Book 3

Year 9

Agricultural Science

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Year 9 Book Three

GOVERNMENT OF SAMOA
DEPARTMENT OF EDUCATION

Acknowledgements

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Unit 1: IMPORTANCE OF CROP PRODUCTION

Objectives

At the end of this unit you should be able to:

1. Explain the importance of crop production.
2. Name some common crops grown for family consumption.
3. List some common fruits, vegetable and root crops which can be sold in the market.
4. List agricultural products that are exported from Samoa.
5. Interpret information on crop production.

Introductory Questions

1. Can you identify the crops shown or used, in the illustrations and photographs on the following two pages?
2. Which crops do you grow in your home garden?
3. Do you sell them?
4. What are some other important reasons for crop production apart from food and income?

Background Information

Growing crops is very important because we need food to provide our bodies with the energy they need. By producing a variety of crops we can meet most of our nutritional needs.

Root crops like taro are energy foods that give us energy for work and play. Crops like peas and beans give us proteins to make us grow tall and muscular. Vegetables and fruits give us minerals and vitamins. Seeds and nuts give us fat.

Crops are also important because we can sell them for money to buy things we need but cannot grow or make. The crops that we sell for money are our "cash crops".

Production of various crops also plays an important role in meeting our traditional and social obligations. Surplus food produced on the farm can be given to relatives or sold for cash to meet other social and financial needs. Over the years, pests, diseases, natural disasters and world market prices have influenced the production of cash crops in Samoa.

This has led to the decline in the production and export of some major cash crops like cocoa and taro.


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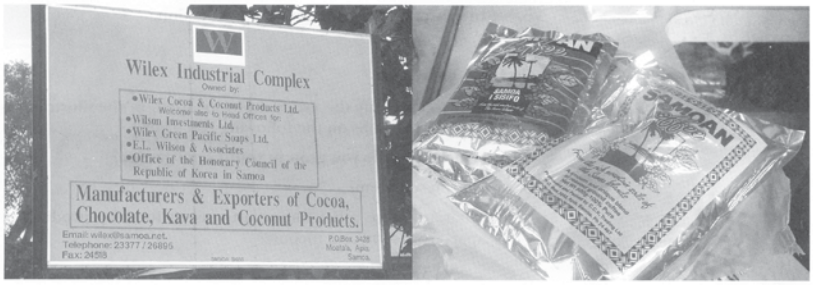
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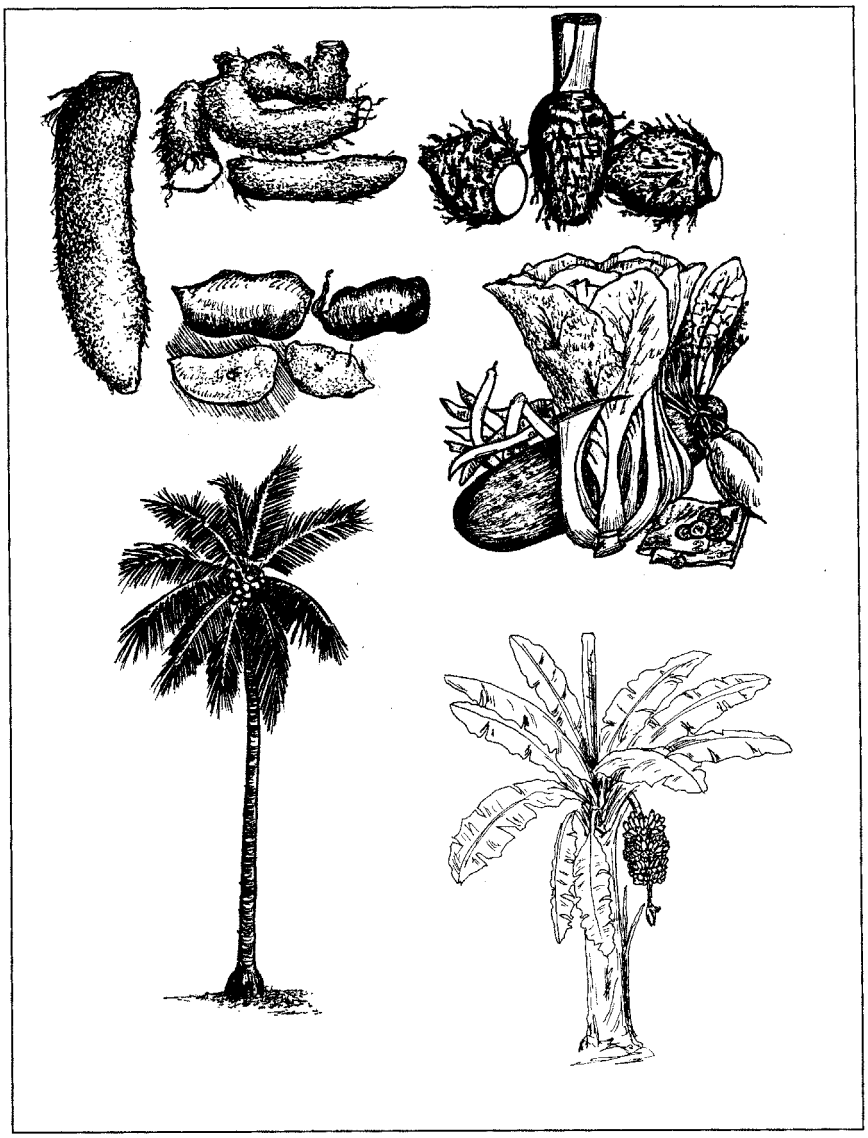


ACTIVITY A — Interview

Materials/Equipment

- No equipment needed for this activity.

In this activity you will go out and interview a farmer in your village using the questions given below. If you live in town, interview a farmer at the market.

Instructions

1. Select a crop farmer.
2. Interview the farmer using the following questions.
   i. What crops do you grow?
   ii. Which crops do you use for food at home?
   iii. What crops do you sell?
   iv. What other needs do you use your crops to provide for?
   v. What problems do you come across when growing these crops?
3. Summarize and discuss your results with your class or partner.

ACTIVITY B — Export Analysis

Materials/Equipment

- No equipment needed for this activity.

Instructions

1. Divide into groups of four.
2. Study Table 1.1.
3. Discuss and answer the questions that follow.

Table 1.1. Quantity and Value of Major Exports, 1994 -1999(Thousands of Tala).

Period	Total Value ($000)	Samoan Cocoa		Banana		Taro		Coconut Cream		Coconut Oil	
		Quantity (mtons)	Value ($000)	Quantity (mtons)	Value ($000)	Quantity (mtons)	Value ($000)	Quantity (mtons)	Value ($000)	Quantity (mtons)	Value ($000)
1994	4777	0	0	91	185	51	73	1211	4519	0	0
1995	13672	11	56	504	594	70	137	1380	4843	6782	842
1996	12534	18	103	496	616	31	77	1413	4913	6489	825
1997	12241	12	237	354	394	28	77	1343	4772	5675	761
1998	7961	5	59	124	144	37	107	1070	3517	2770	134
1999	7876	7	97	224	409	110	432	1443	4550	1633	388

(Source: Department of Customs and Department of Statistics)

*** mtons = metric tons**

Note: Export are valued f.o.b. (free on board). Samoan cocoa represented here is actually the drinking puree and not the raw bean.

DISCUSSION QUESTIONS

1. There were no cocoa exports from 1992 to 1994. What could have been done to improve the situation?
2. Which of the commodities in the table was the highest export earner from 1994 to 1999?
3. What was the highest value of exports for this commodity (from 2 above) and in which year was this?
4. What was the lowest value of exports for the highest export earner?
5. What do you think has caused this sudden drop in the export earnings of this commodity?
6. There had been no export of bananas in 1991 and 1992. What could be the reasons for this?

ACTIVITY C

Interview

Materials/Equipment

- No equipment needed for this activity.

Instructions

1. Use the information in Table 1.1 to plot your graphs.
2. Using graph paper plot the value of cocoa, banana, taro and coconut oil that Samoa exported from 1994 to 1999. Label the x-axis as Years and y-axis as Value($).
3. Write a heading for the graph and label the graphs and x and y axis.
4. Try and answer the following questions;
   - i. What is the general trend of taro exports?
   - ii. In what year did taro exports peak?
   - iii. What was the value of Samoan cocoa exported in 1996?
   - iv. How does it compare with the value of bananas exported in the same year?
   - v. Samoan cocoa and coconut oil exports were nil in 1994. Can you suggest some possible reasons for this?
   - vi. Which commodity was the major export earner in 1999?
   - vii. In which year did Samoa earn the most from exports?

Review

1. Give reasons for the importance of producing crops.
2. Why do we export crops to other countries like New Zealand and the USA?
3. List some of our major export commodities.
4. List some agricultural products that are processed in Samoa.
5. Describe the current crop export trends in Samoa.

Unit 2: PLANT FEATURES

Objectives

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

1. Describe the main parts of a plant and explain their functions.
2. Investigate and compare features of crop types.

Introductory Questions

1. Name four main parts of a plant?
2. What does each of these parts do for the plant?
3. What use does man make from these parts?
4. Why are plants so important to all animals?

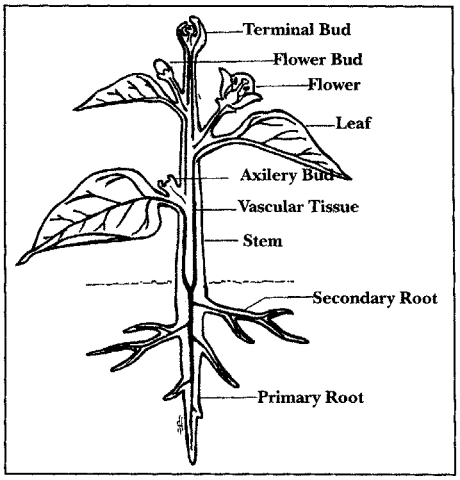
Background Information

The body of a plant is made up of distinct parts known as the roots, stems, leaves, flowers, fruits, and seeds. The organs are composed of different kinds of tissue. The tissue supports various functions such as storage, conducting, supporting and protection. Tissue is made up of cells. The cell is very important because it is the location of all the hereditary material which is passed on from one generation to another.

The growth of plants is a process of mature cells dividing. The rate of growth depends on many factors; among them are food materials available, temperature, sunlight, and water. As plants grow and develop, cells unite to perform various functions. Some cells form a conducting tissue called phloem. The main function for phloem is to move food such as sugar and proteins to parts of the plant. Other cells form the woody portion, the xylem, which transports water and strengthens the tissue of the plant.

The growth process may be said to be the division, enlargement, maturation and specialisation of cells. As these cells grow, divide and specialize they perform basic plant functions of photosynthesis, respiration and transpiration.

Fundamental Plant Parts.



Roots

The root is the part of the plant that ordinarily grows downward into the soil, anchoring the plant and absorbing water and an inorganic salt solution. Not all roots are underground; the prop roots of corn and the air roots of orchids are examples of roots that mainly stay above ground. Unlike stems, roots do not divide into nodes so they tend to branch irregularly.

Roots are used by plants in different ways but the main functions are: absorption, conduction, anchorage and storage. It is important to the plant that materials are absorbed from the soil by the roots and are then passed to the stem. The tiny root hairs that are in close contact with the soil are responsible for the absorption. The xylem of the root is continuous with that of the stem and through these tubes the water and nutrients can be distributed to the rest of the plant.

It is important that the plant receives air and light. For many plants this is accomplished by having an upright stem and extending branches. Roots support and anchor the plant to the soil. Deep roots can do this better than shallow roots especially during high winds.

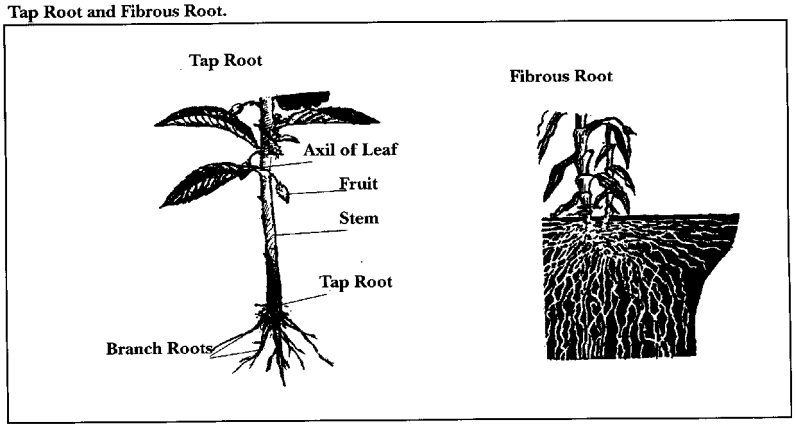
For roots to grow it is necessary that there be air and water in the soil. In poorly aerated soils roots die slowly. The more root hairs the plant has, the more nutrients it can absorb and the better crop it produces. It is important to prepare soil for plants to stimulate root growth.

In most plants, part of the food manufactured in the leaves is carried to the roots and stored there until it is needed. Many roots become large and fleshy as a result of starch storage.

Roots are classified as primary, secondary and adventitious roots; also tap, fibrous and fleshy. Studies have shown that the roots are of greater mass than the plants they support.

Roots need water and will grow toward a moisture supply.

Tap Root and Fibrous Root.



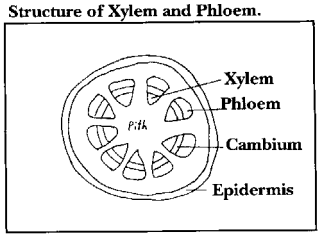
Stems

The most important functions of the stem are support of the leaves, flowers and fruits, the conduction of water and nutrients, and food storage. The leaves carry out the process of photosynthesis. After the food is made, the stem provides a pathway through which the food is carried from the leaves to the other regions of the plant. Similarly, the stem supports the flowers, fruits and seeds, and provides the pathway through which these organs are supplied with the necessary food for development.

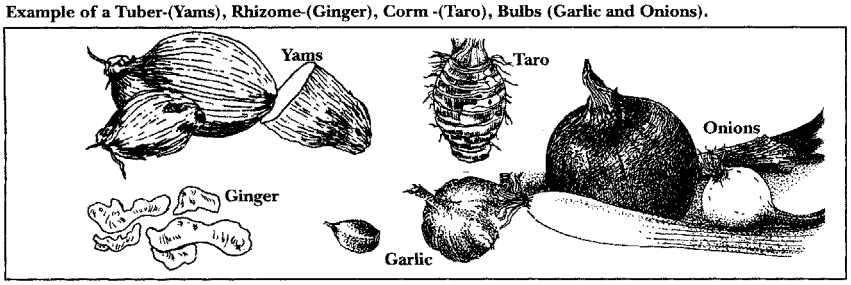
Some stems act as the food storage containers as in sugar cane. For some plants like cactus, they act as a water storage tank. At times, the stem is a means of propagation as for laupele. While most stems are erect structures, some remain underground, others creep along the surface of the ground and others are short and hidden.

There are two types of conducting tissues ie., channels or tubes found in stems - the phloem and the xylem. The phloem carries food substances such as sugar and proteins to and from the various parts of the plant. Xylem carries water and minerals from the roots to the stems and leaves.

Structure of Xylem and Phloem.



Example of a Tuber-(Yams), Rhizome-(Ginger), Corm -(Taro), Bulbs (Garlic and Onions).



Some stems are mistaken for roots because they grow underground. There are four possible kinds of underground stems – rhizomes, tubers, corms, and bulbs.

Leaves

Leaves are an important part of plants. The main functions of leaves are:

1. To carry out photosynthesis.
2. To allow carbon dioxide from the air to pass into the plant.
3. To allow water vapour to pass out into the air.
4. To store protein, vitamins and other plant food.

Being rich in chlorophyll, they are responsible for the green colour of forests and fields. Leaves grow on the stems. The part of the stem that the leaf attaches to is called the **node.** The upper angle that the leaf makes with the stem is called the **axil**; sometimes there is a bud found in the axil but it is too immature to be seen by the naked eye.

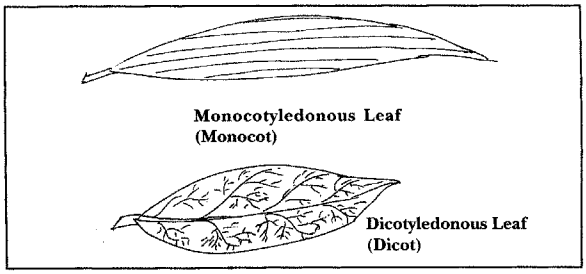
A complete leaf consists of the **lamina** or blade, which is attached to the stem by a **petiole.** When any of these parts are lacking the leaf is said to be incomplete. The lamina is strengthened by the presence of veins. These veins are made up of connecting tissue, which is continuous with the petiole. The vein serves to distribute water and dissolved inorganic salts throughout the lamina, and to carry away foods as they are made.

There are two **vein patterns**, parallel and net. In parallel veined leaves, the main veins run from the base to the tip. In the net veined leaves, the veins branch many times and form a complete network through the leaf.

The outermost layer of cells is called the **epidermis** and acts as your skin does. The epidermis has many small pores known as **stomata**. Stomata are tiny holes in leaves that allow carbon dioxide (CO_2) from the air to enter the leaf and allow water and oxygen (O_2) to escape. There are about 125,000 stomata on an average leaf.

The leaf is the center of two very important processes; photosynthesis and transpiration. Probably no other plant processes have been studied more and yet little is still known about the processes.

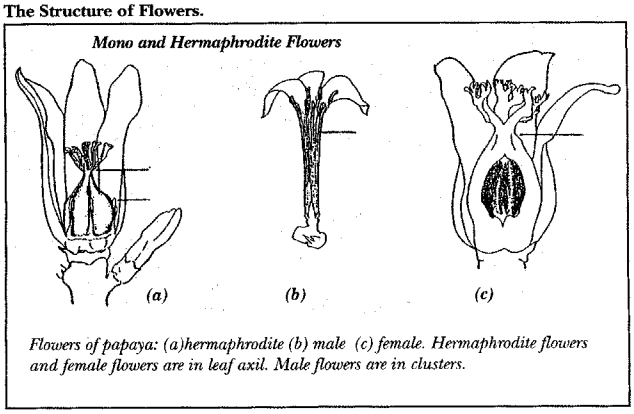
Structure of Leaves.



Flowers

The flower is the structure concerned with reproduction processes of plants. Flowers lead to the production of fruit and seeds. Flowers may be composed of as many as four different sets of organs: sepals, petals, stamens, and pistils. The stamens are the male organs, the pistils the female organs. The petals are the bright part of the flower used to attract pollinating insects. The sepals are underneath the petals and give them support. They also provide protection to the inner parts of the flower during early stages of growth. They are usually green and leaf-like.

The Structure of Flowers.



Flowers of papaya: (a)hermaphrodite (b) male (c) female. Hermaphrodite flowers and female flowers are in leaf axil. Male flowers are in clusters.

Fruit

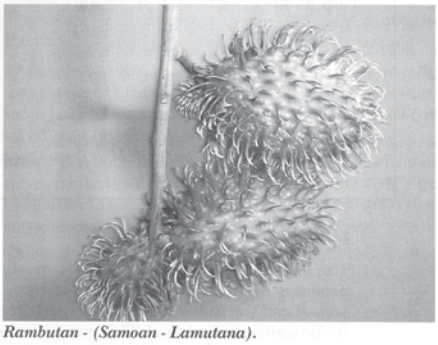
The fruit is a container for the seeds, much like packaging for other food products. Bright colored and sweet-smelling fruits will attract animals. An animal eats the fruit and seeds and then drops them in another spot in the fertile waste of the animal. This promotes the growth of new plants.

Fruits are full of sugar and energy food for humans and other animals.

Fruits.

Hawaiian Solo Papaya - (Samoan - Esi Hauai).

Pomelo- (Samoan - Pomelo poo le meleke).

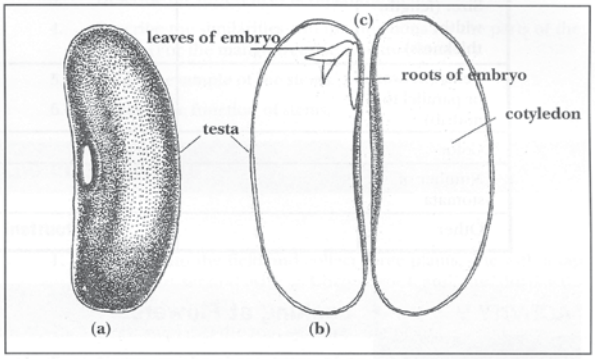


Rambutan - (Samoan - Lamutana).

Seeds

A seed has been described as a plant packaged for shipment. Seeds are crucial for the survival of the species. They contain the embryo of a flowering plant as well as a supply of stored food. The seed structure is protected by a seed coat. Seeds are food for animals and spread new life. Many seeds have built in dormancy mechanisms that ensure the seed does not germinate until just the right growing conditions exist.

Picture of a Bean Seed and the Parts of a Seed.



(a) A bean seed.
(b) The two halves of a bean seed showing the embryo.
(c) The embryo.

ACTIVITY A

Looking at Leaves

Materials/Equipment

1. Hand lens.
2. Broad and narrow leaves.
3. Microscope (if available).

Instructions

1. Divide into groups of three.
2. Go outside and collect three leaves – one from a grass, the second from a tree and the third from a small plant.
3. Observe and draw the three leaves.
4. Label the parts of the leaf.
5. Compare the leaves and complete Table 2.1.
6. After completing the Table 2.1 try and answer these questions:
   i. What is the function of the leaf?
   ii. Why do the leaves have different shapes?
   iii. Why are the leaves of different size?
   iv. How might the size and shape of leaves help them control their internal temperature?
7. Discuss the results with your group.
8. Present your results to the class.

Table 2.1 Comparison of Different Leaves.

Features of the leaf	Type of leaf		
	Narrow leaf e.g., grasses, maize, bamboo.	Broad leaf e.g., taro, bean, laupele.	Tree e.g., pawpaw, mango, breadfruit.
Shape			
Size: (length, width, thickness)			
Veins (network or parallel to midrib)			
Color			
Number of stomata			
Other			

ACTIVITY B — Looking at Flowers

Materials/Equipment

1. Two different flowers.
2. Hand lens.
3. Sharp scalpel.

Instructions

1. Divide into pairs.
2. Go out and collect two different flowers (preferably from crops).
3. Observe, discuss, draw and label the flowers.
4. Compare the flowers and complete Table 2.2.
5. Present your results to the class.

Table 2.2 Comparison of Two Types of Flowers.

Features of a flower	Flower	
	A	B
Type of flower (have both male and female parts on flower or only one sex).		
Number of petals.		
Colour of petals.		
Number of stamens.		
Number of sepals.		

ACTIVITY C — Looking at Stems

Materials/Equipment

1. Banana tree stem.
2. Mango tree stem (mature).

Instructions

1. Cut a cross section of each of the trees.
2. Using a magnifying glass look at the structures in each of the stems.
3. Describe the differences between the stems.
4. Describe the similarities and the functions for the parts of the stems. (For the mango tree use a mature branch).
5. Draw an example of the stems.
6. Explain the function of stems.

ACTIVITY D — Looking at Roots

Materials/Equipment

1. Tap root.
2. Fibrous root.
3. Adventitious roots.
4. Hand lens.
5. Ruler or measuring tape.
6. Plastic bags.

Instructions

1. Go out into the field and collect three plants, one with a tap root, the second with a fibrous root and the third with adventitious roots.
2. Draw and label the root system of the plants you collected.
3. Compare the three types of root system and state their advantages and disadvantages.
4. Complete Table 2.3 below.
5. Divide into groups of five and discuss the differences between the three root systems.

Table 2.3

	Root System		
	Tap Root	**Fibrous Root**	**Adventitious Root**
Features; (shape, length, number, other features).			
Advantages.			
Disadvantages.			

ACTIVITY E

Comparing Features of Crops

Materials/Equipment

1. Samples of taro, taro palagi and ta'amu.
2. Samples of different crop species – taro, ta'amu, beans.

You can either do this activity in the classroom by bringing in plant samples or go out into the garden and do your investigation.

Instructions

1. Observe the plant features of taro, taro palagi and taamu plants.
2. Draw and label the different features of each plant.
3. Compare the leaves, stems, and roots by completing Table 2.4.
4. Divide into groups of five and discuss the similarities and differences between the three aroids.
5. Follow instructions 1 to 4 for a crop species and complete Table 2.5.
6. Present your group's results to the class.

Table 2.4 Comparison of the Plant Features of Taro, Taro Palagi and Ta'amu.

Plant feature	Taro	Taro palagi	Ta'amu
Leaf (shape, size, number, color, orientation).			
Flower (shape, size, number, color).			
Stem (shape, size, number, color).			
Root (shape, size, number, color).			

Table2.5 Comparison of the Plant Features between Two Crop Varieties.

Plant feature	Crop	
	Variety 1 e.g., Ta'amu Toga.	**Variety 2** e.g., Ta'amu Niukini.
Leaf (shape, size, number, color, orientation).		
Stem (shape, size, number, color).		
Root (shape, size, number, color).		

Review

1. Why are plants important to us?
2. Why do leaves have different shapes and sizes?
3. Which part of the taro, taro palagi and ta'amu do we eat?
4. Give reasons why plants have different root systems.
5. What advertising methods do plants use to attract insects and animals?
6. What are the functions of the leaf, flower, stem and root?
7. What are some advantages of having both the male and female parts of a flower on the same flower?

Unit 3: MANAGING PLANT GROWTH

Objectives

At the end of this unit you should be able to:

1. Explain the importance of good crop management.
2. Irrigate the soil.
3. Drain excess water from the soils.
4. Control weeds, insect pests and disease.

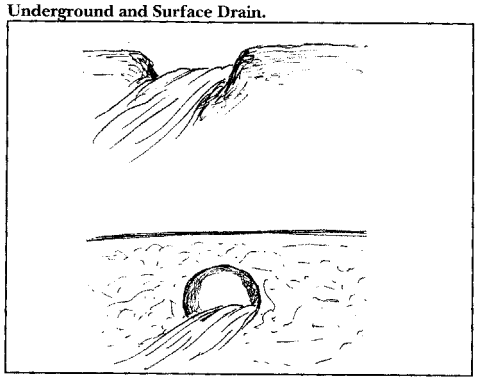
Background Information

Drainage and Irrigation

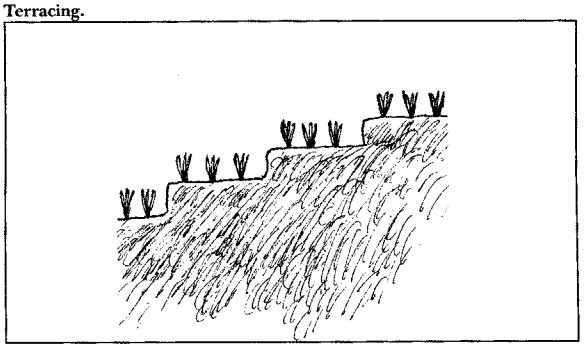
All plants need regular water for the many of the processes that take place in plants, for example, photosynthesis and transpiration. Water can be supplied to plants in many ways. The natural method is by rain. When there is no rain, farmers can supply water to plants by hand watering using a watering can, buckets, or hose pipe. On big farms, watering is controlled using sprinklers and drip irrigation methods.

Excess water causes flooding and reduces the amount of oxygen available to plants. Too much water in the soil can increase the soil acidity. These can have negative effects on plant growth. Therefore excess water should be removed from soils. Some methods that can be used to remove excess water include surface and underground drains, terracing and making raised beds.

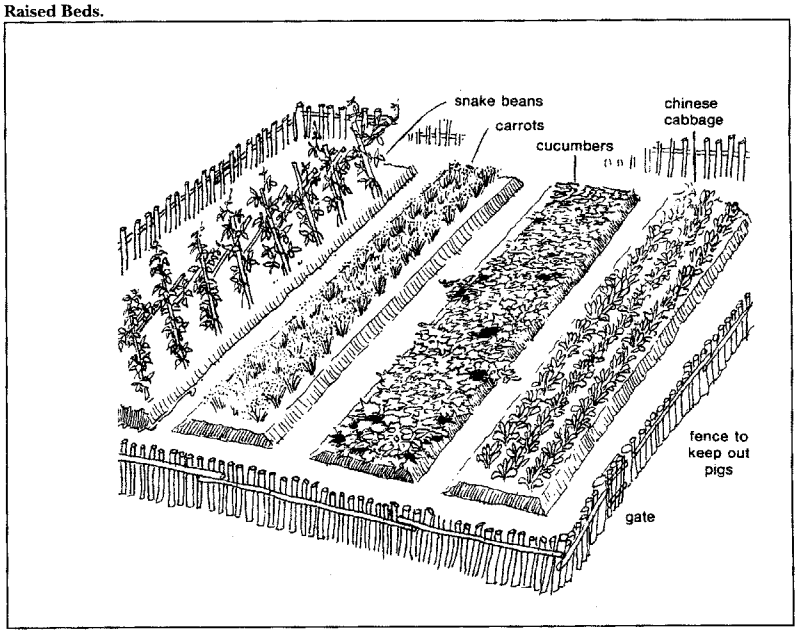
Underground and Surface Drain.



Terracing.



Raised Beds.



Importance of Good Management

Good management of an enterprise simply means providing everything a plant needs in order to produce high or maximum yields. For example, a farmer planting cucumber will ensure that all the correct husbandry practices are followed:

- The cucumber is planted during the cool season.
- The soil is kept fertile and is prepared well.
- Water is provided regularly at the right time or drained if there is an excess.
- Weeds, insect pests and diseases are controlled.
- The cucumber plant is staked to receive maximum sunlight and it is harvested at the right time. Table 3.4 contains information that is required to manage cucumber, dwarf beans, Chinese cabbage and laupele.

Good management will result in high yields. This means that a farmer will be able to sell more cucumbers and receive a better income. Good management also ensures that farm resources like land, labor, capital and fertilizer are used wisely.

ACTIVITY A

Importance of Crop Management

Materials/Equipment

1. Class garden plot.
2. (Use another class' garden for observation if your class does not have a garden ready).

In this activity you will visit your class garden and observe how you have managed your plots.

1. Visit your class garden plot.
2. Select one well-managed plot and one not so well managed plot for the class to observe.
3. Divide into groups of 4 or 5.
4. Observe the two plots in groups.
5. Discuss the differences between the plots and answer the questions in Table 3.1 and 3.2.
6. Present your table to the class for discussion.

Table 3.1 Observations of How the Garden is Managed.

List some differences between the two plots:		
Area	**Plot A (Well-managed)**	**Plot B (Not well-managed)**
1.Plot (size and height)		
2.Soil preparation (degree of preparation)		
3.Plant spacing (correct, too wide or narrow)		
4. Weeds, insect, pests, and disease (existence and levels)		
5. Growth of plants (colour, health, yield, quality and quantity)		
6. Drainage and irrigation (method used)		
7.Techniques used; (mulching, staking, inter-planting, phase planting, etc.)		

Table 3.2 Observations of How the Garden is Managed.

A. How can the plot that was not well-managed, be improved?
1.
2.
3.
4.
5.
B. Why is good crop management important?
1.
2.
3.
4.
5.

Table 3.4 Information on Cucumber, Dwarf Beans, Chinese Cabbage and Laupele.

Crop	Varieties	Planting Material/ When to plant	Spacing /Soil type	Fertilizer	Weed control	Disease and control	Insect and control	Matures in...	Yield (t/ha) tonne
Cucumber (Cucumis sativa)	Market King. Early - Perfection. Progress. Southern-Cross. Early Set. Spacemaker.	2 kg/ha. All year round. Better from April to September.	**Rows:** 1.5m. **In-rows:** 30cm Fertile well drained.	NPK. Urea. Poultry manure.	Hand weed. Hoeing.	Powdery mildew. Gummy stem blight. Anthracnose. ***Control*** *– Spray Mancozeb.*	Beetle. Aphid. ***Control*** *– Spray Ambush and Orthene.*	42-56 days.	15-20 t/ha.
Dwarf beans (Phaseolus vulgaris)	Contender. Top Crop.	35-50 kg/ha. All year round. Best from April-September.	**Rows:** 50-90 cm. **In-rows:** 15cm Fertile well drained.	NPK. Urea.	Hand weed. Hoeing.	Leaf spot. Rust. ***Control*** *– Spray Mancozeb.*	Pod Borer. Leaf Miner. ***Control*** *– Spray Ambush and Orthene.*	50-60 days.	7-10 t/ha.
Chinese cabbage (Brassica cernua)	Wong Bok. Pak Choy. Kwang Moon. Saladeer. Tropicana. Pe-tsai.	300 kg/ha. All year round. Better in the cool season.	**Rows:** 30-60 cm. **In rows:** 15-20 cm. Fertile well drained.	NPK. Urea.	Hand weed. Hoeing.	White rust. Soft rot. ***Control*** *– Spray Mancozeb and Thiram.*	Diamond-back moth, Cutworms. Aphids. Caterpillars. ***Control*** *– Spray Ambush, Dibron, Orthene, Diazinon and Tridex.*	40-50 days.	15-25 t/ha.
Laupele (Hibiscus)	White local.	53000 /ha. cuttings. All year round.	**Rows:** 60cm **In rows:** 30cm. Fertile well drained.	NPK. Urea.	Hand weed. Hoeing.	Root rot.	Leaf Miners. Beetles. ***Control*** *– Spray Sevin, Orthene and Ambush.*	56 days.	10-15 t/ha

ACTIVITY B

Removing and Adding Water from Soil (Drainage and Irrigation)

Materials/Equipment

- No equipment needed for this activity.

In this activity you and your partner will plan how to drain and irrigate your class garden.

If you have already made your plot you will assess the plot and suggest any drainage and irrigation improvements required.

Instructions

1. Visit your garden site.
2. Select a partner you will be working with on your plot in the garden.
3. Plan and sketch a drainage system for your garden.
4. Plan and sketch a watering/irrigation system for your garden.
5. Present your plan to the class for discussion.
6. Select the most practical and economical drainage and irrigation system for use.
7. Use the drainage and irrigation system in your garden.

ACTIVITY C

Weed, Insect Pest and Disease Investigation

Materials/Equipment

1. Hand lens.

In this activity you will, in groups, investigate the common weeds, pests and diseases of cucumber, dwarf beans, Chinese cabbage and laupele. (Information is available from the USP library and the Information section or Nu'u Research Station of the Ministry of Agriculture).

Instructions

1. Divide into groups of 4.
2. Investigate only two common weeds, two insect pests and two diseases of cucumber, dwarf beans, Chinese cabbage and laupele in Samoa. (one student may investigate one crop).
3. Complete Table 3.3.
4. Share your findings within your group.
5. Present your findings to the class (with real specimens, pictures/diagrams/photographs if available).
6. Display the best group result on the notice board.

Table 3.3 Weed, Insect Pest and Disease Investigation.

Crop	Weed	Control	Insect pest	Control	Disease	Control
Cucumber	1.Vao fefe 2.	1.Hand weed 2.	1.Aphid 2.	1.Spray Attack 2.	1.Powdery mildew 2.	1.Spray with Mancozeb 2.
Dwarf Beans						
Chinese Cabbage						
Laupele						

Review

1. Explain the importance of good farm management.

2. Define "drainage" and list two methods of draining flooded or waterlogged soil.

3. Define "irrigation" and list three methods used in irrigating soil.

4. Define "weed" and explain why farmers remove them.

5. Name an insect pest that attacks Chinese cabbage and explain the damage it does to the cabbage.

6. When is the best stage to control diseases?

7. Explain your answer to question 6 above.

Unit 4: SEED STRUCTURE AND GERMINATION

Objectives

At the end of this unit you should be able to:

1. Investigate the seed structure of a range of plants.
2. Identify the basic structure of a monocotyledon and dicotyledon seed.
3. Name and describe the functions of the basic parts of a seed.
4. Carry out an investigation into a factor that affects germination.
5. Summarize information on the germination of a named plant.

Introductory Questions

1. What is a seed?
2. Do all seeds have the same size and shape?
3. What is the difference between a bean seed and a corn seed?
4. What is the difference between a coconut seed and a bean seed?
5. Why do seeds have a hard covering?
6. How long can a seed be stored?
7. When will a seed start growing?
8. Have you ever planted any seeds in your garden or plantation?
9. Do you have to water the seeds after planting? Why?
10. Living things need energy at all times. Where does a seed planted in the soil get its energy from?
11. What could soil provide for seeds to help them germinate?
12. Why do small seeds like cabbage seeds not germinate if planted too deeply in the soil?

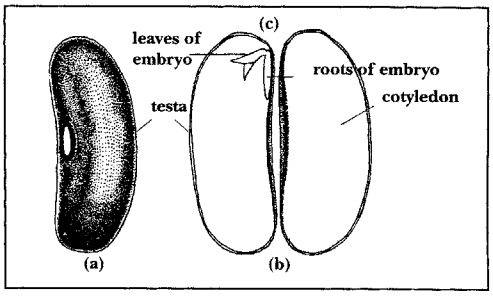
Background Information

Seed Structure

A typical seed consists of a seed embryo and food store enclosed in a seed coat or testa. The testa is a the hard outer layer covering a seed. The testa protects the seed from being damaged by the weather and organisms.

Picture of a Bean Seed and the Parts of a Seed.

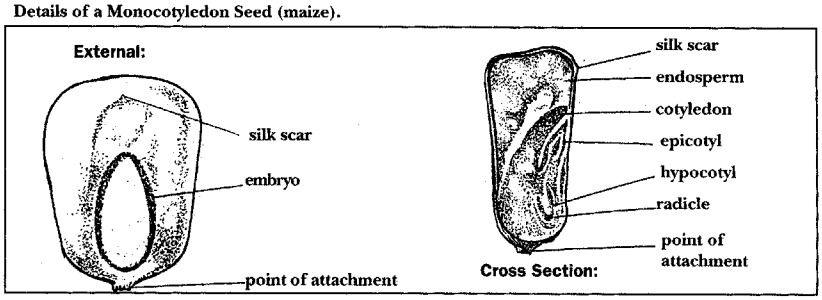
(a) A bean seed.
(b) The two halves of a bean seed showing the embryo.
(c) The embryo.



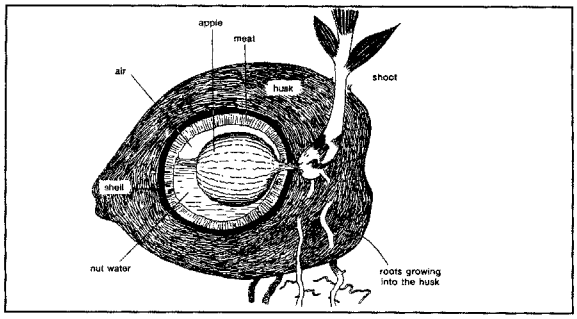
The embryo(baby plant) consists of;

- a radicle which develops into the root system during germination;
- the plumule which develops into the shoot system during germination;
- one or two cotyledons or seed leaves which store food for the embryo.

Details of a Monocotyledon Seed (maize).



Labelled Cross Section of a Coconut Seed.



During development the embryo also develops a supply of stored food. Depending on the species, food may be either stored in the cotyledons (as in beans) or in a mass of cells called endosperm (as in corn and coconut). The endosperm surrounds the embryo.

Seeds having one seed leaf (cotyledon) are called monocotyledon seeds and those with two seed leaves are called dicotyledon seed. Seeds with endosperm have thin seed leaves.

Food Storage in Seeds

The food stored in seeds is important in the early development stages of a seedling ie.,until it is able to photosynthesise food. The seeds that take longer periods for germination have more food stored in them. For example a coconut has a germination period of 4 to 6 months whereas a bean seed takes only 3 to 5 days. Seeds have special openings called a micropyle or seed pore. Air and water are taken into the seed through the micropyle.

Germination

All the changes that take place during the growth of an embryo of a seed to a seedling, are called germination. A seedling is a young plant which can synthesize its own food.

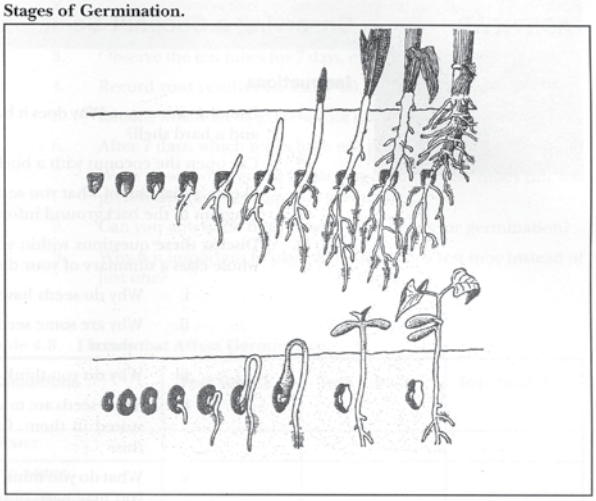
For germination to occur, a seed needs warmth, water and oxygen. Warmth and water are needed to start the chemical reactions in the seed. Oxygen is needed to release the energy from the food that is stored in the cotyledons or the endosperm.

When seeds are stored, they slowly use up energy. When all the energy in the seed is used up by the embryo, it will die. We can prolong the viability (ability to grow) of seeds by drying the seeds well and storing them in a cool place. A seed will swell when it takes in water (germination will begin). Many seeds nowadays stored in vacuum sealed bags or packets.

The first sign of germination is when a root emerges from the seed. It is the root or radicle that comes out first. This helps the seedling to get established well in the soil and to absorb water and minerals. Then the shoot or plumule grows. Until the seedling develops chlorophyll, it has to depend on the stored food for its energy needs.

It is important to loosen and prepare the soil well for planting. Plant roots grow well in the loose and well-aerated soil. It is also important to plant the seeds at the correct depth recommended on the seed packets. If small seeds are planted too deep in the soil the shoots may not have enough energy to push through the soil to the surface. The seeds may also not get enough oxygen for germination. During germination the cells in the embryo divide very rapidly. For this the embryo needs a lot of energy. Therefore the germinating seed respires at a much faster rate and, for this, the seed needs a lot of oxygen. This is why the soil in the garden should be loosened and why the seed should be planted near the surface.

Stages of Germination.



ACTIVITY A

Looking at Seeds

Materials/Equipment

1. 20 bean seeds or other dicotyledon seeds.
2. 20 corn/maize seeds or other monocotyledon seeds.
3. Magnifying glass.

Instructions

1. Work in groups of 3 or 4.
2. Examine the bean and corn/maize seeds and sketch an outline of the seeds. Label the parts by referring to the diagrams given in the background information, if necessary.
3. Soak some bean and corn/maize seeds overnight.
4. Examine the soaked bean and corn/maize seeds. Are they bigger than the dry seed?
5. Gently squeeze the soaked bean seed and observe the seed pore. What happens?
6. Carefully remove the outer covering of a soaked bean seed and examine the internal structures. Carefully open the two seed leaves. Sketch a diagram of the internal parts of the bean seed. Label the diagrams. You may refer to the diagrams in the background information.
7. Cut open the soaked corn/maize seed. Try to identify some of the structures you see in the corn seed by making use of the diagram in the background information.
8. Compare and contrast a bean seed with a corn/maize seed.

ACTIVITY B — Observing a Coconut Seed

Materials/Equipment

1. 2 mature coconuts.
2. A bush knife.

Instructions

1. Examine a coconut. Why does it have such a thick outer covering and a hard shell?
2. Cut open the coconut with a bush knife.
3. Sketch a diagram of what you see and label the parts using the diagram in the background information.
4. Discuss these questions within your groups and report to the whole class a summary of your discussions.
   - i. Why do seeds have a hard covering?
   - ii. Why are some seed coverings much harder than others?
   - iii. Why do you think seeds store food in them?
   - iv. Some seeds are much bigger and have more food stored in them. Can you think of a reason for this?
   - v. What do you think is the use of the small opening you may have observed in a bean and coconut seeds?
   - vi. Why does the seed have some air space?
   - vii. Will the coconut seed germinate or grow if kept in a dry place?

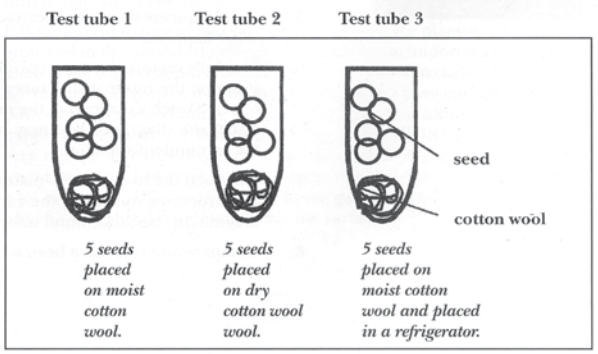
ACTIVITY C — Factors Affecting Germination

Materials/Equipment

1. 3 test tubes.
2. Water.
3. Cotton wool.
4. 20-30 bean seeds.
5. Refrigerator.

Instructions

1. Set up the apparatus as follows:



2. Leave all the test tubes at room temperature except Test Tube 3 that is to be placed in a refrigerator.
3. Observe the test tubes for 7 days, examining each test tube daily.
4. Record your results in a Table 4.0.
5. Record which seeds grow a root out from the seed first.
6. After 7 days, which seeds have not put out a root?
7. Write down what could be lacking in these test tubes but was present in the test tubes that germinated.
8. Can you now write down what a seed needs for germination?
9. Why is it important to place a few seeds in a test tube instead of just one?

Table 4.0 Factors that Affect Germination.

Conditions	Test tube 1	Test tube 2	Test tube 3
Water			
No water			
Temperature			
Number of seeds germinated			
Day 1			
Day 2			
Day 3			
Day 4			
Day 5			
Day 6			
Day 7			
Total			

10. Fill in the missing words in the conclusion.

Conclusion

This activity shows that seeds germinate if_____, _____, and_____are present. The seeds in Test Tube 3 did not germinate because chemical reactions take place very slowly at_____temperatures. _____ is also needed for seeds to germinate.

Review

1. What are the main parts of a seed?
2. Name the main parts of a seed that make up the embryo?
3. What are the differences between a moncot and dicot seed?
4. Why is it important for seeds to have food stored in them?
5. Why do some seeds have more food stored in them than others?
6. Name two seeds used by Samoan people for food.
7. Why does a seed have a coat or testa?
8. What are the functions of the roots of a seedling when the baby plant is planted?
9. Why is it not good to sow small seeds too deeply in the soil?
10. Why is it important to loosen the soil well, before sowing seeds?
11. Why is it important to water the soil after sowing seeds?

Unit 5: TRANSPIRATION AND THE WATER CYCLE

Objectives

At the end of this unit students should be able to:

1. Explain the role of transpiration in the water cycle.
2. Carry out an investigation on a factor that affects the transpiration rate.

Introductory Questions

1. What happens to you when you are hot?
2. How do you think a plant keeps cool on a hot day?
3. What will happen if a plant loses a lot of water?

Background Information

All living things need to keep cool. Animals keep their bodies cool in many different ways, for example a dog puts out its tongue and breathes faster. Evaporation from the tongue cools its body. Humans sweat or perspire when the body temperature increases. The evaporation of sweat needs a lot of energy. The energy needed for the evaporation of sweat is taken from the body. In this way the body is cooled.

Similarly, plants may die if the temperature is too high. Leaves keep cool by evaporation of water given out through openings in the leaves. These openings are called stomata. Loss of water from the plants through stomata is called transpiration. Plants remain cool on hot days by the evaporation of water given out during transpiration. A big mango tree may have 170,000 leaves and lose 50 gallons or (250 liters) of water an hour on a hot day. This is one reason why it is much cooler under trees on hot days.

ACTIVITY A — Transpiration

Materials/Equipment

1. Large pot plant or small tree near the classroom.
2. 2 plastic bags.
3. 2 rubber bands/ string.

Instructions

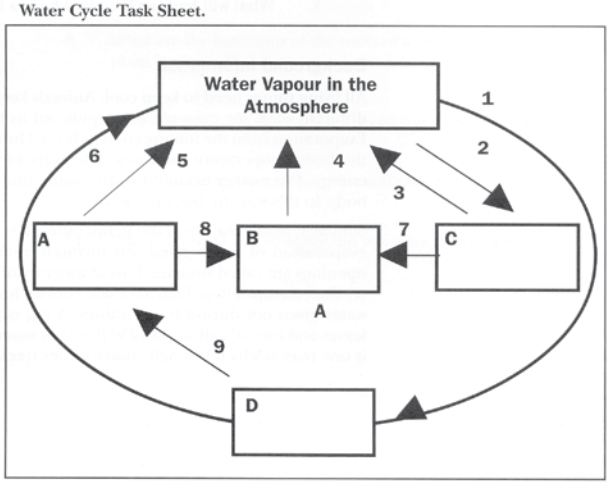
1. If you are using a pot plant, place it in strong sunlight.
2. Pull off the leaves from a small branch.
3. Put a plastic bag over this branch and seal it.
4. Leave the leaves on another branch in the sun.
5. Also cover the branch with the leaves with a plastic bag.
6. Watch both bags for several minutes.
7. Write the title of the activity in your workbook.
8. Draw a labeled diagram of the activity.
9. Write down your observations.
10. Write a conclusion for this activity.

ACTIVITY B — Water Cycle

Materials/Equipment

1. Task sheet of water cycle.
2. Crayons (if students want to draw coloured pictures).

Water Cycle Task Sheet.



Instructions

1. Divide class into groups.
2. Give each group their task sheet.
3. Complete the cycle by matching the correct word or phrase to the corresponding number or letter.

Word list for letters	Word list for numbers
Soil water	Evaporation
Plants	Transpiration
Animals	Rain
Rivers, lakes, ocean	Absorption
	In breath
	Drink

(Some words may be used more than once).

4. First group to finish correctly will get a prize and will explain the cycle to the rest of the class and lead the discussion.

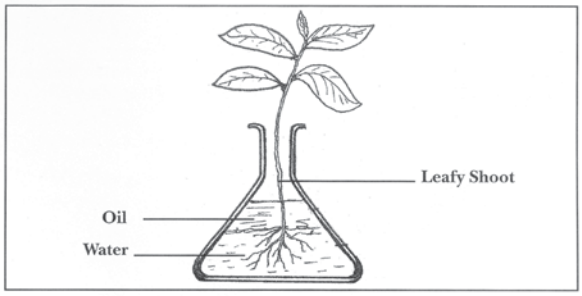
ACTIVITY C — Factors Affecting the Rate of Transpiration

Materials/Equipment

1. 2 conical flasks.
2. Oil.
3. Water.
4. 2 leafy shoots (should be very similar in number of leaves).
5. Triple beam balance.
6. Thermometer.
7. Measuring cylinder.
8. Beakers.

Instructions

1. Measure and pour 70 millilitres of water into the 2 conical flasks.
2. Place leafy shoots into the 2 flasks.
3. Pour similar amounts of oil into the flasks.
4. Weigh the 2 flasks and record their masses.



5. Leave one flask in the sun and one in the shade for a few hours.

6. Record the temperatures of the sunny and shady areas.

   (If wind is the factor studied, leave one flask near a fan, or students can fan it, and one in a non-windy place).

7. Reweigh your flasks and record their masses.
8. Calculate the changes in masses.
9. Change them into percentages.
10. Compare and comment on your results.

Table 5.1 Results.

Mass (g)	Flask in Sun/Wind	Flask in shade/non-windy area
At start		
At end		
Change in mass		

Percentage = Change in mass / mass at start X 100

DISCUSSION QUESTIONS

1. What caused the changes in the mass of the flasks?

2. Why was oil poured into the conical flask?

3. What conclusions can you make from this activity?

Review

1. Define transpiration.

2. List two factors that can increase the rate of transpiration in plants.

3. Discuss with your teacher some adaptive features in plants that help them control transpiration.

4. How can a farmer affect a plant's rate of transpiration?

Unit 6: THE SAFE USE OF TOOLS, EQUIPMENT AND FACILITIES

Objectives

At the end of this unit you should be able to:

1. Identify the use of different tools, equipment and facilities.
2. Use appropriate tools, equipment and facilities.
3. Explain why tools and equipment must be serviced and stored.
4. Report faults or problems with tools, equipment and facilities.

Introductory Questions

1. What agricultural science facilities do you have in your school?
2. Where do you store tools and chemicals?
3. What are some common procedures for looking after the Agricultural Science facilities?
4. Do you have any rules regarding the use of the Agricultural Science facilities of your school?
5. Can you name some tools you use at home?
6. Do you always clean and oil tools after use?
7. Have you ever been accidentally hurt by a garden tool? How did the accident occur?

Background Information

You must know your garden tools. Many farmers in Samoa will have basic tools that are used for weighing, lifting, measuring, applying, cutting, digging, carrying, leveling.

These tools can be used on both crop and animal work:

Weighing tools - scales, balances
Measuring tools - rulers, yard stick, tapes
Cutting tools - knives, mattock, hoes, shears
Carrying tools - wheel-barrow, buckets, bags
Lifting tools - pulleys, ropes, levers

Applying tools	-	sprayers, spreaders
Digging tools	-	pick, crowbar, spades, forks.

As a general rule:

1. When buying tools, always buy the best you can afford. Cheap tools bend, break or go blunt quickly.
2. When choosing tools, select tools that you feel comfortable using and can get the job done.

We now have a special tool for nearly every job. It is important wherever possible to **USE THE RIGHT TOOL FOR THE JOB.**

Tools are available for different jobs. If you use the right tool you can work easily and faster and at the same time not cause damage to the tool.

If tools are kept clean and maintained properly, they last much longer and work better. It is important to take good care of tools because they are expensive. Proper care and storage of tools helps prevent injuries from accidents.

Storing Tools

Tools must be hung up securely in their right and proper position so that they don't fall down and cause injury.

Before storing any tool clean it up first. Apply a thin film of oil, especially to any moving parts.

Keeping Tools Sharp

Tools such as knives, axes, picks should be kept sharp. Work is more easily done with a sharp edge. Blunt cutting tools do not cut well.

Preventing Rust

Most farm tools are made of metal. When they are stored wet they will rust quickly. Rusty tools do not last as long as clean tools. To prevent rust, clean tools, oil and store them in a dry area. The action phrase KNOW-HOW may be linked with the safety precautions necessary for using and handling tools.

Safety

The **KNOW-HOW** to properly handle and use tools will give you the satisfaction of having tools working with efficiency and durability. Tools are machines which make our work easier and better. In the school garden you will work beside others. Be very careful that you do not accidentally strike someone when carrying or using a tool.

A few of the safety rules to remember are:

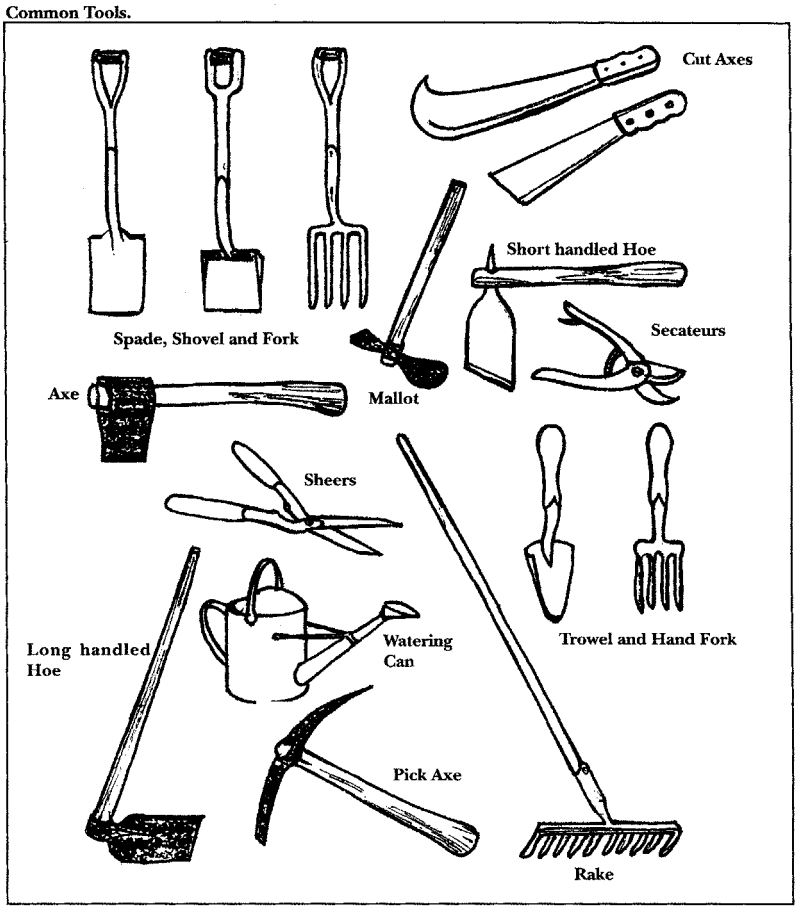
- Do not carry tools over your shoulders.
- Always carry tools, where possible, with blades close to the ground.
- Keep a good distance between the next worker/student and yourself.
- When storing cutting tools, be sure that the sharp edges do not stick out.
- Never leave a rake with the prongs pointing up.
- Keep wooden handles smooth at all times.
- When using chemicals be sure to read the instructions on the label.
- Store chemicals in a well ventilated room.
- Dispose of empty containers safely. (Refer to labels).
- Always wear protective clothing.
- Avoid direct contact with, or inhaling, chemicals/fumes.
- Wash hands thoroughly after using chemicals.
- Always keep chemicals in their original containers.
- Keep chemicals away from children.

Agricultural chemicals are very useful in agricultural production if used correctly but they can be very dangerous if not used properly.

Agricultural Science facilities are important for teaching Agricultural Science. These facilities help you to learn the skills necessary for successful farming. It is important that you should have practical skills in the use and maintenance of Agricultural Science facilities. The common practices, procedures and maintenance of facilities are as follows:

- Keep all facilities clean and workable at all times.
- Store away tools and equipment properly.
- Facilities should provide a safe and healthy environment.
- Provide a secure place for the instruments, tools, equipment and supplies that are essential to agriculture science.
- Keep up-to-date records of all facilities.

Common Tools.



ACTIVITY A

Materials/Equipment

1. Access to (if available):
   - Store room.
   - Agricultural Science Laboratories.
   - Agricultural Science Resource Center.
   - School garden.
   - Animal buildings.
   - Nursery.
2. Some garden tools like pruning shears (secateurs) bush knife, pickaxe spade, shovel, fork, rake, hoe etc.
3. A collection of old or rusty broken tools.
4. Sharpening file.
5. Chemicals; samples of insecticides, fertiliser, herbicide, etc.
6. Knapsack sprayer.
7. Safety or protective clothing– overalls, masks, gloves, boots.
8. Safety charts (*Note: make sure that chemicals have labels on them).*
9. Branches: different diameters – 2 cm, 4 cm different types of branch:-
   - hibiscus;
   - cassava;
   - felila.
10. Pocket Knife/Small Kitchen Knife.
11. Pruning Saw.

Agricultural Science Facilities

Instructions

In this activity you will be guided by your Agricultural Science teacher to identify and learn how to use some of the Agricultural Science facilities in your school. You may also be taken elsewhere on field trips.

1. List down all the Agricultural Science facilities in your school or seen elsewhere.
2. Your teacher will demonstrate the correct use and procedures for using Agricultural Science facilities, such as store rooms, laboratories, resource centre, animal buildings, a nursery, tools and equipment.
3. After the demonstration given by your teacher, you should demonstrate how to correctly use these facilities.

Store Room

1. Clean and sweep the floor.
2. Store tools and equipment properly.
3. Check if their record book is up-to-date.
4. Lock doors firmly.

Laboratories

1. Clean and sweep floor.
2. Carefully clean and store away apparatus and equipment.
3. Store safely chemicals and other hazardous substances.
4. Turn off gas taps and water taps.
5. Lock doors firmly.

ACTIVITY B - Tools

Instructions

1. Examine each tool.
2. List in your books the tools you have at home.
3. Draw a picture of each tool.
4. Write its name beside it and state what you can use it for.
5. Write the name and draw diagrams for the tools which you do not have at home.

(Refer to background information for their names and use).

6. Copy the following chart and fill in column two.

Work To Be Done	Tool To Be Used
1. cut down a tree	
2. cut a small branch	
3. prune	
4. dig a hole	
5. level soil	
6. dig up rocks	
7. sharpen a knife	
8. carry soil	
9. fill planting bags	
10. to spray crops	

ACTIVITY C — Cutting Tools

Instructions

1. Choose several branches of different sizes.
2. Make a cut with each tool.
3. Record your results as shown in the table below.

Example: a) Easy to cut.
b) Not easy to cut.
c) Cannot be cut.

Results.

	Hibiscus 4cm diameter	Cassava 4cm diameter	Felila 4cm diameter	Hibiscus 2cm diameter	Cassava 2cm diameter	Bougainvillea 2cm diameter
Bush Knife						
Pocket Knife						
Pruning Shears						
Pruning Saw						

(N.B. These are only suggested plants. You may use other alternatives).

Conclusion

1. Is it easy to make a clean cut with all tools?
2. Which tool cuts all branches easily?

ACTIVITY D — Handling Tools

Instructions

Your teacher will explain and demonstrate the proper way to handle and use tools, such as:

a) THE HOE: The hoe is used for loosening weeds, and breaking up the soil surface.

b) HAND FORK: Also good for making shallow trenches for sowing seeds.

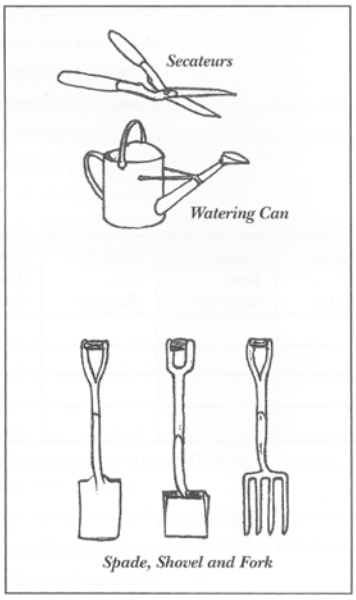
c) TROWEL: The trowel is a small hand spade for planting and lifting small plants.

d) FORK: A fork is good for loosening weeds and breaking up heavy soil.

e) SPADE: The spade is for digging and cultivating. (lifting, turning and chopping soil).

f) RAKE: Removing small stones, weeds and leveling of soil.

Rake



Spade, Shovel and Fork

ACTIVITY E — Rust Prevention

Instructions

1. Look at the collection of tools you have in school. Are they clean or rusty?
2. Why did they go rusty?
3. Will the rusty tools last long? Why?
4. How will you clean the rusty tools?
5. How can you prevent a clean tool from getting rusty?

ACTIVITY F — Maintenance of Tools

Instructions

Your teacher will demonstrate the steps in cleaning and maintaining common agricultural tools:

Cleaning

1. Wash the tools thoroughly with water after use.
2. Clean rusty tools using sandpaper, a wire brush, or a piece of metal. A sharpening file can be soaked overnight in a mixture of lemon juice and water.

Sharpening Tools

Bush Knife

- File always in a forward direction towards the pointed end of the knife. Never file forward and backward at the same time.
- File away from the sharp edge. An axe can also be sharpened in a similar way.

Oiling and Storage

- All tools have to be oiled before storing to protect them from rusting. Use engine oil or any lubricating oil.
- Use grease or oil for moving parts.
- Store all tools in a dry clean place. Tools can be hung from walls, kept in shelves or in tool boxes. If they are kept on the floor, make sure that the floor is covered with a mat, cardboard, newspaper or planks.

ACTIVITY G — Reporting Tools

Instructions

1. Divide students into groups of three or four.
2. Let each group discuss how tools can be recorded and reported when borrowed, returned or in need of repair.
3. Each group is to design a form in which tools can be recorded. Use the following headings:
    - Date Borrowed.
    - Comments when Returned.
    - Tools/Equipment.
    - Condition of Tools/Equipment.
    - Name of Borrower.
    - Signature of Borrower.
4. Each group is to present their design to the class for discussion.
5. Discuss and select the best records format for the class to use when borrowing, returning or reporting tools and equipment.

Review

1. List the Agricultural Science facilities in your school.
2. What are the common practices and procedures for using a building in which animals are kept?
3. What management procedures are to be carried out to maintain any one of your Agricultural Science facilities?
4. Which tools can be used to pile up soil?
5. Which tools can be used to pile up grass cuttings?
6. Which tools can be used to measure spacing between plants?
7. a.) List the cutting tools.
   b) List the digging tools.
8. Explain why tools with cutting edges must be sharpened and remain sharpened at all times.
9. Can you use any tool for any job?
10. State the general purpose of tools.
    i. List common methods of cleaning garden tools.
    ii. Why is it important to clean tools after use?
    iii. Why do farmers oil tools before storing?
    iv. What are the advantages of cleaning, and proper storage of, agricultural tools?
    v. Describe briefly the proper way of sharpening a bush knife.
11. List any three safety rules for handling chemicals.
12. List two safety rules for handling tools.
13. What is the first thing you must do when using chemicals?
14. What are the dangers of using chemicals?
15. How is the environment affected by chemicals?

PRACTICAL EXPERIENCE PROGRAMME (PEP)

Most of us are involved in some sort of gardening or farming activity, so whatever skills you develop through this practical experience program will be useful in the future. This PEP aims to develop a positive attitude towards farming in general and growing vegetables in particular. It also hopes to provide knowledge, understanding and appropriate skills in growing short-term crops. These practical experience programs should help you to grow some of these crops in your home gardens and improve the nutritional quality of your diet. It can also provide you with extra income. You will have the opportunity to grow both vegetables and field crops using good farming methods.

In Year 9 you will learn to grow four vegetables (cucumber, dwarf beans, Chinese cabbage and laupele) and three field crops (ginger, banana and coconut).

Unit 7: GROWING VEGETABLES

Your class can plan vegetable growing projects if land is available at your school. You may work in groups and grow the vegetables suggested in this practical experience program. You may also try these activities in your homes. Always remember to keep an accurate record of your activities with regard to the type of soil, seeds used, details of pesticides and pests, disease and weed control methods, dates of planting, fertilizers used (if any), date of harvest, quantity and quality of harvest, and marketing.

Objectives

At the end of this practical unit you should be able to:

1. Select a suitable garden site.
2. Select good seeds and cuttings.
3. Prepare land for planting.
4. Directly plant and transplant vegetables.
5. Explain why it is necessary to grow some seedlings on seed beds.
6. Control weeds, pests and diseases in cucumbers, dwarf beans, laupele and Chinese cabbage.
7. Apply fertilizers.
8. Harvest vegetables at the right time.

Introductory Questions

1. Do you grow vegetables at your homes or school?
2. Why do we grow vegetables?
3. What kind of vegetables do you grow?
4. What kind of vegetables do you eat?
5. Why is it important to have vegetables in your diet?

Background Information

The steps involved in growing common vegetables are similar. Although this background information focuses on cucumber, the same principles apply to other vegetables.

Growing Cucumbers

The important steps in growing vegetables are:

Selecting a Site

The best site for cucumber and other vegetables is open, fairly level land with good fertile soil. The soil should have good drainage. The yield is smaller for cucumbers grown under too much shade. Avoid windy areas, as cucumber is very sensitive to winds.

Land Preparation

The land must be cleared by cutting down trees and bush. The logs, stones and weeds should be removed. It is important to clear land to stop competition for plant nutrients, water and sunlight by other plants. Consideration should also be given to drainage. Plants do not grow well in waterlogged soils.

If necessary, the area must also be fenced to protect the plants from animals.

Preparing the Soil for Planting

Plants grow better in a well-prepared ground. Good soil preparation also helps to control weeds. Seeds germinate easily and quickly in well-worked soil. During the preparation of the land, soil fertility can be improved by mixing farm manure, compost, organic matter or chemical fertilisers into the soil.

When to Plant

Deciding when to grow crops depends on:

- **Climate**

  Some crops like banana, coconut etc. are planted during the wet season. However, many vegetables may easily be affected by diseases and pests if planted in a very wet climate.

- **Growing Period**

  This is the period between planting and harvesting. If you want to harvest the crops at a particular time, count back the number of weeks of the growing period to decide the best time to transplant or plant.

- **Harvest Period**

  This is the time when crops and produce are gathered or picked.

- **Fallow Period**

  This is the period when the soil is not used. During this period the soil will build up its fertility.

- **Crop Rotation**

  This is changing the crops planted in a particular area. Crop rotation can break the lifecycle of various pests and diseases affecting a crop. Crop rotation prevents these diseases from being passed on from one crop to the next. Different kinds of crops need different amounts of plant nutrients from the soil. Legume plants add nitrogen to the soil.

Selecting Seeds

Choose seeds from a group of plants with the characteristic wanted in your plants. For example, large fruits or resistance to pests and disease, sweetness, colour etc. Seeds should be properly dried before storing. The seeds may be mixed with fungicides before storing. Other planting materials such as stem and root cuttings, should be chosen from the best available plants that are free from pests and diseases.

When buying seeds, choose seeds which are resistant to various diseases and have a high germination percentage. When seeds remain alive and can germinate to form seedlings, we say the seeds are viable. It is good to test the viability of seeds before planting, otherwise money, time and effort is wasted on useless seeds. Seed resistance to disease and germination percentage are printed on the seed packet. Do not buy seeds that have passed the expiry date on the packet.

Planting

There are three commonly used methods of planting:

- **Direct Planting**

  Plant the seeds or cuttings straight into the soil. Cucumber is an example of a crop that is usually planted directly into the prepared ground. The soil must be prepared and fertilized before planting. Planting must be done at the correct depth and at the correct spacing.

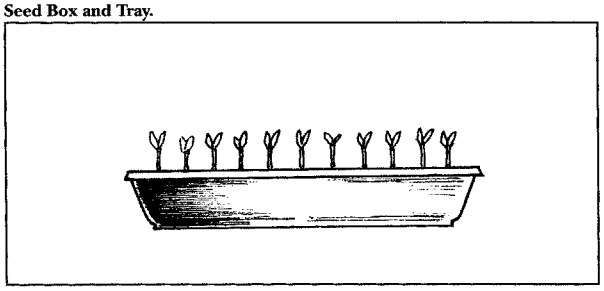
- **Planting in a Seed Bed**

  Small seeds may be first planted in a seed bed of fine even soil sheltered by a roof. Later the best plants are chosen and transplanted.

- **Seed Boxes**

  Seeds may also be grown in seed boxes sheltered by a roof. The seed boxes and the soil in them can be sterilized to kill pests and diseases. The boxes can be easily transported to the field for transplanting.

Seed Box and Tray.



The advantages of direct planting are:

- it is cheap and simple;
- no damage is done to roots due to transplanting;
- plants are easier to look after.

The advantages of growing seeds in a seed bed or seed box are:

- providing the best conditions for germination and rapid growth of the seedlings;
- the land can still be in use while the plants are in the nursery;
- allowing land preparation right up to the time of transplanting.

Weed Control

It is important to keep weeds under control at all times as the weeds will fight for essential nutrients, water and light. In the case of small gardens, weeds can be removed manually. In big plantations chemical weed killers like Sting, Round-up etc, could be used.

Fertilizers

Soil fertility can be improved by mixing the soil with well-rotted compost, animal manure, legume crops and by adding chemical fertilizers. Remember not to put the chemical fertilizers closer than 15cm around the plant.

Disease Control

The common diseases that affect cucumber are:

- **Gummy Stem Blight**

  Circular brown spots appear on the leaves. The disease also affects the stem. The affected plants will produce only very little or no fruits at all. Treat with Manzate or Dithane.

- **Powdery Mildew**

  It is caused by a fungus. Circular, white, powdery patches appear on the leaves, stalk and stem. They appear first on the underside of the leaves and gradually cover both surfaces. Affected leaves shrivel and die. Use Benlate or Milcurb to control the disease.

Insect Control

The common insect pests that affect cucumber are aphids, cucumber beetle, leaf miner and spotted ladybird.

- **Aphids**

  They are wingless insects which suck up the cell sap. As a result the plants become stunted and the leaves curl down. The insect also spreads disease. Can be controlled by spraying Orthene or Malathion.

- **Cucumber Beetle**

  The adult beetles are yellow in color. They feed on the epidermis of the leaves and flowers, scraping the tender tissues. The affected leaves will have a shredded appearance. If the beetle problem is serious, use Orthene or Malathion.

Cucumber.

- **Leaf Miner**

  They are small insects. This larvae bore through leaves. If young plants are attacked the damage can be quite serious. Since the damage of the miner is done inside the leaves, chemicals will have to be used that can enter the tissues and kill the insect larvae.

- **Spotted Ladybird**

  It is an orange colored beetle with black spots on its back. The insect lays its eggs on the underside of the leaves. The larvae that come out from the hatched eggs and the adults feed on the leaves, stripping them and leaving only the veins. The leaves shrivel and dry up. The plant gradually dies. Spraying with Malathion or Orthene is effective.

Harvesting

Cucumbers can be harvested in 10 weeks time if they are looked after well. Harvest only cucumbers that are not too young and not too old.

Dwarf Beans

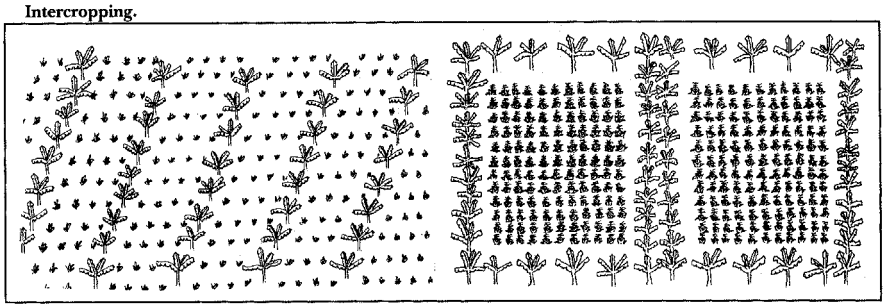
Plants belonging to the bean family are called legumes. Legumes are ideal rotational crops. The root nodules of legumes contain bacteria which can absorb nitrogen from the atmosphere and add nitrates to the soil.

Beans are used for food in two ways:

- The green tender pods are used as a vegetable. They are rich in vitamins when eaten soon after picking. The mature dry beans can be boiled and eaten. They contain about 20% protein, 60% carbohydrates and 3% minerals and vitamins.

There are several varieties of beans; some are grown for food and others for growing between tree crops for green manure and as a cover crop to stop weed growth by shading them.

Intercropping.



Step 1 **Selecting a Site**

Same as for growing cucumbers.

Step 2 **Clearing and Planting**

Clear the land of all weeds and bush. Dig and loosen the soil using a spade and a hoe. The soil should be well-drained to prevent attacks by fungus and nematodes. Beans are planted directly into the ground, two seeds per hole about 2.5 cm to 3 cm deep. Follow the recommended spacing in the table.

Plant Spacing.

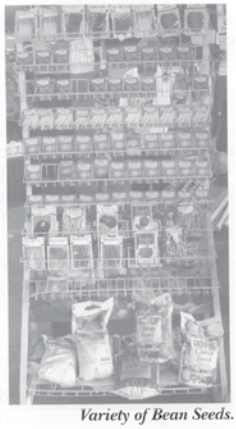
Type of Bean	Distance from Plant to Plant	Distance from Row to Row
Dwarf Beans	20 – 25 cm	50 – 60 cm
Climbing Beans	20 – 30 cm	75 –100 cm

Step 3 **Fertilizers**

Beans can produce their own nitrogen foods. Therefore, only a relatively small amount of fertilizer is needed to produce a good yield.

Step 4 **Disease and Pest Control**

The common diseases that affect beans are stem rot, leaf spot, and bacterial blight. They can be controlled by good management practices such as selecting disease-free seeds, cultural practices like crop rotation, and the use of chemical sprays. The common insect pests that affect beans are:



Variety of Bean Seeds.

- **Leaf Miner**

  The larvae of the insects mine through the leaves leaving snake-like patches on the leaves. Most of the insect pests can be controlled by good management practices and the use of chemical sprays.

- **Bean Pod Borer**

  The young larvae bore into buds, flowers and young pods. The larvae spin silken threads which mesh the leaves, flowers and pod together.

- **Bean Fly**

  This is a black insect which lays eggs in the stem of young plants. The larvae feed on the stem. The plants gradually wilt and die.

- **Bean Aphids**

  They are small, pale green wingless insects. They suck the plant sap stunting the growth of the plants. Aphids also spread virus diseases.

Step 5 **Harvesting**

Beans can be harvested in about 6-10 weeks after planting. The pods should be harvested when they are a tender green. As the beans mature, the pods become fibrous. The pods can be harvested every second day in the early morning.

Chinese Cabbage

Chinese cabbage is an important leafy vegetable which is easy to grow. They can also be planted at any time of the year. It is possible to start harvesting them from 3 to 4 weeks after planting.

Step 1 **Site Selection**

Open areas are the best even though Chinese cabbage grows reasonably well in partially shaded areas.

Step 2 **Planting**

The seedlings are raised on beds or in seed boxes. A seed box is best as it can be easily moved to the field or protected from extreme weather conditions. A good soil mix to be used in a seed box, can be prepared by mixing 60% top soil, 20% sand and 20% rotten compost or animal manure. The soil may be sterilized by fumigating or baking.

The advantages of growing seedlings on seed beds include easy weed and pest control, effective watering and better use of the garden area.

Chinese Cabbage.

Step 3 **Transplanting**

Transplanting is the transfer of seedlings from the seed bed to the field and planting them in a new place to grow as a crop. Before removing the seedlings from the bed, water the seedlings thoroughly. Great care should be taken to reduce the damage to the roots during transplanting. It is good to keep as much soil around the roots as possible. During transplanting, ensure that the planting hole is deep enough to cover the roots well. Then press the soil firmly around plant. After transplanting, water the plants well. Choose cool times such as cloudy days or late evenings for transplanting.

Step 4 **Pest and Disease Control**

Some of the common insect pests that damage Chinese Cabbage are caterpillars, slugs and snails. Some of the common diseases include mould, blight, root rot and stem rot. Cultural Practices which include crop rotation and controlling weeds help with pest and disease control. Chemicals like Sumicidine or Thuricide may be used.

Step 4 **Harvesting**

Chinese cabbage can be harvested from 3 to 4 weeks onwards depending on the desired size of the head.

Laupele

Laupele is a good, dark green, leafy vegetable which can be grown easily at any time of the year. The plant does not need much care and can be grown on any reasonably good soil.

Step 1 **Site Selection and Land Preparation**

Same as for other vegetables.

Step 2 **Selecting Cuttings**

Laupele is grown from stem cuttings.

Step 3 **Planting**

1. A spacing of about 60-100 cm is recommended.
2. Plant the cutting at any any angle you want.
3. Water the cuttings when planting. Water daily until plants produce leaves.

Laupele.

Step 4 **Weeding**

Once the plants are big, very little care is needed for them.

Step 5 **Pest and Diseases**

There are few pests or diseases for laupele so you do not need to control them. However observe the leaves of laupele- the holes you can see on the old (and sometimes young) leaves are caused by caterpillars and beetles.

Step 6 **Fertilizer**

Laupele does not require fertilizer unless the soil is not fertile.

Step 7 **Harvesting**

Harvest only the young leaves. Old leaves are tough when cooked. You can harvest at any time after leaves are produced on the plant. You may prune the plants if they grow too tall.

ACTIVITY A

Growing Cucumbers

Materials/ Equipment

1. Digging fork.
2. Garden rake.
3. Spade.
4. Measuring tape.
5. Fertilizers – NPK, Poultry Manure.
6. Weedicide – Gramoxone, Round up, Sting.
7. Pesticides – Attack, Orthene, or any pesticide recommended by the Agriculture store.
8. Fungicides – Benlate or any fungicide recommended by the fungicide store.
9. Bushknife.
10. Hoe.
11. Knapsack sprayer.
12. Bucket/watering can.
13. Axe and Wheelbarrow.
14. Chain Saw (for demolition purposes only).

Cucumbers.

Instructions

Step 1 **Site Selection**

When selecting a site for a vegetable garden these factors should be taken into consideration.

Select an area near to your home/school and a water source. Look for:

- Good well-drained and fertile soil.
- Fairly level land. Avoid steep slopes.
- Sunny and not shaded by large trees.
- The area should be an open area.
- The area should be protected from pigs, chickens etc.

Step 2 **Land Preparation** (Clearing the land and preparing for planting).

1. Cut down large trees and remove large stones.
2. Remove logs, roots, stones and weeds.
3. Two weeks later pull out all new weeds.
4. Turn the ground over a depth of 15-30 cm. Work backwards using spades for turning and hoes for breaking up clods of earth.
5. Dig compost or other recommended fertilizers into the soil.
6. Use rakes and hoes to make the soil fine and even.

Step 3 **Seed Selection**

1. Read the labels of seed packets carefully and select seeds which are resistant to various diseases of cucumber and have a high germination percentage.
2. The seed resistance to disease and germination percentage should be printed on the seed packet.
3. Make sure you do not buy/sow seeds after the expiry date printed on the packet.

4. Some recommended varieties of cucumber than can be planted in Samoa are:
   i. Million Green.
   ii. Delight Green.
   iii. Sweet Green.
   iv. Sure Green.

EXTRA ACTIVITY

Germination Test

Materials/Equipment

1. Two plates or saucers.
2. Twenty seeds for each group.
3. Tissue paper/news print folded over.

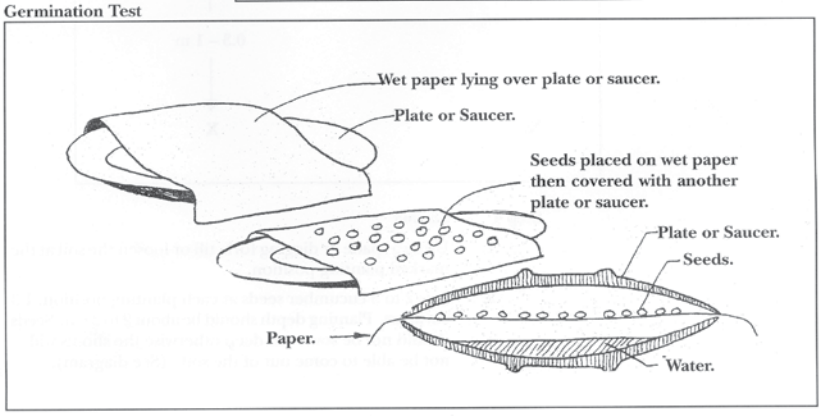
This is an interesting activity you could do to test the germination rate of any seed.

Instructions

1. Soak 20 seeds for an hour.
2. Pour 3 or 4 spoonfuls of water into the plate or saucer.
3. Wet the paper and place it across the top of the plate. (See Diagram).
4. Drop 20 seeds on to the paper, spacing them evenly.
5. Cover the paper and seeds with an other saucer or plate.
6. Leave the saucers on the table or in a safe place in the class room.
7. Inspect the seeds daily.
8. After 4 or 5 days count the number of germinated seeds.
9. Calculate the germination rate using the formula below:

$$\text{Germination percentage} = \frac{\text{No. seeds germinated X 100}}{\text{No. soaked/planted seeds}}$$

Germination Test



Step 1 **Planting**

Deciding when to grow cucumbers:

Suitable Climate

Cucumbers can be grown all year round, but the best time to plant cucumbers is from April to September.

Step 2 **Growing Period**

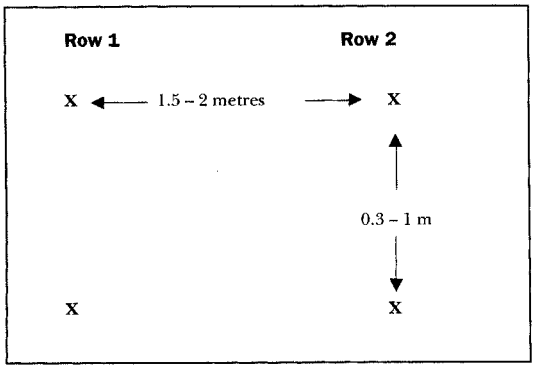
In order to get the crops ready for harvesting at the desired time, count back the number of weeks of the growing period and determine the best planting/transplanting time. Cucumbers take about 42-56 days from planting to harvest.

Harvesting Period

Most crops can be harvested over a few weeks. If you want to harvest for a longer period, you can plant a few rows every week (succession planting). For school gardens it is best to time your planting so that crops grow during holidays and ready for harvesting during the term.

Step 3 **Marking/Spacing**

Using a measuring tape, mark out two planting rows on the prepared ground between 1.5 – 2 meters apart. Mark 0.3 – 1 meter distances on each row. See diagram below.



Step 4 **Sowing**

1. Using a spade or digging fork, till or loosen the soil at the marked planting position.
2. Sow 2 to 3 cucumber seeds at each planting position, 1-3 cm apart. Planting depth should be about 2 to 3 cm. Seeds should not be sown too deep otherwise the shoots will not be able to come out of the soil. (See diagram).

Watering

1. Water the seeds after sowing.
2. Water plants at least once a day.

Step 5 **Weeding**

1. It is important to keep cucumber plants free of weeds at all times.
2. Remove weeds by hand or use simple tools such as a bush knife or hoe.
3. Weeds can also be controlled by spraying them with a chemical spray (your teacher will demonstrate this). Some chemicals that can be used are Gramoxone, Round Up and Sting.

Step 6 **Fertilizer**

1. Apply NPK fertilizer about 10 cm away from plants. Do this about three weeks after sowing. Use about one tablespoon full of NPK per plant.
2. If you can get some poultry manure, mix it with the soil while digging the soil. Use about half a spade-full per plant.

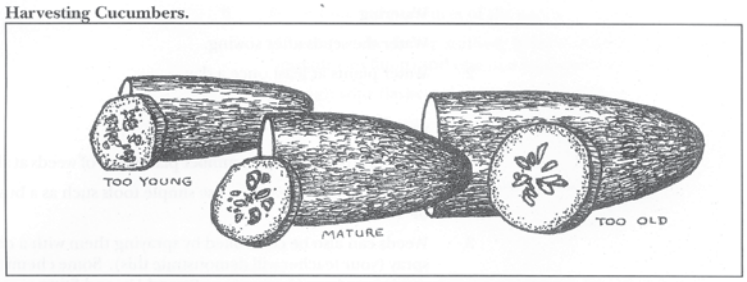
Step 7 **Pests and Disease**

1. Observe your cucumber plants daily for the following signs:
    - Rotting of stem and roots;
    - Brown, watery, soft rot of the stem, leaves and pods with masses of white, fluffy, fungal growth;
    - Dark streaks on the underside of the leaves;
    - Small, dark brown flecks with reddish border to circular spots;
    - holes (left by chewing insects).
2. Use pesticides or fungicides (your teacher will demonstrate their correct use) if you see any signs of disease or insects. Use the background information to identify some of the diseases and insect pests on cucumber plants. Some common diseases of cucumber are powdery, downy mildew and cucumber virus. Some common pests are rats, aphids, caterpillars and the spotted ladybird.

Step 8 **Harvesting**

1. Harvest cucumbers about ten weeks after planting.
2. Harvest only cucumbers that are either not too young or not too old.

Harvesting Cucumbers.



ACTIVITY B

Growing Dwarf Beans

Materials/Equipment

1. Dwarf Bean Seeds.
2. Digging Fork.
3. Spade.
4. Bush Knife.
5. Tape measure.
6. String -30m long.
7. Watering can.
8. Wheel Barrow.
9. Knapsack Sprayer.
10. Garden Hose.
11. Fertilizer-NPK, Poultry Manure.

Instructions

Step 1 Seed Selection

1. Refer to Seed Selection under "growing cucumbers".
2. Some recommended varieties for Samoa are:
   - (i) Contender.
   - (ii) Top Crop.

Step 2 Site Selection

1. Refer to Site Selection under "growing cucumbers".

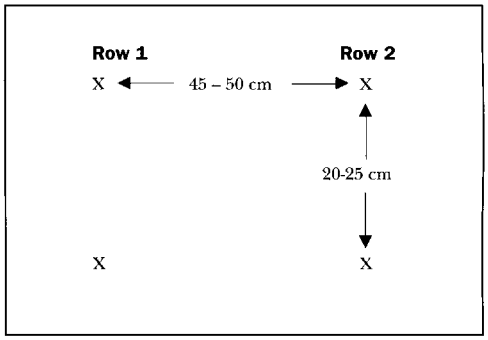
Step 3 Land Preparation

1. Refer to Land Preparation under "growing cucumbers".

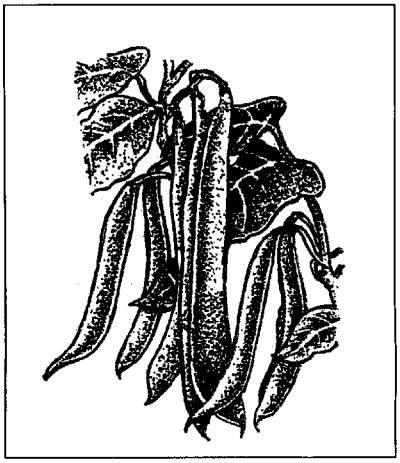
Step 4 Planting

1. Marking/Spacing.

   Using a measuring tape, mark out spacing of 45 to 50 cm between rows and 20 to 25 cm between plants within rows. See the diagram below.
2. Plant 2 seeds directly into each 2.5 cm deep hole.



Dwarf Beans.



Step 5 Weeding

1. Same as for "cucumbers".

Step 6 Fertilizers

Beans belong to the legume family which can produce their own nitrogen. Therefore only a low application rate of nitrogen fertilizer is required for beans. Mix poultry manure with the soil, if available, before sowing seeds.

Step 7 Disease and Insect Pest Control

Observe your dwarf beans daily for the following signs:

- Rotting of the stem and roots;
- Brown, watery soft rot of the stem, leaves and pods with masses of white, fluffy, fungal growth;
- Dark streaks on the underside of the leaves;
- Small, dark brown spots with a reddish border;
- Yellowing and stunted growth;
- Damaged leaves;
- Red spots on leaves which turn brown;
- Snake-like white lines in the leaves;
- Holes on young pods.

Step 8 Harvesting

1. Harvest the beans about 6-10 weeks after planting.
2. Harvest beans while they are still young. The bean should make a snapping sound when broken. If you harvest old beans the pods will be fibrous.

ACTIVITY C

Growing Chinese Cabbage

Materials/Equipment

1. Chinese Cabbage seeds.
2. Trowel.
3. Digging fork.
4. Spade.
5. Tape Measure.
6. String -30m long.
7. Bush Knife
8. Watering can.
9. Knapsack Sprayer.
10. Wheel-barrow.
11. Trays.
12. Garden Hose.
13. Fertilizer -NPK, Urea, Poultry Manure.

Chinese Cabbage.

Instructions

Step 1 Site Selection and Land Preparation

Follow the same instructions as for "growing cucumbers".

Step 2 Seed Selection

Follow the same guidelines as for " growing cucumbers".

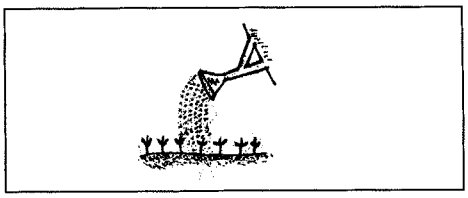
Step 3 Making the Nursery

1. Get good seeds.
2. Make a seedbed as follows:
   a) Measure out an area which will depend on how big your garden is going to be. The average size of a seedbed is 1m x 2m.
   b) Loosen up the soil in the marked area. The soil can be heaped up to form a raised seedbed.
   c) Sow the seeds. Seed sown in seedbeds are broadcasted or sown in straight lines at proper spacing. Broadcasting is a method of sowing seeds by scattering them over the surface of the soil and is usually done by hand.
3. Seedlings can also be raised in trays or some other container. Containers should be filled with media material such as soil and peat. The seeds are then sown in the containers.
4. Make a temporary shelter for the nursery using coconut leaves, plastic or other materials.
5. If seedlings are crowded, it is important to thin them to avoid competition. Seedlings which are over-crowded are usually weak and susceptible to disease. If each student can sow a few seeds in a given space, crowding can be avoided.

Step 4 Transplanting of Seedlings

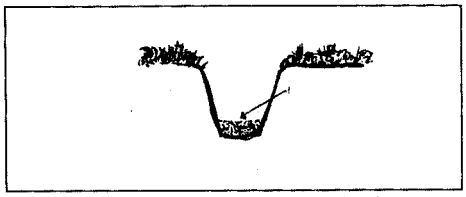
Using a measuring tape, mark out spacing of 30-45cm from plant to plant and 45 – 65cm between the rows.

1. Water the seedlings well.

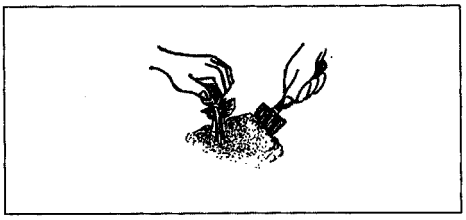


Chinese Cabbage.

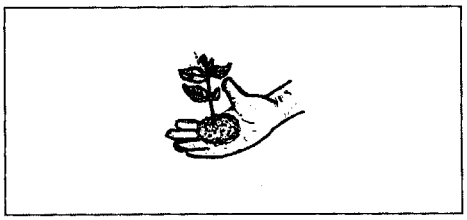
2. Dig a hole and put some organic fertilizer (e.g.,poultry manure) into it.



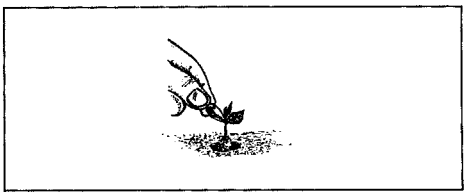
3. Using a trowel or fingers, lift up a clump of seedlings making sure that the roots are not damaged.



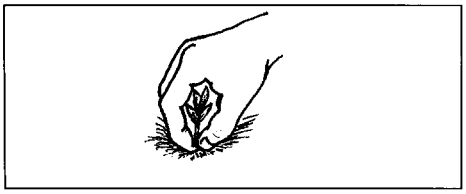
4. Hold the ball of roots in the palm of your hand.



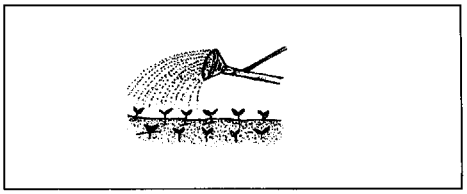
5. Carefully pick up seedlings by the tops.



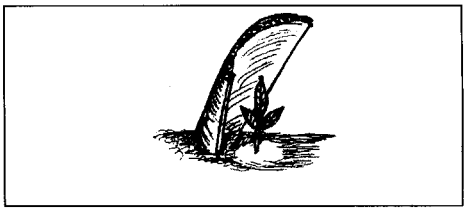
6. Place the seedling in the hole and cover the roots with soil. Press firmly around the roots.



7. Water the seedlings with a watering can.



8. Protect seedlings from sun, wind and too much rain.



Step 5 Fertilizer

1. Apply fertilizer as illustrated.
2. Use a balanced fertilizer such as 15-15-15 (NPK).
3. Repeat the fertilizer application at 3 weekly intervals.

Step 6 Pests and Diseases

Observe regularly for any of the following symptoms:

1. Small round holes on the leaves. Chemicals like Sumicidin or Thuricide may be used.

2. Examine the leaves for any signs of caterpillars, snails or slugs. For snails and slugs, use Blitzem bait.
3. Stem rot for seedlings.
4. Stem rot for mature plants.

Step 7 Harvesting

If they are well looked after, the plants will be ready for harvesting in three to four weeks after planting. It is best to harvest them early in the morning when the leaves are very fresh.

ACTIVITY D

Growing Laupele

Materials/Equipment

1. Laupele Cuttings.
2. Tape Measure.
3. String -30m long.
4. Bush Knife.
5. Spade.
6. Digging Fork.
7. Crowbar/Digging Stick.
8. Fertilizer - NPK, Urea, Poultry Manure.
9. Hoe.
10. Knapsack Sprayer.

Laupele is a good, dark green, leafy vegetable which can be grown easily at any time of the year. The plant does not need much care and can be grown on any reasonably good soil.

Step 1 Site Selection and Land Preparation

Same as for other vegetables.

Laupele.

Step 2 Selecting Cuttings

Laupele is grown from stem cuttings.

- Choose medium or large size laupele branches from healthy plants to use as cuttings.
- Using a bushknife cut the selected branches at a 45^0 angle, into pieces of about two feet long.
- Be careful when cutting the branches so that you do not tear the bark on the branch.

Step 3 Planting

1. Using a spade or digging fork, loosen the soil where you want to plant the cuttings. A spacing of about 60-100 cm is recommended.
2. Plant the cutting at any any angle you want.
3. When cuttings are in the soil, press the soil around the base lightly.
4. Water the cuttings when planting. Water daily until plants produce leaves.

Step 4 Weeding

Remove weeds by hand, using a bush knife or hoe. Once the plants are big, very little care is needed for them.

Step 5 Pest and Diseases

There are few pests or diseases for laupele so you do not need to control them. However observe the leaves of laupele- the holes you can see on the old (and sometimes young) leaves are caused by caterpillars and beetles.

Step 6 Fertilizer

Laupele does not require fertilizer unless the soil is not fertile.

Step 7 Harvesting

Harvest only the young leaves. Old leaves are tough when cooked. You can harvest at any time after leaves are produced on the plant. You may prune the plants if they grow too tall.

Review

1. What is transplanting?
2. What are the advantages of growing seedlings in seed beds or seed boxes?
3. List down the important factors you need to consider when transplanting seedlings.
4. Why are vegetables important?
5. For each of the crops covered in the PEP, name one pest that attacks it.
6. Describe the general steps you would take in trying to control pests, diseases and weeds.
7. What kind of area would you select for a garden site?
8. Why do we apply fertiliser?
9. Why do we use proper spacing when planting vegetables?
10. Why do we have to water seedlings before and after transplanting?
11. Name the two general types of planting methods used in growing vegetables.
12. What is the best time to plant vegetables?
13. How would you know when to harvest vegetables?

Unit 8: GROWING FIELD CROPS

Your class can plan growing field crops if land is available at your school. You may work in groups and grow the field crops suggested in this practical experience program. You may also try these activities in your homes. Always remember to keep accurate records of your activities with regard to the type of soil, seeds used, details of pesticides, pest control methods, dates of planting and harvesting, fertilizers used (if any), and quantity and quality of crops harvested.

Background Information

Ginger

Economic Importance

Ginger is an important cash crop which can be grown particularly well in Samoa. Ginger is widely used as a spice in cooking and as a flavoring agent in ginger bread, biscuits, cakes, soups, pickles etc. It is also used in the production of ginger beer, ginger ale and ginger sweets, ginger syrup and medicine.

Within a period of two decades, ginger has become Fiji's third biggest export earner. Samoa has a good potential to develop ginger into an even bigger cash crop for export.

Ginger.

Step 1 Selecting a Site

1. Soil Type

The most suitable soil for growing ginger is a soil that has a high humus content.

2. Slope and Drainage

Do not plant ginger on steep slopes as severe soil erosion will result. Where possible, it is strongly recommended that ginger be planted on slopes of less than 15 degrees. Low, wet land is to be avoided as ginger grown on it is often hit by wilt disease.

3. Land Use History

In order to minimize nematode problems, use only newly-cleared land, or land where a 4 to 5 year crop rotation has been practiced.

4. Climatic Requirement

Ginger thrives in a hot, humid climate. Thus ideal areas should have rainfall exceeding 3000mm annually, accompanied by a prolonged hot season. This is one factor which governs the quality of ginger produced, both mature and immature.

Step 2 Land Preparation

Clear the selected land area of all weeds and stones. This can be done manually or with the use of a tractor. When large areas of land are to be cleared, it is better to use a tractor. Land clearing begins in June/July.

1. Cultivation by Tractor

This method is used by the farmers who grow crops on fairly flat, or gently sloping land. A tractor, when used for land preparation, considerably reduces labour requirements. Land preparation absorbs a lot of work days. Using labour-saving machinery like a tractor helps farmers cultivate large areas.

2. Digging by Fork

The vast majority of ginger farmers use a fork for land preparation. After land clearing, the first digging of soil should commence in July/August. If poultry manure is available it can be mixed with the soil. The second digging should start in late August. Land preparation, if delayed, would mean a delayed planting and this, in turn, will affect the quality and yield of ginger.

Step 3 Selection of Planting Material

Select rhizomes from healthy plants that have no damaged eyes, rotten edges or thick swellings. Diseased and nematode-infested planting materials will adversely affect yields and the quality of ginger produced. Use of good quality rhizomes will minimize

diseases such as Fusarium Bacterial Wilt. Cut rhizomes into pieces of about 70g ensuring that each piece has at least two eyes. Allow the cuts to heal before rhizome treatment.

Step 4 Rhizome Treatment

Hot water treatment must be used. Place rhizomes into hot water (51°C) for 10 minutes.

Remember: If the water is too hot, or the rhizomes are left in it for too long a time, the pieces will not germinate. Diseased ginger will rot and shrink a few days after treatment. Discard this material at planting.

Step 5 Planting

a) Variety

The most common variety grown for fresh export is from the 'Canton' group, preferred for the size and appearance of the rhizomes. It is commonly grown by Asian and Hawaiian producers. For processing, the "so-called" 'Fijian' variety, with its strong citrus like aroma, is better suited.

b) Planting Rate and Plant Spacing

Spacing and the size of the planting piece used, determine the planting rate. A rhizome piece size of about 70 grams (size of farmer's thumb) with at least two eyes is best. Spacing and planting rate for ginger is a very important factor to consider. Seed rate is the amount of material to be planted per acre. Plant about 1.5 tons of rhizome/acre. For easy care and maintenance, plant in rows of 60cm X 15cm.

c) Depth of Planting

The ginger rhizome pieces are generally planted at shallow depths (about 8 to 10cm). The depth to which the pieces are planted can influence the yield and the size of the knobs on the rhizomes. With greater depth of planting (15 to 20cm), yield declines. Therefore, plant at 10cm deep and ridge up the plants as the new rhizomes grow to keep them covered. Ridging is very important for this reason.

d) Hilling

Hilling helps weed control and strengthens rhizome development. It is particularly necessary when the ginger has been planted on slopes to replace any soil which has eroded away from the base of a plant.

Immature/Premature ginger – hill twice (November, December).

Mature ginger – hill three times (November/December/January/February).

Step 6 Weed Control

Prepare the land well to prevent major weed problems. Follow this with correct chemical weed control. Fields should be sprayed with a triazin (eg. Gesprimso 80) after planting. For the rate of application, follow instructions on the package. Spray an even layer of the chemical on the surface of the soil. With good land preparation this should prevent any weed growth for about 2-3 months.

Step 7 Fertilizer Application

Ginger is normally produced with high rates of fertiliser application. Ginger responds well to timely fertiliser dressings, and heavy applications are common amongst growers of mature ginger.

a) Rate

Poultry manure	4 tons/acre
13:13:21 NPK	400kg/acre
Urea	120kg/acre

b) Timing of Applications

Dig poultry manure in at the time of land preparation. Apply 200kg/acre of NPK at the time of planting. Apply 200kg/acre of the NPK three months after planting. Top dress with Urea (30 kg/ha) four times at equal intervals between October and February.

Step 8 Pests and Disease

The most serious pests of the ginger industry are nematodes. Nematodes are particularly serious in mature ginger. The burrowing nematode is the most destructive because it normally carries the fungus which causes rotting of the ginger rhizome and severe post-harvest losses.

Control

- Select healthy and disease-free rhizomes. Do not plant export rejects as these are under-sized and are usually disease infested.
- Follow strict rhizome treatment procedures. If a field is to be planted year in and year out, then follow a strict 4 or 5 year crop rotation programme.

Harvesting and Post Harvest Handling

Time of Harvesting

Ginger may be harvested at 3 different stages for different purposes:

- Immature ginger which has least fibre content is harvested at about six months. It should be harvested at a time when there is a rapid increase in rhizome yield.
- Premature ginger is harvested 7 months after planting.
- Mature Ginger is harvested after 10 months.

Post-Harvest Handling

Rhizomes must be washed until clean before packing and selling. Prompt delivery is essential to avoid shrinkage with immature ginger, or rotting and breakage of mature ginger. Every care needs to be taken to minimize breakage.

Banana

Today, because Taro has been affected by Taro Leaf Blight, bananas have become more important for food in Samoa. A banana crop can be produced in 7-9 months. This means food needed will be quickly available. It is also a source of ready cash at the local market. In the past bananas used to be one of the major export earners for Samoa. The Department of Agriculture is trying to revive banana exports to the New Zealand market.

Banana Plant.

Different Types of Bananas

There are many different types of bananas, some of which were recently introduced into Samoa. The most common ones are:

1. **Cavendish or Fa'i Palagi**

   This type is grown for the export market and food. The variety needs efficient management and disease control.

2. **Mysore or Misi Luki**

   This variety is very resistant to diseases and needs less rain, pest and disease control. It is mainly eaten when ripe. When there is a shortage of Fa'i Palagi it may also be used for cooking. The Department of Agriculture is making efforts to promote Misi Luki in the New Zealand market.

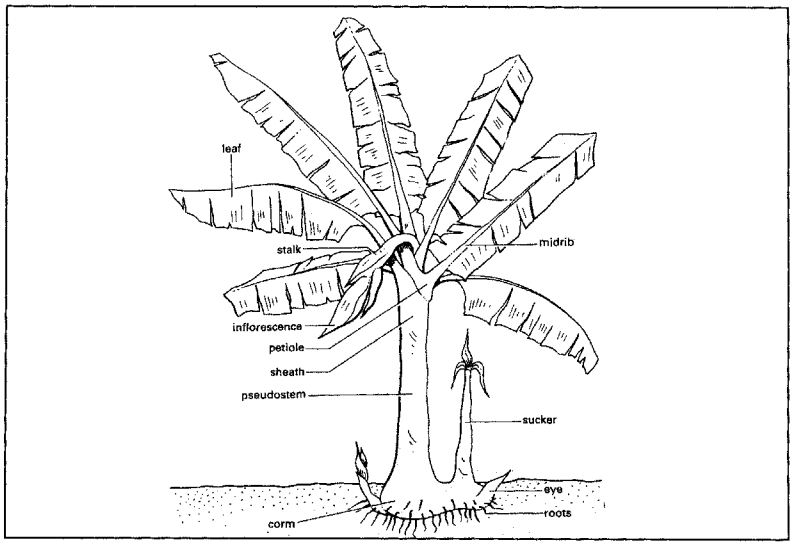
3. **Fa'i Samoa**

   These are a big and round fruit and very popular both for cooking and as a fresh fruit. Recent efforts by the Department of Agriculture to export it to the New Zealand market have been very successful.

4. **Pata**

   The fruit of this type is long and thick. This variety is quite resistant to diseases but it has no export market.

Parts of a Banana Plant.



The Main Parts of a Banana Plant

The important parts of a banana plant are:

1. **Roots**

   Roots of the banana are of poor quality and are easily broken. These roots do not grow deeply into the soil and cannot easily grow around such things as rocks because they are thick in size.

2. **Corm**

   This is the true stem of the banana even though it is under the soil. The corm holds water and food for the plant. It is from the corm that new suckers are formed to become new plants.

3. **Sucker**

   A sucker is a young plant which begins as a bud or eye growing from the corm. There are four types of suckers:

   a) **Sword Sucker**

      This is a young banana tree still joined to the Corm and receiving food and water from it. The false stem is broad at the base and narrow at the top with narrow pointed leaves. Sword suckers are the strongest and fastest growing material.

   b) **Water Sucker**

      This is a weak banana tree loosely attached to the corm. The leaves are broad and the plant has to make its own food.

   c) **Peeper**

      This is a small sucker with small scaly leaves.

   d) **Followers**

      They are larger and older suckers that do not have a flowering stalk. The leaves must be cut to a small size before planting, to stop water loss through transpiration.

4. **False Stem**

   The false stem is like the trunk of a tree but is made of tightly packed leaf sheaths.

5. **Leaves**

   A banana plant grows a new leaf every ten days. A parent tree has 12-15 leaves and produces about 36 leaves a year. The leaves grow from the inside of the false stem. As the plant develops, the old leaves are on the outside of the stem while the newest leaves are in the middle.

The leaf is the place where food is made. To make the food the leaf must be in the sun. If the leaves are not healthy, the fruits will be of poor quality. Leaves may be blown off by wind, eaten by insects, destroyed by fungus disease or may get covered with creepers. The leaf edges are adapted to tear or break in strong winds. This reduces damage to leaves in strong winds.

6. **Fruit**

The flowering stem of a banana has rows of both male and female flowers. Each group of male and female flowers are enclosed by a large coloured leaf-like covering called a bract. The female flowers develop into a "hand" of banana fruit. The male flowers soon fall off leaving a bare stem.

The young bracts at the end of the stem are wound one around the other forming a cone shaped structure called the bell.

Preparing the Land

All large trees and bush should be cleared. The best time of the year to clear the site is in the dry season. If bananas are already growing on the soil they can leave living things in the soil carrying banana diseases. Therefore it is important to let the land lie fallow before replanting, or to rotate crops.

1. **Weed**

Bananas need minerals, water and air or oxygen. Weeds can take these away from the banana's weak roots. Weeds should be cleared away in a 3ft. (1 metre) wide circle around the banana tree.

2. **Fertilizers**

A farmer must know the soil fertility of the banana plantation site before planting. The result of a soil test will tell the farmer exactly how much fertiliser and which kind of fertiliser is required for the plantation.

The main benefits of a properly fertilized banana plantation are:

- Increased yield of fruit per acre.
- Shorter time to harvest.
- Greater resistance to disease.

The most important nutrient needed by banana plants is potassium, followed by nitrogen, then phosphorus. When using a complete (NPK) fertiliser, the best mixture for bananas is (10-5-20).

Banana plants require a continuous supply of nutrients and should be fertilized every two months. Soil and leaf tests should be taken once each year.

The leaves and false stem of a banana contain many nutrients

that should be returned to the soil. Old leaves should be left to decay on the ground. After a banana bunch is harvested, the false stem should be cut down, chopped and spread between the rows of plants.

3. **De-suckering**

This is removing unwanted suckers. De-suckering reduces the number of plants in a stool. This helps the remaining plants to grow faster, healthier and produce better fruits. It also reduces pest and disease problems.

A correctly de-suckered banana plant will have three false stems:

- A main stem which is flowering or bearing fruit;
- A "maiden sucker" that is slightly younger and soon to bear fruit;
- A follower or peeper that will grow and become a maiden sucker.

A banana plant should not be de-suckered when it is about to flower. Remove unwanted suckers when they are still small.

4. **Pests**

A pest is any living thing which can attack and destroy a crop.

- **Nematodes** are very small worms which eat and make holes in the roots. This causes the roots to rot because of fungus entering the root.

  Treatment: Cut off dead parts of corms and soak in 56°C hot water for 10 minutes to kill the worms and other pests.

  After planting, spread about 30g of the chemical Vydate on top of the soil around each plant. Repeat every six months.

- **Banana Weevil** is a black beetle which digs into the corm above the soil. It then lays its eggs. The eggs hatch into caterpillars which eat the corm and cause fungus to rot the corm.

  Treatment: A chemical, Vydate, placed around the plant kills both nematodes and weevils.

- **Scab Moth** lays its eggs just after the fruit has formed from the flowers. The eggs hatch and the caterpillars eat the surface of the young fruit leaving it covered with dark scabs.

  Treatment: Before flowers begin to open, a 0.1% solution of Dicidex may be injected into the vertical bunch or a 2% Dianon powder puffed under the red brackets of the bunch.

- **Bunchy Top** is caused by a virus which is injected into the young emerging leaves by an insect (an aphid). If attacked, banana leaves do not grow properly and die.

Treatment: There is only one treatment: cut down the tree and burn it to kill the virus and stop it spreading to other banana trees.

- **Fungus or Leaf Spot Diseases.** There are fungus diseases which destroy the green part of the leaf. This causes the leaves to die and the fruits developed will be of poor quality.

  Treatment: Every two weeks a fungicide is sprayed onto the banana leaves and stems. This should be done during the cool part of the day when there is no wind.

Coconuts

The Importance of Coconuts

The history of coconut cultivation goes back hundreds of years. Large areas of coconuts were grown in Western Samoa and played an important role in Samoan economy until the price of copra fell considerably and plantations were badly destroyed by the two recent cyclones - Ofa and Val.

The coconut also plays an important role in the everyday life of Samoan people; it is used in many food preparations, feeding livestock, the tender nut is served as a drink, the shell is used in making handicrafts, as a fuel, the leaves are used for thatch, the mature trunk is used in making furniture, buildings and fence posts.

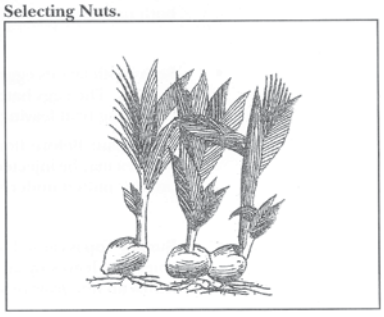
Selecting Nuts and Growing them in a Nursery

It is important to choose good quality, mature nuts from healthy, well-bearing plants. The main reasons for planting coconut seeds in a nursery before planting them are:

- To find the early germinating seeds.
- To select the strongest seedlings.

Approximately half of the nuts you grow will be the early germinating, strong seedlings that are best for a plantation.

Selecting Nuts.



Selecting the Site

Coconuts grow well from sea level to an elevation of approximately 300 metres. The plants need plenty of sunshine and will not be good producers if they are shaded by large trees. Coconuts also need good rainfall. Coconuts grow well on well-drained soils.

Preparing the Site

The land needs to be cleared of large trees and/or light bush:

- Large trees should be cut with a chainsaw or axe and piled into heaps. These heaps must be burnt to remove breeding sites for damaging insects.
- Light bush is best cleared with a bush knife in large circles around the place where each seedling will be planted. Regrowth of weeds can be controlled by slashing or with weedicide.
- Cut weeds and bush should be saved for mulching the newly planted seedlings, not burned on the ground in the plantation. Burning can destroy some soil nutrients and useful soil organisms.

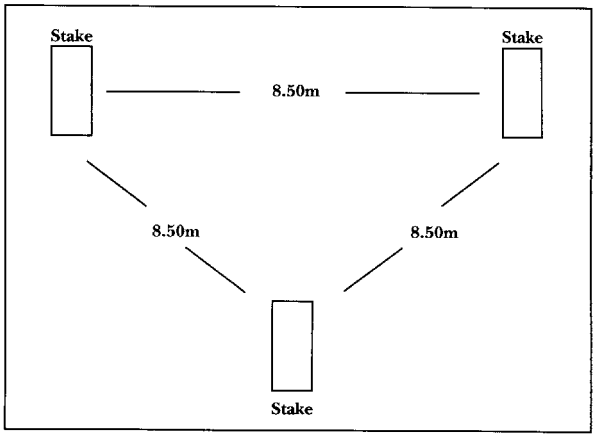
Planting the Seedlings in a Plantation

The best planting time is during the wet season (October-April). The distance from one coconut to another is dependent mostly on the variety. The dwarf varieties do not need as much space as the tall varieties.

Spacing the Seedlings in a Plantation. Coconut trees that are too close together do not grow well and do not bear nuts. Their roots fight for the same food and water in the soil and the leaves fight for sunlight.

Coconuts can be planted using two different spacings. If a farmer plans to plant only coconuts on his land then he would plant his coconuts 8.50m apart in a triangle pattern. This gives the largest number of trees (160 trees per hectare) that will grow well. The close spacing will reduce weed growth when the trees are big enough to shade the ground.

If a farmer plans to grow another crop under the coconut trees, (e.g., cocoa) the seedlings must be planted further apart. This will let more sunlight reach the second crop when the trees have grown. The seedlings should be planted 9.20m apart in a square pattern.



Managing a Coconut Plantation

In a well looked-after plantation the coconut trees begin to flower in three to five years. Poor conditions can delay flowering for as long as seven or eight years from planting.

Weeds

Weeds in coconut plantations must be controlled because they compete with coconuts for minerals, water and light. Weeds may be slashed, or cattle fed on them, or they can be sprayed with weed-killers.

Soil Fertility

There are three ways of improving soil fertility in a coconut plantation:

- Mulching – This is the covering of the ground under the coconuts with grass, leaves and other organic materials. Mulch adds organic matter and nutrients to the soil and, at the same time, controls weeds.
- Growing Legumes – Legumes are a group of plants which can absorb nitrogen from the air and convert them into nitrates. In this way they add nitrogen to the soil as they grow. They can be grown with grasses for cattle pasture beneath the coconut trees.
- Applying Fertiliser – Chemical fertilisers can be added to soil to improve soil fertility. They can be bought from the Agriculture Store. Fertiliser is labeled by the amount of Nitrogen – Phosphorus – Potassium (NPK) it contains. For example if it's labeled N20P15K20 it means this fertiliser contains 20% nitrogen, 15% phosphorous and 20% potassium.

Controlling Insect Problems

The most damaging insects affecting coconut palms are the Rhinoceros beetle and the Brontispa beetle.

Rhinoceros Beetle

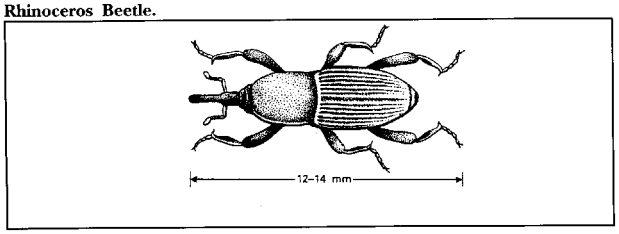
Rhinoceros beetles damage coconut trees in two ways:

- They eat parts of the young leaves. When the size and number of leaves are reduced the tree will produce fewer nuts; badly damaged trees may produce none at all. They may also tunnel down into the top of the palm trunk; this will kill the whole tree.

There are two ways to identify rhinoceros beetles and the damage they cause in a plantation:

- When new leaves unfold, the insect damage can be clearly seen as a large V shaped cut in the palm leaf.
- The eggs and young insects grow in dead wood, mainly rotten coconut logs. These can be seen by splitting the logs (adult beetles fly only at night and are not often seen).

Rhinoceros Beetle.



Controlling the Rhinoceros Beetle

- Keep the plantation clean of all dead wood. Cut up and pile in heaps all palm logs, dead standing trees, and stumps. Gradually burn the piles until they are gone. Burn them every 2-3 months. The heat kills young insects in the wood.
- By building traps and spraying them.

  Coconut logs are piled on the ground side by side. This creates an ideal breeding site.

  Piles are sprayed with a material that will kill young rhinoceros beetles. Must be re- sprayed every six months.
- A biological control method developed under German assistance was also widely used to control the beetle. This method makes use of a fungus which feeds on the beetle larvae.

Brontispa Beetle

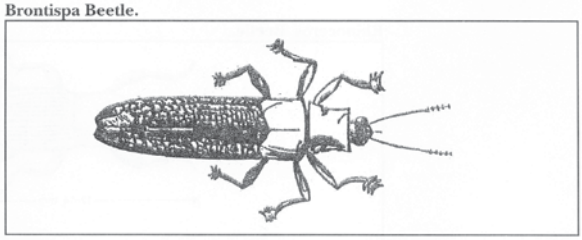
The Brontispa beetle was first identified in 1980. It is now found throughout most of Upolu and in a few places on Savaii. The Brontispa beetle was probably brought into the country on things woven from coconut leaves.

The adult beetles lay their eggs on the top and youngest leaf of a coconut tree, and starts eating the whole leaf before it is opened. When this new leaf unfolds there are often only a few brown pieces left. From a distance, the top leaves of a palm damaged by Brontispa appear to have been burnt by fire.

Control

- The Crop Protection Service of the Department of Agriculture is using biological control to control Brontispa beetle. They release wasps (the size of a brown ant) whose eggs hatch into small caterpillars which feed on Brontispa caterpillars. When young coconut seedlings about 2 years old are damaged by Brontispa they can be sprayed with insecticide. It is good to dip or spray seedlings in Ambush before transportation.

Brontispa Beetle.



ACTIVITY A — Growing Ginger

Materials/Equipment

1. Ginger planting materials (rhizomes).
2. Digging fork.
3. Spade.
4. Bush-knife.
5. Measuring tape.
6. String (30m).
7. Hose pipe/watering can.
8. Fertilizer – NPK, Urea and Poultry manure.

Ginger.

(equipment continued)

9. Big pot or empty 5 or 44 gallon drum.
10. Thermometer.
11. Cocoa wire (1m).
12. Hanging scale (100 kg).
13. Knapsack sprayer.
14. Sharp knife.
15. Trizine.

Objectives

After completing this practical activity you should be able to;

i. select the best site for planting ginger;
ii. prepare land for ginger using two recommended methods;
iii. explain the factors to consider in selecting planting materials;
iv. state the reasons for treating rhizomes before planting;
v. identify and control common diseases of ginger;
vi. harvest ginger according to recommended practices.

Introductory Questions

1. Have you seen ginger?
2. Do you use a lot of ginger at home and what do you use it for?
3. Do you grow ginger in your garden or plantation?
4. Does ginger grow well in Samoa?
5. Do you think ginger can be a good cash crop?
6. Is it difficult to grow ginger? Why?
7. What part of the plant do you use for planting?

Instructions

This is a long term activity. If you have some land available at your school, you can do this as a class project. A 1 metre wide by 10 metre long plot will do. You will need to make accurate observations and keep records of the dates of planting, types of fertiliser used, area of land planted, weight of ginger planted and quantity harvested. You will be able to get the planting materials from the Department of Agriculture, Nu'u Research Station, Apia market, farmers or students (bringing a rhizome each from home). A good crop can give you 15-20 times the weight of material you planted.

In order to carry out this project, go through the various steps in growing ginger and follow them strictly. Record your observations and results in a table similar to the one given at the end of the activity.

Step 1 Selecting a Site

1. Select an area of land which is rich in humus.
2. Select flat or gentle slopes and well drained areas. Avoid steep slopes or wet low lands.
3. Use only newly cleared land. Avoid areas that have been planted with banana or other crops to combat the nematode problem.

Step 2 Land Preparation

1. Using bush knives clear the plot of weeds and stones.
2. Mark the area into plots of 1m X 10m blocks.
3. Using digging forks and spades, dig up the soil and form two

raised beds along the plot. If you have some poultry manure mix (10kg) it in with the soil.

Step 3 Selecting and Preparing the Planting Material

1. Collect the planting materials or rhizomes. Ensure that all cuts on the rhizomes have healed before giving them the hot water treatment.
2. Half fill a pot with water and heat it to 51°C. Use a thermometer to check the temperature.
3. Bend in the four corners of a piece of cocoa wire to make a basket. Tie a string to the corners so that the cocoa wire can be dipped in and lifted from the pot.
4. When the temperature is 51°C, put the ginger into the cocoa wire basket. Leave the rhizomes in the hot water for 10 minutes. This is to kill the nematodes and other pests.
5. Take the ginger out and keep it for a few days before planting. Check the rhizomes for any signs of fungus or nematodes. The diseased ginger rhizomes will rot and shrink in a few days. Discard them.

Step 4 Planting and Hilling

1. The best planting time is October to December.
2. Use healthy treated rhizomes for planting. Use seed pieces of about 70g with at least two eyes.
3. Mix 200 kg/acre of NPK into the soil.
4. Plant the rhizomes into the ridges or mounts 15cm apart and 8-10cm deep.
5. Cover the rhizomes with soil.
6. Hill (mounting soil around the plant) 3 times during November, December and January.

Step 5 Controlling Weeds

1. If it is a small plot, you can weed manually. Large areas could be sprayed with Triazine using a knapsack sprayer after planting.
2. For the rate of application follow the instructions on the package.

Step 6 Applying Fertiliser

1. Calculate the amount of fertiliser needed at the rate given.
2. Apply 200 kg/acre NPK three months after planting.
3. Apply urea in 4 applications from October to February. One application of urea should weigh 0.3kg.

Step 7 Harvesting

1. When the ginger is matured (around July, in the year after

planting), use a digging fork to gently lift the ginger plant out of the soil.

2. Shake off the soil and, using a sharp knife, cut off the stem and leaves between the stem and the rhizomes. Handle them carefully so that you do not break them.
3. Wash the ginger well using a pressurized hose.
4. Dry them on a shelf.
5. When they are dry, pack them in boxes and weigh them before selling. Record the results in a table similar to the one given below.

Dates	Nature of land and area	Soil Colour	Height of ridge and distance	Fertiliser Kg/10m²	Quantity planted (kg)	Weed control	Yield (kg)

ACTIVITY B

Growing Bananas

Materials/Equipment

1. Banana planting materials (sucker and bits).
2. Digging fork.
3. Spade – long blade.
4. Bush-knife.
5. Measuring tape.
6. String (30m).
7. Hose pipe/watering can.
8. Fertilizer – NPK, Urea and Poultry manure.
9. Knapsack sprayer.
10. Nematodicide - Vydate.

Objectives

At the end of this practical activity you should be able to:

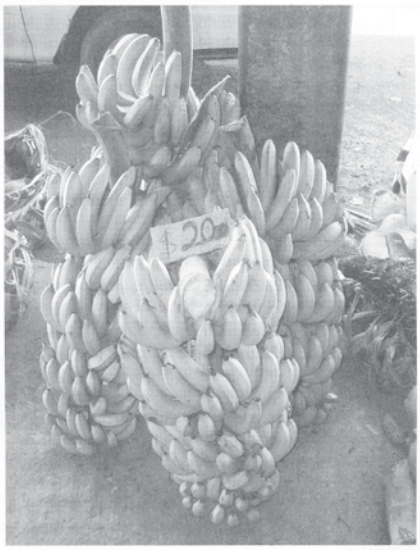
i. Name the main parts of a banana plant.
ii. Select a suitable growing site and prepare it for planting.
iii. Select and prepare good planting materials and plant them properly.
iv. Manage a banana plantation efficiently.

Introductory Questions

1. Do you have a banana plantation?
2. Which part of the banana plant do you use for planting?
3. Do you have any problems in your banana plantation?
4. Which takes longer to grow and harvest, banana or coconut?
5. Do you use fertiliser for your plants? Why?
6. Do you spray your banana plants any time? Why?

7. How long would a bunch of bananas take to ripen from the time of flowering?
8. Can you name an insect which attacks bananas?
9. Have you seen any farmer removing extra suckers from a stool of banana plants?. Why is it important to de-sucker the plants?
10. Why is banana seed not used to grow bananas?

N.B. *You may carry out the following activities as a class project step by step, or they may be done as separate individual activities for observation and learning.*



Bananas at the Market.

Instructions

Step 1 Field Trip

1. Your teacher will take you to a banana plantation.
2. Observe a stool of banana plants. Look at the suckers growing from the mother plant.
3. Observe the differences in the leaf shape of different suckers.
4. Look at the area where the sucker is attached to the mother plant.
5. Push the spade deeply down between the sucker and the mother plant to break (detach) the sucker from the mother plant.
6. Using the sucker that is broken from the mother plant, take a spade and lift the sucker from the soil without damaging the roots.

7. Take the sucker and wash it to remove all soil.
8. Take it to the classroom and place it on a bench or table.
9. Observe the sucker carefully.
10. Sketch a diagram of the sucker exactly as you see it and label the various parts of the sucker.

Step 2 Selecting and Preparing the Site

When you are selecting a site for planting bananas, you should consider the following factors:

1. Open and preferably flat land provides the best situation for growing bananas.
2. Nearness of roads is important for transportation purposes.
3. The soil should have good drainage.
4. Avoid sites which catch a lot of wind.

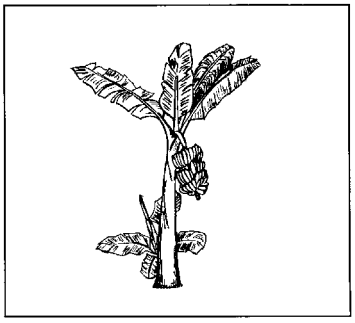
Step 3 Soil Preparation

1. Dig holes at a distance of 3m between plants and 2.5m between rows.
2. Dig holes of 46cm x 46cm and 30cm deep.
3. When planting put the top soil at the bottom of the hole.
4. Place the sucker or corm bits in the hole and cover with soil. Press down firmly. In the case of corm bits, make sure the bud is always pointing downwards. This will ensure proper rooting and anchorage for the young plant.

Step 4 Selecting and Preparing the Planting Materials

Your teacher will demonstrate how to select and prepare good planting materials.

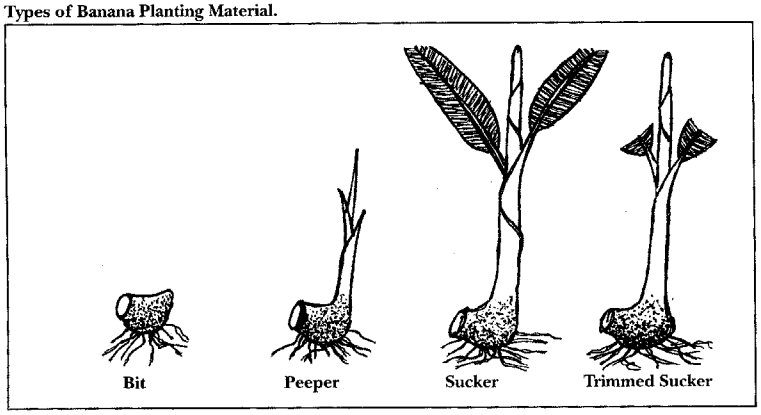
Banana Plant.



Using Suckers

1. Always select suckers from a disease-free plantation.
2. Always select healthy sword suckers and de-sucker them from the mother plant.
3. Remove all the roots.
4. Soak the suckers in hot water (56°C) for half an hour to get rid of nematodes and other pests. You may also treat the suckers with a nematodicide such as Vydate.
5. Now the sucker is ready for planting.

Types of Banana Planting Material.



Using Corm Bits

1. Choose corms from a disease free plantation.
2. Dig out the selected corms.
3. Remove all roots, dead parts and infected areas.
4. Cut the corms into bits. Each bit should weigh not less than 1lb and should have a bud.
5. Soak the corm bits in hot water (56°C) to kill disease and pests.
6. These bits should be planted immediately.

Step 5 Management

Your teacher will take you to a well managed banana plantation. During your visit observe the following and record your findings:

1. **Leaves**
   - Colour.
   - Any spots.
   - Appearance.
   - Number.
   - Signs of disease.
2. **Stem**
   - Size, appearance, height etc.
3. **Fruit**
   - Number of hands in a bunch.
   - Number of fruit in each hand.
   - Size of the fruit.
   - Appearance of the fruit.
   - Signs of any disease.
4. **General Appearance**
   - General maintenance of the plantation.
   - Weed and pest control.

Discuss the following questions with the owner of the plantation and make a report of your findings.

i. Methods of weed control.
ii. Any disease problems and how they are controlled.
iii. How is the soil fertility controlled and maintained?
iv. How big is the plantation?
v. How much money is spent for inputs eg., labour, fertiliser, pesticides.?
vi. How much money is the farmer able to make?
vii. Is the farmer happy with the returns gained from the plantation?
viii. Does he grow any other crops in the plantation?

ACTIVITY C

Growing Coconuts

Materials/Equipment

1. Coconut planting materials.
2. Digging fork.
3. Spade.
4. Bush-knife.
5. Measuring tape.
6. String (30m).
7. Hose pipe/watering can.
8. Fertilizer – NPK, Urea and Poultry manure.
9. Knapsack sprayer.
10. Handicraft made from coconuts.
11. Ambush.

Objectives

After completing this practical activity you should be able to:

i. List important uses of coconuts.

ii. Develop and manage a coconut plantation successfully.

iii. Identify the common pests and diseases that affect coconuts and explain ways of controlling them.

iv. List the important factors to be considered while selecting seed nuts when developing seedlings in a nursery.

v. Explain the need to keep proper spacing between coconut plants.

Introductory Questions

1. What are our main export crops?
2. Do you use a lot of coconut in your cooking? What foods are cooked in this way?
3. Can you name some other uses of coconut tree parts?
4. Are coconuts important ? Give some reasons.

Instructions

The following activities can be carried out as a long term project if the school has land and facilities. Otherwise they may be adapted for observation and learning purposes. If the class decides to do this activity as a project, it is important that you keep accurate record of the activities, dates, and observations.

Step 1 Selecting a Site

- Select an area of land. Avoid slopes greater than 25°.
- An elevation of up to 300 metres is ideal for growing coconuts.
- Consider the nearness of roads for transportation purposes.
- The soil should be at least 100cm deep and well drained.

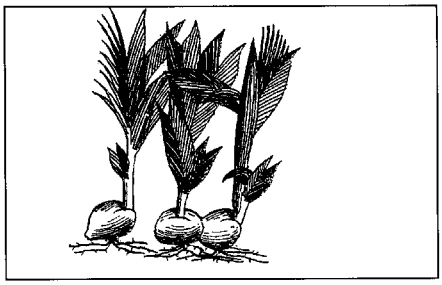
Step 2 Site Preparation

- Clear the under-growth and bush. Small sticks about a metre long can be saved as stakes for marking the points where the holes will be dug.
- Clear the remaining large trees with axes or chain saws.
- Large logs could be removed for timber or burnt to prevent the breeding of beetles and other pests.

Step 3 **Seed Nut Selection**

- Go to a coconut plantation.
- Clear all the undergrowth to make it easy to collect the nuts.
- Identify a number of healthy, high-yielding trees which have thick trunks with many leaves and bearing many nuts with strong nut stalks.
- Remove all the nuts around these trees for copra.
- Return to the same trees after 2 weeks. Collect twice as many nuts as you need as seedlings.
- Select nuts that: are ripe, have enough water inside, disease free, good shape and are of medium size with a less thick husk.

Coconut Seeds.

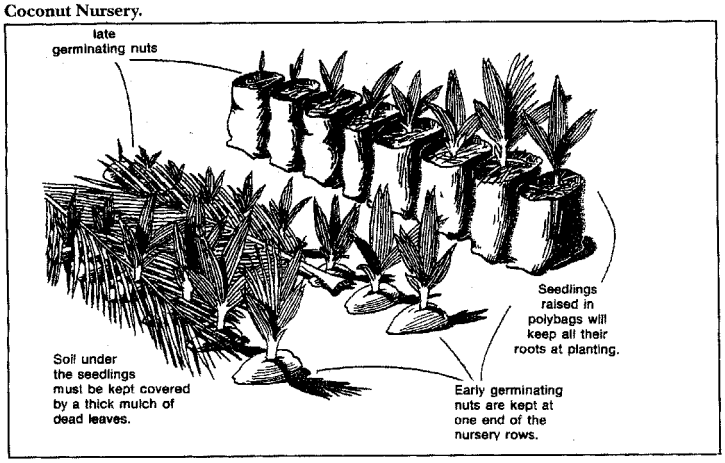


Step 4 **Nursery**

- Select an area of level land near a water source and free of shade. (If it is only for observation purposes, select an area of land near the school).
- Have it close to the area to be planted for easy transportation.
- Make shallow grooves in the soil to hold the nuts in place.
- Place the nuts in rows (1m between rows) with the broad side up.
- Cover the nuts with dead leaves, grass etc. and water them well.
- Observe the nuts daily every 10 days for signs of germination. Identify the early germinating seeds.
- Move the early germinating seeds to one side. Make shallow trenches to hold the nuts. Cover each nut with thick layer of leaves and grass to keep the nut from drying.
- When the seedlings have 4-5 leaves they are ready to be transplanted.

- Select only strong seedlings which have strong, thick stems and broad, deep green leaves that split into leaflets early. Weak seedlings have thin twisted stems and only a few narrow yellowish leaves.

Coconut Nursery.



Step 5 **Plant Spacing (For triangular planting)**

- Prepare two long bamboo sticks exactly 8.50m in length.
- Use the two sticks to make a straight line.
- Put a stake at every 8.50m.
- Put one end of each bamboo stick against two stakes.
- Bring the other two ends together to form a triangle.
- Put a stake at this point where the two bamboo stakes meet.
- Continue until the whole area is marked.

N.B. *You may also use a knotted rope marked at 8.5m intervals.*

Step 6 **Planting**

- Plant during the wet season (between October – April)
- Dig 0.6m X 0.6m X 0.3m deep holes at the marked spots.
- Separate the topsoil and subsoil into two piles.
- Put 2-3 tablespoons of fertiliser (NPK 20-10-10) at the bottom of the hole.

- Add some top soil and place the seedling on top of this. The top of the nut should be level with the top of the hole.
- Add more top soil and press it firmly around the nut. Do not cover the stem of the seedling.

Step 7 Management

Weeding

Use one of the following methods to control weeds.

- Slash the weeds if it is a small area.
- Spray with herbicides in larger areas.
- Allow cattle to feed on the weeds.

Soil Fertility

- Mulching.
- Cover the ground under the trees with leaves, grass and any other organic matter.
- Grow legumes.
- Apply chemical fertilisers if necessary. A soil sample test will help you to determine the type of fertilisers to be used. (You can have soil tested in the Soil Science Laboratory at U.S.P. Alafua).

Step 7 Controlling Pests and Diseases

- Read the background information and follow the procedures suggested there.

Review

Ginger

1. What are the factors to be considered when selecting a site for planting ginger?
2. How long did it take you to dig the plots?
3. What type of soil do you have?
4. What are the advantages of using machines like a tractor for preparing the land?
5. Identify the reasons for the heat treatment of ginger rhizomes.
6. List reasons for leaving the heat-treated rhizomes for a few days before planting.
7. What month do you plant ginger?
8. When will you normally be able to harvest ginger?
9. What are the reasons for not planting ginger too deep into the soil?
10. Why is it better to apply fertiliser at intervals rather than in one lot?
11. List reasons for spraying the soil and not the weeds.
12. Explain how hilling helps in controlling weeds.
13. What is the major pest in ginger?
14. What is the main disease that affects ginger?
15. What are some methods of preventing pests and diseases that attack ginger?
16. Does harvesting ginger involve a lot of labour?
17. How can you reduce the chances of breaking the rhizomes?

Banana

1. Name the common types of banana grown in Samoa.
2. Why are suckers important for the banana tree?
3. Why is desuckering a good management practice?
4. Explain why it is not good to select steep slopes for planting banana.
5. Why are banana trees not planted too close together?
6. What are the common diseases and pests that affect banana crops? How are they treated?
7. Why are parts of the leaves of larger suckers cut off before planting?

8. Why is it good to grow other crops for two or three years before replanting an area with bananas?
9. Name the common pests that affect banana crops in Samoa.
10. How are they controlled and treated?

Coconuts

1. Why do we grow coconuts?
2. Name some coconut products we sell locally and overseas.
3. How long does it take for a coconut tree to fruit ?
4. List some problems farmers face when growing coconuts.
5. How can they solve these problems?

Adventitious Root	Roots growing from stems or leaves.
Aroid	The taro family.
Axil	The upper angle between a petiole of a leaf and the stem from which it grows.
Bulb	A short underground stem enclosed by many fleshy leaves filled with stored food.
Cell	The smallest structural unit in the organism that is capable of self-production. It is surrounded by a plasma membrane and contains a store of DNA.
Corm	A short, solid, vertical, enlarged underground stem in which food is stored.
Chlorophyll	The green pigment found in chloroplast, important in the absorption of light energy in photosynthesis.
Commodity	An agricultural product.
Dicotyledon	A plant whose embryo has two cotyledons.
Dormancy	Being in a state of reduced physiological activity such as occurs in seeds and buds.
Drainage	The process of removing water from an area.
Embryo	A young saprophytic plant, which is retained in the gametophyte or in the seed.
Epidermis	A layer of cells covering all parts of the primary plant body except the root cap and the apical meristem.
F.o.b. (Free on board)	No freight paid.
Germination	The beginning of growth of a seed, spore or other once dormant structure.
Hermaphrodite	Having both male and female reproductive structures in the same individual.
Irrigation	Adding water to soil.
Lamina	Blade or exposed part of a leaf.
Monocotyledon	A plant whose embryo has one cotyledon.
Node	The point on the stem where leaves, axillary buds, and branches arise; often marked by a slight swelling.
Petals	Flower parts, usually coloured, to attract insects.
Perspire	Sweat. To exude (give off) moisture.
Petiole	A stalk of leaf.
Pistil	Seed bearing organ of flower, typically divided into ovary, style and stigma.
Photosynthesis	A process in which light energy is used to drive the formation of organic compounds.
Phloem	Food conducting tissue.

Respiration	To breathe. In the cell, the process by which sugars are broken down, with some of the energy released.
Roots	The descending part of a plant, normally below ground, serving to anchor the plant, and absorb and conduct water and mineral nutrients.
Rhizome	An elongated, underground horizontal stem.
Sepal	Leaflike stuctures that usually enclose the other flower parts.
Species	A group of very similar organisms, usually capable of interbreeding, that are related by recent common ancestry.
Stamen	Flower structure made up of an anther and a filament.
Stem	The portion of the vascular plant that bears nodes, internodes and leaves.
Stomata	Epidermal structure on stems and leaves composed of two guard cells plus the small pore between them, through which gasses pass.
Tissue	A group of cells that perform a collective function.
Transpiration	The giving off of water vapor from the surface of leaves.
Tubers	A much enlarged, short, fleshy underground stem.
Vein	Threadlike lines that make up the framework of a leaf.
Viability	Capability of surviving and developing independently.
Whorl	A number of leaves in a circle round the stem of a plant. Could be a circle of petals.
Xylem	The water and mineral conducting tissue in a vascular plant.