservation practices

c. Stabilization

Give a brief summary for the following topics.

- The types of soil and water conservation practices

Assessment and Follow-up

a. Assessment

- organize your students in to group and encourage them to discuss about the types of soil and water conservation practices
- provide a quiz for the students

b. Follow up

Check your students' understanding of the concepts by asking questions and giving them class activity. Based on the feedback, check that the objectives of the lesson are met. Make sure that you are always grading and rating the students' activities, levels of participation and quiz results.

Answer for Activity 14.5

- There are a variety of soil and water conservation measures. These are biological, physical (mechanical or technical practices), and agronomic (sometimes called best management practices), etc.

14.6. The need of soil and water conservation

Period allotted: 1/2

Lesson objectives

At the end of this lesson, the students will be able to:

- Explain the need of soil and water conservation

Content

- The need of soil and water conservation

Overview

In this lesson, students will learn about the need of soil and water conservation.

Teaching-learning Processes

Suggested Instructional Materials

- Use photograph or pictures as instructional materials

Suggested Teaching Methods

Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach.

- Brainstorming questions.
- Questioning
- Demonstration
- lecture
- Group discussion

Pre-lesson Preparation

- Get the teaching aids and teaching materials ready.

Presentation of the Lesson

a. Introduction of the lesson

You can start the lesson by posing questions like the following:

- Why soil and water conservation is need?

b. Body of the lesson

After testing your students' understanding about the need for soil and water conservation, commence your presentation by explaining the need of soil and water conservation.

c. Stabilization

Give a brief summary for the following topics.

- The need of soil and water conservation

Assessment and Follow-up

a. Assessment

- Organize your students in to group and encourage them to discuss about the need of soil and water conservation and give quiz for the students.

b. Follow up

Check your students' understanding of the concepts by asking questions and giving them class activity. Make sure that you are always grading and rating the students' activities, levels of participation and quiz results.

14.7. Indigenous knowledge in soil and water conservation

Lesson objectives

Period allotted: 1/2

At the end of this unit you will be able to:-

- Mention types of indigenous knowledge's applicable in soil and water conservation

Content

- Indigenous knowledge in soil and water conservation

Overview

In this lesson the students will learn Indigenous knowledge in soil and water conservation.

Teaching-learning Processes

Instructional Materials

Use different pictures or photographs of the structure of soil and water conservation by indigenous knowledge in the student's textbook

Suggested Teaching Methods

Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach.

- Brainstorming questions.
- Questioning
- Demonstration
- lecture
- Group discussion

Pre-lesson Preparation

- Get the teaching aids and teaching materials ready.

Presentation of the Lesson

a. Introduction of the lesson

You can start the lesson by posing question like the following:

- what are different types of indigenous knowledge in soil and water conservation are you aware of?

b. Body of the lesson

Start your presentation by explaining the concept of the indigenous knowledge in soil and water conservation.

a. Stabilization

Give a brief summary for the following topics.

- Indigenous knowledge in soil and water conservation

Assessment and Follow-up

a. Assessment

- organize your students in to group and encourage them to mention the indigenous knowledge in soil and water conservation

b. Follow up

Check your students' understanding of the concepts by asking questions and giving them class activity about the indigenous knowledge in soil and water conservation

Answer for the activity 14.7

- ✓ Indigenous knowledge is a knowledge generated at local level and is unique in local culture and society

Answer for Review Exercise

Part I: Answer for choice

1. E 2. C 3. A

Part II. Short answer

1. Soil is a mixture that contains minerals, organic matter, and living organisms. It consists of inorganic particles and organic matter. It has both physical and chemical properties.
2. The major components of soil are minerals, organic matter, water and air.

- **The physical properties** of soil include all the aspects that we can see and touch such as texture, color, depth, structure, porosity (the space between the particles), stone content and **The chemical properties** of soil include cat ion exchange capacity and soil reaction (pH)

Check list

Check the student's performance according to the given competencies referring the questions under the check list for every unit. Put a tick (✓) mark against each task whether they are able to perform in the competencies of each unit.

Can you:

	Yes	No
explain soil properties.		
elaborate the types of soil erosion		
describe the major causes of soil erosion		
explain the negative impacts of soil erosion on the environment		
explain the types of soil and water conservation practices		
explain the need of soil and water conservation		
mention types of indigenous knowledge's applicable in soil and water conservation		

Unit Assessment

Students' performance has to be assessed continuously over the whole unit. You can determine whether the student has achieved the minimum required level of competence by comparing their performances against the specified level of competencies.

A student working **at the minimum requirement** level will be able to

- describe soil properties.
- elaborate the types of soil erosion
- illustrate the major causes of soil erosion
- analyze the negative impacts of soil erosion on the environment
- describe the types of soil and water conservation practices
- justify the need of soil and water conservation

- mention types of indigenous knowledge's applicable in Soil and water conservation

Students working **above the minimum requirement** level should be praised and their achievement recognized. They should be encouraged to continue working hard and not become self-satisfied.

Students working **below the minimum requirement** level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson time during the breaks or at the end of the day.

Unit 15 / Gender and Human Nutrition

Total Periods Allotted: 3

Unit Introduction

This unit deals with the Gender and Human Nutrition. It is designed in a way that enables learners develop basic understanding of the gender and human nutrition. The unit covers t topics. Which includes basic gender related terminologies, gender role in food production and, empowering women in food production and consumption.

Unit Learning Outcomes

At the end of this unit, learners will able to:

- describe gender related terminologies
- elaborate gender role in food production and consumption
- clarify the role of empowering women in food production and consumption

Main Contents

- 15.1. Basic gender related terminologies
- 15.2. Gender role in food production and consumption
- 15.3. Empowering women in food production and consumption

15.1. Basic gender related terminologies

Period allotted: 1

Lesson objective

At the end of this unit you will be able to:-

- Define gender related terminologies

Content

- Basic gender related terminologies

Overview

In this lesson the students will learn the basic gender related terminologies.

Teaching-learning Processes

Suggested Teaching Methods

Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach.

- Brainstorming questions.
- Questioning
- Demonstration
- lecture
- Group discussion

Pre-lesson Preparation

- Get the teaching aids and teaching materials ready.

Presentation of the Lesson

a. Introduction of the lesson

You can start the lesson by posing questions like the following:

- can you list terms related to gender, and define them?

b. Stabilization

Give a brief summary for the following topic.

- Definition of different terms of gender

Assessment and Follow-up

a. Assessment

- organize your students in to group and encourage them to list and define different terms of gender

b. Follow up

Check your students' understanding of the concepts by asking questions and giving them class activity.

Answer for activity 15.1

1. Answer is student specific
2. Family planning is very important methods used to control unwanted increase in family size in a given households. Increase in unwanted family size increase the demand for the farm land and this in turn increase the land fragmentation. The fragment land cannot give the required yield and then reduce productivity. Family planning, enables determining minimum economic farmland size, improving land productivity and enhance agricultural production.

15.2. Gender role in food production and consumption

Lesson objective

Period allotted: 1

At the end of this lesson, the students will be able to:

- explain the existing perceptions of gender role in food production and consumption

Content

- Gender role in food production and consumption

Overview

In this lesson, students are going to learn about gender role in food production and consumption.

Teaching-learning Processes

Instructional Materials

Use different image and videos that show women/men playing role in food production

Suggested Teaching Methods

Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach.

- Brainstorming questions.
- Questioning
- Demonstration
- lecture
- Group discussion

Pre-lesson Preparation

- Get the teaching aids and teaching materials ready.

Presentation of the Lesson

a. Introduction of the lesson

You can start the lesson by posing question like the following:

- What is the gender role in food production and consumption?

b. Body of the lesson

Commence your presentation by explaining the gender role in food production and consumption.

c. Stabilization

Give a brief summary for the following topic.

- The gender role in food production and consumption

Assessment and Follow-up

a. Assessment

- organize your students into groups and encourage them to discuss

about the gender role in food production and consumption

- Give quiz, class work for the students

b. Follow up

Check your students' understanding of the concepts by asking questions and giving them class activity. You need to provide additional activities that fit the different composition of the students.

Answer for the activity 15.2

As producer, women play important roles as producers of food, managers of natural resources, income earners, and caretakers of household food and nutrition security. As consumers women are an extremely relevant actor since they often determine the consumption patterns of each household. Being a responsible consumer is a direct and easy way to contribute to sustainability. As producers women also have an important role, mainly women farmers but from my point of view that is not that easy. There are increased initiatives that use organic and biological practices as fertilizers, for example. Or initiatives that use solid waste to make organic fertilizers.

15.3. Empowering women in food production and consumption

Period allotted: 1

Lesson objective

At the end of this lesson, the students will be able to:

- Explain the role of empowering women in food production and consumption

Content

- Empowering women in food production and consumption

Overview

In this lesson, students are going to learn about empowering women in food production and consumption.

Teaching-learning Processes

Instructional Materials

- Use pictures or photograph

Suggested Teaching Methods

Use any of the following active learning method(s) that fit (s) the topic and the group of students you teach.

- Brainstorming questions.
- Questioning
- Demonstration
- lecture
- Group discussion

Pre-lesson Preparation

- Get the teaching aids and teaching materials ready.

Presentation of the Lesson

a. Introduction of the lesson

You can start the lesson by posing question like the following:

- What does empowering women in food production and consumption mean?

b. Body of the lesson

Start your presentation by explaining the gender role in food production and consumption.

c. Stabilization

Give a brief summary for the following topic.

- empowering women in food production and consumption

Assessment and Follow-up

a. Assessment

- ask your students either individual or in a group and encourage them to discuss about the empowering women in food production and consumption. Give quiz or test.

b. Follow up

Check your students' understanding of the concepts by asking questions and giving them class activity. You need to provide additional activities that fit the different composition of the students. Make sure that you are always grading and rating the students' activities, levels of participation and quiz results

Answer for review exercise

Part I: Answer for choice

1. B 2. D 3. E 4. B

Part II. Answer for short questions

1. Gender Mainstreaming is the process of incorporating a gender perspective into policies, strategies, programs, project activities. Gender empowerment means improving the status of women to enhance their decision-making capacity at all levels
2. Gender Equality
3. Sex biological differences between males and females, whereas gender is economic, social, political, and cultural attributes and opportunities associated with being women and men.

Check list

Check the student's performance according to the given competencies referring the questions under the check list for every unit. Put a tick (✓) mark against each task whether they are able to perform in the competencies of each unit.

Can you:

	Yes	No
explain what home gardens are.		
elaborate the significance of tree on farmlands		
discuss alley cropping or hedgerow intercropping		
explain about boundary planting		
examine the types of tree fodder and silvopastoral systems		

Unit Assessment

Students' performance has to be assessed continuously over the whole unit. You can determine whether the student has achieved the minimum required level of competence by comparing their performances against the specified level of competencies.

A student working at the minimum requirement level will be able to

- define gender related terminologies
- explain roles of gender in food production and consumption
- describe the role of empowering women in food production and consumption

Students working above the minimum requirement level should be praised and their achievement recognized. They should be encouraged to continue working hard and not become self-satisfied.

Students working below the minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson time during the breaks or at the end of the day.

Unit 16

Safe Food Production and Postharvest Handling

This unit requires approximately 4 periods of teaching time.

Unit Introduction

In this unit, the students will learn about safe food production and postharvest handling. They will be introduced to safety hazards and human health risks, sources of food contaminants that affect human beings, food safety, and nutrition linkage. The unit also familiarize the students with the types of indigenous knowledge in safe food production and postharvest handling.

Unit Learning Outcomes

At the end of this unit, your students will be able to:

- explain safety hazards and human health risks
- state source of food contaminants that affect human beings
- examine food safety and nutrition linkage
- explain types of indigenous knowledge in safe food production and postharvest handling

Main Contents

- 16.1. Food safety hazards and health risks
- 16.2. Source of food contaminants
- 16.3. Food safety and nutrition linkage
- 16.4 Indigenous knowledge in safe food production and post-harvest handling

16.1. Food safety hazards, health risks and sources of contaminants

Period allotted: 2

Competencies

At the end of this lesson, the students will be able to:

- explain safety hazards and human health risks
- state source of food contaminants that affect human beings

Content

- Food safety hazards and health risks
- Source of food contaminants

Overview

In this lesson, the students will learn about food safety and health risks, sources of food contaminants.

Teaching learning processes

Suggested Instructional Materials

- Pictures/photographs, diagrams

Suggested Teaching Methods

Choose and use from the following teaching methods

- Brainstorming questions, questioning, lecture, group discussion, presentation.

Pre-lesson preparation

Before you begin teaching the lesson obtain pictures of the important photographs, diagrams, and other teaching materials.

Presentation of the Lesson

a) Introduction to the lesson

You may begin the lesson asking questions like the following:

- What is food safety?
- What are the sources of food contaminants?

b) Body of the lesson

Explain some food safety hazards and health risks, categories of food safety hazards, and sources of food contaminants.

c) Stabilization

Give a summary of following topics.

- Categories of food safety hazards
- Sources of contaminants

Assessment and follow up

a. Assessment

Ask the students to perform the following tasks.

- Describe the categories of food safety hazards.
- What are the sources of food contaminations?

b. Follow up

Check the students' understanding of the lesson by giving them tasks to do independently. For example, students could write an answer to this question:

What are common examples of biological hazards?

Make sure that you grade and rating the students' activities, levels of participation, and quiz results.

c. Additional Questions

1. Give example of chemical hazards and its causes?
2. What are the major food contamination sources?

Answer to the Activities

Activity 16.1 and 16.2

Let each group share the findings of their group with the whole class.

Answer key to the additional questions

1. Mycotoxins: Produced by fungi and can be toxic to humans and animals. They are formed by molds that grow on crops and foods under certain conditions.
2. Water, air, dust, equipment, sewage, insects, rodents, employees, etc.

16.2. Food safety and nutrition linkage

Period allotted: 1

Competencies

At the end of this lesson, the students will be able to:

- explain food safety and nutrition linkage

Content

- Food safety and nutrition linkage

Overview

In this lesson, the students will learn about food safety and nutrition linkage.

Teaching-learning Processes

Suggested Instructional Materials

- Pictures/Photographs
- charts

Suggested teaching methods

- Brainstorming questions, questioning, group discussion, and presentation.

Pre-lesson preparation

Get the instructional materials and teaching material ready before the lesson. If none is available in your school, prepare your own pictures or photographs with your students in the pedagogical center. Read related literature in the school's library for more ideas on the topic. Prepare notes and activities.

Presentation of the lesson

a). Introduction of the lesson

Introduce the students to what they are going to learn. Ask them questions about food safety and its link with nutrition.

b). Body of the lesson

Explain unsafe food and its effect on nutritional content of food and consumers' health.

c). Stabilization

Give a summary of the following points:

- Causes of nutritional losses
- Linkage between safe food and nutritional content and public health

Assessment and Follow up

a). Assessment

You can ask the students' questions like the following:

- Explain the relationship between unsafe food (or rotten food) with nutritional quality?

b). Follow up

Assign them library work on:

- Characteristics of safe food

c). Additional Questions

1. What are the consequences of eating stale or unsafe foods?

Answer to the Activities

Activity 16.3.

Let each group share their findings with the whole class

Answer key to the additional questions

1. Unsafe food, rotten food, for example, can cause infections or diseases. When people are sick, they are weak and have difficulty

working or concentrating. Some infections also make it difficult for our bodies to absorb the nutrients we need to get healthy. Similarly, stale foods have lost nutrients.

(16.3,16.4) Indigenous knowledge in Safe food production and postharvest handling

Competencies

Period allotted: 1

At the end of this lesson, the students will be able to:

- mention types of indigenous knowledge you know in safe food production and postharvest handling

Content

- Indigenous knowledge in safe food production and postharvest handling

Overview

In this lesson, the students will learn about indigenous knowledge in safe food production and postharvest handling.

Suggested teaching learning process

Suggested Instructional Materials

- Photographs, pictures

Suggested teaching methods

- Brainstorming, lecture , group discussion, and presentation

Pre-lesson preparation

Get the instructional materials and teaching materials ready in advance of the lesson. Read relevant literature to get more ideas on the topic. Prepare notes, activities, and exercises.

Presentation of the Lesson

a. Introduction to the lesson

Introduce the topic briefly with the help of brainstorming. Conduct a brainstorming session. This helps you understand their background

knowledge about indigenous knowledge in safe food production and postharvest handling.

- What are post-harvest losses?
- Do you think post-harvest losses have effect on food security?

b. Body of the lesson

Following the response of your students, try to give explanation of safe food, food handling, and existing postharvest losses.

- Give examples of different forms of indigenous knowledge related to storage structure, pest control, techniques to protect crop or animal products, etc.
- Explain why indigenous knowledge is important in the context of this lesson.

c. Stabilization

- Give examples of indigenous knowledge related to storage structure, pest control, techniques to protect crop or animal products, etc.
- Explain post-harvest losses as a challenge in the developing world.

Assessment and follow up

a. Assessment

Check the students' understanding of the lesson by giving them activities to do individually such as:

- What is the role of traditional knowledge in protecting agricultural products?

b. Follow up

To broaden students' knowledge, give the following library assignments to each group.

- list the storage structures traditionally used by farmers?

a. Additional Questions

1. List some examples of indigenous knowledge used to protect animal or crop products.

Answer to the for Activity

Activity 16.4

Let each student share their answers with the whole class.

Answer to the Additional Question

1. Use of Botanicals, Underground Storage (Pit), Storing unshelled maize, smoking, natural fermentation and proper casing using locally available plant materials, etc.

4.8. Answer Key to the Review Questions

Part I

1. True 2. False

Part II

3. E 4. E 5. A

Check list

Check the student's performance according to the given competencies. Refer to the questions under the check list for every unit. Put a tick (√) mark against each task to see if are able to perform in the competencies of each unit.

Can you:

		Yes	No
1.	explain safety hazards and human health risks_____		
2.	state source of food contaminants that affect human beings_____		
3.	explain food safety and nutrition linkage_____		
4.	mention types of indigenous knowledge in safe food production and postharvest handling_____		

Unit Assessment

The assessment will be made by comparing students' performance with the specified level of competencies. Besides, the teacher has to recognize the level of performance of each student and provide assistance accordingly,

Thus:

Students at the minimum requirement level

A student at a minimum requirement level will be able to:

- explain safety hazards and human health risks state source of food contaminants,
- examine food safety and nutrition linkage,
- mention types of indigenous knowledge in safe food production and postharvest handling

Student working above the minimum requirement level

In addition, a student working above the minimum requirement level and considered as a higher achiever should be able to:

- explain safety hazards
- describe the risk minimization strategies,
- state sources of food contaminants,
- describe food safety and its linkages with nutritional quality,
- compare local knowledge against modern way of safe food production
- explain post-harvest management on the basis of certain attributes.

Students below the minimum requirement level

Students working below a minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson time during the breaks or at the end of the day.

Students who have not only achieved the minimum requirement level but also achieved a little bit more should be supported so that they can attain the higher achiever competencies. Students who fulfill the higher-achiever competencies also need special support to contribute and achieve more.

Unit 17

Application of Information and Communication Technologies (ICT) in Agriculture

This unit requires approximately 3 periods of teaching time.

Unit Introduction

In this unit, the students will learn about roles of ICT in agriculture, major applications of ICT, and Drawbacks and their possible solutions of ICT in agriculture.

Unit Learning Outcomes

At the end of this unit, your students will be able to:

- describe the roles of ICT in Agriculture
- explain the major application of ICT in agriculture
- discuss the drawbacks and solutions of ICT in agriculture.
- Use ICTs in agricultural activities.

Main Contents

- 17.1. Roles of ICT in agriculture
- 17.2. Major application of ICT in agriculture
- 17.3. Drawbacks and solutions of ICT in agriculture

(17.1,17.2,17.3) The roles and major applications of ICT in Agriculture

Period allotted: 3

Competencies

At the end of this lesson, the students will be able to:

- demonstrate an understanding of the role of ICT in agriculture.
- demonstrate and appreciate the major application of ICT in agriculture, drawbacks, and solutions of ICT in agriculture.
- demonstrate skills to use ICT application in agriculture.

Content

- Roles of ICT in agriculture
- Major application of ICT in agriculture
- Drawbacks and solutions of ICT in agriculture

Overview

- In this lesson, the students will learn about the roles of ICT, major application of ICT, and drawbacks and solutions of ICT in agriculture.

Teaching learning processes

Suggested Instructional Materials

- Pictures, computers, mobile phones with applications currently in operation by farmers

Suggested Teaching Methods

Use the following teaching methods as suggested in the general introduction and presentation of the lesson:

- Brainstorming questions, question-answer, group discussion, presentation.

Pre-lesson preparation

Before you begin teaching the lesson obtain pictures, mobile phones, which show roles of ICT, basic ICT applications that can be used in agriculture and other teaching materials.

Presentation of the Lesson

a. Introduction to the lesson

You can begin the lesson by asking questions like the following:

- What is ICT?

b. Body of the lesson

Give brief characteristics of roles, major application of ICT and the challenges and solutions of ICT in agriculture.

c. Stabilization

Give a summary of the following topics.

- Roles of ICT
- Major applications of ICT
- Drawbacks and solutions of ICT in agriculture

Assessment and follow up

a. Assessment

In order to check whether the students have understood the lesson, ask them to present the following task.

- Describe the importance of ICT in agriculture?
- List the types of ICT tool used in agriculture?
- Explain the challenges of ICT in agriculture?

b. Follow up

Check the students' understanding of the lesson by giving them an exercise to do independently.

- What are the advantages of using ICT in agriculture over the conventional way of communication?

c. Additional Questions

1. List examples of ICT application along the agricultural value chain.

Answer to the Activities

Activity 17.1.

- a. market information, extension services, etc
- b.

Traditional forms of communication	ICT based

Activity 17.2.

Following their assessment students may come with a list of advantages of ICT to agriculture production in their localities.

Activity 17.3.

Following their assessment students come with a list of challenges of ICT to agriculture in their localities. Answers may include challenges related to technology, content, or capacity.

Answer to the additional questions

1. Extension (weather data, pest/disease monitoring, and farm advice), market information and places, machinery rental markets.....

Answer to the Review Questions

Part I

1. True
2. True
3. True

Part II

1. D
2. D
3. D

Check list

Check the student's performance according to the given competencies referring the questions under the check list for every unit. Put a tick (√) mark against each task- see whether they are able to perform in the competencies of each unit. Then you can make your own assessment and check whether the competencies are met or not.

Can you:

		Yes	No
1.	explain the roles of ICT _____		
2.	mention the major application of ICT in agricultural production_____		
3.	discuss the challenges and possible solutions of ICT		
4.	motivated to use ICT in agricultural activities _____		

Unit Assessment

The assessment will be made by comparing students' performance with the specified level of competencies. Besides, the teacher has to recognize the level of performance of each student and provide assistance accordingly, Thus:

Students at the minimum requirement level

A student at a minimum requirement level will be able to:

- explain the roles of ICT,
- mention the major application of ICT in agricultural production,
- discuss the challenges and possible solutions of ICT,
- discuss the challenges and possible solutions of ICT, and motivated to use ICT in agricultural activities.

Students working above the minimum requirement level

In addition, a student working above the minimum requirement level and considered as a higher achiever should be able to:

- compare and contrast different tools of ICT in agriculture,
- analyze the advantages of ICT based application and their contribution in livelihood of the farming community,
- discuss the possible solutions for the common ICT related challenges in smallholder farmers.

Students below the minimum requirement level

Students working below a minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson time during the breaks or at the end of the day.

Students who have not only reached the minimum requirement level but also achieved a little bit more should be supported so that they can attain the higher achiever competencies.

Minimum Learning Competency of Agriculture for Grade 12

Thematic area	Unit	Competencies
Crop production and management	1. Vegetable Production and Management	- Students understand what are vegetable crops, their uses, the methods used to produce and manage them, and problems associated with their production and management. - Students develop positive attitudes towards the production of vegetable crops, principles of vegetable crops management and different types of vegetable crops production systems.
	2. Fruit Crops Production and Management	- Students understand what are fruit crops, their importance, the methods used to produce and manage them, and problems associated with their production and management. - Students develop positive attitudes towards the production of fruit crops, principles and technique of fruit crops propagation, establishment of nursery and management of orchards.
	3. Root and Tuber Production and Management	- Students understand what root and tuber crops are, their uses, the methods used to produce and manage them, and problems associated with their production and management. - Students develop positive attitudes towards the production of root and tuber crops, and apply the methods used in the production and management of root and tuber crops.
	4. Coffee, tea and spices production and management	- Students develop the knowledge and skills to produce process and manage coffee, tea and spices from time it is planted to export and use. - Students work cooperatively with others in all processes involved in coffee, tea and spices production and management. - Students propose solutions and act upon to ameliorate the major challenges in coffee, tea and spices production so as to increase productivity.

Thematic area	Unit	Competencies
Livestock production and management	5. Introduction to Plant Biotechnology	- Students demonstrate the ability to understand the concept of tissue culture and genetic engineering techniques of growing plant cells, tissues, and organs to of growing plants in their school and/or home garden using tissue culture techniques. - Students exhibit the attitude of appreciating and skills of applying the techniques of tissue culture and genetic engineering on the plants grown in the local school and/or home garden.
	6. Beef cattle production and management	- Students will develop the ability to comprehend beef cattle breeds, methods of selection, feeds and methods of breeding, housing, and major diseases of beef cattle and their controlling methods. - Students will develop interest in the production and management practices of beef cattle that could help them develop entrepreneurial attitude and skills. - Students develop skills of feeding, housing and controlling major diseases of beef cattle in their locality for better productivity.
	7. Sheep and goat production and management	- Students will develop the ability to identify and analyze types, feeds and feeding, housing, diseases and controlling methods and production and processing of sheep and goat meat and milk production and processing. - Students will demonstrate advocative activities to promote sheep and goat production and management for better productivity in their local areas. - Students will develop the skills of preparing feeds and feeding constructing housing and producing and processing meat and milk of goats and sheet.

Thematic area	Unit	Competencies
Livestock production and management	8. Camel production and management	- Students will develop the knowledge of identifying camel breeds, feeds and feeding, housing, diseases and methods of the control and meat and milk production and processing. - Students will demonstrate sensitivity towards camel production and management based on the benefits they contributes to the producers.
	9. Poultry production and management	- Students will develop adequate knowledge about poultry production and management - Students will develop entrepreneurial attitudes and skills towards poultry production and management. - Students will demonstrate ability to apply the knowledge acquired for better poultry production and management.
	10. Fishery management	- Students will demonstrate knowledge of activities that occur at a fishery including preparing feed, handling fish and fish products, fish rearing and disease in aquaculture. - Students will demonstrate an understanding and appreciation for the indigenous knowledge in fish processing and work to improve the indigenous knowledge for better productivity in fishery management - Students will demonstrate the ability and skills of fishing, handling fish and fish products, removing the scales, the gut and the gills.
	11. Apiculture	- Students will demonstrate an understanding on how to manage honey bee, colony and queen rearing, ability to identify bee diseases, pests and predators with controlling methods. - Students will demonstrate and appreciation for indigenous knowledge in apiculture and will be committed to improve the practice better hive products and processing. - Students will demonstrate skills to prepare modern hives at their schools or home to produce and process hive products.

Thematic area	Unit	Competencies
Natural Resources Management	12. Nursery and plantation technology	- Students demonstrate the ability to establish nursery, plant of nursery and manage based on the principles. - Students develop positive attitudes to the practices of nursery and plantation technology.
	13. Basics of Agro-Forestry Systems and Practices	- Students appreciate and take part in the establishment and management methods of agro-forestry in their vicinities. - Students will develop ability to comprehend agro-forestry practices globally, regionally and locally which could help them develop positive attitude towards the values that agroforestry practices contributes.
	14. Soil and Water Conservation	- Students develop the knowledge of the concepts used in the activities of soil and water conservation, - Students demonstrate skills of conserving soil and water resources and engaging in in soil and water and conservation activities with self-initiation.
	15. Gender and Human Nutrition	- Students demonstrate the ability to explain the roles of gender and empowering women in the food production and consumptions - Students demonstrate positive attitude towards the roles that women play in food production and consumption.
Nutrition Sensitive Agriculture	16. Safe Food Production and Postharvest Handling	- Students will demonstrate an understanding of the food safety hazards and health risks - Students will demonstrate knowledge of the major source of food contaminants, and the linkage between food safety and nutrition linkage - Students will demonstrate an understanding and appreciation for the indigenous knowledge in indigenous knowledge applicable in safe food production and postharvest handling. - Students will demonstrate the ability and skills of safe food production and postharvest handling.

Thematic area	Unit	Competencies
Agricultural Technology	17. Application of Information and Communication Technologies (ICT) in Agriculture	▪ Students will demonstrate an understanding of the role of ICT in agriculture. ▪ Students will demonstrate the ability to use different applications of ICT in agriculture and analyse their solutions to drawbacks of the applications. ▪ Students will demonstrate skills to use ICT application in agriculture. ▪ Students will be motivated to use ICT in agricultural production and utilization

Agriculture Syllabus for Grade 12

Unit One: Vegetable Production and Management (7 Periods)

Unit Learning Outcomes: At the end of this unit, the students will be able to:

- know vegetable crops production, importance, problems and prospect of vegetable crops production
- list environmental factors influencing vegetable crops production
- understand classifications of vegetable crops, types of vegetable crops production system and principles of vegetable crops

Competencies	Main Contents	Learning strategies
Students will be able to: ▪ understand what are vegetable crops, their uses, the methods used to produce and manage them, and problems associated with their production and management. ▪ develop positive attitudes towards the production of vegetable crops management and different types of vegetable crops production systems.	1.1.Importance, problems and prospects of vegetable crop production in Ethiopia 1.2.Environmental factors influencing vegetable production 1.3 Classifications of vegetable crops 1.4. Types of vegetable crop production System 1.5.Principles of vegetable crops management	▪ Provide introductory information on the terms and definition of vegetable crops ▪ Ask students to list the importance, problems and prospect of vegetable crops production in Ethiopia ▪ Make group to discuss on environmental factors influencing vegetable crops production and classify vegetable crops based on different parameters ▪ Ask students to list types of vegetable crops production systems ▪ Let the students to explain principles of vegetable crops management

Unit Two: Fruit Crops Production and Management (7 Periods)

Unit Learning Outcomes: At the end of this unit, the students will be able to:

- define common terms
- list the importance, problems and prospect of fruit crops production in Ethiopia
- classify fruit crops
- mention and explain principles and techniques of fruit propagation
- describe the importance of planning and establishing fruit crops nursery site and management of orchards
- produce and manage some of the fruit crops in their school and/or home garden

Competencies	Main Contents	Learning strategies
Students will be able to: ▪ understand what are fruit crops, their importance, the methods used to produce and manage them, and problems associated with their production and management. ▪ develop positive attitudes towards the production of fruit crops, principles and technique of fruit crops propagation, establishment of nursery and management of orchards.	2.1. Definition of some common terms 2.2. Importance, problems and prospect of fruit crops production in Ethiopia 2.3 Classification of fruit crops 2.4. Principles and techniques of fruit propagation 2.5. Establishing a nursery 2.6. Management of Orchards 2.7. Factors influencing the quality of fruit crops during harvest and post-harvest	▪ Provide introductory information on the terms and definition of fruit crops ▪ Ask students to list the importance, problems and prospect of fruit crops production in Ethiopia ▪ Ask students to classify fruit crops based on different parameters ▪ Make group to practice on fruit propagation, planning and establishing fruit crops nursery site and management of orchards • Ask students to mention factors considered during harvesting and post-harvest handling of fruits crops

Unit Three: Root and Tuber Production and Management (5 Periods)

Unit Learning Outcomes: At the end of this unit, the students will be able to:

- define common terms used in the unit
- classify root and tuber crops
- explain the importance of root and tubers crops
- elaborate what factors considered during harvesting and post-harvest handling of root and tuber crops production
- analyze different management and protection methods used in the production of root and tuber crops
- assess the constraints in the production of root and tuber crops production in Ethiopia and suggest solutions to increase productivity
- give values to the production and management of root and tuber crops
- produce and manage some of the root and tuber crops in their school and/or home garden.

Competencies	Main Contents	Learning strategies
Students will be able to: ▪ understand what root and tuber crops are, their uses, the methods used to produce and manage them, and problems associated with their production and management. ▪ develop positive attitudes towards the production of root and tuber crops, and apply the methods used in the production and management of root and tuber crops.	3.1. Definition of terms 3.2. Classification of root and tuber crops 3.3. Importance of root and tuber crops 3.4. prospects of root and tuber crops production in Ethiopia 3.5. problems of root and tuber crops production in Ethiopia 3.6. Root and tuber crops managements and protection 3.7. Harvesting and post-harvest handling of root and tuber crops	▪ Recall issues they have learnt from previous grade (11th) and try to add some starting points ▪ Tell the students to classify root and tuber crops based on different parameters ▪ Ask students to list the importance, problems and prospect of root and tuber crops production in Ethiopia ▪ Ask students to mention factors considered during harvesting and post-harvest handling of root and tuber crops

Unit Four: Coffee, Tea and Spices Production and Management (16 periods)

Unit Learning Outcomes: At the end of this unit, the students will be able to:

- describe history, origin and economic importance of coffee and tea
- identify ecological requirements of coffee requirements and practices coffee and tea propagation techniques, harvesting, and processing
- differentiate the ecological and soil requirements for and production
- explain the various cultural operations needed to establish coffee and tea plantations
- explain the processes involved in the production and management of coffee and tea from seed to cup
- participate wholeheartedly in production and management of coffee and tea
- develop important skills required in the processes of producing coffee and tea

Competencies	Main Contents	Learning strategies
Students will be able to: ▪ develop the knowledge and skills to produce process and manage coffee, tea and spices from time it is planted to export and use. ▪ work cooperatively with others in all processes involved in coffee, tea and spices production and management ▪ propose solutions and act upon to ameliorate the major challenges in coffee, tea and spices production so as to increase productivity.	4.1. History, origin, production status and economic importance of coffee, tea and spices 4.2. Ecological and soil requirements for coffee, tea and spices production 4.3. Propagation, nursery establishment and management of coffee, tea and spices seedling 4.4. Field establishment and management practices of coffee, tea and spices 4.5. Harvesting and processing coffee and tea	▪ Ask students to describe the history, origin, production status and economic importance of coffee ▪ Make groups to discuss on ecological and soil requirements for coffee production and the most commonly used methods of propagation of coffee ▪ Ask students to explain the various cultural operations for the established coffee plantations in the field ▪ Ask students to mention different methods of coffee harvesting and processing • Let the students to describe history, origin, production status and economic importance of tea • Ask the students to mention the optimum climatic and soil requirements and propagation techniques of the tea • ask the students to mention and describe criteria for site selection, field preparation and management of tea plant under field conditions ▪ Make groups to discuss on different method of tea harvesting and processing • Let the students to describe history, origin, production status and economic importance of spice and herbs ▪ Ask the students to mention the ecological requirements of spices and herbs • Ask the students describe criteria for site selection, field preparation and management of tea plant under field conditions ▪ Make groups to discuss on different cultivation practices of individual Spices and herbs

Unit Five: Introduction to Plant Biotechnology (4 Periods)

Unit Learning Outcomes: At the end of this unit, the students will be able to:

- explain what tissue culture means.
- point out types of crops produced by tissue culture
- describe the benefits of tissue culture in crop production
- appreciate the techniques of growing plant cells, tissues, and organs in growing plants
- apply the techniques of growing plant cells, tissues, and organs

Competencies	Main Contents	Learning strategies
Students will be able to: ▪ demonstrate the ability to understand the concept of tissue culture and genetic engineering techniques of growing plant cells, tissues, and organs to of growing plants in their school and/or home garden using tissue culture techniques ▪ exhibit the attitude of appreciating and skills of applying the techniques of tissue culture and genetic engineering on the plants grown in the local school and/or home garden.	5.1. Introduction to tissue culture 5.2. Types of crops produced by tissue 5.3. Benefits of tissue culture 5.4 Introduction to genetic engineering 5.5. Application of genetic engineering in crop production	▪ Recall the agricultural technology issues learnt in grade 11 and give extended information on plant biotechnology and related concepts ▪ Ask students to explain what genetic engineering is • Introduce brief concepts on the definition of tissue culture and its significance in agriculture and related activities • Ask students to explain what tissue culture mean ▪ Organize buzz-group to classify crops that can be produced by tissue culture and give group leaders' opportunities to present outcomes of their discussions. ▪ Ask students to explain the benefits of tissue culture ▪ Organize buzz-group to discuss application of genetic engineering on crop production allow students to present outcomes of their discussions

Unit Six: Beef Cattle Production and MANAGEMENT (6 Periods)

Unit Learning Outcomes: At the end of this unit, the students will be able to:

- identify different beef cattle breeds and make proper selection
- categorize beef cattle breeds and explain selection procedures.
- describe beef cattle housing
- explain beef cattle feed resources and their feeding methods
- judge the cattle housing used by beef cattle breeders based on the criteria required
- list major diseases and parasites of beef cattle and methods to control them
- describe the processes involved in the processing and handling of meat
- Show interest in breeding beef cattle
- Promote the production and management of beef cattle in their localities.

Competencies	Main Contents	Learning strategies
Students will be able to: - develop the ability to comprehend beef cattle breeds, methods of selection, feeds and methods of breeding, housing, and major diseases of beef cattle and their controlling methods. - develop interest in the production and management practices of beef cattle that could help them develop entrepreneurial attitude and skills. - develop skills of feeding, housing and controlling major diseases of beef cattle in their locality for better productivity.	6.1. Beef cattle breeds and methods of selection 6.2. Beef cattle feeds and feeding methods 6.3. Beef cattle housing 6.4. Major disease of beef cattle and control methods 6.5. Meat production and processing	- Recognize concepts of animal production from grade 11 and give them additional remarks - Ask students to mention beef cattle breeds and selection methods - Organize pair-work to identify beef cattle feedings and feeding methods and let groups explain to the class. - Organize students to visit a beef cattle housing and write a report - Give class work major disease of beef cattle and control methods - Give the chance group leaders opportunities to present outcomes of their discussions - Organize buzz-group to discuss on meat production and processing and let the group present the outcomes of the discussion

Unit Seven: Sheep and Goat Production and Management (6 Periods)

Unit Learning Outcomes: At the end of this unit, the students will be able to:

- classify different sheep and goat breeds and make selections for preferred traits
- clarify sheep and goat feed resources and their feeding methods
- identify different types of housing for sheep and goats
- list the major sheep and goat diseases and parasites and the controlling methods
- explain the major products and product processing of sheep and goat
- give values and proper place to sheep and goat breeds

Competencies	Main Contents	Learning strategies
Students will be able to: ▪ develop the ability to identify and analyze types, feeds and feeding, housing, diseases and controlling methods and production and processing of sheep and goat meat and milk production and processing. ▪ demonstrate advocative activities to promote sheep and goat production and management for better productivity in their local areas. ▪ develop the skills of preparing feeds and feeding constructing housing and producing and processing meat and milk of goats and sheet.	7.1. Sheep and goat breeds and selection 7.2. Sheep and goat feeds and feeding 7.3. Sheep and goat housing 7.4. Major diseases of sheep and goat and methods of controlling the diseases 7.5. Sheep and goat meat and milk production and processing	▪ Introduce sheep and goat what makes them different from large and small animals and their contribution for socioeconomics of human beings ▪ Ask students to mention sheep and Goat breeds and selection methods ▪ Organize pair-work to identify sheep and Goat feedings and feeding methods and let groups explain to the class. ▪ Organize students to visit a sheep and Goat housing and write a report ▪ Give class work major disease of sheep and Goat and control methods ▪ Give the chance group leaders opportunities to present outcomes of their discussions ▪ Organize buzz-group to discuss on meat and milk production and processing and let the group present the outcomes of the discussion

Unit Eight: Camel Production and Management (4 Periods)

Unit Learning Outcomes: At the end of this unit, the students will be able to:

- recognize different camel breeds and selections
- describe camelfeeds and feeding methods
- differentiate camel housing from other livestock housing
- state the major diseases of camel and suggest their controlling methods
- explain the techniques used in camel meat and milk production and processing
- describe camel meat and milk production and processing
- promote camel production and management in their locality (in the low land of Ethiopia)
- construct a model house for camel production

Competencies	Main Contents	Learning strategies
Students will be able to: ▪ develop the knowledge of identifying camel breeds, feeds and feeding, housing, diseases and methods of the control and meat and milk production and processing. ▪ demonstrate sensitivity towards camel production and management based on the benefits they contributes to the producers.	8.1. Camel breeds and selection 8.2. Camel feeds and feeding 8.3. Camel housing 8.4. Major disease of camel and methods of their control 8.5. Camel meat and milk production and processing	▪ Introduce camels what makes them different from large and small animals and their peculiar characteristics as well as their contribution for socioeconomics of human beings ▪ Ask students to mention camel breeds and selection methods ▪ Organize pair-work to identify camel feedings and feeding methods and let groups explain to the class. ▪ Give class work major disease of Camel and control methods ▪ Give the chance group leaders opportunities to present outcomes of their discussions ▪ Organize buzz-group to discuss on meat and milk production and processing and let the group present the outcomes of the discussion

Unit Nine: Poultry Production and Management (6 Periods)

Unit Learning Outcomes: At the end of this unit, the students will be able to:

- analyse the characteristics of both indigenous and exotic poultry breeds in Ethiopia
- recognize poultry breeds, classification and selection methods
- clarify poultry feed resources and feeding methods
- estimate the feed requirements for different types of poultry breeds
- compare common types of poultry housings
- describe egg incubation and hatchery management
- explain poultry brooding and rearing methods
- describe layers and broiler management
- mention poultry and swine diseases and suggest their controlling methods
- initiate their classmates to engage in poultry production and management

Competencies	Main Contents	Learning strategies
Students will be able to: - develop adequate knowledge about poultry production and management - develop entrepreneurial attitudes and skills towards poultry production and management. - demonstrate ability to apply the knowledge acquired for better poultry production and management.	9.1. Poultry breeds, classification and selection 9.2. Poultry feeds and feeding 9.3. Poultry housing 9.4. Poultry incubation and hatchery management 9.5. Poultry brooding and rearing 9.6. Layers and broilers management 9.7. Major diseases of poultry and controlling methods	- Introduce poultry, what makes them different from animals and their peculiar characteristics as well as their contribution for socioeconomics of human beings - Ask students to mention poultry species, breeds and their selection methods - Organize pair-work to identify poultry feed resources and feeding methods and let groups explain to the class. - Give the chance group leaders opportunities to present outcomes of their discussions - Organize buzz-group to discuss on poultry housing, incubation and hatchery methods and let the group present the outcomes of the discussion to the rest the class. - Give class work on major disease of poultry and their controlling methods.

Unit Ten: Fishery Production and Management (6 Periods)

Unit Learning Outcomes: At the end of this unit, the students will be able to:

- recognize farmed fish species in Ethiopia
- explain basic anatomy of bony fishers
- describe fish feeds and feeding practices
- examine the fish culture techniques
- explain fish rearing methods
- identify fishing methods
- express the handling of fish and fish products
- list the major disease of fish and control methods
- elaborate the application of indigenous knowledge in fish processing
- give values for indigenous knowledge in fishery management
- practice handling fish and fish products effectively

Competencies	Main Contents	Learning strategies
Students will be able to: ▪ demonstrate knowledge of activities that occur at a fishery including preparing feed, handling fish and fish products, fish rearing and disease in aquaculture. ▪ demonstrate an understanding and appreciation for the indigenous knowledge in fish processing and work to improve the indigenous knowledge for better productivity in fishery management ▪ demonstrate the ability and skills of fishing, handling fish and fish products, removing the scales, the gut and the gills.	10.1. Basic terms in aquaculture and farmed fish species in Ethiopia 10.2. Basic anatomy of bony fishers 10.3. Fish feeds and feeding practices 10.4. Fish culture techniques 10.5. Fish rearing 10.6. Fishing methods 10.7. Handling fish and fish products 10.8. Diseases in aquaculture 10.9. Indigenous knowledge in fish processing	▪ Introduce aquaculture (fisheries and fishing) and peculiar characteristics as well as their contribution for socioeconomics of human beings ▪ Ask students to mention fish species in Ethiopia and basic anatomy of bony fish ▪ Organize pair-work to identify fish feed resources and feeding methods and let groups explain to the class. ▪ Give the chance group leaders opportunities to present outcomes of their discussions ▪ Organize buzz-group to discuss on fish culture, and fish rearing methods and let the group present the outcomes of the discussion ▪ Ask students to list out the major fishing methods ▪ Give the chance group leaders opportunities to present outcomes of their discussions ▪ Organize buzz-group to discuss on fish and fish product handling methods and let the group present the outcomes of the discussion. ▪ Give class work major disease of fish and control methods

Unit Eleven: Apiculture (8 Periods)

Unit Learning Outcomes: At the end of this unit, the students will be able to:

- explain the situation of honey bee management in Ethiopia
- recognize bee biology and behavior
- list types and members of honey bee colony and describe their roles in a colony
- identify honey bee management and queen rearing techniques
- describe hive products and processing methods
- mention major diseases, pests, predators of honey bees and their control methods
- give values for indigenous knowledge used in apiculture and committed to improve the application
- compare indigenous knowledge against scientific knowledge in apiculture
- give values for indigenous knowledge used in apiculture and committed to improve the application
- Prepare modern hives.

Competencies	Main Contents	Learning strategies
Students will be able to: - demonstrate an understanding on how to manage honey bee, colony and queen rearing, ability to identify bee diseases, pests and predators with controlling methods. - demonstrate and appreciation for indigenous knowledge in apiculture and will be committed to improve the practice better hive products and processing. - demonstrate skills to prepare modern hives at their schools or home to produce and process hive products.	11.1. Introduction to honey bee management 11.2. Bee biology and behavior 11.3. Types of honey bee colony 11.4. Management of honey bees 11.5. Colony management and queen rearing 11.6. Hive products and processing 11.7. Bee diseases, pests and predators 11.8. Indigenous knowledge in apiculture	▪ Introduce apiculture (honeybee production) what makes them peculiar characteristics as well as their contribution for socioeconomics of human beings ▪ Ask students to explain honey bee management practices in Ethiopia ▪ Give class work on the bee biology and behavior and let the group to explain it to the class ▪ Ask students to describe honey bee management and queen rearing techniques ▪ Organize pair-work to identify hive products and its processing methods and let the groups explain their findings. ▪ Ask students to mention the honeybee diseases, pests and predators

Unit Twelve: Nursery and Plantation Technology (3 Periods)

Unit Learning Outcomes: At the end of this unit, the students will be able to:

- define nursery establishment and management.
- explain nursery site selection, preparation and layout.
- discuss methods of producing plants from seeds
- apply the methods of producing plants from seeds using modern techniques and indigenous knowledge

Competencies	Main Contents	Learning strategies
Students will be able to: ▪ demonstrate the ability to establish nursery, plant of nursery and manage based on the principles. ▪ develop positive attitudes to the practices of nursery and plantation technology.	12.1.Nursery establishment and management 12.2 Design and layout of the nursery 12.3. Producing plants from seeds 12.4.Plantation, establishment and management	▪ Give brief description about nursery and related technologies ▪ Ask students to individually explain importance of site selection, preparation and layout ▪ Pair up students and let them to establish nursery and apply proper follow-up and let the group present a report. ▪ Organize buzz-group to discuss on about producing plants from seeds. ▪ Give group leaders opportunities to present outcomes of their discussions

Unit Thirteen: Basics of Agro-Forestry Systems and Practices (6 periods)

Unit Learning Outcomes: At the end of this unit, the students will be able to:

- define what agro-forestry and related terms.
- discuss the significance of agro forestry in the agricultural systems
- Analyze the types of agro-forestry systems
- discuss about agro-forestry species, establishment and management methods
- Value the species, establishment and management of agroforestry in their local area

Competencies	Main Contents	Learning strategies
Students will be able to: ▪ appreciate and take part in the establishment and management methods of agro-forestry in their vicinities ▪ develop ability to comprehend agro-forestry practices globally, regionally and locally which could help them develop positive attitude towards the values that agroforestry practices contributes.	13.1. Definition of agro-forestry, agro forestry systems, practices and technologies 13.2. Significance of agro forestry 13.3. Classification of agro forestry systems 13.4. Agro forestry species, their establishment and management methods	▪ Ask students to define agroforestry and related terms. ▪ Organize buzz-group to discuss on the significance of trees on farmlands ▪ Give group leaders opportunities to present outcomes of their discussions ▪ Ask students to the types of alley cropping or hedgerow Intercropping and boundary planting ▪ Organize buzz-group to discuss on tree fodder and silvo-pastoral systems ▪ Give group leaders opportunities to present outcomes of their discussions

Unit Fourteen: Soil and Water Conservation (5 periods)

Unit Learning Outcomes: At the end of this unit, the students will be able to:

- describe soil properties.
- elaborate the types of soil erosion
- illustrate the major causes of soil erosion
- analyze the negative impacts of soil erosion on the environment
- describe the types of soil and water conservation practices
- justify the need of soil and water conservation
- mention types of indigenous knowledge's applicable in Soil and water conservation

Competencies	Main Contents	Learning strategies
Students will be able to: ▪ develop the knowledge of the concepts used in the activities of soil and water conservation, demonstrate skills of conserving soil and water resources and engaging in in soil and water and conservation activities with self-initiation.	17.1. Soil properties 17.2. Soil erosion 17.3. Major causes of soil erosion 17.4. Negative impacts of soil erosion 17.5. Types of soil and water conservation practices 17.6. Need of soil and water conservation 17.7. Indigenous Knowledge in Soil and water conservation	▪ Provide brief information on soil and water conservation and its role in agriculture or land management ▪ Ask students to individually explain soil properties. ▪ Pair up students and let them to discuss about types of soil erosion and major causes and let the group present a report ▪ Organize buzz-group to discuss on negative impacts of soil erosion on the environment ▪ Ask students to individually list the types of soil and water conservation practices. ▪ Organize buzz-group to discuss on need of soil and water conservation ▪ Give group leaders opportunities to present outcomes of their discussions ▪ Ask the learners to explain the importance of indigenous knowledge in Soil and water conservation. ▪ Mention types of indigenous knowledge's applicable in Soil and water conservation

Unit Fifteen: Gender and Human Nutrition (3 Periods)

Unit Learning Outcomes: At the end of this unit, the students will be able to:

- define gender related terminologies
- explain roles of gender in food production and consumption
- describe the role of empowering women in food production and consumption

Competencies	Main Contents	Learning strategies
Students will be able to: ▪ demonstrate the ability to explain the roles of gender and empowering women in the food production and consumptions ▪ demonstrate positive attitude towards the roles that women play in food production and consumption.	15.1. Basic gender-related terminologies 15.2. Gender role in food production and consumption 15.3. Empowering women in food production and consumption	▪ Remind students what they have learnt in Grade 11 about human nutrition and give additional information on new concepts related to gender and human nutrition ▪ Ask students to define gender related terminologies ▪ Organize buzz-group to discuss on gender role in food production and consumption ▪ Pair-up students to discuss on empowering women in food production and consumption ▪ Give group leaders opportunities to present outcomes of their discussions

Unit Sixteen: Safe Food Production and Postharvest Handling (4 periods)

Unit Learning Outcomes: At the end of this unit, the students will be able to:

- explain safety hazards and human health risks
- state source of food contaminants that affect human beings
- examine food safety and nutrition linkage
- mention types of indigenous knowledge in safe food production and postharvest handling

Competencies	Main Contents	Learning strategies
Students will be able to:	16.1. Food safety hazards and health risks	• Provide basic information on food safety and postharvest handling issues • Ask students to explain safety hazards and health risks
▪ demonstrate an understanding of the food safety hazards and health risks ▪ demonstrate knowledge of the major source of food contaminants, and the linkage between food safety and nutrition linkage	16.2. Source of food contaminants	▪ Organize buzz-group to discuss source of food contaminants and give group leaders opportunities to present outcomes of their discussions
▪ demonstrate an understanding and appreciation for the indigenous knowledge in indigenous knowledge applicable in safe food production and postharvest handling. ▪ demonstrate the ability and skills of safe food production and postharvest handling.	1.3. Food safety and nutrition linkage 1.4. Indigenous knowledge in safe food production and postharvest handling	• Organize pair-work to food safety and nutrition linkage let groups explain to the class. • Ask the learners to explain the importance of indigenous knowledge in Safe food production and postharvest handling • Mention types of indigenous knowledge's applicable in Safe food production and postharvest handling

Unit Seventeen: Application of Information and Communication Technologies (ICT) in Agriculture (3 Periods)

Unit Learning Outcomes: At the end of this unit, the students will be able to:

- describe the roles of ICT in Agriculture
- explain the major applications of ICT in agriculture
- discuss the drawbacks and solutions of ICT in agriculture.
- Value using ICT in agriculture activities
- Use ICT in agricultural activities.

Competencies	Main Contents	Learning strategies
Students will be able to: ▪ understanding of the role of ICT in agriculture. ▪ demonstrate the ability to use different applications of ICT in agriculture and analyse their solutions to drawbacks of the applications. ▪ demonstrate skills to use ICT application in agriculture. ▪ motivated to use ICT in agricultural production and utilization	17.1. Roles of ICT in agriculture 17.2. Major application of ICT in agriculture 17.3. Drawbacks and solutions of ICT in agriculture	▪ Introduce the briefs description of ICT its importance, and application in agriculture ▪ Ask students to explain the advantages of using ICT in agriculture production ▪ Organize buzz-group to discuss different application of ICT in agriculture production ▪ Allow students to present outcomes of their discussions

