RWANDA POLYTECHNIC

TVET LEVEL II

AGRICULTURE

Food Preservation

TRAINEE MANUAL

RWANDA POLYTECHNIC

Approved by: Workforce Development Authority

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FOOD PRESERVATION AND STORAGE

Unit 1: Food preservation techniques

Unit 2: Storage conditions for raw materials

Unit 1: Food preservation techniques

Unit 1: Food preservation techniques

Topics:

1.1 Identification of preservation methods

1.2 Applying preservation techniques

1.3 Packing and storing foods

Unit Summary

This unit describes the skills, knowledge, and attitudes required for food preservation techniques. At the end of this unit, learners will be able to identify preservation methods, apply preservation techniques, and package and store food.

Self-Assessment Unit 1

1. Look at the Unit 1 illustration. What do you observe? What do you think this unit will be about? What topics might be covered in this unit?

2. Fill in the self-assessment below:

There are no right or wrong ways to answer this survey. It is for your own use during this course. Think about yourself: do you think you can do this? How well? Read the statements across the top. Put a check in column that best represents your situation. At the end of this unit, we'll take this survey again. Read the statements in the left column. Then put a tick in the column that best represents your situation.

My experience **Knowledge, skills and attitudes**	**I do not have any experience doing this.**	**I know a little about this.**	**I have some experience doing this.**	**I have a lot of experience with this.**	**I am confident in my ability to do this.**
Describe preservation equipment and materials					
Classify preservation techniques					
Explain application of heat treatment					
Describe food additives and rules for use					
Describe traditional and industrial food preservation techniques					
Define cross-contamination and explain how to avoid it					
Identify packaging material					
Explain packing and labeling requirements					

Topic 1.1: Identification of Preservation Methods

Key Competencies:

Knowledge	Skills	Attitudes
1. Describe preservation equipment	**1.** Select and manipulate preservation equipment	**1.** Safety Conscious
2. Classify preservation techniques	**2.** Apply preservation techniques	**2.** Methodical
3. Explain how to check raw material for correct preservation	**3.** Check raw material for product preservation and storage	**3.** Attentive

Getting Started: What do we know and where are we going?

Topic 1.1 Task 1:

1. Review the two pictures carefully and think about how they relate to your experiences.

2. In pairs, respond to the following questions:

a. What do you see in these two pictures?

b. What do the two pictures have in common?

c. Discuss the activity of this picture and share personal experiences.

Problem Solving Activity

Topic 1.1 Task 2:

1. Your trainer will divide you into groups of three people.

2. Each group will be given one topic from the list below:
- **a.** Fruits and vegetables
- **b.** Milk and dairy products
- **c.** Grains and beans
- **d.** Meat and fish

3. In your group, discuss all your experiences with storing the food category given to your group.

4. Think about all the things you know about how this group of food is preserved and how it can be safely stored.

5. In your group, consider and discuss the following questions to help find many good answers:
- **a.** Does your family store this sort of food? Under what conditions is this sort of food stored? What is done to the food prior to storage that helps the food last longer without spoiling? How long can this sort of food last when it is stored?

- **b.** What equipment (if any) is needed to store this sort of food safely? What processes must be done before the food is stored?

- **c.** How can you tell if this food is well preserved and safe to eat? How can you tell if this food has spoiled during storage times?

6. Write out a list of all the answers your group can think of for your food group.

7. At the conclusion of this activity, you will share your ideas with the rest of the class.

1.1 Key Facts

- **Food preservation** is the process of treating and handling food to stop or greatly slow down spoilage (loss of quality, edibility, or nutritive value) which is caused or accelerated by microorganisms as well as by self-decomposition.[1]

- **Principles of Food Preservation:**
  - Prevent or delay microbial decomposition
  - Keeping out microorganisms (skin or other covering in place)
  - Removal of microorganisms (washing, filtering)
  - Hinder growth/activity of microorganism (low temperatures, drying, chemicals)
  - Kill the microorganisms (heat, pasteurization, radiation)
  - Prevent or delay self-decomposition of the food
  - Destruction of food enzymes (by blanching, boiling)
  - Prevent or delay chemical reactions (antioxidants, fermentation, pickling)[2]

- **Food Preservation Methods:**
  - **Physical methods**
    - Cooling: refrigeration (0 to 7°C) for short periods (days) or freeze for several months
    - Heating (pasteurization, cooking, sterilization)
    - Drying remove water to level which does not support growth of microorganisms
  - **Chemical methods**
    - Apply chemical additives that act as antimicrobial agents
  - **Biological methods**
    - Fermentation-or souring--lactic and acetic acid stop microbes (cheese, yoghurt)[3]

- **Food preservation techniques** can be classified as traditional (or home) methods or industrial (or commercial) methods.
  - **Traditional** methods include: Curing, Freezing, Boiling, Heating, Sugaring, Pickling, Soaking in lye, Canning, Jellying, Confit, Fermentation

[1] *17.5C: Food preservation*. (2019, September 25). Biology LibreTexts. https://bio.libretexts.org/Bookshelves/Microbiology/Book%3A_Microbiology_(Boundless)/17%3A_Industrial_Microbiology/17.5%3A_Food_Preservation/17.5C%3A_Food_Preservation

[2] Shiksha, K. (2012, March 6). *Principles of food preservation*. E-Courses Online. https://ecoursesonline.iasri.res.in/mod/page/view.php?id=17055

[3] Shiksha, K. (2012, March 6). *Principles of food preservation*. E-Courses Online. https://ecoursesonline.iasri.res.in/mod/page/view.php?id=17055

- **Industrial** methods include: Pasteurization, Vacuum packing, Freeze drying, Artificial food additives, Irradiation, Modified atmosphere, Nonthermal plasma, High pressure food preservation, Bio-preservation

- **Cross contamination** of food is a common cause of food borne illness. Germs (bacteria and viruses) from different sources can contaminate foods during preparation and storage. Preventing cross contamination is an important step to help eliminate food borne illness.

- **Cross contamination can occur in three main ways:**
  - Food to food
  - Equipment / Utensil to food
  - People to food

- **Prevent (or reduce) cross contamination hazards to food:**
  - Wash hands between handling different foods
  - Wash/sanitize all equipment and utensils exposed to food
  - Avoid touching face, skin, hair, and avoid wiping hands on cleaning cloths
  - Separate washed or prepared foods from unwashed or raw foods.
  - Prepare types of food one at a time then clean/sanitize all surfaces between each task[4]

Guided Practice Activity

Topic 1.1 Task 3:

1. Consider your experiences and also what you have learned by reading 1.1 Key Facts.

2. In this activity, your trainer will be doing class demonstrations to show you how to use and work some of the industrial machines that are used in food preservation and storage.

3. Your job is to pay close attention and take notes as the following equipment is demonstrated:
   a. Sterilizer:
   b. Pasteurization machine:
   c. Vacuum sealer:

[4] Boulder County Food Safety Program. (n.d.). *Cross contamination*. https://www.bouldercounty.org/families/food/cross-contamination/

d. Freezer and a refrigerator:
e. Thermometer:
f. Hygrometer:
g. Cleaning supplies
h. Other equipment:
i. REMEMBER it is always important to wear the appropriate Personal Protective Equipment. List out all the PPE used by your trainer during this demonstration.

4. Once your trainer has completed the demonstration, you may take a turn with each of the machines so you can practice using them correctly yourselves.

5. Be sure to ask for guidance from your trainer should you have any questions or concerns!]

Application Activity

Topic 1.1 Task 4:

1. You will work with a partner that lives in your community.

2. After school today you will meet, and you will visit a local grocery shop. In the shop you will observe (and take notes) all the different ways that food is being preserved.

Store Name:	**Location of Store:**
Foods that are preserved in cans:	Foods that are preserved by being dried:
Foods that are preserved by being kept cold in refrigerator:	Foods that are preserved by being kept cold in freezer:
Foods that are kept in a cool place:	Foods that have been preserved by pickling:
Foods that have been preserved by being sealed into closed packages:	Foods that are preserved by fermentation:

Foods that are NOT being well preserved:	Foods that are preserved by drying:

3. To complete this activity, copy the table below into your notebook and complete the table with as many good responses in each box as possible.

4. After your visit, review the lists you have made in each box and see if there are other things that you could add to each box, upon your return to class submit your table to your trainer for your trainer to verify, and provide comments for you.

Points to Remember

- Workplace cleanliness and sanitation can reduce food spoilage
- Wear personal protective equipment and wash hands before processing or preservation
- Selection preservation equipment according to the needs of the product being preserved.

Formative Assessment

1. Write out the answers to the following questions:

a. List four ways to delay the action of micro-organisms that can spoil food.

b. Define preservation.

c. Define cross-contamination.

d. Explain how to prevent cross contamination in food storage.

e. Which of the following will NOT help stop the action of micro-organisms spoiling tomatoes?

- **i.** Put them in boiling water
- **ii.** Put them in a freezer
- **iii.** Leave them on the shelf

f. Which of the following methods can be used for preserving meat:

- **i.** Canning
- **ii.** Smoking
- **iii.** Freezing
- **iv.** Drying in the sun
- **v.** All of the above

Topic 1.2: Applying preservation techniques

Key Competencies:

Knowledge	Skills	Attitudes
1. Explain reasons for heat treatment	**1.** Apply heat treatment to preserve food	**1.** Attentive
2. Describe food additives rules	**2.** Use food preservation methods at home	**2.** Precise
3. Describe different processing techniques	**3.** Explain reasons for processing food products	**3.** Accurate

Getting Started: What do we know and where are we going?

Topic 1.2 Task 1:

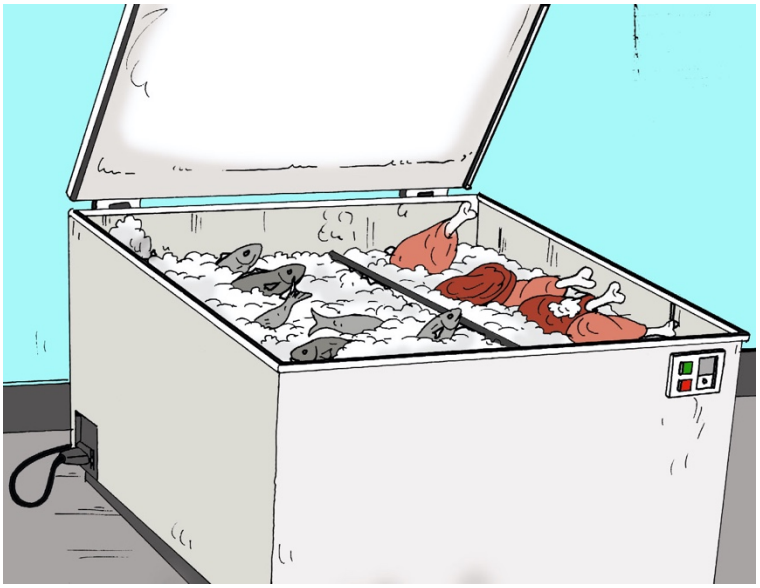
1. Use the following questions to refresh your memory and review the learning from **Topic 1.1**:

a. What did we learn in the last topic?

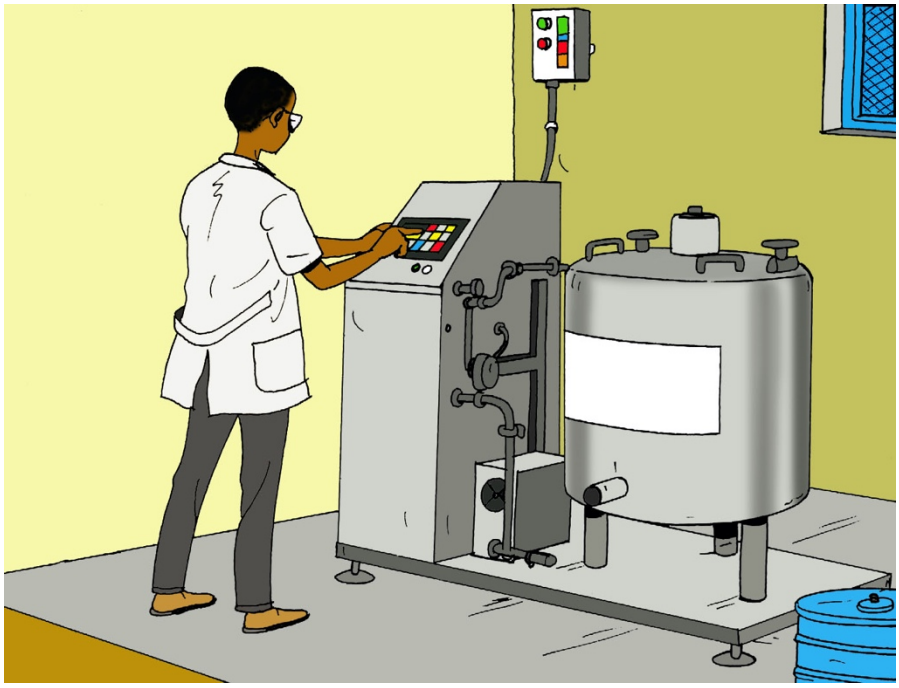
b. Describe the pictures from the last topic which are posted on the blackboard.

c. Now think about what you have learned already and make a guess about what is happening in the next set of pictures that your trainer posts.

2. Your trainer will have posted copies of the following pictures on the board first:



3. Your trainer will then post copies of the following pictures on the board:



Problem Solving Activity

Topic 1.2 Task 2:

1. In groups you will do research on one of the following topics (your trainer will let you know which topic is for your group).

2. You will have approximately 10 minutes to do your research so each group member should search for answers in different sources for about 5 minutes then the last 5 minutes the groups can put all their information together for a quick presentation.

3. The research topics are:
- **a.** Sterilization
- **b.** Pasteurisation
- **c.** Canning
- **d.** Pickling
- **e.** Fermentation
- **f.** Brining
- **g.** Drying

4. When you do your research be sure to include the steps in that particular method as well as which foods can be preserved with this technique.

5. After you have completed the research and gathered all your group information together, organize a quick presentation for the class.

1.2 Key Facts

- **Food spoilage:** the process of food decomposition which makes the food unsuitable for human consumption due to potential illness or due to bad odour, taste, or texture.

- **Careful food preservation reduces food spoilage thus reduces potential related illness.**

- **Description of preservation techniques and equipment requirements for each**

Process	How it works	Equipment needed
Heating: Sterilization or Pasteurization	Kills microbes and stops enzymes which rot food	Thermometer, large pan or pasteurizer, heat source
Cooling: Freezing or keeping chilled	Slow bacterial activity and enzyme activities	Refrigerator, freezer, or cool chamber
Drying or concentrating	Less water reduces microbe activity	Dry, warm climate, suitable area, dryer, filter cloths, heat source
Pickling (adding salt)	Less water limits microbes	Large pan, salt, other additives
Fermentation	Increased acidity reduces bacterial growth or activity	Large plastic bucket source of acid or other additives (cultures)

- **Different techniques for food preservation**

- **Application of heat:** In order of best preservation to least preservation
- **Sterilization-High Temperature:** 100 °C long time or by radiation
- **Pasteurization (high-temperature, short-time/HTST):** Shelf-life still short, food to be chilled.
- **Blanching:** Dipping it in boiling water for a few minutes to kill surface microbes
- **Low temperature:** heat to at least 63℃ then hold temperature for a long time
- **Preservation by cold:** temperature of food is reduced to limit microbe activity usually in a refrigerator (for a shorter time) or in a freezer (for a longer time).
- **Drying:** removes water so microbes cannot thrive thus they do not spoil the food
- **Application of salt:** to dry or change the chemical make-up so microbes cannot thrive
- **Brining** (or wet salting): food is soaked in salty water
- **Dry salting:** surface of food is covered in layers of dry powered salt
- **Pickling:** food is soaked in a solution containing salt with acid or alcohol
- **Canning:** uses heat to cook the food then food is stored in heat sealed containers

Chemical preservatives:

- Chemicals can be used for preservation of food. The can slow food spoilage cause by microorganism. Partial preservation can be achieved using refrigeration, drying, freezing, or fermentation, chemical additives prolong shelf life.

- **For fruits/vegetables:**
  - Sugar (jellies, conserves), salt (as described above), acids which help preserve fruit and vegetable products, and fermentation can be sped up by acids too.

- **Industries often use chemical additives to preserve foods.**

- **Rules to follow for chemical preservation:**
  - Chemical food preservatives must be used only at a needed dosage level
  - Must be strictly limited to chemicals which are not harmful to human health
  - Consider chemical composition and concentration of chemical before adding to food
  - Microbe level in a product determines efficiency of chemical additives for preservation.[5]

Guided Practice Activity

[5] Dauthy, M. E. (1995). *Fruit and vegetable processing: General procedures for fruit and vegetable preservation*. Food and Agriculture Organization of the United Nations. https://www.fao.org/3/v5030e/v5030e0d.htm

Topic 1.2 Task 3:

1. Read the scenario and give as many good answers to the question as you can.

Inyange is one of the biggest food industries in Rwanda. They process different products such as juice and fresh milk, but they have problem of shelf-life for those products which is caused by poor application of preservation techniques. The workers notice that the drinks have become odd colors, this is how they know there is a preservation problem.

a. Can you think of other ways to identify that the food prepared by Inyange has spoiled?

2. Share your answers with the class when your trainer asks.

Application Activity

Topic 1.2 Task 4:

1. You and your class will be visiting a local food processing factory. While at this site, pay close attention to the PPE being worn and the sanitation practices that are in place, as well as watching the food preservation techniques carefully.

2. To guide your notetaking and review of the site visit, please respond to the following questions (as well as any other observations you may have).

a. What are the primary food products being produced at this factory?

b. What PPE are workers wearing? Why do they need these particular pieces of gear?

c. What machine or equipment is being used to process the food?

d. What additives (or other ingredients) are part of the food preservation process?

e. Describe the containers where the food is put after it has been processed. Explain why this sort of packaging is being used.

f. Explain the steps to processing the food.

g. How long is the shelf-life of this food after it has been processed? How long is the shelf life of the food if it had been left in the raw/natural state?

h. are there other ways to preserve this food – or is the factory doing the only method possible?

3. Take notes on all these questions while at the factory. You may need to ask particular questions to the manager or to workers while you are there—which is fine.

4. After the visit, review your notes and write up a complete report that gives the details of this site visit. Submit this report to your trainer during the next class period.

Points to Remember

- Certain methods of processing food can preserve the food, prolong the shelf-life.
- Traditional methods are equally good as industrial methods when carried out in clean conditions.

Formative Assessment

Write answers to the following questions:

1. Why does heat treatment preserve food?

2. Describe how to do pasteurization and sterilization for food preservation.

3. Explain the advantage of pasteurization and the disadvantage compared with sterilization.

4. Describe two ways to preserve food other than using heat.

5. Explain why drying helps to preserve food.

6. Give two rules that should always be followed if using chemical additives to preserve food.

Topic 1.3: Pack and Store Foods

Key Competencies:

Knowledge	Skills	Attitudes
1. Identify packaging material for various product specifications	**1.** Diagnose reactions between food and packaging materials	**1.** Conscientious
2. Describe packing and labeling requirements	**2.** Apply packing and labeling correctly	**2.** Attentive
3. Identify storage requirements for preserved food	**3.** Choose storage spaces for preserved food	**3.** Prudent

Getting Started: What do we know and where are we going?

Topic 1.3 Task 1:

1. Observe the picture below carefully.

2. Answer the questions that follow.

a. What do you see in this picture?

b. What do you see the woman on the right side doing?

c. What information do you think should be put on the outside of the box?

Problem Solving Activity

Topic 1.3 Task 2:

1. Split into groups of 3 trainees. This task is a competition based on the scenario below:

a. You and your group have been hired to help a factor market a new kind of chocolate milk. This milk is tasty with chocolate flavor but also has 9 kinds of vitamins and calcium for strong teeth AND it is sweetened by natural honey from the Nyungwe forest, so it is more natural and more healthful than regular chocolate milk. It will be sold in two sizes: 250ml boxes and 1liter boxes.

b. Your job is to design a label to promote this product and enhance sales so make it attractive!

c. The label must also include all the important information (for eating and for storage as well as all other important information—your group must decide what is needed)

d. When you have completed your sample label (front and back sides) you will present your idea to the class and the class will vote on which design is the best…and that group will get a prize!

1.3 Key Facts

- **Food packaging:** Enclosing or protecting a food product for distribution, storage, sale or use. Correct packaging enhances food preservation.

- **The functions of a package include the following:**
  - Keeps the contents in a secure space (containment)
  - Protects the contents from the environment or other hazards (protection)
  - Identifies the contents through labelling (communication)
  - Enables factory processes like filling or heating (mechanization)
  - Facilitates production, storage, distribution, and use (convenience)

- **When choosing packaging, consider the following questions:**
  - Does the packaging resist a tear, burst, or breakage?
  - Can the package withstand an impact?
  - What can pass through the packaging (Airtight? Watertight?)?
  - How long will this package last in good condition?
  - Does it burn, melt, or deteriorate under normal conditions?

- **Marketing considerations for packaging include:**
  - The brand image and style
  - Compatibility with handling and distribution needs, size and variation
  - Requirements of retailers

- **Choose a packing material based on:**
  - Technical properties of the material (strength, flexible or rigid, weight)
  - Purpose of the packaging (moisture barrier, cushioning, branding,)
  - Availability and cost (locally made or imported)
  - Environmental impacts (such as recycling) and legal requirements

- **Consider the food when choosing packaging:**
  - Avoid chemical reactions between the food and the packaging
  - Consider physical properties of the food – how can it be best preserved?
  - What is the planned shelf life of this food?

- **Recycling** is a real issue for food packaging. Huge amounts of packaging are thrown away as waste every day. We need to make sure that:
  - use only what is needed
  - choose reusable packaging, like glass milk bottles
  - recycle packaging wherever possible
  - Use biodegradable packaging, like paper, that rots naturally, no plastic that doesn't.

- **Storing food:**
  According to category
  - **Non-perishables:** Last a long time. Bottled and tinned foods. Store in a cupboard.
  - **Semi-perishables:** Bread, cakes, eggs, fresh fruit and vegetables. Store in a tin, rack or a basket. Some semi-perishables (salad, vegetables, etc.) are stored in the refrigerator.
  - **Perishables:** Milk, cream, fresh meat, and fish. A very short shelf life so must be used within three or four days. Store in the refrigerator at 4°C or store in the freezer at -18°C.

- **Storage areas** should be controlled for temperature, humidity, circulation, and cleanliness

- **Labels require the following:**
  - Name of the product
  - Name and physical and postal address of manufacturer
  - List of ingredients
  - Net content weights or volumes
  - Date of manufacture and expiry date
  - Storage instructions

Guided Practice Activity

Topic 1.3 Task 3:

1. In this task you will work with a group of other trainees. You will have 5 minutes at each corner so plan your time wisely.

2. Your group will spend 5 minutes at each of the **LEARNING CORNERS** that your trainer has organized in the corners of your classroom.

3. In each LEARNING CORNER you will find three samples of real items and one set of questions.

4. As a group, respond to the three questions and make sure that all in the group participate.

5. The questions fall into two groups: Storage Explorations and Packaging Explorations

6. Storage exploration questions are the following:

a. Describe where you would find these items in a store and explain why they are stored in that place.

b. Once you buy these items and bring them home, where are they stored? Where are they stored if you eat only half the amount inside the package.

c. Explain how you know if these items have not been stored carefully.

7. Packaging exploration questions are the following:

a. Describe how the design of the packaging is good as publicity for each different item.

b. Find where ingredients are listed on the labels and tell the two most common ingredients in each of the items and also find if there is a production and expiry date.

c. Explain what happens to this packaging when the food inside is used up.

8. Your answers will be based on the actual food items that your trainer has gathered for this exploration activity.

Application Activity

Topic 1.3 Task 4:

1. This activity you will re-visit the factory which you visited during your last learning outcome. This visit you will have a different focus.

2. Last visit your observations were focused on the PPE worn, the hygiene and sanitation practices and the food preservation methods and practices that were in place.

3. This visit you will be observing the packaging and labeling that is done at the factory.

4. During the visit use the following questions to guide your observations:

a. What kind of packaging materials are used? Why?

b. How are the packaged goods packed for distribution? How far away are they distributed?

c. Are the packing materials re-useable? Recyclable?

d. Describe the labels that are used on the food packages?

e. What information is included? Can you think of any information that is missing?

f. Can you think of any packaging or labeling that this company could or should do better?

5. After your visit, review your notes and write a one-page summary to submit to your trainer at the start of the next class session.

Points to Remember

- Packaging material must be clean and sanitized to avoid contamination
- Choose packaging based on both the food and the packing requirements
- Label any package carefully and completely

Formative Assessment

1. Answer the following questions:

a. Describe five functions of food packaging.

b. List four things that should be included on a food label.

c. Give three marketing considerations for packaging.

d. List two things to consider when choosing a packaging material.

Self-Reflection

1. You have come to the end of the unit. You are going to do the survey you did at the beginning of the unit again to help you do self-assessment of your knowledge, skills and attitudes.

Again, there are no right or wrong answers to this survey. It is for your own use to gauge your knowledge, skills and attitudes after the unit. Read the Knowledge, Skill or Attitude in the left column. Think about yourself: do you think you can do this? How well? Read the statements across the top. Put a check in column that best represents your situation.

My experience Knowledge, skills and attitudes	I do not have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
Describe preservation equipment and materials					
Classify preservation techniques					
Explain application of heat treatment					
Describe food additives and rules for use					
Describe traditional and industrial food preservation techniques					
Define cross-contamination and explain how to avoid it					
Identify packaging material					
Explain packing and labeling requirements					

2. Complete the table below by identifying areas from the unit where you have improved and where you need improvement with the actions/strategies you will use to help you improve when receiving and interpreting information at the workplace.

3.

Areas of strength	Areas for improvement	Actions to be taken to improve
1. **2.**	**1.** **2.**	**1.** **2.**

Unit 2: Storage conditions of raw materials

Topics

2.1 Preparing food storage facilities

2.2 Receiving and storing raw materials

2.3 Keeping records regarding stored foods

Unit Summary:

This unit describes the skills, knowledge, and attitudes required to inventory and store foods. By the end of this unit trainees will be able to prepare food storage facilities, receive and store raw materials, and keep records of foods and non-food times (under frequent and directive supervision).

Self-Assessment: Unit 2

1. Look at the illustration. What is happening? What do you think this unit will be about? What topics might be covered?

2. Fill in the self-assessment below. There are no rights or wrong ways to answer this survey. It is for your own use during this course. Think about yourself: do you think you can do this? How well? Read the statements across the top. Put a check in column that best represents your situation. At the end of this unit, we'll take this survey again.

My experience **Knowledge, skills, and attitudes**	**I do not have any experience doing this.**	**I know a little about this.**	**I have some experience doing this.**	**I have a lot of experience with this.**	**I am confident in my ability to do this.**
Identify storage facilities according to products					
Describe storage capacity and arrangement of goods					
Describe storage conditions for product specifications					
Identify documents used for order and delivery of raw food materials					
Describe receipt documents					
Identify records of food storage condition					
Classify of inventory records					

Topic 2.1: Storing raw materials

Key Competencies:

Knowledge	Skills	Attitudes
1. Describe storage facilities	**1.** Clean and organize storage facilities for various products	**1.** Attentive
2. Describe best storage arrangement for various products	**2.** Calculate and check storage capacity	**2.** Careful

 **Getting Started: What do we know and where are we going?**

 **Topic 2.1 Task 1:**

1. As a class, brainstorm the following questions:

a. Where does your family store soybeans at home?

b. What do you do if you have new soybeans to store?

c. Where are books stored in school?

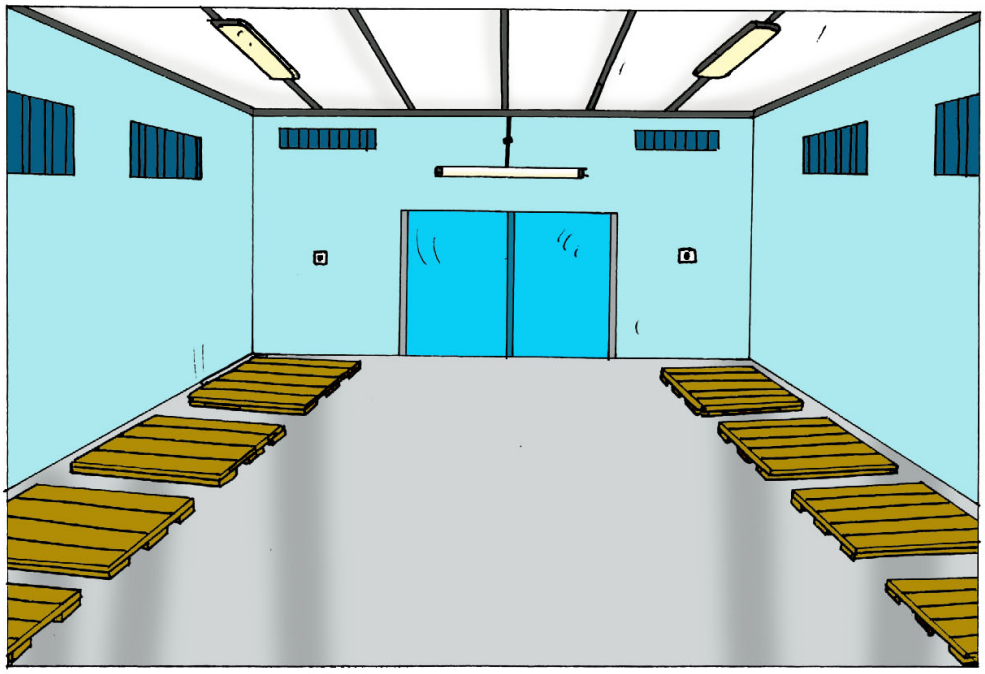
d. How does the school add new books to the library?

e. How is a place to store soybeans different from where books are stored?

Problem Solving Activity

Topic 2.1 Task 2:

1. Work in a small group to observe all the details that are shown in the illustration below.



2. As you can see this is an illustration of an empty warehouse. Your task is to answer the following two questions:
   a. List all the details that you see which make this warehouse a very fine place to store food products.

   b. Describe at least two activities (more if possible) that should be completed before food is stored in this warehouse.

2.1 Key Facts

- **Storage**: Keeping the quantity and quality of an agricultural material safe.
  - Two factors impact storage: humidity (should be low) and temperature (should be moderate)

- There are three basic types of food storage areas: dry storage, refrigerators, and freezers.

- **Dry Storage:** Should be dark, low humidity, and moderate temperatures (not hot or cold).
- **Refrigeration:** Should have stable temperature (1-5°C)
- **Freezer:** Should have stable temperature (0 °C or colder)

- **For refrigerators and freezers, the following are best practices:**
  - Do not overload because this will limit airflow which is needed for stable temps
  - Wait for food to be cooled to room temp before loaded into fridge or freezer
  - Keep door closed as much as possible so cold air does not escape
  - Clean frequently and ensure all food is well wrapped and labelled

- **Basic equipment necessary to prepare a food storage space:**
  - Cleaning equipment and supplies as well as insect and rodent control supplies
  - Pallets on which to stack food and scales to weigh the food
  - Empty containers (bags/sacks, plastic jerry cans) to hold the food while it is being stored

- **Hygiene practice in storage areas:**
  - Keep everything as clean as is practically possible!
  - Clean and fumigate storage areas prior to storing food.
  - Warehouse surroundings should be tidy: vegetation and rubbish can hinder inspections and can provide breeding grounds for insects and rodents.
  - Livestock must be kept away from the store; clean up droppings which attract rodents.
  - Clean storage containers whenever they are empty.
    - Old sacks must be dipped in boiling water to kill insects and then dried in the sun.
    - Remove food residues with a thorough brushing as well as cleaning with soap.
    - Holes should be stitched/patched/repaired.
  - Burn grass inside solid-walled bins or mud-plastered baskets to kill insects and mold.
  - Old grain must be stored separately from new grain, and old grain must be used first.[6]

- **Storage records may include the following:**
  - Warehouse inventory ledgers

[6] United Nations Industrial Development Organization (UNIDO). (n.d.). *Framer's training manual on post harvest management of sorghum, groundnut and rice*. European Union. https://europa.eu/capacity4dev/file/31677/download?token=HHL_plQp

- Stock/bin cards
- Fumigation registers

Guided Practice Activity

Topic 2.1 Task 3:

1. You will visit three storage areas on your school campus.

2. Your task will be to take some careful measurements and then calculate the volume of the storage area. You will then estimate how many sacks of carrots (as estimated above during the classroom example) could fit into that storage area.

3. Fill in the following table as you measure and calculate and estimate.

Name of Area	Length (in meters)	Width (in meters)	Height (in meters)	Volume In m^3	Number of carrot sacks that could fit	Notes:

Application Activity

Topic 2.1 Task 4:

1. Your class will be visiting a Supermarket near your school.

2. Your task is to observe as many different stock storage practices as you can.

3. You will quickly notice that different goods and foods products are stored in different locations and under different conditions.

4. Guide your observations using the following:
   a. Look for dry storage and describe foods stored in these areas.

   b. Look for refrigeration storage and describe foods stored in these areas.

c. Look for freezer storage and describe foods stored in these areas.

d. What are the advantages of dry storage over the other kinds of storage?

e. When is freezer storage the best option?

f. What products are stored in refrigeration? Why?

5. After the visit, write a short, one-page report to present in the class, explain and describe the food storage techniques that were observed.

6. You will submit this report to your teacher for validation at the beginning of the next class session.

Points to Remember

- Clean any storage area prior to use
- Monitor temperature and moisture of any storage area
- Carefully label each stored container and keep detailed records of stock

Formative Assessment

1. Answer the following questions:

a. List and describe the three primary ways to store food.

b. Give three tasks that will help prepare a warehouse prior to storing food there.

c. Give three best practice tips that will help ensure better cold storage conditions.

d. Explain why humidity should be kept low and temperatures moderate in a warehouse.

Topic 2.2: Receiving and Storing Raw Materials

Key Competencies:

Knowledge	Skills	Attitudes
1. Identify documents for ordering, delivering and receiving raw materials	**1.** Correctly fill and verity food stock records	**1.** Attentive
2. Describe order and receipt document details	**2.** Complete receipt documents with weight of raw materials	**2.** Self-confident
3. Explain LIFO and FIFO methods (food stock protocols)	**3.** Arrange raw materials using LIFO and FIFO methods and monitor storage conditions	**3.** Persistent

Getting Started: What do we know and where are we going?

Topic 2.2 Task 1:

1. You will work with a small group to observe this illustration, discuss what you see, then answer the following questions.

2. Be ready for your trainer to ask you to share responses with your group to the following:
   a. Give specific detail to explain what both people in this illustration are doing.

   b. Who do you think is the seller and who is the buyer? Why do you think that?

   c. Guess what will happen next.

   d. Where will bananas be placed?

   e. What will the woman be given? What will the man be given?

   f. What document is the man filling out? What detail is on that document? Who keeps a copy of that document?

Problem Solving Activity

Topic 2.2 Task 2:

1. Stay in the same groups you formed for the previous activity.

2. In this task you see a picture of a young man working in a warehouse:

3. Together with your group, discuss and answer the following questions. Add as much detail to each of your responses as you can.

a. Describe the conditions in the warehouse.

b. Describe the stock that you see stored in this warehouse.

c. Why would a chair and table be placed inside a warehouse?

d. Give at least two ideas for why there are some boxes that are near the table, rather than carefully stacked with the other boxes.

e. What sort of document do you think the man might be filling out?

2.2 Key Facts

- **Raw materials** are the foundation of finished food products

- **A factory or business must make sure that the raw material they receive:**
  - Is protected from contamination;
  - Can be identified while it is on the premises; and
  - is at the correct temperature when it arrives, if it is potentially hazardous.

- **Procedure for receiving and storing raw materials:**
  After receiving raw materials, store person should:

- Unload the materials in the staging area
- Verify quantities
- Clean the materials' containers/packaging
- Transfer raw materials to the storage area
- Record all observations/details in a written record[7]

- **Inventory/Receipt Documents:**
  - All storage facilities must have a filing system of hardcopy documents of stock transactions, and inventory holdings.
  - The following need to be filed:
    - Contracts, Waybills (transport documents including Import / export documents)
    - Goods Received Records / Receipts / Delivery Notes / Loss-damage Forms
    - Inventory Forms and Inspection Reports
    - Other documents depending on the type of raw material and the stocking situation

- **There are two stocking protocols:**
  - **FIFO: First In, First Out**
    - The earliest goods purchased are sold before selling the goods purchased more recently.
    - Older foods will lose their quality and sometimes become unsafe.
    - Ensure proper rotation of foods in storage places.
    - Put the oldest food in the front and the newest food in the back, behind the old.

  - **LIFO: Last in First Out**
    - The latest delivery of goods is sold first.

Guided Practice Activity

Topic 2.2 Task 3:

1. Together with the other members of your group, observe carefully the presented documents and respond the question formulated below:

[7] Choudhary, A. (n.d.). *SOP for handling and storage of raw & packing material*. Pharmaceutical Guidelines. https://www.pharmaguideline.com/2010/03/sop-for-handling-and-storage-of-raw.html#gsc.tab=0

a. Which of the documents in your pile of documents are used for ordering raw materials?

b. Which are used during the delivery process for those raw materials?

c. Describe receipt document and list out all the required pieces of information you see. Is any information missing on this receipt?

d. Identify the documents that are used within the storage facility to keep track of stock that is coming in and stock that is going out. Are there any documents that relate to stock rotation—or stocking protocols like FIFO or LIFO?

e. Describe raw materials presented in the documents –give as much detail about those materials as you can. (weight, packaging sizes, seller, transporter, etc.)

2. Your group will have only about 5 minutes at each of the tables to complete all the questions above then your group will rotate to a new table. You will rotate three times so your group will work at all four of the tables.

3. When you reach the last table, your group will present the documents in that pile to the entire class. Each person in your group should take one of the documents and that person will describe the use of their document and the details that are found on that document to the entire class. Take special note if you find out something that you did not know before.

Application Activity

Topic 2.2 Task 4:

1. You will be visiting a local bakery with your class. While there do careful observations of the ordering, stocking and use of raw materials—and pay close attention to the documents that are used.

2. Answer the following questions in your notebook while you are there:

a. Describe how raw materials are weighed both when they are delivered and again when they are used to bake things.

b. Are the raw materials stored well? Do you have any suggestions for improvement?

c. What documents do you see in use?

d. Are there documents that you think are missing and that would be helpful?

e. Ask the bakery manager if they organize raw material using LIFO or FIFO methods.

f. List three other interesting observations with regard to storing raw materials.

3. Upon your return home after the field visit, use your notes to write up a brief (one-page) report on the things that you observed. Submit your report to your teacher upon return to the classroom. Your teacher will verify and review your responses.

Points to Remember

- Stocking raw materials is critical to smooth running of a business
- Careful record keeping enables good management of stock levels.
- FIFO is the main protocol used with food and food storage to minimize spoilage.

Formative Assessment

1. List the five steps to receiving raw materials into a warehouse.

2. Give examples of 5 different documents that may be used to monitor stock in a warehouse.

3. Explain FIFO and LIFO then explain which protocol is better for food inventory—and why.

Topic 2.3: Keeping records on stored items

Key Competencies:

Knowledge	Skills	Attitudes
1. Identify recording of food storage condition in relation of type stock	**1.** Conduct recording of food storage condition	**1.** Detail-oriented
2. Classify inventory records according to raw materials	**2.** Assist the inventory records according to raw materials stored	**2.** Motivated
3. Identify of recoding calibration based on storage condition and specification	**3.** Perform and assist recording of calibration based on storage conditions and specification	**3.** Carefully
4. Choose records according to type of records	**4.** Collect and report records according to type of records	**4.** Innovative

Getting Started: What do we know and where are we going?

Topic 2.3 Task 1:

1. Form small groups and discuss the picture below:

a. What do you see? Describe it in detail.

b. What topic do you think this activity is related to?

Problem Solving Activity

Topic 2.3 Task 2:

1. Your trainer has brought four different tools or machines to your classroom.

2. Your task (with your group) is to review the tool/machine carefully then calibrate the tool/machine as accurately as possible.

3. Your group will spend approximately 3 minutes at each tool then move along to another until your group has visited all 4 of the demonstration tools/machines.

4. Upon completion your trainer will demonstrate correct calibration techniques for each tool/machine and also will display the correct and complete records that should be kept as each of the demonstration calibrations takes place for the maintenance/calibration records.

2.3 Key Facts

- **Record keeping**:
  - An organized process for storing documents relating to a business.
  - Careful record keeping provides good information for sound management.
  - Records or may be kept on paper or on a computer virtually, usually organized by the type of document and by the date. The preferred system of record storage should be functional, accurate, reliable, and user-friendly.[8]

- **Records should be classified and stored based on:**
  - **Purpose** (How will this record be used?)
  - **Type** (Similar records should be stored together by date)
  - **Date** (How long must this type of record be kept?)
  - **Access** (Who will review or check this record?)

[8] Government of Western Australia. (n.d.). *Record keeping systems*. https://www.commerce.wa.gov.au/book/export/html/5442

- **Important records in food industry businesses include:**
  - Cleaning and pest control schedule records
  - Equipment maintenance and calibration records
  - Storage temperature monitoring records
  - Supply / inventory files
  - Purchase orders/delivery records/invoices/receipts/waybills

- **Business documents must all contain the following:**
  - Title/Purpose of the document/Date
  - Prepared by/issued by/with signature (and preferably a stamp)
  - As much other information as is needed for the purpose of the document.

- **Manufacturing Inventory records and inventory management include records of:**
  - Stock of raw materials and supplies—for manufacturing the final product
  - Stock of consumables (supplies)—tools and material used up during production (gas for heating an oven, or soldering metal, etc.)
  - Work in progress–semi-finished goods which are in the process of production
  - Finished goods – which will then be sold by the factory

- **Calibration:**
  - The process of testing the accuracy and quality of a measurement or measurement tool
  - Instruments that must be calibrated include balances, scales, pH meters

- **The following steps provide process to follow to calibrate an instrument:**
  - Identify a known source to use as a comparison/foundation measurement
  - Check base measure accuracy with source identified in step 1
  - Check accuracy of incremental steps against base measure
  - Take corrective action by re-calibrating the machine against known source
  - Verify revised calibration
  - Document re-calibration steps taken for records.

Guided Practice Activity

Topic 2.3 Task 2:

1. In this task you will work with a team of other trainees. Make sure that your team has at least two female and two male trainees. Everyone will work together and help one another learn.

2. Each team should sit together around one table. The trainer will give you an envelope with a label (A, B, C or D). You will have approximately 5 minutes to complete the following tasks with the documents inside your envelope then you will be asked to exchange envelopes with another team. You will have 5 minutes to work on your second envelope. Then exchange with a different group to get a third envelope, again work for 5 minutes then exchange to get the fourth envelope. By the end of the session your team should have worked on 4 different envelopes.

Your first task:

3. When you get an envelope, open it and distribute the documents among your team members so every team member has at least one document to work on. They will then share their work on their document with other people on their team, so all team members get all the information needed about all the documents—but each person only works on one from each envelope.

4. For each document your team works on, fill in the following table:

Envelope Letter	Type of document	The good things about this document (what is correct?)	What should be changed with this document (what is NOT correct?)
Example:			
Envelope K	Purchase receipt	It shows date, price, seller, buyer and describes goods	Missing: weight of the goods purchased and buyer signature

Your second task:

5. When your group has completed the table for all the documents in all 4 envelopes, the Trainer will ask each person to take one document.

6. Together as a class you will discuss how the different documents should be classified—and grouped together with other like documents.

7. Think about how these documents should all be filed together in a way that is organized and so you can find them, and they are useful when needed.

Application Activity

Topic 2.3 Task 3:

1. This task is a site visit task that you will do with another trainee from your class that lives in the same community as you live.

2. Together with your partner you will choose a local shop or business to visit. You will visit the shop and spend some time observing the operations and then you will discuss the documentation processes and the record keeping for that business.

3. Take careful notes of exactly what sort of documents the owner keeps and also the way the owner organizes the storage of those documents.

4. ALSO notice if the owner uses any machines (is there a fridge? A freezer? A scale?) and review how the owner calibrates and monitors each of the machines that are in use in the business. If possible, review any maintenance and calibration records that are in place during your visit.

5. After the visit, sit with your partner and review your notes. In particular respond to the following questions:
   a. Were the documents used accurate and complete? Were certain records missing? Which ones? Give suggestions for better processes that the owner could use for documentation and records.

   b. How were the records for the business stored? Give suggestions for better processes that the owner could use to store the documentation and records for the business.

   c. Explain how each machine in the business is maintained and calibrated. Were the records clear and helpful? Give suggestions for better maintenance or records.

   d. What else did you observe that was an area that you felt the owner might benefit from a different process or better records or record keeping?

6. Upon return to the class, you will be asked to share your experiences and your insights.

Points to Remember

- A good system of record storage should be functional, accurate, reliable, and user-friendly.
- Records may be kept in paper copies in files or in e-copies on a computer or laptop.
- Calibration is the process of testing accuracy and quality of a measurement tool.

Formative Assessment

Answer the following questions:

1. How should records be classified and stored? Give 4 tips.

2. Choose two of the following words to fill the blanks in the sentence below:

The good system of record keeping should be functional, _____, _____, and user-friendly. (calibrated, accurate, materials, storage, reliable, factory, inventory).

3. Explain what it means to calibrate an instrument.

4. List five examples of documents that a factory would be likely to keep.

Self-Reflection

1. You have come to the end of the unit. You are going to re-do the survey you did at the beginning of the unit to help you assess your learning.

There are no right or wrong answers. Think about yourself: Can you do this? How well? Put a check in column that best represents your situation now at the end of the unit. Review where you have improved and where there is still room for more learning.

My experience **Knowledge, skills, and attitudes**	**I do not have any experience doing this.**	**I know a little about this.**	**I have some experience doing this.**	**I have a lot of experience with this.**	**I am confident in my ability to do this.**
Identify storage facilities according to products					
Describe storage capacity and arrangement of goods					
Describe storage conditions for product specifications					
Identify documents used for order and delivery of raw food materials					
Describe receipt documents					
Identify records of food storage condition					
Classify of inventory records					

2. Complete the table below by identifying areas from the unit that show where you have improved and those that show you still need improvement. Identify the actions and strategies that will help you improve, focus on learning strategies used in a workplace.

Areas of strength	Areas for improvement	Actions to be taken to improve
1. **2.**	**1.** **2.**	**1.** **2.**

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