

UNITE for the Environment

Sustainable Agriculture Training

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OBJECTIVES OF THE TRAINING

- Describe how to practice sustainable agriculture practices
- Understand the process of composting and its benefits
- Develop lessons that motivate student participation

INTRODUCTION

What is sustainable agriculture?

Sustainable agriculture is a farming practice that puts emphasis on methods and processes that improve soil productivity minimize harmful effects on the environment and human health, while ensuring maximum productivity and profit.

Sustainable agriculture focuses on local people and their needs, knowledge, skills, socio-cultural values and institutional structures.

Benefits of sustainable agriculture

- In sustainable agriculture, pesticides, herbicides and fertilizers are not used. These can poison fresh water, marine ecosystems, air and soil. They also can remain in the environment for generations. Many pesticides are suspected of disrupting the hormonal systems of people and wildlife. Fertilizer run-off impacts waterways and coral reefs. Therefore sustainable agriculture reduces pollution
- Because of good practices such as crop rotation, agro-forestry and use of compost, sustainable agriculture reduces land degradation. Land degradation usually leads to declining harvests which sometimes people to clear lands expand into surrounding wild lands such as wetlands and forests that are rich in biodiversity, resulting in a cycle of increasing poverty and biodiversity loss.
- It ensures that the basic nutritional requirements are met in both quantity and quality terms. This especially through the use of compost manure
- Crop diversity and higher yield result into increased profits. Therefore sustainable agriculture provides long-term employment and adequate house hold income and reduces poverty.
- It reduces the agricultural sector's vulnerability to adverse natural conditions (e.g. climate), socio-economic factors (e.g. strong price fluctuations) and other risks. This through practices such as irrigation, good storage and growing marketable crops.
- It fosters sustainable rural institutions that encourage the participation of all shareholders and promote the reconciliation of interests.
- It improves micro-climate (climate of a small area) and environment. Additionally it mitigates climate change which is partly attributed to clearing land especially forests for as the carbon stored in intact forests is released when they are cut or burned.
- It leads to lower costs of operation in the long run.

Examples of sustainable agriculture practices

Sustainable agriculture practices include soil nutrient management, tillage and residue management, agroforestry, soil and water conservation, companion planting, integrated pest management and improved livestock management.

KITCHEN GARDEN AS A FORM OF SUSTAINABLE AGRICULTURE.

What is a kitchen Garden?

A kitchen garden is where vegetables, fruits or other crops are grown around the house for household and commercial purposes.

Reasons for having Kitchen gardens

- To grow healthy, fresh vegetables and fruits yourself
- To save the cost of buying vegetables, fruits and herbs
- To more easily put to use waste resources such as sweepings, kitchen scraps and dirty water
- Wasteland around the house can be made productive
- To conserve the soil
- Kitchen gardens are not so prone to Human Wildlife Conflicts
- They are in most cases small and manageable
- Kitchen gardens do not require a lot of land

How to prepare a Kitchen garden

To make and manage a kitchen garden easily so as to get best production, the following things should be considered

Site selection

If you already have a kitchen garden you may not need to choose a new site, it's enough to improve the old site. If you are making a new garden, there are many factors to consider in terms of the site:

- Ensure that the site protected from livestock
- Be sure on how water will be brought and distributed to the site
- Have a proper plan on soil fertility will be managed?
- It is also important to have the garden which is easily accessible from the house/ school.

When these issues are considered, the best site can be chosen and the work of making the garden will be easier.

Water management

It is important to provide enough moisture for the kitchen garden. There are many ways of conserving and increasing the moisture available. For example:

- Provide shade: In the hot season trees can provide shade to the kitchen garden. Hedges, a few small indigenous trees or even fruit trees in the fence or within the garden can be used for this. These can also act as windbreakers. Wind dries out the soil and therefore

windbreakers will help in maintaining soil moisture. These trees can also provide other benefits, such as firewood, fodder or mulch material.

- **Green Manures:** These are created by leaving uprooted crop parts to wither on a field so that they serve as a mulch and soil amendment. The suitable plants to use for green manure are cover crops. Green manures not only provide nutrients to the soil but also help in soil water conservation by acting as mulch.
- **Irrigation:** If it is not a rainy season, mechanisms to provide crops with water through irrigation should be devised. Collecting and using waste water from the kitchen can be enough to water the garden. When watering with little water, a wider area should not be watered, only the surface will be kept moist. This can cause roots to stay near the soil surface and in strong sun they can dry out very easily. So it's much better to use a watering can. One can also use drip irrigation by dripping small holes in a plastic bottle and having the bottle filled with water. Filled bottles can then be suspended or buried half way next to plant/s you intend to water. This will help the moisture to go deeper in the soil. Then this area will not need watering again for a long time. In the dry season, irrigate in the evening or at night, and not in the daytime.

Seed & seedlings:

A kitchen garden can provide very good food from local, traditional fruits and vegetables, and it's important not to lose these local varieties. However, sometimes farmers are also interested in trying new varieties. So it's very important to save and protect any good seed. From good seed, it is important to be able to raise good, healthy seedlings.

Protection:

The kitchen garden area needs protection from the start. It should not be possible for livestock to enter the area. Thorny plants can be cut and used to make a fence, but the best method is to plant a living fence to protect the garden. Crops within the garden will also need protection from damage by many types of pest and disease.

Fertility of the soil

All farmers know that without fertility in the soil, crops won't grow. But fertility can be as limited as water. Before planting any crops in a kitchen garden, it is therefore important to ensure that your soils are fertile such that the kitchen is self-reliant for fertility. Fertile soils have the following nutrients

Nutrient	Importance
Nitrogen	Helps in plant growth
Phosphorus	Transfer of sunlight to plants, hastens early root and plant growth
Potassium	Increases disease resistance, improves flower and fruit quality, helps remove starches, sugars and oils
Calcium	Helps in root health, growth of new roots and root hairs, and the development of leaves
Magnesium	Vital for photosynthesis
Sulfur	Helps in energy-producing, flavor and dour e.g. in onions

Iron	Regulates and promotes growth
Manganese	Helps with photosynthesis
Copper	Essential constituent of enzymes in plants
Zinc	Responsible for stem elongation and leaf expansion

Sources of nutrients include;

- Green manures: Sowing seeds of green manure helps to protect the soil and gives extra fertility for more production.
- Mulching: Putting a thick layer of biomass mixed with compost on the soil helps to increase fertility.
- Legumes: Planting legumes such as peas, beans, Sesbania, sun hemp, etc., provides extra nitrogen to the soil which is good for other crops.
- Sweepings pit: By collecting every-day sweepings, food off cuts and other biodegradable waste from the house and yard in one place, you can make enough compost for the kitchen garden.

ACTIVITY: THE PLANT GROWING PROCESS

Background

Plants need three things in order to grow: Sunlight, Soil and Water. These three things are provided by the natural or artificial environments where the plants live. If any of these elements are missing they can limit plant growth.

Procedure

Ask students to mention what things they think are vital for plants to grow. Students should be able to list different things that plants need to grow

Work as a group to identify the three most important needs. At the end of this; sunlight, water and soil should be highlighted as the major things needed for plants to grow.

Discuss with students why they think, the sunlight, water and soil are important for plant growth

Divide the class into 3 groups.

The first group is going to do an experiment on the Sun, the second group on Soil and the third group on water

Have each group to place two sprouts into two separate clear cups (one sprout per cup).

For group 1

Add soil and water to each cup.

Place one plant in a sunny spot of the garden and place the second plant in the classroom where it will not be exposed to much light.

Ask the children to observe the two plants each day and record as a group what they are noticing.

For group 2

Add water to both plants

Add soil to one plant and place both plants in a sunny spot of the garden.

Ask the children to observe the two plants each day and record as a group what they are noticing.

For group 3

Add soil to both plants

Add water to only one of the sprouts and place both plants in a sunny spot of the garden.

Ask the different groups to observe the two plants for three days and record what they are noticing.

Group Name	Color		Height in inches		Other observations	
	Plant A	Plant B	Plant A	Plant B	Plant A	Plant B
Day 1						
Day 2						
Day 3						

Discussion questions

- How do the two plants in each group differ in height and appearance from the beginning to the end of the experiment? Can you explain the differences?
- How did each group's results compare to the other group's findings?
- Do you think that any one of the 3 elements that a plant needs are more important than another? (You may have groups compare the health of the plants.)
- Why do you think we removed one of the basic (e.g. water, air and soil) in one of the plants in the experiment?
- Where do plants in the environment get the basics they need to grow?
- What can we do to ensure that these basics are available to plants in the best way possible?
- Can you name limiting factors that might affect your plant growth in a garden or field at home?

COMPOSTING AS AN ELEMENT OF KITCHEN GARDENING

Introduction

Organic waste constitutes the highest percentage of the waste flow in most developing countries like Uganda. While other waste types (glass, plastics, scrap metals, etc) are seen as a problem to the environment and as a result programs on their reduction, reuse and recycle are underway, however there are very limited activities on recycling and reusing of organic materials. This is hampered by the fact that organic waste is not looked at as an environmental hazard. This is worsened by lack of awareness on appropriate composting technologies and associated benefits coupled with high competition with more synthetic fertilizers.

Most organic waste generated from households and markets is usually mixed (i.e. biodegradable and non-biodegradable) and this makes their use for compost creation a bit difficult. The most

economical way therefore is to collect waste from sources where the material is sorted properly. To achieve this awareness on waste sorting is very important.

What is composting? Composting is the controlled biological and chemical decomposition and conversion of animal and plant wastes with the aim of producing humus. Humus is the dark organic material in soils, produced by the decomposition of plant or animal matter and is essential to the fertility of the soil.

Decomposition is a result of the activities of micro-organisms that live in nature and are responsible for the natural maintenance and return of nutrients back to the soil which ensures sustainable soil productivity.

Compost making is one of the most effective processes for recycling organic wastes intended for use in agriculture. It is a natural process that turns the waste material into a valuable natural fertilizer which is essential for kitchen gardens.

Benefits of composting

- Compost functions as a form of organic fertilizer made from leaves, weeds, manure, household waste and other organic materials, thus it can reduce the cost of fertilizer from other sources.
- Proper compost management leads to an increased proportion of humic substances in the soil due to high micro-organic activity, and therefore applying compost leads to quantitative and qualitative improvements of the humus content of the soil, which leads to an increase in crop yields.
- Composting helps to improve soil fertility.
- Composting reduces soil loss by increasing soil moisture and soil cover.
- It improves waste management and hygiene in and around our homes and schools.

What is required before Starting Compost Making?

To establish a composting facility a number of items are required.

Composting site

The most important requirement for composting is the space. A flat piece of land under shade is ideal for composting. The space should include a sorting place.

Personnel

When planning for composting, labour requirements need to be planned for carefully taking each step into account. Consultation with someone with good knowledge in composting maybe necessary, unless one has already attained some training.

Equipments

Various types of equipment which include wheelbarrows, pangas, shovels, sieves and, packaging materials are required before this activity is started.

Dos and Don'ts in composting

Do	Don't
Sort waste from the source to remove non-biodegradable and hazardous waste.	Add trimmings, which tend to compact, inhibiting the flow of air through the pile.

Keep the pile damp, but never soggy (too wet).	Add weeds that contain seeds or roots easily from cuttings
Turn the pile often (Weekly or once in two weeks). The more often you turn your pile, the quicker it will break down into compost.	Add dairy products, meat, bones or animal waste from dog and cats. This can contain harmful pathogens, so avoid any organic matter likely to be contaminated by pests or disease.
Monitor the temperature of the compost using a stick as a thermometer.	Add diseased or insect-infested plants. Avoid using eucalyptus and cassia tree leaves or any biomass suspected to contain substances toxic to microbes, meat and animal fat.
If you can afford, use protective gear such as gloves, gumboots and masks or always wash with soap during each and every step of composting.	Add mounds of organic matter without mixing in something brown (like shredded dry leaves or newspapers), or there will be a bad odor or delayed decomposition
Mix a variety of vegetable food scraps with grass trimmings and leaves.	Use unfinished compost on plants, as it will rob them of nitrogen
Control odors/smell and flies through covering compost pile with a layer of dry organic material that allows air into the heap.	Use Charcoal ashes which are high in carbon dioxide content and thus interferes with oxygen supply in the composting system thus slowing down the process.

COMPOSTING METHODS THAT CAN BE PRACTICED IN OUR COMMUNITIES

There are two main composting methods that can be practiced in our communities. These are Windrow method and Compost Pit method.

Windrow Method

This is one of the commonly practiced systems for composting. Windrow method of composting involves the following steps:

Steps 1: Preparing the land

In the windrow system, a pile of compost is made and then turned. The turned pile is placed in an adjacent space; a new pile can be started in the original area. This is a continuous process, every time a pile is turned, free space is required. Prepare two sites, the first one for construction of the compost heap while the second one will be used for turning. The land will need to be cleared of all vegetation and the soil dug slightly to loosen it up so as to allow any excess water to drain away

Step 2: Setting up the pile

Measure a space of land preferably 1.5m by 1.5m at one edge of the cleared and loosened land. Evenly spread a layer of larger dry wastes (small tree branches, straw, banana leaves etc.) up to a thickness of up to 15cm. Add a layer of smaller dry vegetation (chop/shred if necessary) on top of this, to make up the layer to about 30cm. Sprinkle water to moisten. The dry layer is important, as it will allow air to pass freely through the pile. The dry layer is then followed by a layer of 30cm of green wastes. If possible, the green waste layer should then be covered with 2.5cm of coffee pulp or animal manure. Precaution must be taken when balancing these two important layers, as these

are the layers that determine the decomposing rate of a compost pile. Moisten the pile, and then repeat this process of layering until the pile is about 1.5m high.

Remember to water each of the dry layers.

Once the pile has been built, insert a long sharpened stick diagonally right through to the centre of the pile and leave the process to start. The stick acts like a thermometer, and within the first 72 hours the pile should have started to undergo the decomposition process. This is indicated by steam seen flowing from the pile and hotness on the part of that stick that was driven into the pile on completion of layering (take the stick out of the pile every week, and feel it!). If the stick is hot, the process is going well. If the stick is not hot, the pile may need more or less water, and/or aeration. If the stick shows signs of a white substance on it, the pile will need more water added to it. To increase the amount of air, the pile should be turned more frequently.

Step3: Turning/ aeration

Within one to two weeks, the pile shall have reduced by almost a quarter. This will reduce the air spaces in the pile and most moisture will have escaped due to high temperatures. If the pile is not turned to improve these conditions, the process will change into an anaerobic process, which is slow, time consuming, and unhygienic.

Turning also promotes uniform decomposition of all the wastes. Well-balanced compost pile will always keep gaining higher temperatures, which is again detrimental to micro-organisms survival, thereby slowing down the composting process. The turning process is necessary on a weekly basis till between 6 – 8 weeks when the temperature of the pile becomes cool which is an indication that the entire organic fraction has decomposed.

Step 4: Processing mature compost

Controlled drying may be necessary before the compost is weighed and packed for farm use. The final product should be both easily handled and visually accepted (e.g. should not have contaminants such as pieces of glass etc.).

Windrow method has the following advantages

- It is cheap and easy to operate
- Uses local equipment and adjustable size
- Can be operated in the open in most climates
- Easily adjusted to cope with changing types of material quantities
- Suitable to both small and large community schemes
- The compost manure gets ready in less than a year

The main drawback to windrow system is that control of the composting process is not as effective, which means that it sometimes takes longer to mature.

2. Pit Composting

In this method, organic wastes are piled into a pit daily and as time goes on those underneath decompose into compost.

The method is suitable for use in institutions like hospitals, boarding schools, children's homes, etc, where daily production of organic waste is high. The process uses the following procedures.

Step 1 Land preparation

Identify a space of land preferably under shade and dig a pit of 2.5m x 2.5m x 1m dimension.

Step 2: Layering the waste

All the organic waste should be evenly spread out in the pit. At the end of each day cover your waste with a thin layer of soil and remember to moisten with water where necessary. This process should be continued on daily basis till the pit is full. The full pit should be covered with soil and be left to decompose. The decomposition period will vary between 6 to 10 months as it is an anaerobic process. Ready compost could be removed for use in the garden, however if the pit was of the size of a garden bed it could be planted with crops directly. To ensure health and safety the materials being decomposed in the pit need to be carefully sorted to exclude inorganic materials.

NB: The compost should be prepared at least 3 months for the windrow method or 10 months for the pit composting before establishing the kitchen gardens to enable the compost to completely break down

ACTIVITY: COMPOSTING

Locate a shaded, protected area on the school grounds where you can make the compost pile. This should be away from buildings. If you are in a dry area, you can dig a pit for your compost heap in the ground and if you are in a wet area you make it above the ground.

Collect the following compost materials and set them next to the compost site a couple of days prior to the activity.

- Twigs and stalks
- Dry grass/crops
- Green vegetation and peelings
- Livestock droppings E.g. from cows, goats , poultry
- Soil/ wood ash
- Water
- Long stick

Procedure

1. Talk to pupils about the ways to make improvements to the soil as a practice for kitchen gardens. One way is to use fertilizers. Ask students what a fertilizer is and emphasize the benefits of organic fertilizer over the artificial fertilizer.
2. Tell the class that organic fertilizers are made from decomposed plant and animal material and one type of organic fertilizer is compost. Ask students if they have compost heaps at home and emphasize the need to sort biodegradable and non biodegradable waste in the composting process.
3. Tell the class that they are going to build a compost heap and ask pupils what will be needed to create compost. You can give pupils a hint by asking them what things are found in the soil (answer: decomposers, air , water and food)
4. Discuss with the class the items they should not add to a compost heap or pit such as plastic, metal, glass or glossy paper.
5. Discuss with the class what can be turned into compost in their homes such as maize cobs, sorghum and millet husks, banana and potato peelings, fruit, off cuts etc
6. Divide the class into groups, group 1 lines the ground with twigs, stalks or hay and add dry grass or crops, group 2 adds green vegetation and peelings, group 3 adds live stock

- droppings such as cow dung or poultry droppings, group 4 adds soil or wood ash and water.
7. On the board, draw and label the diagram showing the components of a compost heap. Encourage them to take this information home and make their own compost heaps at home.
 8. Take students outside to the compost site. Ask them what a good site for building a compost heap is. Answer: *The best site to build a compost heap is in a shady spot so the sun doesn't dry out the materials. It should also be away from the buildings.*
 9. Have different groups allocated with their duties to encourage team work
 10. Tell the class that they will check the heap every few days by pulling out the stick, if the stick feels warm, the compost is decomposing. If it is cool or has white fungus, it is not decomposing and they should add some water (not too much to make it wet) and mix the pile. Instruct the students to wash hands with soap after touching the stick
 11. Tell the pupils that they must mix the heap at least every two weeks so that the middle becomes the outside of the heap. (You may ask them why they think this important) *This also allows air to circulate through the heap.* The compost heap should not smell bad. If it does, then it is too wet and it will not form good compost
 12. The compost is ready when all materials are broken down to a semi rotted state; it has a rich earthy smell, and is dark brown in color. When it is finished , pupils can add the fertilize to the school garden and/or kitchen gardens at home
 13. Discuss the advantages of using compost manure in the kitchen garden such as that it is a cheap resource, environmentally friendly source of manure that involves recycling and doesn't create pollution, provides a variety of nutrients, is easily collected and created from readily available, free materials.

ENHANCING STUDENT PARTICIPATION IN LEARNING

Introduction

Keeping learners engaged during the learning process is one of the most important considerations for the teacher. The importance of engagement to academic achievements is almost self-evident and has been commented on by a number of researchers and theorists (Marzano, 2007).

There are different factors that cause or encourage learners to engage in appropriate classroom behavior and the teacher must be ready to employ different action steps at any moment when (s) he notices decline in student participation in a classroom.

There are several ways for a teacher to boost learner participation and these include

- Teachers can use different learner-centered teaching methods and instructional strategies to enhance learner motivation
- Identify something that interests learners beyond the teacher-identified goals
- The teacher-learner relationship is also very important in enhancing learner motivation. The better the relationship, the more the engagement and vice versa
- Teachers must somehow communicate the message to the students that they can count on them to provide a clear direction in terms of learning and behavior
- Provide a sense that a teacher and learners are a team devoted to the well-being of all participants and success of the lesson

Why is it important to enhance student participation?

Participation adds interest. It's hard to maintain students' focus and attention when all they hear is the teacher talking. It helps to hear another voice as well as an answer or another point of view.

Participation engages students. A good question can stimulate their interest, make them wonder why, get them to think, and motivate them to make connections with the content. This benefit is magnified when teachers play a bit with the question, when they repeat it, write it on the board, and don't call on the first hand they see.

Participation provides the teacher feedback. When students answer or try to explain, teachers can see the extent of their understanding. They can correct (or help the students correct) what the students haven't got right or don't see quite clearly.

Participation provides the students feedback. When teachers ask questions or otherwise seek student input over a topic, they are letting students know something about the importance of certain ideas and information.

Participation can be used to promote preparation. If an instructor regularly calls on students and asks questions about assigned reading or what's in their notes from the previous class session, that can get students (at least some of them) coming to class prepared.

Participation can be used to control what's happening in class. If a student is dozing off, quietly chatting, or otherwise not attending to what's happening that student can be called on or the student next to the offender can be asked to respond.

Participation can be used to balance who's contributing in class and how much. In the vast majority of cases, it is the teacher who selects the participant. If teachers will wait patiently and not always select the same student, if they look expectantly to others and confirm verbally and nonverbally the value of hearing from different people, they can influence who speaks and how much. Participation even helps teachers control how much they talk.

Participation encourages dialogue among and between students. Students can be asked to comment on what another student has said. A question can be asked and students can be invited to discuss possible answers with each other before the public discussion.

Participation can be used to develop important speaking skills. In many professional contexts, people need to be able to speak up in a group. They may need to offer information, ask questions, or argue for a different solution. People don't learn to speak up in a group by reading about how to do it. It's one of those skills best developed with practice. And it's one of those skills that develop better with feedback. If participation is being used to teach students this public communication skill, they will need feedback.

HOW TO ENCOURAGE STUDENT PARTICIPATION IN CLASSROOM

It's a common challenge that despite teachers' efforts, students sometimes seem unmotivated and disengaged. For better understanding and to have student empowered with knowledge and skills, student participation, is very important.

This can be in the following ways

Keep learning 'bite-sized', and mix it up

Student attention spans (especially the young ones) are short; therefore giving them a classroom session that's monotone and one-dimensional may not be a good idea. Always break things into small portions, and try to vary the nature and pace.

This can be through matching the age of your students to their attention span. For example a class of 10 year olds, will appreciate a series of different 10-minute learning experiences.

Don't do all the teaching yourself

The traditional model may have been for the teacher to lead the lesson. In an ideal classroom, students should be busier than the teacher.

This principle fits well with the notion of flipped learning, where knowledge acquisition happens outside the classroom, and it instead becomes a place for exploration and discussion.

Give your students worksheets, activities and projects so they're fully active and involved. None of these mean you'll be redundant. Your role now is to engage with students, moving from one individual or group to another, contributing, evaluating, and encouraging

Use groups to improve participation

It is recommended not to do this on the basis of ability. While dividing students up purely on the basis of ability has some uses, it also has limitations.

However you don't need to use 'academic ability' as your sole criterion for grouping students.

Indeed, when it comes to encouraging participation, you might want to look more at personality dynamics. Might quiet students talk more if they're in smaller groups? Can creating 'teams' for a problem-solving task generate fun and competitiveness?

Give students a voice

Do your students have a "say" in your classroom?

Of course you need to take key decisions yourself, but involving the learners as much as possible is very important. A classroom that feels democratic and to an extent 'owned' by the students is much more likely to generate "give-and-take" involvement.

Showing students that their opinions are important, in ways that are both small and significant, can be extremely beneficial.

Involve visual aids alongside other methods

Most students need something to focus their eyes on (besides the teacher) when they are trying to learn a new concept. It's hard to get students to listen and actively participate when there is not a visual aid to focus on. When you use a teaching aid, it will not only help you get your point across, but it will also help your students to focus on what they are learning, and in turn get them to participate.

Change your regular routine:

While a daily routine is good for students to follow, it can also become so monotonous that students will not want to participate. For example If students have to learn the same way day in and day out, there will come a time that they will just get bored of it. Mix it up and change your regular teaching by giving students a different task to complete. By turning their regular classroom routine upside-down, you are keeping students on their toes. This excitement will motivate them and get them to want to participate more often.

5E MODEL

Student participation can be enhanced in different phases. This can be best described by the 5 E model. The model is an instructional model which says that learners build or construct new ideas on top of their old ideas.

Each of the 5 E's describes a phase of learning, and each phase begins with the letter "E". The 5 E's allows students and teachers to experience common activities, to use and build on prior knowledge and experience, to construct meaning, and to continually assess their understanding of a concept. These phases are

Engagement phase: In this phase, the teacher assesses the learners' prior knowledge and helps them become engaged in a new concept through the use of short activities that promote curiosity and bring out prior knowledge. The activity should make connections between past and present learning experiences, expose prior conceptions, and organize students' thinking toward the learning outcomes of current activities. The purpose of this introductory stage is to capture students' interest, uncover what students know and think about a topic as well as determine their misconceptions.

Engagement activities might include a reading, a demonstration, or other activity that piques students' curiosity

	Consistent	Inconsistent
Teacher	Generates interest and curiosity. Raises questions. Assesses current knowledge, including misconceptions.	Explains concepts. Provides definitions and conclusions. Lectures.
Student	Asks questions such as, "Why did this happen? What do I already know about this? What can I find out about this?" Shows interest in the topic	Asks for the "right" answer Offers the "right" answer Insists on answers and explanations

Exploration phase: In this stage, learners may complete activities that help them use prior knowledge to generate new ideas, explore questions and possibilities, design and conduct an investigation. In this stage you provide students with cooperative exploration activities, giving them common, concrete experiences that help them begin constructing concepts and developing skills. Students can build models, collect data make and test predictions, or form new predictions. The purpose is to provide hands on experiences you can use later to formally introduce a concept, process, or skill through simple activities especially outside classroom

	Consistent	Inconsistent
Teacher	Provides time for students to work together. Observes and listens to students as they interact. Asks probing questions to redirect	Explains how to work through the problem or provides answers. Tells students they are wrong. Gives information or facts that solve the problem.

	Students' investigations when necessary.	
Student	Thinks creatively, but within the limits of the activity. Tests predictions and hypotheses. Records observations and ideas.	Passively allows others to do the thinking and exploring. "Plays around" indiscriminately with no goal in mind. Stops with one solution.

Explanation phase: This phase focuses students' attention on a particular aspect of their engagement and exploration experiences and provides opportunities to demonstrate their conceptual understanding, process skills, or behaviors. This phase also provides opportunities for teachers to directly introduce a concept, process, or skill. Learners explain their understanding of the concept. An explanation from the teacher may guide them towards a deeper understanding, which is a critical part of this phase. In this phase, learners articulate their ideas in their own words and listen critically to one another. The teacher clarifies their concepts and corrects misconceptions. It is important that you clearly connect the students' explanations to experiences they had in the *engage* and *explore* phases.

	Consistent	Inconsistent
Teacher	Asks for evidence and clarification from students. Uses students' previous experiences as a basis for explaining concepts. Encourages students to explain concepts and definitions in their own words, and then provides explanations and vocabulary.	Does not solicit the students' explanations. Accepts explanations that have no justification. Introduces unrelated concepts or skills.
Student	Explains possible solutions to others. Listens critically to explanations of other students and the teacher. Uses recorded observations in explanations.	Proposes explanations from "thin air" with no relationship to previous experiences. Brings up irrelevant experiences and examples. Accepts explanations without justification.

Elaboration Phase: Teachers challenge and extend students' conceptual understanding and skills. Through new experiences, the students develop deeper and broader understanding, more information, and adequate skills. Students apply their understanding of the concept by conducting additional activities. At this point in the model, some students may still have misconceptions, or they may understand the concepts only in the context of the previous exploration. Elaboration activities can help students correct their remaining misconceptions and generalize the concepts in a broader context. These activities also challenge students to apply, extend, or elaborate upon concepts and skills in a new situation, resulting in deeper understanding.

	Consistent	Inconsistent
Teacher	Expects students to apply concepts, skills, and vocabulary to new situations.	Provides definite answers. Leads students to step-by-step

	Reminds students of alternative Explanations. Refers students to alternative explanations.	solutions to new problems. Lectures
Student	Applies new labels, definitions, explanations, and skills in new but similar situations. Uses previous information to ask questions, propose solutions, and make decisions, design experiments. Records observations and explanations.	"Plays around" with no goal in mind. Ignores previous information or evidence. Neglects to record data.

Evaluation phase: The evaluation phase encourages students to assess their understanding and abilities and provides opportunities for teachers to evaluate student progress towards achieving the educational objectives. In this phase, you evaluate students' understanding of concepts and their proficiency with various skills. You can use a variety of formal and informal procedures to assess conceptual understanding and progress toward learning outcomes. The evaluation phase also provides an opportunity for students to test their own understanding and skills.

	Consistent	Inconsistent
Teacher	Observes and assesses students as they apply new concepts and skills Allows students to assess their own learning and group process skills Asks open-ended questions	Tests vocabulary words and isolated facts Introduces new ideas or concepts Promotes open-ended discussion unrelated to the concept
Student	Demonstrates an understanding of the concept or skill Answers open-ended questions by using observations, evidence, and previously accepted explanations Evaluates his/her own progress and knowledge	Draws conclusions, not using evidence or previously accepted explanations Offers only yes-or-no answers and memorized definitions or explanations Fails to express satisfactory explanations in his/her own words

Activity: Plants in compost

Materials needed

Soil cups

Two types of soil (One rich in compost and one not rich in compost)

Bean Seeds

Water

Background:

The structure of soil is improved when compost is added. Compost increases the soil's ability to hold water, helps soil to achieve a good airflow, and adds nutrients for plants. Compost will reduce the risk of plants getting diseases and will give life and vitality to your soil. Healthy soil means healthy plants.

Procedure:

- Inform teachers that they are going to teach a lesson aimed at enabling learners to understand that soils rich in compost support plant growth better than soils not rich in compost.
- Divide the teachers in groups of 5 and allocate each group a 5E model phase and instructions
- Give each group 30 minutes to come up with ways and questions that will guide in teaching to meet the requirements of the phase
- Have at least one group presenting each of the phases. Other groups can critique as the facilitator of the training gives further guidance following "how it can be done."

Group 1 and 6 task: Engagement Task

- Describe how the teacher will capture students' interest.
- What kind of questions should the students ask themselves after the engagement?

Example of what can be done

- The teacher captures the attention by bringing two types of soils in pots, one with compost manure added and the without
- He/she ask the students to observe the soil and tell how different the two types of soil are and what might be the causes of the two differences? He may further ask if bean seeds are planted in the two different pots, which of the two types can support plant growth better?

Group 2 and 7 Task: Exploration

- Describe what hands-on/minds-on activities students will be doing.
- List "big idea" conceptual questions the teacher will use to encourage and/or focus students' exploration

Example of what can be done?

- Create groups of 5 and give each group two pots of soil (one with compost manure and ne without)
- Ask students to add same quantity of water to the pots (Teacher may need to guide them on how much water to put, students may be required to adds equal quantity of water during the week
- Ask students to put the pots where they can access sunlight but should not be in a place that is extremely open
- Ask students why might seeds planted on the same piece of land grow differently?
- After one week, ask the students to examine the progress of the seeds
- Ask them to measure the height of each plant and record (They may do this after every two days for a week)
- After ask the students to examine the information collected group per group. Questions may include; of the two pots, which pot grew the taller plant, which plant looked healthier and why?

Group 3 and 8 task: Explanation

- What questions or techniques will the teacher use to help students connect their exploration to the concept under examination?
- List higher order thinking questions which teachers will use to solicit student explanations and help them to justify their explanations.

Example of what can be done

- Teacher asks questions such as 'Why are most soils around our homes darker than those far away from our home? Why do you find healthier plants in gardens around our homes than those which are far away from our homes?'
- If we have a sloping garden, where do we find better plants growing and why? If you leave a piece of land to rest for one or two seasons, does it support plants in the same way as one used season after season?
- The teacher may help students to justify their explanations.

Group 4 and 9 task: Elaboration

- Describe how students will develop a more understanding of the concept.
- What vocabulary will be introduced and how will it connect to students' observations?
- How is this knowledge applied in our daily lives?

Example of what can be done

- To enable students will develop a more understanding of the concept. Inform students that compost manure is one of the factors that makes soil fertile rich because it contains multiple nutrients. Ask students to work hand in hand with their parents to apply compost manure in their gardens(they can start with ones around home) and overtime see if they will get better yields
- How is this knowledge applied in our daily lives? Ask them how similar plants are to human beings. You may need to mention to them that plants, like human beings need food to grow(if they don't mention it)
- Vocabulary to introduce may include nutrients , deficiencies , etc

Group 5 and 10 task: Evaluation

- How will students demonstrate that they have achieved the lesson objective?
- This should be embedded throughout the lesson as well as at the end of the lesson

Example of what can be done

- You may create groups to discuss how food important is to plants as much as it is to humans basing on the activity and ask them what they can do to keep the soils fertile. Why is it important to use compost manure in our gardens

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