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Workshop
Vertical farms

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1. Introduction

This workshop introduces students to vertical farming as a sustainable solution in modern construction. Participants learn how integrating vertical farms into urban buildings reduces food transport emissions, improves air quality, and lowers a city's carbon footprint. The session highlights innovative design ideas that connect architecture and agriculture for decarbonization.

1.1 Learning Objectives

- Understand what vertical farming is and how it works.
- Learn how integrating farms into buildings reduces food transport emissions.
- Explore how vertical farms can improve urban air quality and energy efficiency.
- Discover sustainable design ideas combining construction and agriculture.
- Reflect on how such innovations help cities lower their carbon footprint.
- Encourage creative thinking about future eco-friendly building designs.

1.2 Required Knowledge

- Basic knowledge of biology (what plants need to grow)
- Awareness of how food usually reaches cities

2. Workshop Structure

Table 1 Example of a workshop structure

Phase	Duration	Activities	Purpose	Materials
Opening	5-10 min	Welcome, introductions, icebreakers	Set tone and expectations	Name tags, agenda
Context Setting	15-20 min	Share objectives and relevance	Align participant expectations	Printed objectives
Main Content	60-70% of time	Core sessions with interactive elements	Deliver key learning	Presentation materials, worksheets
Wrap-up	15-20 min	Summary, reflection, next steps	Consolidate learning	Action plan templates

2.1 Workshop Agenda

Table 2 Example workshop agenda

Time	Activity	Format	Duration	Materials	Facilitator Notes
9:00-9:05	Welcome & Introductions	Group discussion	5 min	Name tags	Create welcoming atmosphere
9:05-9:25	Agenda Review	Presentation	20 min	Printed agenda, slides	Describe vertical farms concept, energy consumption for logistics
9:25-9:50	Core Content	Interactive presentation	60 min	Computers	Describe vertical farms technology, assist in designing own farms
9:50-10:00	Wrap-up & Next Steps	Networking	10 min	Refreshments	Discuss the pros and cons, Ш identify the area of application

2.2 Required Equipment

Table 3 Example of Required Equipment

Category	Item	Quantity	Purpose	Alternative Options
Technology	Projector/screen	1 set	Presentations	Large monitor, flip charts
Materials	Computers	5-10 pieces	Group activities	A4 sheets, laptops, tablets
Supplies	Scissors	1 per participant	Group activities	
Supplies	Duct tape	1 per participant	Group activities	
Supplies	Markers/pens	1 per participant	Writing activities	Digital tools, tablets
Documentation	Handouts	1 set per person	Reference materials	Digital distribution

2.3 Evaluation Framework

Table 4 Example for Workshop Evaluation

Evaluation Type	Timing	Method	Key Metrics	Follow-up Actions
Immediate	End of workshop	Feedback forms	Satisfaction, objective achievement	Immediate improvements
Short-term	1-2 weeks later	Email survey	Knowledge retention, initial application	Provide additional resources
Long-term	3-6 months later	Interview/survey	Behavior change, performance impact	Plan follow-up sessions

3. Detailed Explanation

Welcome & Introductions

Slide 1 – The Earth is getting hotter

Today we're going to talk about something that affects the whole planet — carbon dioxide, or CO2. This is a gas that comes from things like cars, factories, and even buildings. When there's too much CO2 in the air, the Earth gets warmer. That's called climate change.

Slide 2 – What is CO2

Now let's talk about something very important — CO_2, or carbon dioxide.

You can't see it, you can't smell it, but it's all around us. It's a gas that gets into the air when we burn things like coal, gas, or oil — for example, when we drive cars or turn on lights in buildings that use fossil fuels.

And guess what? When there's too much CO_2 in the air, it traps heat from the sun — kind of like when you wear a winter coat on a sunny day. The heat stays inside, and the Earth gets warmer and warmer. That's what we call climate change.

And since we all live on this planet — we all care about what happens to it, right?

Questions:

Can you think of something in your house that might use energy and make CO_2? Maybe a light? A heater? A car?

Slide 4 – What is Decarbonization?

Let's talk about a big word: decarbonization. That simply means making less carbon dioxide. It's about changing the way we do things, so we create less CO2.

For buildings, it can mean using clean energy like solar power instead of electricity made from coal. It can also mean using better designs or materials that don't waste energy. When we use less fuel or make cleaner choices, we help the planet. That's what decarbonization is all about! Think of it like turning down the heat on a stove before something burns. The sooner we start, the better.

Questions:

Can you think of something you use that could be more eco-friendly?

Slide 5 – Why decarbonization matters?

Why is decarbonization important? Because it helps us protect the Earth. When we lower CO2 emissions, we reduce global warming, make the air cleaner, and keep nature healthier. It also helps people save money on energy bills and live more comfortably. Decarbonization is not just about big companies or governments. It's something we all can be part of. Even small changes can make a big difference when many people do them together. So, every action counts.

Questions:

If you could make one small change at home or at school to help reduce CO2, what would it be?

Agenda Review

What is a vertical farm? How vertical farms help in the matter of decarbonization?

Slide 6 – Why We Talk About Farms?

Let's think about where our food comes from. Most of it is grown on big farms outside the cities. These farms are important, but they also take up huge areas of land. They need a lot of water to grow crops and use heavy machines that run on diesel fuel. Once the food is grown, it often travels long distances by trucks, which also use fuel and add carbon dioxide (CO_2) to the air. All of this contributes to climate change. So, while farming feeds us, it also adds to global warming. That's why we are looking for new ways to grow food that are better for the environment — like vertical farms. Today, we'll learn how they work and why they might help.

Slide 7 – What is a Vertical Farm?

A vertical farm is like a garden inside a building — but instead of spreading out across a field, the plants grow up! Imagine tall shelves full of plants, stacked on top of each other. These farms are indoors, which means they're not affected by bad weather or changing seasons.

Slide 8 – What is a Vertical Farm?

Instead of using sunlight, the plants grow under special LED lights. And there's no soil — just water with nutrients added. This method saves space, uses less water, and can be placed closer to cities. That means less transportation is needed, which helps reduce CO_2 emissions. Vertical farming is a modern way to grow food that's smart, clean, and can help fight climate change.

Questions:

What do you think is the biggest difference between a vertical farm and a regular outdoor farm?

Slide 9 – What is a Vertical Farm

Now let's talk about types of vertical farms, their features applications

Slide 10 – How Vertical Farms Work: Hydroponics

One of the most widespread and well-known technologies is hydroponics. That means the roots of the plants sit in water instead of soil. This water isn't just plain water — it's full of nutrients that help the plants grow. Sometimes, the roots sit in a special material like clay pebbles or coconut fiber, and the nutrient water flows through it. The water is recycled, which saves a lot compared to traditional farming. With hydroponics, plants grow faster and use less space. It's clean, efficient, and doesn't need large fields or tractors. That's why many vertical farms choose this method — especially for leafy greens and herbs.

Slide 11 – How Vertical Farms Work: Aeroponics

Aeroponics is another exciting way to grow plants on vertical farms. In this system, the plant roots hang in the air — they're not in water or soil. Instead, they get sprayed with fine mist that contains water and nutrients. This gives the roots plenty of oxygen, which helps plants grow fast and stay healthy. Aeroponics uses even less water than hydroponics, and it's great for clean, controlled environments. But it needs good technology to work well. This method is often used in research and for growing certain kinds of vegetables and herbs indoors

Slide 12 – How Vertical Farms Work: Aquaponics

Aquaponics is a super interesting way to grow food — it's like a mini-ecosystem! It combines fish and plants in one system. Here's how it works: fish live in a tank and produce waste. That waste has nutrients in it, but it's not directly useful for plants. Luckily, good bacteria break down the waste and turn it into natural fertilizer. This water then goes to the plants, helping them grow. And in return, the plants help clean the water before it goes back to the fish. It's a circle — both the fish and the plants help each other! Aquaponics uses very little water and no chemicals, which makes it great for the environment

Slide 13 – Quiz

Slide 14 – Quiz: answers

Slide 15 – How Do Vertical Farms Help the Earth?

Vertical farms may seem like science fiction, but they're already helping the Earth. First, they use much less land — because the plants grow up, not out. That means we don't need to cut down forests to grow food. Second, they use up to 90% less water than traditional farms. Since they're inside buildings, they don't need big tractors or heavy machines — which means less fuel and less CO_2. They can also be built right near cities, so food doesn't need to travel far in trucks. And the best part? They can grow food year-round — even in winter!

Slide 16 – Challenges of Vertical Farms

Vertical farms sound amazing — but they aren't perfect. One big challenge is energy. These farms need special lights, fans, and pumps — and all of that uses electricity. Another challenge is cost. Building a vertical farm with all its equipment can be very expensive. Also, not every crop grows well indoors — things like corn or big fruit trees are too hard to manage right now. And because it's all based on technology, it needs experts to monitor and fix things. So while vertical farms are promising, they still face some big challenges

Slide 17 – What about the Energy?

Vertical farms need a lot of energy — mostly for their bright lights, air systems, and water pumps. That means electricity becomes very important. If the electricity comes from burning fossil fuels, it could still create a lot of CO_2. But here's the good news: if vertical farms use clean energy like solar or wind power, they stay eco-friendly! Some vertical farms even place solar panels on their roofs or use green energy from the grid. It's all about making the system as clean as possible — from the water to the power

Slide 18 – Comparing Farms

Let's compare regular farms and vertical farms. Traditional farms use a lot of space, water, and fuel. They depend on good weather and sometimes crops fail if there's too much rain or not enough sun. But they use less electricity than vertical farms. On the other hand, vertical farms don't need as much land or water. They grow food all year, no matter what the weather is, and can be set up near cities — so delivery is quicker and cleaner. But they do need more electricity and technology. So, each type has its pros and cons — and maybe we need both

Question:

Do you think vertical farms could one day replace traditional farms completely?

Slide 19 – What Can the Future Look Like?

Imagine a future where cities grow their own food in the buildings nearby. You could walk into a supermarket, and the vegetables would grow right there — upstairs!

Slide 20 – What Can the Future Look Like?

Or maybe you'll live in an apartment with a mini vertical farm on your balcony or in the kitchen, near the fridge.

Slide 21 – What Can the Future Look Like?

Some people are even working on skyscraper farms — buildings full of lettuce, herbs, and berries from top to bottom. This future is closer than you think. With new technology, we might not have to ship food across the world anymore — we could grow it right where we eat it.

Core Content

Participants individually or in groups create their own version of vertical farms section using suitable tools: paper, computer modeling, cardboard etc.

Slide 22 – How to design a Vertical Farm?

Now, let's learn how to design a vertical farm on our own. As you already know, there are different types of vertical farms, and each type of farm is suitable for a specific type of plants. Let us try and build a vertical farm for cherry tomatoes.

Slide 23 – How to design a Vertical Farm?

The characteristics of cherry tomatoes are presented on the slide. Water symbol refers to moisture requirement, oxygen - The need for oxygen at the roots, nutrition is a growth rate and nutritional requirements, sensitivity - sensitivity to over-watering, roots depth is a root system depth/volume. The blue lines represent the importance of the characteristics.

Every plant has its special feature, that influences how the final version of the farm would look like. In the case of cherry tomatoes, the special feature is that this plant is tall.

Slide 24 – How to design a Vertical Farm?

Now, based on the characteristics provided we can start designing our vertical farm. Cherry tomatoes is a large plant with a deep root system. Requires good access to water but does not like constant

over-watering. Drip irrigation allows us to accurately dose the amount of water and nutrients. In deep water hydroponics (DWC), the roots are partially immersed in water with oxygen, which is useful for stable growth, but an aeration system is needed. Cherry tomatoes require support and stability, so it is easier to use systems with a substrate or baskets.

Slide 25 – How to design a Vertical Farm?

In the end, our vertical farm would look like the system that is presented on the image

Slide 26 – It's time for you to contribute?

Now, you will get the materials, and based on the information provided you will have to design a vertical farm of your own.

Wrap-up & Next Steps

The key advantages and disadvantages in comparison with traditional farming