



Ministry of Education, Heritage & Arts



Agricultural Science for Year 11



Technology & Employment Skills Training Department
2020

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Year 11, this is based on the Year 11 Agricultural Science Syllabus, 2020.

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Technology and Employment Skills Training

Ministry of Education, Heritage & Arts, Fiji

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Ministry of Education

Level1, Harbour Front Building

Rodwell Road

Private Mail Bag

Suva

Fiji

Phone 3306077

Email: www.education.gov.fj

:test_info@govnet.gov.fj

PREFACE

Welcome to Agriculture for Year 11.

This book was designed to complement lessons prepared by teachers for the learning and teaching of the Year 11 Agricultural Science Syllabus implemented in 2020.

Teachers are encouraged to use other resource materials to reinforce lesson content.

Ministry of Education, Heritage & Arts

Suva

15th January 2020

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This textbook has been produced by the Agricultural Science Section of the Technology and Employment Skills Training Section of the Ministry of Education, Heritage & Arts.

It has been written and compiled by:

Mrs. Salote Matameli (Assemblies of God High School)

Mr. Vikal Prakash (Suva Grammar Secondary School)

Mr. Cabemaiwai Turagasau (Bau College)

Mrs. Elizabeth Whippy (Sacred Heart College)

Mr. Mukesh Chand (Saraswati College)

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ABOUT THIS BOOK

INTRODUCTION

This is a guide to the way in which the rest of the book is set up.
It also contains suggestions on how the book is to be used.

The content of the book is based on the Year 11 Agricultural Science Syllabus prepared by the Technology and Employment Skills Training [TEST] Section of the Ministry of Education, Heritage & Arts and implemented in 2020.

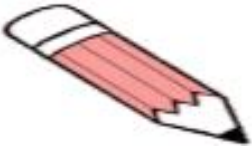
As a subject of the Technology Key Learning Area, this book contains concepts and skills which relate to real life situations. As such practical work is encouraged to ensure learning of these lifelong skills.

Like the respective syllabus, this book is divided into four strands and six sub-strands, details of which are:

STRAND	SUB-STRAND
AS 11.1 AGRICULTURAL CONCEPTS	AS 11.1.1 Field Trials
	AS 11.1.2 Value Adding
	AS 11.1.3 Biosecurity
	AS 11.1.4 Careers
AS 11.2 FARM MANAGEMENT	AS 11.2.1 Physical Capital * AS 11.2.1.1 Fences * AS 11.2.1.2 Buildings
	AS 11.2.2 Financial Capital * AS 11.2.2.1 Farm Planning * AS 11.2.2.2 Decision Making
AS 11.3 AGRONOMY	AS 11.3.1 Physical Properties of Soil
	AS 11.3.2 Horticulture * AS 11.3.2.1 Asexual Propagation * AS 11.3.2.2 Landscaping * AS 11.3.2.3 Field Crops
AS 11.4 LIVESTOCK	AS 11.4.1. General
	AS 11.4.2 Goats
	AS 11.4.3 Sheep
	AS 11.4.4 Pigs

The Content Learning Outcomes from each Sub-strand has been unpacked and presented as Lessons.

Lessons follow the following format:

TITLE AND LESSON OUTCOME	Relate the content of the lesson to the Agricultural Science Syllabus
	Lists and defines new words or jargon pertinent to the content of the lesson. To incorporate the words into their vocabulary, students and teachers are encouraged to use the words in sentences, activities, games, discussions and assessment.
	Highlights and provides background information on the main points. Teachers are advised to use student centered learning and teaching methods to assist the students to understand the concepts and in doing so simply and summarise these notes. Students should not be required to copy these sections word for word into their note books.
	Teachers are encouraged to prepare their own learning and teaching strategies to students can put into practice and demonstrate what they have learnt during the lesson. Some suggested activities are included for each lesson.
	A brief summary of the main points of the lesson is provided. Students and teachers may extend the summary if they feel it is warranted.
	These are extra activities which students can use to gauge what they have learnt from the lesson. It also contains suggestions for practical work which will assist students in learning and practicing concepts for use in real life situations.

STRAND 11.1

AGRICULTURAL CONCEPTS

SUB – STRAND 11.1.1

GENERAL AGRICULTURE

CLO 11.1.1.1 FIELD TRIALS

CLO 11.1.1.2 VALUE ADDING

CLO 11.1.1.3 BIOSECURITY

CLO 11.1.1.4 AGRICULTURAL CAREERS

This strand will facilitate the exploration of field trials, value adding, biosecurity and careers associated associated tent of this syllabi.

Students will be introduced to the importance and types of field trials then conduct field trials to determine solutions to address challenges faced by agricultural enterprises in the school.

The importance and types of value adding method will be practiced on a raw product available locally.

The importance and role of biosecurity will be explored. Students will also be encouraged to research career agricultural fields associated with the content of this syllabus.



AS 11.1 GENERAL AGRICULTURE

AS11.1.1 FIELD TRIALS

CONTENT LEARNING OUTCOME

AS 11.1.1.1 Deliberate on the importance of conducting field trials in obtaining environmental friendly solutions in solving challenges faced by agricultural enterprises in the school.

LESSON 1 AGRICULTURAL ENTERPRISE

LESSON OUTCOME

At the end of this lesson, the student will identify agricultural enterprises on the school farm in the preceding three years from records kept by the Agriculture Science Department.



Enterprises – a project or business on a farm, such as the production of any crop or livestock.

Preceding – to come before, go ahead of.



The majority of farmers engage in farming to make a profit.

Each crop and/or livestock raised on a farm is termed an enterprise.

Government backs new initiatives which it feels would help develop the agriculture sector in Fiji.

Schools run different agricultural enterprises to:

- enable students to learn the husbandry and management skills involved.
- facilitate students practicing and becoming competent in agricultural skills.
- guide students as they investigate, practice, analyse and adopt the skills related to a range of enterprises.



List of Enterprises found in schools in Fiji

	Enterprises	By-products
Horticulture	Current Vegetables, fruit, root crops, ornamentals, hedges, lawns	Crop residue Compost
	Potential Seaweed, mushrooms, worms, spices,	
Livestock	Current Broilers, layers, sheep, goats, pigs, honeybees and dairy cattle	Manure, feathers, innards, bedding, weed control, wax, offal
	Potential Fish, prawns, eels, crabs, beche-de-mer, clams, pets etc	Shells, pond water

There is potential for schools to look into prolonging the shelf life of the products of enterprises.

The development of value adding skills and result in the increase in the value of the goods produced on the farms.



1. State two crop enterprises carried out in your school garden.
2. State two livestock enterprises carried out in your school.
3. List one current government initiative aimed at agricultural



Agricultural enterprises are run in schools to provide students with opportunity to master and practice husbandry and management skills associated with lesson content.

Pick a potential agricultural enterprise which would suit your school and discuss the challenges the school would face in trying to implement it.

LESSON 2 : CHALLENGES FACED BY AGRICULTURAL ENTERPRISES

LESSON OUTCOME:

At the end of the lesson, the student will identify and discuss the challenges faced by agricultural enterprises and debate possible solutions to address the challenges identified.



Challenges – new or difficult task that needs to be addressed.
Adaptability – flexibility to fit changed circumstances.



Agricultural enterprises face challenges. These challenges hinder the growth, production and profitability of agricultural enterprises.

CHALLENGES	DESCRIPTION	POSSIBLE SOLUTION
1. Soil Water Condition	Water logged areas	Drainage to be installed, change garden orientation, forming ridges and furrows, planting adapted crops/varieties, expose soil surface for evaporation of water.
	Low moisture content	Irrigation, change garden orientation, planting drought resistant crops/varieties, cover soil surface to minimize evaporation e.g. mulching, cover cropping, closer crop spacing, interplanting.
	Erosion and leaching	Cover the soil surface e.g. mulching, cover crops, zero cultivation. Slow down the speed of moving water e.g. burying drains, terracing, contouring, etc.
2. Soil Fertility	Soil nutrient deficiency	Application of fertilizing materials (organic if possible)
3. Crop Adaptability	Ability of the crop to thrive in the environment supplied	Crop species and varieties that are tolerant and have the favoured traits should be selected.

CHALLENGES	DESCRIPTION	POSSIBLE SOLUTION
4. Pests	Pests attack crops and livestock, reducing quality and quantity of products produced, increase cost of production	Minimising the economic effect of pests by Preventing infestation Controlling pests so numbers are kept below the economic threshold level.
5. Diseases	Diseases of crops and livestock reduce quality and quantity of products produced; increase cost of production.	Minimising the economic effect of diseases by Preventing infestation Controlling infections so effects are kept below the economic threshold level
6. Livestock Feed	The quality and quantity of feed affects growth of livestock	Use the recommended type, quality and quantity of feed.
7. unfavourable temperature	Area too hot or too cold for crop or livestock.	Raise crop or animal indoors e.g. shade houses, sheds, pens.

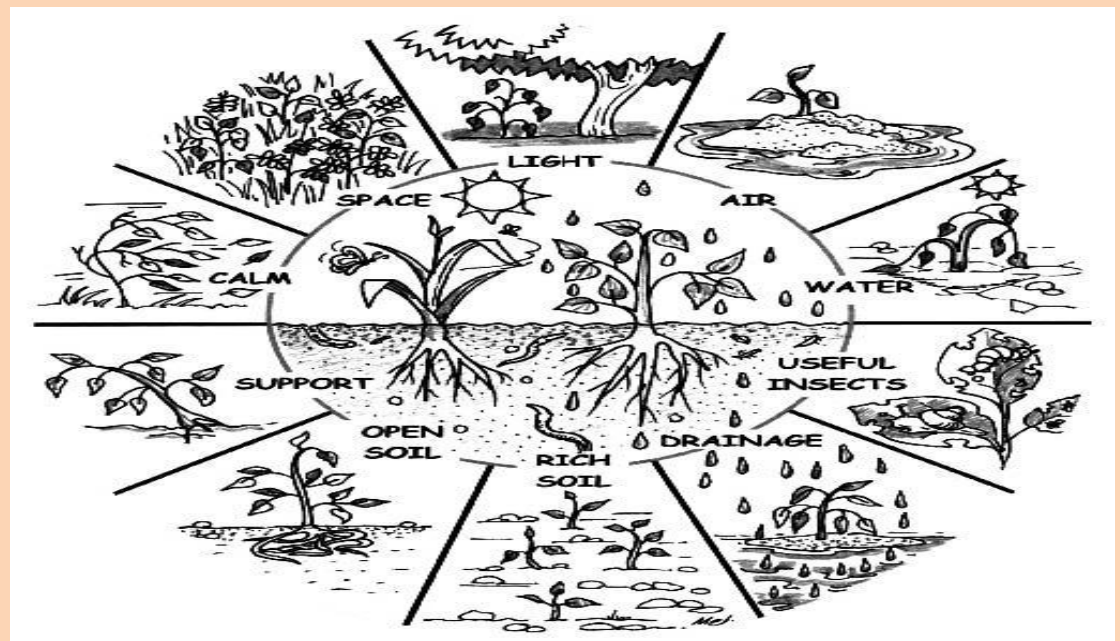


Discuss crops and livestock farmers safeguard the farming enterprises during a drought.

Challenges faced by agricultural enterprises may vary from school to school, however they all pose a threat in reducing quality and quantity of products produced and increasing cost of production

Identify the challenges faced by the plants in the illustration below.

Discuss possible solutions which could be implemented to address these challenges



LESSON 3: CHALLENGES FACED BY THE SCHOOL'S AGRICULTURAL ENTERPRISES

Lesson Outcome:

At the end of this lesson, the student will determine the challenges faced by enterprises on the school farm in the last 3 years.



Soil
Degradation

- loss of productive capacity of a soil which is the result of destructive processes accelerated by men.

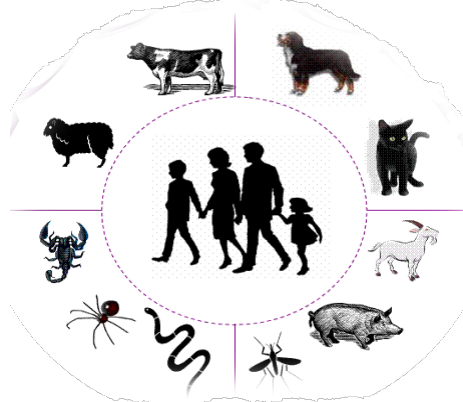


Schools have developed crop and livestock enterprises, based on the content of the Agricultural Science Syllabi, resources available and market demand.

SOME CHALLENGES FACED BY CROP ENTERPRISES IN SCHOOLS.

	Challenge	Possible solution		
1	Land	Evaluate, upgrade and utilise any available space including shade houses, old boats, bamboo culms, pots and areas around school buildings.	Old Boat  https://www.flowersabout.com	Bamboo culms  http://s-media-cache.ak0.pinimg.com
2	Soil degradation	Use methods of soil conservation and nutrient retention management like mulching.	Mulching  thailand.ipm.info.org	Terracing  homeguides.sfgate.com
3	Pest and disease infestation	Integrated Pest Management Crop rotation	Toad  http://www.google.com	Spider  http://www.qpm.ca
4	Water Supply problems	Collection of water from building roofs into tanks then piped out to garden area. Divert clean waste water to gardens	Bucket irrigation  http://www.harvesttotable.com	Water tank for irrigation  http://www.sswm.infom

SOME CHALLENGES FACED BY LIVESTOCK ENTERPRISES IN SCHOOLS.

Challenge	Possible solution	Poultry shed
Housing	- Proper housing that is secure, well ventilated, protected from adverse weather conditions, has provision for light and the control of temperature should be provided.	 http://www.farmersweekly.co.za/
Feed	- Provide recommended feed or mix	
Predators	- Provide secure housing	
Pests and diseases	- Buy inoculated stock - Keep shed clean	
Waste products	- Plans should be made for the use or disposal of waste products which can become a nuisance or health concern. This includes dead animals, soiled bedding, faeces and urine. Some solutions include: making compost, manure for gardens, bio fuel production, drying and selling, place in pit and bury.	Poultry waste  https://www.archive.infonet-biovision.org
Daily management	- Livestock need to be checked on, fed, watered etc. each day including non-school days and during adverse weather conditions [cyclone, flooding] - Enterprises chosen and planned to coincide with school terms. - A plan for the individual responsible for the daily management and care of the animals	Chicks in brooder  food-skills-for-self-sufficiency.com
Zoonosis	- The possibility of the spread of diseases from livestock to humans and vice versa. - Livestock species chosen [e.g. avoid cattle in areas where brucellosis has been detected on surrounding farms] - All stock to be disease free - Limit visitors to sheds - Protective clothing especially footwear to be worn when dealing with livestock - Prevent 'wild' animals from entering shed [birds, rats] as they are carriers and	Zoonosis  http://www.larioja.gov.ar



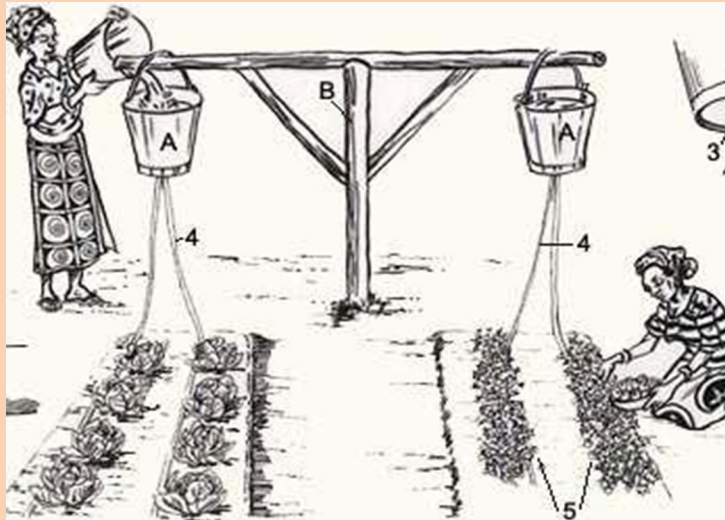
Study the school records [farm plan, diaries, reports etc.] for the last 3 years and determine challenges faced by the enterprises on the school farm.



Each school enterprise has its own challenges.

Schools implement solutions which address those challenges.

Identify the challenge faced by the plants in the illustration below. Discuss how suitable the solution illustrated would be in addressing the same challenge in your school



LESSON 4: AGRICULTURE FIELD TRIALS

LESSON OUTCOME

At the end of this lesson the student will discuss the importance of agricultural field trials.

WORDS TO KNOW

Field Trial - an experiment conducted in real life setting.

NOTES

Most challenges faced by agriculturists have more than one possible solution.

To determine which solution will best address the challenge on a particular farm, field trials are conducted.

Variety field trial



<http://www.cefsapprenticeblog.files.wordpress.com>

Fertilizer field trial



<http://spudsmart.com>

Field trials are experiments carried out in the plant or animal habitat [real life] where the possible and recommended solutions are implemented, data collected and analysed and recommendations made for implementation.

Importance of Conducting Field Trials

There are many places to obtain advice on how to deal with challenges faced by farming enterprises including the Ministry of Agriculture Extension staff and resource materials, internet, teachers, farmers and literature. Most of these sources of information base their recommendations on research and personal experience.

Farmers react to this advice by:

- a) doubting the advice and so not adopting it, b) believing the source and adopting it,
- c) being skeptical and wanting to see further proof that the suggested solution works.

It is recommended that the farmers be encouraged to carry out their own field trials to compare the possible solutions and so determine the best solution for their farm.

1. **Reliable answers** – the trials are conducted in real life settings so if data is carefully collected and recorded, reliable results can be obtained. Results found in laboratory trials can also be verified.
2. **Site specific** – there are differences between farms including soil fertility, water content, chemical pollutants, history of use. The results obtained from one location are not as reliable as the results collected from the actual site where the challenge is faced.
3. **Understandable** – the end user [farmer] either carries out or assists with the field trial. The results and sources of error are observed and recorded so the end result, conclusion and recommendations are better understood by the end user.
4. **Repeatable** – the trials may be repeated several times to verify recommendations and to account for seasonal variations [what suits the cool, dry season may not be best for the hot, wet season].
5. **Comparable** – the various solutions recommended for addressing a challenge can be tested in a trial and realistic comparisons made to allow the end user to make informed decisions.



For the challenges identified in lesson two, list and discuss all the possible solutions with your group [or classmates] and rank the solutions in order of suitability.



Challenges faced by agricultural enterprises usually have more than one possible solution. To determine the solution most suitable for implementation on a farm, farmers are encouraged to conduct field trials.



Research all possible solutions to challenges faced by the school farm. Identify one challenge on which to conduct a field trial.

LESSON 5: CONDUCTING A FIELD TRIAL

LESSON OUTCOME

At the end of this lesson the student will design and run a field trial.



The overriding principle for experimental design is

"keep the design as simple as possible while satisfying the required level of scientific soundness"

The following steps are to be followed when conducting a field trial:

1. **determine a suitable topic/challenge to investigate**

After studying the records of the school farm for the previous 3 to 5 years, a list of challenges

2. **formulate a hypothesis.**

Based on research conducted on the challenge chosen for testing, a hypothesis is formulated. The experimental hypothesis is a prediction of the outcome of the experiment.

3. **determine the variable to trial.**

Based on the hypothesis, the variable, control and treatments to include in the trial are determined.

4. **write an abstract.**

The abstract is a statement that summarises the experiment:

- a) purpose of the experiment, b) method used,
- c) results obtained,
- d) conclusions made.

The abstract should not include many details; rather it should be a simple statement of a few lines but can even be stated in a paragraph[s] of between 100 to 300 words

5. **write a literature review**

Before beginning the field trial, research must be conducted on current findings on the topic and a summary of the findings prepared. This will allow anybody reading the paper to establish why this particular research or trial is being pursued.

6. **design [plan] the field experiment**

Due to the duration and work involved in a Field Trial, it is usually divided into **phases**.

The design will include the time line, aim, materials and inputs needed, layout of the plots, method to follow, data to collect and method of collection, data collection template and the methods to use to analyse the data collected.

7. prepare a budget for the field experiment.

A list of all inputs is made including land area, structures, soil/shed preparation, labour, tools and equipment, inputs [chemicals, planting material, feed, stock etc.]

Quotations are to be sourced for the items not readily available on the farm. The quotations are to be summarised and comparisons made to determine when and where to obtain inputs.

A budget is prepared and presented.

8. plan a Schedule of Work.

The phases from No# 6 [above] are plotted on a calendar. A schedule of work for the field trial, which has planned and actual columns, is prepared so that progress can be recorded analysed and plans amended should the need arise.

9. carry out the field trial.

The field trial is now carried out.

It follows all the rules of carrying out an experiment but is conducted on a larger scale. [control, variables, replications, uniform conditions etc.]

10. collect, record and analyse data relevant to the aim of the field experiment.

There is a lot of data that can be collected from a field trial so a decision must be made on:

- i) the type of data to collect which will depend on the aim of the trial [e.g. height of plant],
 - ii) the interval at which to collect the data [e.g. once a week]
 - iii) the measuring instrument to use [e.g. centimetre ruler]
 - iv) who will take the readings
 - v) the template for recording data
- In this way reliable and valid data is collected.

Measuring plant height



Source: <http://www.bulletin.ipm.illinois.edu>

11. draw conclusions from the analysis and make recommendations

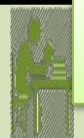
The data is then analysed. Graphs are constructed to summarise and present data in summary.

Statistical analysis is carried out to verify the validity and reliability of the data.

The results are discussed and, with sources of error taken into account, conclusions will be drawn. Recommendations will be made for dealing with the challenge which the field experiment was based on.



Design a field trial to address the challenge identified in Lesson 4.



Field trials are carefully designed [planned] and conducted to ensure that results are valid and reliable.



Conduct the field trial identified above

LESSON 6: FIELD TRIAL LAYOUT LESSON OUTCOME

At the end of this lesson the student will discuss the various layouts for crop field trials.



Variable - any factor, trait, or condition that can exist in differing amounts or types [e.g. mulching]

Treatment [T]- the amount of the variable tested by the trial e.g. [type of mulching material]

Control [C]- the standard with which a new technique or variety is compared or the plot that receives no treatment [e.g. no mulch applied]

Replication [R] - The number of times the experiment is repeated.



The layout design of field trial for crops must be carefully planned to ensure that results are valid.

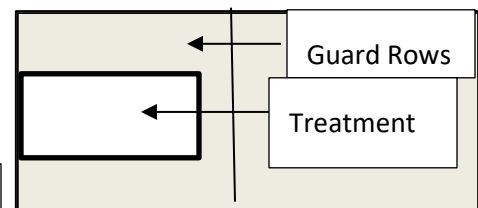
The field used must have conformity in elevation, slope, access to water, fertility, wind impact, sunlight intensity etc.

All trial plots must have guard rows. These are rows of the same crop planted a week before the experiment to “guard” the crop from disturbances like pests, theft etc.

To minimise sources of error, all activities carried out on the trial, must be identical and synchronised including clearing, tilling, planting, weed control, fertilizer application, hilling, staking, collecting data. Only the variable being tested will differ and is called the treatments.

For example:

Title of the field trial - “Determining the best mulching material to use on French bean crops during the dry and cool season at Progressive Secondary School in 2020”



Variable – Type of mulching material

Control – no mulching

Treatments – lawn grass clippings, coconut fronds, mango leaves, banana leaves, clean wood shavings, black plastic, transparent plastic, newsprint, cardboard, seaweeds, ‘yagona’ waste [‘kosa’].

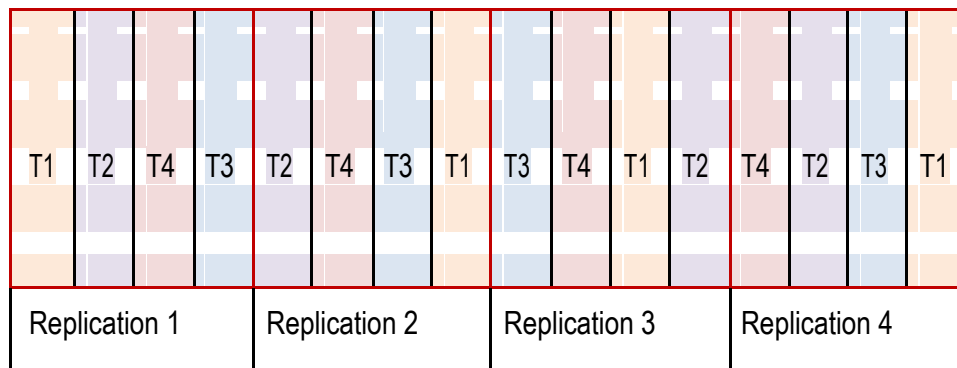
There are many field trial designs used for conducting experiments on the farm namely demonstration strip design, replicated control design, replicated measurement t-test design, replicated complete block design, completely randomised design, split plot design and factorial designs.

The **two** commonly used field trials in school are:

1. Randomized Complete Block Design (RCBD)

The randomized complete block design (RCBD) is widely used in field experimentation. The purpose of randomizing the locations is to avoid biasing the results. Randomization process is the distribution of treatments equally in a experiment.

This design is appropriate when you are collecting quantitative data, such as yield.



The two cornerstones of the RCB design are *replication* (i.e., repetition) and *randomization*. Replicate each treatment a minimum of **three** times. Although four or five treatments are better, the statistical advantage gained is successively smaller with each added replicate.

On sloping land, position plots down the slope, not across.

Each treatment must be included *once* in each block of replications.

The treatment locations must be randomly assigned to plots within the block.

This design is recommended for field trials conducted in schools.

2. Completely Randomized Design (CRD)

- It is useful when experimental units are essentially homogenous ie variation between units are very small
- Grouping this units into plot could reduce to a slight extent the accuracy for the analysis
- It is good for glasshouse experiments ie controlled environment
- May be influenced by factors not directly related to the treatments eg soil type, border effects or microclimate changes

• Example: Fertilizer treatments

- 1.

A

- 2.

B

- 3.

A	A
---	---
- 4.

B	B	B
---	---	---
- 5.

A	B	A
---	---	---

- The above has **two** treatments
- 1. Fertilizer treatment A - urea
- 2. Fertilizer treatment B - superphosphate



Differentiate among the two field trial plot layout designs.



There are many designs for the layout of field trial plots. However, each plot must have guard rows. The recommended design layout for school field trial is Randomized Complete Block and Completely Randomized design.



Choose the design which best suits the challenge you choose to research in Lesson 5.

LESSON 7: ANALYSING FIELD TRIAL DATA

LESSON OUTCOME

At the end of this lesson the student will analyse the results of the Field Trial.

Graphical analysis - the use of graphs and tables to interpret data.

Statistical analysis - the use of mathematics to determine the validity and reliability of the data collected.



When relevant data has been collected, it must be analysed.

Data analysis is the process of interpreting the meaning of the data which has been collected.

The process involves looking for patterns -similarities, disparities, trends, and other relationships - and thinking about what these patterns might mean.

The analysis is both graphical and statistical.

- i) Graphical analysis involves organising and displaying the data in the form of tables, charts [bar, histogram, pie] or other representation.

This summarises all the data collected and allows you to “see” the results.

- ii) Statistical analysis involves the calculation of the product of some form of mathematical or scientific design including mean, mode, median, range, variance, coefficient of variance and standard deviation.

This allows you to determine if the data collected is valid and reliable.

1.	Measures of central tendency – mean median and mode are three kinds of averages. They determine a single value that attempts to describe a set of data by identifying the central position within that set		
i)	Mean	the average of the numbers	Add up all the numbers, then divide by how many
ii)	Median	the "middle" value in the list of numbers.	List all the numbers in numerical order and then
iii)	Mode	the value that occurs most often. If no numbers are repeated, then there is no mode.	Look at the listed numbers and find the number which <u>appears most often</u>

2.	Measures of spread- range, quartiles, variance, absolute deviation and standard deviation.		
	i) Range	the difference between the lowest	Find the lowest value [number] and subtract it
	ii) Quarterlies	tell about the spread of data by breaking the data set into quarters.	Arrange the marks from highest to lowest. Divide the marks into 4 – highest, first $\frac{1}{4}$ mark,
	iv) Variance	measures how far a set of numbers is spread out. A variance of zero indicates that all	Square the numbers then add them together. Divide the total by the total number of scores in the group of data
	v) Absolute deviation	the simplest way of calculating the deviation of a score from the mean	take each score and minus the mean score. Scores above the mean have positive deviations, whilst scores below the
	vi) Standard deviation	a measure of the spread of scores	square root of the variance. This removes the +
	vii) Coefficient of variance	an absolute measure of dispersion, the smaller the value the greater is the reliance that can be placed on the results.	Divide the standard deviation by the mean and then multiply the answer by 100.

Example:

The following are the heights of 20 recently germinated wheat plants in centimetres (cm).

5, 7, 7, 6, 8, 7, 5, 3, 10, 9, 7, 8, 9, 3, 5, 7, 8, 4, 6, 6.

Calculate the:

- (i) sample mean
- (ii) mode
- (iii) median
- (iv) range
- (v) sample variance
- (vi) standard deviation
- (vii) coefficient of variation

Solution:

- (i) **Mean = $\frac{\text{sum of all variables}}{\text{Total no of variable}}$**

$$= \Sigma x / n$$

$$= 130/20 = \underline{6.5 \text{ cm}}$$

- (ii) **Most common score**
= 7 cm (5 times)

- (iii) 3, 3, 4, 5, 5, 5, 6, 6, 6, 7, 7, 7, 7, 7, 8, 8, 8, 9, 9, 10
= 7cm

(iv) Highest score – Lowest score

$$10 - 3 = \underline{7 \text{ cm}}$$

$$\text{Variance} = \frac{(\text{sum of each value})^2 - (\text{total sum of variable})^2}{\text{no. of variable} \times \text{no. of variables} - 1}$$

$$= [916 - (130^2/20)] / (20 - 1) = [916 - 345] / 19 = \underline{3.74 \text{ cm}}$$

(v) Standard deviation = $\sqrt{\text{variance}}$

$$= \sqrt{3.74}$$

$$= \underline{1.93 \text{ cm}}$$

(vi) Coefficient of variation = $SD / \text{mean} \times 100 / 1$

$$= 1.93 / 6.5 \times 100 / 1$$

$$= \underline{29.69 \%}$$

Exercise:

The following are the heights of 10 recently germinated rice plants in millimetres (mm).

5, 6, 6, 7, 7, 8, 8, 9, 10, 10

Calculate the:

- (i) sample mean
- (ii) mode
- (iii) median
- (iv) range
- (v) sample variance
- (vi) standard deviation
- (vii) coefficient of variation



Discuss the difference between the graphical and statistical analysis of data and the reason for each statistical analysis of data and the reason for each



Data collected from a field trial must be verified and interpreted so conclusions can be drawn



Analyse the data collected from the field trial

AS 11.1.2 VALUE ADDING**CONTENT LEARNING OUTCOME**

AS 11.1.2.1 Evaluate the importance of value adding on locally produced agricultural commodities.

LESSON 1 VALUE ADDING**LESSON OUTCOME:**

At the end of this lesson the student will discuss the advantages and disadvantages of value adding and relate value adding methods to locally produced agricultural commodities



Value adding	-	processing a product so that it can be sold at a higher price.
Enzyme	-	an organic catalyst which speeds up reactions.
Self – life	-	the length of time for which an item remains usable, fit for



The raw products produced on farms usually have a limited shelf life because of:

- i) enzyme action – natural substances which cause ripening and then decay.
- ii) microbial spoilage – the spoilage caused by bacteria, yeasts and moulds.

This is why post-harvest treatment and storage is crucial in maintaining the quality of raw products until they are used by consumers. Some crops favour certain production seasons resulting in a:

- (i) glut of the raw products during the season with corresponding lower selling prices
- (ii) scarcity of the raw product during the off season with corresponding higher prices.

Farmers are encouraged to look at ways of adding value to and prolonging the shelf life of raw products.

Most agricultural products are processed in a variety of ways from the time they leave the farm till the time they reach consumers.

In general, adding value is the process of changing or transforming a product from its original state to a more valuable state.

Advantages of value adding

- i) Preserves food for future use.
- ii) Some methods remove toxins present in raw food.
- iii) Reduces wastage in times of glut
- iv) Extends shelf life by killing microorganisms which cause product deterioration
- v) Enhances the nutritive value of food by adding vitamins and minerals.
- vi) Presents food in a form which is convenient for the consumer to transport and use vii) Ensures food is available all year round
- viii) Makes food is easy to store and prepare
- ix) Solves the problem of price fluctuation

Disadvantages of Value Adding

The cost of establishing and maintaining facilities and skilled workforce reflects on the cost of the items

- ii) To work efficiently, there is to be a constant supply of the raw agricultural products for value adding. This is why it is recommended that facilities built be adaptable to process different agricultural goods.
- iii) Some nutrients and fibre present in the raw food may be destroyed or removed.

The food additives used as ingredients in value adding processes may be detrimental to health e.g. fats, sugar, salt, oil.

- v) Consumer taste may change so products must meet demand.

- vi) Hygiene may not be maintained



Discuss the advantages and disadvantages of value adding



Adding value is the process of changing or transforming a product from its original state to a more valuable state. It addresses the issue of wastage during periods of glut and unavailability during the offseason.



Argue for or against value adding raw agricultural products

LESSON 2 VALUE ADDING METHODS

LESSON OUTCOME:

At the end of this lesson the student will discuss value adding methods in relation to local produce.



There are many methods used to preserve and add value to raw agricultural products.

Value Adding Method	Locally Produced Agricultural Product
1. Cooling - chilling and freezing inhibits the growth of micro-organisms so slows down deterioration. If stored at an incorrect temperature freezing damage may occur so plant products are usually blanched before freezing.	Frozen cassava  
2. Dehydration -removing water from food preserves nutrients and discourages the growth of bacteria, yeasts, and moulds. Often salt is added to food to remove moisture prior to drying.	Dried fish  

3. Curing -the addition of a combination of salt, nitrates, nitrite or sugar. Many curing processes also involve smoking, spicing, or cooking.	Cured meats  foodsafetynews.com
4. Fermentation - the conversion of carbohydrates to alcohols and carbon dioxide or organic acids, using yeasts, bacteria, or a combination of the two, under anaerobic conditions.	Yogurt  zamnar.com
5. Pickling -food is soaked in brine or vinegar which causes anaerobic fermentation. The resulting food is called a pickle Example: chillies, citrus, mango	Pickled chillies  www.friendfiji.com
6. Preserving in sugar Where sugar is used as the preserving agent e.g. jams, lollies, jellies	Guava jelly  http://2.bp.blogspot.com
7. Cooking -brings about chemical changes in food. Cooking brings about changes to texture and taste, kills harmful microbes and makes food easier to digest. Example: roasting, boiling, and frying.	Roasted chicken  www.chicken.ie
8. Heat Treatment -heat sterilization involves exposing food to a temperature generally exceeding 100 ° C for a period sufficient to inhibit enzymes and all forms of microorganisms, including bacteria spore.	Pasteurised milk  http://i.colnect.net

9. Enrichment -replacing nutrients that were lost during food processing.	Flour enriched with vitamin B 
10. Fortification- -adding essential vitamins and minerals (e.g. iron, vitamin A, folic acid, iodine) to staple foods to improve their nutritional content.	Fortified beverage  http://www.g02.s.alicdn.com
Pick your favourite fruit or vegetable and discuss how its value and shelf life can be	



The shelf life of products can be extended and value added by a variety of methods.



Choose a raw agricultural product which is in glut supply in your locality. Research methods which can prolong its shelf life and increase its value. Carry out one of these methods with your group or as a class

AS 11.1.3 BIOSECURITY

CONTENT LEARNING OUTCOME

Explore the importance of safeguarding and maintaining bio-diversity in Fiji's agricultural sector.

INTRODUCTION

LESSON OUTCOME: At the end of this lesson the student will discuss the importance of protecting Fiji's flora and fauna.

Half of all animal and plant species in the world live in only one country and nowhere else.

Often less familiar than a country's cultural wonders, these living national treasures are similarly important as irreplaceable parts of a nation's heritage.

LESSON 1: FIJI'S FLORA AND FAUNA

LESSON OUTCOME: At the end of this lesson the student will identify some flora and fauna species in the country.



- Flora - All the plants of a particular region, habitat, or geological period.
- Fauna - all of the animals of a particular region, habitat, or geological period



Fiji has more than three hundred islands which are home to numerous flora and fauna. According to <http://Intreasures.com/fiji.html> Fiji has as many as 800 plant species and numerous animal species which are endemic to the country. The majority of these species are found nowhere else in the world so a national treasures.

The endemic species include flora and fauna which live on land, in fresh water and also in the marine environments. They reflect the rich diversity which is a treasure to the country.

Some endemic animal species include:

One mammal	Twenty five birds	Fourteen reptiles	Two Amphibians
Fiji Monkey Faced Fruit Bat  http://www.australiannature	Peale's Imperial Pigeon  http://www.gryllosblog.files	Rotuma Forest Gecko  http://www.upload.wikimedia	Fiji Tree Frog  http://www.s-media-cache-ak0.pinning.com
Six fresh water fish	11 marine fish	World's 2 nd largest beetle	Butterfly
Orange Spotted Therapon  http://www.fishbase.org	Wrasse  http://reefbuilders.com	Giant Fijian Longhorn Beetle  http://www.coleoptera-atlas.com	Fijian Emperor  http://www.theinsectcollector.com

Some endemic species are Masiratu and Tagimocia.

Fiji has also adopted many exotic species which have acclimatised well and become a part of our flora and fauna, many of them introduced as crops, livestock or for ornamental purposes. Some examples of this are goats, mynah, tilapia, water hyacinth, rice and dumb cane.



Differentiate between endemic and exotic species



Fiji has a wealth of endemic flora and fauna, many of which are only found in Fiji. Many exotic species have been introduced to Fiji too



Choose and research one animal or plant endemic to Fiji and discuss your

LESSON 2: BIODIVERSITY

LESSON OUTCOME: At the end of this lesson the student will discuss the importance of maintaining bio-diversity in Fiji.



Biodiversity - the variety of life in the world or in a particular habitat or ecosystem

Ex situ - the process of protecting an endangered species of plant or animal outside of its natural habitat



Biodiversity is the basis of agriculture and has enabled farming systems to evolve ever since agriculture was first developed some 10,000 years ago. Biodiversity is the origin of all species of crops and breeds of domesticated livestock and the variety within them. It is also the foundation of ecosystem services essential to sustain agriculture and human well-being. Today's crop and livestock biodiversity are the result of many thousands of years of human intervention.

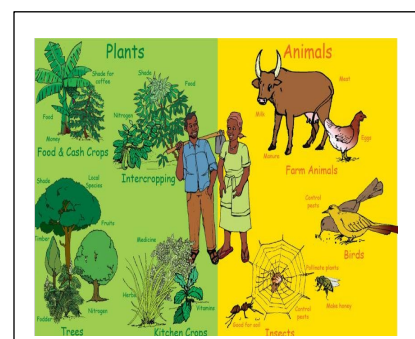
Importance of biodiversity

- ensures the production of food, fibre, fuel and fodder.
- maintains other ecosystem services like soil and water conservation, maintenance of soil fertility and biota, and pollination
- allows adaptation to changing conditions - provides species with the ability to adapt to changing environmental conditions and evolve, by increasing their tolerance to changing temperatures,

drought and water-logging, as well as their resistance to particular diseases, pests and parasites as well as adaptation to climate change

- sustains rural peoples' livelihoods

The importance of agricultural biodiversity encompasses socio-cultural, economic and environmental elements. All domesticated crops and animals result from human management of biodiversity, which is constantly responding to new challenges to maintain and increase productivity under constantly varying conditions.



Special nature of agricultural biodiversity

▮ Agricultural biodiversity is essential to satisfy basic human needs for food and livelihood security. Agricultural biodiversity has been - and is still - shaped and developed through human activities and practices over generations. Farmers' communities play a key role as custodians and managers of agricultural biodiversity. This is why local and traditional knowledge and culture are considered integral parts of agricultural biodiversity management.

Because of the degree of human management, conservation of agricultural biodiversity in production systems is inherently linked to sustainable use.

Nonetheless, much agricultural biodiversity is now conserved *ex situ* in gene banks or breeders' materials.

For crops and domestic animals, diversity within species is at least as important as diversity between species and has been greatly expanded through agriculture.

▮ Many farming systems are based on alien crop species introduced from elsewhere; this creates a high

degree of interdependence between countries for the genetic resources for food and agriculture.

The interaction between the environment, genetic resources and management practices that occurs within agro-ecosystems often contributes to maintaining a dynamic portfolio of agricultural biodiversity.

Fiji is blessed with a wide variety of flora and fauna which must be maintained to:

- i) safeguard our future food supply.
- ii) conserve species endemic to the country
- iii) sustain our diverse range of plant and animal and so retain our unique country.



Discuss the relationship between agriculture and the biodiversity of Fiji



Biodiversity is important to maintain because it ensures future food security, conserves our unique flora and fauna and sustains agricultural production in Fiji



Discuss the special nature of agricultural biodiversity in Fiji

LESSON 2: SAFEGUARDING FIJI'S BIODIVERSITY

LESSON OUTCOME: At the end of this lesson the student will discuss the methods used to safeguard bio-diversity in Fiji



Regulatory laws

- rules and administrative codes issued by governmental agencies at all levels, municipal, county, state and federal.

Quarantine - a state, period, or place of isolation in which people or animals that have arrived from elsewhere or been exposed to infectious or contagious disease are placed

Prohibition - the action of forbidding something, especially by law.



Biodiversity is challenged by human activities, pests, diseases, climate change, habitat destruction and competition. Each of these issues is dealt with by farmers.

Safeguarding biodiversity is vitally important to Fiji as we are heavily reliant on agriculture and our natural environment. New pests can not only devastate our food security, but can also damage agriculture, horticultural production, forestry and tourism and affect trade in international markets.

The economic consequences of failing to protect Fiji are dire: it could affect our

employment opportunities, our human health and also our traditional lifestyle which is highly treasured.

Biosecurity is the protection of the economy, environment, biodiversity and human health from the negative impacts associated with the entry, establishment and spread of organisms including pests, diseases and invasive species.

The prevention of the introduction and spread of pests and diseases is the responsibility of the Biosecurity Authority of Fiji which works under regulatory laws.

They provide the following services:

1 Information

The authority carries out awareness campaigns which keeps locals and visitors informed of biosecurity threats and how to cope with them.

Those entering the country are provided with information on the following:

prohibited items

including all food, plants, animals, animal products, organisms, and salt or fresh water products

including all used equipment like camping, farming, hunting, sporting, gardening, and other recreational equipment

dangerous species

quarantining, checking, drying, and declaring

- fines and other penalties

2. Inspection – everything entering the country by air and sea is inspected for prohibited items at the port of entry as in the list above. If prohibited items are found the passenger is penalised and the item is confiscated and destroyed

3. Quarantine services – any organisms [plants or animals] being brought into the country is placed in quarantine until declared free of pests and diseases which could harm the local biodiversity.

4. Pest and disease control – when pest and disease outbreaks occur, the authority carries out research to identify the causal organisms and the spread of the outbreak. They then determine and carry out the control or eradication method

5. Prohibition – sometimes a pest or disease may be restricted to an area. The Biosecurity officers will plan and put in place methods to stop the spread of the pests and diseases e.g. prohibiting the movement of the species between islands.



Discuss the importance of safeguarding the biodiversity of Fiji



The Biosecurity Authority of Fiji has the task of safeguarding the biodiversity of Fiji.



Discuss ways in which the biodiversity of Fiji is safeguarded

AS 11.1.4 AGRICULTURAL CAREERS

These are advocacy lessons to assist students to identify careers related to the content of this syllabus. It is not intended for examinations.

CONTENT LEARNING OUTCOME

Discuss careers related to the content of the Year 11 syllabus. [Not to be examined]

LESSON 1: CAREERS RELATED TO THIS SYLLABUS

Lesson outcome:

At the end of this lesson the students will discuss the possible careers and jobs related to the concepts covered in this syllabus.



There are many concepts discussed in this syllabus and each concept relates to employment opportunities.

The concepts covered prepare students to work in many fields including;

Advocacy and advisory work – teachers, extension workers, community workers and youth group coordinators.

Management work – managing field trials and activities in the production, harvesting, postharvest treatment, value adding and marketing of livestock and crops.

Research work – conducting research involving field trials, soil analysis, biodiversity issues, community opinions and latest recommendations from stakeholders.

Analysing data collected and making recommendations to stakeholders.

Production work – the planning and production of an enterprise related to the course content e.g. rearing and milking dairy goats, separating milk, making and packing ghee for sale. This option includes self-employment.

5. **Value adding work** – processing raw agricultural products.

Landscaping work – planning, designing, constructing, establishing and maintaining landscapes.

7. **Biosecurity work** – researching, advocating, preparing and enforcing plans to address issues related to ensuring the security of Fiji's biodiversity.



Each student is to identify careers related to the content of the syllabus and identify any two careers of interest to them

LESSON 2: CAREER PATHWAY

LESSON OUTCOME:

At the end of this lesson the students will discuss a pathway for the career which they identified as interesting in Lesson One.



Choosing a career which interests you is only one step in finding enjoyable gainful employment in future.

You must take into consideration the requirements of the career including;

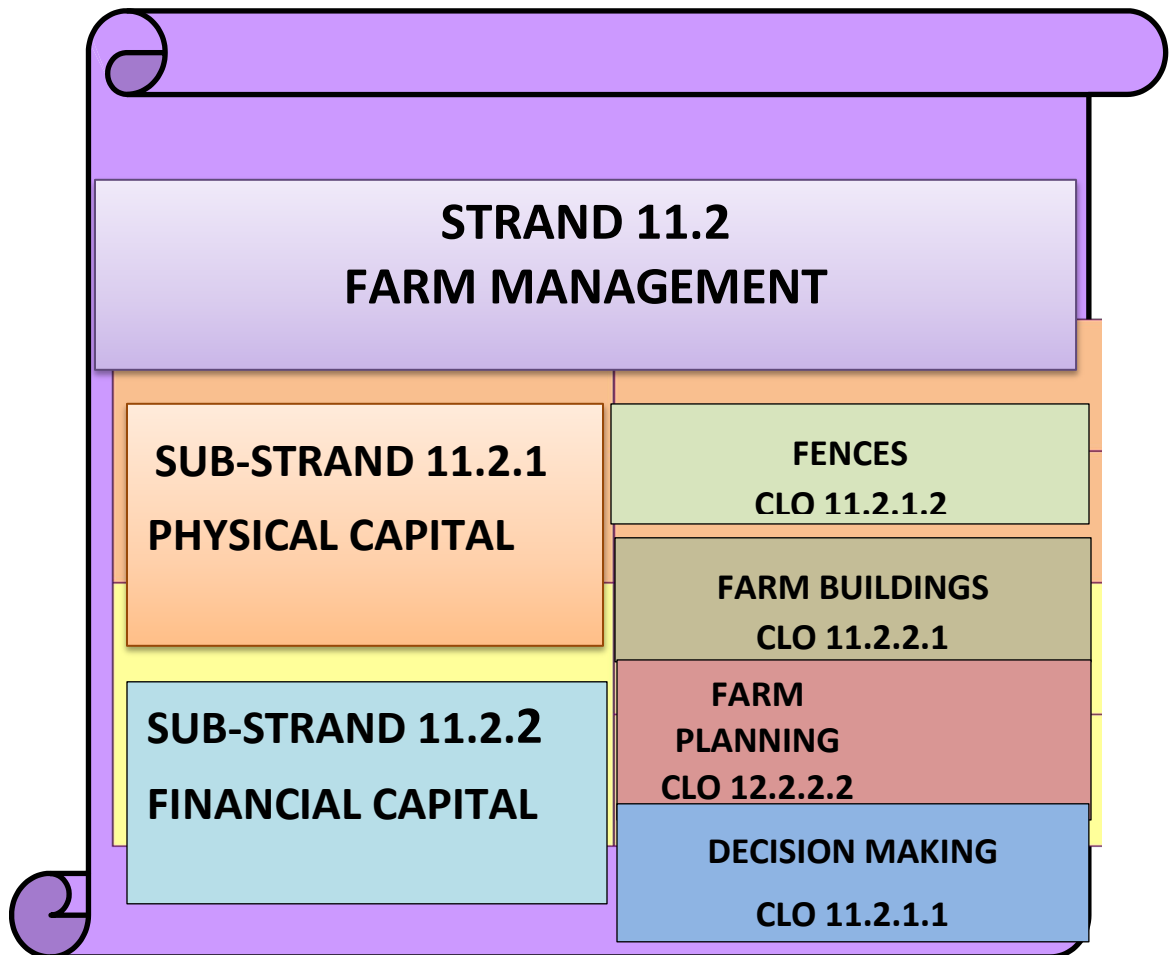
1. **Nature of the work** – some jobs work with people while others work with animals, plants, machines or soil while some jobs work with a combination of these. Look for an occupation which involves activities which you enjoy and can do well.
2. **Working conditions** – this refers to the environment in which a particular job is done. It may be indoors or outdoors; involve high levels of dust, noise, physical hazards or mental stress; working alone or in groups; if hours are standard or flexible and the number of hours per day.
3. **Special abilities required** – some jobs call for aptitude with machines, animals, plants; artistic talent or other abilities and talents. You must match your aptitudes and talents to those requirements.
4. **Physical demands** – some occupations are physically demanding like lifting, operating large machines, herding and controlling animals, repetitive tasks, standing for long hours, keen vision. You must ensure that you are physically able to perform the tasks.
5. **Academic qualification** – the subject combination, level of education and grades you must attain to qualify for the job and to progress in the job hierarchy. How will you cover the costs of education?
6. **Chances of employment** – consider all the alternative jobs which you can possibly get if you train for a job but it is not available when you graduate.
7. **Probable earnings** – decide if the amount of money you can expect to earn from a job will be sufficient to support yourself and possible dependants.
8. **Social status** – what will your standing in the family and community be if you pursue this job?
9. **Timeline** – how long will it take before you are competent to begin work?



Conduct research on the careers you identified in Lesson One

Prepare a career pathway using the template recommended by the counsellor or careers teacher in the school.

Discuss your findings with your parents, friends or classmates and begin preparing for your future career



Farm house with fence



<http://www.1.bp.blogspot.com>

Introduction

This strand will facilitate the exploration of fences and farm buildings as well as farm planning and decision making.

Students will be introduced to the types, functions and maintenance of fences and building found on farms.

They will also use the steps in farm planning and decision making.

PHYSICAL CAPITAL

FENCES

CONTENT LEARNING OUTCOME: Explore knowledge and skills on types of fences used on farms in Fiji.

LESSON 1: FUNCTIONS OF FENCES

LESSON OUTCOME

At the end of this lesson the student will identify the major functions of fences.



Boundary - a line which marks the limits of an area; a dividing line

Fences - a barrier, railing, or other upright structure, typically of wood or wire, enclosing an area of ground to prevent or control access or escape



A fence is a solid barrier which is used to demarcate an area, beautify the landscape, restrain animals and keep pests out of an area.

Fencing is one of the most important pieces of farm infrastructure. A fence is an investment that can last many years, so the farmer will have to carefully consider the farm fencing needs now and in the future.

Agricultural fences are often used to keep animals in or out of an area.

Fences are made from a wide variety of materials, depending on terrain, materials available, finance available, location and its intended use.

Most agricultural fences average about 1.2 m in height, and in some places, the height and construction of fences designed to hold livestock is mandated by law.

Functions of Fences

1. Boundary Markers



Source: <http://www.fencelandscaping.com>

A **boundary marker** is a robust structure or physical marker that identifies the start of a land boundary or the change in a boundary, especially a change in direction of a boundary.

These boundary fences demarcate where land belonging to one owner/individual ends and another begins

2. Confine stock



Source: <http://www.oakhillhomestead.com>

Some fences are built to keep animals in a confined area, usually for safety, and to minimise the movement of animals.

Fences are also used to keep different animals separated e.g. does away from kids; sires away from dams.

3 Restrain stock



Source: <http://www.marineinsight.com>

Some fences are strongly built stalls or cages for holding cattle, horses, or other livestock safely while they are examined, marked, or given veterinary treatment.

4. Windbreak



Source: <http://www.adamsappletrees.blog.sp>

Fences are used as windbreaks, usually with the intent of slowing down the wind.

5. Protection.



Source: <http://www.countrybluefarms.com>

Fences are constructed for protecting farm animals from predators



Source: <http://www.homes-kid.com>

Fences are also constructed to protect crops from pests which steal, eat and trample crops.



Compare the type and function of a residential fence and a farm fence.



Fences are used on Fiji farms as boundary markers, to contain livestock, to protect stock and crops and as wind breaks.



Discuss the main functions of fences on farms.

LESSON 2: TYPES OF FENCES USED ON FIJI FARMS

LESSON OUTCOME

At the end of this lesson, the student will identify the major types of fences used on Fiji Farms.



Barbed wire	- fencing wire with sharp barbs attached.
Goat wire	- fencing mesh used on goat farms.
Electric Fence	- strand of wire through which an electric current flows.
Hedge	- fence of living plants.

Fences found on farms in Fiji are constructed from various materials depending on the intended use of the fence

Types of Fences used on Fiji farms

1. Barbed wire

Barbed-wire fence is made strands of high tensile wire which have been wrapped around each other with small lengths of wire that are regularly spaced and twisted so that their sharp end points stick out. It is sometimes called razor wire.

Barbed wire



<http://www.hamshardware.co.uk>

Razor wire



<http://www.bizrice.com>

Barbed wire is stored in rolls.



Source: <http://www.alibaba.com>

Barbed wire is stretched between posts to deter larger animals from crossing boundaries.



Source: <http://www.homes-kid.com>

Barbed wire and razor wire are also stretched or wound around the top and bottom of chain link fences to deter crossing.



Source: <http://www.singletonefence.com>

2. Goat/sheep Wire

Goats are very inquisitive and will find any weakness in a fence, which they will lead other goats to exploit and escape. For that reason, wire mesh is used for goat fencing.



Source: <http://www.rangemasterfence.com>

Goats are able climbers and easily escape fence enclosures.



Source: <http://www.missingwillowfarm.com>
<http://www.gayarumah.ga>



Source: <http://www.pinterest.com>

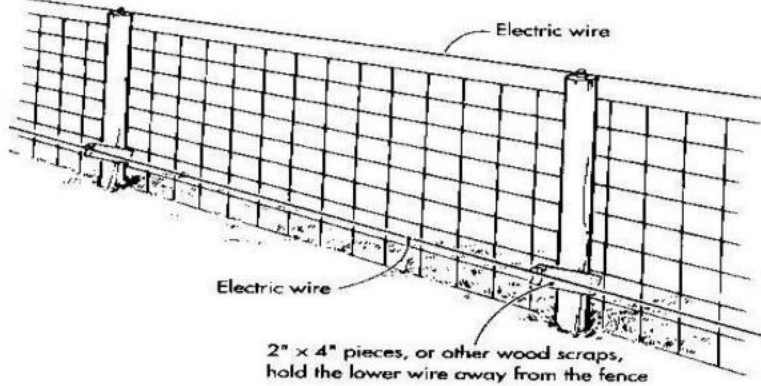


Source:

It has 10 horizontal strands, is 1.5 meters high, and has a 8 centimeter spacing of vertical wires. There are two versions of this fence, a standard low tensile type that is easily bent, and a newer, high tensile version in which the wire is difficult to bend and will to some extent spring back to its original shape. Goat wire is stored in rolls

Source: <http://www.rangemasterfence.com>

To help control the goats, a strand of electric wire is stretched across the top and bottom of the goat mesh.



Source: <http://www.goatworld.com>

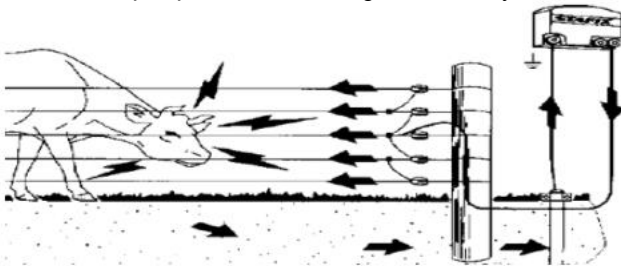
This confines goats to the allocated area.



Source: <http://www.gallaghereelectricfences.com>

3. Electric fence

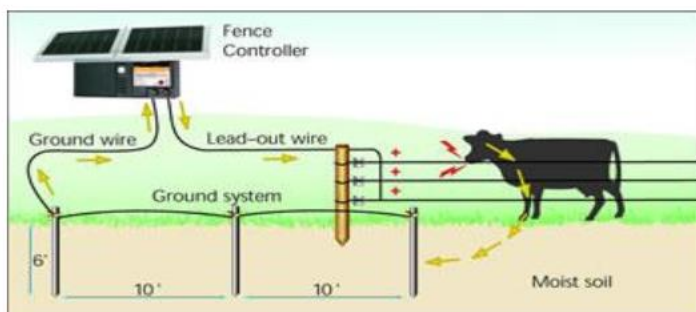
An **electric fence** is a barrier that uses electric shocks to deter animals or people from crossing a boundary.



Source: <http://www.kencove.com>

Once the electric fence is installed correctly and the animal comes in contact with an electrically charged fence wire, it will feel a shock because the electric current will pass through the animal to the ground, thus completing the electrical circuit.

The typical electric fence is a psychological barrier in the sense that the animal will touch the electric fence and become "trained" not to go near the fence.



Source: <http://www.zarebasystems.com>

Advantages of electric fences

1. Safe
2. Light weight
3. Cheap to install, move and maintain
4. Substitute for traditional wooden and wire fences
5. Keeps animals safe from predators
6. Suits cattle, sheep, goats, horses and pigs.

Fences are most commonly made using lightweight steel wire (usually 14-17 gauges) attached to posts with insulators made of porcelain or plastic.



Source: <http://www.rxwildlife.org.uk>

4. **Wooden fence** - A structure like a wooden wall built outdoors to separate two areas or prevent people or animals from entering or leaving.



Source: <http://www.fencepanels.net>



<http://www.intelyex.com>



<http://www.floatproject.org>

Wooden Fence - material and storage. Timber from durable species are treated and stored for fencing. The length, size and shape of timber are determined by its purpose.



Source: <http://www.woodfencecontractor.com>



<http://www.alibaba.com>



<http://www.103fence.com>

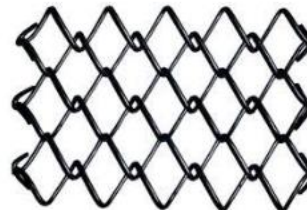
5. **Chain link** -

A chain-link fence (also referred to as wire netting, wire-mesh fence, chain-wire fence, cyclone fence, hurricane fence, or diamond-mesh fence) is a type of woven fence usually made from galvanized or plastic coated steel wire.



Source: <http://www.chainlinkmesh.com>

Chain link fence are stored in rolls.



Source: Guruprukawirenetting.com

Vinyl coated chain link fence



Source: <http://www.fencematerial.com>

6. Hedge

A row of bushes or small trees planted close together, forming a **fence** or boundary.

Golden Hedge



Source: <http://www.ultrdacha.ru>

A slow growing, golden leaved plant with small shiny golden leaves on top, pale yellow underneath.

Common Characteristics of plants used for hedges in Fiji.

- *will stay looking good all year round
- *have dense compact form
- *easy to clip.

Ixora coccinea (Sinu)



Source: <http://www.mgonline.com>

Used for hedges as it flowers all year round. Flowers are used for decoration and leis.

Box is a slow growing, evergreen plant with small shiny dark green leaves on top, pale green underneath



Source: <http://www.tree-shop.co.uk>

Panax spp. Hedge (Danidani)



Source: www.tree-shop.co.uk

7. Poultry wire

A mesh of wire commonly used to fence poultry livestock, such as chickens, in a run or coop. It is made of thin, flexible galvanized steel wire, with hexagonal gaps.



Source: <http://www.imgkid.com>

Poultry wire fence Source: Jcwiremesh.com



Source: <http://www.ew-wiremesh.com>

Poultry wire is rolled tightly for easy storage.

 1. List the seven common types of fences used on Fiji farms 2. Differentiate between the seven types of fences used on Fiji farms	 Different types of Fences are used on Fiji farms for three main reasons: as boundary markers, to restrain livestock and to protect stock and crops. While there may be many other fencing materials and types, farms in Fiji commonly adopt seven main types: barbed wire, goat wire, electrical, wooden, chain link, hedge and poultry wire
 Discuss three main characteristics of plants used for hedges.	

LESSON 3 CHOOSING A FENCE

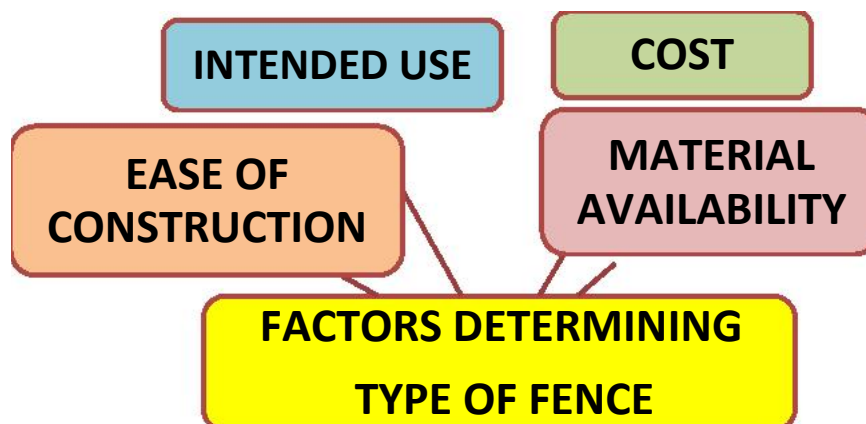
LESSON OUTCOME

At the end of this lesson, a student will discuss four main factors to be considered when choosing fences for the various farms in Fiji.

	<table> <tr> <td>Restrain</td> <td>- keep under control or within limits.</td> </tr> <tr> <td>Install</td> <td>- place or fix in position ready for use.</td> </tr> <tr> <td>Entanglement</td> <td>- to cause to become twisted together or caught in a snarl or entwining mass:</td> </tr> <tr> <td>Versatility</td> <td>- having varied uses or serving many functions.</td> </tr> <tr> <td>Durability</td> <td>- the ability to withstand wear, pressure, or damage.</td> </tr> </table>	Restrain	- keep under control or within limits.	Install	- place or fix in position ready for use.	Entanglement	- to cause to become twisted together or caught in a snarl or entwining mass:	Versatility	- having varied uses or serving many functions.	Durability	- the ability to withstand wear, pressure, or damage.
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Entanglement	- to cause to become twisted together or caught in a snarl or entwining mass:										
Versatility	- having varied uses or serving many functions.										
Durability	- the ability to withstand wear, pressure, or damage.										



There are many different factors to take into consideration before installing a new fence for any farm. One specific material or style is not necessarily better than the other—each has its own advantages and disadvantages. At the end of the day, the type of fence you choose will be determined by your budget, the terrain of your property and the purpose the fence will serve.



ADVANTAGES AND DISADVANTAGES OF FENCE TYPES

FENCE TYPE	ADVANTAGES	DISADVANTAGES
Barbed Wire	* Keep livestock restrained * For interior or exterior fences. * Fast and economical to install.	* The animal can be entangled and injured.
Electric fence	* Economical method of dividing pastures into smaller areas to improve rotational grazing. * Can be installed with minimal equipment and relatively quickly. * Can be used as either a temporary or permanent fence * Come in a variety of materials from high tensile wire, woven wire, electric braided rope or ribbons.	* Requires a lot of maintenance with constant weed control, tightening of wires, and daily checks to see that enough current is reaching remote areas. * Animals must be trained to respect fence * Entanglement is possible with horned breeds * May not be acceptable for young kids or problem animals as a sole fencing solution.
Goat/woven wire	* Strong, durable, and permanent fence. * the most basic, multi-purpose animal fence for livestock * It is readily available	* More expensive and harder to install than electric or barbed wire fences. * Horned goats may get entangled. * Small kids and smaller dwarf breeds may be able to squeeze through. * Goats have a tendency to rub against fencing, or eat through it, possibly knocking it down or stretching it. * Can be difficult to install on hilly or brushy terrain.
Wooden Fence	* Can quickly and easily be cut to match the contours of your farm or ranch. * Its versatility is one of the characteristics that make it the most common type of fencing used today. * The lifespan and durability of a wooden fence depends on the type of wood you choose	* Needs to be treated and maintained every few years to keep it looking good and performing well.
Chain Link	* A popular choice, affordable, durable and virtually maintenance free. * Keeps large animals from escaping. * Has a lifespan ranging from 20 to 30 years * Able to withstand strong gusts of wind.	* Does not offer any privacy * Expensive, heavy, and not good for large areas.
Hedge	* Nicer aesthetically, * Usually less expensive than fences * Natural	* Takes a long time to establish. * Needs at least yearly trimming. * Can take moisture & nutrients away from plant borders



1. List and discuss four main factors to be considered when choosing fences in Fiji.
2. State one advantage of choosing each fence type.
3. State one disadvantage of choosing each fence type.



Things to consider when selecting a fence include what the fence is to be used for, how easy it is to build, what it costs to build and maintain and how long it is supposed to last.



Compare and choose the best types of fence for crops, goats, cattle, and poultry.

LESSON 4: CONSTRUCTING FARM FENCES

LESSON OUTCOME:

At the end of this lesson the student will list five factors to be considered before constructing farm fences and describe why each factor is important for the successful construction of farm fences in Fiji.



- | | |
|---------------------|---|
| Contour | - the outline of something, such as of a social or geographic boundary. |
| Floodway | - the channel and adjacent shore areas under water during a flood. |
| Paddock | - a small, usually enclosed field for pasture or exercising animals |
| Mustering | - to gather animals together for a purpose like inspection or treatment |
| Stock Yard | - a large yard containing pens and sheds, in which livestock is kept |
| Loading Ramp | - an inclined surface or roadway connecting different levels |



The following factors must be considered before a farm fence is erected.

Factors to consider	Reasons
1. Geography a. Land Contour 	*Having fences follow land contours and obstacles is recommended to increase usable land area. *Fences which follow creek beds, hill and tree lines are ideal as they exclude these features from inside the paddock which can make management tasks such as spraying and mustering difficult. *Fence off potential flood areas to prevent stock and vehicle access. *Climate and geographic location should decide what fencing materials to use in the construction of a fence.

Source: <http://www.barnpros.com>

b. Access to stock water.  Source: http://www.ecan.govt.nz	Fence layout must allow livestock easy access to natural waterways like streams. If the paddocks do not have clean, natural waterways, fences must be erected to allow the provision of water to the paddocks.
c. Availability of trees  http://www.beefproducer.com	Trees provide much needed shade and shelter for stock, so it is important to consider the prevailing wind and if the stock can gain shelter on the opposite side of it. Also consider the path of the sun particularly in summer, and if the established trees will provide adequate shade
2.Safety a. Gate access.  http://www.hurricanefenceinc.com	Positioning of gates is critical for ease of stock movement. Gates should always be placed in a corner or a recess. Stock will almost always run along a fence line to a corner or around a corner when being mustered. Gates placed in the middle of a fence line require experienced stock handlers to successfully negotiate stock through. Future machinery requirements should also be taken into account when considering gate access.
b. Environmental issues.  http://www.uwrl.usu.edu/ucwrr	It's an environmentally friendly practice to keep stock out of creeks, streams, rivers, and dams. These areas are prone to soil erosion and giving stock unrestricted access can cause water pollution from disturbed soil as well as livestock urine and faeces. However, stock can use the waterways to bathe and cool off during hot weather.
c. Access and laneways.  http://www.sheepandgoat.com	Stock movement around the farm must be taken into account including access to milking parlours, stock yards and loading ramps. Having adequate lane access with a sound fence layout ensures simpler stock movement and overall management of the whole farm.

3. Infrastructure availability



<http://www.nonantymochwindfarm.co.uk>

Availability of adequate water, electricity and road will ensure faster and efficient construction, patrolling and maintenance of fences. Water is needed for the mixing of the cement which is needed for the base of the posts; electricity is needed to run fencing equipment like saws. This is why farmers often include a portable generator with their fencing equipment. Transport is needed to move the fencing materials, tools and equipment from storage to the fence site.

4. Labour availability



<http://www.portsdown.hampshire.org.uk>

Labour must be skilled in the building of fences so as to minimise injury and eliminate the wastage of time and materials while ensuring that quality fences are erected. Special training and knowledge needed include the use of chain-saws and tools or machines for digging post holes, erecting posts, unrolling and stretching wire, placing and fastening wire, hanging gates and installing crossings over drains. Most fencing work requires two people, one to operate equipment and the other to act as a guide and for OHS purposes.

5. Material cost, availability and durability



<http://www.farmingmagazine.com>

The fencing material which a farmer decides to use on his farm influences the overall cost of fencing. The farmer will conduct research on the cost and availability of materials before deciding if the farm should have permanent or temporary fences. The farmer must also select fencing material based on the durability of the materials available.



Your family has decided to raise dairy goats on the 10 ha of land pictured, which is situated 5 km from a major town.



<http://wonderinginwellington.filewordpress.com>

A. Draw a plan of the farm fences taking into consideration:

1. location of milking parlour.
2. location of shed in which goats will be housed at night.
3. topography of land.
4. availability of natural water supply.
5. risk of flooding.

B. Decide the type of fencing material you will use for the goat farm and explain your decision.

Before constructing a farm fence it is important to consider the following factors; geography, infrastructure, available utilities, safety, labor and materials.



Discuss five main factors that need to be considered before constructing a farm fence.

LESSON 5: MAINTENANCE OF FARM FENCES

LESSON OUTCOME:

At the end of this lesson the student will name five methods of maintaining farm fences, describe the practices carried out in each method discuss the reasons for each practice methods.



Underbrush -shrubs and small trees forming the undergrowth in a forest



All types of agricultural fencing require regular maintenance to ensure their effectiveness.

Cattle and horses are strong enough to go through most types of fence by force and occasionally do so when frightened or motivated by hunger, thirst, or sex drive.

Weather, flood, fire, and damage from vandals or motor vehicle accidents can do similar damage and may allow livestock to escape. Properly installed and maintained, the fence will save you time, frustration, money, and your relationship with your neighbors.

METHOD OF MAINTENANCE

1. Mending



Source: <http://www.littlefieldfarmblog.blogspot.com>

- *By regularly inspecting farm fencing, you reap two benefits—fresh air and the prevention of further damage to your fences.
- * Un-mended fences may lead to the unwanted movement of livestock into and out of the field
- * Un-mended fences may cause injury to livestock as they flee predators, climb over the broken fence or wonder onto roads.
- *Damaged fences are to be mended as soon as the damage is detected.

2. Painting



Source: <http://www.rammfence.com>

- *Painting lengthens the life of the material used by preventing the rusting of iron parts.
- *Painting also minimizes the effect of rain and so prevents the rotting of timber parts.
- *Fencing materials often blend into the environment so painting makes for a more visible fence and boundary line.
- *Painting also allows the damaged fence part to be more easily seen.

3. Clearing



<http://www.abandonedkansai.com>

- *Plants growing along the fence line may creep up the fence and because of the extra weight, loosen the wires or cause the wood to rot.



<http://www.shutterstock.com>

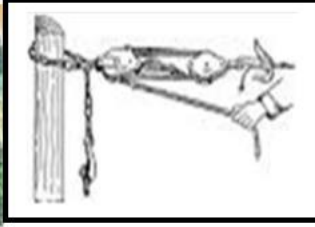
- *Certain types of plants growing on the outside of the fence line may poison or sicken the livestock



<http://www.chumcreekfencing.com.au>

- * Vegetation growing along the fence line also makes fences less visible. Farmers clear vegetation off the fence and along both sides of the fence line

4. Straining



Source: <http://www.gutenberg.org>

- *Falling and slack fences act as litter traps and become hazards capable of trapping or injuring larger mammals
- *The farmer will tighten the fencing wire using a strainer.

5. Replacing parts



Source: <http://www.weeklytimesnow.com.au>

- *Damaged fence allows livestock to move out of the field and be injured or lost
- *Unwanted entry into the field by humans and livestock can cause production loss
- *May cause further damage to the whole fence structure which would be more expensive



1. Define farm maintenance
2. List six practices that must be carried out during farm maintenance
3. Give two reasons for carrying out the different farm practices you have named



Maintenance conserves farm fences while compensating for normal wear and tear.



State one advantage and one disadvantage of painting, strengthening and clearing farm fences.

FARM BUILDINGS

Content Learning Outcome: Explore knowledge and skills on types of buildings used on farms in Fiji.

LESSON 1: TYPE AND FUNCTIONS OF FARM BUILDINGS

LESSON OUTCOME

At the end of this lesson the student will describe the major functions of farm buildings used on Fiji farms.



Green house

- a structure, primarily of glass or sheets of clear plastic, in which temperature and humidity can be controlled for the cultivation or protection of plants like vegetables and flowers. .

Shade house

- structure which is covered in woven materials to allow sunlight, moisture and air to pass through the gaps. The covering material is used to provide a particular environmental modification, such as reduced light or protection from severe weather conditions. Used for growing ornamentals and seedlings.

Farmstead

- the land and buildings on a farm.

Homestead

- a homestead consists of a dwelling, often a farm house .

Agricultural buildings are structures designed for farming and agricultural practices, including but not limited to: machine storage, growing and harvesting of crops and raising livestock and small animals.

Types and Functions of Farm Buildings

Farm office – where the farmer keeps records and conducts farm business including meetings and consultations.



<http://www.mrbratpacker.wordpress.com>

Honey House - place where honey is extracted, processed and stored, ready for marketing.



<http://www.thepananimal.wordpress.com>

Farm House - family dwelling on the farm



<http://www.houseplansandmore.com>

A **barn** is an agricultural building usually on farms and used for various **purposes**. These structures are used to house livestock, including cattle and horses, as well as equipment and fodder, and often grain.



Sources:

<https://www.hobbyfarms.com>

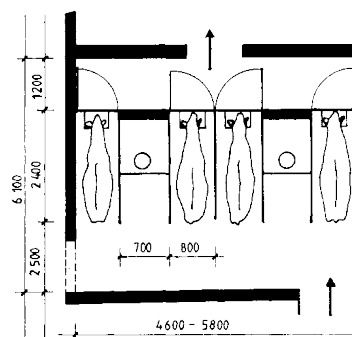
Milking parlours- where cattle, sheep or goats are milked and milk is stored for collection.

Herringbone Milking Parlour



<https://www.google.com/search?q=herringbone+milking+parlour>

Abreast Milking parlour



www.fao.org

Storage facilities for physical capital – many farms use the same facility to store tools, equipment, machines, implements and chemicals. This storage facility is usually attached to the office building or is located near the homestead.

Tool and equipment storage-

- used to store farm tools and equipment for safety, easy access, recording and to avoid the misplacement of tools.



Source: <http://www.jackdaniel.com>

Machine and implement storage

-where machines and associated implements and spare parts are kept safe from thieves, dirt, rain, wear and tear.



Source: <http://www.Kbuildings.com>

Chemical storage

- where chemicals are kept cool and dry and out of reach of children, thieves and animals in a well aerated area, usually on shelves.



Source: <http://www.badger.uvm.edu>

Crop Raising structures are erected and used to alter the environment conditions to favour the growth of certain crops.

Shade house- with woven material sides and roof used to raise delicate plants like ornamentals and seedlings.



<http://www.gothicarchgreenhouses.com>

Glass house- with glass sides and roof used to manipulate the environment, especially the temperature, for raising plants like vegetables and for floriculture.



<http://www.flickrhivemind.net>

Green house- with plastic sides and roof used to raise plants under controlled environmental conditions.



<http://www.naturalplanter1.com>

Produce storage – where the produce from the farm is stored, awaiting further post-harvest treatment or sale.

Cool and dry storage -

goods are kept cool and dry to minimise wilting and rotting.



<http://www.bucklinbuildings.com>

Cold storage –goods are usually kept between 10 and -10°C to reduce the incidence of pathogen and microbial activity which causes spoilage



<http://www.thetyee.ca/news/2010>

Hermetic storage- where the dried produce is kept in airtight containers which are stored in sheds, to avoid germination, the



growth of mould and rotting.
<http://www.pestcontrolindia.com>

Post-harvest treatment – the goods are brought to these buildings to be cleaned, sorted, processed and packed for sale.

Ripening shed- where fruits are kept under appropriate conditions for ripening.



<http://www.incomingbytes.com>

Egg grading shed- where eggs are graded for quality and pricing.



<http://www.poultryhub.org>

Cleaning shed- where produce is cleaned and sorted according to size, shape and quality.



<http://www.vermontvalleyfarm.wordpress.com>

Livestock are raised in sheds to maximize the results of management. These sheds may include nurseries, brooders, growing out structures, production pens and harvesting as well as post-harvest buildings.

Broiler shed- broiler birds are raised in a controlled environment either for meat or eggs.



<http://www.mangawhaifocus.co.nz>

Cattle shed- where cattle are kept for mustering, supplementary feeding and other management practices.



<http://www.Roysfarm.com>

Pig shed- pigs are raised according to their age, size or gender for quality production and management



[http:// www.odt.co.nz](http://www.odt.co.nz)

Layer bird shed- used to keep layer birds; this system allows clean egg collection and avoids egg damage by the birds.



<http://www.sspoultry.en.made-in-china.com>

Goat shed- goats kept indoors for supplementary feeding, resting and for management practices



<http://www.Pixshark.com>

Sheep Shed - sheep kept indoors for supplementary feeding, resting and for management practices e.g. shearing.



<http://www.pinterest.com>

LESSON 2:**CHOOSING AND CONSTRUCTING FARM BUILDINGS****LESSON OUTCOME**

At the end of this lesson, the student will discuss the major factors to be considered when choosing the type of farm buildings to construct.

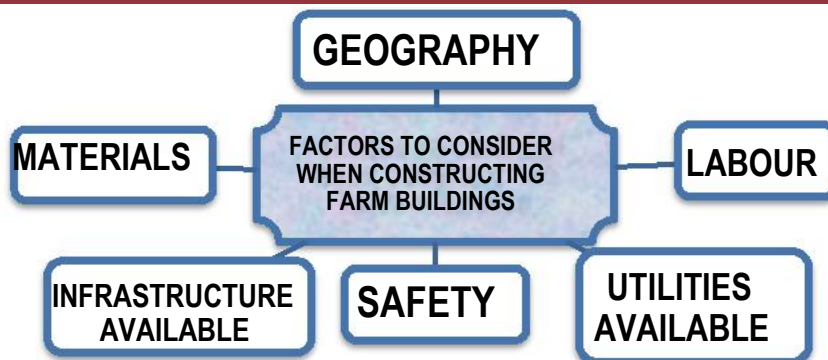
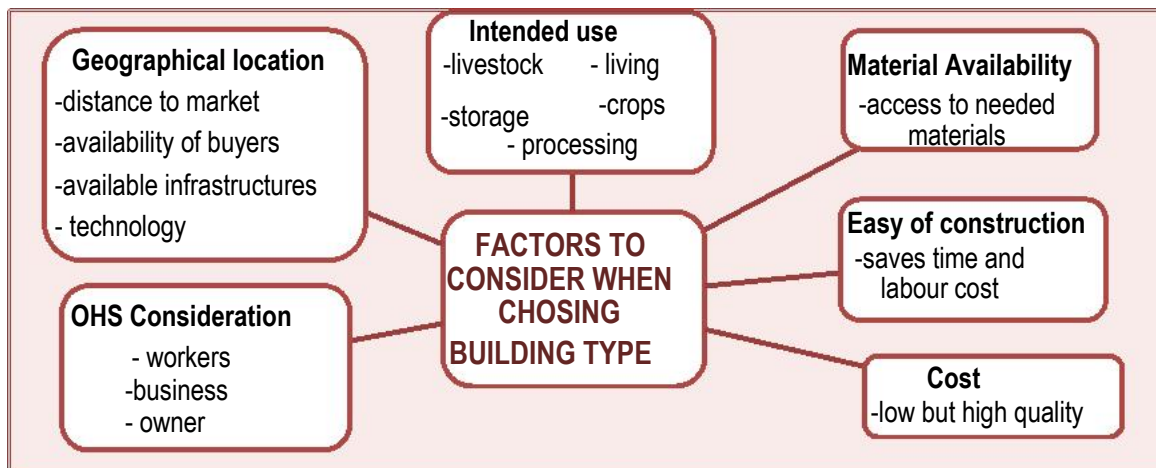


Geographical location - a specific physical point on Earth

Utilities - public service as a telephone, electric power system, road and water system



There are different factors that need to be considered before choosing and constructing farm building. This includes its intended use, the geographical location and cost, availability of building material, ease of constructions and the related OHS considerations.



Discuss the importance of OHS before and during the construction of a farm building.



Choosing building types for any farm is greatly influenced by the purpose it is intended for, the availability and cost of materials and the geographic location of the farm. Before construction of any building, it is important to give consideration to the OHS of all involved.



Discuss the reasons why the geographical location of a farm should be considered when choosing and constructing farm buildings.

LESSON 3:**MAINTAINING FARM BUILDINGS.****LESSON OUTCOME**

At the end of this lesson, the student will discuss the major factors to be considered when maintaining farm buildings.



Mend - to make something which is broken, worn, torn, or otherwise damaged whole, sound, or usable by repairing



Parts of a building will weather when exposed to the natural environment. Without proper maintenance, the building will deteriorate easily. Regular inspection and maintenance may enable timely identification of deteriorated building elements. Inadequate maintenance in the building may lead to OHS threats.

FACTORS TO CONSIDER WHEN MAINTAINING FARM BUILDINGS**MENDING**

- prevents further damage which will incur more cost
- keep the building to its full potential

**CLEARING**

- prevents breeding of building pest
- maintain OHS conditions

**PAINTING**

- prevents rust in metals like roofing iron
- prevents rot in timber

**REPLACING**

- replace damaged parts
- strengthen parts



Discuss the difference between mending and replacing parts of farm building.



Buildings undergo wear and tear but when the maintenance of a building is neglected or postponed, major and expensive repairs may result. Regular maintenance can greatly reduce the expense associated with repairs and in many cases, eliminate them completely.



Discuss the importance of painting, replacing, clearing and mending of farm buildings.

FINANCIAL CAPITAL

CONTENT LEARNING OUTCOME

Explore the importance of farm planning in any given farm situations based on the seven farm planning steps.

LESSON 1 THE BUSINESS OF FARMING

LESSON OUTCOME:

At the end of this lesson the student will explain why farming is a business.



Agribusiness - the business of agricultural production

Risk - a situation involving exposure to danger



Making a profit is the main purpose of agriculture. However, due to its dependence on organisms producing to their potential, agriculture is a risky business.

Risk is an important aspect of the farming business. The uncertainties inherent in weather, natural disasters, yields, prices, Government policies, global markets, diseases and other factors that impact farming can cause fluctuations in farm income.

Risk management involves choosing among alternatives that reduce financial effects that can result from such uncertainties.

Five general types of risk are described below:

- **Production risk** derives from the uncertain natural growth processes of crops and livestock. Weather, disease, pests, and other factors affect both the quantity and quality of commodities produced.
- **Price or market risk** refers to uncertainty about the prices producers will receive for commodities or the prices they must pay for inputs. The nature of price risk varies significantly from commodity to commodity.
- **Financial risk** results when the farm business borrows money and creates an obligation to repay debt. Rising interest rates, the prospect of loans being called by lenders, and restricted credit availability are also aspects of financial risk.
- **Institutional risk** results from uncertainties surrounding Government actions. Tax laws, regulations for chemical use, rules for animal waste disposal, and the level of price or income support payments are examples of government decisions that can have a major impact on the farm business.
- **Human or personal risk** refers to factors such as problems with human health or personal relationships that can affect the farm business. Accidents, illness, death, and divorce are examples of personal crises that can threaten a farm business.

To help foresee, prepare for and reduce the impact of risk factors, farmers must treat agriculture as a business. Planning is therefore a must.



Discuss the five types of risks in relation to one agricultural enterprise on the school farm.



Agribusiness is very high risk. Planning and educated decision making are tools which can be used to foresee, reduce and cope with risk.



Differentiate between the types of risk which farming enterprises need to be prepared for.

FARM PLANNING

LESSON 2: CONCEPTS OF FARM PLANNING

LESSON OUTCOME

At the end of this lesson the student will explain the concept of farm planning.



- | | |
|----------------------|---|
| Farm planning | - forward planning of the farm. |
| Sketch plan | - a visual record or map of the farm. |
| Goal | - an aim or desired result. |
| Budget | - An estimate of income and expenditure for a set period of time. |



All business undertakings plan their production and marketing operations consciously in respect of **what to produce** [enterprise], **how much to produce** [size], **how to produce** [system/technology], **who to produce** [labour], **when to produce** [market demand], **where to buy inputs** [source] and **where to sell products** [markets].



Planning for the future is one of the most important functions of management.

The planning of operations and their execution is the secret of the success of an enterprise. By implementing a **whole farm approach** to planning, the farmer can have an overview of all the enterprises intended for the financial year with associated inputs and expected outputs and so prepare to face the future with confidence.

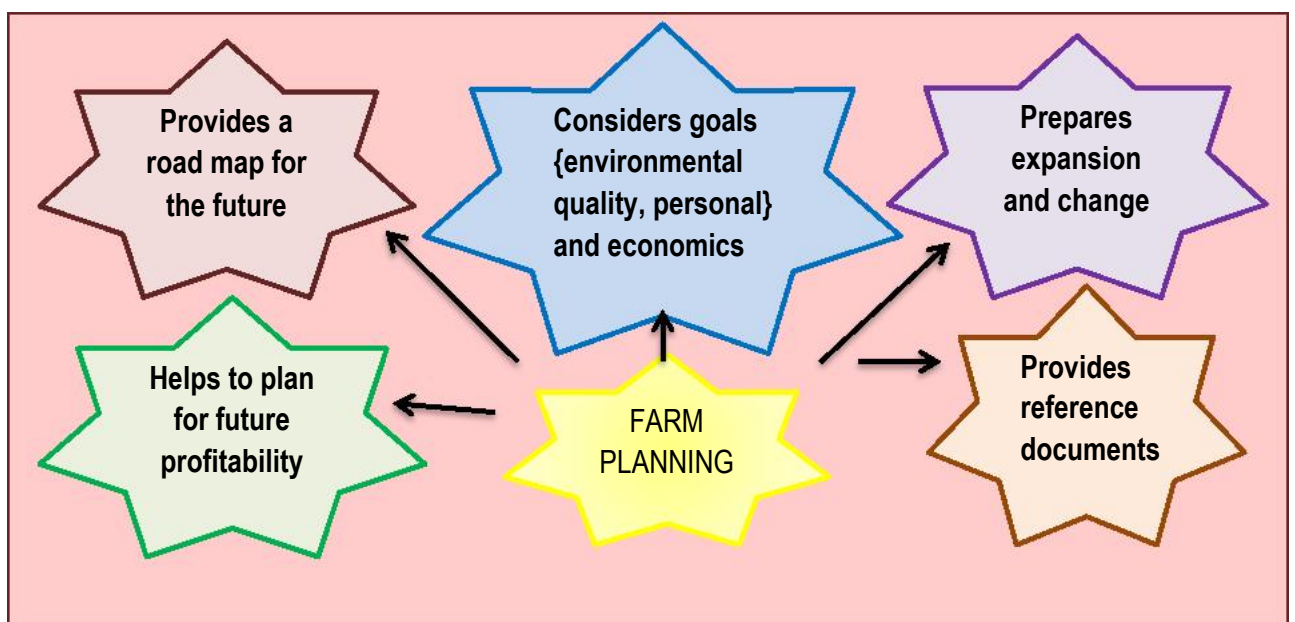
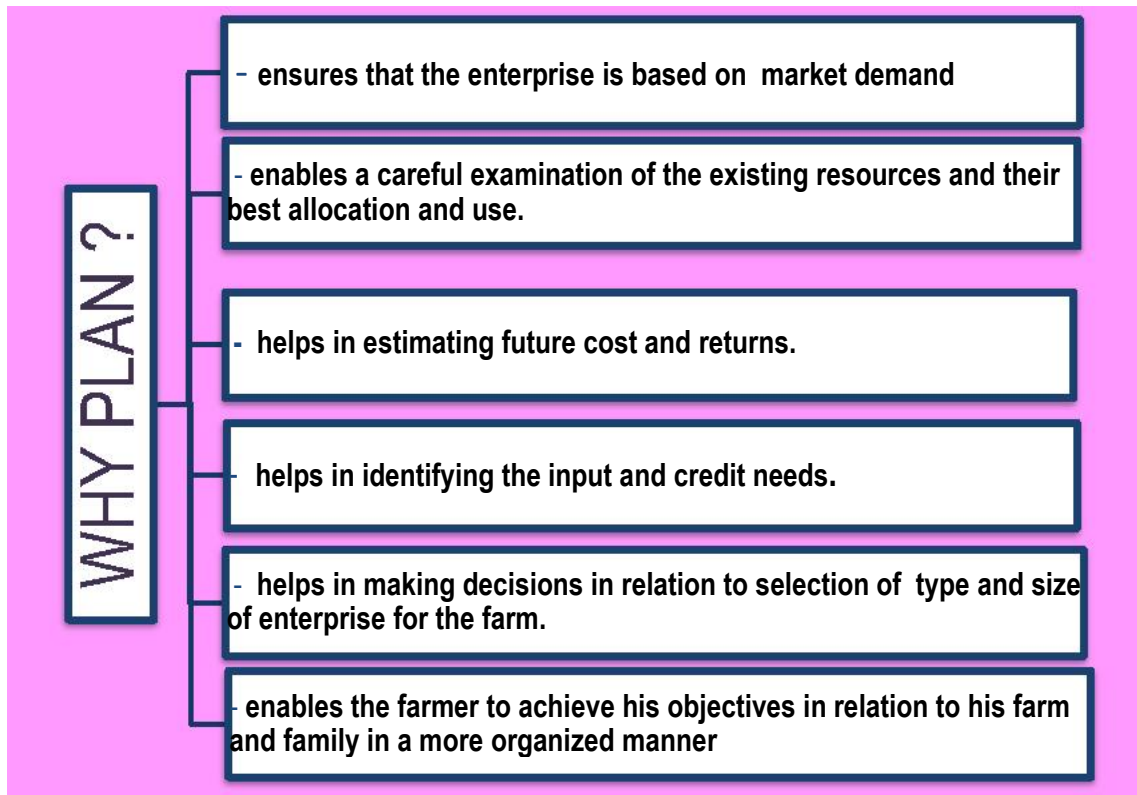
All planning is a matter of forecasting.

It is an attempt to state logically, in conformity with economic principles, what will happen in the future; therefore, planning serves as a blue print.

Farm planning has been defined by different farm economists as:

1. a process to allocate the scarce resources of the farm to organize the farm production in such a way as to use resources efficiency and maximise the income of the farmer.

2. a process of deciding in the present what to do in the future about the best combination of crops and livestock to be raised through rational use of resources.
3. a process of choice making or choosing from among competitive alternatives. It is concerned with various adjustments the farmer makes in the existing organizations with the purpose of making the most profitable use of scarce resources.



Some of the things which may need to be planned for include:

- Upgrading facilities (e.g. Introducing technology, new procedures, replacing or improving worn out or damaged facilities)
- Expansion of operations
- Changing direction (e.g. moving from one type of livestock to another, or diversification)
- Major maintenance (of property, buildings or equipment)
- Training staff
- Holidays
- Contingencies in case of anything going wrong (eg. economic downturn, drought, illness).

Opposition to planning!

Although farmers agree that planning is important some farmers offer the following excuses against it:

- planning reminds them that the future is uncertain and risky
(Often farmers prefer to ignore this risk).
- planning is not easy
(Although it involves careful thought and analysis, planning just needs practice).
- planning makes farmers vulnerable
(When seeking advice in developing a plan, they have to admit that they don't have all the answers).
- planning is time consuming

The vast majority of men die poor, not because their intentions were not right, but because their plans were not right.
Anonymous

Planning is limited by:

- lack of or inaccurate information.
- time and cost.
- resistance to change.
- lack of ability to plan.
- environmental constraints.



1. Explain why it is important to plan.
2. State the reasons why plans should be changed over time.
3. Discuss why farm planning is a continuous process.



Planning for the future is one of the most important functions of management



List and explain five importance of farm planning.

LESSON 3: THE IMPORTANCE OF FARM PLANNING

LESSON OUTCOME

At the end of this lesson the student will discuss the value of planning in the management of a farm.



- | | |
|-------------|--|
| Efficiency | - a level of performance that describes a process that uses the lowest amount of inputs to create the greatest amount of outputs |
| Risk | - the chance that an investment's actual return will be different than expected. |
| Innovations | - The process of translating an idea or invention into a good or service that creates value |



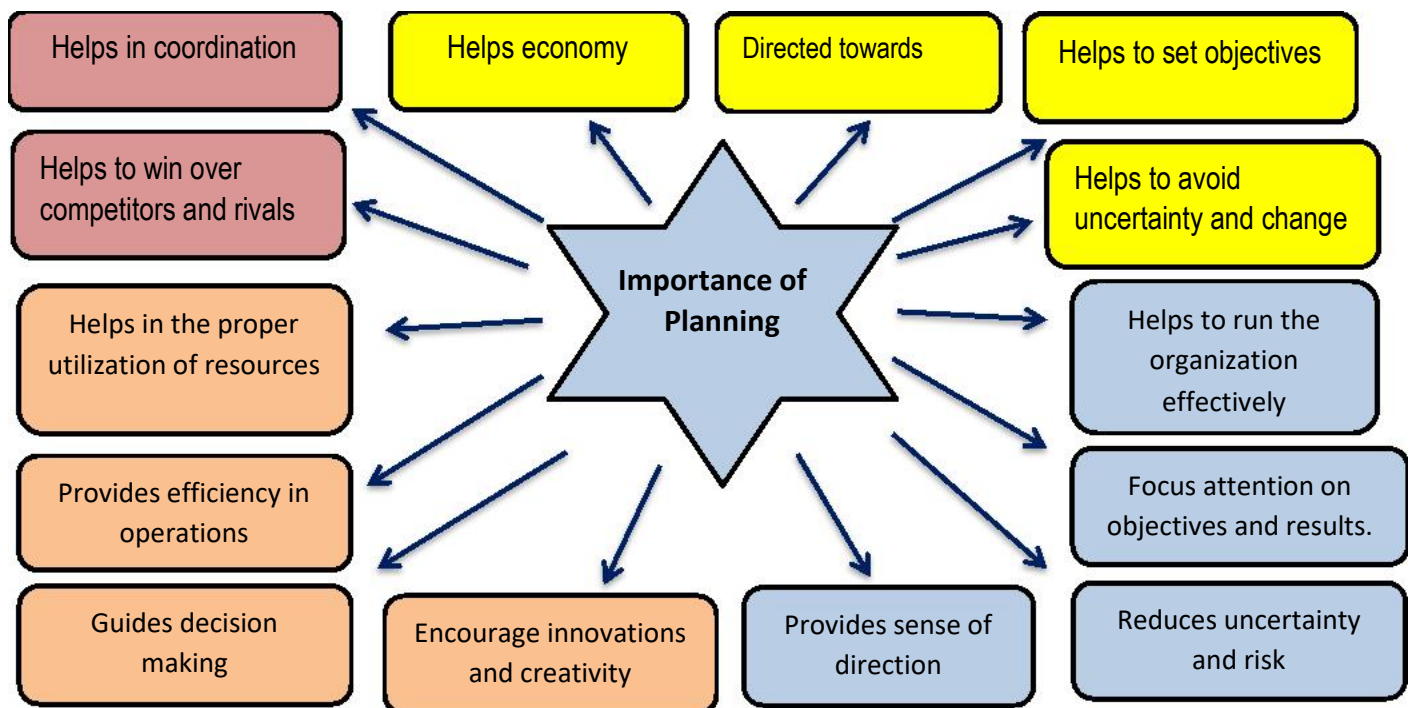
Planning is deciding in advance what to do, how to do it, when to do it, who to do it and how much to do.

Whole farm planning is a comprehensive approach to farm decision-making. It brings the entire farm and all its resources into the thought process. The purpose is to help farmers achieve their goals, while at the same time enhancing natural resources and the environment.

It is based on the concept that a farmer can make better decisions if he or she has all relevant information about available resources, alternative solutions, and potential impacts.

If the steps are being implemented but they are not really solving the problem, the farmer should take note and alter the plan. Periodically, like every three to five years, farmers should review, evaluate and update written plans to reflect changing circumstances, goals, technologies, and regulations.

At the same time farmers continuously monitor their progress on the farm.



Briefly outline the value of farm planning?



A plan helps farm managers coordinate the different functions and divisions of their enterprises to ensure that they all pull in the same direction and work to achieve the farms objectives.



Explain how farm planning reduces uncertainty and risk.

LESSON 4: FARM PLAN CHARACTERISTICS and COMPONENTS

At the end of this lesson the student will discuss the characteristics and components of a farm plan.



Stocking - the number of animals on a given amount of land over a certain period of time e.g. head of cows per hectare.



A good farm plan should have the following characteristics:

- a) flexibility - essential to account for changes in the environment and circumstances around the farm e.g. if the children decide to take a career outside of farming; disease hits the crop etc.
- b) maximize resource use efficiency on the farm e.g. tractors should be used throughout the year.
- c) provide for the attainment of the objectives of profit maximization through optimum resource use and balanced combination of farm enterprises.
- d) account for risk and uncertainty.
- e) timely acquisition and repayment of farm credit

Components of a Farm Plan:

Any systematic farm planning necessarily has the following five components:

a) Goal or Aim statement :

Goals and a long-term vision for:

- the quality of life the farmer wants for the farming family within the community.
- the farmers vision for the future of the farm.
- how the farm enterprise will provide the income and living environment the farming family need.

These three goals correspond to three resource areas:

- Human and social resources
- Environmental and natural resources
- Economic and financial resources

b) Inventory of scarce resources and constraints:

An inventory of all the resources at the farms disposal is made including:

- 1) **Land:** tenure, location, topography, soil type, fertility, drainage, irrigation systems etc. affect enterprises in many ways and hence, it is useful to divide all the land on a farm according to intended enterprises.
- 2) **Labour:** On subsistence farms, all labour is supplied by the farmer and his family. Thus, it is important to record the number of workers - male, female and children - and the type of manual work each is capable and prepared to undertake.
However, on commercial farms, hired labour constitutes a major component of costs and so receives more attention in the planning process.
- 3) **Capital:** physical capital like buildings and machines and financial capital like cash on hand and borrowing power, act as a very powerful constraint.
- 4) **Personal:** Farmers' past experience, attitude towards risks and uncertainties, ability, aptitude and personal likes and dislikes influence the choice of enterprise.
- 5) **Institutional:** Markets often serve as a constraint for the production of perishable goods like vegetables, poultry, milk, etc. Even if the location of the farm is suitable for a particular crop, a contract may still have to be obtained e.g. sugarcane production. Similarly, the crop or livestock must be legal.

c) **Rotations:**

Maximum permissible stocking rates for a particular livestock would serve in maintaining soil fertility and help controlling pest and diseases.

d) **Alternative Choices:**

Alternative choices in planning refer to the various enterprises, crops and livestock, which can be considered for attaining the stated objectives. There are alternate ways to use the scarce farm resources and produce the same goods. A comprehensive list of different alternative enterprises can be prepared.

e) **Input Output Co-efficient:**

The requirements of each of the several scarce resources and the financial returns per unit of each enterprise or activity need to be considered.

The precision in planning depends more on accurate input-output data than on the technique of planning.



Briefly outline the characteristics and components of a farm plan?



For a farm plan to work, it should be flexible, maximize the efficient use of resources, account for time, risk and uncertainty and ultimately allow the farm to meet the stated objectives.



Discuss how each farm plan characteristic assists the farm in achieving its stated aim.

LESSON 5: WHOLE FARM PLANNING

At the end of this lesson the student will discuss whole farm planning.



Action plan - document that lists what steps must be taken in order to achieve a specific goal. The purpose of an action plan is to clarify what resources are required to reach the goal and formulate a timeline for when specific tasks need to be completed.



There are many types of farm plans but whole farm planning is discussed.

Whole Farm Planning

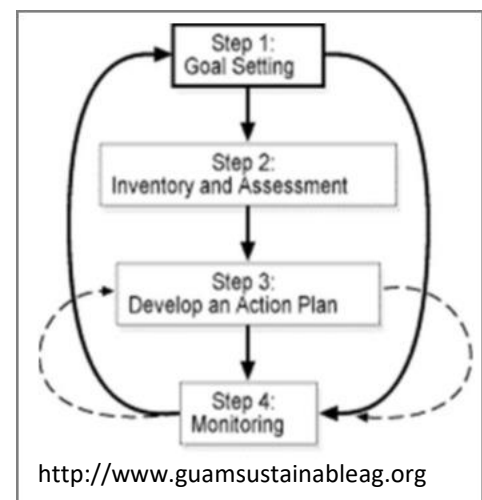
This is a term popularised in the 1990's that covers taking a "holistic" approach to farm planning.

It involves four steps:

1. Setting goals
2. Making an inventory and assessment of farm resources
3. Developing and implementing an action plan
4. Monitoring on-farm progress toward goals

It requires giving due consideration to:

- ii) all of the farm assets (physical and non-physical);
- iii) time – usually set over a long period of time (perhaps several generations);
- iv) all of the aims which the farmer may aspire to (eg. profit, lifestyle, family wellbeing, sustainability of production, conservation etc.).



In any whole farm planning strategy the farmer must;

1. assess the site in terms of present and potential use/suitability.
2. subdivide the farm, usually by fences, to emphasise useful or problem areas (e.g. level land, erosion prone area, flood prone area, areas affected by rising sea levels – high salinity).
3. deal with appropriate sections or issues for example:
 - a) dependable clean water source
 - b) access routes for vehicles, livestock, machines and people.
 - c) cropping or livestock rates and plans to increase them
 - d) shelter is planned and planted out (trees), or built (farm building)
 - e) pest animals and plants are located, identified and controlled by chemical or natural alternatives.

Conservation is a very important aspect of whole farm planning:

- i. native birds, honey bees, lizards, toads, centipedes, and spiders are mostly beneficial on the farm, as they control a range of pest animals and insects, so must be conserved.
- ii. soil use and conservation methods to employ to ensure continued availability and fertility of soil.
- iii. water source, use, storage and conservation is important so the layout of drains or irrigation systems are planned. The use or disposal of wastewater must also be considered.

Costs will be a deciding factor. The farmer needs to determine:

- i. what costs may be involved
- ii. what the benefits of whole farm planning is to the future of the farm.

In the majority of cases long term gains far outweigh the time and resources used in establishing such a plan.



Discuss the four stages of whole farm planning.



Whole Farm Planning takes into consideration time and resources available for a farm to reach realistic goals of the farming family, while taking into account the conservation of soil, water and other organisms which inhabit the farm area.



Discuss the importance of whole farm planning.

LESSON 3: STEPS IN FARM PLANNING.

LESSON OUTCOME

At the end of this lesson, the student will list and explain the seven [7] steps used in farm planning.



- | | | |
|----------------|---|--|
| On farm report | - | a description of the farm and how it is being managed by the farmer |
| Back casting | - | a way of planning in which a successful outcome in the future is imagined, followed by the question; "What do we need to do today to achieve that outcome successfully?" |



To be successful, a farm plan must be organised and systematic.

STAGES IN FARM PLANNING:

The various steps involved in planning are discussed below:

a) Planning:

The problem is identified and defined; information is collected; possible solutions listed, analysed and compared. Planning is the basic management function as it means deciding on a course of action, procedure or policy.

b) Implementation:

Once the planning process is completed, the best alternative must be selected and action should be taken to place the plan into operation. This requires the acquisition and organization of

necessary resources [inputs]. An important part of the implementation function is the financing of the necessary resources.

c) Control:

The results of the implemented plan are analysed to see if the specified goals and objectives are being met. Many things can cause a plan to go “off its track”. Price and other changes, which occur after the implementation of the plan, can cause the actual results to deviate from the expected. Control requires a system for making regular checks on the plan and **monitoring** progress and results as measured against the established goals.

Below are the seven steps recommended for effective planning:

1. Decide upon objectives

- Prepare a set of objectives which state what the farmer actually wants to achieve, based on the records of the farm e.g. 2 hectares of land is to be prepared for planting.

2. List available resources

- List the quantity and quality of resources which are available including land, labour, financial capital, physical capital, managerial skills and technology. e.g. 2 hectares of level land, 10 youths from nearby settlement, 1 skilled tractor operator, \$200.00 to complete the task, neighbour hires out tractor and implements, 10 digging forks on farm, youths know how to prepare soil using diggig forks.

3. List alternative activities

- State all the possible enterprises which the resources can be used for.
- List of crops and/or livestock enterprises and/or method which the resources can be used for.
- Focus on items such as costs, price, yield and time, market.
 1. Youth can dig area
 2. Hired tractor

4. Prepare budget for alternative activities

- Use financial tools such as gross margin, partial budget and cash flow budgets to determine the alternative which gives the highest return per limited resource.
- a) Youth costs - 10 youths will take 5 days at \$10.00 per day/youth = \$500.00
- b) Tractor hire - 4 days of 5 hours/ day [20 man hours x \$20 per hour] = \$ 400.00

5. Choose a Planned alternative.

- Choose the alternative that best meets the stated objectives, is within the budget, meets the family goals and justifies cost and time.
- Choose to hire tractor because it costs less and takes less time

6. Put the *plant* into action

- Implement the chosen alternative as planned out.
- Hire the tractor to prepare the land

7. Evaluation

- Evaluate the course of action whether the aim or stated objectives have been achieved . If the objectives were not achieved, then further planning is needed.
- e.g was the 2 ha of land prepared to expectation and within the time limit?



Work as a group.

Explain the steps of farm planning to your group and apply this to a small broiler farm at your school that produces 100 chickens per week. Illustrate how the steps will be applied in this situation.



As the whole farm plan is implemented, the farmer needs to evaluate the different options and plans to determine if it works. It might be necessary to make minor adjustments to the plan as time goes on. Accurate records are evaluated to see if the farming business is still on the right track and achieving the goals set out



What role does farm planning play regarding the conservation of natural resources?

LESSON 4: PRACTISING FARM PLANNING

LESSON OUTCOME

At the end of this lesson, students will use the seven steps to make farm plans with given information and scenarios.



On farm report - a description of the farm and how it is being managed by the farmer



Use the farm planning steps in lesson 3 to prepare plans for the following activities.

Activity 1

A crop farmer in your area has 2 hectares of dalo which is mature.

The farmer has secured a market for the crop with a dalo exporter.

The dalo is to be harvested, cleaned, packed and ready for pick up by the dalo exporter in 3 days' time. **Plan this activity.**

Activity 2

Your class has a batch of 50 broiler birds which are ready for sale.

The teacher has advertised the sale and received orders for the 50 birds to be picked up in 4 days' time. Students are to slaughter, dress, pack and chill the birds for collection in 3 days' time.

Plan this activity.



Work as a group and present your activity discussion to the class.



The organizing of activities on the farm is assisted when the planning steps are used.



Use the planning steps to organise a class or school activity.

DECISION MAKING

Content Learning Outcome

Explore the importance of decision making in determining appropriate solutions for challenges faced by given farming situations.

LESSON 1: CONCEPTS OF DECISION MAKING

LESSON OUTCOME

At the end of this lesson the student will explain the concept of decision making.

	Decision analysis	-a technique used to explore various facets of a decision such as consistency or accuracy
	Decision maker	- a person who makes the final choice.



People make decisions every day. Sometimes the decisions made only affect the decision maker but in a farming business, most decisions have an effect on the running and success of the farm. Effective and successful decisions make profit for an enterprise while unsuccessful decisions result in losses.

There are usually many alternatives to choose from when deciding how to achieve an objective. Before making decisions the advantages and disadvantages of each alternative should be evaluated and compared before tools, techniques and perceptions are used.

Decision making is a process of selecting the best from among different alternatives.

DECISION MAKING IS:	Choice about a “course of action”
	Choice leading to “a certain desired objective”
	Knowledge indicating the nature of a commitment to action.

Brain Teaser

A farmer with his wolf, goat, and cabbage come to the edge of a river they wished to cross.

There is a boat at the river’s edge which only the farmer can row.

The boat can only handle one animal/item at a time, in addition to the farmer.

If the wolf is ever left alone with the goat, the wolf will eat the goat.

If the goat is left alone with the cabbage, the goat will eat the cabbage.

What should the farmer do to get across the river with all his possessions?

Decision-making is an ongoing process which consists of three major phases, intelligence, design, and choice. These lead to the decision maker choosing a course of action that is “good enough” and meets a certain minimal set of requirements. The majority of decisions involve some level of dissatisfaction or conflict with another party.

Some decisions are easy to make, like:	Some decisions are harder to make, like:
What to have for breakfast.	What career to choose
	

Decision making is the function of a manager. Making a decision is a delicate process which helps farmers to achieve their goals and objectives. Decisions also help farmers to be aware of the difficulties ahead.



1. Define decision making
2. Explain why farmers need to make informed decisions



Decision making is a process of selecting the best from among different alternatives.



What was the most important decision you have ever made? Explain how you came to that decision.

LESSON 2: IMPORTANCE OF DECISION MAKING

LESSON OUTCOME

At the end of this lesson the student will understand the value of decision making.



- | | |
|--------------------|---|
| 6 M's | - Men, Money, Materials, Machines, Methods and Markets |
| Rational decisions | - a series of analytical steps employed to review relevant facts, observations and possible outcomes before choosing a particular course of action. |



Informed decision making is valuable because it facilitates:-



1. Better Utilisation of Resources
2. Facing Problems and Challenges
3. Business Growth
4. Achieving Objectives
5. Increases Efficiency
6. Facilitates Innovation
7. Motivates Employees

1. Better Utilization of Resources

Decision making helps to utilize the available resources for achieving the objectives of the Farm. The available resources are the 6 M's, i.e. Men, Money, Materials, Machines, Methods and Markets. The manager has to make correct decisions for all the 6 Ms, which will result in better utilization of these resources.

2. Facing Problems and Challenges.

Decision making helps the organization to face and tackle new problems and challenges. Quick and correct decisions help to solve problems and to accept new challenges.

3. Business Growth.

Quick and correct **decision making** results in better utilisation of the resources. It helps the organization to:

- i) face new problems and challenges.
- ii) achieve quick business growth.

However, wrong, slow or no decisions can result in losses and industrial sickness.

4. Achieving Objectives.

Decision making helps the organisation to achieve all its objectives quickly. This is because rational decisions are made after analysing and evaluating all the alternatives.

5. Increasing Efficiency

Decision making helps to increase efficiency.

Efficiency is the relation between returns and cost. If the returns are high and the cost is low, then there is efficiency and vice versa. Rational decisions result in higher returns at low cost.

6. Facilitating Innovation

Decision making facilitates innovation.

This is because it helps to develop innovative ideas, products, methods and process which result in a competitive advantage to the organisation.

7. Motivating Employees

Decision making helps motivate employees.

This is because the employees are motivated to implement rational decisions. When the rational decisions are implemented the organisation makes high profits. Therefore, it can give financial and non-financial benefits to the employees.

The steps followed to make the decision should be recorded so that it can be used in future to justify the decision made should it be considered a bad decision

By keeping a record and engaging with the decision making process the farmer will strengthen his/her understanding of how it works - this can make future decisions easier to manage.



Briefly outline some of the values of decision making



An informed decision is important because it can help the farmer to consider all factors before making a decision which will motivate employees to utilise resources efficiently to deal with challenges.



Explain how decision making will help a farm business grow

LESSON 3: STEPS IN DECISION MAKING

LESSON OUTCOME

At the end of this lesson the student will list the steps in decision making.



Farm management is concerned with helping the manager to make some decisions.
Decision making involves choosing between alternatives to achieve goals.

The decision making process has 8 recognized steps:

1. Recognise that there is a situation which needs a decision

2. Observation-Identify the objective of the decision

3. Gather and evaluate data and diagnose the situation/ Collection and Analysis of Facts

4. Find alternative solutions to problems

5 Implement the decision

6. Gather feedback

7. Take responsibility for the decision

8. Learn from mistakes



List the eight steps of decision making.



Decision making involves choosing between alternatives to reach a goal.
There are eight basic steps in decision making



Why is "learning from your mistakes" the last step in decision making?

LESSON 4: MAKING DECISIONS

LESSON OUTCOME

At the end of this lesson the student will use the decision making steps to make informed decisions.



Coptotermes gestroi the Asian subterranean termite



Use the decision making steps in lesson 3 to reach the goals set by the farmer in the following activities.

Activity 1

The Asian Subterranean termite, *Coptotermes gestroi*, is one of the most devastating of the flying ant species and the agricultural department warns of its devastating effects on houses, timber trees and crops. According to the Ministry of Agriculture, "the insect can affect crops such as, cassava, sugarcane, yams, and many species of fruit trees and ornaments."

The Fiji Times, 20/03/10.



<http://www.termiteweb.com>

Use the decision making steps to assist a farmer who grows and exports breadfruit in the termite infested area decide on how the farm will address this issue.

Activity 2

The papaya export sector has been affected by pests, local weather and increased local demand.

The Fiji Times – Thursday 12/03/2015

Use the decision making steps to assist a farmer from the affected area that grows papaya for the local market, decide on how the farm will address this issue.



<http://www.archive.isnfonet-biovision.org>

Activity 3

American iguanas on Qamea Island continue to feed on small fish and leaves of cassava plants.

The Fiji Times:-Tuesday, 10/3/2015

Use the decision making steps to assist a farmer from the affected area who grows cassava for export, decide on how the farm will address this issue.



<http://www.petslady.com>



In groups, address the issues above.
Present your activity to the class.



farmers use the decision making steps to make informed decisions.



Use the decision making steps to determine a decision involving the whole class.

Below is a work sheet which may assist in the decision making activities above.

Name _____ Date _____ Year Level _____

Steps in Decision Making Activity Worksheet

1. Is there a situation which needs a decision?

2. Define the situation and the decision which needs to be made.

3. Gather information concerning the situation.

A. What are the facts of the situation?

4. List all alternative decisions that can be made

a. _____

b. _____

Weigh, compare your options.

	Positives.	Negatives.
a.		
b.		

5. Make a decision

6. Make a plan of action. (What can you do to get the best possible outcome?)

6. Gather information and evaluate the decision.

(Are you happy with the outcomes of your decision? Do you need to make some changes in your plan?)

7. Take responsibility for your decision

8. What lessons have you learnt?

Additional thoughts/Notes

STRAND AS 11.3

AGRONOMY

SUB-STRAND 11.3.1 SOILS	CLO 11.3.1.1 PHYSICAL PROPERTIES	
SUB-STRAND 11.3.2 HORTICULTURE	CLO 11.3.2.1 ASEXUAL PROPAGATION	
	CLO 11.3.2.2 LANDSCAPING	
	CLO 11.3.2.3 HORTICULTURE	

Introduction

This strand will facilitate the exploration of the physical properties of soil, asexual plant propagation, landscaping and the production of three field crops.



Students will be introduced to concepts relating to the relationship of the physical properties of soil to use and husbandry practices employed.

They will also study plant asexual propagation methods, skills involved in landscaping and the production of three field crops.

"Be it deep or shallow, red or black, sand or clay, the soil is the link between the rock core of the earth and the living things on its surface. It is the foothold for the plants we grow. Therein lays the main reason for our interest in soils."

Roy W. Simonson, USDA Yearbook of Agriculture, 1957

SOILS

CONTENT LEARNING OUTCOME

Demonstrate the assessment methods used in determining the physical properties of the soil.

INTRODUCTION:

Soil is the mixture of minerals, organic matter, gases, liquids, and the countless organisms that together support life on earth. Soil is a natural body known as the pedosphere which performs four important functions: it is a medium for plant growth; it is a means of water storage, supply and purification; it is a modifier of the atmosphere of Earth; it is a habitat for organisms; all of which, in turn, modify the soil.

Soil acts as;

- a. an engineering medium.
- b. a habitat for soil organisms.
- c. a recycling system for nutrients and organic wastes.
- d. a regulator of water quality.
- e. a modifier of atmospheric composition.
- f. a medium for plant growth,
- g. a reservoir of genetic diversity
- h. a reservoir for carbon.

Soil is a major component of the Earth's ecosystem and the processes carried out in soil have far-reaching impacts ranging from:

- a) ozone depletion, global warming and climate change.
- b) water pollution, flooding and environmental degradation.
- c) food security.

Fiji soils can be grouped genetically into 8 major types as follows:

Group	Description
1	Young sandy soils formed around the coast of the islands
2	Fertile, deep agriculturally important alluvial soils occupying the valley bottoms
3	Shallow and moderately-deep, dark coloured, nutrient rich soils on rolling and hilly land
4	Sandy and silty moderately-deep to deep soils formed from volcanic materials containing particles of unweathered parent material.
5	Deep, highly weathered clay-rich soils, often acidic and of low base saturation, derived from basic parent materials.
6	Deep, highly weathered oxide-rich clay soils of limited agricultural value.
7	Deep sandy soils derived from acid parent materials having clay increases in sub-soils, usually strongly weathered and of low base saturation.
8	Gleys and peats occupying low-lying areas in valleys or on plateaus.

Source: <http://www.comapipnm.org>

PHYSICAL PROPERTIES OF SOIL

LESSON 1: SOIL PHYSICAL PROPERTIES

LESSON OUTCOME:

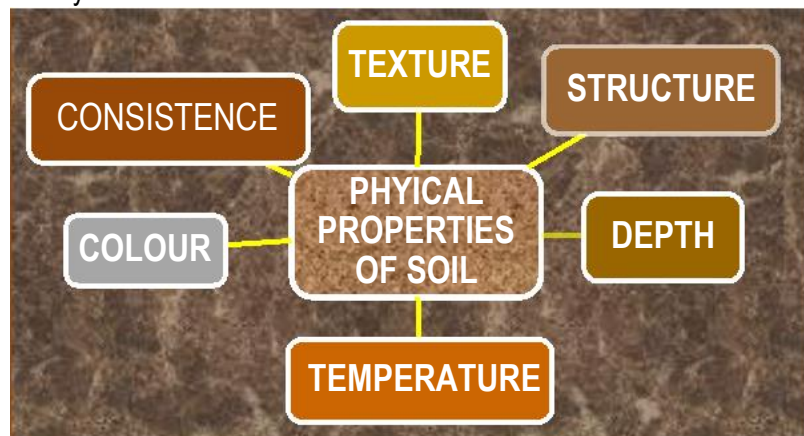
At the end of this lesson the student will explain and identify physical properties of soil.



Soil texture	- refers to the size of the particles that make up the soil
Structure	- the arrangement of the solid parts of the soil and of the pore space located between them.
Porosity	- pore space refers to the volume of soil voids that can be filled by water and/or air.
Consistence	- the strength with which soil materials are held together or the resistance of soils to deformation and rupture.



The characteristics of soil which can be seen by the eye or felt between the fingers are termed **the physical properties of soil**. They include:



These characteristics are the result of soil parent material being:

- acted upon by climate factors [such as rainfall and temperature changes]
- affected by topography and landform [slope and direction/ aspect]
- affected by life forms [kind and amount of flora and fauna]



Visit the school garden and identify as many of the physical properties of the garden soil as you can.



Soil colour, texture, structure, depth, temperature, porosity and consistence can be seen with the eye or felt between the fingers so are classified as the physical properties of soil.



Without looking back, list the seven physical properties of soil mentioned above.

SOIL COLOUR

LESSON 1: HOW SOILS GET THEIR COLOUR

LESSON OUTCOME:

At the end of this lesson the student will discuss how soils get their colour.

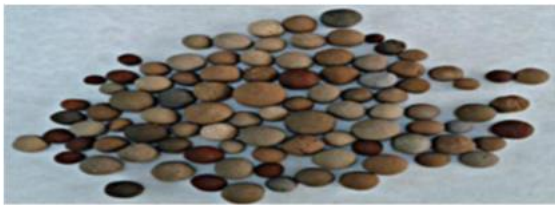


- Elements - elements are atoms, the smallest piece that matter can be split into
- Minerals - a collection of one or more elements that are stacked neatly together in a form called a crystal structure
- Rock - mineral matter of variable composition, consolidated or unconsolidated, assembled in masses or considerable quantities in nature.
- Organic matter - is matter composed of organic compounds that has come from the remains of organisms such as plants and animals and their waste products in the environment.



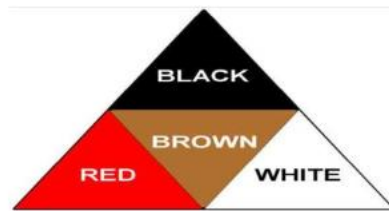
Soil colour ranges from white to black and all colours between.
It also varies from location to location; both across the landscape and with depth.

Different soil made into balls in the laboratory demonstrates that there is a range of soil colour.



Source: <http://www.blogs.egu.eu>

The most influential colours in a well-drained soil are:



Source: <http://www.ballina.nsw.gov.au>

Geologists officially recognise over 170 different soil colours, but the most common soil colours are shades of black, brown, red and grey

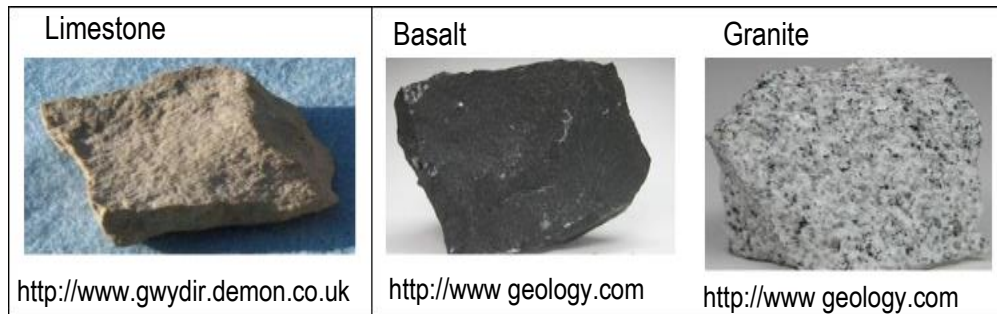


There are four factors which influence the colour of soil.

1. **Mineral matter** - rocks contain minerals. More than two thousand three hundred different types of minerals have been identified.

Rocks are combinations of one or more minerals that we find in nature for example:

- **Limestone** is composed of only one mineral – calcite
- **Basalt** is commonly composed of three minerals – feldspar, pyroxene, and olivine
- **Granite** is commonly composed of five minerals – two kinds of feldspar, mica, amphibole, and quartz



As the rocks weather the minerals form compounds which have distinct colours.

The colours from these minerals and compounds influence the colour of the resulting soil.

2. **Organic matter** – as organic matter decomposes it changes from brown to black. Therefore the colour of a soil will be influenced by the amount and stage of decomposition of the organic matter it contains as organic matter darkens soil. Organic matter is associated with the surface layers of soil and often masks all other coloring agents.



3. **Air and water content of the soil** – air and water both react with certain minerals in soil usually by oxidising the minerals **e.g. Iron** is the primary colouring agent in the subsoil. The colour of iron will vary from red to yellow, grey and bluish grey, depending on the air and water content of the soil. The orange brown colors associated with well drained soils are the result of Fe oxide stains coating individual particles.

Red soil	Yellow soil	Grey soil	Bluish soil
			
http://www.karlymegan.files.wordpress.com	http://www.indiamart.com	http://www.vro.depi.vic.gov.au	http://www.bpw.maryland.gov

Soil colour will reflect the effect, amount and type of iron in it.

4. Manganese (Mn) is common in some soils resulting in a very dark black or purplish black color.
Water content – The immediate effect of water is readily seen: soil colour darkens as water content changes from dry to wet.

Dry soil



<http://www.123rf.com>

Damp soil



<http://www.lovetextures.com>

The water content of soil over a long period of time also affects the colour of soil as described in (3) above.



Visit a location in or near the school compound where a soil profile can be observed. Compare the colour of the soil in relation to the parent material, organic matter content, iron content and water content. Discuss your observations with your class mates.



There is a wide range of soil colour in the world. The colour of soil is influenced by the mineral content of the soil's parent material; the organic matter content and stage of decomposition; the content and form of minerals in the soil and the water content of the soil.



Farmers often say that black soil is best for farming. Discuss this statement.

LESSON 2: IMPORTANCE OF SOIL COLOUR

LESSON OUTCOME:

At the end of this lesson the student will discuss the importance of soil colour.



Soil science	- scientific study of the formation, classification, mapping, and the physical, chemical and biological properties of soil.
Pedology	- the science that deals with the study of soils in their natural environment.
Tundra soil	- soil which forms in cold environments with short growing seasons and harsh winters. These soils may be at high elevation (mountains) or high latitude (Arctic or Antarctic).
Desert soil	- soil which forms in areas where the demand for water by the atmosphere (evaporation) and plants (transpiration) is much greater than precipitation. Deserts cover 20 to 33% of the Earth's land surface, and can be found in the tropics, at the poles, and in between.
Latosol	- soils found under tropical rainforests with a relatively high content of iron and aluminium oxides.
Podzol	- soils which form under forested landscapes on coarse parent material that is high in quartz. They have a characteristic subsurface layer known as the spodic horizon made up of accumulated humus and metal oxides, usually iron and aluminum

Soil scientists study the colour of soil to:



1. assist with the field identification of types of soil
2. describe and classify soil
3. determine the origin and the condition under which soil was deposited
4. determine the mineral composition of soil
5. determine the age of soil
6. determine the chemical processes which have made the soil
7. differentiate between the types of horizons of the soil profile

Light color in a calcium carbonate-rich soil (southeastern Spain)



Source: imagedio.edu.eu



Why is the soil colour determined by looking at the colour of the various horizons of the soil profile?



The colour of soil assists soil scientists identify, classify and describe soil. Colour is also used to determine the origin, age, mineral composition and conditions under which soil was formed.

By determining these facts soil scientists can decide the use and management practises that are needed to improve the productivity of the soil.



On a map of the world, find at least one area in which each of the soils above is located. Discuss your observations with your class mates.

LESSON 3: DETERMINING SOIL COLOUR

LESSON OUTCOME:

At the end of this lesson the student will discuss how soil colour is measured.



- Mottles - small spots or "blotches" of contrasting colour often occur due to oxidized or reduced iron
- Gley - the grey colour which indicates that iron in the soil is in a reduced state
- Red soil - the bright red colour which oxidised irons, especially in well drained, warm, humid climates, give soils
- Matrix - the major portion of the soil
- Munsell Colour System - an international standard reference system used so that everyone knows precisely what soil colour is being described.



Soil Scientists use soil colour to assess and classify soil.

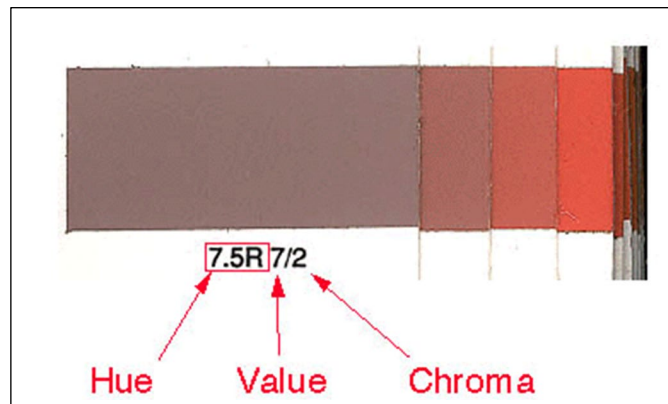
Often soil colour is described in terms such as "dark brown", "black" or light red".

These descriptions reflect the interpretation of the person describing the colour of the soil so is unreliable.

Soil colour is measured using a standardized system called the **Munsell Colour System**.

This system was invented by Albert H Munsell (1858-1918) as an accurate way to numerically define colours.

The system is composed of 1000 colour samples which are presented in a book of removable cards as illustrated below.



Each sample is designated a **letter** and **number** which relate to the hue, value and chroma of a colour.

The soil is compared to the colour samples and so that colour of the soil is determined and can be described e.g. a soil colour may be expressed as **R 5/10** meaning – Hue Red, Value 5, Chroma 10.



Discuss why the Munsell Soil Colour System is important to soil scientists, geoscientists and geoarchaeologists



Albert H Munsell (1858 – 1911) developed an accurate way to numerically define colours called the Munsell Colour System which is accepted and used throughout the world to describe the colour of soil.



Discuss the importance of soil colour to a farmer.

SOIL DEPTH

LESSON 1: WHAT DETERMINES SOIL DEPTH?

LESSON OUTCOME:

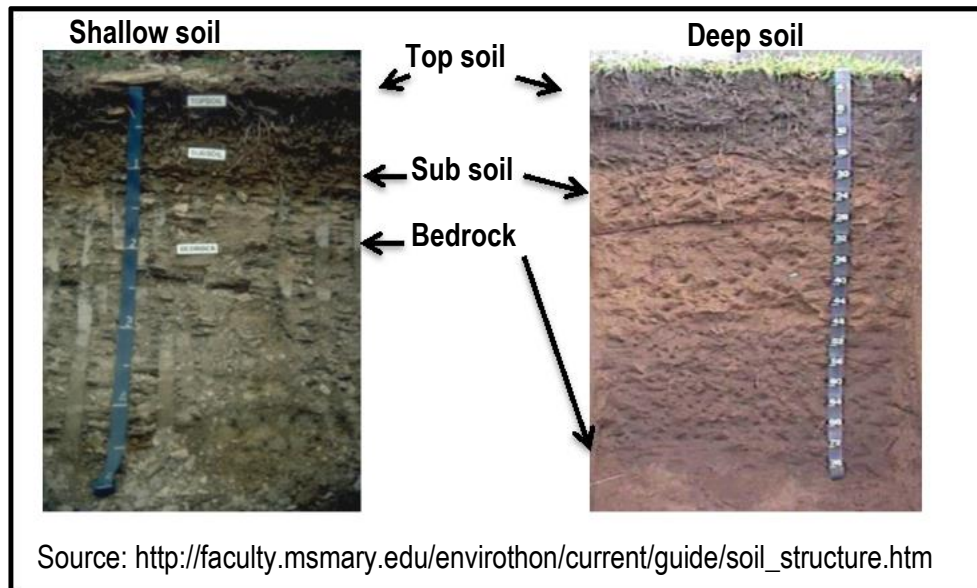
At the end of this lesson the student will discuss the factors which determine the depth of soil.



Pedogenesis	the science and study of the processes that lead to the formation of soil
Soil profile	a vertical cross-section of a soil showing the different layers of soil, called horizons
Compact	joined and packed firmly together
Evaporation	a change from liquid to vapour form



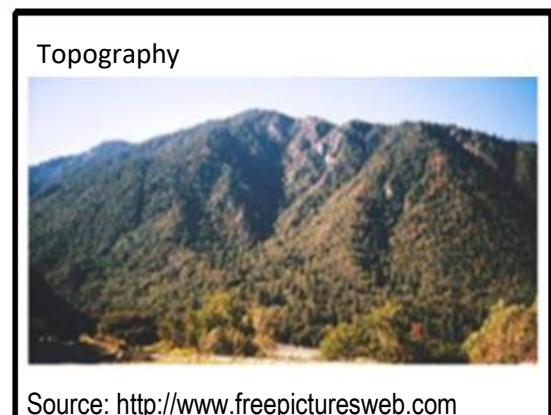
Soil depth is the vertical distance into the soil from the surface to a barrier layer that essentially stops the downward growth of plant roots.
This barrier layer may be rock, sand, gravel, heavy clay, or a cemented layer.



The depth of soil in an area is influenced by:

1. Age of the soil – soil formation is a process which takes millions of years. Undisturbed older soils are usually deeper than soils formed on newly formed or exposed rocks.
2. Erosion – the rate at which soil is removed from a site determines how deep the remaining soil will be.
3. Topography – soil formed on steep slopes and which is exposed is removed by wind, water or gravity usually to the bottom of the slope.

As rain falls, the topsoil's nutrient-rich organic matter will move down the steep slope, especially if vegetation is scarce and water amounts become excessive.



If strategic vegetation is not planted, heavier soil particles, like gravel, will commonly remain at the top

of the slope and the base will have an accumulation of lighter soil particles. As a result, the topsoil's even distribution relegates its nutrients to the slope's base.

Lightweight particles, like fine sand, will continue to move with the water flow away from the slope's base; they stay suspended in the water for a longer period. In contrast, any heavier soil particles, like loam, will drop quickly from the water directly at the base.

4. Ground cover – exposed soil is more susceptible to erosion. Mulch and cover crops reduce erosion.
5. Formation of hard pan.

- a) Minerals dissolved in soil water are carried close to the soil surface where they are left behind when the soil water evaporates. These minerals form a hard pan which in turn makes the depth of soil shallow.



Study the soil depth at two locations in the school compound and discuss the factors which may have contributed to the depth of the soil.



Soil depth is the distance from the surface of a soil profile to a barrier level which stops the downward growth of plant roots. Soil depth is influenced by topography, ground cover and the formation of a hard pan. It can be measured by exposing and measuring the horizons of the soil profile.



Explain how repeated ploughing at the same depth can result in a shallow soil.

LESSON 2: IMPORTANCE OF SOIL DEPTH

LESSON OUTCOME:

At the end of this lesson the student will discuss the categories and importance of soil depth



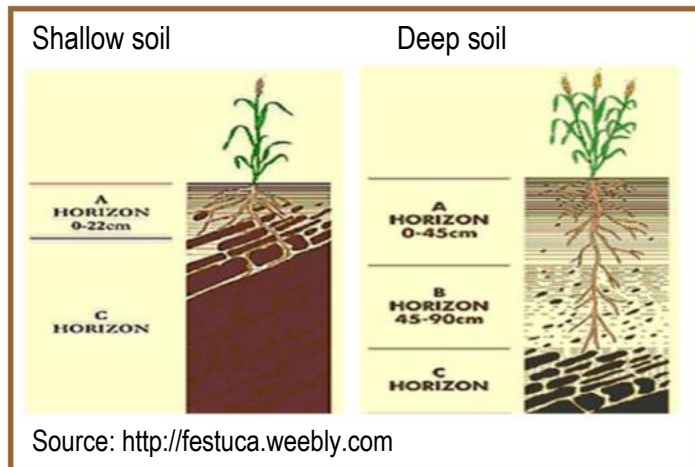
- | | | |
|-------------------|---|---|
| Drainage | - | removal of excess water |
| Soil fertility | - | capacity or ability of soil to supply water, nutrients, air and the correct temperature needed by plants to grow. |
| Soil productivity | - | capacity of soil to produce crops and is expressed in terms of yield. |



Plants rely on the soil in which they grow for water, minerals, mechanical support and oxygen.

Crops have adapted features which suit different depths of soil. Farmers wish to know the depth of soil on the farm to determine which crops will do best on the soil. Soil depth is determined by digging a hole in the soil to expose the soil profile and then measuring the depth of the individual horizons up to the barrier layer.

The five categories of soil depth are compared below where the texture, structure and drainage of the soil are the same.



Depth of soil	Very shallow	Shallow	Moderately deep	Deep	Very deep
Distance from surface to a layer which retards root development	less than 0.25 m	0.25 to 0.5 m	0.5 to 1 m	1 to 1.5 m	1.5 m or more
Nutrient availability	low	high	higher	higher	highest
Water availability	low	high	higher	higher	highest
Mechanical support	low	high	higher	higher	highest
Effect on plant roots	Restricts root growth	less restrictive	less restrictive	less restrictive	least restrictive
Suitable for	very shallow rooted plants like Carpet grass and ornamentals like ferns.	shallow rooted plants like vegetables and spices	field crop like maize, sugarcane, dalo and palms.	all crops including vegetables, field crops and shorter tree crops	all crops including tree crops like mahogany.



Determine a suitable crop to grow in the soil which you studied earlier and discuss your reason for choosing these crops.



Plants rely on the soil in which they grow for water, minerals, mechanical support and oxygen. Farmers will study the depth of soil on the farm to decide which crops to grow as crops will produce well in soils of certain depth.



Differentiate between the depth of soil required by a coconut palm and a rain tree and explain the difference.

SOIL TEMPERATURE

LESSON 1: WHAT INFLUENCES SOIL TEMPERATURE

LESSON OUTCOME:

At the end of this lesson the student will discuss the factors which influence soil temperature.



Thermal energy	- the energy that is generated and measured by heat.
Soil respiration	- the production of carbon dioxide when soil organisms respire
Rhizosphere	- the narrow region of soil that is directly influenced by root secretions and associated soil microorganisms.
Thermal conductivity	- the rate at which heat passes through a specified material,
Soluble salts	- compounds that are readily dissolved in water



Temperature is one of the most important factors which influence the growth, development and yield of agricultural commodities including both crops and livestock.

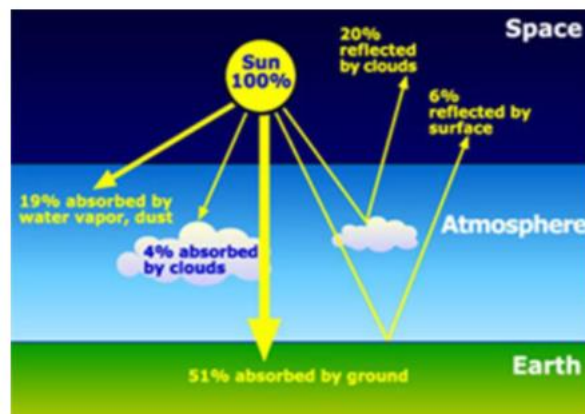
Soil gets heat from the following sources:

1. Solar radiation

The rate of solar radiation reaching the earth's atmosphere is called solar constant and has a value of $2 \text{ cal cm}^{-2} \text{ min}^{-1}$.

A major part of this energy is absorbed by the atmosphere and plants and is also scattered in the atmosphere.

Only a small part of it reaches the soil.



Source: <http://education.missouri.edu>

2. Microbial decomposition of organic matter

One of the by-products of decomposition is heat.

3. Respiration by soil organisms including plants

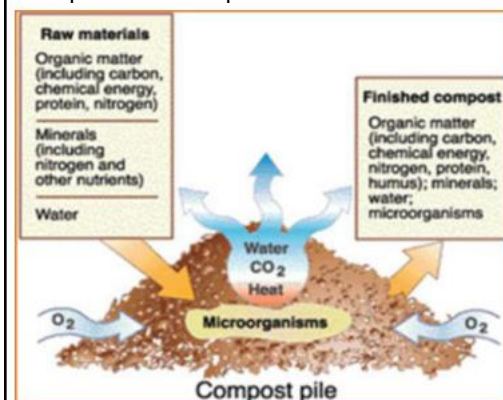
Soil respiration refers to the production of carbon dioxide when soil organisms respire. This includes respiration of plant roots, the rhizosphere, microbes and fauna. During the same process, heat is also produced and transferred to soil.

4. Internal source

This heat is from the interior of the Earth and is negligible.

The average annual soil temperature is about 1°C higher than mean annual air temperature.

Respiration in compost



Source: <http://www.uaex.edu>

LESSON 2: IMPORTANCE OF SOIL TEMPERATURE

LESSON OUTCOME:

At the end of this lesson the student will discuss the importance of soil temperature.



Cardinal temperature - the maximum, optimum and minimum temperature points at which an organism can survive and grow.



Soil scientists study soil temperature because it plays an important role in each of the following:

1. **Determines which crops can survive in an area.**
2. **Soil temperature directly affects plant growth.**
All plants have maximum, optimum and minimum temperature limits. The limits are cardinal temperature points. Optimum temperature range is very important.
3. **Germination** - seeds require different soil temperature ranges for example, maize starts to germinate at soil temperatures from 7°C to 10°C.
4. Most **soil organisms** thrive at temperatures between 25 and 35
They are essential for healthy productive soil as they are the recyclers of waste materials.
5. **Soil moisture content**
Heat from soil will transfer to soil water. Once the soil water reaches boiling point it will turn into water vapour and evaporate out of soil, resulting in drier soils.
6. **Nitrification** requires a soil temperature of 32°C.
7. **Soil aeration**
8. **Availability of plant nutrients.**

SOIL TEXTURE

LESSON 1: WHAT IS SOIL TEXTURE?

LESSON OUTCOME:

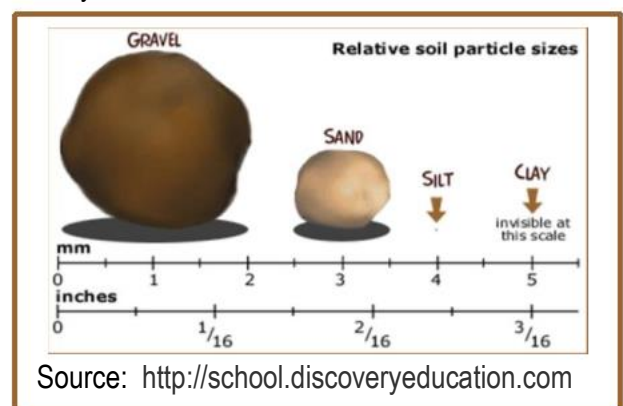
At the end of this lesson the student will distinguish between the three soil separates and define the term soil texture.

	Soil separate	- Size divisions of mineral particles (sand, silt, and clay) that comprise the fine earth, each particle being less than 2 mm in diameter.
	Quartz	- the second most abundant mineral in the Earth's continental crust with the chemical formula of SiO_2 .
	Volcanic glass	- is the amorphous (uncrystallized) product of rapidly cooling magma.
	Foraminifera	- single-celled amoeboid protists found in marine environments..
	Echinoid	- any of the echinoderms constituting the class <i>Echinoidea</i> , typically having a rigid ovoid body including sea urchins and sand dollars
	Feldspar	- an abundant rock-forming mineral typically occurring as colorless or pale-colored crystals and consisting of aluminosilicates of potassium, sodium, and calcium.



The mineral matter of soil is comprised of particles of various sizes.

The finer particles which are called **soil separates** vary in size as illustrated below:



Certain minerals tend to dominate the various soil separates:

- **Sand** is a naturally occurring granular material composed of finely divided rock and mineral particles. The composition of sand is highly variable, depending on the local rock sources and conditions, but the most common constituent of sand is silica (silicon dioxide, or SiO_2), usually in the form of **quartz**.

The second most common type of sand is calcium carbonate, for example aragonite, which has mostly been created, over the past half billion years, by various forms of life, like coral and shellfish. It is, for example, the primary form of sand apparent in areas where reefs have dominated the ecosystem for millions of years, like the Caribbean.

Sand from the Sahara Desert is composed almost exclusively of rounded quartz grains	Heavy mineral sand from Sri Lanka which contains lots of different minerals.
	
Source: http://www.sandatlas.org/what-is-sand-made-of/	

Sand from Punalu'u Beach in Hawaii is composed of volcanic glass.	Sand from Bermuda contains pink fragments from foraminifera as well as some mollusc and even echinoid remains.
	
Source: http://www.sandatlas.org/what-is-sand-made-of/	

- **Silt** is granular material of a size somewhere between sand and clay whose mineral origin is **quartz and feldspar**. Silt may occur as a soil or as suspended sediment (also known as suspended load) in a surface water body. It may also exist as soil deposited at the bottom of a water body. Silt can be visually observed with a hand lens. Silt has a moderate specific area with a typically non-sticky, plastic feel and usually has a floury feel when dry, and a slippery feel when wet.
- **Clay minerals** are typically formed over long periods of time by the gradual chemical weathering of rocks, usually **silicate-bearing**, by low concentrations of carbonic acid and other diluted solvents.

Types of clay soils

Kaolinite clay soil is used for making ceramics	Vermiculite clay soil is able to adsorb water and is used in potting mixtures	Smectite clay soil is sometimes referred to as " swelling clay " and is used in the bottom of ponds
		
http://www.wikipedia.org	http://www.wikipedia.org	http://www.wikipedia.org
Chlorite clay soil is stable in cool, dry or temperate climates	Attapulgite clay soil, also called palygorskit, is used in some drilling operations	
		
http://www.wikipedia.org	http://www.wikipedia.org	

The relative proportion of soil separates in a mass of soil is termed **soil texture**.



Differentiate between the three soil separates.



As rocks weather to form soil the size of mineral matter decrease from rocks to stones to gravel to fine soil. The fine soil is comprised of soil separates which include sand, silt and clay.

The proportion of soil separates in a soil mass is termed soil texture.



Compare the relative size of the three soil separates to rocks, stones and gravel.

LESSON 2: CLASSES OF SOIL TEXTURE

LESSON OUTCOME:

At the end of this lesson the student will identify the classes of soil texture.

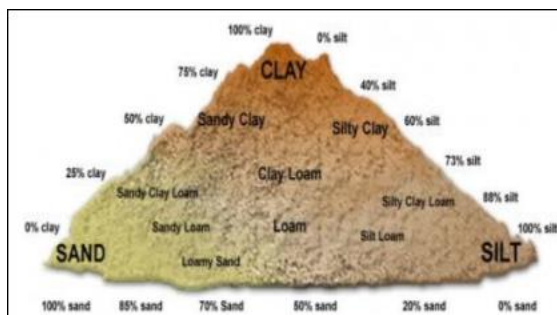


- Course textured soil - comprised primarily of medium to large size sand particles
- Medium textured soil - comprised of equal amounts of sand, silt and clay
- Fine textured soil - comprised of tiny clay particles

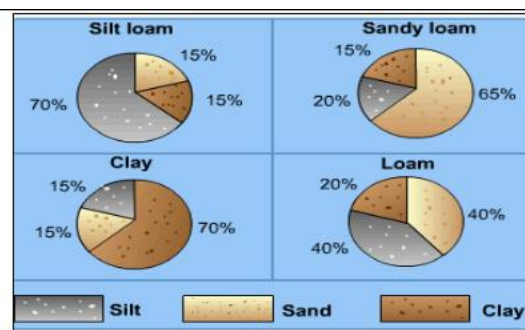


Agricultural soils are divided into textural classes according to their physical texture.

1. A course textured soil is one comprised primarily of medium to large size sand particles and includes sands and loamy sands.
2. A medium textured soil is one comprised of equal amounts of sand, silt and clay and includes loams, clay loams, sandy loams and silt loams.
3. A fine textured soil is one dominated by tiny clay particles and includes clays, sandy clays and silty clays.



Source: <http://www.pininterest.com>



Source: <http://www.s-cool.co.uk>



List the classes of soil texture.



Agricultural soils are divided into textural classes according to their physical texture



Differentiate among the particle sizes of sand, silt and clay.

LESSON 3: DETERMINING SOIL TEXTURE

LESSON OUTCOME:

At the end of this lesson the student will practise three methods of determining soil texture



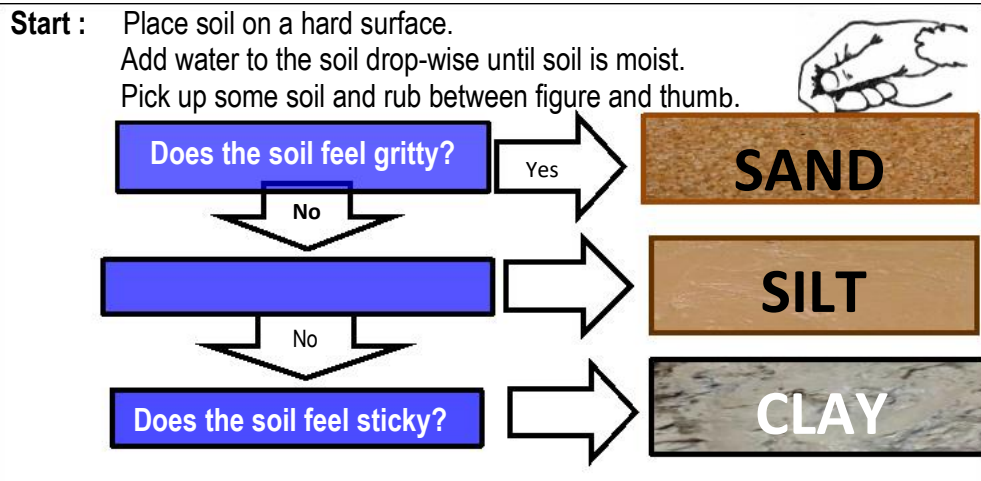
- | | |
|--------|---|
| Gritty | - textures that are rough to the touch or consisting of large particles |
| Smooth | - having a surface free from roughness or bumps or ridges or irregularities |
| Sticky | - having the property of adhering |

There are five methods used to determine the texture of a soil.

Method 1: Feel Method:

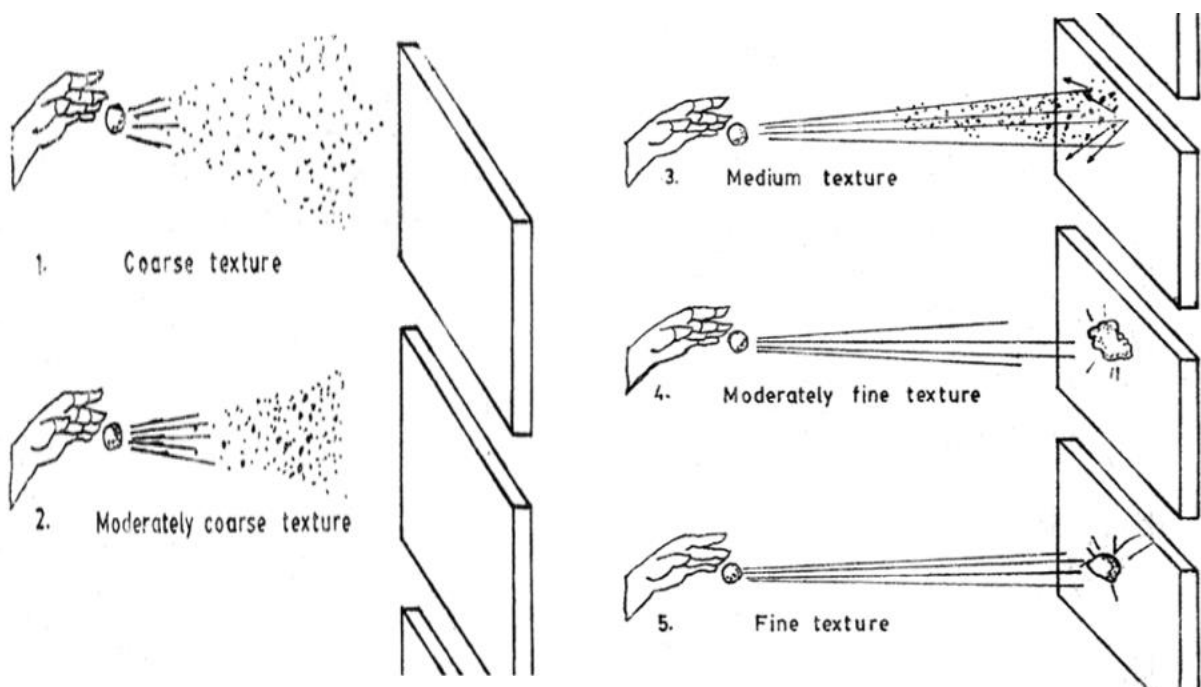


This test is suitable for the field. It will give a rough idea of the texture of the soil.



Method 2: Ball Throwing Method:

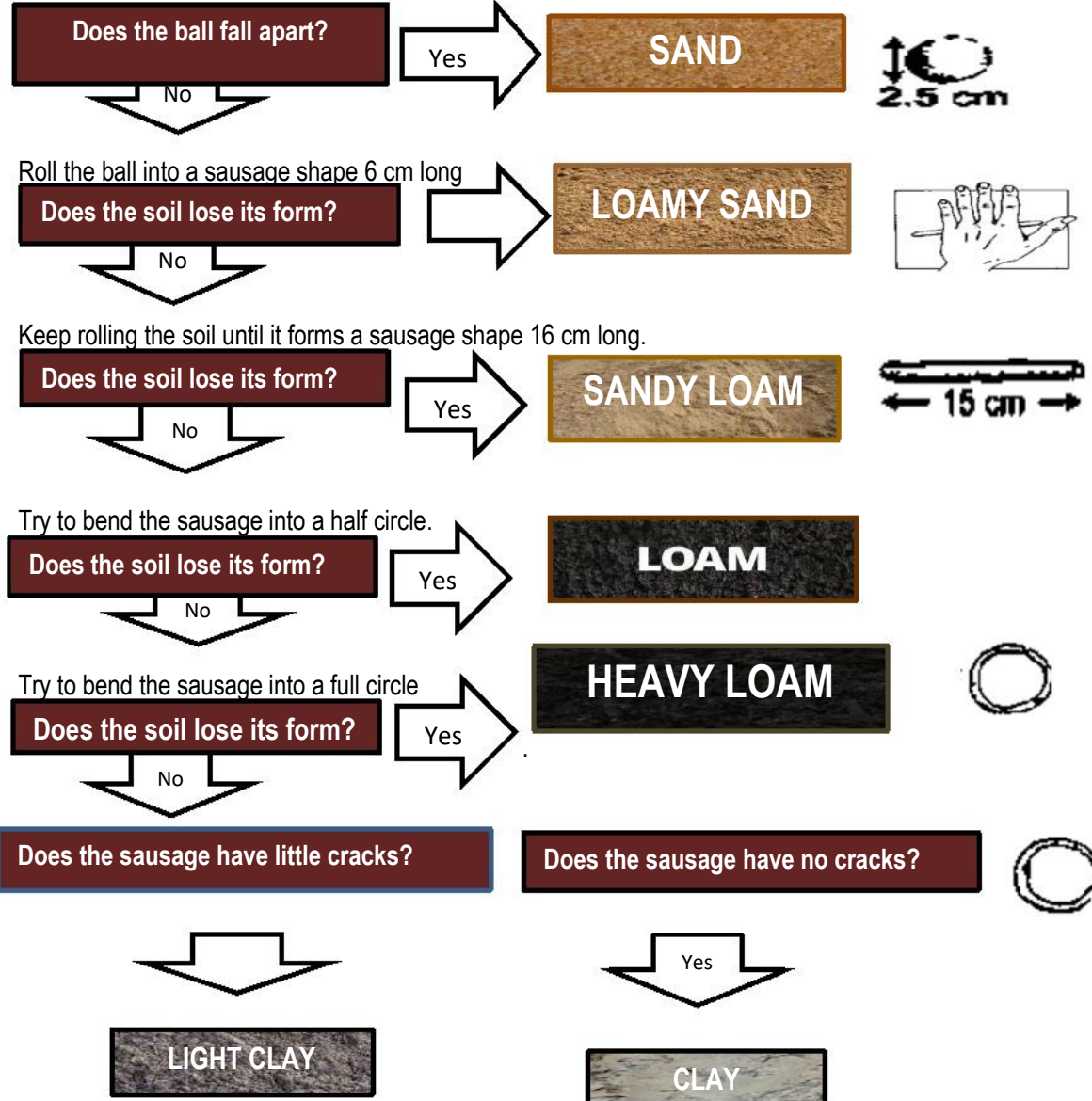
The texture of the soil can be inferred by the way a ball of soil acts when it is thrown at a hard surface such as a wall or a tree.



Method 3: Ball and Ribbon Method

This test is suitable for the field. It will give a rough idea of the texture of the soil.

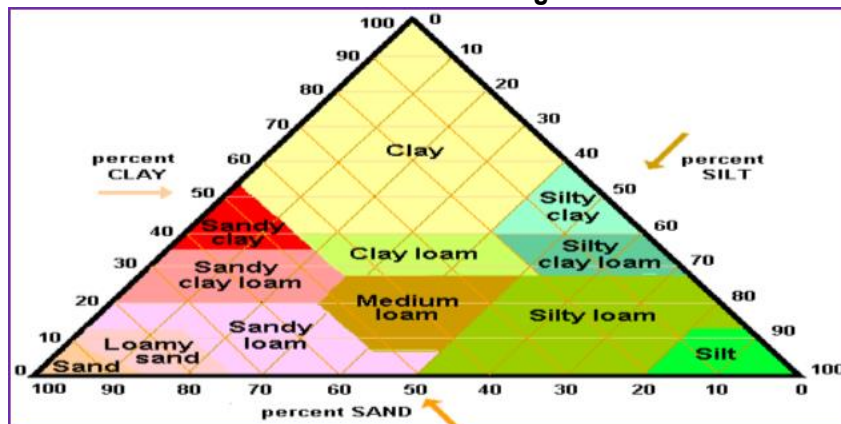
Start : Take a handful of soil and wet it so that it begins to stick together without sticking to the hand. A ball of about 2.5 to 3 cm diameter is made and put down.



The Pipette Method and the Hydrometer Method are used to determine soil texture in the laboratory.

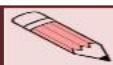
Both methods determine the proportions of sand, silt and clay in the soil. The proportions are then plotted on the Soil Texture Triangle and an accurate determination of the texture of the soil is made.

Soil Texture Triangle



Source: <http://www.oneplan.org/Images/soilMst/SoilTriangle.gif>

Collect a sample of soil from the school gardens and divide it into three.



Divide the class into three groups and get each group to use a separate method to determine the texture of the soil sample.
Compare the results and discuss challenges associated with each method.



There are three methods used to determine the texture of soil:

Feel, Ball and Ribbon and **Ball Throwing** methods are suitable for field testing a soil while the **Pipette** and **Hydrometer** methods are suitable for testing in the laboratory.

Below are the percentages of separates in 5 soil samples. Use the soil texture chart above to determine soil texture of each sample:



	% sand	% silt	% clay	Soil Texture
	75	10	15	Sandy loam
a	37	42	_____	_____
b	21	_____	52	_____
c	40	50	_____	_____
d	_____	64	30	_____
e	40	50	_____	_____

LESSON 4: IMPORTANCE OF SOIL TEXTURE

LESSON OUTCOME:

At the end of this lesson the student will discuss the importance of soil texture.



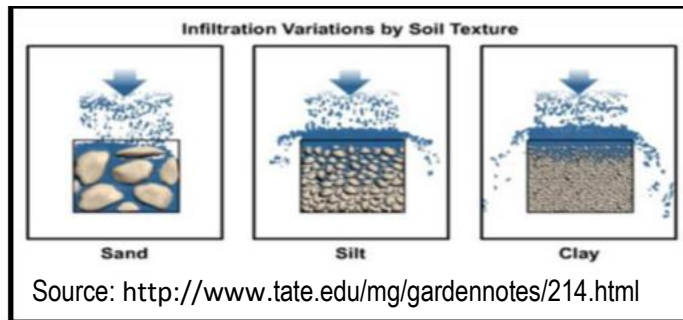
- | | | |
|--------------|---|--|
| Infiltration | - | the process by which water on the ground surface enters the soil. |
| Percolation | - | the movement of water through the subsurface soil layers, usually continuing downward to the groundwater or water table reservoirs. |
| Erodibility | - | measure of the soil's susceptibility to raindrop impact, runoff and other erosional processes. |
| Retention | - | the action of absorbing and continuing to hold a substance |



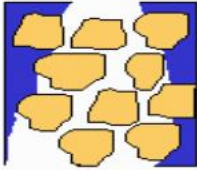
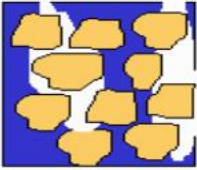
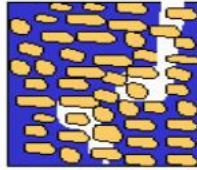
The surface area of a soil separate affects properties of the soil.

Soil texture can give a guide to:

- Soil water - its infiltration, percolation, retention and release to plants;
- Soil structure - its development and stability;
- Nutrient retention and availability;
- Activity and retention of residual soil-acting herbicides;
- Erodibility by wind and water;
- Stickiness and ease of cultivation;



Drainage characteristics and suitability for artificial drainage, cropping suitability, soil temperature changes.

Soil texture:	Sand	Silt	Clay
Size [mm]:	0.05 - 2	0.002 - 0.05	< 0.002
			
Macropores	+++	++	(+)
Medium-sized p.	++	++	++
Micropores	(+)	++	+++
Percolation:			
Leaching:			

Source: <http://www.soils.ifas.ufl.edu>

In the table below, the properties of soils high in sand are compared with the properties of soil high in clay.

	Soil high in sand	Soil high in clay
Water infiltration	quick entry so less run off	slow entry so more run off
Drainage	drains quickly so needs irrigation	drains slowly so less irrigation needed
Water retention	does not hold enough water for plant growth	holds more water, may be waterlogged
Air content	air moves easily,	air difficult to move due to small spore spaces
Erosion	susceptible to sheet and gully erosion	Susceptible to all forms of erosion
Nutrient retention	cannot hold nutrients, fertilizer washed away minerals easily leached	can holds nutrients, needs less fertilizer
Ease of cultivation	easy to plough [light soil] not good seed bed	hard to plough if wet [heavy soil]

Source: <http://www.ext.colos>



Discuss why farmers should determine the structure of soil on the farm before deciding which crop to grow.



The surface area to volume ratio plays a big part in determining many properties of soil and the husbandry practices which suit a soil.



Make a third column for the table above and fill it the details for a loam soil.

LESSON 5: SOIL PARTICLE SIZE AFFECTS SOIL POROSITY AND PERMEABILITY

LESSON OUTCOME:

At the end of this lesson the student will discuss the relationship between particle size and soil properties.



Porosity - the volume of open space between soil particles
Permeability - the ability of water and air to flow between particles.

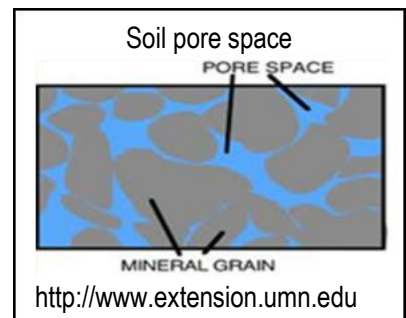


The size of soil particles and aggregates has an effect on soil porosity and permeability. Porosity is directly affected by the size of the soil particles.

Larger particles like sand have more space between them, so they have higher porosity.

Smaller soil particles like clay have tiny spaces between them, so they have very low porosity.

When particles of different sizes are mixed together, the small pieces fill in the gaps between the large ones, making the porosity VERY low.

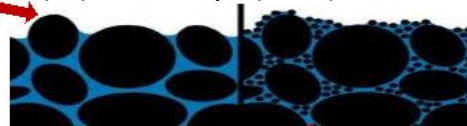


Larger Particle = Higher Porosity

<http://peter-mulroy.squarespace.com>

Smaller Particle = Lower Porosity

Mixed Particle Size = Lowest Porosity



Permeability

Permeability and porosity are related in an obvious way. If a soil is very porous, then it has lots of space between particles, so it will be easy for water to flow through it. In contrast, if a soil has low porosity, then there is very little space between the particles, so it is difficult for water to move through it.

High Porosity = High Permeability
Low Porosity = Low Permeability

Permeability



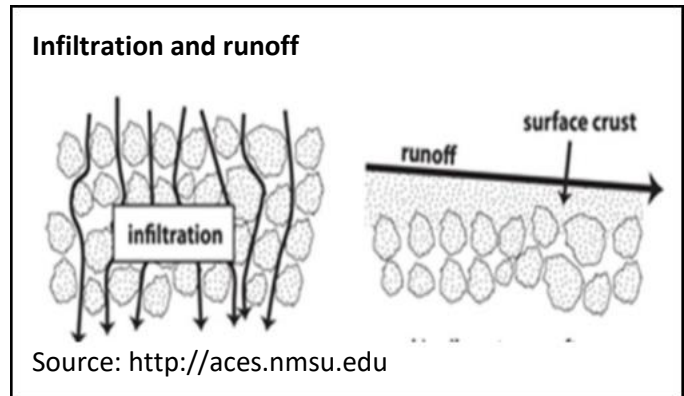
<http://www.static1.squarespace.com>

Infiltration and Runoff

When rain falls onto the ground it has to go somewhere. If the soil has high porosity and high permeability, then that rain will **infiltrate**, or drain into the soil.

If the soil is impermeable and has low porosity, then the rain won't be able to drain into it. Instead the rain will have to flow across the surface as **runoff**.

In general, more infiltration is better for soil.



Differentiate between soil porosity and soil permeability



The size of soil particles and aggregates has an effect on soil porosity and permeability.



Discuss how the particle size of soil influences and soil porosity and permeability.

SOIL STRUCTURE

LESSON 1: WHAT IS SOIL STRUCTURE?

LESSON OUTCOME:

At the end of this lesson the student will define soil structure and describe how soil structure develops.



Soil aggregate	-	a general term for any distinct lump or clumping of soil particles, including peds, casts, clods or fragments.
Soil ped	-	natural, relatively permanent aggregates, separated from each other by voids or natural surfaces of weakness like cracks and voids.
Clod	-	An aggregate 100 mm or more in length and formed by soil disturbance such as cultivation.
Fragment	-	An aggregate less than 100 mm in length and formed by soil disturbance such as cultivation



Soil structure describes the arrangement of the solid parts of the soil and of the pore space located between them.

Soil structure refers to the arrangement of the primary particles called soil separates which include sand, silt and clay, into units called soil aggregates.

Natural aggregates are called peds whereas clod is an artificially formed soil mass.

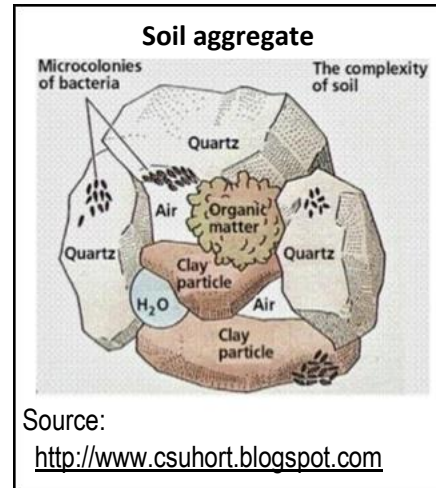
Pores are important for the movement of air, water, and plant nutrients and occur within and between aggregates. Pores also provide thoroughfares for soil organisms and root growth.

Soil structure is created through pedogenic (soil forming) processes over long periods of time, and involves two steps

1. A clump of soil particles stick loosely together to form soil aggregates.

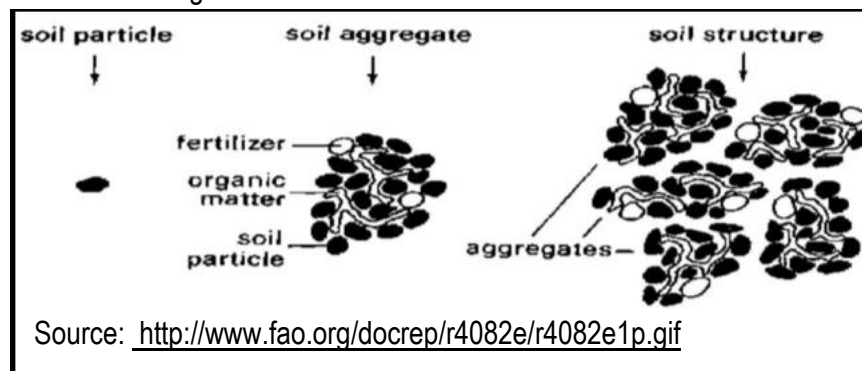
These aggregates are influenced by:

- plant roots surrounding and separating clumps of soil
- freezing and thawing of soil
- soil becoming wet and dry
- tillage
- fungal activity



2. Weak aggregates are cemented to make them distinct and strong. Cementing agents include:

- clay,
 - iron oxides
 - organic matter
- .gums produced when micro-organisms break down organic matter.



Differentiate between a soil particle and a soil aggregate.



Soil structure refers to the arrangement of the soil separates, sand, silt and clay, into units called soil aggregates.



Discuss how soil structure develops.

LESSON 2: DESCRIBING SOIL STRUCTURE

LESSON OUTCOME:

At the end of this lesson the student will discuss how soil structure is described.

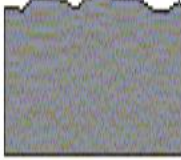
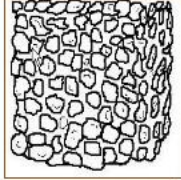
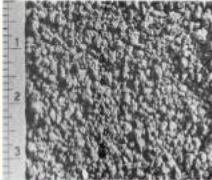
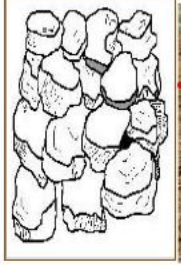
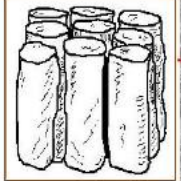
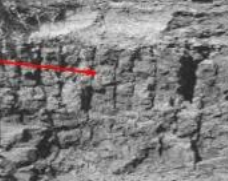
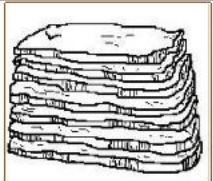


Type	-	the shape or form and arrangement pattern of peds
Class	-	the size of the individual peds.
Grade	-	the degree of distinctness of the individual peds



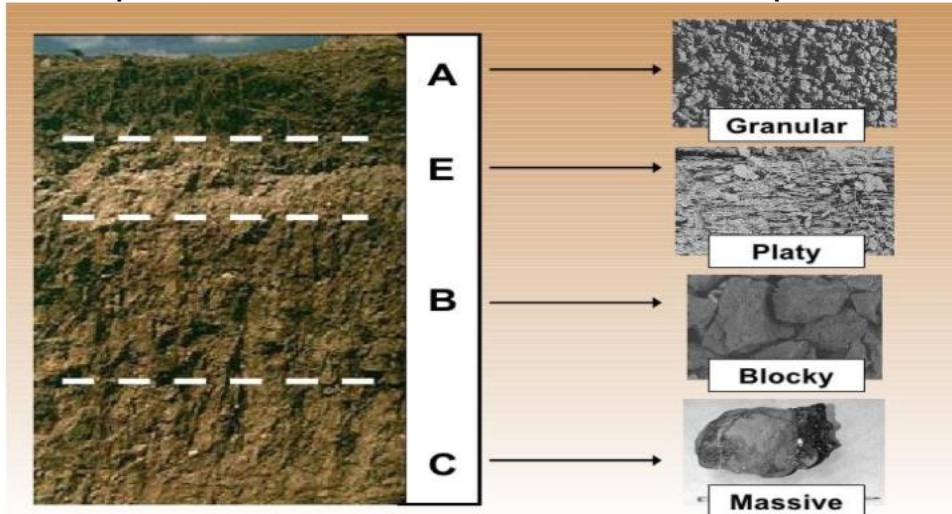
Soil structure is studied in the field under natural conditions and is described under three categories:

1. **Type** - describes the shape or form and arrangement pattern of peds.

SOIL STRUCTURAL UNIT		DESCRIPTION	LOCATION
Structureless soil: A] SINGLE GRAINED	 	Soil is broken into individual particles which do not stick together	Commonly found in sandy soils like beach soils
Structureless soil: B] Massive	 	Soil does not easily break along plains of weakness because there are none.	Common in C horizons where it is only parent material and no (or little) soil development has occurred
GRANULAR BLOCKY A] Angular has sharp edges  B] Sub angular has rounded edges 	   	Resembles cookie crumbs usually less than 0.5 cm in diameter Irregular blocks which are usually 1.5 to 5.0 cm in diameter.	Commonly found on surface horizons with high organic matter content and where roots have been growing Commonly found in the B-horizon where clay has accumulated
PRISMATIC	 	Vertical columns of soil that are taller than they are wide and may be a number of cm long, with <u>flat</u> top.	Usually found in B horizon
COLUMNAR	 	Vertical columns of soil that are taller than they are wide that have a <u>rounded</u> cap on top.	Found in soils of arid climates.
PLATEY	 	Thin, flat planes of soil that lie horizontally so are wider than they are tall.	Usually found in compacted soil.

Source: Adapted from <http://www.swac.umn.edu>

An example of the soil structure of different horizons of a soil profile



Source: <http://www.slideshare.net/andykleinschmidt>

2. **Class** - This describes the size of the individual peds. Each primary structural type of soil is differentiated into 5 size classes depending upon the size of the individual peds.

The terms commonly used for the size classes are:

- Very fine or very thin
- Fine or thin
- Medium
- Coarse or thick
- Very Coarse or very thick

The terms thin and thick are used for platy types, while the terms fine and coarse are used for other structural types.

3. **Grade** – This indicates the degree of distinctness of the individual peds.

It is determined by the stability of the aggregates.

Grade of structure is influenced by the moisture content of the soil. Grade also depends on organic matter, texture etc. Four terms commonly used to describe the grade of soil structure are:

- Structureless: There is no noticeable aggregation, such as conditions exhibited by loose sand.
- Weak Structure: Poorly formed, indistinct formation of peds, which are not durable and un-aggregated material.
- Moderate structure: Moderately well-developed peds, which are fairly durable and distinct.
- Strong structure: Very well formed peds, which are quite durable and distinct.



Soil Structure Naming: For naming a soil structure the sequence followed is grade, class and type; for example a) strong coarse angular blocky b) moderate thin platy.



Differentiate among the type, class and grade of soil texture.



Soil structure is described under three categories: type, class and grade.



Study a soil profile in the locality and identify the soil structure present in each horizon.

LESSON 3: IMPORTANCE OF SOIL STRUCTURE

LESSON OUTCOME:

At the end of this lesson the student will discuss the importance of soil structure.



Soil porosity - the fraction of void space in the material, where the void may contain, for example, air or water.



Pore spaces form within and between soil aggregates. There are three main categories for pore sizes that all have different characteristics and contribute different attributes to soils depending on the number and frequency of each type.

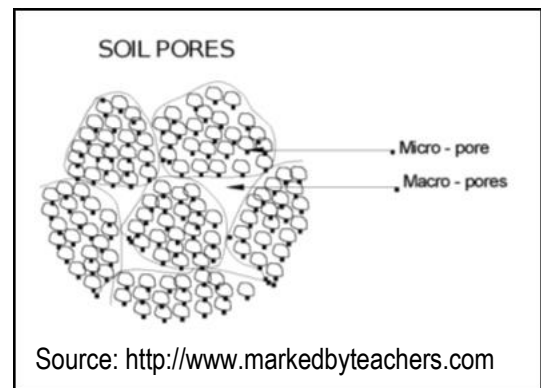
- i) **Macropores** are the large pores which usually form between soil aggregates. They are the cavities that are larger than 0.05 mm and are too large to have any significant capillary force.

Macropores increase the hydraulic conductivity of soil, allowing water to infiltrate and drain quickly, and shallow groundwater to move relatively rapidly via lateral flow.

These pores allow soil solution to flow through transporting solutes and colloids by eluviation or leaching and are full of air at field capacity.

They also provide habitat for soil organisms and plant roots can grow.

In soil, macropores are created by plant roots, soil cracks, soil fauna, and by aggregation of soil particles into peds.



- ii) **Micro-pores** are small pores which usually form within soil aggregates. They are the cavities which are smaller than 0.05 mm and have significant capillary force.

The water associated with micro-pores is usually adsorbed onto the surfaces of clay molecules so is very difficult for plant to use. These pores are filled with water at permanent wilting point.

The water held in micro-pores create moist anaerobic conditions which is important for the activity of microbes. The water can also cause either the oxidation or reduction of molecules in the crystalline structure of the soil minerals.

It is important for soil to have a balance of macro and micro pores which provide for good soil aeration, permeability and water-holding capacity.

Soil structure influences the following factors:

1. **Soil water** – infiltration, retention, percolation, availability to plants, water holding capacity.
In soils with good structure, the pore space which occurs between pores in relatively large and facilitates air and water movement.
Clay soils with poor structure resist water movement.
2. **Soil porosity** - the fraction of void space in the soil which can contain air or water.
3. **Soil aeration** - the amount of water in soil pores is inversely proportionate to the amount of water, hence soil aeration is influenced by soil structure.
4. **Heat transfer**- heat will travel through soil with larger pore spaces. The temperature of soil with a well-developed structure will not fluctuate a lot.
5. **Emergence of seedlings**- seedlings push their way through pores as they germinate towards light.
6. **Root penetration** – Roots push between soil aggregates as it grows towards water and nutrients.
7. **Root access to nutrients and water**- nutrients which are dissolved in soil water that is contained in pore spaces between aggregates are more accessible to plant roots.



Make models of different soil structure. Use the models to demonstrate the importance of soil structure.



Soil structure affects water and air movement through soil, greatly influencing soil's ability to sustain life and perform other vital soil functions.



Discuss the importance of soil structure on a crop farm.

LESSON 3: MAINTAINING and IMPROVING SOIL STRUCTURE

LESSON OUTCOME:

At the end of this lesson the student will discuss ways in which soil structure can be improved.

Cloddy - made of clods.

Soil structure is easier to maintain than improve.

Soil structure can be maintained by employing conservation management practices:

a) Tillage

Only till soil when it is at the proper moisture content. Tilling when the soil is too wet will cause the soil to become cloddy and will destroy aggregates.

Farmers may decide to use conservation tillage methods including zero tillage, minimum tillage, strip tillage, ridged tillage, and mulch tillage. They may choose to stop tilling using machines and revert to using animal pulled tillage implements as animals are lighter than tractors.

Spot tillage can also be used.



<http://www.swac.umn.edu>

b) Cultivate only when the soil is not too wet

Farmers are to get their soils tested and seek advice from the Ministry of Agriculture on the best moisture content for the tillage of soil.

c) Limit traffic

It is advisable to have designated roads or throughways for animals, vehicles and implements to travel on

Water troughs are to be located on the side of fields or along throughways to minimise the trampling of a field by animals waiting to drink.

Lost soil structure can be regained by:

i) breaking the hard pan

Use an implement for deep ripping to destroy the plough pan, which is an expensive procedure.

ii) maintaining soil fertility

Soil fertility will encourage plant growth. This in turn will lead to the development of good soil structure. Soil can be tested and fertility improved by:

- correcting soil pH by adding liming materials to acidic soil or gypsum to alkaline soil.
- adding the recommended rates of fertilizer needed by the crops
- providing the amount of water needed by the crop.

iii) adding organic matter

Grow a green manure crop and plough in crop residues instead of removing or burning.

- plant cover crops in fall and winter
- turn under crop residue
- add manure

iv) **growing grasses and legumes**

These plants cover the soil and lessen the impact of heat and erosion agents. Their organic matter will help stabilise soil aggregates.

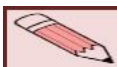
Growth of legumes will increase the Nitrogen content of soil and promote the growth of beneficial fungi which will stabilize peds.

v) **rotating crops**

Using a pasture phase for 4-5 years as part of a crop rotation plan

vi) **controlling erosion**

Using runoff control structures e.g. contour banks on sloping or steep land.



Discuss the difference between maintaining and improving soil structure.



Soil structure is easier to maintain than to improve so limiting traffic on soil and the frequency of cultivation especially on wet soil are encouraged. To improve the structure of soil farmers are encouraged to break the hard pan, add organic matter, include pasture in their crop rotation plan and control erosion.



Discuss ways in which farmers can maintain and improve soil structure.

SOIL CONSISTENCE

LESSON 1: WHAT IS SOIL CONSISTENCE?

LESSON OUTCOME:

At the end of this lesson the student will define soil consistence and discuss factors which influence soil consistence.



Cohesion	- attraction of one molecule to another molecule of the same type
Adhesion	- attraction of one molecule to another molecule of a different type.
Stickiness	- having the property of adhering or sticking to another surface.
Plasticity	- capacity to be moulded (to change its shape depending on stress) and to retain the shape even when the stress is removed



Soil consistence is the ability of soil particles to stick together [cohesion] or to stick to other objects [adhesion] and so resist deformation and rupture when under stress.

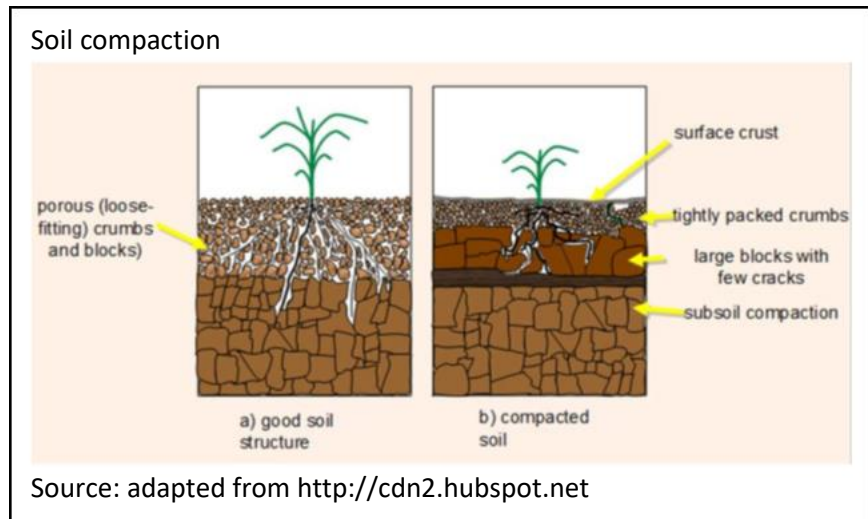
It is the measure of the mechanical strength of a soil, based on the force necessary to break a block of soil or penetrate a clod.

Consistence indicates

- Amount and type of clay material
- Condition for tillage
- Potential for compaction

Soil consistence is influenced by:

1. **Soil texture** - soil strength increases with increasing clay content.
2. **Mechanical compaction** – the particles of soil which are compact tend to have higher consistency.
3. **Organic matter content** – organic matter acts as a cementing agent, binding soil particles together.
4. **Cementing agents** – organic matter, silicate clays, lime (CaCO_3) and sesquioxides (Al_2O_3 , La_2O_3) hold soil particles together.
5. **Soil density** - as density increases so does soil strength. You have more material in the same area which makes it harder for the plant root to grow.
6. **Water content of soil** -
 - soil particles will move more easily when soil is wet because water acts as a lubricant
 - soil strength increases as the soil dries out.
 - soils will compact, become denser, if put under stress when wet e.g. tilled, trampled, driven over.



Water content significantly affects properties of silty and clayey soils (unlike sand and gravel).

1. Strength decreases as water content increases.
2. Soils swell-up when water content increases.
3. Fine-grained soils at very high water content possess properties similar to liquids.
4. As the water content is reduced, the volume of the soil decreases and the soils become plastic.
5. If the water content is further reduced, the soil becomes semi-solid when the volume does not change.

 Why is soil consistence important?

 Soil consistence is the ability of soil particles to stick together [cohesion] or to stick to other objects [adhesion] and so resist deformation and rupture when under stress.

 Discuss the factors which influence the consistency of soil.

LESSON 2: EVALUATING AND DESCRIBING SOIL CONSISTENCY

LESSON OUTCOME:

At the end of this lesson the student will discuss how soil consistency is evaluated and described.



Atterberg Limits - a basic measure of the critical water contents of a fine-grained soil, such as its shrinkage **limit**, plastic **limit**, and liquid **limit**.



Soil consistency is evaluated using the “Atterberg Limits”.

Albert Mauritz Atterberg, a Swedish scientist, considered the consistency of soils in 1911 and proposed a series of tests for defining the properties of cohesive soils.

He found that:

- at a very low moisture content, soil behaves more like a solid.
- when the moisture content is very high, the soil and water may flow like a liquid.

Hence, on an arbitrary basis, depending on the moisture content, the behaviour of soil can be divided into 4 basic states:

1. solid,
2. semisolid,
3. plastic,
4. liquid.

Based on the above, soil consistency is evaluated and described for three moisture levels:

1. **Wet soils:** Consistency is denoted by terms stickiness and plasticity.

Stickiness is grouped into four categories namely i) non sticky, ii) slightly sticky, iii) sticky and iv) very sticky   Non sticky Very sticky	There are four degrees in plasticity namely i) non plastic, ii) slightly plastic, iii) plastic and iv) very plastic. Slightly plastic Very plastic soil
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2. **Moist soil:** provides a measure of the tendency for peds or masses of soil material to break when pressure is applied between the thumb and forefinger.

The different categories are

- i) Loose-non coherent
- ii) Very friable - coherent, but very easily crushed
- iii) Friable - easily crushed
- iv) Firm - crushable with moderate pressure
- v) Very firm - crushable only under strong pressure
- vi) Extremely firm - completely resistant to crushing.

3. **Dry soil:** In the absence of moisture, the degree of resistance is related to the attraction of particles for each other.

The different categories are

- i) Loose - non coherent
- ii) Soft - breaks with slight pressure and becomes powder
- iii) Slightly hard - break under moderate pressure
- iv) Hard - breaks with difficulty with pressure
- v) Very hard - very resistant to pressure
- vi) Extremely hard - extreme resistance and cannot be broken.



Differentiate among the solid, semisolid, plastic and liquid states of soil consistency.



Albert Atterberg, a Swedish scientist, considered the consistency of soils in 1911, and proposed a series of tests for defining the properties of cohesive soils.



Activity 1 Measuring Stickiness:

Moisten soil and press between thumb and forefinger.

Use the following criteria to determine stickiness:

- a) Non-Sticky - little or no soil adheres to fingers, after release of pressure.
- b) Slightly Sticky - soil adheres to both fingers, after release of pressure. Soil stretches little on separation of fingers.
- c) Moderately Sticky - soil adheres to both fingers, after release of pressure. Soil stretches some on separation of fingers.
- d) Very Sticky - soil adheres firmly to both fingers, after pressure release. Soil stretches greatly upon separation of fingers.

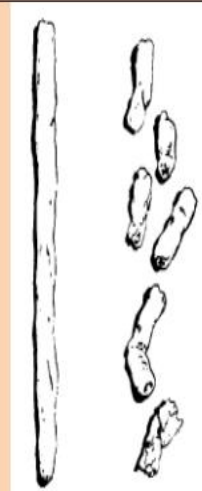


Plastic - if a 2 mm worm supports its own weight

Activity 2: Measuring Plasticity

Form a "worm" of soil (4 cm long) so that the soil is the most plastic you can make it. Then see how thin the worm can be and still stay intact. Use the categories below to determine plasticity:

- a) Non-Plastic - if the soil will not form a worm 6 mm in diameter or, if formed, it will not support itself on end:
- b) Slightly Plastic - If the 6 mm worm supports itself, but a 4mm worm does not
- c) Moderately Plastic - if a 4 mm worm supports itself, but a 2 mm worm will not
- d) mm worm will not



LESSON 3: IMPORTANCE OF SOIL CONSISTENCE

LESSON OUTCOME:

At the end of this lesson the student will discuss the importance of soil consistence.

Soil consistence is important because it describes the way in which soil behaves.



i) Tillage

Machinery interacts with soil as described below:

MACHINE	EFFECT ON SOIL
Mouldboard plough	~ causes little shattering ~ compacts wet soil ~ may form clay pans
Disc plough	~ causes some shattering of soil ~ causes less compaction than a mouldboard plough
Rotary hoe	~ develops fine soil structure ~ causes excess shattering of soil

- ii) **Vehicle and animal movement** – whether the soil surface can handle the weight of the vehicle or machine or if the machine deforms the soil or gets stuck.
- iii) **Soil water** – whether there is space between particles to allow infiltration and percolation. It also determines the water holding capacity of soil.
- iv) **Soil productivity** - soils of poor consistency like desert sand or pavements, have only sparse or non-existent vegetation, and hence support very low animal populations, if any.
- v) **Structures** – whether the soil can support the weight of a building and its content. It determines the tillage operations recommended for use on farms.



List the husbandry practices on livestock and crop farms which are impacted by soil consistency.



Soil consistence is important in determining the operations which can be carried out on a farm.



Discuss the importance of soil consistency.

PROPAGATION IN PLANTS

LESSON 1 OVERVIEW OF CROP REPRODUCTION

LESSON OUTCOME:

At the end of this lesson the student will differentiate between the two types of crop reproduction.

INTRODUCTION

The word reproduction means the action or process of making a copy of something. Propagation on the other hand refers to the deliberate reproduction and spread of something. In this topic both words will be related to plants. Plant reproduction therefore is producing offspring's of plants for the continuity of species from generation to generation. There are two basic forms of reproduction in plants. **Sexual reproduction** and **Asexual reproduction** There are two types of asexual propagation

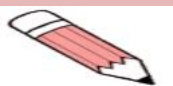
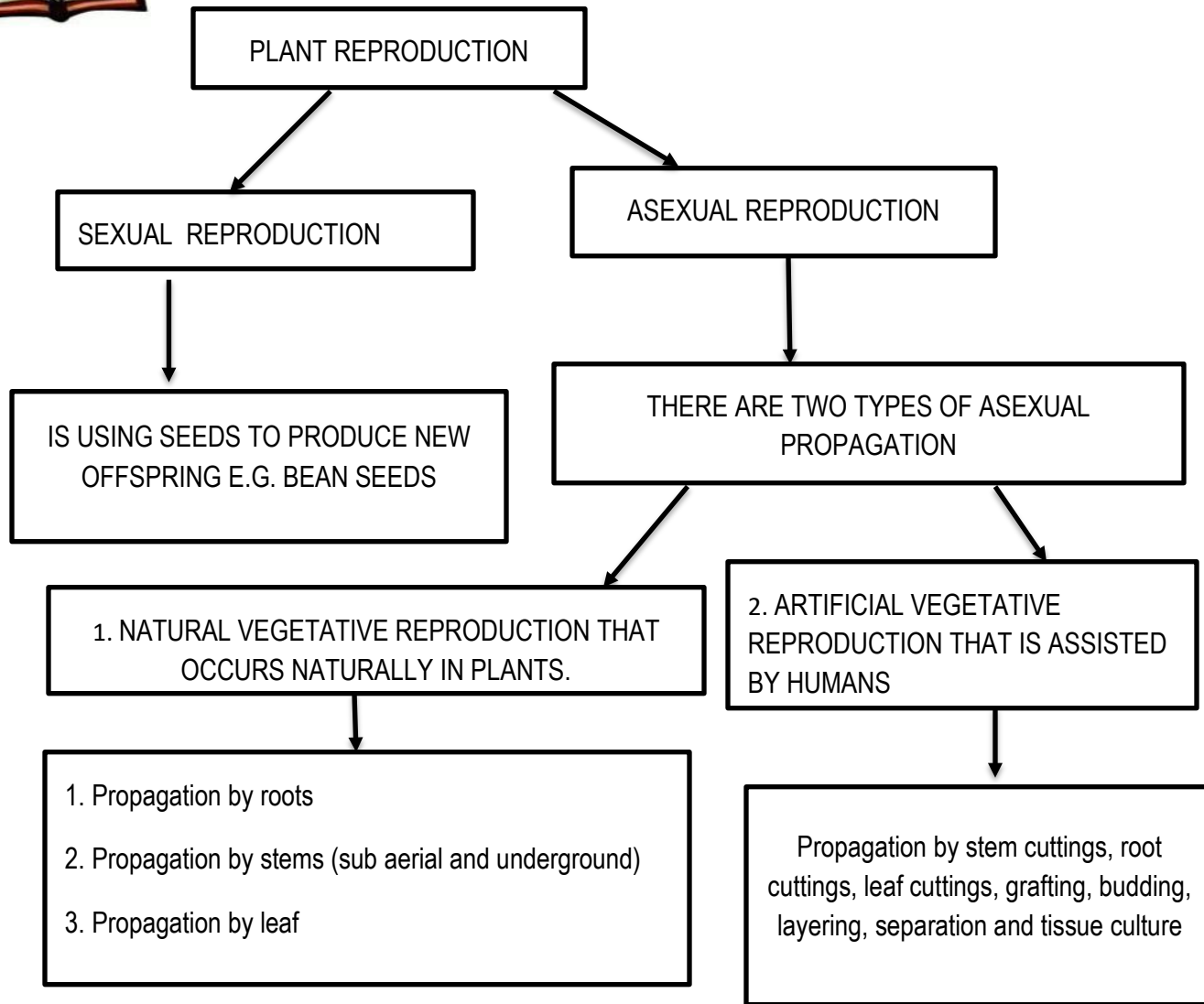
Natural vegetative propagation – which occurs naturally in plants.

Artificial vegetative propagation – which is assisted by human intervention.



1. **Sexual reproduction** – production of offspring involving two parents releasing gametes or sex cells e.g. using seeds.
2. **Asexual reproduction** - production of offspring involving single parent from which the planting material is extracted e.g. stem cuttings.
3. **Gametes** - refers to sex cells released from parents.
4. **Male gametes (plant)** - refers to pollen grains.
5. **Female gametes(plant)** - refers to ovules produced in the ovary.
6. **Pollination** – transfer of pollen grains from anther to stigma of flower by agents of pollination.
7. **Fertilisation** - fusion of male and female gametes to form a zygote.
8. **Embryo** - is an advanced developmental stage of cells after zygote formation.
9. **Seed Dormancy** - resting stage of seeds or inactive growth stage of seeds.

Reproduction in plants



1. Describe the following terms?

a. **Crop Reproduction**

b. **Plant propagation**

2. Differentiate between **Sexual reproduction** and **Asexual reproduction**

3. Differentiate between **Artificial vegetative** propagation and **Natural vegetative** propagation



There are two types of plant propagation which are natural propagation and artificial propagation.



Identify some plants in your locality that be propagated naturally and artificially.

LESSON 2

SEXUAL REPRODUCTION

LESSON OUTCOME:

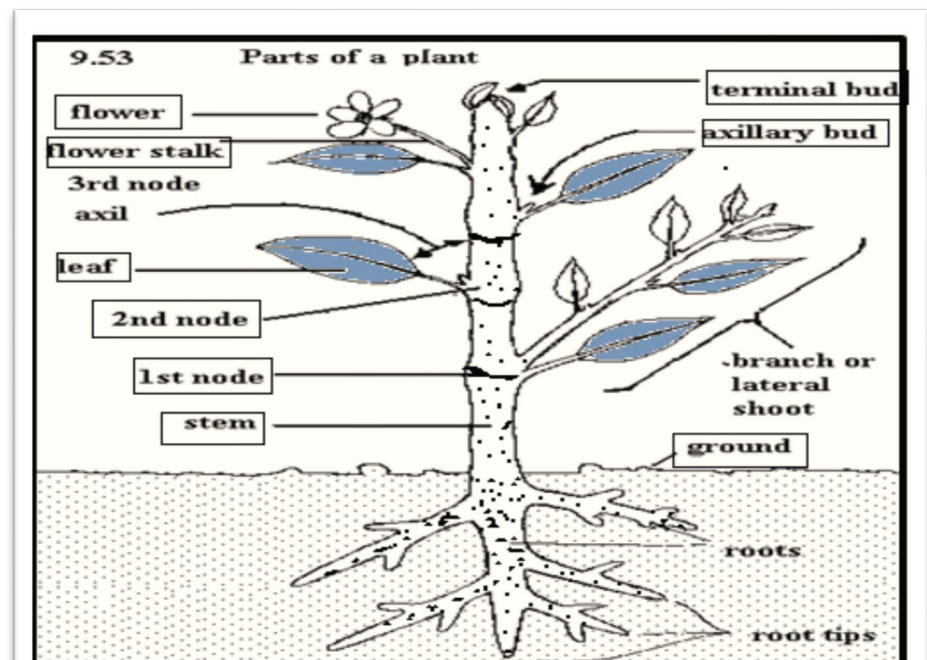
At the end of this lesson the student will describe components of sexual propagation methods.



VOCABULARY

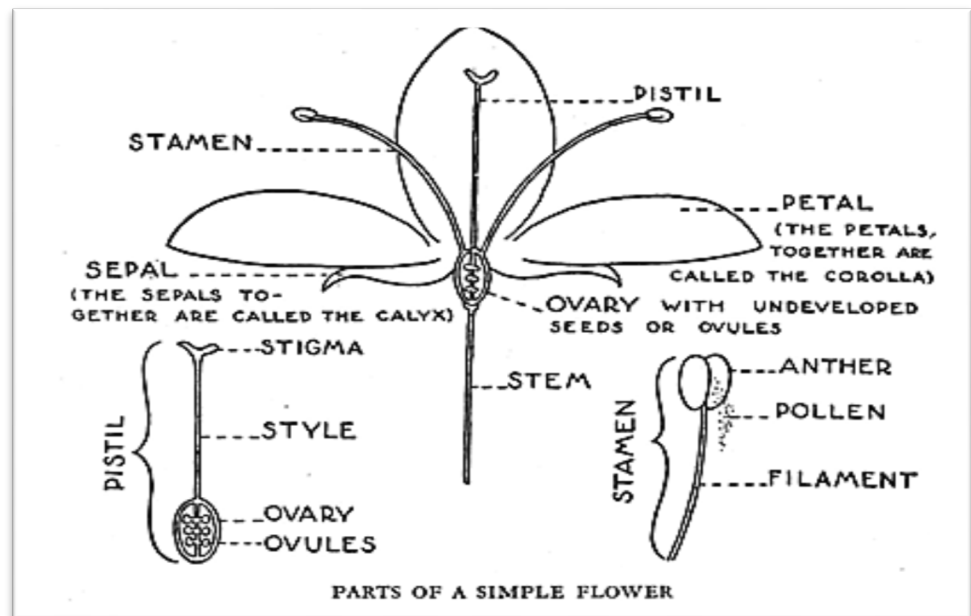
1. **Stamen** – male part of the flower
2. **Pistil** – Female part of the flower
3. **Axillary Bud** – (or lateral **bud**) is an embryonic shoot located in the axil of a leaf.
4. **Node** – The part of a plant stem from which one or more leaves emerge, often forming a slight swelling
5. **Prop Roots** – An aerial **root** that arises from a stem or trunk, penetrates the soil, and helps support the plant, as in mangroves. Also called **stilt root** .
6. **Underground stems** – are modified plant structures that derive from stem tissue but exist under the soil surface e.g. bulbs, corms, rhizomes.
7. **Leaf Venation** – The distribution or arrangement of a system of veins, as in an a **leaf** blade
8. **Aestivation** – the arrangement of petals and sepals in a flower bud before it opens.

Parts of a plant





Parts of a simple flower



The Roots

Source: <https://www.carolina.com>

1. The main functions of the root system are absorption of water and minerals from the soil, providing a proper anchorage to the plant parts, **storing reserve food material** and **synthesis of plant growth regulators**.
2. Hanging structures that support a mangrove tree are called **prop roots**. Similarly, the stems of **maize** and **sugarcane** have supporting roots coming out of the lower nodes of the stem. These are called **stilt roots**.

The stem

1. The region of the stem where leaves are born are called **nodes** while internodes are the portions between two nodes.
2. Some stems perform the function of storage of food, support, protection and of vegetative propagation.
3. Underground stems of **potato, ginger, turmeric, and, colocasia** are modified to store food in them.
4. **Stem tendrils** which develop from **axillary buds**, are slender and spirally coiled and help plants to climb such as in gourds (cucumber, pumpkins, watermelon) and grapevines. A **terminal bud** is the primary growing point at the top of the stem of a plant. An example of **terminal bud** is where a flower opens up on a plant.
5. Axillary buds of stems may also get modified into woody, straight and pointed **thorns**. Thorns are found in many plants such as Citrus, Bougainvillea. They protect plants from browsing animals.

LESSON 3

DIFFERENCE BETWEEN SEXUAL AND ASEXUAL PROPAGATION

LESSON OUTCOME:

At the end of this lesson the student will differentiate between sexual and asexual reproduction together with their advantages and disadvantages.



1. **Offspring** – is the product of the reproductive processes of an animal or plant .
2. **Dormancy** – is the resting stage of seed when it will simply not grow due to a number of factors.
3. **Vigour** – is the capacity for survival or strong healthy growth in a plant or animal: hybrid vigour.
4. **Uniform** – remaining the same in all cases and at all times; unchanging in form or character.
5. **Variation** – to show difference in characteristics.
6. **Viable** – capability of a seed to germinate under ideal conditions.

Difference between Sexual and Asexual Reproduction

	1. Sexual reproduction	2. Asexual reproduction
Parents involved	Two	one
Gametes	involved	not involved
Offspring	not identical to parents	identical to parents
Number of offspring	Comparatively less	Comparatively more
Examples	e.g. seeds	e.g. plant parts other than seeds

Advantages and disadvantages of Sexual Reproduction

Advantages of Sexual Propagation	Disadvantages of Sexual Propagation
Seeds are cheap way of growing large number of plants	Some seeds don't last in storage
Simple equipment and facilities are required then other propagation methods	Seeds also undergo dormancy
Seeds are easily transported and stored.	Some plants don't produce seeds
Seeds are easy to store.	New plants may take long time to reach maturity.
Seeds give rise to variations that can be used for selection and plant breeding	May produce un uniform crops

Advantages and disadvantages of Asexual Reproduction

Advantages of asexual propagation	Disadvantages of asexual propagation
Is the simplest form of reproduction	Dependent on favourable environmental conditions and human skill.
Plants that cannot produce viable seeds can be grown by vegetative propagation.	Vegetative parts such as roots, stems, leaves and bulbils cannot be preserved for long periods
Only one parent is required which eliminates the need for special mechanisms such as pollination.	The plants gradually lose their vigour as there is no genetic variation.
Year after year the same variety can be produced.	Does not adapt to the changing genetic makeup of pests and disease causing organisms.
The offspring are genetically identical so advantageous traits can be preserved.	Unwanted characters cannot be eliminated from plants.
It is faster so helps the organisms to increase in number at a rapid rate that balances the loss in number due to various causes.	Since many plants are produced, it results in overcrowding and lack of nutrients.
Plants survive unfavorable conditions because of organs of asexual reproduction like the tubers, corm, bulbs, etc.	Since all the plants are genetically alike, they are susceptible to same diseases.
Vegetative propagation is especially beneficial to agriculturists and horticulturists who can raise crops like bananas, sugarcane and potato that do not produce viable seeds. The seedless varieties of fruits are also a result of vegetative propagation.	



1. List down any four factors needed for a viable seed to germinate?
2. Name the condition in plants where it does not produce seeds?
3. State one use of the variation in offspring ?
4. Draw and label a diagram of a typical seed and show the following (endosperm, embryo, plumule, radicle, micropyle and seed coat
5. Discuss on the survivability of seeds and a bulb during unfavorable condition?

LESSON 4

NATURAL AND ARTIFICIAL VEGETATIVE METHOD OF PLANT PROPAGATION

LESSON OUTCOME:

At the end of this lesson the student will distinguish among and explain natural vegetative propagation and artificial vegetative propagation methods.



1. Artificial – made or produced by human beings rather than occurring naturally,
2. Natural – existing in or derived from nature; not made or caused by humankind.



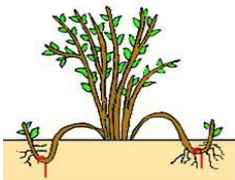
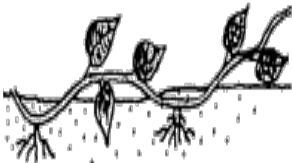
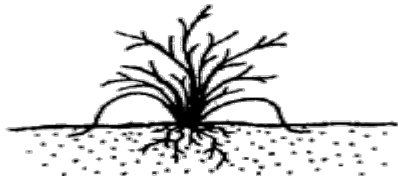
There are two types of asexual plant propagation which are :

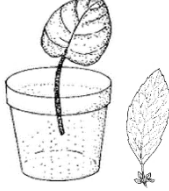
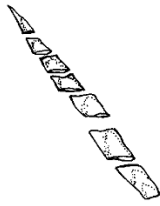
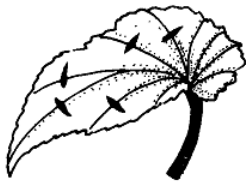
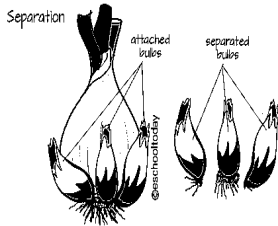
1. Natural Vegetative Propagation – which occurs naturally in plants.
2. Artificial Vegetative Propagation – which is assisted by human intervention.

NATURAL VEGETATIVE PROPAGATION METHODS

Methods	Propagation	Examples	Diagram
1.0 Vegetative propagation by roots	a. swollen tap roots -a primary root that grows vertically downward and gives off swollen lateral roots	Roots of Carrot, Turnip and Radish.	
	b. adventitious roots - aerial root that arises from a stem or trunk, penetrates the soil,	Roots of Asparagus, Dahlia, Sweet Potato, Yam etc	

ARTIFICIAL VEGETATIVE PROPAGATION METHODS

Methods	Propagation	Examples	Diagram
1.0 Vegetative propagation by Layering	a. Simple layering	Citrus and Rose	
	b. Mound layering	Heavy-Stemmed, Closely Branched Shrubs.	
	c. Compound layering	Plants With Flexible Stems	
	d. Tip layering	Raspberries and Trailing Blackberries	
2.0 Vegetative propagation by cuttings	a. Root Cuttings	This method is often used on outdoor plants.	5 cm section of root 
	b. Plants with small roots	This method is often used on indoor plants.	5cm section of root 
	b. Stem cutting	Kumala cuttings (2 to 6 inches cut)	 <i>Tip</i>

Methods	Propagation	Examples	Diagram
	ii) Cane Cuttings	Sugarcane (contains 2 eyes or nodes)	
	iii) Heel Cutting	Plants with woody stems	
3.0 Vegetative propagation by leaf cutting	i). Whole Leaf with Petiole	Few indoor plants e.g, African Violet	 <i>Figure 1. Leaf-petiole.</i>
	ii) Whole Leaf without Petiole	Few indoor plants e.g, Snake Plant	 <i>Figure 2. Leaf without a petiol.</i>
	iii) Split Vein	Few indoor plants e.g. Rex Begonia	 <i>Figure 3. Split-vein.</i>
	iv) Leaf Section	Few indoor plants e.g Cactus	
4.0 Vegetative propagation by Separation	The planting material is separated from the parent plant and planted out	Propagation of bulbs, tubers corms and suckers	

5.0 Vegetative propagation by Micro-propagation (also known as tissue culture)	Production of a large number of individual plants from a small piece of plant tissue cultured in a nutrient medium	Egg plant, Banana, tomato, cassava, rubber tree etc	Tissue cultured banana plant  http://freshplaza.com  http://soiltest.in

LESSON 5

MICRO PROPAGATION (TISSUE CULTURE)

LESSON OUTCOME:

At the end of this lesson the student will Describe the micro plant propagation method.



1. Protoplast – the colourless material comprising the living part of a cell
2. Aseptic – free or freed from pathogenic microorganisms
3. Ex-plant – pieces of tissue or organ removed from a plant or animal.
4. Callus culture – is a growing mass of unorganized plant parenchyma cells
5. Stolons – special slender horizontal branch serving to propagate the organism.



Notes

The production of a large number of individual plants from a small piece of plant tissue cultured in a nutrient medium is also known as tissue culture. It is another method of asexual plant propagation used widely. The aseptic culture of plant protoplasts, cells, tissues or organs under conditions which lead to cell multiplication or regeneration of organs or whole plants.

Steps of micro propagation

Stage I: Selection of planting material – where a healthy plant with desired characteristics is chosen for tissue culture e.g. using axillary buds

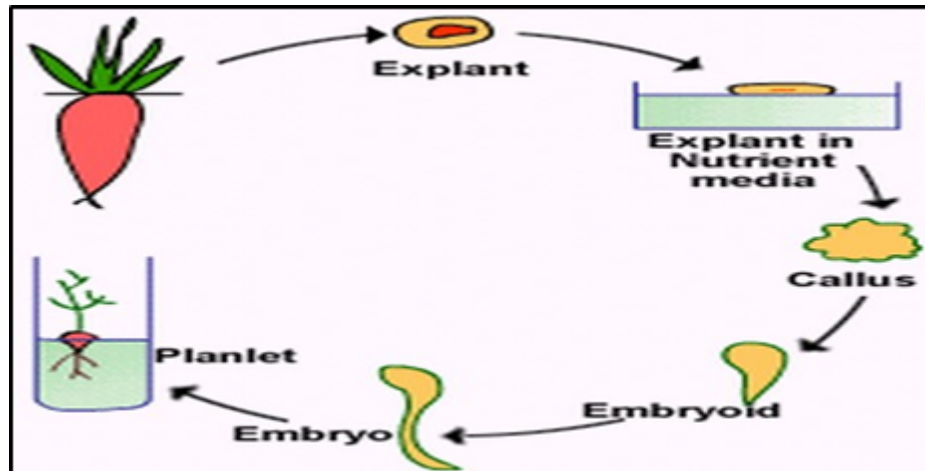
- a) vegetative parts (shoot tip, meristem, leaves, stems, roots)
- b) reproductive parts (anthers, pollen, ovules, embryo, seed, spores.)

Stage II: Initiation stage -The explant is extracted under sterile conditions and placed in a nutrient medium with disinfectant solution of suitable concentration for a specific period. Bleach, Ethyl alcohol, bromine water, mercuric chloride, silver nitrate, sodium hypochlorite, calcium hypochlorite can be used as disinfectant.

Stage III: Multiplication stage- The explant is placed in a growth medium which provides all it requires to undergo rapid tissue multiplication and the formation of a callus.

Stage IV: Rooting stage- the callus is divided up and provided with a different growth medium to induce root formation from Stage III plants .

Stage V: Acclimatization stage. Transfer of the plants to potting medium for growing out and hardening.



ADVANTAGES AND DISADVANTAGES OF PROPAGATION BY TISSUE CULTURE TECHNIQUE

ADVANTAGES	DISADVANTAGES
Produces large number of plants in a short time	Requirement of sophisticated facilities e.g. High Tech Lab
Produces disease free plants	Requirement of skilled personnel
A technique that uses a small explant from a plant to mass produce plants	High production and maintenance cost



1. Describe the term tissue culture ?
2. State any two reasons for opting to use tissue culture ?
3. Discuss the importance of tissue culture in relation to disease elimination
4. Where is tissue culture process carried out ?
5. Which method of plant propagation does tissue culture come under?

LANDSCAPING

Students will research and elaborate on the value, practice and skills involved in landscaping.

LESSON 1 OVERVIEW OF LANDSCAPING

LESSON OUTCOME:

At the end of this lesson the student will explain, identify the four main elements of and distinguish among the main types of landscaping.

	Landscape Architecture Landscaping	- the design of outdoor public areas, landmarks, and structures to achieve environmental, social-behavioural or aesthetic outcomes. - any activity that modifies the visible features of an area of land, including: living elements, such as flora or fauna
	Aesthetic Ornamental	- concerned with beauty or the appreciation of beauty. - a plant grown for its aesthetic appearance.



Landscape is defined as an expanse of scenery that can be seen in a single view. Landscapes are divided into the elements which are the visual qualities that people see and respond to when viewing a space.

The four main elements of a landscape are:

1	Natural Elements 	landforms, terrain shape, elevation, bodies of water
2	Living Elements 	flora and fauna
3.	Abstract Elements 	weather and lighting
4.	Human Elements 	paving, walls, parapets, bridges, sculptures, steps, bollards, planters

The word *landscaping* is derived from the word Landscape, a verb that means to improve the aesthetic appearance of an environment by changing its contours, adding ornamental features, or planting trees and shrubs.

Landscape design is a process of developing practical and pleasing outdoor living space.

Landscaping is divided into two components which complement each other.

1. Hard landscaping  http://www.neonusantara.com	- where inanimate elements like paths, water features, structures, pergolas and walls give the landscape form and structure on which the softer elements can perform.	2. Soft landscaping  http://www.bucksgardens.co.uk	- where the flowers, trees, shrubs, lawns and animals softening the landscape
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Types of landscaping include

1. Environmental landscaping

- which is used for educational, sporting and aesthetic purposes.

Gardens  http://www.charliesgardens.com	Lawns  http://www.blueskyturf.com	Playing fields  http://www.schmidtawnlcare.com	Parks  http://www.123rf.com
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2. Residential landscaping

- which is meant to improve the area to be lived in by individuals and families.

Apartment  http://www.usagold.net	Bungalow  http://www.ontarioarchitecture.com	Mansion  http://www.home-designing.com
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3. Commercial landscaping

- which involves buildings used for business.

Office building  http://www.hampshirehills.co.uk	Restaurant  http://www.naturafashiongardening.com	Shopping mall  http://www.-cache-ak0.pinimg.com	Hotel  http://o.homedsgn.com
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Differentiate between soft and hard landscaping.



Landscaping refers to any activity that modifies the visible features of an area of land, including living elements, such as flora or fauna; natural elements such as landforms; human elements such as structures, and abstract elements such as the weather and lighting conditions.



Identify properties where landscaping is practiced.

LESSON 2: BENEFITS OF LANDSCAPING

LESSON OUTCOME

At the end of this lesson the student will discuss the benefits of landscaping.



Conservation - the act of preserving, guarding, protecting or wise use



Landscaping is practiced for many reasons, some of which are discussed below:

1. Economic reasons

- a) **Increases tourist revenue** – many tourists who visit the South Pacific are interested in the scenic beauty of the area and are attracted to landscaped venues and accommodation.
- b) **Increased property value** - a well landscaped garden can increase the value of property. A landscaped garden can also improve the aesthetic quality of property.



Source; <http://www.landscape-authority.com>

- c) **Employment** – landscaping provides a variety of employment opportunities including grounds keeper, landscape planner and maintenance labourer.

2. Life style reasons

- a) **Physical exercise** – the establishment and maintenance of a landscaped space provide opportunities for exercise.
- b) **Healthy food** – crops are often included in landscape designs and produce fresh fruit and/or vegetables.
- c) **Therapeutic** – the aesthetic value of landscaped areas afford patients solace and tranquillity and so assist in healing.
- d) **Privacy** – shrubs, trees and buildings provide a private outdoor space for relaxation.
- e) **Creates outdoor rooms** – the relaxed outdoor setting provides a suitable environment for learning, entertaining and exercising.



<http://www.0.s3.envato.com>

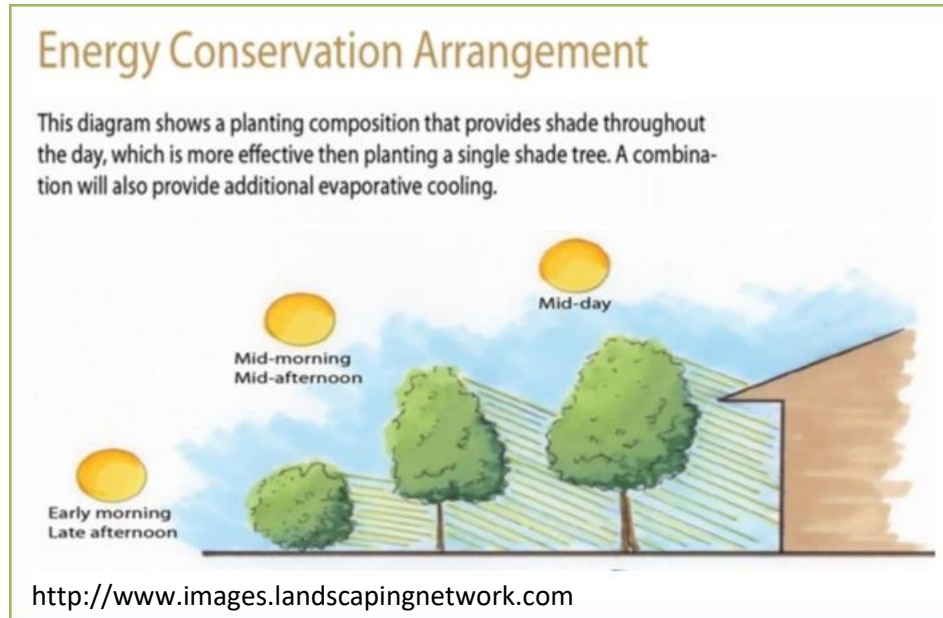
3. Environmental reasons

The most obvious benefit of landscaping is the beauty you get to enjoy.

- a) **Protects water quality** - the chemical, physical, biological, and radiological characteristics of water are altered by landscaped areas so improving the water quality.
- b) **Improves air quality** – plants filter air of impurities.
- c) **Reduces noise, wind and glare** – landscapes can be planned to minimise the effect of pollution including noise, wind and glare from direct and reflected sunlight.

d) **Conserves energy**

- landscaped gardens can reduce the fluctuations in temperature of the environment so can reduce utility bills and conserve energy.
- trees, hedges, grasses and shrubs can protect buildings from harsh winds.
- trees and hedges can absorb heat from the sun to help keep the surrounds cooler.



e) **Haven for Wildlife**

- a landscaped garden can attract wildlife such as lizards, toads, birds, spiders and insects.
- natural landscaping is a haven for wildlife because it offers shelter from predators as well as natural food supplies.

Connecting with plants and trees provide immeasurable health and emotional benefits. Landscaped areas including house plants, gardens and backyards reduce the need to travel to the rainforest or the woods for the benefit that nature provides.

Fiji Crested Iguana



Study the picture of a site at Laucala Island Resort and answer the question which follows. Discuss the benefits of having a landscaped site, like the one above, in a resort.



<http://www.hotels2see.com>



Landscaping impacts economic, lifestyle and environmental value of an area.



Discuss the effect that landscaping your school compound would have on the school community.

LESSON 3: LIMITATIONS OF LANDSCAPING

LESSON OUTCOME

At the end of this lesson the student will discuss the disadvantages of landscaping.



Site	- the location on the surface of the earth.
Investment	- time, energy, or matter spent in the hope of future benefits



Landscaping is a financial investment and can be both labour-intensive and costly depending on the size of the work that needs to be carried out. Landscaping a home garden will differ in costs when compared to landscaping a resort lawn.

Disadvantages of Landscaping	
Time and Effort	- Plants need continuous care throughout the growing season. - Patios, deck and fences require occasional cleaning, repair and painting to maintain them.
Money	Landscaping is an expensive exercise.
Expertise	A skilled person is needed to carry out the job of landscaping.
Hazard	In certain areas wild fire may be of great concern
Attractiveness	May look less attractive due to reduced available range of plants to choose from
Native Plant Species	May be hard to find native plants which produce adequate quantities of edible matter.



Explain why landscaping can be a costly exercise.



Landscaping is a complex art, materials used in landscaping are plants, rocks, water, and human made features like walkways, decks etc. To establish and maintain landscaped areas needs money and expertise.



Discuss the disadvantages of landscaping.

LESSON 4: LANDSCAPING SKILLS

LESSON OUTCOME

At the end of this lesson the student will discuss the skills involved in landscaping.



A landscaper's job is to transform an area, using what resources are available, into an area which is pleasing to the client.

The landscaper must have the following skills.



Planning:

Before landscaping begins, the landscaper must meet the client at the site and discuss the client's "dream" for the area so that ideas can be envisaged.

Sometimes, the envisaged may not be achieved due to limitations faced along the way.

Designing:

Using a map of the property, the landscaper will sketch out possible landscapes. The landscaper and client will discuss and amend the plan to suit the needs and wants of the client, the availability of resources, time and budget available.

Constructing

The hard landscaping elements are constructed.

Establishing

Selected vegetation is established.

Maintaining

The landscape is maintained e.g. paths are swept, lawn mown, hedges trimmed, structures repaired, and drains kept clear of debris.

Original	Constructing	Establishing	Landscaped	Maintaining
				

adapted from: <http://www.jaclandscapes.com>



List the skills that a landscaper needs.



Landscapers need a variety of skills to modify and maintain a landscape.



Imagine that the school community has requested the class to landscape a portion of the school compound. In groups, design the landscape.

AS 11.3.2.3 FIELD CROPS

Students will research and elaborate on:

- i) One field crop traditionally cultivated in the area
- ii) One field crop recommended for cultivation in the locality
- iii) One field crop not commonly grown in the locality.

INTRODUCTION

At the end of this lesson the student will distinguish between the crops classified as “field crops” for this course.



Field crop

Any crop, other than vegetables and fruit trees, which are grown for agricultural purposes.



There are a number of definitions for the term field crops. In this sub-strand, the following crops have been classified as field crops:

	Category	Definition	Examples in Fiji
	1 Cereals	a grass grown for its small edible seed	Rice and maize
	2 Fruit	fruit that are not produced on trees	pineapple, strawberry, watermelon
	3 Root crops	plants grown for their modified, thickened root or stem which generally develops underground	dalo, cassava, yams, sweet potato, potato
	4 Sugar crops	plants which are natural sources of sweet substances called sugar	sugarcane (source of sucrose)

AS11.3.2.3.1

RICE

LESSON 1:

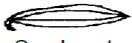
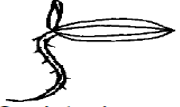
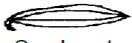
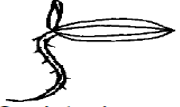
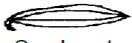
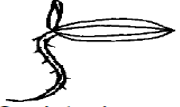
CULTIVATION OF RICE

LESSON OUTCOME

At the end of this lesson the students will discuss the cultivation of rice.



Scientific name	<i>Oryza sativa</i>	
Varieties	Dry land varieties Boldgrain, Star, Maleka, Totoka, Uttam, Nuinui, Deepak. Wet land varieties Star, Deepak, uttam, Nuinui, Bold grain Traditional varieties (can be planted year round) BG 75, Saray-6 months, China Motka, Lalka Motka, Takur Ram, Ram Kajar	
Planting season	<u>Dry land rice</u> –November-December <u>Wetland rice</u> Traditional variety November-January	
Site selection	<u>Dry land rice</u> -suitable to be grown on dry land -level to gently rolling slope -free drainage and high water retention -precipitation needed during the transplanting phase.	<u>Wetland rice</u> -suitable to be grown on level land in the wet zone of Vitilevu and Vanualevu namely Navua, Nausori and Dreketi. -soil with high water holding capacity required so fertile loamy to clay soils -precipitation needed throughout the growing period.

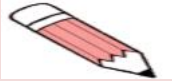
Seed selection	Select quality seeds which are free from: -weed seeds -seed-borne diseases -insects -pathogens -other extraneous matter -damage										
Pre-germination of rice seeds	The following are steps used in the pre-germination of rice seeds 1. Sunbathing rice seeds- rice seeds are spread out evenly in the sun for one or two days to kill pathogen and weaken the husk. 2. Sorting seeds- seeds are poured into a container of water ,stirred gently and left to settle.seeds which float are removed as they will not germinate. 3. Seed soaking- seeds are soaked in fresh water at a ratio of 1 part seeds to 5 parts water for about 24 hours. This allows the water to soak in to the seed and cause the embryo to grow. 4. Incubating seeds- pour water away and spread the seeds thinly over a clean surface. Cover the seeds with jute sack or clean straw for three days to allow the seeds to germinate. 5. Broadcast seeds- the germinated seeds can be broadcasted into: • Prepare paddy field- where they can take root and grow in to wetland rice crop. • Prepared seedbeds- where they grow until ready for transplanting.	sun bathing rice seeds  http://www.pleisbilongtumi.wordpress.com  <table border="1"> <thead> <tr> <th>Two days</th> <th>Three days</th> <th>Five days</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td></td> </tr> <tr> <td>Seeds not ready for sowing</td> <td>Seeds ready for sowing</td> <td>Seeds too large and delicate for sowing</td> </tr> </tbody> </table>   Source: http://www.flickr.com	Two days	Three days	Five days				Seeds not ready for sowing	Seeds ready for sowing	Seeds too large and delicate for sowing
Two days	Three days	Five days									
											
Seeds not ready for sowing	Seeds ready for sowing	Seeds too large and delicate for sowing									

Raising seedlings	Construct raised seed beds, 1.5m wide, 4-5cm high and of any convenient length. Sow the pre-germinated seeds uniformly at 1kg /10 sq.m. After 4 days irrigate the seed beds to 3cm deep. Gradually increase the water level to 5cm to control weeds and to make lifting of seeds easier.	Seedbed of rice seedlings 
Spacing	Wet land rice Transplanting - 30cm x 25cm (3-4 seedlings per hill) at the age of 3-4 weeks after germination. Dry land rice Between rows: 20cm Plants within rows: 15cm Drop seeds in furrows or use seed drill at a depth of 4-6cm. If broadcasting, this should be evenly broadcasted followed by laddering	
Soil preparation	Clearing-Remove all vegetation, including crop residues, by slashing or ploughing under. Dry land rice is grown in rainfed fields while wetland rice favours flooded fields Repair bunds-Construct no wider and taller than 50 cm x 30 cm bunds, around the field. Make sure that bunds are well compacted and properly sealed, with no cracks, holes, etc. This will minimize water losses through seepage Tilling Dry land rice Turn and pulverize soil to a fine tilth then level soil surface Wet land rice Irrigate the field to soften soil then turn and puddle waterlogged soil before levelling the soil surface.	 Source: http://www.imgkid.com  Source: http://www.123rf.com  Source: yesicaneatwithchopsticks.com  Source: yesicaneatwithchopsticks.com
Transplanting seedlings	There are four stages in the transplanting of rice seedlings: Stage 1: Lifting-involves lifting seedlings from the seedbed . Stage 2: transporting-where seedlings are carried in wheelbarrow with the roots covered in jute sacks to avoid dehydration.	 Source: http://www.123rf.com

	Stage 3: placement-bundles of seedlings are placed at intervals in the rice fields so they are within reach for the workers. Stage 4: planting out- rice seedlings are planted in to the field.	
Planting	The following are the steps used in planting rice seedlings: -Untie the bundle of rice seedlings - break off the top of the leaves - hold the seedling in one hand with roots against the extended thumb - working backwards and across, place the seedlings in the soil with recommended spacing. -irrigate the field.	 Source: http://www.wikihow.com
Crop care	Land preparation should start 3-4 weeks before planting. Ploughing and harrowing two or more times will destroy weeds The following are some weed control methods used: Manual weed control-weeds are cut or pulled out, this type of control is labor intensive and is not practical for large areas. Chemical weed control-where herbicides are either sprayed on to the plant or added to the irrigation water. Cultural control-in which weed control is intergrated	 Source: http://www.knowledgebank.in.org
Fertilizing material	Superphosphate at 20kg/ha at planting Muriate of potash at 75kg/ha at planting Nitrogen at 50kg/ha in split applications, 25kg at 20 days after seeding and 25kg in between panicle initiation and booting stages Urea at 50kg/ha in two split applications at 21 days after germination and 25kg at 45 days after germination for Star, Maleka, Totoka and 60 days for Boldgrain, Uttam, and Nuinui. Soil analysis should be done before fertilizer application.	 Source: managingnutrients.blogspot.com  Source: china-ogpe.com  Source: freepresspicture.com

Pest and control	Plant Hoppers: Spray Acephate 75% a.i at 20g/15L of water (Acephate is sold as Orthene & Sunthene) or Diazinon at 60ml/15L of water or Apply Malathion at 30ml/15L of water. Rice Leaf Roller: Apply Carbaryl at 40g/15L of water (Sold as Sevin) or Diazinon at 60ml/15L of water Rice Armyworm: Spray Dipterex 80% W.P. 1.12kg a.i/ha or 30ml/15L of water using knapsack sprayer, and use 81ml/10L of water in a Mist blower Spray Acephate 75% a.i at 20g/15L of water using knapsack sprayer and 75g/10L of water when using a Mist blower or Diazinon at 60ml/15L of water or Apply Malathion at 30ml/15L of water	    Rat in rice field Source: http://www.flickr.com  Droppings and urine in stored rice grain Source: http://www.agriculturesnetwork.org
Diseases and Control There is no serious diseases in Fiji.		
Harvesting Rice is harvested between 130-136 days after sowing for late maturing varieties. -110 days for early maturing varieties. Harvesting rice can be done manually using a sickle. The rice stock is cut 15 – 25cm above the ground. -Mechanical cutting – where reapers or harvesters are used. Handling – rice plants are carefully placed so that the grains are not touching the water or soil. Stacking – piling of rice plants with panicles. Threshing – where the grains are separated from the straw. Winnowing- where the grains are separated from lighter materials, such as chaff, weed seeds and straw.		 

Post –harvest treatment	The following post- harvest treatment are done -Drying the paddy by sun drying or heated air drying. -storing paddy in bags, containers and silos. -milling is done to make rice edible by de-husking and polishing -storage of rice is done once it has been milled. It is stored in dry pest proof conditions.	Sun drying rice paddy   http://www.knowledgebank.irr.org
Use of products and by products	The main product of a rice crop is rice. Although there are many other uses rice is mainly used for food and animal feed. The by-products include: 1. Rice stubble-(remains of the rice crop after harvesting). This crop residue is grazed by ruminants. 2. Rice straw- (remains of rice plant after harvesting). The straw is used for mulching,thatch,weaving and organic fertilizing. 3. Rice hulls-(inedible outer husk layer). It has many uses from fuel in power plant tomulch and abrasives. It can be used as a packing material to pad fragile cargo during shipping. 4. Ash from hulls- used to clean discoloured teeth and turned in to cellulose products eg rayons and rice products. 5. Rice bran- used in cereals, mixes and vitamin concentrates due to its high level of vitamin B6, iron, phosphorous , magnesium, potassium,niacin, thiamine and fibre. 6. Rice bran oil- used as a cooking oil and is also effective in lowering blood cholesterol levels. 7. Rice flour- is used to produce rice pasta,crisps, cereals and snacks. 8 Rice starch- used as a thickner in sauces and desert and in the manufacture of rice syrup. 9. Brown rice syrup- also known as rice malt, is a natural sweetener. 10. Rice breakfast cereals- made from granulated white milled rice. 11. broken rice-used in the manufacture of various products, including rice flour, pet food and dairy feed. 12. Brewers rice-an ingredient used in fermenting and is used as an ingredient by some beer manufacturers.	Rice stubble  http://www.123rf.com Rice straw  http://www.dreamstime.com Rice hulls  http://www.agntech.tnau.ac.in Rice bran oil  http://www.naturalplantoil.com Brewers' rice  http://www.legroupindustries.com Rice bran  http://www.naturalplantoil.com Rice breakfast cereal  http://www.breakfast-eaters.org Broken rice  http://www.agntech.tnau.ac.in Rice starch  http://www.imgarcade.com Brown rice syrup  http://www.nutsonline.co.nz



1. Discuss how rice is cultivated from site selection till post harvest treatment of rice.
2. Explain the importance of rice in Fiji.
3. Explain one reason why Fiji imports more rice.

YAQONA

LESSON 2:

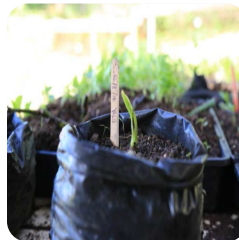
CULTIVATION OF YAQONA

LESSON OUTCOME

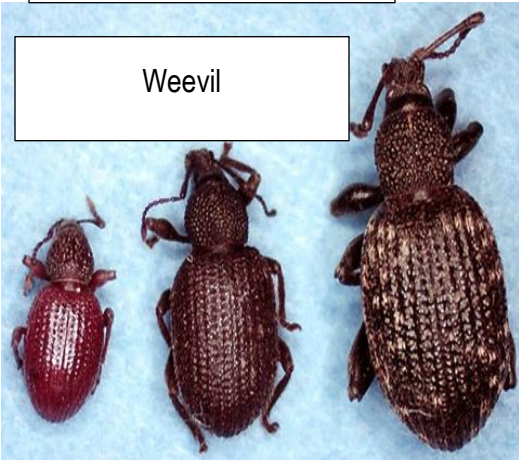
At the end of this lesson the students will discuss the cultivation of yaqona (kava).



Scientific name	<i>Piper methysticum</i>	
Varieties	There are 13 kava varieties in Fiji : -Vula kasabalavu/Vula kasa leka -Matakaro balavu/Matakaro leka - Yonolulu -Loa kasabalavu/Loa kasa leka -Damu --Qila balavu/Qila leka -yalu - Dokobana vula/Dokobana loa	
Planting season	All year round when adequate moisture exist in the soil.	
Site selection	The soil needs to be of good quality (deep, light, fertile and rich in organic matter) and well drained. -Deep, loose, fresh friable soil that is rich in organic matter. -should be close to the road and water for washing and transportation of kava	

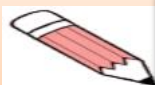
Soil preparation	Land preparation on slopes and in traditional farming systems usually use minimum tillage using a digging fork or a traditional digging stick. The soil should be loosened and well mixed with organic matter before planting. On flat land, it is useful to plant on high mounts of about 40cm high and 2 meters apart. There should be adequate drainage	
Seed selection	Kava is propagated using cuttings from mature plants. • Choose cuttings from vigorous, healthy plants. • Select clean stems that are free from disease, insects and rot. • Use cuttings from the middle stems of the plant that are strong and woody • Select cuttings with the eye of the bud still Intact and not damaged on the nodes.	
Spacing	Between rows:2m Within rows:2m	
Raising seedlings	There are three main techniques used to sprout cuttings. These are 1. Using potting bags or homemade pots Potting bags are filled with rich top soil, sand, compost. Cuttings can be kept in this way for as long as 1-6 months before planting. 2. Using woven coconut leaf baskets. Cuttings are put into woven baskets and covered with grass mulch and are watered on a daily basis and buds can usually be seen after 3-4 weeks, at which point they need to be transplanted into the field. 3. Using a nursery bed. Cuttings can be spread out in a single layer and covered with a layer of loosened top soil under a shade and covered with a thick mulch of grass. These heaps need to be kept moist with regular watering. Cuttings will usually be ready for planting after three to four weeks.	   
Transplanting	Young plants can be transplanted at any time from when the buds have sprouted until they are 20–30cm high and even 2–6 months old. Sprouted cutting should be hardened a few days before transplanting. When transplanting cuttings grown in a potting bag, first make a 30-cm deep hole (just under 12 inches) in the soil and make the hole wide to provide enough space for both seedlings and soil. It's recommended that you transplant the kava cuttings during wet or rainy days to assist the plant in establishing roots.	

Planting	Direct planting is the most common method of establishing kava. Three to five cuttings are planted in a mound. Two nodes are to be below the surface and the other two or three above at an angle and covered with soil. Mulch is used to cover mounds, retain moisture and help in suppression of weeds and sprouting.	
Cultivation	It is important that young kava plants are: -watered regularly - mulched during dry periods to retain moisture - weed free as weeds compete for nutrients and water. -add compost mulch or animal manure. -Provided with shade during the early years -protected from strong wind to avoid breakage of branches.	
Fertilizing material	It is always important to take soil tests before planting to know the fertility of the soil and whether it is necessary or not to use fertilizers. Suitable types of fertilizer and rates can then be worked out from soil test results. In some cases, fertilizer may be required to obtain the best yields of kava, and in these circumstances fertilizer may assist plants compete against disease, pests and weeds. Fertilizers should be applied sparingly and care should be taken not to over-fertilize. Over-fertilizing plants is a waste of money but also can pollute streams and may encourage the growth of weeds. Fertilizer is sometimes applied during early stages of growth to assist kava plants to outgrow weeds and help the kava plants get established. During the early stages of growth a basic fertilizer guide is: NPK: Mix 30g with the soil at planting per mound; and • Urea: 30g per mound at 4 weeks after planting and to be well incorporated with soil -Animal manure that has been thoroughly composted to destroy harmful microorganisms and weed seeds can also be used as a fertilizer	   Animal Manure

Pest and control	There are no records of major pests of kava in Fiji but there are some general pests to be aware of. These are: Weevils Damage roots or stems by burrowing into them and encouraging rots to develop Resting the land after harvesting kava can help reduce populations of weevils. Aphids Damage the leaves by feeding on them and spreading diseases like kava dieback and other viruses. Removing weeds and not growing kava near vegetables can help to control aphids. Nematodes Damage the roots and rhizomes by feeding on them and spreading diseases which can then cause rots to develop. Resting the land after harvesting kava and not growing kava with vegetable crops can help to control nematodes. Snails and slugs Damage emerging shoots of young plants. Can be controlled by applying snail baits or wood ash around the plantation	 Damage caused by Aphids  Damage caused by Nematode  Snail  Weevil
Disease and control	Kava die back <u>Control:</u> -Use traditional growing methods: - remove and destroy infected plants by burning & burying. -Grow only on good soils, with adequate shade. -Intercrop with crops such as dalo, dalo-ni-tana under coconuts. -Avoid nematode host plants. Use clean and healthy planting materials from non infected plants	

Harvesting	After 3-5 years from planting but can be left longer. Harvest to individual preference. Harvesting of kava plants begins by: • cutting the leaves and stems of the plants above the first two nodes • loosen the soil around the plant using a digging fork or stick to expose all surface and subsurface lateral roots before digging under the rhizome for the anchor roots to loosen the plant from the soil before lifting it off the ground. During harvest, care should be taken to ensure there is little or no damage to the plant and no foreign matter, weeds or toxic plants are mixed with the harvested kava.	
Post-harvest treatment	The post harvest treatment of kava are as follows: 1. cutting / separation Cutting is done to separate the roots 2. Washing The kava should be thoroughly washed to remove all soil particles 3. Cutting and chipping The rhizome of the plant (lewena) where the roots join the stem should be separated and then peeled, well cleaned, and cut/chopped into thin even slices for drying. 4. Drying The kava needs to be dried to 12% or less moisture to prevent mould growth. When it is dry enough it should easily snap when bent with your fingers. It needs more drying if it is soft and can bend. 5. Sorting and packing Once dried the kava is separated and packed in dry clean bags for storage ready for marketing. 6. storage It is important that kava is stored in a clean, dry and well ventilated place and protected from contamination to maintain its quality before it is taken to market.	 Cutting and chipping  Drying  Sorting  Packaging and storage

Product and by products	1. Kava roots and lewena- is usually pounded or grinded and normally used for drinking in pacific island countries. 2. medication – kava is being prescribed by health care providers to treat a wide range of ailments. 3. leaves- can be used as compost. 4. kava grounds(kosa)- is used as mulch for crops and can be added to compost as a source of manure	  
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1. Explain the importance of Kava in Fiji.
2. Discuss the reason why most farmers are investing more into the Kava Industry
3. If you were a farmer how would you market your Kava. Locally or international market and why?

DALO/TARO

LESSON 3:

CULTIVATION OF DALO/TARO

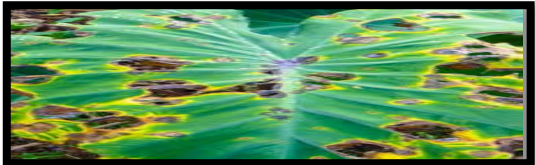
LESSON OUTCOME

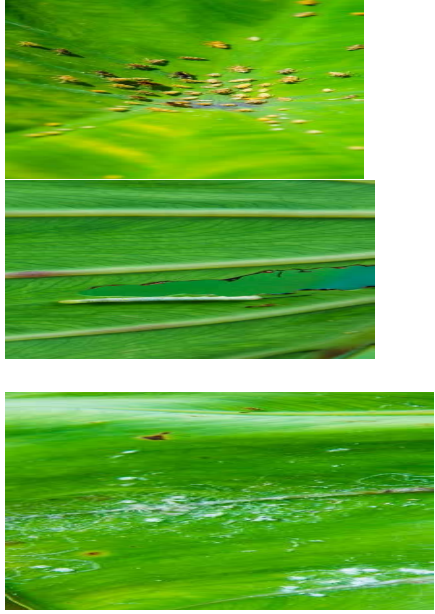
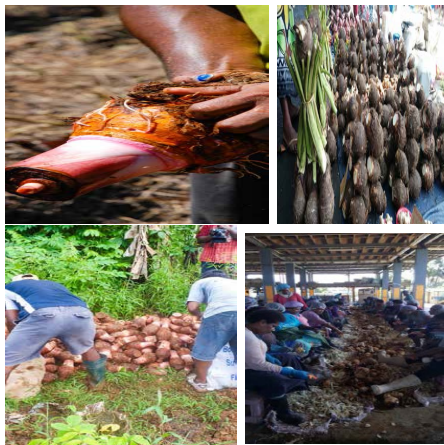
At the end of this lesson the students will discuss the cultivation of dalo/taro.



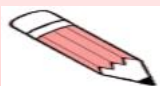
Crop	Dalo/Taro
Scientific name	<i>Colocasia esculenta</i>
Varieties	Recommended varieties: Samoa Hybrid Samoa Tausala ni samoa Vula ono Maleka dina Dalo ni Toga Kuro Kece Wararasa Toakula Vaivai

New varieties	Tarova loa and Tarova vula These two new varieties were introduced in 2018 which are both resilient to taro leaf blight.	
Seed selection	Taro is mostly propagated using suckers and tops. When selecting suckers : -Select healthy suckers of a similar size to help produce a crop of consistent size and quality. -Suckers should be 4cm in diameter and trimmed so that 20-30cm of the leaf stalk remains. - Suckers should be carefully stored prior to planting. Under ideal circumstances they should be stored in a covered, ventilated area and kept off the ground. This helps to maintain their condition, allow wounds to heal before planting and reduce the likelihood of damage from pests and diseases. - Use dips where appropriate to prevent dalo beetle and other pests and diseases, and do not use diseased suckers.	 
Planting season	July – January Off season-March – June Wet zone-Throughout the Year Intermediate zone-September- March	
Site selection	In general fertile, well-drained, deep loamy soils rich in organic matter are preferred for dalo production. Flat to gently sloping sites with alluvial soils in river valleys are often used. Steep slopes (>15° incline) should be avoided as they are prone to erosion and difficult to manage. Wet and high rainfall areas are particularly sought after as they allow dalo to be grown year round, allowing the farmers to supply local markets and exporters during the 'off season' when prices can be relatively high. In intermediate rainfall areas dalo can usually only be grown from September to March when there is sufficient moisture in the soil.	
Soil preparation	Soil on the dalo patch needs to be loosened by digging with fork or by ploughing, and harrowing. If mechanical methods are used to prepare the land care should be taken to reduce the likelihood of soil compaction which can damage the soil and may result in yield decline over time. On the flat land drains may need to be built using bullocks or tractor to allow any excess water to drain away. It is best not to plant dalo in waterlogged soil as this may result in corm rot. Sites should be prepared to ensure there is adequate drainage and care taken not to overwork soil.	

Spacing	Traditional System: Between rows: 1m Plants within rows: 1m Mechanize Systems: Between rows: 1m Plants within rows: 60cm	
Planting	Holes are dug to a depth of 25cm deep by hand with a spade or planting stick, or in furrows made by tractors or horses/bullocks. The soil in holes dug by hand may be loosened using a fork prior to planting. The tops are planted with the corm section 15-20cm below ground level, and the new dalo corm grows upwards from the planted piece of corm. Soil is then firmly pressed against the planted sucker. Planting too deep can reduce the vigour of the plant, decreasing the quality of the dalo harvested.	
Fertilizer and manure	a) Poultry Manure: 5 tons/ha Broadcast and mix well with soil 2 weeks before planting. b) NPK: - 13:13:21 200kg/ha basal application before sowing. c) Urea: 100kg/ha. Side dressed in 2 split applications i.e 2 -4 weeks after transplanting. - Soil analysis should be done before fertilizer application.	 
Weed control	Paraquat at 100ml/15L of water (Sold as Gramazone, Agazone & Royal paraquat) Hand weeding.	
Disease control	Taro Leaf Blight A major disease of taro not present in Fiji but present in other pacific island countries. Strict quarantine measures must be observed to prevent the spread of the disease to countries where it does not currently occur. Any movement of planting material between countries should be limited to sterile plantlets growing in a tissue culture medium, and they should be indexed for viruses. 	

Insect control	Plant Hoppers, Cutworms, White Fly, Cluster Caterpillar: Spray Malathion 50% EC, 30ml/15L of water or Spray Acephate 75% a.i at 20g/15L of water (Acephate is sold as Orthene & Sunthene) or Spray Phyrethroids at 40ml/15L of water (Sold as Attack) or Diazinon at 60ml/15L of water Taro Beetle: Apply Confidor at 5ml/15L of water or or Sunclopid at 3.75 to 7.5ml/15L of water or Bifenthrin at 14 to 18ml/15L of water. or Bifenthrin at 2.5ml/L of water	
Harvesting	Harvesting @ 6-7 months for Hybrid Varieties whilst traditional varieties are ready at 9 months for harvest. Yield: 20-25 tonnes/ha Harvesting should occur in the morning or late afternoon when temperatures are cooler. It is best to harvest in dry conditions as this can help to reduce the incidence of rots. Harvesting in cool conditions helps to maintain the quality of the dalo. If harvesting dalo in wetland areas it is important that excess water in the fields is drained before harvest to reduce the possibility of secondary rots occurring.	
Post-harvest management	The following are the post harvest management for dalo: cleaning and sorting-After harvesting, farmers should clean and check the harvested dalo and discard any corms that are damaged, diseased or infested with pests packing –dalo for the local market are tied in bundles with similar sizes and transported to the market. Storage-Corms should be stored in a dry, shady location, and in a manner that will prevent contamination with pests, insects, weed seeds or other things that might damage the quality of the dalo.	

	Dalo for exports-the tops should be cut to approximately 5 cm in length once harvested in the field. Cutting the tops shorter than 5 cm may cause the corms to dry out during transport and handling, reducing the quality of the dalo. -dalo is then washed to remove all dirt and other materials like pests. -corms are dried in a clean rack. -it is then graded and checked a multiple times so that it meet quarantine requirements from other countries. -corms are then packed in bags which must be sewn or tied closed and labeled -dalo is stored in the clean and cool facility ready for export.	   
Products and by products	Then main product of dalo is the corm which is mostly used for food and other products. 1. Ready-to-eat taro chunks and patties. Pacific Islanders consume considerable amount of taro in baked or boiled form with or without coconut cream 2. Taro flour-Taro corms which are not suitable for the fresh market or for the taro chip industry can be converted to taro flour. The taro flour can then be used in other food formulations such as taro bread, taro cookies, kulolo, baby food, pasta, instant or flavored poi, or other products 3. Taro starch 4. Taro peels-The peels may be used as animal feed, to generate bio-energy, or dried to a mulch for the agriculture industry 5. Taro leaves- used for wrapping meat during cooking and for Palusami where leaves are cooked in coconut milk. 6. taro chips	    



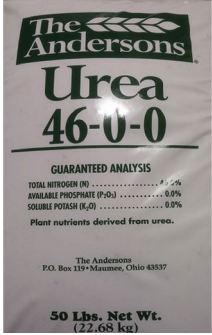
1. List down the countries that Fiji exports taro to.
2. Describe the characteristics of two taro varieties that you studied.
3. Explain one disease and pest that affects the taro industry in Fiji.
4. Discuss the cultivation practices of taro from planting to harvesting.

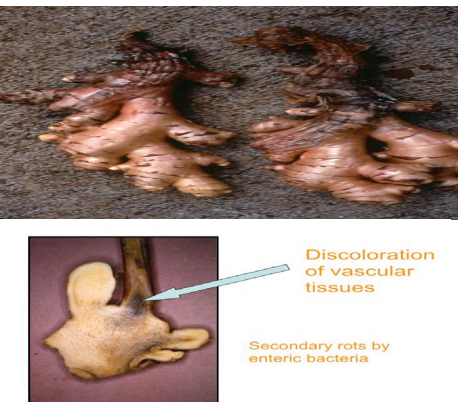
GINGER**LESSON 4:****CULTIVATION OF GINGER****LESSON OUTCOME**

At the end of this lesson the students will discuss the cultivation of ginger.



Crop	Ginger
Scientific name	<i>Zingiber officinale</i>
Varieties	There are only two varieties of ginger grown in Fiji and they are: • pink ginger • white ginger
Planting season	September
Site selection	Ginger does well in slightly acidic to neutral, well drained soils rich in nutrients and organic matter. -Soils with pH lower than 5 should be limed. -Select land with a gentle slope. -Avoid waterlogged or imperfectly drained soils as they retard shoot growth.
Soil preparation	-To produce well shaped rhizomes, thoroughly clear bush, remove root stumps, plough deeply and harrow. - Raise beds 1.2-1.8m wide or ridges 60-90cm apart for planting. -Ginger can also be grown on the flat.
Seed selection	Select clean, fresh and diseased free rhizomes with several eyes.  

Seed treatment	Hot water treatment is done to the planting material at 52° C for 10 minutes. This is done to control or eliminate nematodes.	
Spacing	Slope land: Green 60cm between rows and 15cm plants within rows. Mature: 60cm between rows and 20cm plants within rows Flat land/Semi Mechanized: Green 90cm between rows 15cm plants within rows. Mature 90cm between rows and 20cm plants within rows.	
Planting	Ginger is propagated using the rhizome. During planting, the tip of the eye bud should face upward and the rhizome should be planted at the depth of 5cm.	
Fertilizing material	Poultry manure: 10t/ ha. Mix well with soil at land preparation 2 to 3 weeks before planting. N:P:K: 13:13:21 1tonne/ha at 3 months after planting. Apply 500kg/ha at planting and 500kg/ha at 3 months after planting. Urea: 300kg/ha. Top dress immature and premature in 3 split applications of 100kg/ha first at 2 to 3 leaf stage, second at 8 wks after first application and third at 4 wks after second application. Hilling to be followed after each application. Soil analysis should be done before fertilizer application.	 

Pest and control	Eelworms or Nematode: 1. Root knot nematode & Burrowing nematode - hot water treatment of planting material at 52° C for 10 minutes. -Crop rotation with cassava & dalo -Sanitation-remove all rhizomes from the field after harvesting. -Proper selection of seed choose healthy seeds. Tuber Scale Insect: Apply Diazinon. Pre-Plantation treatment 1) Use clean planting material and dip in Ridomil and water 2) Ridomil rate at 55g/15L of water to control fungal disease. Dipping of rhizomes in Diazinon at 60ml/15L of water before planting.	
Disease and control	Pythium rot: Treat planting material in Sundomil 3.5g/L water for 5 min. -spray affected plants with Sundomil at 50g/15L of water Bacteria Rot (Erwnia): 52° C treat planting material -3.5g/L. - Remove & destroy disease plants. - Improve drainage.	 Discoloration of vascular tissues Secondary rots by enteric bacteria
Harvesting	Harvesting: Green: 5 months from planting (fiber content 30-40%) Mature: 10 months from planting The rhizomes are harvested by hoeing the field or beds or by toppling the ridges. Care should be taken not to bruise or injure the rhizomes during harvesting. Ginger for the fresh export market should be harvested earlier (about 7 months) to reduce the fibre content of the rhizome	

Post- harvest treatment	After digging, shake off soil, remove all roots and wash rhizomes thoroughly. Dry for 2 days in shade. After drying ginger is then packed for export or for sale in the market.	
Products and by products	Ginger rhizome is the main product of ginger it has many uses and benefits ginger oil- It is produced by steam distillation from coarsely ground rhizomes and is used in food preparations and in perfume industries. ginger powder-made by pulverising ginger to mesh size 50-60 . It is used in curry powder, recipes and in distilleries for preparation of ginger beer. ginger lollies- ginger is cooked until soft and the root is covered with a light coat of sugar. Ginger tea Ginger juice Ginger leaves- it is used for garnishing and treatment of various ailment such as constipation , joint pain , toothache and reducing the risk for heart disease.	



1.Name one country that Fiji exports ginger to?

2.Explain the most serious pest of ginger and how farmers control the name pest?

VANILLA**LESSON 5:****CULTIVATION OF VANILLA****LESSON OUTCOME**

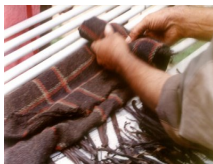
At the end of this lesson the students will discuss the cultivation of vanilla.



Crop	Vanilla
Scientific name	<i>Vigna Mungo</i>
Recommended Varieties	Bourbon vanilla
Planting season	Vanilla can be planted all year around
Site selection	Vanilla requires a warm climate with frequent rain Partially uncleared jungle land is ideal for establishing vanilla. Vanilla prefers loose and friable soil with loamy texture It also requires a land with high organic matter content for better yield.
Land preparation	When preparing land for vanilla it should be taken in to account that vanilla needs support. Support for vanilla is divided into two categories: living support and the non- living support. If living support is used than establishment of it needs to take place first before vanilla is planted. Some support trees used include <i>Glyrideidai</i>, <i>Erythrina</i>, <i>Jatropha carcas</i>, <i>Plumeria alba</i> and <i>Casuarina equisetifolia</i>. The land should be ploughed a couple of times to bring the soil to fine tilth stage. Weeds should be removed and drains prepared to drain out water. For land that is not fertile organic manure should be applied during land preparation.

Planting material selection	Vanilla is usually propagated using stem cuttings. When choosing stem cutting : -choose stems that are diseased free -stem should be at least 1 metre long with a minimum of 10-12 internodes in each cutting.	
Planting	Vanilla is generally planted at a time when the weather is not too rainy or too dry. Cuttings for planting should be collected in advance, and after removing three or four basal leaves, dipped in one per cent Bordeaux mixture and kept in shade to loose moisture for about a week. Since establishment of cuttings is almost 100 per cent, planting of single cutting per support is enough. The defoliated part of the vine is laid on the loose soil surface and covered with a thin layer of about two to three cm soil. The basal tip of the cutting should be kept just above the soil to prevent rotting. The growing end is gently tied to the support for climbing by the aerial roots. The cuttings are shaded with tall dry grass, palm fronds or with other suitable materials. In dry soil, a light sprinkling of water helps for early establishment of cuttings. It takes about four to eight weeks for the cuttings to strike roots and to show initial signs of growth. Vanilla can also be planted as an intercrop in coconut and plantations.	
Cultivation practices	Flowering and pollination Vanilla will start flowering from the third year of planting Pinching off the top 7.5 to 10.0 cm of the vine, 6-8 months before the flowering season encourages flower production. In Fiji natural self-pollination is not possible due to the absence of specific pollinating agent however artificial pollination is carried out by hand using a bamboo splinter or a sharpened toothpick to get fruit set 	

	Mulching Dried leaves, coconut husk /leaves, rotten trimmed branches from support trees can be used as mulch to prevent soil erosion and moisture loss from the soil. Mulching also help in weed control and enriches soil fertility	
	Manures and fertilizer Require heavy mulching: 20-30 cm around base. (Coconut husk, dry leaves & rotten decaying timber can be safely used as mulch). Poor Soils: Apply 20-30g of Nitrogen & Phosphorus, 60-100g Potash per Vine per year beside the organic mulch. Soil analysis should be done before fertilizer application	
	Irrigation Irrigation is essential in the first 2-3 years of seedling growth. Regular watering is required during the dry and hot summer seasons.	
	Trailing Trailing in vanilla is done in order to limit growth of plant. In vanilla orchard vine growth should be limited to 150-160 cm height to facilitate easy manual pollination. The vanilla vine should be trailed by coiling them around branches of the support pillars or on horizontal support without allowing the vines to touch the ground.	
Weed control	Weeds in vanilla farms can be controlled by: -Suppressing weeds with addition of heavy mulch. -Hand weed around the plant at least four times a year. - Slash between rows	

Disease control	In Fiji there is no significant disease pest of concern.	
Insect control	Slugs & Snails: control by hand picking and use Metaldehyde baits. Keep ground clean. Scales: spray the affected vines with a mixture of Diazinon at 60ml/15L of water with white oil.	 
Harvesting	Vanilla is ready for harvest between 6-9 months after flowering when the pods are still dark green and the tip is beginning to turn yellow. The vanilla bean should be harvested when the distant end turns yellow in colour.	 
Post- harvest treatment	Curing – vanilla beans are dipped in hot water at 63- 65 degrees Celsius for 3-4 minutes. Sweating- vanilla beans are exposed to sunlight for 2 hours by raising them on a raised platform every day for 5-6 days. Drying – vanilla beans are spread on racks in an airy room for up to one month. Conditioning – keeping the dried vanilla beans bundled and covered in butter paper, in wooden boxes for about 3 months. Grading - Once fully cured, the vanilla fruits are sorted by quality and graded	    

Products and by products	Vanilla is mainly used as flavours in many products such as ice creams, soft drinks, chocolate, candies, yogurt, perfumes, pastries, and many other products.	
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1. Name two cultivation practices of vanilla.
2. Explain the cultivation practices named in 1 above.
3. Discuss the importance of pollination in vanilla.
4. Name two products of vanilla.

LESSON 1 OVERVIEW OF FRUIT

LESSON OUTCOME:

At the end of this lesson the student will explain what a fruit is and identify the 3 types of fruit discussed in this course.



Pericarp the part of a fruit formed from the wall of the ripened ovary.



The word *fruit* derives from “fructus”, the Latin word meaning “enjoyment of produce, harvest”.

In these lessons, fruit will refer to the fleshy, sweet smelling part of the plant, edible to humans, which develops from the ovary of the flower and may or may not contain seeds.

Some of the locally grown vegetables is illustrated below.

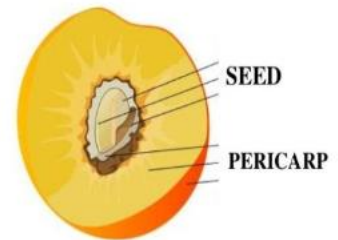


Fruit can be divided into the following categories:

1. Simple fruit

– fruit that developed from a single or compound ovary with only one pistil (of a single flower).

Simple fruits may either be fleshy or dry fruit.

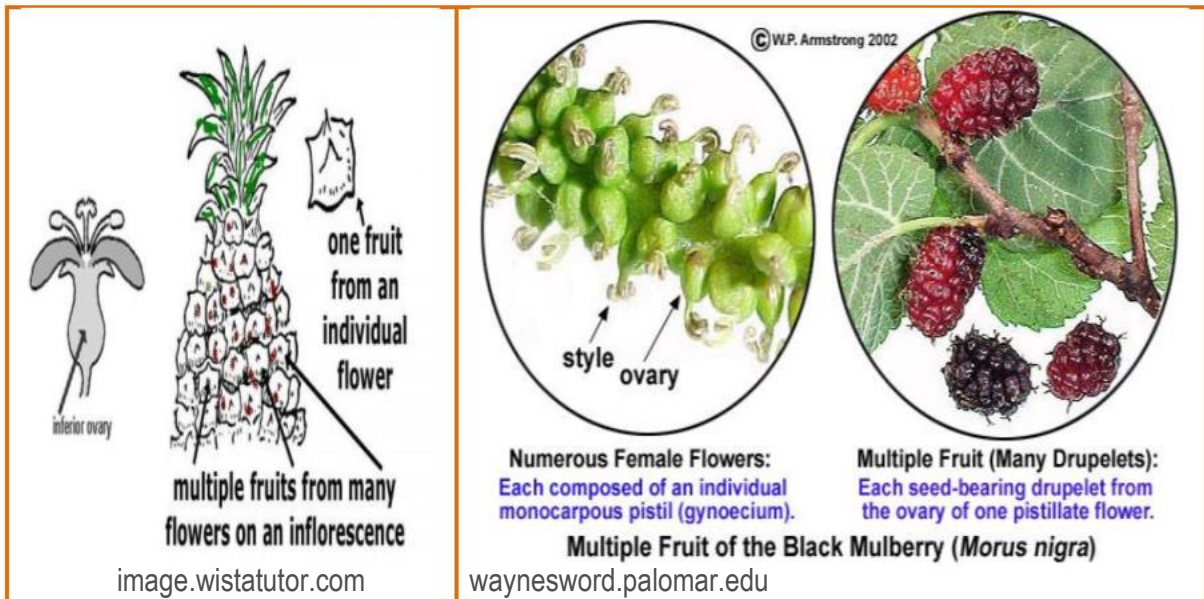


- berry –fruit that has its seeds enclosed in a fleshy pulp e.g. grape, papaya, guava, avocado and banana as well as tomato,
- pepo –fleshy, watery fruit with numerous seeds and a firm rind. watermelon, rock melon as well as cucumber and squash
- hesperidium – having a thickened leathery rind and juicy pulp divided into segments e.g. orange, lemon, grapefruit, tangelo kumquat
- drupe – a fleshy fruit with thin skin and a central stone containing the seed e.g. mango, peach, plum, nectarine, cherry as well as olive
- pome – fruit consisting of a fleshy enlarged receptacle and a tough central core containing the seeds apple, pear, quince, loquat.



2. Multiple Fruit

– fruit that develop from the ovaries of many flowers growing in a cluster e.g. pineapple and mulberry. A pineapple is considered to be a cluster of 100-300 little fruitlets.



3. Aggregate Fruit

fruit that develop from numerous ovaries of a single flower.



Source: <http://www.waynesword.palomar.edu/>

Fruit which grow on trees or are used as vegetables will not be discussed in this course.

 Differentiate among the three categories of fruit mentioned above.

 Fruit refer to the fleshy, sweet smelling part of the plant, edible to humans, which develop from the ovary of the flower and may or may not contain seeds. Most flowering plants bear fruit which are categorised as simple, multiple and aggregate.
In this sub-strand fruit which grow on trees or are used as vegetables will not be studied.

 Make a list of fruit grown in Fiji which not vegetables and do not grow on trees.

Pineapple

LESSON 1

OVERVIEW OF PINEAPPLE

LESSON OUTCOME

At the end of this lesson the students will discuss the origin of pineapple.

 *Ananas comosus* - Scientific name of pineapples.



Pineapple, *Ananas comosus*, is a tropical plant which produces edible multiple fruit also called pineapple. It is considered the most economically significant plant in the Bromeliaceae family which comprises 2,000 species, mostly epiphytic and many strikingly ornamental.



<http://www.ndsu.edu>

Native to southern Brazil and Paraguay, the pineapple was apparently domesticated by the Red Indians and carried through South and Central America to Mexico and the West Indies long before the arrival of Europeans. Christopher Columbus and his shipmates saw the pineapple for the first time on the island of Guadeloupe in 1493.

They imported the fruit and cultivated it in hot houses and because European royal families developed a liking for it, pineapples gradually became available to the rich, the noble and the elite. Over the past 100 years, the pineapple has become one of the leading commercial fruit crops of the tropics

Ornamental pineapples



<http://www.i2.wp.com>

LESSON 2: SITE SELECTION FOR PINEAPPLE

LESSON OUTCOME

At the end of this lesson the students will discuss the factors to consider when selecting a site to cultivate pineapple.



Pineapple is a tropical crop which is sensitive to the climate in which it is cultivated.

A combination of optimum temperature and high humidity results in soft, large leaves and juicy fruit, low in acid content.

1. The crop is grown between 31°N and 34°S, primarily in regions with high relative humidity.
2. The optimum air temperature is 32°C during the day and 20°C at night for the whole growing period. Temperatures below or above this range affect the acid and sugar content and hence the fruit quality.
During periods of intense sunlight and high temperature (above about 35°C), fruit is susceptible to sunburn damage.
For non-irrigated crops, rainfall should be well distributed throughout the year and more than 750 mm per year.
3. Pineapple can grow on a wide range of soils but:
 - a) a non-compacted, well aerated and free draining sandy loam textured soil is preferred.
 - b) optimum soil pH is 4.5 to 6.5. The soil should have low lime content so pineapple grows well on the slightly acidic soils of Dawasamu and Naiyala.
 - c) Soil with high organic matter content is favourable.
4. Water
 - a) The crop is sensitive to waterlogging and therefore requires a well-drained soil with good aeration. To counter rots associated with waterlogging, pineapple is usually planted on sloping land.
 - b) Good water availability for irrigation is recommended in drier areas and is useful in all situations for watering at planting and 8-12 weeks before harvest in dry seasons. Pineapples are reasonably sensitive to saline irrigation water and yields tend to reduce

Pineapple growing on a hillside



5. Proximity to markets, transport and labour

Proximity to markets, transport routes and urban areas will help reduce the costs of transport, supporting services and infrastructure, and make management easier.

Availability of suitable and reliable labour is important and can be difficult to source, especially for planting and harvesting, which involve physically demanding work.



Explain why your school compound is either suitable or unsuitable for pineapple production.



Pineapple favour areas with temperature fluctuations between 20 and 32 °C; slightly acidic soils on gentle slopes.



Discuss why commercial pineapple farms are located in the Dawasamu [Tailevu] and Naiyala [Wainibuka] areas.

LESSON 3: VARIETIES OF PINEAPPLE

LESSON OUTCOME

At the end of this lesson the student will discuss the criteria used for the choice of pineapple varieties by consumers, discuss the four main classes of pineapple varieties and name the pineapple varieties cultivated in Fiji.



Customers use the following criteria to choose pineapple fruit:

- i) Size
- ii) Flavour
- iii) Shell [skin] colour
- v) General appearance
- iv) Shelf life – 10 to 14 days at temperatures of 15 °C

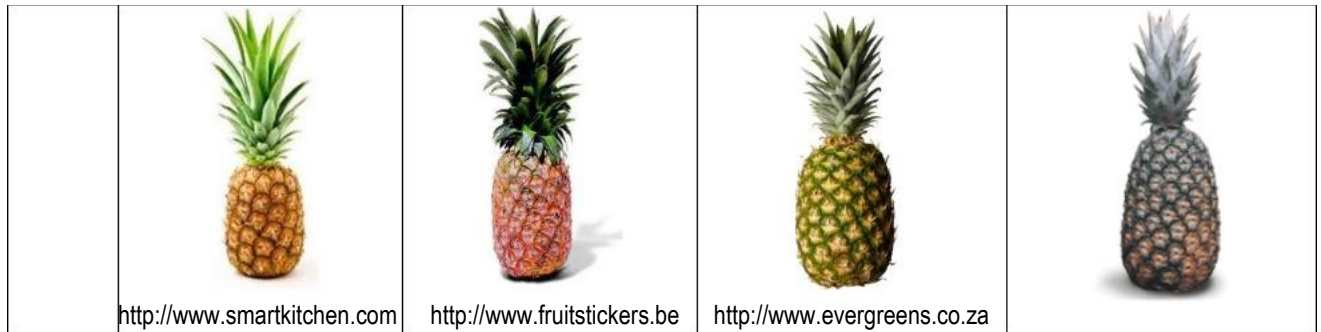
There are more than 100 recorded varieties of pineapple; however the 37 main cultivars are grouped into 4 main classes:

Some pineapple varieties



<http://www.stcroixsource.com>

	Smooth Cayenne	Red Spanish	Queen	Abacaxi.
Fruit size	cylindrical fruit 2 kg average	"squarish" fruit 1.5 kg average	cone shaped fruit 1kg average	pyramidal fruits 2.5 kg average
Flesh	orange rind golden - yellow flesh	purplish rind light flesh	yellow rind yellow flesh	pale yellow flesh nearly coreless
Flavour	juicy and sweet but slightly acidic	pleasant aroma	crispy and sweet	sweet and juicy
Use	canning and processing	fresh fruit	fresh fruit and canning	non- commercial as fruit is easily damaged



Fiji has its own wild pineapple variety but the two main commercially grown varieties are Smooth Cayenne and Ripley Queen.



Describe the characteristics which you look for when buying pineapples to eat.



There are more than 100 recorded varieties of pineapple; however the 37 main cultivars are grouped into 4 main classes:

The two main varieties cultivated in Fiji are Smooth Cayenne and Ripley Queen.



Compare the Smooth Cayenne and Ripley Queen varieties of pineapple.

LESSON 4: PINEAPPLE PLANTING MATERIAL

LESSON OUTCOME

At the end of this lesson the student will discuss the types and preparation of the pineapple planting material.



Primordia - an organ or tissue in its earliest recognizable stage of development.



A pineapple plant flowers only once, and produces one pineapple. Then it dies. But before it dies it also produces offspring.

Although seeds and tissue culture can be used for pineapple breeding, they are seldom used on farms because they take too long to grow and produce fruit.

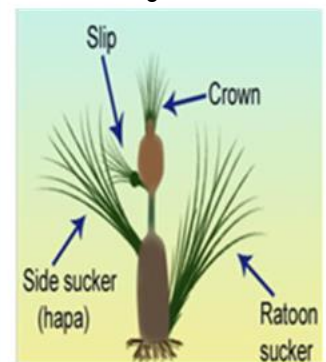
Instead, vegetative methods are used and depending on the part used, may take from 21 to 34 months before mature fruit are harvested.

These vegetative parts include:

1. **ratoon suckers** which develop from the base of the plant grow once the mother plant dies. They produce flowers 17 months after planting.
2. **suckers** are sometimes called **side suckers** and originate in the leaf axils. These produce flowers 17 months after planting.
3. **slips** grow from the base of the fruit itself or along the stalk below the fruit and produce flowers 20 months after planting.
4. **crowns** are the leafy tops of the fruit and produce flowers 22 months after planting.

The best planting material are suckers weighing 250 to 300g or 25 to 30cm high.

Planting material



<http://www.geochembio.com>

Choosing planting material;

When selecting planting material the farmer must ensure that the planting material is:

- 1) from a pest and disease free source
- 2) pest and disease free
- 3) free from excess dirt [which may harbour pests and diseases]
- 4) of similar size

Storing planting material:

- 1) handle planting material carefully to avoid injury to both the plants and the farmer.
- 2) spread the planting material out as piling leads to rotting caused by the build-up of humidity and temperature.
- 3) store in a shady area
- 4) place planting material up-side-down to allow healing and drying of the cut surfaces.
- 5) keep the planting material clean of soil to minimise the development of soil borne pathogens which will deteriorate the planting material.

Treating planting material

- 1) remove the lower 4 to 5 leaves to expose the root primordia for quicker root emergence.
- 2) divide planting material into different sizes to enhance uniformity in the field.
- 3) The planting material is then treated to kill pathogens and pests by one of the methods below:

a) Chemical treatment

The planting material is submerged in a 10% bleach solution, like Janola, for 10 minutes.

b) Hot Water treatment

The planting material is submerged for 30 minutes in water which has been brought to the boil then allowed to cool to 60 °C.

- 4) The planting material is then turned up-side-down and left in the sun to dry for up to 30 minutes.
- Planting material per hectare
- i) on sloping land 37,037 ii) on level land 48,000.



Why do farmers seldom use seeds and tissue culture to propagate pineapples?



Although farmers use suckers, ratoon suckers and slips to propagate pineapple, crowns are the favoured planting material.



Differentiate among the six planting material which can be used to propagate pineapple.

LESSON 5: SOIL PREPARATION

LESSON OUTCOME

At the end of this lesson the student will discuss the preparation of soil for the cultivation of pineapples.



Double
staggered row

- Pineapples are planted in 3 rows. Plants in rows 1 and 3 are in line while plants in row 2 are offset.



In Fiji, pineapples are grown on both level land and on hillsides.

The land is well tilled using either plough and harrow or digging forks. Pineapple is planted in double staggered rows.

1. On sloping land – erosion may become a problem.
Ridges are prepared and double staggered rows are marked out.
Spacing - 1.2m between ridges, 0.6m between rows per ridge and 0.3m between plants.
2. On flat land – waterlogging may become a problem.
Raised beds are prepared and double staggered rows are marked out.
Spacing- 1m between ridges, 0.4m between rows per ridge and 0.3m between plants



Pineapple crop

Source: <http://www.kiran.nic.in>

Planting Time: The best time to plant is in the dry season (April to July) to prevent base rot however phase planting is recommended for year round production.



Sketch of the spacing layout of a double staggered row of pineapple propagated on a gentle slope.



In Fiji, pineapple plants are grown in double staggered rows on both flat land and slopes.



Compare the advantages and disadvantages of the methods used for preparing soil for the cultivation of pineapple.

LESSON 9: CROP CARE

LESSON OUTCOME

At the end of this lesson the student will discuss the management practices involved in the care of a pineapple crop.



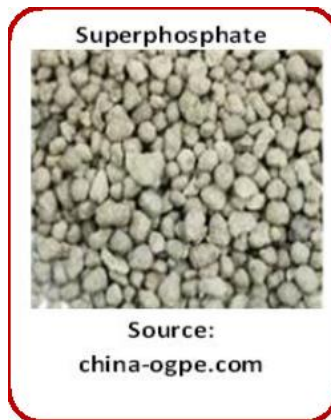
Forcing

- causing a plant to produce flowers and subsequent fruit by the application of chemicals like hormones.



Pineapples take from 21 to 34 months to grow, depending on the climate and planting material used. Once the flowers are fertilized, a fruit takes 6 months to develop into mature fruit. During the growing period farmers carry out husbandry practices to help the crop grow to its potential. This care includes the application of fertilizing material, weed control, pest control and disease control

FERTILIZING MATERIALS



It is recommended that fertilizer should be applied at the following stages of pineapple development:

- 1) at soil preparation, organic fertilizers like compost or poultry manure are tilled into the soil.
- 2) at planting, Superphosphate is basally applied at 250kg/ha
- 3) 1 month after planting, Urea is side dressed at 110 kg/ha.
- 4) every 4 months between planting and harvesting, NPK 13:13:21 is side dressed at 250 kg/ha.

FORCING



adapted from <http://forums.gardenweb.com>

Although flowering occurs naturally only at certain times of year, artificial induction of flowering with chemicals may be done at any time of year. The process is called forcing.

Forcing permits the scheduling of flowering and fruiting so that harvests can be spread throughout the year. It is also used in closing out the crop to assure a complete and synchronous change at the time of natural flowering. Forcing is sometimes not completely effective during hot weather.

Month	Growth regulators & concentration
September-January	N AA 10 ppm (Planofix 1 ml/4.5 litres of water)
March-May	Eitherel (Ethyphon) 10 ppm (2.5 ml/100 litres of water) + 2% urea + 0.04% sodium carbonate
All months	Eitherel (Ethyphon) 25 ppm (6.5 ml/100 litres of water) + 2% urea + 0.04% sodium carbonate.

Apply the hormone mixture to the centre or heart of plant at 50ml/plant after 3pm and repeat the application if it rains within 3 hours of the application.

Ethephon is also sprayed on mature-green pineapple fruits to degreen them to meet produce marketing requirements. There can be some detrimental effect on fruit quality.

WEEDS

Lantana



gardeningknowhow.com

Prickly solanum



keyserver.lucidcentral.org

Navua sedge



1.bp.blogspot.com

The leaves of some varieties of pineapple, including Ripley Queen, have sharp spines which hinder the husbandry practices like manual weed control.

Weeds are controlled:

1. Before planting

Land preparation should start 3–4 weeks before planting. Turning, pulverising and forming soil into beds destroys weeds and remaining stubble from the previous crop, however weed seeds and underground storage organs may remain viable. Therefore, weeds should be allowed to emerge and grow for at least two weeks between tillage operations, especially primary tillage. This reduces the number of weed seeds remaining in the soil and future weed problems.

2. During the establishment of plants

Weeds remaining in the soil will grow while the pineapple planting material is beginning to grow. Weed control is essential at this stage to reduce competition. Pre-emergence herbicides like Diuron [3 kg] or Bromacil [2.5 kg] in 600 litres of water per hectare completely controls all types of weeds in pineapple plantation so the crop is weed free for the first 3 months.

3. 1 to 3 months after planting

Any weeds which survived would have emerged by now so need to be controlled by manual weeding using a push-pull hoe or inter-row cultivation using a horse and mouldboard plough.

4. Before or after flowering and fruit set – spray Karmax (Diuron 80/Diuron 90) at 100g/15 l of water.

PESTS

Adult Mealy bug



Eggs in cocoon



Source: <http://www.organicgardeningnewsandinfo.files.wordpress.com>

1. Mealy bugs - very small (about an eighth of an inch long), oval-shaped flightless scale insect that have a white powdery appearance and infest both indoor and outdoor plants. They move slowly, when they move at all. Mealybugs are soft-bodied insects, but they secrete a powdery wax layer over themselves. This protective layer gives them their name, as it makes them look as though they've been coated in meal or flour. It is also what makes them quite hard to kill.

This insect forms a symbiotic relationship with ants, live in large colonies and is a serious pest of citrus, sugarcane, grapes, pineapples coffee trees, cassava, ferns, cacti, gardenias, papaya, mulberry, sunflower and orchids.

Adult mealy bug with nymphs



<http://www.organicgardeningnewsandinfo.wordpress.com>

Symptoms

- a) fuzzy, white cottony-looking mass around the stems and leaf nodes in which female mealy bugs hide 300 to 600 eggs.
- b) Mealy bugs feed on plant sap and generally position themselves under leaves and at stem joints, while they attack the plant with their piercing mouths known as stylets.
- c) possibly transmit bacterial and fungal infections.
- d) slow plant growth,
- e) yellowing and deformed leaves and leaf drop.
- f) They also excrete large amounts of sticky 'honeydew' that attracts ants and may lead to the growth of sooty mold.

Ants tending mealy bugs



<http://www.3.bp.blogspot.com>

Damage is not often significant at low pest levels; however, heavy infestations can kill a plant.

Prevention

- a) Remove weeds and host plants from the field and surrounding areas.
- b) Avoid indiscriminate insecticide use because it destroys natural enemies.
- c) Quarantine, carefully inspect and treat planting material that is to be introduced from other farms.
- d) Dispose of any infected plants.

Control

The first rule of successfully ridding plants of mealy bugs (or any pest for that matter) is to detect and act upon them early. It's far easier to control a small infestation than to eradicate a full-blown attack. Inspect your plants regularly to ensure early detection.

- a) **The water cure:** Isolate the infected plants. Spray as strong a stream of water as the plant can bear. This will dislodge most of the bugs. Kill dislodged bugs, if not already dead. For this to be effective, repeat on a daily basis until the mealy bugs are gone.
- b) **Sanitation and cultural control:** It is a good practice to keep your garden clean and void of old and unwanted material. Dead leaves and prunings should be removed as these may have mealy bugs or their eggs on them.
- c) **Control ants:** Ants protect mealy bugs from predators because they feed on the honeydew that mealy bugs produce.

- d) **Organic insecticidal soap:** Buy an organic insecticidal soap which utilizes the power of potassium salts of fatty acids that works by weakening the insect's waxy protective outer shell and spray on infestations. These soaps are generally safe to use on vegetables but always check the label.
- e) **Rubbing alcohol method:** Spot treat mealy bug infestations with a cotton ball dipped in rubbing alcohol. Simply dab the critters and rub them away. The alcohol strips away the waxy coating leaving the mealy bugs exposed.
- f) **Organic dishwashing liquid:** Any soap will effectively suffocate the mealy bugs as the soap coats the bug and also breaks down their protective waxy layer. Just mix the dishwashing soap in water and spray on infestations.
- g) **Neem oil:** Neem oil derived from the neem tree has insecticidal properties in addition to being a fungicide and having systemic benefits.
- h) **Kitchen insect spray:** Combine 1 garlic bulb, 1 small onion and 1 teaspoon of cayenne pepper in a blender. Mix into 1 quart of water and allow it to infuse for an hour. Strain through a cheesecloth and add a tablespoon of organic soap and mix well and spray!
- i) **Beneficial insects:** Beneficial insects and parasites are considered the best long-term solution for mealy bug infestations. Ladybirds, lacewings and hover flies kill mealy bugs. Parasitic wasps (*Leptomastix dactylopii*) parasitize mealy bug eggs and are an effective method of controlling infestations. There is also a commercially available mealy bug predator known as the 'mealy bug destroyer', which is a small dark brown ladybug (*Cryptolaemus montrouzieri*) whose preferred food happen to be all the stages of mealy bugs.
- j) Mealybugs can be controlled using the fungus [*Lecanicillium lecanii*](#).
- k) Diazinon can be used, but often requires multiple applications.
- l) Spray Malathion at 30ml in 15L of water or Suncloprid at 3.75 to 7.5ml/15L of water or Bifenthrin at 14 to 18ml/15L of water or Diazinon at 56 ml/15L of water.
Spray must be applied to all parts of the plant and the surrounding plants too.

Ladybird feeding on mealy bugs



<http://www.3.bp.blogspot.com>

DISEASES

heart rot



root rot



Source: <http://www.plantvillage.com>

There are many diseases of pineapple grown around the world but the three main diseases in Fiji are:

1. Phytophthora heart (top) rot

This is a fungal disease caused by the oomycete *Phytophthora cinnamomi* and *Phytophthora nicotianae*. Infection is related to excess water in the soil which affects plants of all ages especially three to four month old crown plantings. Fruiting plants or suckers on ratoon plants may be affected.

Symptoms

- a) The colour of the heart leaves changes to yellow or light coppery brown.
- b) Later, the heart leaves wilt (causing the leaf edges to roll under), turn brown and eventually die.
- c) Once symptoms become visible, young leaves are easily pulled from the plant.
- d) The white tissue at the base of the leaves becomes water-soaked and rotten with a foul smell due to the invasion of secondary organisms.
- e) The growing point of the stem becomes yellowish-brown with a dark line between healthy and diseased areas.

**Prevention**

- a) Ensure good drainage of the plantation with water table at least 60 cm from the soil surface.
- b) Use disease free planting material.
- c) Treat planting material prior to planting.

Control

- a) Carefully remove all infected plant parts and burn.
- b) Spray fungicide Sundomil at a rate of 50g/15L of water
- c) Dip the planting material in fungicide before planting like:
Dithane M-45 at 22g/15L of water or Apply Benomyl at 10g/15L of water (Sold as Benlate)

2. Phytophthora root rot

This is a fungal disease caused by the oomycete *Phytophthora cinnamomi*. Infection is related to excess water in the soil which affects plants of all ages.

Symptoms

- a) Leaves change from a healthy green to shades of red and yellow.
- b) Leaf tips and margins become necrotic.
- c) Roots die so plants are easy to pull out of the soil
- d) Fruit small and unmarketable

**Prevention**

- a) Ensure good drainage of the plantation with water table at least 60 cm from the soil surface.
- b) Use disease free planting material.
- c) Treat planting material prior to planting.

Control

- a) Carefully remove all infected plant parts and burn.
- b) Spray fungicide Sundomil at a rate of 50g/15L of water
- c) Dip the planting material in fungicide before planting like:
Dithane M-45 at 22g/15L of water or Apply Benomyl at 10g/15L of water (Sold as Benlate)

3. Sun burn: During summer months it is necessary to protect the fruit from the scorching sun.

Discuss the management of a pineapple crop.



A pineapple crop is cared for from planting until it is ready for harvesting. This care requires knowledge and skills in; detecting nutrient requirements, selecting and applying fertilizing materials; identifying, judging the economic threshold level and controlling weeds, pests and diseases.



Explain why farmers use push-pull hoes to control weeds in pineapple crops?

LESSON 10 HARVESTING PINEAPPLES

LESSON OUTCOME

At the end of this lesson the student will discuss the harvesting of pineapples.



Pineapple crops are ready for harvest once the fruit have matured. For fruit which were formed in response to hormones, harvest 5 months after the application.

Harvesting must be timed correctly because:

- harvesting too early results in a larger percentage of fruit that cannot be sold or used since pineapples do not ripen once harvested.
- harvesting too late leads to excessive losses and fruit rotting.

Signs of maturity:

1. Pineapple requires 105 to 130 days from flowering to maturity.
2. The colour of the lower 2/3 portion of fruit turns green yellow.
3. The eyes on the fruit become smooth or flat and they bulge on the sides.
4. The eye bracts become loose and turn brown in colour.

Toxicity of the un-ripened flesh of the pineapple is due to the enzyme bromelain which causes swelling in the throat and around the mouth. It may also lead to digestive problems such as nausea and vomiting.

Mature pineapple crop



Source: <http://www.theresnoplacelikeoz.com>

Harvesting

The stages involved in harvesting pineapple are:

CUTTING

HANDLING

STACKING

CUTTING

A sharp knife is used to sever the fruit stalk 5 to 7 cm below the base of the fruit with a clean cut



Source: <http://www.cms.cnr.edu.bt>

HANDLING

A wheel barrow is used to transport the fruit to a central location.



Source: <http://www.alamy.com>

STACKING

Fruit are brought to a central location and piled.



Source: <http://www.shramajeeviimages.com>



Discuss the harvesting of a pineapple crop.



A pineapple fruit must be harvested when it is mature because immature fruit are toxic and ripening stops as soon as the fruit is removed from the plant



Discuss the process used by farmers to harvest pineapple.

LESSON 11: POST HARVEST TREATMENT OF PINEAPPLE

LESSON OUTCOME

At the end of this lesson the student will discuss the post-harvest treatment of pineapple.

1. GRADING:

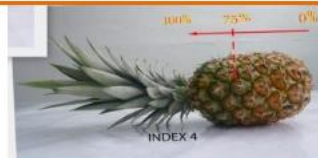
Index 1

Suitable for fresh export which take 7-20 days transit time.



Index 4

Still Suitable for fresh domestic market.



Index 2

Suitable for fresh export purpose (<7 days transit time) and domestic market.



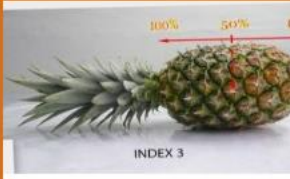
Index 5

Too matured to be traded for fresh but still good for juice production.



Index 3

Suitable for fresh domestic market and great for immediate consumption.



Source: Adapted from <http://www.1.bp.blogspot.com>

2. STORAGE

Pineapple should be eaten or processed as soon as possible after it is harvested.

If it is to be stored, the Optimum Temperature is 10-13°C for partially-ripe pineapples and 7-10°C for ripe pineapples. The Optimum Relative Humidity is 85-90%



Explain why pineapples are graded.



Pineapples are graded and stored in preparation for marketing.



Distinguish between optimum temperature and optimum relative humidity.

LESSON 12: USE OF PRODUCTS AND BY-PRODUCTS OF PINEAPPLE.

LESSON OUTCOME

At the end of this lesson the student will discuss the use of the products and by-products of pineapple crops.



The main product of a pineapple crop is the fruit, 20 million tons of which was produced worldwide in 2013.

The fruit is:

- i) eaten fresh.
- ii) made into juice.
- iii) processed [slices or pieces in syrup, crystallized pieces, juice, jam, liquor, fermented drink, vinegar and brandy.
- iv) used as an ingredient and flavouring in other dishes.

Eaten fresh	Juice	Jam	Vinegar
			
previews.123rf.com	gyros2grill.com	tarladalal.com	images.wisegeek.com

The by-products include:

1. Bromelain:

The proteolytic enzyme, bromelain, is derived from pineapple juice and the mature plant stems left after fruit are harvested.

The enzyme is used for:

a) tenderizing meat.	e) tanning leather.
b) chill proofing beer.	f) anti-inflammatory action after surgery.
c) increasing the solubility of gelatine	g) reducing swellings in cases of physical injuries.
d) stabilizing latex paints	

2. Fiber:

Pineapple leaves yield a strong, white, silky fibre which is:

- a) weaved into coarse textiles resembling grass cloth in China.
- b) prized by shoemakers in India.
- c) used for stringing jewels in Africa.
- d) made into capes and caps worn by tribal chiefs in Africa.
- e) used to make fine casting nets in Guam.

3. Juice:

Pineapple juice is used as a cleaning agent for knife blades and, with sand, for scrubbing boat decks.

4. Animal Feed:

- Pineapple crowns are sometimes fed to horses.
- Final pineapple waste from the processing factories may be dehydrated as "bran" and fed to cattle, pigs and chickens.
- Crop residues can be processed as silage for maintaining cattle when other feed is scarce. The silage is low in protein and high in fibre and is best mixed with urea, molasses and water to improve its nutritional value.

5. Folk Medicine:

- Pineapple juice is taken as a diuretic, as a gargle in cases of sore throat and as an antidote for seasickness.
- The flesh of very young (toxic) fruits is deliberately ingested to expel intestinal worms and as a drastic treatment for venereal diseases.
- In Africa the dried, powdered root is a remedy for oedema.
- The crushed rind is applied on fractures.
- The rind decoction with rosemary is applied on haemorrhoids.
- Indians in Panama use the leaf juice as a purgative, emmenagogue and vermifuge.

6. Ornamental Value

The pineapple fruit with crown intact is often used as a decoration and there are variegated forms of the plant universally grown for their showiness indoors or out.

Pineapple juice used to tenderise meat	Fabric made of Pineapple fibre	Guam casting nets made of pineapple fibre	Ornamental arrangement
			
cdn.instructables.com	dbathis.com	g02.a.alicdn.com	history.org



List six uses of pineapple and its by-products.



Pineapple fruit is used for many culinary reasons. There are uses for nearly every part of the remaining plant.



Discuss the possible enterprises which can be developed to use the by-products of the fresh pineapple industry.

WATERMELON

LESSON 1: OVERVIEW OF WATERMELON

LESSON OUTCOME

At the end of this lesson the students will discuss the origin of watermelon.

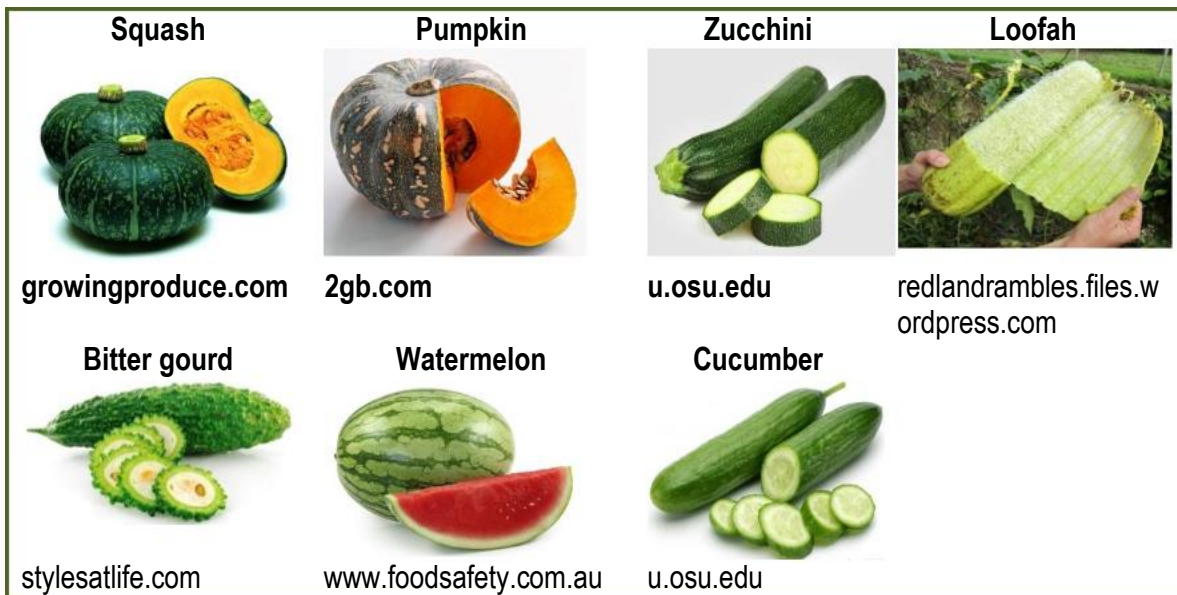


Citrullus lanatus - Scientific name of watermelon



Watermelon, *Citrullus lanatus*, is a vine-like tropical plant which produces edible fruit also called watermelon. It belongs to the Cucurbitaceae family which comprises 975 species including:

- *Cucurbita* – squash, pumpkin, zucchini, some gourds
- *Lagenaria* – mostly inedible gourds
- *Citrullus* – watermelon (*C. lanatus*, *C. colocynthis*) and others
- *Cucumis* – cucumber (*C. sativus*), various melons
- *Luffa* – the common name is also luffa, sometimes spelled loofah (when fully ripened, two species of this fibrous fruit are the source of the loofah scrubbing sponge)
-



Native to Southern Africa, the watermelon has spread throughout the tropical and subtropical world. The first recorded watermelon harvest occurred nearly 5,000 years ago in the Nile Valley of Egypt and is depicted in Egyptian hieroglyphics on walls of their ancient buildings with seeds found in the tomb of the Egyptian Pharaoh Tutankhamen dating back to 1341 BC.

Captain James Cook is believed to have introduced watermelon to the South Pacific and over the past 100 years, the watermelon has become one of the leading commercial fruit crops of the tropics

LESSON 2: SITE SELECTION FOR WATERMELON

LESSON OUTCOME

At the end of this lesson the student will discuss the factors to consider when selecting a site to cultivate watermelon.



Watermelon is a crop adapted to tropical and sub-tropical conditions.

1. The optimum **air temperature** is 32°C during the day and 20°C at night for the whole growing period. Temperatures below or above this range affect the sugar content and hence the fruit quality. To produce sweet fruit a watermelon plant requires direct sunlight. During periods of intense sunlight and high temperature (above about 35°C), fruit is susceptible to sunburn damage, so are partially covered with the plant leaves. For non-irrigated crops, rainfall should be well distributed throughout the year and more than 750 mm per year.
2. Watermelon can grow on a wide range of soils but:
 - a) a non-compacted, well aerated and free draining loam textured soil is preferred.
 - b) optimum soil pH is 6 to 6.8 .
 - c) soil with high decomposed organic matter content is favourable.
3. Water
The crop responds to the water content of soil.
 - a) Moist [not waterlogged] soil is recommended from sowing of seeds to the setting of fruit.
 - b) Excess water causes the fruit to crack.
4. Proximity to markets, transport and labour
Proximity to markets, transport routes and urban areas will help reduce the costs of transport, supporting services and infrastructure, and make management easier. Availability of suitable and reliable labour is important and can be difficult to source, especially for planting and harvesting, which involve physically demanding work.

Watermelon crop



Source://www.agrifarming.in



Explain why your school compound is either suitable or unsuitable for watermelon production.



Watermelon favour areas with temperature fluctuations between 20 and 32 °C; slightly alkaline free draining soils.



Discuss a suitable site to establish a commercial watermelon farm.

LESSON 3: VARIETIES OF WATERMELON

LESSON OUTCOME

At the end of this lesson the student will discuss the criteria used for the choice of watermelon varieties by consumers, discuss the four main classes of watermelon varieties and name the watermelon varieties cultivated in Fiji.



Rind - the outer protective layer of a fruit or vegetable which is also called the skin or peel.



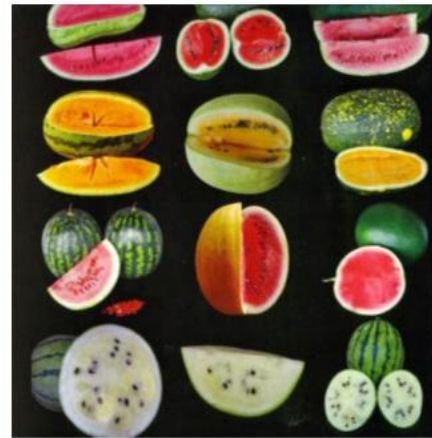
Customers use the following criteria to choose watermelon fruit:

- i. size
- ii. weight
- iii. flesh colour
- iv. flavour
- v. shell [skin] colour- yellow patch only where watermelon touched the soil.
- vi. shelf life – uncut fruit should have a shelf life at room temperature of at least 10 days after purchase.
- vii. general appearance- clean and waxy

Some watermelon types have:

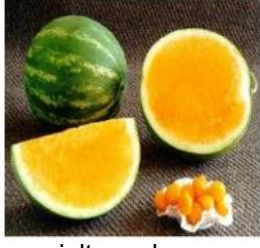
- a) higher sugar content and are sweeter;
- b) different coloured rind and flesh. Most of us are familiar with the oblong dark green watermelon with vibrant ruby red pulp, but melons may also be round, with flesh of light pink, yellow, orange or even white.
- c) different size from between 1 and 90 kilograms.

Some watermelon varieties



<http://www.4.bp.blogspot.com>

There are four basic types of varieties of watermelon:

	Seedless	Picnic	Icebox	Yellow/orange
Special feature	under developed white seeds which can be eaten.	traditional large oblong or round melons with a green rind and sweet, red flesh.	small fruit with sweet pulped flesh.	round to oblong in shape with orange to white flesh
Example	Queen of Hearts  http://www.copal.es	Charleston Grey  croom4203.files.wordpress.com	Sugar Baby  earlsorganic.com	Tender Gold  specialtyproduce.com

Fiji's main commercially grown watermelon varieties are Charleston Grey, Sugar Baby, Sugar Delicata, Farmers Giant and Empire No 2.



Describe the characteristics which you look for when buying watermelon to eat.



There are more than 200 recorded varieties of watermelon which are classified into 4 basic types: Seedless, Picnic, icebox and yellow/orange.

The main varieties cultivated in Fiji are Charleston Grey, Sugar Baby, Sugar Delicata, Farmers Giant and Empire No 2.



Compare the Charleston Grey and Sugar baby varieties of watermelon.

LESSON 4: WATERMELON PLANTING MATERIAL

LESSON OUTCOME

At the end of this lesson the student will discuss the types and preparation of the planting material of watermelon.



In Fiji, most farmers grow watermelon from seeds. These seeds are either direct seeded or transplanted.

However, stem cuttings can also be used.

Seeds	Seedlings
	
moonbattery.com	rowaytongardeners.org

Choosing planting material:

When selecting planting material the farmer must ensure that the planting material is:

1. from a pest and disease free source
2. dark brown or black
3. proven to have 80% germination rate [farmers conduct the test themselves]
4. free from inert matter [impurities and weed seeds]
5. firm and full, so sink when placed in water.

Preparing your own planting material:

- 1) mature watermelons should be cut open and the mature seeds removed.
- 2) the watermelon pulp is cleaned off the seeds.
- 3) the seeds are tapped dry and allowed to dry in a shady, windy place.
- 4) the seeds are then placed in an airtight container until needed.
- 5) the container of seeds may be stored in the refrigerator or in a cool, dry area until needed.
- 6) seeds should last for up to 1 year.

4 to 5 kg of watermelon seeds are needed to plant 1 hectare.



Why do farmers seldom use stem cuttings when planting watermelon?



Although farmers use seedlings and stem cuttings to propagate watermelon, seeds are the favoured planting material.



Differentiate among the three planting material which can be used to propagate watermelon.

LESSON 5: SOIL PREPARATION and PLANTING

LESSON OUTCOME

At the end of this lesson the student will discuss the preparation of soil for the cultivation of watermelons.



In Fiji, watermelons are grown on level land and hillsides.

The land is well tilled using either plough and harrow or digging forks.

To ensure that waterlogging does not become a problem during the fruit development stage, watermelon is planted on:

1	Mounds  wjfarm.files.wordpress.com	i. mounds are spaced 1.5 meters apart. ii. a shovel full of compost or poultry manure is mixed into the soil of each mound. iii. seeds are sown 4 cm deep iv. 3 seeds are sown per mound.
2	Ridges  gardenlovetoknow.com	i. ridges are spaced 3 meters apart and plants are planted 1 m apart along the ridge. ii. compost or poultry manure is spread along each ridge and mixed well into the soil. iii. seeds are sown 4 cm deep iv. 3 seeds are sown per drill

Seeds take 6 days to germinate.

Seeds can also be propagated in containers and planted out on the mounds. Care must be taken not to expose the roots during transplanting.

Planting Time: The best time to plant is in the cool season (April to September) however phase planting is recommended for year round production.



Sketch of the spacing layout of a row of watermelon propagated on a ridge.



In Fiji, watermelon plants are grown on mounds or ridges on both flat land and gentle slopes.



Compare the advantages and disadvantages of the methods used for preparing soil for the cultivation of watermelon.

LESSON 9: CROP CARE

LESSON OUTCOME

At the end of this lesson the student will discuss the management practices involved in the care of a watermelon crop.



Thinning

-the removal of some plants, or parts of plants, to make room for the growth of others.



Watermelons take from 70 to 120 days from planting to harvesting, depending on the variety.

During the growing period farmers carry out husbandry practices to help the crop grow to its potential. This care includes the application of fertilizing material, thinning, weed control, pest control, disease control and water control.

FERTILIZING MATERIALS

Compost



blog.midwestbiosystems.co

Superphosphate



Source:

china-ogpe.com

Urea



It is recommended that fertilizer should be applied at the following stages of watermelon development:

- 1) at soil preparation, 10 tonnes per hectare of organic fertilizers like compost or poultry manure are tilled into the soil.
- 2) at planting, Superphosphate [NPK 13:13:21] is basally applied at 200 kg/ha
- 3) 2 and 4 weeks after planting, Urea is side dressed at 100 kg/ha.

THINNING

Before thinning



After thinning



Sometimes all the seeds which are sown germinate, leading to competition. To minimise the competition, thinning is carried out where the strongest seedling is retained while the others are cut away.

<http://3.bp.blogspot.com>

PRUNING

Unpruned vine



<http://3.bp.blogspot.com>

Pruned vine



Vine and fruit pruning is practiced to obtain greater uniformity of size and shape of fruit. This is done by selecting 2 or 3 best fruit per plant after fruit set and cutting the rest of the fruit off the vine.

Some farmers argue that pruning leaves and vines decreases the sweetness of the fruit as more leaves mean more photosynthesis.

WEEDS

Koster's Curse



nus.edu.sg

Nutgrass



goodmanslandscape.com

Watermelons are vine-like scramblers and trailers which spread along the soil surface. Care must be taken when controlling weeds to avoid damaging the roots and stem

Weeds are controlled:

1. Before planting

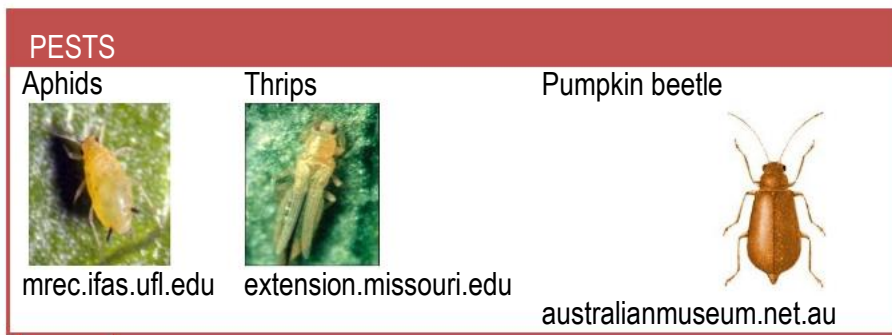
Land preparation should start 3–4 weeks before planting. Turning, pulverising and forming soil mounds and ridges destroys weeds and remaining stubble from the previous crop, however weed seeds and underground storage organs may remain viable. Therefore, weeds should be allowed to emerge and grow for at least two weeks between tillage operations, especially primary tillage. This reduces the number of weed seeds remaining in the soil and future weed problems.

2. During the establishment of plants

Weeds remaining in the soil of the beds will grow while the watermelon planting material is beginning to grow. Weed control is essential at this stage to reduce competition. Soil is mulched with black plastic or grass clippings. Slugs may be a problem for watermelon seedlings.

3. For the remaining growing period

Any weeds which survived would have emerged by now so need to be controlled by manual weeding using a hoe.



2. Aphids

These tiny soft-bodied insects of the family *Aphididae* are distributed throughout the world. They suck the sap from the stems and leaves of plants and reproduce rapidly so some develop wings when overcrowding occurs.

Some vegetable hosts include asparagus, bean, beet, cowpea, cucurbits, eggplant, okra, spinach, and tomato.

Honeydew secreted by aphids makes plants sticky and enhances development of black sooty mould on plant foliage.



Symptoms

- aphids congregate on lower leaf surfaces and terminal buds.
- aphids pierce plants with their needle-like mouthparts and extract sap
- leaves curl downward.
- wilting and discoloration follow.
- aphid damage weakens plants and may reduce fruit quality and quantity.
- excretion of honeydew dirties fruit and leaves, and is also a medium for the growth of black sooty mould on plant leaves. This affects photosynthesis.
- injection of toxic substances cause crop damage.
- plant growth is halted.
- Aphids can also transmit and spread viruses.

Prevention

- Remove weeds and host plants from the field and surrounding areas.
- Avoid indiscriminate insecticide use because it destroys natural enemies.
- Dispose of any infected plants.

Control

The first rule of successfully ridding plants of aphids (or any pest for that matter) is to detect and act upon them early. It's far easier to control a small infestation than to eradicate a full-blown attack. Inspect your plants regularly to ensure early detection.

Biological control

- Predators such as lady beetles and their larvae reduce aphid populations.
- Damp weather promotes fungal diseases
- Hard, driving rain tends to kill large numbers of aphids.

Cultural practices

- d) Planting in a well-prepared, fertile seedbed helps produce a vigorous crop better able to withstand aphid attack.
- e) The seedbed should not be located near an aphid-infested crop or on land from which an aphid-infested crop has recently been removed.

Chemical control

Insecticides should be applied when it becomes evident that natural and cultural controls are not keeping aphids in check.

- a) Dimethioate (sold as Rogor) is sprayed at a rate of 15 ml in 15 litres of water
- b) Sunclopid is sprayed at a rate of 7.5 ml in 15 litres of water
- c) Bifenthrin is sprayed at a rate of 16 ml in 15 litres of water

3. Thrips

6,000 species of these minute black winged insect with fringed wings are distributed throughout the world. Both nymphs and adults suck sap from leaves, stems, flowers and fruit. They are normally found in large numbers in the cracks present on fruit and can be a serious pest of ornamental and food plants when present in large numbers.

Some vegetable hosts include asparagus, bean, beet, cowpea, cucurbits, eggplant, okra, spinach, and tomato.



Symptoms

- a) direct feeding on plant sap caused dehydration
- b) excretion of honeydew dirties fruit and leaves, and is also a medium for the growth of fungus.
- c) injection of toxic substances cause crop damage
- d) plant growth is halted and leaves become curled.

Prevention

- a) Remove the alternative host plants.
- b) Infested crops should be destroyed immediately after harvest to prevent dispersal of thrips.
- c) Mulching would check the damage at the early stage of the plant.
- d) Setting up of blue sticky traps in the field will check the thrips population.

Control

The first rule of successfully ridding plants of thrips (or any pest for that matter) is to detect and act upon them early. It's far easier to control a small infestation than to eradicate a full-blown attack. Inspect your plants regularly to ensure early detection.

Cultural practices

- a) Remove alternative host plants.
- b) Infested crops should be destroyed immediately after harvest to prevent dispersal of thrips.
- c) Mulching would check the damage at the early stage of the plant
- d) Planting in a well-prepared, fertile seedbed helps produce a vigorous crop better able to withstand thrip attack.
- e) The seedbed should not be located near a thrip-infested crop.

Chemical control

Insecticides should be applied when it becomes evident that natural and cultural controls are not keeping thrips in check.

- h) Avoid indiscriminate insecticide use because it destroys natural enemies
- i) Spraying of the following chemicals at 30, 45 and 60 days after sowing:
 - 1) Confidor at 5 ml in 15 l litres of water
 - 2) Sunclopid at 7.5 ml in 15 litres of water
 - 3) Bifenthrin at 14 ml in 15 litres of water.

4. Pumpkin beetle

There are two types of pumpkin beetles which can cause damage to cucurbit crops. They are of similar size (6–7 mm) and colour (yellow/orange).

- a) Pumpkin beetle - (*Aulacophora hilaris*)
 - has four large black spots on the back.
- b) Plain pumpkin beetle (*Aulacophora abdominalis*)
 - does not have black spots.

The adults lay their eggs into the soil amongst the roots of the plants where, once hatched, the creamy white larvae will feed until they pupate and emerge as adults that then feed on the leaves and roots of plants.

Pumpkin beetles
Aulacophora hilaris



media.bowerbird.org.au

Aulacophora abdominalis



ces.csiro.au

Symptoms

- a) Large holes on leaves where adults have fed
- b) Removal of all soft tissue of leaves with only veins remaining
- c) Total defoliation of seedlings leading to death.

Prevention

- a) Remove the alternative host plants.
- b) Infested crops should be destroyed immediately after harvest to prevent dispersal of beetles.
- c) Till soil after harvesting to disrupt the life cycle of beetles.

Control

The first rule of successfully ridding plants of pumpkin beetles (or any pest for that matter) is to detect and act upon them early. It's far easier to control a small infestation than to eradicate a full-blown attack. Inspect your plants regularly to ensure early detection.

Insecticides should be applied when it becomes evident that natural and cultural controls are not keeping beetles in check.

- a) Avoid indiscriminate insecticide use because it destroys natural enemies
- b) Spraying of the crop with Melathion at a rate of 30 ml in 15 litres of water.

DISEASES	
Powdery mildew  http://www.aggie-horticulture.tamu.edu	Gummy Blight  http://www.daf.qld.gov.au
Anthrachnose  http://www.ipm.uconn.edu	Blossom End Rot  http://www.uaex.edu

There are many diseases of watermelon grown around the world but the four main diseases in Fiji are:

1. POWDERY MILDEW

A disease caused by fungi called *Sphaerotheca fuliginea* and *Erysiphe cichoracearum* which favours high humidity.

Symptoms

- a white to grey dusty material forms on the upper leaf surface.
- the fungus quickly spreads to completely cover the leaf surface.
- Once the leaf is covered, it dies and has a crisp texture.
- It tends to occur on older leaves and later in the growing season, so control is not usually warranted.

Prevention

- Ensure good drainage of the plantation with water table at least 60 cm from the soil surface.
 - Use disease free planting material.
- Treat planting material with Benomyl at 10g/15L of water (Sold as Benlate)

Control

The fungus is best controlled with fungicide applications when symptoms are first observed.
Apply Benomyl at 10g/15L of water (Sold as Benlate)



2. GUMMY BLIGHT

A disease caused by the fungus called *Didymella bryoniae* which affects all parts of the host including leaves, stems and fruit.

Symptoms

- Early symptoms are round black, wrinkled spots on young leaves and dark sunken areas on stems.
- Infected seedlings will have lesions on the stem.
- On older leaves in the field, irregular brown to black spots develop and expand between leaf veins and eventually result in the death of leaves.
- As the disease progresses, older stems near the crown, most commonly near a leaf petiole or tendril, split and a light brown gum oozes from the water soaked areas
- Infected runners die, leaving fruit exposed.

Prevention

- Crop rotation with a non-related crop.
- Early infection usually develops from contaminated seed so seeds are to be treated with Belate.
- Ensure good drainage of the plantation with water table at least 60 cm from the soil surface.
- Use disease free planting material.

Control

- Carefully remove all infected plant parts and burn.
- Spray fungicide Antracol at a rate of 30 ml in 15 litres of water.



3. ANTHRACNOSE

A disease caused by the fungus *Colletotrichum orbiculare* which affects all above ground plant parts, including the fruit. Spores require 24 hours of 100% relative humidity to infect, and infection is greatest when temperatures are between 30 and 35 C. The fungus survives in fields on crop residue and also can be spread from seed obtained from infected fruit.

Symptoms

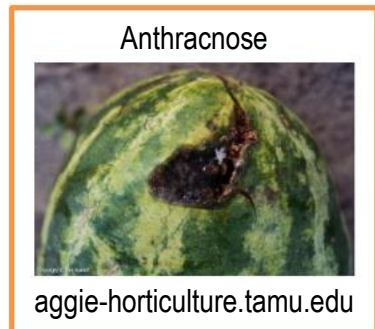
- Initial symptoms show up 4 days after infection.
- The disease starts as small circular lesions on leaves.
 - Lesions gradually expand into large tan or brown spots that can fall out from the leaf or crack with age.
 - Foliar lesions also tend to follow leaf veins with dark sunken areas on stems.
 - On fruit, lesions can grow to several centimetres in diameter, and often are cracked.
 - Under periods of high humidity, masses of pink gooey spores can be seen in and on fruit lesions.

Prevention

- Crop rotation with a non-related crop.
- Early infection usually develops from contaminated seed so seeds are to be treated with Belate.
- Ensure good drainage of the plantation with water table at least 60 cm from the soil surface.
- Use disease free planting material.

Control

- Carefully remove all infected plant parts and burn.
- Spray fungicide Antracol at a rate of 30 ml in 15 litres of water at a 7 to 10 day interval during periods of humid and rainy weather.



4. BLOSSOM END ROT

A disease caused by a lack of calcium in the developing fruit of watermelon, tomato and pepper. This may be due to a lack of calcium uptake from the soil or to extreme fluctuations in water supply. Incidence of blossom-end rot is also increased where there is a low ratio of calcium to certain other nutrients such as potassium and nitrogen.

Symptoms

- The first symptom is a slight water-soaked area on or near the blossom end of the fruit.
- The affected area soon darkens and enlarges in a constantly widening circle until the fruit begins to ripen.
- The tissues are dark and shrunk and have a dry, leathery appearance.
- The affected area may be merely a speck or it may involve half or more of the fruit
- Secondary microorganisms may grow on the decayed area.



Prevention

Test soil pH before planting and apply liming materials to achieve a pH reading of between 6 and 6.8 to ensure the availability of the Calcium needed during the flowering and fruiting stages of watermelon.

Control

- regulate moisture supply in the soil.
- cultivation and hoeing should be shallow to avoid root damage.
- mulching, which serves to maintain an even supply of soil moisture, should be practiced where feasible.
- if irrigation of any kind can be used, it may prove profitable during hot, dry weather.



Discuss the management of a watermelon crop.



A watermelon crop is cared for from planting until it is ready for harvesting.

This care requires knowledge and skills in;

Detecting nutrient requirements, selecting and applying fertilizing materials; thinning seedlings; identifying, judging the economic threshold level and controlling weeds, pests and diseases.



Explain why farmers prune the young watermelon fruit leaving only a few fruit per vine.

LESSON 10 HARVESTING WATERMELONS

LESSON OUTCOME

At the end of this lesson the student will discuss the harvesting of watermelons.



Watermelon crops are ready for harvest once the fruit have matured.

A vine may have fruit of different ages so a farmer may find one fruit ready for harvesting while others are still immature.

Signs of maturity:

1. it takes from 70 to 120 days from planting to harvest, depending on the watermelon variety.
2. the vine's tendrils begin to turn brown and die.
3. some varieties develop a circular crack around the stem while others soften at the blossom end.
4. if one side of the watermelon was resting on the ground, it will go from white to yellow.
5. tap the melon with your flat hand. If the sound is deep and thick you probably have found a ripe and sweet fruit.
6. as you see some of the signs emerging, irrigate the plant with lime water for the last week before harvesting to concentrate sweetness.

Harvesting

Below are the stages involved in harvesting watermelon.

CUTTING**HANDLING****STACKING****CUTTING**

A sharp knife is used to sever the fruit stalk 5 to 7cm from the base of the fruit with a clean cut.



<http://filmnorthflorida.com>

HANDLING

A wheel barrow is used to transport the fruit to a central location.



<http://www.sitemaker.rcstn.net>

STACKING

Fruit is piled in the shade.



<http://static1.squarespace.com>

Mature watermelon



fifteenspatulas.com

Tapping watermelon



i0.wp.com



Discuss harvesting of a watermelon crop.



A watermelon fruit is harvested when it is mature and placed in a cool site to avoid cracking from heat.



Discuss the process used by farmers to harvest watermelon.

LESSON 11: POST HARVEST TREATMENT OF WATERMELON

LESSON OUTCOME

At the end of this lesson the student will discuss the post-harvest treatment of watermelon.



According to Guinness World Records, the world's heaviest watermelon was grown by Chris Kent of Sevierville, Tennessee in 2013 and weighed 122 kg.

Watermelon is a fruit that:

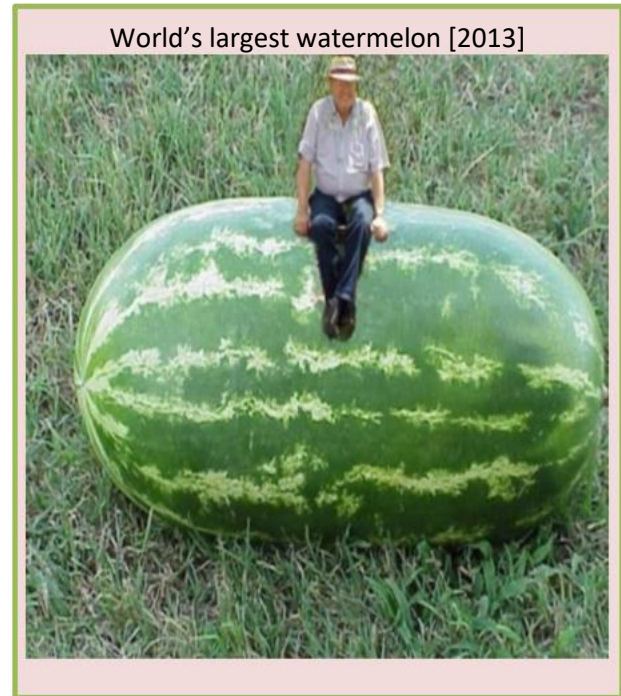
- i. is sensitive to temperature
- ii. once harvested the sugar content or sweetness will not improve.

Fruit can get over-ripe fairly quickly if not cooled.

- a) watermelon should be cooled to between 12-15 °C within 24 hours of harvesting, if
- b) watermelon is stored for 2-3 weeks if stored at between 12 – 15 °C.
- c) temperatures below 10 °C can result in chilling injury to the fruit (pitting of the skin, flesh breakdown and blackrot).

Watermelon colour will:

- a) continue to improve for up to 7 days after harvesting if kept at temperatures of 18-22 °C.
- b) fade (get lighter) if kept at temperatures of below 12 °C for long periods of time.



After picking, watermelons will keep in the refrigerator for up to a week, but they will last two to three weeks before cutting, without refrigeration, if kept in a cool, slightly moist place.

Therefore keep the watermelon shaded to ensure it is cool so that it lasts for longer.



Explain why harvested watermelons are cooled.



Once harvested the sugar content of watermelon will not improve but shelf life can be extended by cooling of the fruit.



Discuss why harvested watermelon should be kept shaded.

LESSON 12: USE OF PRODUCTS AND BY-PRODUCTS OF WATERMELONS

LESSON OUTCOME

At the end of this lesson the student will discuss the use of the products and by-products of watermelon crops.



The main product of a watermelon crop is the fruit, 18 million tons of which was produced worldwide in 2013.

The watermelon fruit is:

- i) eaten fresh,
- ii) made into juice
- iii) used for art

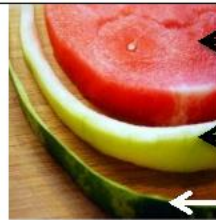
The by-products include:

1. **Seeds:** eaten either raw or cooked as a snack.

Eaten fresh	Fruit salads	Juice
		
healthyeating.sfgate.com	3.bp.blogspot.com	healthylivinghub.net

2. **Rind** - the firm white part of the fruit that's left behind after the bright pink flesh has been eaten or scooped away is used as/for:

- a) a vegetable
- ii) pickles
- iii) chutney
- iv) candy

	Flesh		
	Rind		
	Skin		
adapted from static1.1.sqspcdn.com	3.bp.blogspot.com	media.tumblr.com	

3. Ornamental Value

The watermelon fruit is often used as a bowl for serving fruit. It is also carved into intricate designs.

Bowl	Carving
	
vegetablefruitcarving.com	-media-cache-ak0.pinimg.com



List six uses of watermelon and its by-products.



Watermelon fruit is used for many culinary reasons.



Discuss the possible enterprises which can be developed to use the by-products of the watermelon industry.

STRAND AS 11.4 LIVESTOCK

SUB-STRAND 11.4.1 GENERAL



SUB-STRAND 11.4.2 GOATS



SUB-STRAND 11.4.3 SHEEP



SUB-STRAND 11.4.4 PIGS



Introduction

This strand will facilitate the exploration of the production of any two of the following livestock: goats, sheep and pigs.

Students will be introduced to general concepts relating to raising livestock then will investigate the history, importance, products and by-products of any two of the three livestock mentioned.

AS 11.4.1 GENERAL

Content Learning Outcome:

The students will explore on the livestock concepts common to sheep, pigs and goats in Fiji.

LESSON 1: BASIC REQUIREMENTS AND SYSTEMS OF PRODUCTION

LESSON OUTCOME:

At the end of this lesson the student will identify the basic systems in which goats, sheep and pigs are raised and describe how each system provides the basic requirements of these livestock.

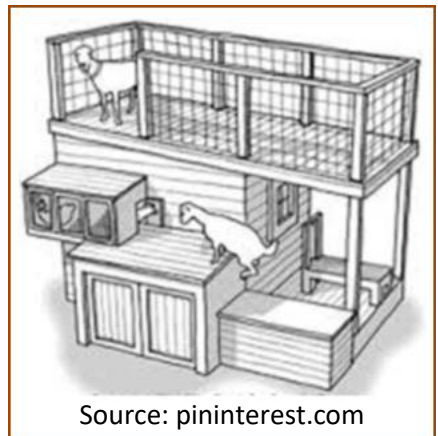
	Extensive	– where animals fend for themselves
	Semi-intensive	– where animals forage in the day and are kept in sheds at night
	Intensive	– where animals are kept in sheds and provided with all their needs
	Tethered	– where animals are tied up, moved to feed during the day and provided shelter at night.



Livestock will produce quality products when managed well as they require the following:

Basic requirements of livestock

Space - pollution, disease and pest free
 Shelter - protection from wind, rain and sunlight
 Security - safe both day and night
 Temperature control - minimise fluctuations
 Light - for feeding and security
 Water - clean and readily available
 Feed - nutritious, fresh and readily available



Most livestock are social animals which thrive when raised in groups. There are raised in 4 distinct systems under which livestock are raised in Fiji.

	Extensive	Semi-intensive	Intensive	Tethered
Area of farm	Largest [browsing or foraging]	Medium sized	Smallest	Smallest
Animals/ unit area	Low	More	Most	Lowest ≤10 animals/farm
Labour	Farmer or family member	Farmer and family members or few labourers	Farm manager and hired skilled labourers	Farm family members
Inputs used	Minimal From the farm	Medium From farm and bought	Maximum Latest recommended Mainly bought	Animals moved to feed Medications Water

	Extensive	Semi-intensive	Intensive	Tethered
Housing	Minimal or absent Classes seldom separated	Sheds for night and unsuitable weather Classes kept separated	Animals kept indoors High standard housing Kept in sheds Classes separated	Tethered in pasture during day and in safety at night
Capital invested	Low	More	Most	Low
Environment	Minimal pollution All wastes naturally recycled	More pollution Wastes recycled	Most pollution Wastes recycled	More pollution Wastes recycled on farm
Management level	Lowest	Higher	Highest	High individual animal care provided
Records kept	Few	More	Detailed	Seldom
Use of produce	Home use and occasional scales	Sales	Sales	Home use and sale
Number of farms in Fiji	Many	Many	Few	Most
Location of farms	Remote and outer islands	Areas where land is not limited	Areas where land is limited	Throughout Fiji
Tenure system	Freehold, Crown & Native land	Freehold Native land	Freehold Native land	Freehold, Crown & Native land
GOATS	 adventureinthegoodland.blog	 cremlypoi.com	 agriculturesnetwork.org	 www.geography.org.uk
SHEEP	 www.123rf.com	 bobbimela.blogspot.com	 sheepfarm.in	 judyblankenship.com
PIGS	 www.afrivip.org	 moonbeamsland.co.uk	 en.wikipedia.org	 nyerology.blogspot.com



Discuss the importance of each basic requirement of livestock



To produce to their potential, livestock require water, lights, shade/shelter, food, temperature control, security and pollution/disease/pest free space.

Livestock can be kept in extensive, semi-intensive, intensive or tethered production systems depending on the number of animals, intended use of the animals and the availability of land.



Differentiate between the four management systems used to raise livestock in Fiji.

LESSON 2: CHALLENGES & SUGGESTED SOLUTIONS.

LESSON OUTCOME

At the end of this lesson the student will discuss the challenges facing livestock farming in Fiji and evaluate suggested solutions to each challenge.

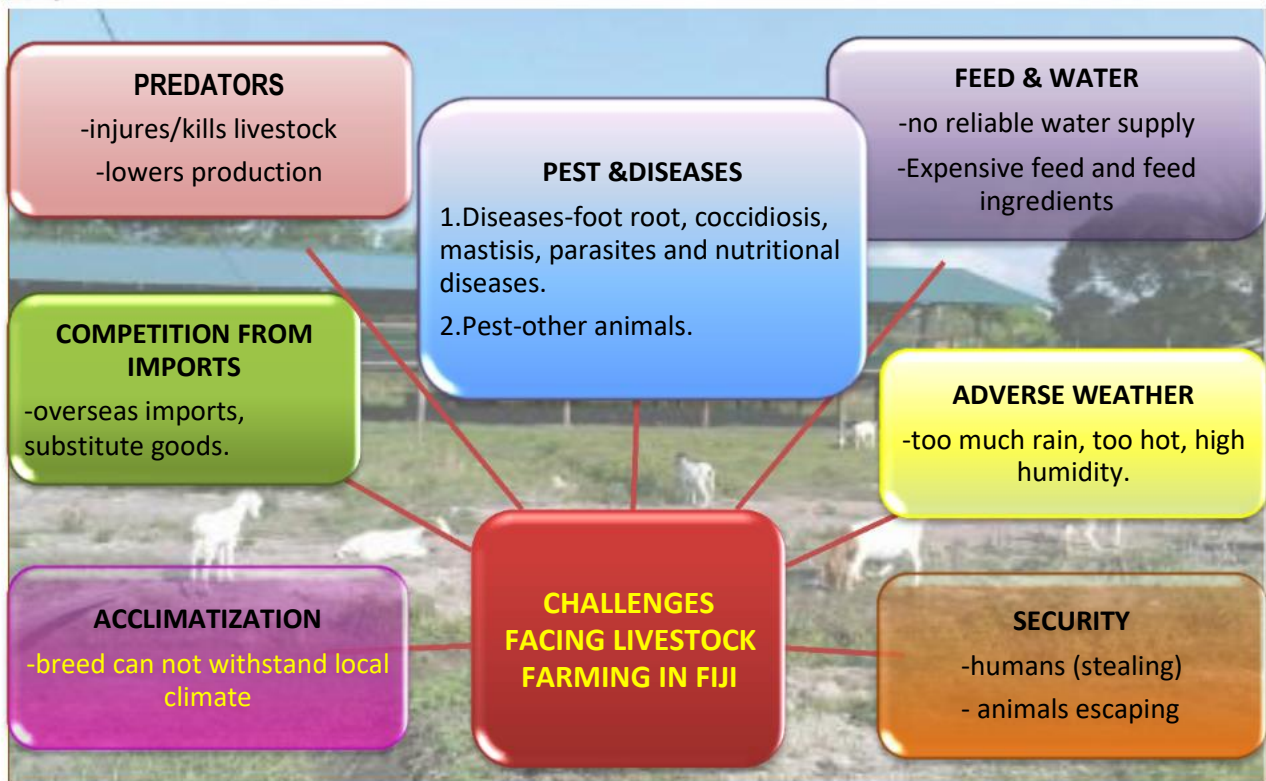


Acclimatisation – to adjust or adapt to a new climate, place, or situation.

Predators – an animal that lives by killing and eating other animals



The farming of livestock is faced with many challenges each of which is dealt with by farmers. Below are some of these challenges:



	Challenges	Solutions
1.	Acclimatization	Cross breeds to adapt to and produce well in local climatic conditions.
2	Feed	Use local feed ingredients which will lower production costs and increase efficiency.
3	Water	Have reliable water supply at all times.
4	Security	Secure sheds, locked and safe.
5	Adverse weather	Practice semi- intensive and intensive farming during the hot and wet season.
6	Competition from imports	Improving carcasses quality to satisfy consumers.
7	Diseases, predators, Pests	Minimizing visitors, frequent health check, fencing out pest.

 Discuss in groups how a farmer can solve the challenges of high feed cost and poor growth rate on a livestock farm.

 Farmers face many challenges when raising livestock. Each challenge is dealt with by the farmers and the successful methods employed are adopted as solutions.

 Discuss the challenges facing livestock farming in Fiji and recommend possible solutions.

LESSON 3: Housing Livestock

LESSON OUTCOME:

At the end of this lesson, the student will discuss the types and functions of livestock housing.

	Pen - an enclosure for confining livestock
	Drench - administer a drug in liquid form orally to an animal



Livestock housing should be dry, well ventilated and provide the animals with a healthy comfortable environment which is secure from predators.

Livestock are raised in intensive, semi-intensive and extensive systems and the housing provided usually correspond to these systems. Tethered animals are commonly raised in Fiji.



1. Intensive Housing



<https://cetfa.files.wordpress.com>

- Livestock live in sheds
 - Pasture supplied in hoppers or chaffed and mixed with concentrates
 - Classes kept separated
 - Animals docile due to contact with workers
- All husbandry practices easy to carry out.

2. Semi – Intensive Housing



<http://www.nairaland.com>

- Day time graze on fenced pastures when weather is favourable
- Night time in sheds
- Can drench if worm problem arises
- Less feed costs
- Less expensive enterprises

3. Extensive



<http://www.agridr.in>

- Animals are free ranging within a boundary or on the mountains.
- Animals are rarely provided with housing but take shelter under natural shade like trees and shrubs.
- could be affected by helminths and foot rot
- lower food conversion ratio
- lower live weight compared to intensive housing.
- Less disease problems due to area per animal.

4. Tethered animals



<http://www.slideawayhayfeeders.farmnet.com>

- Animals are taken to food source, usually pasture and browse, where they are tethered to a stake. The animals are provided with water and shade during the day and brought back to shelter near the homestead at night.
- Anti-helminths seldom a problem
- Animals well cared for
- Predator attack may be a problem because animals cannot escape

Farms also have special rooms, often called pens for housing certain livestock.

Special pens for animals			
 QUARANTINE Where new animals are kept for inspection and treatment prior to introduction to the herd.	 SICK BAY Where diseased or injured animals are kept for observation and treatment.	   Boar Pen Ram Pen Buck pen Where male breeders are kept separated from females until mating.	
 Farrowing pen	 Kidding pen	 Lambing pen	Where the dam is separated from the rest of the herd for parturition and care of the young.
WEANING PENS   			Where young are separated from the dam and allowed to eat concentrates and pasture.

Adapted from: <http://www.agridr.in>

 Visit a livestock farm near the school or choose one system of animal rearing. Discuss the advantages and disadvantages of the type of housing used on the farm.

 Despite the system used, livestock housing should be dry, well ventilated and provide a healthy comfortable environment which is secure from predators.

 Differentiate the housing provided for tethered, extensive, intensive and semi-intensive livestock animal. Discuss which method is most suitable for the area in which you live.

LESSON 4: NUTRITIONAL NEEDS

LESSON OUTCOME:

At the end of this lesson the student will discuss the nutritional needs of livestock.



Fastidious feeders	- will look for nutrients from different sources as it will only grow when specific nutrients are included in its diet.
Dermatitis	- is inflammation as well as thick, dry patches on skin
Glandular meal	- here the animal is fed with the internal organs of animals including the liver and kidney.
Pica	- depraved appetite, eating wood, rocks and bones
Hemolytic crisis	- the body cannot make enough red blood cells to replace those that are destroyed.
Lymphadenopathy	- Abnormally enlarged lymph nodes
White muscle disease	- cardiac and skeletal muscles have white spots



Livestock need a balanced diet to thrive and are fastidious feeders that can extract nutrition from a variety of sources including a wide variety of grasses, leaves, weeds and small branches of bushes and trees as well as pasture, legumes and grains. They also consume food peelings and other waste plant residues and glandular meals. Farmers also provide livestock with concentrates which contain the nutrients that are recommended for the animals.

Goats and sheep are ruminants and therefore ferment cud so are able to utilise roughage with high fibre content. They produce protein and Vitamins B and K in the rumen. Pigs on the other hand are monogastrics so need these vitamins in their feed.

Livestock require five major classes of feeds: Water, Energy, Protein, Vitamins and Minerals.

Water

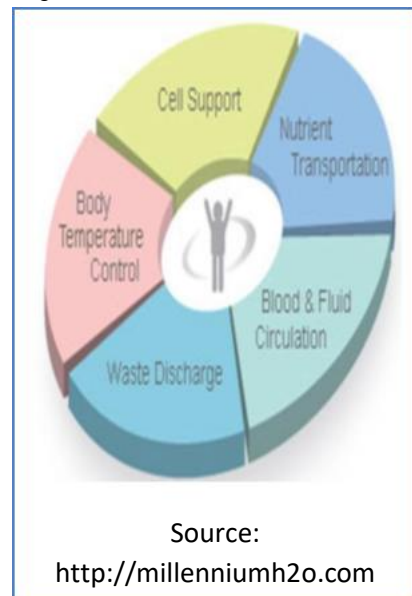
Water is needed in the body to help in the digestion of feed, regulating temperature and weight, lubricating joints and membranes, cooling the body and transporting waste from the body. It is also a factor in determining health (losing one tenth of the body's water results in death, for example).

Animals gain water from the food they eat, from oxidation of fats and proteins in the body, and from the action of drinking water from a source such as a river or stream.

Insufficient water intake will depress livestock performance earlier, and more severely, than any other dietary insufficiency.

Adequate water is the paramount management concern.

Livestock should be consuming more water if fed high protein rations. Decent water quality, not just quantity, is a must.



Energy

Energy is not considered a nutrient but can be derived from the breakdown of several nutrients, including fat, protein, and carbohydrates.

Energy is needed in the body to propel the biochemical processes that are necessary to sustain life, stay alive, carry out bodily functions, grow and produce meat, milk and young.

The major sources of energy for small ruminants is usually pasture, browses, and grains while pigs are fed vegetables, root crops and grains. However poor-quality pastures and roughage or inadequate amounts of feed are the primary causes of energy deficiency.

An energy shortage will result in weight loss, low productivity, reproductive failure, increased mortality, increased susceptibility to diseases and parasites and the ultimate death of an animal.

Protein

Protein is composed of building blocks called amino acids, which the body uses to produce all the proteins required for growth, production and maintenance.

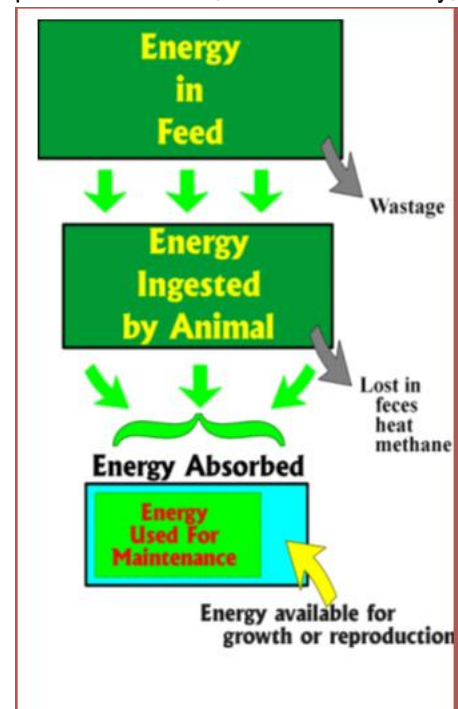
Protein is needed in the body to repair old tissues, build new tissues, produce skin and fur, wool or mohair, produce young and milk and to develop muscles which are used as meat.

In small ruminants, the amount of protein is more important than the quality of protein with the major sources of protein being legumes, fresh pasture and concentrates.

Pigs are provided with fish and meat blood and bone meal as well as nuts and legumes.

Protein deficiency is more detrimental to the young animal, so an adequate amount of protein, usually in the form of milk, must be supplied if rapid growth and high production are to be obtained.

A protein shortage will result in slow repair of old and injured tissues; poor skin and fur, wool or mohair; reduced milk and meat production and poor body condition.



Vitamins

Vitamins function as critical chemicals in the body's metabolic machinery and as cofactors in many metabolic processes.

A deficiency of a vitamin will slow or block the metabolic process in which that vitamin is involved, resulting in deficiency symptoms.

Vitamins which are fat soluble - Vitamins A, D, E and K must be provided to livestock in the diet.

Vitamin	Needed for	Deficiency symptoms	Food source
Retinol Vitamin A	- Fortifying the outer defences of the skin and mucous membranes against disease. - Vision, lactation and reproduction - Healthy teeth, skin, coats, hooves, bones, nerves, kidneys, mucus glands, and adrenal glands.	- Tearing of the eyes - Night blindness - Diarrhoea - Respiratory infection - Reproduction problems.	- Synthesized from carotene, the pigment that gives grass and hay their green color. - Other sources of vitamin A include organ meat (particularly liver), cod liver oil, egg yolks, and whole milk.
Calciferol Vitamin D	- Calcium & Phosphorus absorption - metabolism	- Rickets, lameness, weak bones and bowed and crooked legs, milk fever, osteomalacia.	- Ultraviolet light in sunshine converts pre-vitamin D found in the skin to a pro-vitamin D form that is used by the animals

Tocopherol Vitamin E	- Antioxidant - White blood cell health	- White muscle disease - Depressed immune system - Reproductive failure - Lameness, weak pulse, haemorrhaging	- Green grass - Grain oils
Phylloquinone [Vitamin K ₁] Menaquinone [Vitamin K ₂] Menadione [Vitamin K ₃]	- Clotting of blood	- Excessive bleeding	- Produced by bacteria in the digestive tract and absorbed. - Green vegetation - Fish meal

Night blindness	Rickets,	Lameness
		
http://www.editthis.info	http://3.bp.blogspot.com	www.nadis.org.uk

Vitamins which are water soluble – Vitamins B and C – are seldom stored in the animals' body but are synthesised in the rumen by microbes so are seldom deficient in goats and sheep. However, these Vitamins must be present in pig feed on a daily basis.

The main sources of these Vitamins are green leaves, fruit, cereal bran and pollards as well as fish and meat meals. Below are **some** of the uses, deficiency symptoms and sources of water soluble vitamins.

Vitamin	Needed for	Deficiency	Food source
Thiamine Vitamin B1	Coenzyme in carbohydrate metabolism	<u>DEFICIENCY SYMPTOMS</u> malaise, staggering, slow breathing, drooling, poor appetite and daily gain, often vomiting, low body temperatures and poor heart rates. Sudden death may also occur.	Cereal including pollards and brans Lentils and green vegetation
Riboflavin Vitamin B2	- assists digestion and the metabolism of energy , carbohydrate, fat and protein - tissue repair in eyes, mouth, and nervous system. - proper growth and embryo development.	<u>DEFICIENCY SYMPTOMS</u> - still births - small animals - poor development of hair, and skin and dermatitis	Fish and meat blood and bone meal
Niacin Vitamin B3	- Synthesis of fatty acids, cholesterol , carbohydrates, and amino acids. - Health of the skin, bones, joints, mucous membranes, digestive system, and central nervous system.	<u>DEFICIENCY SYMPTOMS</u> excessive salivation, anemia, weakness, dermatitis, vomiting, diarrhoea	Rice polishings, fish meal, wheat bran, and brewer's yeast

Pantothenic Acid Vitamin B5	- Release of energy from fats, proteins and carbohydrates. - Removes toxic substances from the body. - Assists in the production of hormones, the transmission of signals along the nerves, and the creation of blood cells.	<u>DEFICIENCY SYMPTOMS</u> poor health, posterior paralysis in pigs inability to fight infections	Cereal brans Poultry by-products
Pyridoxine Vitamin B6	- protein metabolism - release of glycogen from muscle and liver - over 60 enzyme reactions depend on vitamin B6. - Resisting viral infections. - regulates blood pressure, assist in the development of new blood cells, and produce neurotransmitters in the brain.	<u>DEFICIENCY SYMPTOMS</u> Impaired immune system, dental cavities, kidney stones, compulsive licking in baby pigs.	-Cereal brans and pollards -Fish and meat blood and bone meal -Milk for young -Fresh green vegetation
Biotin Vitamin B7 or Vitamin H	- carbohydrate, fat and protein metabolism and is critical for cell growth. - maintains muscles, connective tissue, nervous system, thyroid, adrenal glands, and reproductive system - helps transfer carbon dioxide out of the body	<u>DEFICIENCY SYMPTOMS</u> Dry scaly skin, cheilitis, swollen hair and painful tongue, protruding tongue	Brewer's yeast, cereal brans and pollards pollards, fish and bone meal
Inositol Sometimes called Vitamin B8	Structural component of all body tissues, with the highest concentrations in the brain and heart, lens of the eye and skeleton.	<u>DEFICIENCY SYMPTOMS</u> memory loss, eczema, alopecia, atherosclerosis	Cereal grains, fish and meat blood and bone meal
Folic acid Vitamin B9	- Haemoglobin synthesis & blood cell development - synthesizing fatty acids, - works with vitamin B12 to produce certain amino acids - manufacture of DNA, hormones and neurotransmitters - tissue repair, foetal development, immunity	<u>DEFICIENCY SYMPTOMS</u> anemia, confusion, lethargy, watery eyes, poor immunity, confusion, abortion, birth defects.	Fruit, cereal brans and fresh green leaves
Cobalamin Vitamin B12	- Metabolising nucleic acids, forming proteins, processing fats, carbohydrates and glucose, compliments folic acid [to modify Vit B12, produce essential amino acids, manufacture red blood cells] - Maintaining nervous system, production of wool, mohair or hair.	<u>DEFICIENCY SYMPTOMS</u> Poor immune function Fatigue Loss of voice Poor wool production Low litter size	Made by micro-organisms, In seaweed, Fish and poultry glandular meals [kidney and liver],
Ascorbic acid Vitamin C	Maintaining integrity of connective tissue, blood vessels, bone tissue and wound repair	<u>DEFICIENCY SYMPTOMS</u> gingivitis, petechiae, rash, internal bleeding, impaired wound healing	Citrus fruit, green leaves, fresh insects, glandular meals,

blood and bone meal

Minerals

The inorganic nutrients are called minerals. Most minerals are present in the pasture and browse that livestock eat. However, farmers provide the livestock with mineral blocks or licks, which

contain minerals so that the animals can lick off the minerals that they need ad lib.

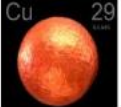
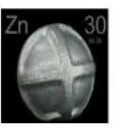
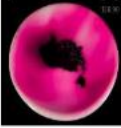
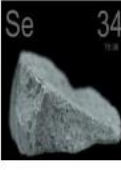
These minerals are divided according to the amount needed by animals.

Macro-minerals include calcium, phosphorus, sodium, potassium, chloride, sulfur and

magnesium which are required at 0.1 percent or more in the diet.

Mineral	Needed for	Deficiency symptoms	Toxicity symptoms	Food source
Calcium 	Formation and repair of bones and teeth - Muscle contraction - Nerve conduction - Blood clotting - Milk formation	- Rickets or osteomalacia - Tooth decay - Heart problems, dystocia - Lameness - Excess bleeding - Hypocalcaemia	- Urinary calculi - Abnormal bone growth	- Milk for kids - Milk replacers - Limestone - Dicalcium phosphate.
Phosphorus 	- Skeleton structure - Energy metabolism - Acid-base balance - A constituent of enzymes and genetic material.	- Reduced growth - Listlessness - Unkempt appearance - Decreased serum phosphorus - Depressed fertility, Pica	- Urinary calculi	- Protein supplements - Cereal byproducts - mineral supplements - Di-calcium phosphate.
Sodium 	- Electrolytes carry +ve and -ve charges that the body uses for osmotic balance, - Maintains blood volume and pressure - pH balance - Water movement - Transmission of nerve impulses.	- Reduced growth - Reduced feed efficiency	- Swelling in legs - High blood pressure	- Salt
Potassium 		- Could occur on high concentrate diets - Poor appetite, Pica. - Urinary calculi, - Body stiffness progressing from front to rear	- Vomiting - Muscle weakness	- Most forages
Chloride 		- Depressed growth - Loss of appetite - Muscle weakness, lethargy - Dehydration	- Hyperchloremia - Ph imbalance, - Fluid retention, - High blood pressure.	- Salt -
Sulphur 	- Protein synthesis - Milk, hair & connective tissue - Enzymes & hormones - Hemoglobin - Vitamins biotin and thiamine.	- Poor animal performance, hair loss, - Excessive salivation, - Tearing of eyes - Weakness	Polioencephalomalacia.	- Protein - Mineral blocks
Magnesium 	- Normal skeletal development - Nervous & muscular system functions - for enzyme systems.	- Exhibit a loss of appetite - Excitable - Stagger - Convulsions - May die	- Headaches, - Muscle cramps - Fatigue - Aggressiveness	- Magnesium oxide

Micro-minerals include iron, copper, cobalt, manganese, zinc, iodine, selenium, molybdenum and others are needed in trace amounts.

Mineral	Needed for	Deficiency symptoms	Toxicity symptoms	Food source
Iron 	- Hemoglobin - Enzymes	- Anemia	- Suppressed utilization of other trace minerals.	- Soil contamination on forages - Iron sulfate
Copper 	- Red blood cells - Hair pigmentation - Connective tissue - Enzymes. - Normal immune system function	- Anemia - Bleached looking and rough hair coat with hooked end tips - Diarrhea and - Weight loss - Rear leg paralysis [kids] - Abortions/stillbirths	- Copper deficiency - Hemolytic crisis due to stress [e.g. die if chased]	- Soil contamination on forages
Cobalt 	- Nerve conduction.	- Loss of appetite - Anemia, - Decreased production - Weakness	- Fever - Hypothyroidism - Abdominal discomfort - Lymphadenopathy	- Pasture - Forage
Zinc 	- Component of Vitamin B12. - Rumen microbes utilize cobalt for growth and production of Vitamin B12	- All animal tissue - Immune system - Skin growth. - Male reproduction	- Deformed hooves - Stiff joints, - Chronic skin problems - Abnormally small testicles and poor libido	- Abdominal pain - Nausea - Vomiting - Diarrhoea - Excessive salivation
Manganese 	- Bone formation - Reproduction - Enzyme functioning	- Deficiency and toxicity very unusual	- Pasture	
Iodine 	- Component of thyroid hormones that regulate energy metabolism and reproductive function.	- Reluctance to walk - Deformity of forelegs - Delayed onset of estrus - Poor conception rate - Low birth weight - Goiter - Reduced growth and milk yield, - Pregnancy toxemia & reproductive problems: late-term abortion, hairless fetus, retained placenta, weak kids	- Abdominal pain - delirium - fever - vomiting - shortness of breath	- Soil - Mineral licks - Salt/ salt water
Selenium 	- Functions with vitamin E as an antioxidant, - Reproduction - Metabolism of copper, cadmium, mercury, sulfur and vitamin E.	- Poor growth rate - Kids unable to suckle - White muscle disease - Sudden death by heart attack, - Progressive paralysis - Retained afterbirth.	- Shedding of hair - Diarrhea - Lameness	- Plant materials
Molybdenum 	- cofactor for a number of enzymes and catalysts	- No records	- fatal copper deficiency diseases in grazing animals.	- If excess Molybdenum in feed, then Copper cannot be absorbed

Goats do not adapt as easily to high-concentrate diets as pigs and sheep and are more likely to get acidosis, founder, urinary calculi and enterotoxaemia. To avoid these problems, very gradually increase the concentrate level in the

diet when placing goats on high-concentrate diets and maintain a minimum of 12 percent crude fibre in the diet or about half of the diet as grass, browse or hay.



Summarise the nutrient requirements of the different classes of livestock.



All livestock need water, energy, protein, vitamins and minerals and fibre in their daily diet. The requirements of the different classes of animals differ due to their growth and physiological stage



Investigate the causes and symptoms of the following diseases in livestock and share your findings with the rest of the class: Acidosis, founder, urinary calculi and enterotoxaemia.

LESSON 5: REPLACEMENT BREEDERS

LESSON OUTCOME

At the end of this lesson, the student will discuss the criteria used for the selection of replacement stock.



Doeling	- immature female goat
Ewe lamb	- immature female goat which reaches puberty at 5 - 8 months of age
Gilt	- immature female pig which reaches puberty at 6 months of age
Ram lamb	- immature male sheep which reaches puberty at 6-8 months of age
Buckling	- immature male goat
Boar	- male pig



Breeders are the animals raised on livestock farms to produce young.

The farmer will have animals of different ages on the farm and will replace breeders which are:

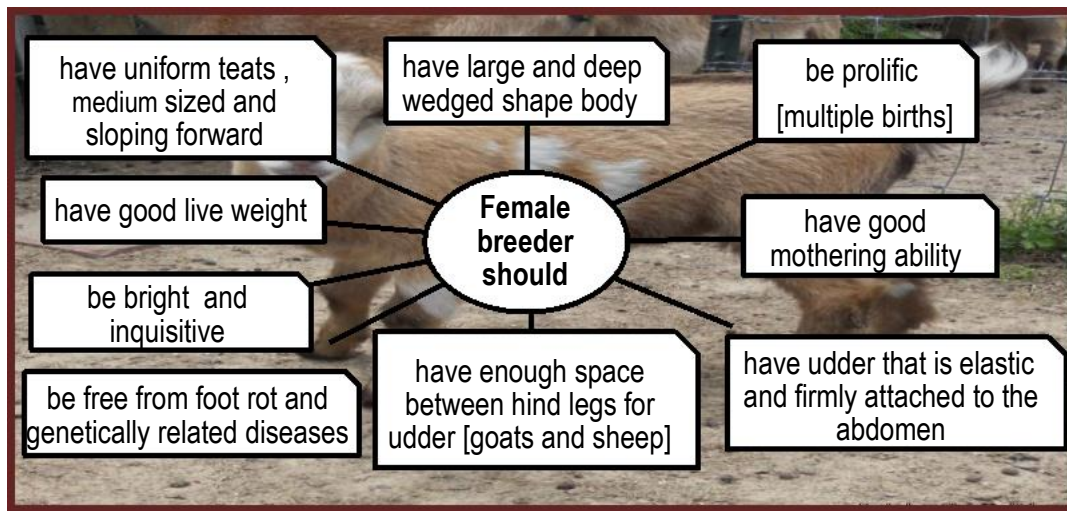
1. related by blood
2. infertile
3. diseased
4. under performing
5. old
6. injured

The replacement animals are usually chosen from the herd or bought as young and reared on the farm. Farmers usually buy new male breeders to avoid the problem of inbreeding while selecting does from the farm.

Breeding females:

The young female replacement animals are initially selected at weaning. Goats and sheep selected must be a member of a larger litter [e.g. twin or more] with average or above birth weight, two teats, a perfect bite, functioning third eyelid, structurally sound feet and legs, and correct/consistent body conformation. At eight months they are re-evaluated and final selection is concluded at one year of age.

Pigs are selected on the same criteria but must come from a litter of at least 12 piglets and have 12 teats or more.



Breeding males:

The young breeders are screened at weaning, eight months, yearlings and selected as a major herd sire at two years of age.

The male breeders are selected on many of the same rigid conformation standards as the females—structure of feet, legs and pasterns, width across the withers and rump, length and width of back and loin, depth of heart girth and chest floor, as well as both the shoulder and pelvic angles and expressed muscle definition of the hindquarter and inside hind leg. A pear shaped scrotum containing firm testicles of equal size is a major criterion.

Selection Criteria for male breeders:



Therefore, physical fitness and age are important when selecting breeding stock.



In groups, discuss and present to the class the reasons for the various selection criteria for replacement breeders.



Male breeders are important members of a livestock farm because they contribute 50% of the genetic material of offspring. Replacement male breeders are often bought. Female breeders produce young and milk. Farmers often choose replacement female breeders from young born on the farm. Selection criteria are important for the informed choice of future replacement stock.



You are tasked to buy a buckling for a dairy goat farm. Discuss what you would look for when selecting the animal.

LESSON 6: PRODUCTION OF YOUNG

LESSON OUTCOME

At the end of this lesson, the student will discuss the production of young on livestock farms.



Teaser - a male animal used to identify females on heat but is prevented from mating.
 Kidding - parturition in goats.
 Farrowing - parturition in pigs.
 Lambing - parturition in sheep.
 Sire - the male parent of an animal, especially kept for breeding.
 Issue - young born to a dam
 Dam - mother



The young produced on a livestock farm ensure that there is milk and stock to either grow out or sell.

The average reproduction cycles of the ewe, sow and doe are given below:

Species	Length Of Oestrus Cycle	Length Of Oestrus	Ovulation	Average Gestation
doe	21 days	24 to 40 hours	near end of oestrus	150 days
ewe	17 days	29 hours	near end of oestrus	150 days
sow	21 days	48 to 72 hours	35 to 45 hours into oestrus	115 days

Once heat is detected in the female breeder, she is taken for mating.

There are four main systems of mating carried out on farms.

Pasture Mating	Hand Mating	Pen Mating	Artificial Insemination
Male breeders run with female breeders.	Male breeders are kept away from the female breeders in special enclosures. Females on heat are introduced to male breeders enclosures.	Male and female breeders kept separately. Male breeders introduced to females which are on heat.	Teaser males used to identify does on heat. Females are inseminated.
Females mate when not fully developed.	Females mate when fully developed.	Females mate when fully developed.	Females mate when fully developed.
No control over sires of young.	Matching of breeding pairs possible	Matching of breeding pairs possible	Matching of breeding pairs possible
Male breeders waste time establishing right to mate. Many females may be mated but some unsuccessfully.	Female breeders on heat are introduced to the male breeder's enclosure one at a time. Limited number of females may be mated in one day.	Male breeders introduced to batches of does on heat overnight then separated in the morning.	Female breeders on heat identified and inseminated with semen from reliable source.
Mating ratio: 1 male to 10 females	Mating ratio: 1 male to 100 or more females.	Mating ratio: 1 male to 20 females	Mating ratio: 1 male to thousands of females
Some female breeders not mated if heat is synchronised. Successful mating ratio lower.	All female breeders mated if heat detected. Higher successful mating ratio.	Some female does not mated if heat is synchronised. Successful mating ratio may be lower.	All female breeders are mated if heat detected. Higher successful mating ratio
Parturition all year round	Parturition can be predicted or synchronised.	Parturition can be predicted or synchronised.	Planned parturition possible.
Difficult to take care of young stock of different ages.	Management of dams and young easier.	Management of dams and young easier	Management of dams and young easier

Parturition

Some signs that parturition is approaching include:

- hollowness on either side of the dam's tail,
- the dam isolating herself from the rest of the herd,
- an enlarged udder and teats that begin to fill with milk.

Just prior to parturition, the dam may:

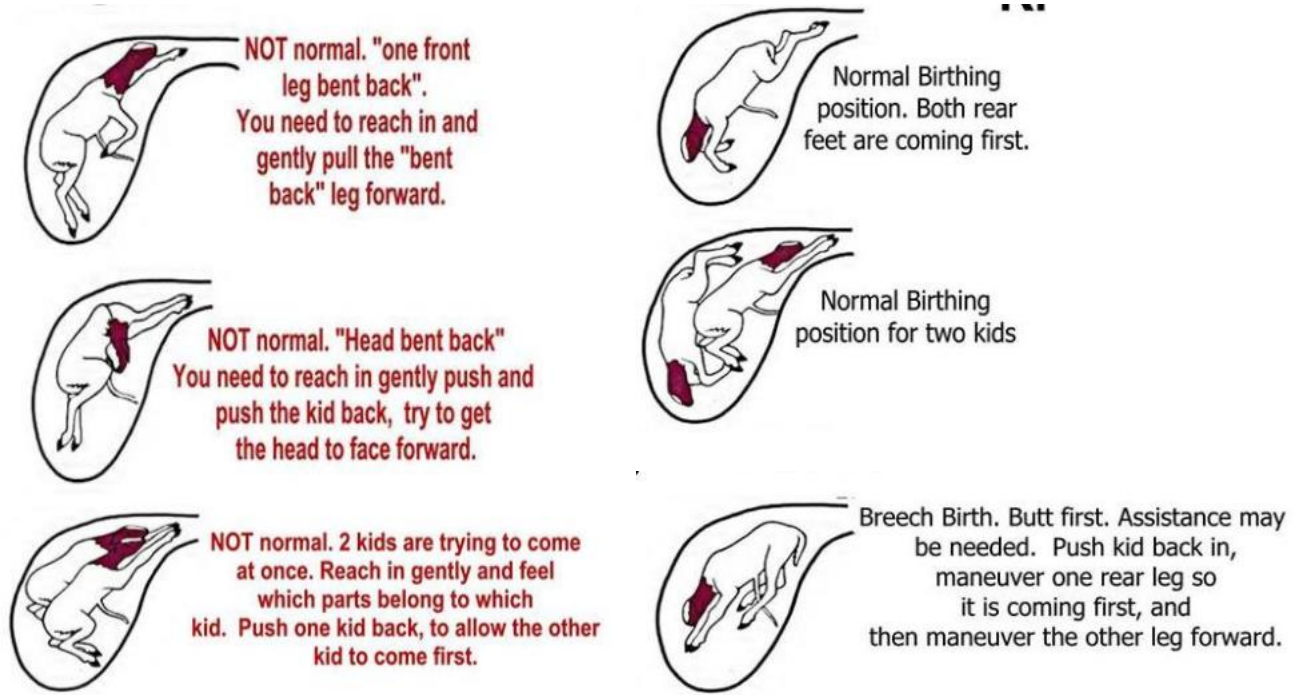
- paw at the ground,
- act restless ,
- expel a mucous discharge from the vulva,
- continually bleat,
- hold the tail straight out or slightly elevated,
- the first several vertebrae of the spine in front of the tail head may appear to stand higher and taller than usual.

A normal delivery usually takes five hours. Cervix dilation (which you cannot see) usually requires four hours, and then one hour is required for the delivery of the offspring.



Normal Birthing position. Both front feet and head forward single kid.

The young should be right side up with the front feet first, with legs extended and the head lying between the knees and pasterns in a "diving" position. After the water sac breaks, the dam should start to give birth within 30 minutes to one hour.



Source: Adapted from www.jrcnboergoats.net

If the dam is distracted or weak, clean the mucus away from the nose, mouth, and throat of the first issue. Weigh the young, tag one ear, and dip the navel cord in 7-percent iodine solution to prevent joint ill. Make sure each issue receives its mother's first milk (colostrum) within one to four hours of parturition and that the issue is suckling well within 24 hours.

GOAT	SHEEP	PIG
1. Veterinarian to assist if the dam needs help.		
 youtube.com	 rosiessheepherd.blog.com	 www.rheritagefarm.com

2. Mucous membrane should be removed from the nose, mouth and throat so the issue can breath.

GOATS

blackmesaranchonline.com

SHEEP

theanxiousgardener.com

PIGS

www.amylpeterson.com

3. If the dam is distracted, cut the naval cord and tie it to protect from infection. Apply iodine solution.



pinterest.com



www.ukagriculture.com



<http://www.uniferon.com>

4. Healthy issue starts feeding from the mother soon after birth.



<http://www.youtube.com>



<http://theroundupnews.com>



<http://www.utube.com>

5. Ensure the issue receives colostrum to develop resistant to diseases



motherearthnews.com



rosiessheepherd.blog.com



www.pig333.com

6. Provide issue with housing protected from wind and rain.
Bedding materials and warmth should be provided.



betterhensandgardens.com



rosiessheepherd.blog.com



www.watchusgrow.org

	Single	Twins	Triplets	Quadruples
goats				
sheep	 www.escofarms.com	 janetbaxterphotography.co.uk	 ceresfarm.co.nz	 egacymedia.localworld.co.uk

	Single	Twins	Medium sized litter	Large litter
pigs	 http://www.featurepics.com	 http://ontrack-media.net	 media-2.web.britannica.com	 http://i.dailymail.co.uk



Discuss the production of kids on a the following farms:

1. Farm with two tethered does,
2. Extensive farm with 10 ewes and 1 ram,
3. Semi-intensive farm with 20 does and 2 bucks,
4. Intensive farm with 100 sows and 1 teaser boar.



Kids, lambs and piglets are the young of goats, sheep and pigs respectively. With the parturition of young come animals to sell, milk and replacement animals. The farmer will provide facilities and services to ensure optimal conditions for the production of young on the farm.



Goats and sheep only have two teats on the udder. How can a farmer ensure that does and ewes which have produced triplets or quadruples feed all their young?

LESSON 7: FEEDING YOUNG

LESSON OUTCOME

At the end of this lesson, the student will discuss the rearing of young on livestock farms.



Suckling pig - 2 to 6 week old piglet slaughtered for meat
Lamb - one month and one year old sheep slaughtered for meat
Colostrum - the first milk produced by dam after each parturition.



The young born on livestock farms can be used for the following purposes:

1. **For replacement animals** – farmers may keep young for breeders.
These young are allowed to suckle from the dam so as to develop strong immune systems and bones and to learn to respond to humans.
2. **For meat** – young animals are often slaughtered for meat
3. **For sale** – many farms sell their excess young animals.

Young animals reared on the farm are provided with the following:

1. **milk** – the young are allowed to suckle from the dam. Young livestock are born with a limited defence mechanism against disease. The young are allowed to suckle from the dam within the first 8 hours of birth to obtain colostrum. The young livestock must be with their dam for regular sucking of milk or fed cow's milk, milk substitutes [skim or powdered full cream milk] until they are ready for weaning. In case where the dam is to be milked, then the young should be weaned from the doe and fed with milk replacer.

Kid sucking from dam	Hand raised kid
	
cache2.asset-cache.ne	edenhills.files.wordpress.com

2. **creep feed** - piglets, kids and lambs all begin nibbling at solid feeds soon after birth as creep feed encourages the development of the digestive system. Fresh grass and grain are made available to 1 to 2 week old kids and lambs to develop the rumen. Prepared feeds in crumble form are provided for lambs, kids and piglets.
The creep feed should be kept out of reach of the dam.
3. **water** – young animals must be provided access to clean, fresh water which does not dampen the whole living area.

Lamb eating creep feed


<http://farm4.static.flickr.com>

Piglet drinking water


<http://www.fotoagent.dk>


Discuss the important considerations that must be made when raising young on a livestock farm.
Why should young livestock suckle colostrum for their dam?



The young born on livestock farms are used for replacement stock, slaughtered for meat or sold. The animals chosen for rearing are provided with milk and creep feed and water before being weaned. Other husbandry techniques are employed depending on the planned use of the animal.



Discuss the raising of a pet male piglet, lamb or kid.

LESSON 6: IMPROVEMENTS

LESSON OUTCOME:

At the end of this lesson, the student will discuss methods used to:

1. identify stock
2. prevent damage from needle teeth
3. reduce damage caused by horns
4. reduce inbreeding
5. reduce foot rot and lameness



Horned	-	having a horn or horns.
Polled	-	livestock without horns in species which are normally horned



The following husbandry techniques are used by farmers to improve the production of livestock herds.

A] Identification

The young from one litter will often all look alike so the farmer must have a way of telling them apart for recognition and recording purposes.

The following identification methods are used:

ear tags	tattoos	ear notching	transponders
a plastic or metal tag is hung from the ear.	where a number is written in ink into the ear	where notches are cut into the ear, signifying numbers	an electric tag is inserted under the animal's skin.
			
http://www.allflexusa.com	http://www.ak0.pining.com	http://www.townnews.com	http://www.mannebeck.com
suitable for goats, sheep, pigs and cattle	suitable for light coloured pigs and calves	suitable for pigs	new invention suitable for all livestock

B] Teeth Clipping.

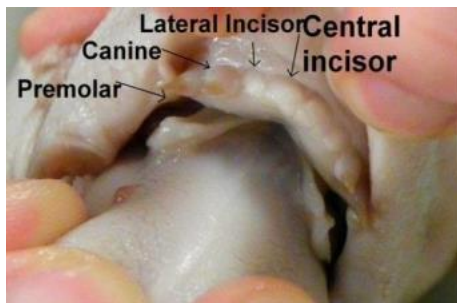
Pigs are born with eight needle (sometimes called wolf) teeth, the lateral and central incisors, located on the sides of the upper and lower jaws.

The needle teeth are used in competition with littermates for teat access, as piglets form a feeding order and each piglet will suckle from one set of teats. This competition leads to facial injuries of littermates and injury to the sow's teats.

Farmers may avoid problems associated with needle teeth by altering the needle teeth within 7 days of birth:

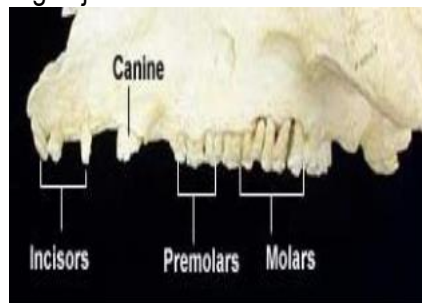
Piglets suckling	Facial injury	Pig teat injury	Sow refusing to suckle
			
http://media.pennlive.com	http://www.nadis.org.uk	http://www.nadis.org.uk	http://www.l2.picdn.net

Piglet teeth



<http://howtodissectafetalpig.weebly.com>

Piglet jaw



<http://arbl.cvmb.colostate.edu>

i) **Teeth clipping** –

A sharp teeth clipper is used to remove the sharp point of each needle tooth.

ii) **Tooth filing**

A file is used to wear down the sharp tip of each needle tooth

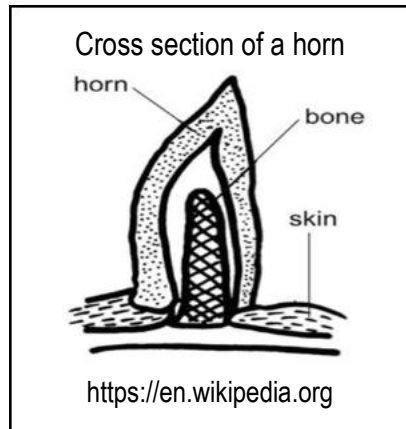
C] Disbudding and dehorning.

Most goats and sheep naturally have two horns, of various shapes and sizes depending on the breed.

Goats and sheep have horns unless they are polled or the horns have been removed, typically soon after birth.

Animal horns serve different purposes:

1. provide cooling in hot weather.
The blood vessels in the bony core allow the horns to function as a radiator.
2. attracting a mate.
3. intimidating predators and enemies.
4. defending themselves from predators.
5. fighting members of their own species (*horn fighting*) for territory, dominance or mating priority.
6. scratching their sides.



media.web.britannica.com



http://www.pixabay.com



http://www.lapoflove.blogspot.com

Horns can be a problem!

1. **Serious injury**

Goats and sheep are prone to herd infighting in which leadership is continually challenged. Males will use their horns on each other in such a way that they can result in serious injury.

And there are also some animals that will wait until you turn your back on them and use their horns on you!



2. Getting stuck in the fence

Goats and sheep are curious so will sometimes stick their head through a mesh fence. The horns get stuck so the animal is not able to get out, leaving it defenceless against predators, dehydration and starvation.

The farmer comes to the rescue, only to discover that the animal has stuck its head through again and gotten caught not more than 5 minutes later!



Farmers may avoid problems associated with horned animals in two ways:

1. Raising polled goats

The herd is comprised of animals which are polled.

2. Removing horns by

i) Disbudding

Some kids and lambs are born with horn buds which later grow into horns. The farmer can kill the horn buds, usually by burning, so that the horns do not develop.

ii) Dehorning

The grown or growing horns on an older goat are removed usually by cutting.

Horned kid



Polled goat



Disbudded kid



Source: <http://www.flicka.com>

The practice of either disbudding or dehorning is a subject of controversy amongst many people simply because some people prefer to leave the animal in its natural state while others have found that leaving the horns on an animal can cause certain problems.

D] Castration

-The process by which the testes, epididymis and a portion of each spermatic cord are removed from a male animal. It is advantageous to castrate extra males on a livestock farm because:

- i) castrated animals grow faster and put on weight rapidly.
- ii) unwanted genes don't manifest in the herd (inbreeding avoided)
- iii) castrated males are more easily handled than whole males.
- iv) meat has more marbling of fat.
- v) less meat taint.

Castration may be immediate as with the knife method, or may take several weeks as with the emasculator or elastrator methods.

Castration should take place at the youngest age possible since the stress of castration can adversely affect growth in older animals and the chances of complications increase.

Only healthy animals should be castrated to promote rapid recovery.

Tetanus antitoxin injections are recommended in conjunction with castration procedures to avoid tetanus or lock jaw.

Methods of castration

i) Knife Method – used on kids, lambs and piglets

- cutting with a knife is the most reliable and least expensive method of castration. The testicles are cut open and the testes removed.

Care should be taken not to excite kids before or immediately after castration to avoid excessive bleeding

Note: Animals with a scrotal hernia should not be castrated by the cutting method.

ii) Emasculator Method - used on kids and lambs

- the emasculator or burdizzo method involves an instrument (emasculator) which crushes the spermatic cord, thus destroying the blood supply to the testes. Without this blood supply, the tissues eventually atrophy even though the scrotum will be visible for the animal's lifetime. This method is known as a "bloodless" method since no cutting is done and when performed well, the skin is not even broken. Care must be taken to be sure that both cords have been properly crushed.

Even though this is supposed to be a bloodless method, it is possible to break skin with the corners of the emasculator.

Examine each kid carefully after castration. If the skin is broken, apply an antiseptic and give the kid an injection of tetanus antitoxin.

iii) Elastrator Method - used on kids and lambs

- this method involves cutting off the blood supply to the testes with a heavy rubber band or ring. In 10 to 14 days, the scrotum and testes will slough off. This method is most effective for young animals whose scrotal tissues have not yet become well developed.

Double crush emasculator



<http://www.medical-tools.com>

Elastrator



<http://www.medical-tools.com>

E] Hoof trimming

The nails on the hooves of goats, pigs and sheep keep growing. In nature, the nails would get worn and trimmed naturally by the rocks the animals would be walking and climbing on or scratching.

Livestock reared indoors are kept in sheds and graze on pasture grown on soil so the animals' hoof nails are not worn down like in nature.

When the nail grows long, it curves into the pad of the foot injuring the softer tissue. The nail also grows around and over the sole of the foot creating a place where dirt collects and foot rot starts.

The nail and all the areas where dirt and rot can collect need to be trimmed.

The whole point of trimming the animal's nails is to keep it rot free as well as comfortable to walk on.

How to trim hoof nails:

- Clean out any dirt with a hoof pick or the tips of your trimmers.
- Trim the nails and heel down so that they are even and flat with the sole of the foot (sometimes referred to as the "frog"). Trim the sole if necessary.
- Trim slowly and carefully until you start to see pink. Once you see pink, stop, or you will cause the animal to bleed.
- Trim any excess between the two heel areas, if necessary.



F] Weaning – the young are taken away from the dam so that they can no longer suckle. The time of weaning depends on what the animal is being reared for and the decision to re-breed the dam. Kids are usually weaned at 3 months of age, while piglets and lambs are weaned at 2 months of age.



Visit a goat, sheep or pig farm near the school or choose one system of rearing. Discuss the advantages and disadvantages of horns and hoof nails, identification, castration and weaning on the farm.



Despite the system used, undulates horns and hoofs may pose a problem. Farmers are to carefully weigh the advantages of disbudding, hoof trimming, identification methods, weaning and castration before performing these operations on the animals of their flock.



Differentiate between dehorning and disbudding.

LESSON 8: DISEASES OF LIVESTOCK**LESSON OUTCOME**

At the end of this lesson, the student will discuss diseases of livestock.



Ketonemia	- a condition marked by an abnormal increase of ketone bodies in the circulating blood. - also called hyperketonemia.
Ketonuria	- the excretion of abnormally large amounts of ketone bodies in the urine, characteristic of diabetes mellitus, starvation, or other medical conditions.
Acidosis	- an excessively acid condition of the body fluids or tissues.
Parasite	- an organism that lives in or on another organism (its host) and benefits by deriving nutrients at the host's expense.
Infectious	- likely to spread or influence others in a rapid manner.
Oedematous	- fluid retention and build-up which causes tissue to become swollen
Opisthotonos	- spasm of the muscles causing backward arching of the head, neck, and spine, as in severe tetanus, some kinds of meningitis, and strychnine poisoning.

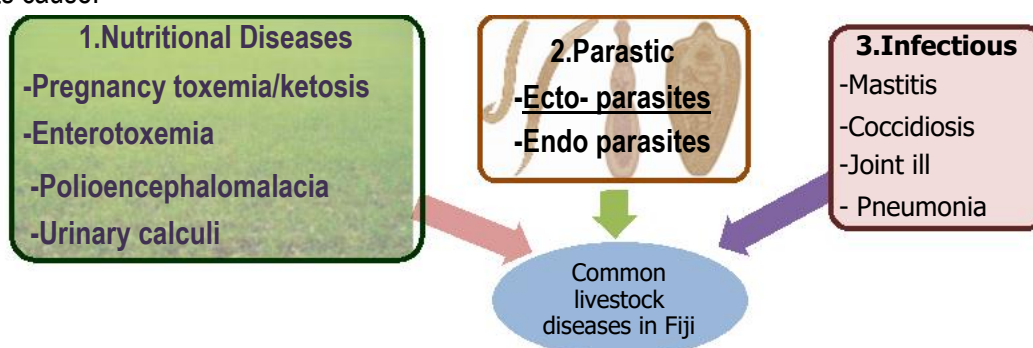


Diseases of livestock can lower the productivity of the farm, especially if the animals are intensively raised and not treated.

A farmer can only identify a sick animal if he or she knows what a healthy animal looks like.

HEALTHY		UNHEALTHY
straight	STANCE	drooping head, lying down
mixes with herd, inquisitive	SOCIALING	isolates itself, lethargic
clear, clean and bright	EYES	burred, blood shot, discolored, discharge
cold, clean and damp	MUZZLE	hot, dirty, very wet or very dry
clean, eats freely	MOUTH	sore, discharge, swollen
clean, reacts to sound	EARS	discharge, sore to touch, swollen, deaf or unreacting to sound
smooth, clean and unbroken, "normal colour"	SKIN	rough, "dirty", broken, rashes, boils, flushed, scratching, abnormal colour.
shiny, clean, 'combed look"	FUR, WOOL, HAIR	dull, matted, dirty
"talks"	VOCALISATION	quiet or moaning or "yelling"
even and little sound produced	BREATHING	wheezing, panting, coughing
clean	TAIL AREA	dirty, coated with faeces
firm, "clean"	FAECES	too soft, too hard, bloody, mucus, smelly

Disease in livestock can be classified into three groups; nutritional, infectious and parasitic, depending on its cause.



SOME LIVESTOCK DISEASES

a) Nutritional diseases

1 Pregnancy toxemia



<http://www.grannysbest.blogspot.com>

Pregnancy toxemia occurs when the nutrient requirements of the growing foetus in the uterus exceed the nutrient intake of the dam and is usually seen during the last 30 days of pregnancy.

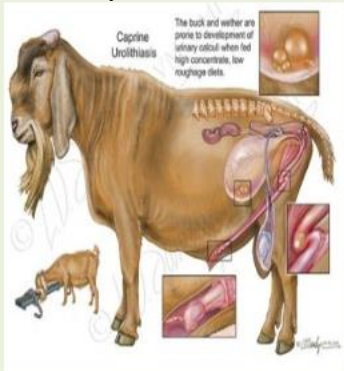
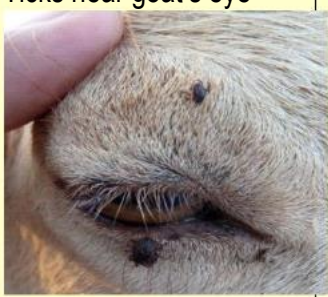
Caused by:

- (1) Presence of two or more foetuses;
- (2) Undernourishment during late pregnancy when the foetuses have very rapid growth;
- (3) Addition of stress such as severe weather, sudden changes in feed, other disease or transportation.

The dams show signs of ketonemia, ketonuria, acidosis and central nervous system involvement.

The mortality rate is high in affected animals.

Solution – increase the quality and quantity of feed before a female is mated [flushing] and during gestation as providing better nutrition to sick dams is seldom

	successful.				
2. Enterotoxemia  http://www.jn.nutrition.org	Animal eats large quantities of protein which is converted to an enterotoxin by bacteria, causing blood poisoning. Caused by: the toxin (poison) produced by the bacterium <i>Clostridium perfringens</i> type C or type D, damages organs. Symptoms: kids and lambs– death with no other symptoms adults - dull, starry look, loose faeces, an irregular appetite and drop in milk production followed by death. Solution- introduce milk and high protein diet gradually				
3. Polioencephalomalacia [PEM]  http://www.jn.nutrition.org	PEM is a disease of the Central Nervous System and occurs in cattle, sheep and goats where the cerebrocortical grey matter [brain tissue] softens. Caused by: thiamine deficiency, carbohydrate-rich and roughage-poor rations. Symptoms may include: head pressing, dullness, opisthotonos, central blindness, anorexia, muscle tremors, teeth grinding, trismus, drooling, convulsions, <u>nystagmus</u> and recumbence. Solution: Early administration of thiamine may be curative, but surviving animals may remain partially blind and mentally dull.				
4. Urinary calculi  http://www.sawchynmi.com	Urinary calculi is a disease where solid particles made of phosphate salts lodge in the urinary system disrupting urination. Caused by: feeding concentrate diets which are excessive in Phosphorus and Magnesium • Lack of water or water is high in minerals. Symptoms: difficulty urinating, swollen belly, dribbling urine, pain, nausea, vomiting, hematuria, and, possibly, chills and fever due to secondary infection Solution- avoid feed high in phosphorus and magnesium, provide grass and a lot of water.				
b) Ectoparasites					
Ticks near goat's eye  www.tukanabasin.com	Ectoparasites are lice, ticks, mites and flies which suck blood. <table><tr><td>Sucking louse  http://www.goatbiology.com</td><td>Biting Louse </td><td>Tick  http://www.studyblue.com</td><td>Fly  http://www.pods.daguna.edu</td></tr></table> Symptoms –animal becomes anaemic, has ruffled coat, scratches excessively, loses hair and develops raw skin; loses body weight and develops sunken eyes. Treatment - spray animal and it's living area with Melathion -take precautions to avoid spraying the face, food and water.	Sucking louse  http://www.goatbiology.com	Biting Louse 	Tick  http://www.studyblue.com	Fly  http://www.pods.daguna.edu
Sucking louse  http://www.goatbiology.com	Biting Louse 	Tick  http://www.studyblue.com	Fly  http://www.pods.daguna.edu		

b. Endo Parasites:  Anemic goat eye membrane is white Look here At the membrane http://www.goat-link.com	Endo-parasites : * Stomach worms - Haemonchus, Ostertagia * Intestinal worms - Trichostrongylus, Nematodirus, * Lungworms - Dictyocaulus * Flukes - Fascioloides Symptoms: Animal looks pale and dull, wet lung, scouring, pot belly, ruffled coat, anaemic, loss of condition, bottle jaw. Treatment: Oral drenching with Nilverm or Valvazen, Give injections of Ivomac (Rate: 1ml/5kg body weight Nilverm) Control- Rotational grazing. Drenching of all animals at the same time. Have a quarantine area – so other animals cannot pick up the worms from the infected ones. Rotational grazing.
3 Infection Diseases a. Mastitis  http://www.sandrakimler.com	The inflammation of the udder which is contagious. Causes- Bacterial infections including <i>Streptococcus agalactia</i>, <i>Staphylococcus aureus</i>, <i>Escherichia coli</i>, <i>Actinomyces pyogenes</i>, and <i>Corynebacterium pseudotuberculosis</i>. Damage to udder, damp places, failure to keep bedding clean, bruising from nursing kids, and trauma to the udder or teats. Symptoms- Early signs of mastitis- decrease in milk production, lameness, or young appearing hungry or increase loss of kids. Misshapen and either swollen (indicating acute infection) or withered (indicating chronic infection) udder. In acute mastitis, udder is hot, red, swollen and painful to the touch. Chronically affected udders may be firm or withered without evidence of pain. Abscess formation may be evident. The dam may show signs of generalized illness: depression, fever or loss of appetite. Gangrene mastitis should be suspected if the udder is cold, oedematous and the milk is watery or bloody. Treatment- Both injectable antibiotics and intramammary infusions, like penicillin should be considered. Control- quarantine the infected dams, hygienic living quarters, remove any sharp objects from grazing area
b. Coccidiosis  http://www.imgwhoop.com	Coccidiosis is a disease that results from overcrowding, dirty and/or wet pens and unclean water. Coccidiosis is highly contagious and spreads through a herd rapidly. Causal agent - a Protozoa [Eimeria] Symptoms- anaemia, weight loss, diarrhoea and blood in waste [black waste], sudden death in kids if severe. Treatment- isolate sick animals, provide water and green pasture, Use antibiotics like Primor and Albon Anti-helminth drugs will not cure Coccidiosis. Prevention - give balanced diet, practice hygiene in sheds and paddocks, avoid overcrowding.

c. Joint ill  http://www.nadis.org.uk	Joint ill is a disease caused by blood poisoning related to poor management of young animals and is also called Navel Ill. Causal Agent – bacteria entering the blood through untreated navel or other injury and settling in joints Symptoms: Painful and swollen naval areas which may contain pus, listless and loss of appetite, fever, stiff and swollen joints, death. Treatment – broad spectrum anti-biotic Prevention– dip umbilical cord of newly born young in iodine solution, allow young to suckle colostrum, keep living area warm, dry and clean, treat any injury with antibiotics.
d . Pneumonia  http://www.dpi.nsw.gov.au	Pneumonia is a disease of young and growing animals which is related to poor management, unbalanced diet, overcrowding, poor ventilation, dirty living conditions and cold. Causal agent - virus with bacteria often compounding the problem and cold, poorly ventilated, unhygienic living conditions. Symptoms: heavy breathing, coughing, loss of appetite, loss of condition, dehydration and death. Treatment - Broad spectrum antibiotics



Summarise the main diseases of livestock.

Discuss two ways in which farmers can prevent the introduction and spread of diseases in herds.



Diseases of livestock lower the farm production and costs money to treat so affects the farm's returns. It is very important for any farm owner or manager to prevent diseases entering the farm. Should a disease outbreak occur, the farm workers must be alert so that the diseased animal can be isolated and treated or culled. This will stop the spread of the disease.

Visitors should not be allowed on the farm unless they have been cleared of any disease.



Discuss the difference between infectious, parasitic and nutritional diseases of livestock.

LESSON 9: RECORD KEEPING

LESSON OUTCOME

At the end of this lesson, the student will discuss record keeping in livestock production.

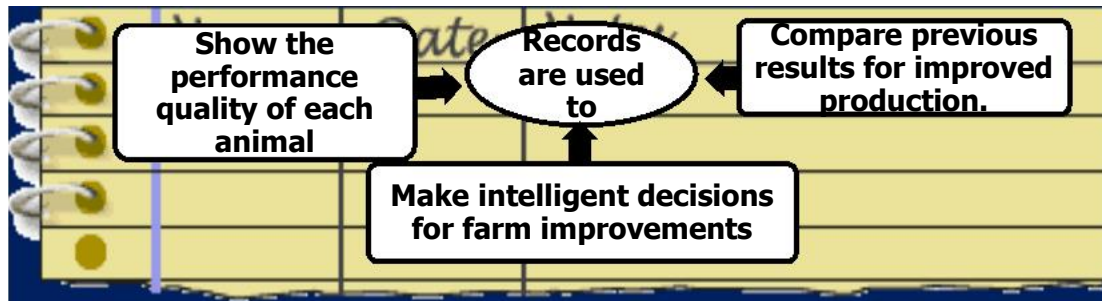


Successive	- following each other without interruption
Prolificacy	- producing in large quantities or with great frequency
Dressing percentage	- the percent of the live animal that ends up as carcass.
Hot hanging weight	- the carcass weight taken immediately after skinning and evisceration



The main aim of record keeping is to head for maximum production at minimum cost. Records help the producer to follow up the performance of the enterprise and assists in making decisions based on concrete facts. It is a tool that enables the producer to take timely corrective measures based on monitoring of progress.

Record keeping is an important tool in livestock management



Records are divided into 2 categories:

- Includes information over successive years of:
 - herd health
 - performance of the herd
 - performance of individual animals within the herd
 - These records should also include information on fertility,
 - prolificacy
 - rearing or mothering ability
 - milk production directly or indirectly estimated through kid growth rate to a given age.

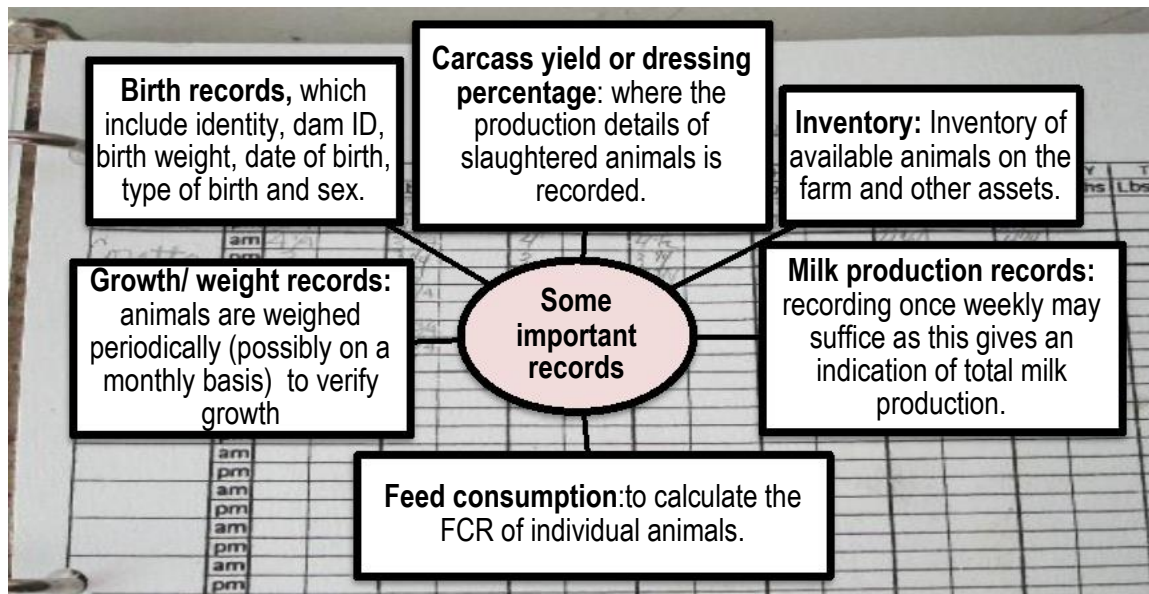
Production records



- Relate to economic interactions on the farm.
 - Financial records justify or prove farm income or expense transactions.
- Examples:**
- product sales
 - operating expenses (feed cost) veterinary expenses, forage seeds etc.)
 - equipment purchases
 - accounts payable
 - inventories
 - depreciation records
 - loan balances
 - price information

Financial records:





1. Discuss five importance of keeping records on livestock farms.
2. List and discuss any 2 financial and production records that should be kept on a livestock farm.



A good recording system which is well kept, detailed, accurate and transparent will allow informed decision making on a farm. It will also allow the farmer to know if the animals are producing according to expectations or if there is a need to change direction to meet the set target or goal.



Discuss the difference between production and financial records

LESSON 8: MILKING GOATS and SHEEP

LESSON OUTCOME:

At the end of this lesson, the student will discuss the milking of does and ewes..



- Emulsified - thoroughly mix two liquids that can't be completely blended together.
- Homogenised - subject (milk) to a process in which the fat droplets are emulsified and the cream does not separate.
- Taint - contaminate or pollute something.



Goats produce about 2% and sheep 4% of the world's total annual milk supply. Goat and sheep milk naturally have small, well-emulsified fat globules, which means the cream remains suspended in the milk, instead of rising to the top, as in raw cow milk; therefore, it does not need to be homogenized.

Goat Milk

PROS: Goat milk is closest in structure to human milk. The fat globules are smaller, which aids in digestion. A recent study of infants allergic to cow's milk found that 93% of them were able to drink goat's milk with absolutely no allergic reaction! The ease of digestibility is also due to the high amount of medium-chain fatty acids (has 35% compared to cow's 17%). Goat's milk also contains less lactose (milk sugars) than cow's milk, so is suitable for people who are lactose intolerance. Goat's milk is slightly alkaline, unlike cow's milk which is slightly acidic.

CONS: Some people dislike the taste of goat's milk

Sheep Milk

PROS: While there's some debate on the actual amounts of fat soluble vitamins in sheep's milk, they still produce creamier milk than goats. Sheep are famous for the deliciously succulent cheeses their milk makes. They are efficient producers, only needing 100% grass to produce rich milk. Like goats, they also produce naturally homogenised milk. That means smaller fat globules and more medium-chain fatty acids.

CONS: Sheep are naturally prey animals, which means they have difficulty "relaxing" while being milked. Trying to milk a ewe is difficult, because if you scare them even slightly, their bodies will produce adrenaline. This counteracts the "letting down hormone" oxytocin and the subsequent production of milk.

The milk production of goats and sheep is affected by different factors, including body size, weight, and parity, stage of lactation, udder size, litter size, nutrition, breed and birthing season.

Does and ewes should be kept separately from bucks and rams to minimise musk which may taint milk.

MILKING A DOE OR EWE

Due to their small stature, dairy does and ewes are usually placed on milking stands for milking.

HAND MILKING:

 1. Place concentrate feed in the feed bowl to distract the animal. 2. Place dairy doe or ewe on the milking stand. http://www.henrymilker.com	 3. Wash your hands.  4. Wash all dirt off the udder and dry the udder with a clean tissue.
5. Place the teat in the palm and wrap the thumb and fingers around the teat one at a time as in the picture below. This forces the milk out of the teat. 	

Milk is placed in clean containers and cooled.

MACHINE MILKING

A milking machine is a combination of several components that work together to create a vacuum that draws milk from the teats, alternating with air, which causes the milk to flow into a container in a rhythmic fashion, similar to a kid or lamb nursing.

Milking machine	Milking by machine	Milking the herd.
		
http://www.hambydairysupply.com	http://www.goatherdmatt.wordpress.com	http://www.clabbermouth.com

When intended for human consumption milk must be filtered and chilled immediately after milking to limit bacterial growth. The temperature at which milk will remain the best is at 4.4° C. The milk that is refrigerated has a shelf life of about three to four weeks. However, consumers like to freeze milk and increase its shelf life by about four to five weeks.

Goat milk products

Cheese, yogurt, ice-cream



<http://www.goodgoat.net>

Soap



<http://www.humblehousegardens.com>

Cosmetics



<http://www.greensandgoats.com>

Sheep milk products

Yogurt, ice cream



<http://www.grandandgorgeous.com>

Cheese



<http://www.ocello.com.au>

Skin care products



<http://www.storesonlinepro.com>



Discuss reasons for placing a dairy doe or a ewe on a milking stand for milking.



To assist with the milking of a doe or ewe, place the animal on a stand, clean the dirt off the teats and extract milk by wrapping the thumb and fingers around the teats one at a time.



Explain why goat meat and milk are considered healthy foods when compared to meat and milk from other mammals.

LESSON 10: TRANSPORTING AND HOLDING LIVESTOCK

LESSON OUTCOME:

At the end of this lesson, the student will discuss the catching and moving of livestock.



Shackle - something that checks or prevents free action.

Chute - fenced path for leading animals to strongly build holding pens.



Livestock are habit forming animals and may become sensitive and highly strung when routine is changed.

Prior to selling or slaughtering of livestock, the animals are caught and transported with care to minimise stress and injury.



<http://www.haleraiserfarm.com>

Catching Livestock

Minimize stress when catching livestock.

Avoid sudden moves or noises.

Herd livestock into a small area.

Catch gently.

For humane reasons, do not shackle the animal for slaughter. Place the animal on a double rail or firmly restrain the animal, which is safe and comfortable for both animal and people.



<http://www.advocacy.britannica.com>

Transporting livestock:

1. a chute or lane can be used to move animals calmly.
2. use animal-friendly, low-stress loading and holding facilities.
3. ensure driving habits provide livestock with a safe ride.
4. ensure vehicles are appropriate and comfortable for transporting livestock



<http://www.iga-goatworld.com>

Selling livestock

Livestock being sold on the hoof should be restrained and provided with water, shade and feed.



<http://www.porkcares.org>

Moving livestock

Move livestock to slaughter quickly to minimise stress.

If small enough, carry with one arm over the horns/head and the other arm tucked between hind legs.

For larger animals, have one person lead the animal with chin held high, while another person pushes from behind.

If handler is alone, hold animal's chin with one hand while grasping the dock or tail head area with the other hand, or carry forelegs to lead the animal.



Why is the process of catching during harvesting very important in quality goat meat production?



Catching is the first process of harvesting livestock. It involves the proper handling of animal before slaughtering to ensure tender and quality meat. Never catch an animal by its hair. Not only is it painful, but it can cause bruising to the carcass which will lower its quality.



Discuss the catching and handling of livestock prior to sale or slaughter.

LESSON 11: SLAUGHTERING & POST HARVEST TREATMENT OF LIVESTOCK

LESSON OUTCOME:

At the end of this lesson the student will discuss the slaughtering of livestock.



Ante Mortem - before death.

Chemotherapeutic - the use of chemical agents in the treatment or control of disease



A major objective of the slaughter and post-harvest treatment of livestock is to maintain the quality of the meat and to prevent harmful microbial contamination.

Ante mortem inspection



<http://www.safefoodfairfood.ilr.org>

All animals are screened for diseases and rested.

Animals are to be humanely treated and injured animals receive emergency slaughter.

Animals with reportable diseases are identified and removed to prevent killing floor contamination.

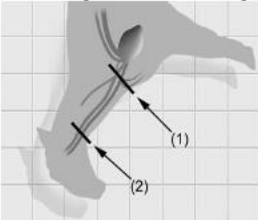
Sick animals and those treated with antibiotics, chemotherapeutic agents, insecticides and pesticides are only slaughtered after withholding periods.

Stunning



<http://www.fao.org>

The technique involves the passing of an electric current through the brain which leads to the temporary loss of consciousness.

Sticking and Bleeding

<http://www.hsa.org.uk>

The unconscious animal is killed by the process of cutting the throat and sticking a knife into a group of veins and arteries at the neck and then bled over a bleeding trough.

Halal is performed on all animals slaughtered except pigs.

The carcass is allowed to bleed out and is then rinsed with clean water to remove blood.

Scalding and dehairing [pigs only]

<http://www.aps.uoguelph.ca>

The carcass is dipped into a scalding tank which contains hot water at about 60°C to loosen the hair. The carcass is then placed on a dehairing machine which scrapes bristles off the carcass.

Skinning [all except pigs]

svmga.files.wordpress.com

countryfarm-lifestyles.com

The carcass [except for pigs] is skinned

<http://cdn-4.countryfarm-lifestyles.com>

Evisceration & post mortem inspection

<http://cdn-4.countryfarm-lifestyles.com>

Health Inspectors eviscerate and inspect the carcass and offal for the presence of diseases, bruises, breaks and contamination.

Only meat and offal that are fit for human consumption will pass the inspection and unfit meat / offal / parts will be condemned.

Splitting the carcass

<http://www.aps.uoguelph.ca>

The carcass may be split in half along the spine to allow for transportation, storage and further cutting.

Stamping

<http://www.jamaicaobserver.com>

The inspected carcass and offal which are fit for human consumption will be graded and officially stamped

Chilling

<http://i.dailymail.co.uk>

The carcass is placed in the chiller and is often left overnight, to reduce the temperature of the meat.

Delivery

www.alibaba.com

The carcass and offal are transported by refrigerated meat delivery vehicles to individual customers and retail outlets.

World meat consumption		Per 3 oz. Cooked	GOAT	PORK	LAMB	CHICKEN	BEEF
Pork	40 percent	Calories	122	180	175	162	179
Beef	32 percent	Fat (g)	2.6	8.2	8.1	6.3	7.9
Poultry	22 percent	Sat Fat (g)	0.79	2.9	2.9	1.7	3
Lamb and mutton	6 percent	Protein (g)	23	25	24	25	25
		Cholesterol (mg)	63.8	73.1	78.2	76	73.1

Source: <http://www.wikipedia>.

	Why is the process of slaughter and postharvest treatment very important in quality meat production?		The slaughter and post-harvest treatment of livestock is important in the quality of the meat produced
	Discuss the slaughter and post-harvest management of livestock.		

SUB STRAND AS 11.4.2 GOATS

Content Learning Outcome: AS 11.4.1.1

The student will explore, discuss, practice and evaluate livestock concepts and relate them to raising goats in Fiji.

LESSON 1: INTRODUCTION:

LESSON OUTCOME:

At the end of this lesson, the student will discuss the origins of the domesticated goat.

	Bovidae	- the family of wild and domesticated mammals including 140 species including antelopes, cattle, gazelles, goats and sheep.
	Caprinae	- part of the <i>Bovidae</i> family of ruminants, consisting of mostly medium-sized bovids referred to as goat-antelopes or caprids, of which goat and sheep are members.
	Neolithic	- the period of human culture that began around 10,000 years ago in the Middle East and later in other parts of the world. It is characterized by the beginning of farming , the domestication of animals, the development of crafts such as pottery and weaving, and the making of polished stone tools.
	Sinew	- a piece of tough fibrous tissue uniting muscle to bone or bone to bone; a tendon or ligament.

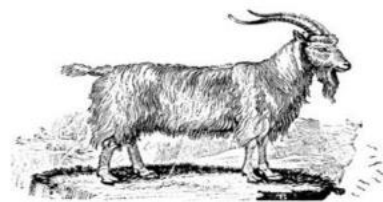


The goat is a member of the family Bovidae and is closely related to the sheep as both are in the goat-antelope subfamily Caprinae. The domestic goat, *Capra aegagrus hircus*, is a subspecies of goat domesticated from the wild goat of Southwest Asia and Eastern Europe.

Goat remains have been found at archaeological sites in Jericho, Choga Mami, Djeitun and Çayönü, dating the domestication of goats in Western Asia at between 8000 and 9000 years ago while studies of DNA evidence shows that goats were domesticated 10, 000 years ago in Ganj Dareh in Iran.

Neolithic farmers began to herd wild goats for easy access to milk and meat, primarily, as well as for their dung, which was used as fuel, and their bones, hair, and sinew for clothing, building, and tools.

Feral goats introduced to European countries in Neolithic times



Source: www.nhsn.ncl.ac.uk

Historically, goat hide has been used for water and wine bottles in both traveling and transporting wine for sale. It has also been used to produce parchment.

In 2011, there were more than 924 million live goats around the globe, according to the UN Food and Agriculture Organization.

British Primitive Goat



The British Primitive Goat encompasses what has previously been known as the Old English/Scottish/Welsh/Irish, British Landrace or Old British Goat.

The breed descends from the goats introduced by the first farmers in the Neolithic period. It was this little, hairy all-weather goat that was moved around the periphery of Europe by the Celts, Vikings and Saxons. It sustained the people of the bronze and iron ages alongside a few cattle and sheep.

Source: <http://www.rarebreedgoats.co.uk/british-primitive-goats>

LESSON 2: HISTORY OF GOATS IN FIJI

LESSON OUTCOME:

At the end of this lesson, the student will investigate and outline the history of goats in Fiji.



Carcass

The dead body of an animal, especially one slaughtered for food



Goats are not endemic to Fiji. They are believed to have been introduced to the country and reared by foreigners.

Pre- Commercial goat rearing in Fiji

- ✧ When the first missionaries brought their families to Fiji, they could not find a source of milk. To rectify this situation, it is believed that the early missionaries introduced goats in the early 19th Century.
- ✧ Early European realized that goats adjusted well to the conditions in Fiji so introduced goats for their skin.
- ✧ The Indian indentured labourers from the Asian sub-continent introduced goats for milk and meat purposes during the late 19th and early 20th centuries.

Commercial goat rearing in Fiji

- ✧ The goat industry grew out of small holder farms with farmers concentrating on producing meat animals.
- ✧ In the 1980's the Fiji Government supported the industry with the strengthening of the goat section of the Nacocolevu Research Station. Improved breeds were developed and introduced to commercial farms.
- ✧ The industry has seen a surge of interest in recent years resulting in a substantial decline in the importation of goat carcass from New Zealand
- ✧ Goat research stations continue to supply goat farmers with genetically superior breeding stock to improve production.



www.rootswab.ancestry.com

Anglo-Nubian buck



<http://www.poultryfeedsuppil>

- * In 2014, the Ministry of Agriculture facilitated the introduction of breeders of the Boer breed from Australia, with the aim of improving the meat production efficiency of local herds.
- * The main problem affecting production is the heavy infestation of internal parasites.
There are over 251,765 goats in Fiji which are used for dual purpose production where meat goats also produce milk mainly for home use as Fijians are more familiar with cattle milk.
- * Goat meat continues to face stiff competition from imported sheep and lamb meat. However, the availability of live sheep has not affected the sale of local goats, which continues to attract a high price all year round.



It has been estimated that approximately 20,726 farmers run 251,765 goats, with the majority of goats being kept on small farms in the dry Western Division of Fiji.



Discuss the development of the goat industry from pre-commercial to commercial production in Fiji.



Goats are not endemic to Fiji but were introduced by Missionaries.

They were raised for milk, meat and skin.

The industry has developed, with the help of Government research, into a successful commercial sector of agriculture in Fiji.



Explain why goats are raised mainly for meat in Fiji.

LESSON 3: BREEDS OF GOATS IN FIJI

LESSON OUTCOME:

At the end of this lesson, the student will investigate and discuss the breeds of goats raised in Fiji.



Milking stock - breed of animals reared because they produce high quality and /or quantity of milk

Vocal - the goat that makes a lot of noise calling it's owner or other goats

Paint - goats with large spots of a different color on their bodies.



Domestic goats have been bred for the production of meat, milk, fibre, skin and for pets and show purposes. There are over 300 distinct breeds of goats in the world. These goats are usually classified according their primary purpose. The main breeds raised in Fiji are developed as dual or multi-purpose breeds.

Four breeds of goats were introduced to Fiji's farms to upgrade the existing stock in the following order: Alpine, Saanen, Anglo Nubian and the Boer. They have a life span of 15 to 18 years.


Anglo-Nubian (<http://www.nswschoolanimals.com>)

- The **Anglo-Nubian** breed was developed in Great Britain of native milking stock and goats from the Middle East and North Africa.
- Its distinguishing characteristics include large, pendulous ears and a "Roman" nose.
- Due to their Middle-Eastern heritage, Anglo-Nubians can live in very hot climates
- Anglo-Nubians are large in size and carry more flesh than other dairy breed. they have a longer breeding season than other dairy goats.
- Considered a dairy or dual-purpose breed, Anglo-Nubians are known for the high butterfat content of their milk.
- The Anglo-Nubian temperament is sociable, outgoing, and vocal and it is quick to learn routines.


Saanen (<http://www.nswschoolanimals.com>)

- The Saanen breed was originally developed in Switzerland, south of Canton Berne in the Saanen Valley.
- The profile of the head is straight or dished (concave), with erect, forward-pointing mid-sized to large ears.
- Due to their white or cream-colored coloration, they can be sensitive to harsh sunlight and hot climates.
- Saanens are the largest of the goat dairy breeds, and one of the largest milk producers.
- Saanen does are known for their ease of management in herds, mellow temperament and adaptability.


Alpine(<http://www.imgbuddy.com>)

- The Alpine breed originated in the French Alps.
- They are of medium size and have no set markings. They have horns, a dish-face and erect ears. The face is straight with a straight nose.
- Alpine goats can range from white or gray to brown and black. These are hardy, adaptable animals that thrive in any climate while maintaining good health and excellent production.
- Alpine goats are renowned for their docile manner.


Boer (<http://www.suggestkeyword.com>)

- The Boer goat was developed in South Africa in the early 1900's for meat production. Due to selective breeding it has a fast growing rate and excellent carcass quality, is resistant to diseases and adapts well to hot climatic conditions.
- It is a horned cross breed with lop ears that are large and usually have white bodies with distinctive brown heads but may be all white, all brown or paint.



If you were requested by your family to develop a milking goat herd, explain which breed you would raise.



There are over 300 distinct breeds of goats in the world with each breed raised for its meat, milk, fibre, skin; for pets or show purposes.
There are four breeds which have been introduced to upgrade the productivity of the Fiji herds viz. Alpine, Saanen, Anglo- Nubian and Boer.



In a table with 4 columns, summarise the four breeds of goats introduced to upgrade local stock in Fiji.

LESSON 4: CLASSES OF GOATS ON FIJI FARMS

LESSON OUTCOME

At the end of this lesson, the student will identify and compare the classes of goats used on Fiji Farms.



- Does – adult female goat. Also called a nanny.
- Bucks – adult, intact or whole male goat. Also called a billy or ram.
- Wether – a castrated male goat.
- Goatling – a female goat between one and two years old
- Kid – a young goat, less than 6 months of age.
- A soft leather made from goat skin.



Goats are divided into classes based on their age and function on a farm. This classification also assists in determining the husbandry requirements of the animals.

Young goats, under the age of six months are called kids.

Young male goats are sometimes castrated and are then called wethers. These goats are reared for sale. Goatlings are young female goats which are often called maiden does. They are usually sold as breeding stock or kept as replacement animals.

Breeding goats include bucks and does.

The four main breeds introduced to Fiji are compared below.

	Anglo-Nubian	Saanen	Alpine	Boer
Buck				
	http://www.wolfcreekranh1.tripod.com	http://www.highuintapackgoats.com	http://www.highuintapackgoats.com	http://www.boergoats.co.za
	* Weigh at least 79 kg	o Weigh on average 73 kg	• Weigh on average 70 kg	• Weigh 110–135 kg
	* Minimum height 89 cm	o Average height of 81 cm	• Average height 80cm	• Height 90 cm

Wether	 http://3.bp.blogspot.com	 http://www.highuintapackgoats.com	 http://www.missouridairygoats.com	 http://www.bellgoatfarm.com
Doe	 http://www.glenafon.webs.com * Weigh at least 61 kg * Minimum height is 76 cm * Milk has high butterfat content but produces less milk than other dairy breeds. * Multiple births common	 http://www.theselfsufficientliving.com - o Weigh at least 61 kg - o Minimum of 76 cm tall - o High milk production but lower butterfat content - o Multiple births common	 http://www.extension.org ■ Weigh around 61 kg ■ Average height 0.8 m ■ High milk production and high butterfat content ■ Multiple births common	 http://www.boergoats.co.za ❖ Weigh 90–100 kg ❖ Average height 80cm ❖ Medium milk production ❖ High quality and quantity meat production ❖ Multiple births are common
Goatling	 www.rarebreeds.co.nz/	 www.flickr.com	 www.missouridairygoats.com	 bellgoatfarm.com
Kid	 homeschoolingtoday.com	 tumblr.com	 goatmilkstuff.com	 vtsheepandgoat.org



Distinguish between each class of goat by discussing their purpose on a farm.



Explain the function of each class of goat.



When goats are categorised in classes, the function and husbandry requirements are easier to determine and carry out.

LESSON 5: IMPORTANCE OF GOATS

LESSON OUTCOME

At the end of this lesson the student will discuss the importance, advantages and disadvantages of raising goats.



Mohair	— a silk-like fabric or yarn made from the hair of the Angora goat
Browse	— to eat, nibble at, or feed on leaves, tender shoots, or other vegetation.
Brackish water	— is salt water and fresh water mixed together.
Bleat	— the wavering cry made by a sheep, goat, or calf.
Herder	— a person in charge of a herd, especially of cattle or sheep



Goats are unique, fascinating, resourceful, hardy, intelligent, inquisitive, entertaining, sociable and extremely useful animals which are believed to be one of the first animals to be domesticated.

Advantages of raising goats:

- a. Goats are a source of many items including:
 - i) Meat
 - ii) Milk
 - iii) Skin and leather
 - iv) Cashmere
 - v) Mohair
 - vi) Manure

These items may be used by the farming family or sold.

- b. Goats acclimatise well in Fiji especially in the drier zones like Western Viti Levu.
- c. When well-managed, goats do not catch many diseases and pests. However, they need to be kept dry to avoid chilling and foot rot.
- d. Goats are browsers and can eat a wide range of low grade feed like mature grass, crop residues, leaves and the bark of trees.
- e. Goats are very social animals and readily adapt to farm routines. They adopt their herders and respond to commands and gestures.
- f. Goats require small areas for housing.
- g. Goats can survive on fresh and brackish water.
- h. Goats make good companions and family pets.

Disadvantages of raising goats:

- a) Due to their browsing habits, goats need a lot of feed each day.
- b) Goats are very inquisitive so will eat almost any kind of green feed including farmed vegetables and crops.
- c) Goats learn routines quickly and will shun new herders and create a lot of noise until satisfied.

Angora goat are raised for mohair



<http://www.singingfalls.com>

Browsing goats



Source: <https://www.extension.org>

Bleating goats



Source:

<https://www.irishmirror.ie.com>

- d) Goats are very clever so can find ways out of confined areas like climbing over or burrowing under fences and opening doors and gates.
- e) Goats will readily break out of confined areas and revert to living in the feral state.
- f) Bucks produce a strong musk during the mating season.

Before deciding to raise goats, a farmer must weigh the advantages and disadvantages.



Compare the advantages and disadvantages of raising goats.



The goat industry has developed because of the advantages associated with raising this curious and versatile animal.



Debate the advantages and disadvantages of raising goats in your area.

LESSON 7: RAW PRODUCTS FROM GOAT FARMS

LESSON OUTCOME:

At the end of this lesson the student will discuss the main products which goats are raised for.



- Chevon - the flesh of adult goats as food; goat meat.
- Cabrito - the meat of a kid (Spanish)
- Capretto - the meat of a kid (Italian)
- Cashmere - very soft, expensive wool material that is made from the hair of goats from Kashmir.

Goats are versatile animals that are raised around the world for a variety of products.

Humans find both living and dead goats useful. Goats are:



- i. a renewable provider of milk, manure, and fiber.
- ii. used for driving and packing purposes.
- iii. used for meat and hide.
- iv. intestines are used as material for catgut and stings for musical instruments.
- v. horns signify plenty and wellbeing and are used to make spoons.

Some charities provide goats to impoverished people in poor countries, because goats are easier and cheaper to manage than cattle, and have multiple uses. In addition, goats are used for driving and packing purposes.

1. **Goat milk** is widely consumed in the world and is highly nutritious.

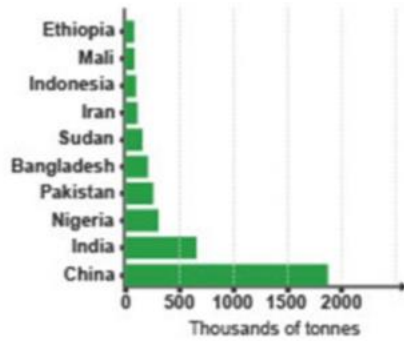
Goat milk is often sought for its perceived health benefits and unique taste. Comparison of average milk composition			
Nutrient	Human	Cow	Goat
Energy (kcal/100 ml)	68.00	69.00	70.00
Lactose (%)	7.30	4.70	4.10
Protein (%)	1.10	3.50	3.20
Fat (%)	4.00	3.60	3.80
Cholesterol (mg/100 ml)	20.00	15.00	12.00
Ash (%)	0.20	0.70	0.80
Calcium (%)	0.04	0.18	0.19

Comparison of average milk composition			
Nutrient	Human	Cow	Goat
Phosphorous (%)	0.06	0.23	0.27
Iron (%)	0.20	0.06	0.07
Vitamin A (IU/g fat)	32.00	21.00	39.00
Vitamin D (IU/g fat)	0.30	0.70	0.70
Vitamin C (mg/100ml)	3.00	2.00	2.00
Thiamine (µg/100 ml)	17.00	45.00	68.00
Riboflavin (µg/100 ml)	26.00	19.00	21.00

Source: <http://extension.psu.edu>

2. **Goat meat** is widely consumed in the world and most goats raised in Fiji are for meat purposes. Goat meat has different names depending on the age of the animals slaughtered:
- Adult animals - **chevon** or mutton,
 - Young animals - **cabrito**, capretto, or kid
- Goat meat is the most nutritious red meat you can ingest.

Top 10 goat meat producing countries 2012

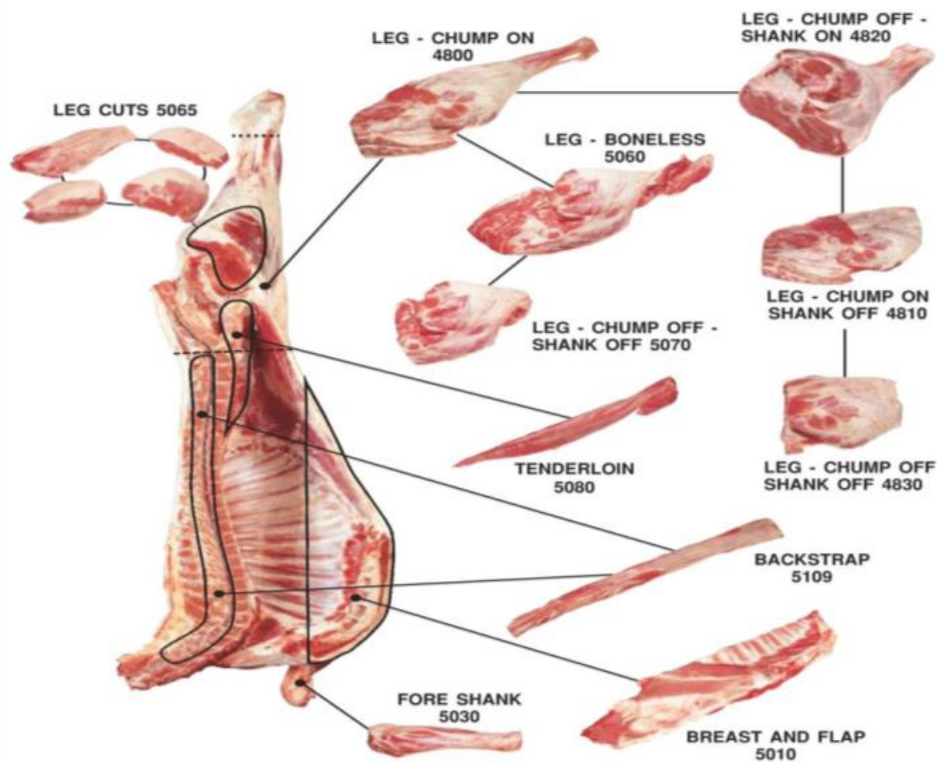


Source: <http://news.bbcimg.co.uk>

Chevon



Cuts of goat



Source: <http://www.gloryridgefar.com>

3. **Mohair** is one of the oldest textile fibers in use dated from the 8th Century and is believed to have originated in Tibet. Both durable and resilient, mohair is notable for its high lustre and sheen and is often used in fibre blends to add these qualities to a textile. It is warm in winter as it has excellent insulating properties, while remaining cool in summer due to its moisture wicking properties. It is durable, naturally elastic, flame resistant and crease resistant. It is considered to be a luxury fibre, like cashmere, angora and silk, and is usually more expensive than most wool that comes from sheep.
4. **Cashmere** wool is in fact the fine hair obtained from the neck region of the Cashmere goat. This animal produces a double fleece that consists of a fine, soft undercoat of hair mingled with a straighter and much coarser outer coating of hair called guard hair. When separated, the finer hair is collected and sold as cashmere. Cashmere has a fine texture and is strong, light, and softer than regular wool. Its insulating capacity is approximately 3 times that of regular sheep wool.

Mohair fabric


www.etsy.com

Cashmere fabric


www.ecw.com


Discuss the goat industry in Fiji and the potential for each of the four main products mentioned above.



Goats are raised around the world for many reasons but the four main products of the goat industry are milk, meat, mohair and cashmere.



Explain why goat meat and milk are considered healthy foods when compared to meat and milk from other mammals.

LESSON 9: GOAT BY- PRODUCTS

LESSON OUTCOME

At the end of this lesson, the student will discuss the by-products of goats and their uses.

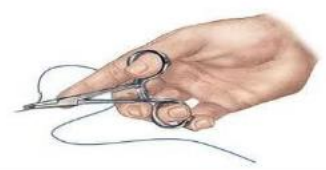


- Catgut** - a type of cord that is prepared from the natural fibre found in the walls of animal intestines including sheep, goats, cattle, pigs, horses, mules, or donkeys.
- Biogas** - any gas fuel derived from the decay of organic matter. It is mixture of methane and carbon dioxide produced by the bacterial decomposition of sewage, manure, garbage, or plants.



When goats are slaughtered and meat is sold, by- products are also available for sale.

Leather	Angora goat skin	Wool	Manure
			
topleathermessengerbag.com	peavinehollow.com	heatherknits.com	agrifarming.in

Catgut	Paint	Blood and bone meal	Biogas
			
dir.indiamart.com	www.harleyfarms.com	www.planetnatural.com	spp.doriline.wordpress.com

	Discuss the use of the by-products of goat production.		Goat by-products are those products made from goats apart from meat, milk and hair. These products are also sold in the markets for extra income. Leather, goat manure, catgut, biogas and paint are a few
	Research the by-products of the goat industry and present your findings to the class.		

AS 11.4.3 SHEEP

Content Learning Outcome: AS 11.4.3.1

The students will explore, discuss, practice and evaluate livestock concepts and relate them to raising sheep in Fiji.

LESSON 1: INTRODUCTION

LESSON OUTCOME:

At the end of this lesson, the student will discuss the origins of the domesticated sheep.

	Ovis aries - Scientific name of sheep.
	Mouflon - a small wild sheep with chestnut-brown wool, found in mountainous country from Iran to Asia Minor. It is the ancestor of the domestic sheep.



The sheep is a member of the family Bovidae and is closely related to the goats as both are in the goat-antelope subfamily Caprinae.

The domestic sheep, Ovis aries, most likely descended from the wild mouflon of Europe and Asia.

Around 11,000 BC wild mouflon were domesticated in ancient Mesopotamia.

Sheep remains have been found at archaeological sites in Iran dating the selection of sheep for wool at between 8000 and 9000 years ago.

Farmers began to herd the mouflon for their relative lack of aggression, manageable size, reaching sexual maturity early, social nature and high reproduction rates.

Herding sheep provided easy access to milk and milk products, hide for leather and wool primarily, as well as for their dung, which was used as fuel, and their bones, hair, and sinew for clothing, building, and tools.



In 2014, there were more than 1,162.9 million live sheep around the globe, according to the UN Food and Agriculture Organization.

LESSON 2: HISTORY OF SHEEP IN FIJI

LESSON OUTCOME:

At the end of this lesson, the student will investigate and outline the history of sheep in Fiji.



Sheep are not endemic to Fiji. They are believed to have been introduced to the country and raised by foreigners.

Pre- Commercial sheep rearing in Fiji

Sheep farming was not a major pre-commercial enterprise in Fiji because the sheep introduced from Australia and New Zealand found the Fiji climate too hot.

Commercial sheep rearing in Fiji

In 1980, the Fiji Government began Phase One of the Sheep Breeding Programme aimed at producing a sheep breed suitable for Fiji conditions. This breeding programme began on Makogai Island, in Lomaiviti, where the Barbados Black Belly sheep and the Wiltshire Horn sheep were cross bred. This 10 year programme developed the Fiji Fantastic breed.

In 1993, Phase Two of the Sheep Breeding Programme began, aimed at distributing fattening and breeding stock produced from this programme to farmers in Fiji.

A few farmers took up the challenge and began breeding their own stock and selling to other interested farmers.



The success of this programme saw our Pacific neighbour, Samoa import 40 ewes and 4 rams which they used to establish breeding herds in 2004. This was followed the next year by the export of the same number of animals to Tonga.

In 2014 Samoa imported another 100 strong female and 10 strong male flock to boost their herds.

It has been estimated that in February 2014, there were approximately 18,603 sheep being raised on farms in Fiji and the Ministry of Agriculture plans to implement a rapid multiplication program in the next four to eight (4-8) years to increase the number of breeding animals for distribution to farmers.



Discuss the development of the Fiji Fantastic sheep breed.



Sheep are not endemic to Fiji and did not do well because of the climate. Since 1980 Fiji has developed and distributed the Fiji Fantastic sheep breed to farmers here and exported breeders to our neighbours Samoa and Tonga.



Explain why sheep are raised mainly for meat in Fiji.

LESSON 3: BREEDS OF SHEEP IN FIJI

LESSON OUTCOME:

At the end of this lesson, the student will investigate and discuss the breeds of sheep raised in Fiji.



Inguinal region - lower lateral region of the abdomen on either side of the pubic region



Sheep come in all different sizes, shapes, and colours, and there are many ways to classify them: according to their primary purpose (meat, milk, or wool), the type of coat they have or fibres they grow (fine, medium, long or carpet wool; or hair), the colour of their faces (black, white, red, or mottled), and/or by specific physical or production characteristics. Worldwide, it is estimated that there are more than 1000 distinct sheep breeds

Two breeds were cross bred to produce a breed suitable for rearing in Fiji.

. They have an average life span of 11 years.



Barbados Black Belly

The Barbados Black Belly sheep originated on Barbados Island in the Caribbean from African ancestors.

Its distinguishing characteristics include light tan to mahogany red hair with black stripe on the face and black legs, inguinal region, chin and chest.

Due to their African heritage, Barbados Black Belly sheep can live in hot climates

They are comparatively small in size, fleet of foot, of high stamina and disease resistant.



Wiltshire Horn

The Wiltshire Horn sheep originated in Wiltshire in Southern England in 1794.

Its distinguishing features include horns, white fine wool intermixed with hair, black tips, straight back and prominent shoulders.

The sheep naturally moult when the weather is hot and produces quality meat.

They are medium sized and easy to handle.



Fiji Fantastic

In 1980, the Ministry of Agriculture began a 10 year breeding programme in Makogai where the Barbados Black Belly was crossed with the Wiltshire Horn to develop a foot and mouth free sheep breed adapted to Fiji conditions and named the result Fiji Fantastic.

In 1993, the sheep breeding project distributed Fiji Fantastic sheep to farmers for breeding and fattening.

The Fiji Fantastic's distinguishing feature is that it is white, produces high quality lean meat with little excess fat, produces twins and triplets which have a high growth rate and low mortality rate.

Fiji now exports this breed to Samoa and Tonga.



If you were requested by your family to develop a sheep herd, explain which breed you would recommend.



There are over 1000 distinct breeds of sheep in the world with each breed raised for its meat, milk, fibre, skin; for pets or show purposes.

There are two breeds which have been cross bred to produce the Fiji Fantastic breed.



In a table with 4 columns, summarise the two breeds of sheep introduced to upgrade local stock in Fiji.

LESSON 4: CLASSES OF SHEEP ON FIJI FARMS

LESSON OUTCOME

At the end of this lesson, the student will identify and compare the classes of sheep used on Fiji Farms.



Wether	- castrated male
Ram lamb	- immature male
Ewe lamb	- immature female
Lamb	- newborn
Flock	- group (3 or more)
Birth weight	- 5 - 8 lb.
Average number born	- 1.1 - 1.4 lambs/year
Weaning age	- 2 - 3 months
Pasture carrying capacity	- 3 ewes & lambs hectare



Sheep are divided into classes based on their age and function on a farm. This classification also assists in determining the husbandry requirements of the animals.

Young sheep, which is yet to be weaned, are called lambs.

Young male sheep are sometimes castrated and are then called wethers. These sheep are reared for sale.

An immature whole male sheep is called a ram lamb while an immature female is called a ewe lamb.

They are usually sold as breeding stock or kept as replacement animals.

Breeding sheep include rams and bucks.

The three main breeds introduced to Fiji are compared below.

	Barbados Black Belly	Wiltshire Horn		Barbados Black Belly	Wiltshire Horn
Ram			Ewe		
	www.raisingssheep.net	d121tcdkpp02p4.cloudfront.net		hobbyfarms.com	hayefarm.co.uk

Wether	 nsi.okstate.edu	 hawkhurstwines.co.nz	Lamb	 dreamstime.com	 encrypted-tbn1.gstatic.com
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Distinguish between each class of sheep by discussing their purpose on a farm.



Explain the function of each class of sheep.



When sheep are categorised in classes, the function and husbandry requirements are easier to determine and carry out.

LESSON 5: IMPORTANCE OF SHEEP

LESSON OUTCOME

At the end of this lesson the student will discuss the importance, advantages and disadvantages of raising sheep.



Landscape - all the visible features of an area of countryside or land, often considered in terms of their aesthetic appeal.



Sheep are unique, fascinating, resourceful, hardy, intelligent, inquisitive, entertaining, sociable and extremely useful animals which are believed to be one

of the first animals to be domesticated.

Advantages of raising sheep:

- Sheep are a source of many items including: i) Meat ii) Milk iii) skin and leather iv) pets iv) "lawn mowers" on landscapes
These items may be used by the farming family or sold.
- Hair sheep acclimatise well in Fiji especially in the drier zones like Western Viti Levu.
- Sheep are easy to handle and generally require little input.
- Sheep production does not require elaborate facilities and equipment.
- Sheep help control weeds so assist with landscaping.
- Sheep utilise waste feed and fodder, grazing the forage at ground level, which goats refuse to eat.
- Sheep require a minimum amount of supplemental feeding.
- Sheep require small areas for housing.
- Sheep tend to eat faster and have more time to rest, chew the cud and therefore gain weight faster than goats.
- Sheep make good companions and family pets.

Disadvantages of raising sheep:

- sheep are less efficient at using coarse and cellulose feed materials.
- sheep will follow the leader even into trouble.

Sheep "lawn mower"



<http://www.thedailywaster.files.wordpress.com>

Sheep following the leader



s-media-cache-ak0.pinimg.com

- c. rams produce a strong musk during the mating season.
 - d. sheep are subject to predation by dogs.
 - e. sheep require better fencing than do cattle.
 - f. internal parasites can create health problems when sheep are intensively grazed.
- Before deciding to raise sheep, a farmer must weigh the advantages and disadvantages.



Compare the advantages and disadvantages of raising sheep.



The sheep industry has developed because of the advantages associated with raising this versatile animal.



Debate the advantages and disadvantages of raising sheep in your area.

LESSON 7: RAW PRODUCTS FROM SHEEP FARMS

LESSON OUTCOME:

At the end of this lesson the student will discuss the main products which sheep are raised for.



Lamb	- flesh from sheep that are less than one year old.
Yearling mutton	- the meat from a sheep that is between one and two years of age.
Mutton	- meat from a sheep that is over one year of age.
Wool	- the fine, soft, curly hair that forms the fleece of sheep and certain other animals.

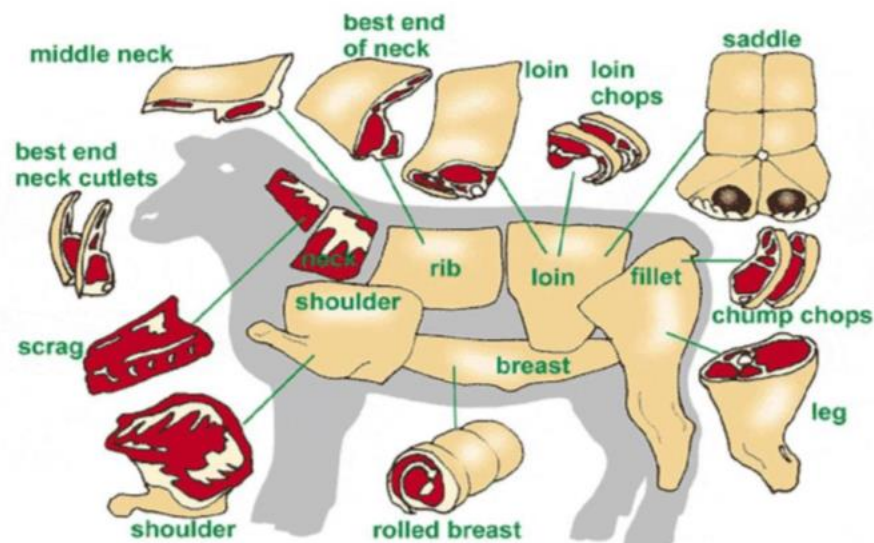
Meat

The most important product we get from sheep is meat.

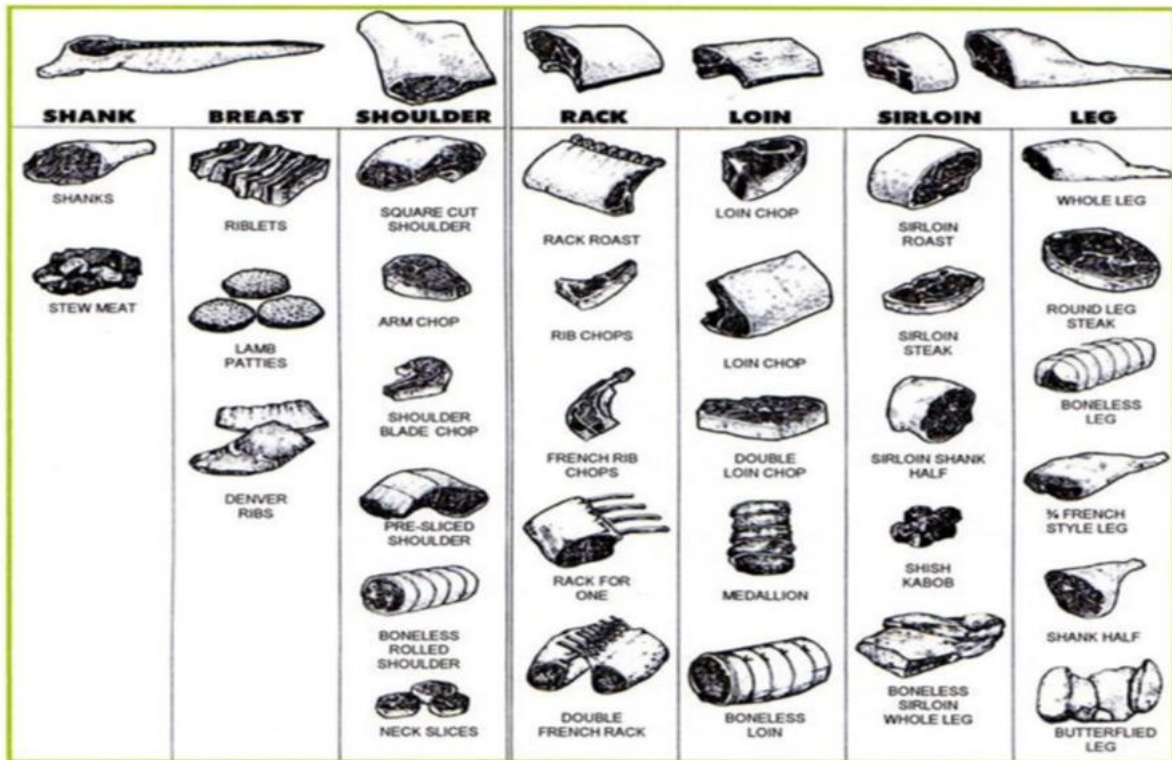
While sheep meat only accounts for 6% of the world's meat consumption, it is the principle meat in regions of North Africa, the Middle East, India, and parts of Europe.

The European Union is the world's largest lamb consumer and number one importer of lamb, whereas 99% of the lamb imported originates from Australia and New Zealand.

CUTS OF LAMB



CUTS OF LAMB IN DETAIL



Source: <http://www.db-farms.com>

Wool

Wool is the product for which sheep are best known. Wool is widely used in clothing from knitwear such as socks and jumpers to cloth used for suits and costumes. It is used in the furniture trade both for making chair covers and for upholstery. Many of the better carpets are made from wool. Wool is used to fill mattresses. It is used in diverse products, such as tennis ball covers, pool table baize, and hanging basket liners.



Adapted from: <http://www.raising-sheep.net>

Alternative uses of wool are increasing. Pads made from wool can be used to soak up the oil from oil spills. In 1999 when an oil spill occurred near Phillip Island, Australia, the Phillip Island penguins were fitted with wool sweaters which helped maintain the tiny penguin's body heat and prevented them from being poisoned by the oil.

There is a company in the United Kingdom that makes caskets out of wool. Several companies are making insulation from wool. Mulch pads made from wool offer an environmentally-friendly alternative to plastic mulches.

Bricks reinforced with wool and seaweed are less toxic than those reinforced with traditional alternatives. Plus, they're stronger. An entrepreneur in England is making packaging material out of left over wool. Not only are the wool-insulated boxes more environmentally-friendly, but they have out-performed poly-based insulating material, keeping items twice as cool.

Wool Casket



<http://thenaturalfuneralcompany.co.nz>



Discuss the sheep industry in Fiji and discuss the potential for meat, milk and wool.



Sheep are raised around the world for many reasons but the three main products of the sheep industry are milk, meat and wool.



Explain why sheep meat and milk are considered healthy foods when compared to meat and milk from other mammals.

LESSON 9: SHEEP BY- PRODUCTS

LESSON OUTCOME

At the end of this lesson, the student will discuss the by-products of sheep and their uses.



Tanning - convert hide (animal skin) into leather by soaking in a liquid containing tannic acid, or by the use of other chemicals.



When sheep are slaughtered and meat is sold, by- products are also available for sale.

Skins

Sheep skins are removed from the carcasses after slaughter. They are treated in a process called tanning and made into soft leather and chamois cloth which are commonly used for washing cars.

Chamois cloth



ebay.co.uk

A small number of skins are preserved and sold as sheepskins, with the wool still attached.

The skins from hair sheep produce the highest quality leather.

Persian lambskin

Persian lambskin is the skin of a new-born lamb, 1 to 3 days old and is known as karakul lambskin. Newly born lambs have tightly-curved, shiny, black fur which is typically used in full-fur garments, such as coats and skirts, and as trimming, edging, lining, and for accessories.

Karakul lamb fur accounts for almost 12% of the world's fur trade, second only to mink.

Garment made of Persian lambskin



<http://www.polyvore.com>

Dairy

Sheep cheese comprises about 1.3% of the world's cheese production. Some of the world's most famous cheeses were originally made from sheep's milk: Roquefort, Feta, Ricotta, and Pecorina Romano. Sheep's milk is also made into yogurt, butter, and ice cream.

Science and medicine

Sheep make many contributions to the fields of science and medicine. They are used as research models to study disease and perfect surgical techniques. They are used in stem cell research. Their blood is the ideal medium for culturing bacteria. Sheep are used to produce pharmaceuticals in their blood and milk. Scientists are using wool proteins to create new wound dressings, bone graft implants, and medical sutures.

Landscape management

While sheep have been used for centuries to control unwanted vegetation, grazing as a fee-based service is a relatively new phenomenon. Along with goats, sheep are the best livestock to use to control unwanted vegetation, such as noxious weeds and invasive plants. Sheep are also a good companion enterprise to solar farming, orchards and tree crops as they can control vegetation under the solar panels and trees, while producing an income.

Intestines

In most cases after the intestines are eviscerated, they would be disposed of. However, they can be converted to many valuable products. Once cleaned, the intestines can be used as:

- i. natural casings for foods such as sausages and frankfurters.
- ii. instrument strings.
- iii. suture material.

By using natural sutures from sheep, veterinarians avoid complications such as immune responses, which arise from synthetic sutures. Also, these sutures are less invasive because the body reabsorbs them over time.

Violin strings



whstatic.com

From Horns, Hooves, & Bone

The horns, hooves, and bones are rich sources of keratin and collagen which are used for their binding ability and strength. Products include: bone charcoal for high grade steel, shampoo and conditioner, bone china, collagen and bone for plastic surgery, horn and bone handles, bone meal, bone jewelry, adhesive tape, gelatin capsules, bone charcoal pencils, marshmallows, piano keys, gelatin desserts (ice cream, yogurt, and jello), film, and shepherd crooks.

Sheep bone jewellery



etsy.com

Manure

The manure contains nitrogen, phosphorous, potassium carbonate, and lower levels of various minerals. Since manure contains these minerals, it is a valuable part of such products as fertilizer and potash.

Fat & Fatty Acids

Fat and fatty acids are processed and:

- i) added to dog and chicken feeds
- ii) are an inexpensive source of energy to fill the needs of the diet.
- iii) through further processing, fats and fatty acids can be used as components in wax products including paraffin, crayons, candles, and floor wax.



THE BACON FAT
Candle
A little bit of bacon in every day.

butternutrition.com

- iv) is a component of other chemicals; glycol is found in brake fluid and glycerol is the ingredient that makes asphalt stick together.
- v) is an ingredient in beauty products such as: makeup, cosmetics, tanning lotion, shaving cream, and hand cream.

From Wool

By-products from wool include: lanolin, artists brushes, insulation, and rug pads. Without wool by-products there would be no baseball because: the ball is stuffed with wool, it is sewn with wool thread, its rubber lining is made from stearic acid, and the cork center contains processed blood.

Lanolin

Raw wool contains 10 to 25% grease or "lanolin," which is recovered during the scouring process. Lanolin consists of a highly complex mixture of esters, alcohols, and fatty acids and is used in adhesive tape, printing inks, motor oils, and auto lubrication. Lanolin is also used in cosmetics and pharmaceuticals. Virtually all cosmetics and beauty aids, such as lipsticks, mascara, lotions, shampoos, and hair conditioners, contain lanolin.

From Hide

As an alternative to expensive leather from beef hides, sheep hides can be used as an economical alternative. Once removed and processed, the hides can be used in the making of sporting goods such as baseballs, footballs, tennis balls, and basketballs. Also, the leather from sheep hide can replace virtually all leather products made from the leather of cattle hide such as footwear and drum heads.

Baseball



wikimedia.org

Beauty aids



<http://blogs.rspca.org.uk/>

Leather footwear



gcdn.indiabizclub.com



Discuss the use of the by-products of sheep production.



Sheep by-products are those products made from sheep apart from meat, milk and wool. These products are also sold in the markets for extra income. Leather, manure, lanolin and insulating material are a few by-products of the sheep industry.



Research the by-products of the sheep industry and present your findings to the class.

AS 11.4.4: PIGS

Content Learning Outcome: AS 11.4.4.1.

The students will explore, discuss, practice and evaluate livestock concepts and relate them to pig farming in Fiji.

LESSON 1: INTRODUCTION:

LESSON OUTCOME:

At the end of this lesson, the student will discuss the origins of the domesticated pig.



Undulate	hoofed animal
Babirusa	- forest-dwelling wild pig with several upturned hornlike tusks, native to Malaysia.
Warthog	- an African wild pig with bristly gray skin, a large head, warty lumps on the face, and curved tusks.



The pig is a member of the family **Suidae**, even toed undulates and is closely related to numerous species of wild pig, such as the babirusa, *Babirusa babirusa* and the warthog *Phacochoerus aethiopicus*.

The domestic pig, *Sus scrofa domestica*, is a descendant of the Eurasian wild boar, *Sus scrofa*, which is native to the Eurasian and African continents.

Babirusa also called pig-deer  blog.nature.org	Warthog  lostworldarts.com	Eurasian wild boar  planet-mammiferes.org	Pig  www.npr.org
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Pigs have been domesticated since ancient times in the Old World. Archaeological evidence suggests that pigs were being managed in the wild from wild boar as early as 13,000–12,700 years ago in the Tigris Basin. Remains of pigs have been dated to earlier than 11,400 years ago in Cyprus.

Pigs were among the first of all animals to be domesticated with the Chinese accredited as being the first to raise wild pigs for food around 6,000 years ago.

Chinese farmers began to domesticate pigs for easy access to meat and lard. Pig hides were used for shields and shoes; bones for tools and weapons; bristles for brushes; their feeding behaviour in searching for roots churned up the ground and made it easier to plough; their sensitive noses lead them to truffles and their omnivorous nature enabled them to eat human rubbish, keeping settlements clean.



According to wikipedia.org, a total of 977.27 million pigs were raised around the world in 2014, yielding 109.075 million metric tons of pork for consumption. China was by far the largest pig producer at 482.4 million head with USA producing 64.78 million pigs that year.

LESSON 2: HISTORY OF PIGS IN FIJI

LESSON OUTCOME:

At the end of this lesson, the student will investigate and outline the history of pigs in Fiji.



Churn

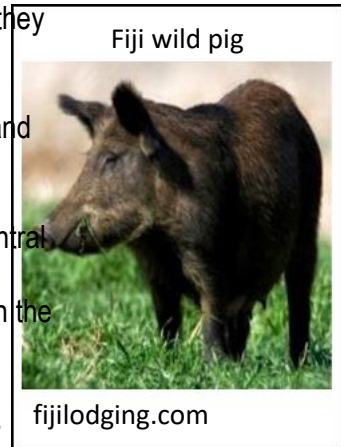
- agitate or turn (milk or cream) in a machine in order to produce butter



Pigs are not endemic to Fiji. They are believed to have been introduced to the country and released by foreigners.

Pre- Commercial pigs rearing in Fiji

- ✳ When the explorers and sandalwood traders voyaged to Fiji, they wanted a protein source other than fish and some suffered from protein deficiency diseases including marasmus and kwashiorkor.
- ✳ To address this situation, it is believed that the early traders and voyagers released pigs on the main islands in the early 19th Century. These pigs were the founding stock for Fiji's wild pigs.
- ✳ Pigs were raised in extensive herds, usually returning to a central area for feeding.
- ✳ In the old days, hundreds of pigs in a semi-wild state rooted in the forest and the scrub near the villages. [Coulter, J.W. 1943, "Fiji: Little India of the Pacific", University of Chicago Press, Chicago]
- ✳ Traditionally pigs have played an important role in indigenous traditions and culture and are presented at important social occasions.



Commercial pig rearing in Fiji

- Pigs were reared for subsistence use while excess animals were sold.
- European soldiers returning from World War 1 after 2018 were given dairy cattle and farm land in Tailevu as payment for leading the Fiji troops which fought for Great Britain. The milk produced was separated so that the cream could be taken to the Rewa Dairy Company in Korovou, Tailevu, to churn into butter for export. To use the skim milk produced, farmers introduced pigs, hence the beginning of the larger pig farms.
- ✳ The pig industry grew out of dairy farms.
- ✳ Commercial pig production is closely related to tourist arrivals, approx. 64% of local pork production entering the hotel trade, 20% is sold from the farm gate for social and cultural occasions and 16% enters the local butcher trade.
- ✳ In the 1980's the Fiji Government supported the industry with the strengthening of the pig section of the Koronivia Research Station. Improved breeds were developed and introduced to commercial farms.
- ✳ The industry has seen a surge in interest in recent years resulting in the industry being 80% self-sufficient in pork production and value adding, valued by the EU at \$32 million. Some pig products like ham and bacon are still imported to cater for the hotel industry needs.
- ✳ Pig research stations continue to supply pig farmers with genetically superior breeding stock to improve production.
- ✳ The main problem affecting production is the heavy infestation of parasites and high cost of feed.
- ✳ There were over 73 697 pigs in Fiji in 2009., with 5 large farms producing 90% of the pigs for sale.



Pig products are not consumed by a large portion of the Fiji population due to religious beliefs [Muslim, Seventh day Adventists, and some Hindus], health reasons and the high cost.



Discuss the development of the pig industry from pre-commercial to commercial production in Fiji.



Pigs are not endemic to Fiji but were introduced by explorers and traders. These first pigs were released into the wild and from them developed the feral pigs which were trapped when needed. The industry developed alongside the dairy industry, and with the help of Government Research, Fiji is 90% self-sufficient in pork.



Explain the relationship between the dairy and pig industry in Fiji.

LESSON 2: BREEDS OF PIGS IN FIJI

LESSON OUTCOME:

At the end of this lesson, the student will investigate and discuss the breeds of pigs raised in Fiji.



- Bacon - the back and sides of the pig, salted and dried or smoked, usually sliced thin and fried for food.
- Pork - the flesh of a pig used as food, especially when uncured



Domestic pigs have been bred for the production of bacon, pork, pets and for show purposes. Breeds are usually classified by their primary purpose but the main breeds raised in Fiji are developed for their ability to withstand high temperatures and sunshine.

There are hundreds of distinct breeds of domestic pigs in the world, many having developed through cross-breeding. Below are some interesting facts:



Source: <http://www.majesticminipigs.com>

Four breeds of pigs were introduced to Fiji's farms to upgrade the existing stock: Large White, Landrace, Duroc and Hampshire. They have an average life span of 8 years.

Large White



First recognised in 1868 the Large White owes its origins to the old Yorkshire breed.

The Large White pig is also known as the English Large White pig or the Yorkshire Pig.

Features include picturesque bearing, erect ears, slightly dished faces, white color, pink skins, long deep sides and large size.

This rugged and hardy breed can withstand variations in climate and other environmental factors; has the ability to cross with and improve other breeds; produce high quality bacon and pork; produce large litters; heavy milk producers; excellent maternal instincts.

While the Large White was originally developed as an active outdoor breed, they do very well in concentrated or confined conditions.

Temperament is sociable, outgoing, and vocal and is quick to learn routines.

Landrace



First recognised in 1895, the Landrace pig was developed in Denmark by crossing a native pig with a Large White.

Features include ears droop and slant forward with its top edges nearly parallel to the bridge of a straight nose, white colour, pink skin.

Landrace pigs are noted for their ability to farrow and raise large litters, length of body, high percentage of carcass weight in the ham and loin, ideal amount of finish. The sows produce large litters and are exceptionally heavy milkers. They are known for their good mothering ability.

Duroc



The Duroc breed originated in New England, America in the 1800's possibly from pigs imported from Africa.

Features include slightly dished face, medium frame with colour ranging from light golden to mahogany.

Duroc pigs can withstand both hot and cold conditions and are less susceptible to heat stress and sunburn.

They have a fast growth rate and produce good carcass quality.

- they are known for being docile with good mothering ability.



Hampshire

The hampshire breed originated in South Scotland and Northern England in the 1800's.

Features include erect ears, black animal with a white strip across the shoulders, front legs and belly.

hampshire are heavy muscled, hardy and good foragers that produce good carcass quality. The sows are prolific and good mothers.

Source: Adapted from <http://www.thepigpage.com>



If you were requested by your family to develop a semi-intensive piggery for the family, explain which breed you would raise.



There are hundreds of breeds of pigs in the world with each breed raised for its meat, skin, for pets or show purposes.

There are four breeds which have been introduced to upgrade the productivity of the Fiji herds viz. Large White, Landrace, Duroc and Berkshire.



In a table with 4 columns, summarise the four breeds of pigs introduced to upgrade local stock in Fiji.

LESSON 3: CLASSES OF PIGS ON FIJI FARMS

LESSON OUTCOME

At the end of this lesson, the student will identify and compare the classes of pigs raised on Fiji farms.



Boar	— whole male pig.
Barrow	— castrated male pig
Gilt	— young female pig, up to and including primiparous.
Primiparous.	— bearing young for the first time
Grower pig	— pig being grown out to market weight, usually 16 weeks.
Porker	— 4 to 6 month old pig slaughtered between 40 and 67 kg, fattened to provide meat such as pork chops.
Baconer	— 8 to 10 month old pig slaughtered between 80 & 100 kg reared for bacon rather than pork.
Sow	— adult female pig



Pigs are divided into classes based on their age and function on a farm. This classification also assists in determining the husbandry requirements of the animals.

Young pigs, under the age of four months are called pigs or piglets.

Young male pigs are sometimes castrated and are then called barrows. These pigs are reared for pork or bacon. Gilts are young female pigs. They are usually sold as breeding stock or kept as replacement animals. Breeding pigs include boars and sows.

The four main breeds introduced to Fiji are compared below.

	Large White	Landrace	Duroc	Hampshire
Boar	 http://www.hypor.com	 http://rattlerow.co.uk	 acutabovesires.com	 http://nationalswine.com
Sow	 http://topigsnorswin.us	 waldogenetics.com	 adambeckshowpigs.com	 brinkgenetics.com
Gilt	 http://www.nucleus-sa.com	 adn-genetic.com	 thepigpage.com	 lensmanshowpigs.com



Distinguish between each class of pig by discussing their purpose on a farm.



When pigs are categorised in classes, the function and husbandry requirements are easier to determine and carry out.



Explain the function of each class of pig.

LESSON 4: IMPORTANCE OF PIGS

LESSON OUTCOME

At the end of this lesson the student will discuss the importance, advantages and disadvantages of raising pigs.



Musk

a strong-smelling reddish-brown substance that is secreted by the male for scent-marking and is an important ingredient in perfumery.



Pigs are unique, fascinating, resourceful, hardy, intelligent, inquisitive, entertaining, sociable and extremely useful animals which are believed to be one of the first animals to be domesticated.

Advantages of raising pigs:

- a. Pigs are a source of many items including:
 - i) pork and bacon
 - ii) skin
 - iii) manure
 - iv) biogas

These items may be used by the farming family or sold.

Pigs eating kitchen wastes



<http://agritech.tnau.ac.in>

- b. Pigs can acclimatise well in Fiji especially if reared indoors.
- c. When well-managed, pigs do not catch many diseases and pests. However, they need to be kept cool to avoid heat stress and clean to avoid parasites.
- d. Pigs are omnivores and can eat a wide range of feed including mature grass, root crops, crop residues, kitchen wastes and abattoir wastes.
- e. Pigs are very social animals and readily adapt to farm routines. They adopt their herders and respond to commands and gestures.
- f. Pigs require small areas for housing.
- g. Pigs make good companions and family pets.

Disadvantages of raising pigs:

- a) pigs are monogastrics, so need a balanced diet each day.
- b) pigs are very inquisitive and will find new games to play with anything in their pens, even their siblings tails.
- c) pigs learn routines quickly and will shun new herders and create a lot of noise until satisfied.
- d) Pigs are very clever so can find ways out of confined areas like climbing over or burrowing under fences and opening doors and gates.
- e) pigs will readily break out of confined areas and follow other pets or revert to living in the feral state.
- f) boars produce a strong musk during the mating season.
- g) pigs like to wallow in mud to control parasites but also enjoy a daily bath.
- h) pigs are susceptible to disease when overcrowded and share the same diseases as other mammals.

Before deciding to raise pigs, a farmer must weigh the advantages and disadvantages.



Compare the advantages and disadvantages of raising pigs.



The pig industry has developed because of the advantages associated with raising this clever and versatile animal.



Debate the advantages and disadvantages of raising pigs in your area,

Pet pig



<http://i.telegraph.co.uk>

Escaping pig



LESSON 12: RAW PRODUCTS FROM PIG FARMS

LESSON OUTCOME

At the end of this lesson the student will discuss the main products which pigs are raised for.



Suckling pig	- 2 to 6 week old pig which is slaughtered for roasting.
Pork	- the flesh of a pig used as food, especially when uncured.
Bacon	- cured meat from the sides and belly of a pig, having distinct strips of fat and typically served in thin slices.
Spare ribs	- a cut of meat from the rib section, especially of <i>pork</i> or beef, with some meat adhering to the bones
Loin	- the sides between the lower ribs and pelvis, and the lower part of the back.
Gammon	- Gammon is hind leg of pork after curing.
Ham	- meat from the upper part of a pig's leg salted and dried or smoked.



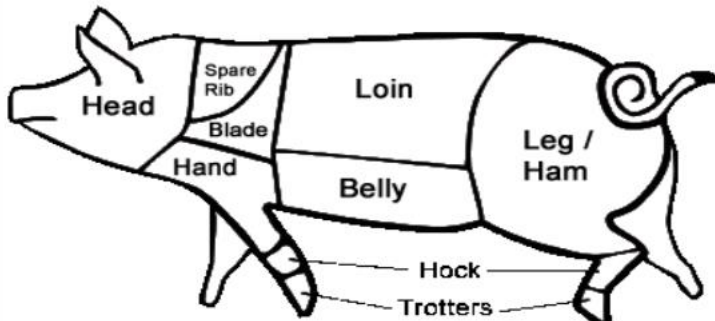
Humans find both living and dead pigs useful.

Pig meat is the most widely meat consumed in the world [40 %] and most pigs raised in Fiji are for meat purposes.

Pig meat has different names according to the age of the animal slaughtered, the part that the meat is harvested from and the curing method used

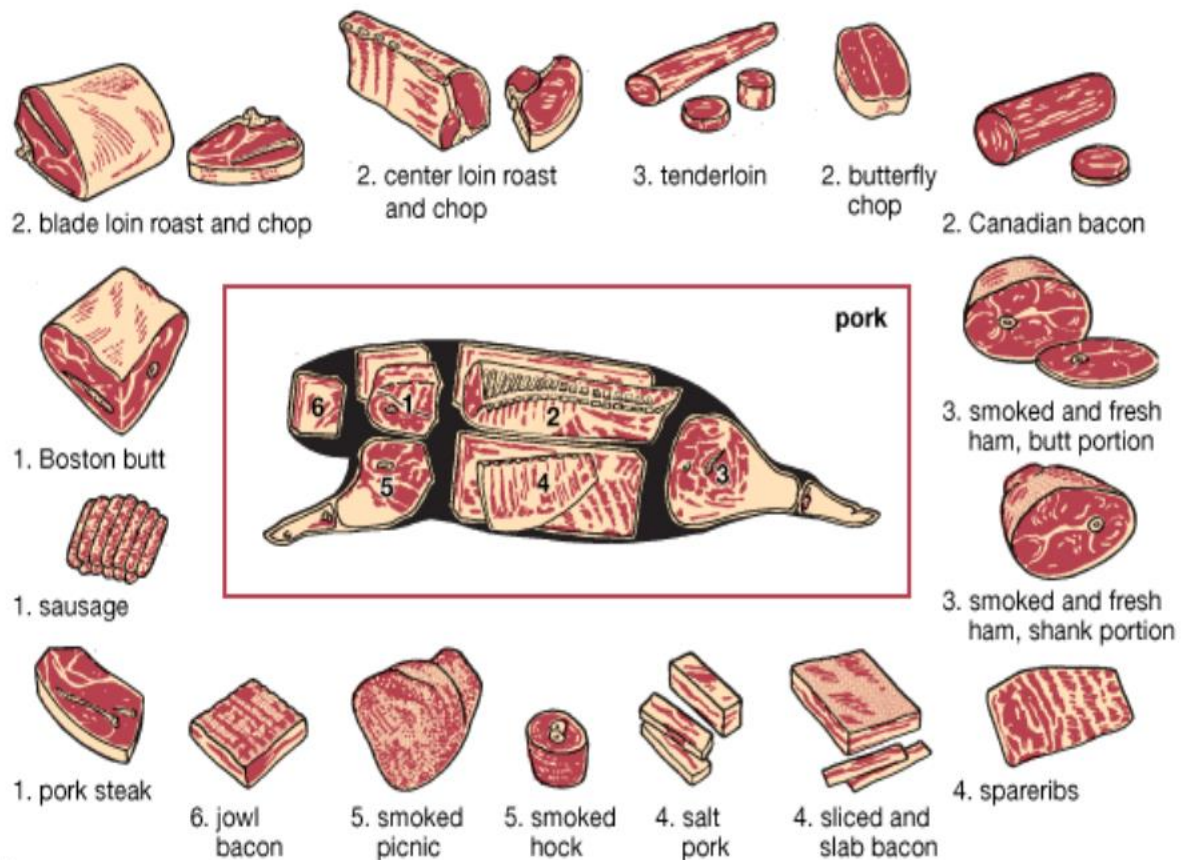
The FAO estimated that the world will produce 1 billion pigs in 2015 [<http://www.fao.org>]

Pig cuts



Source: <http://www.westwitteringbutchers.co.uk/>

PIG CUTS



© 2011 Encyclopædia Britannica, Inc.

Source: <http://www.yvonnebeuker.files.wordpress.com>



Discuss the pig industry in Fiji and the potential for the main products mentioned above.



Pigs are raised around the world for many reasons but the main product of the pig industry is meat.



Discuss some of the ceremonies and occasions when pigs are presented.

LESSON 15: PIG BY- PRODUCTS

LESSON OUTCOME

At the end of this lesson, the student will discuss the by-products of pigs and their uses.

	Gelatine	- virtually colourless and tasteless water-soluble protein
	Glycerine	- sweet, syrupy liquid obtained from animal fats and oils or by the fermentation of glucose.



When pigs are slaughtered and meat is sold, by- products are also available for sale or use to produce other useful products. Every part of the pig, from the trotter to the snout, has a use. Below is a list of some of the 185 products.

1. Testing – due to the similarity between pig and human tissue, the pig is used for testing chemicals used in weapons, cleaners, makeup, medications etc.
2. Insulin – is taken from the pancreas for treatment of human conditions like diabetes.
3. Body parts – skin, blood vessels and organs are transplanted from pigs to humans.
4. Pigs hair
 - a) Fertilizer – made from processed pig hair.
 - b) Paint brush – made from pig hair
 - c) Bread – protein from pig hair is used to soften dough.
5. Gelatine
 - a) Ice –cream - gelatine is used to regulate sugar crystallisation and slow down the melting process.
 - b) Low fat butter – gelatine replaces fat for texture.
 - c) Beer – gelatine reacts with tannins to make liquid clear.
 - d) Fruit juice – gelatine absorbs cloudy elements to give clear drinks.
 - e) Wine – gelatine absorbs cloudy elements to give clear wine.
 - f) Medicine tablets – gelatine is used to harden the shell.
 - g) Paper – bone gelatine is used to improve stiffness and reduce moisture.
 - h) Cork – bone gelatine acts as a hardener.
 - i) Photographic film- bone gelatine acts as a bonding agent.
 - j) Cream cheese – gelatine used as stabilising agent.
 - k) Whipped cream – gelatine gives texture.
 - l) Sweets – gelatine used for binding and gelling and forming texture in sweets like liquorice, wine gums, chewing gum etc.



<http://www.thepoisonreview.com>

Photographic film



<http://www.wordpress.com>

6. Fatty acids

- a) Fabric softener – fatty acids from bone fat gives colour
- b) Shampoo – fatty acids from bone fat used to give the pearl like appearance.
- c) Candle – fatty acids from bone fat are used to stiffen the wax and raise the candles melting point.
- d) Washing powder – fatty acids from the bone fat hardens the powder.
- e) Paint – fatty acids from bone fat increases gloss.
- f) Bullets – bone gelatine used to help transport the gunpowder or cordite into the casing.
- g) Soap - fatty acids from the bone fat acts as a hardening agent and adds colour.
- h) Beauty products – moisturisers and other beauty products made with pig fatty acids.
- i) Crayons - fatty acids from the bone fat acts as a hardening agent.

7. Pigs Bladder Tambourine – made from pigs bladder.

8. Intestines – heparin is taken from the mucus in the intestines and used to stop the formation of blood clots.

9. Pig bone calcium – is used in some yoghurt.

10. Pig bone glue – used to improve the quality and texture of leather.

11. Pig snout – dog snack made from deep fried pig snout.

12. Pig bone ash – used to produce train brakes.

13. Pig bone fat – glycerine from bone fat used to give toothpaste texture.

14. Pig Collagen

- a) hide glue for woodworking produced from pig collagen.
- b) face mask for reducing wrinkles produced from pig collagen.

15. Pig Blood

- a) Cigarette filters - haemoglobin from blood used in cigarette filters.
- b) Dog food treat – haemoglobin used as a red colouring agent

16. Photodynamic therapy- haemoglobin used in drugs to treat retina decay in the eye.

17. Pig wastes

- a) Used to produce bio-gas
- b) Used as fertilizing material



Discuss the use of the by-products of pig production.



Pig by-products are those products made from pigs apart from meat. These products are also sold in the markets for extra income.



Research the by-products of the pig industry and present your findings to the class.

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