Module 6: Agri-Systems Across the City-Rural Gradient
Optional Extended Learning
Red Notes

Circular Agri-Systems in Urban Environments
Activity Worksheet: Optimize Your Compost System

Grouping: Pairs or small groups (3–4)
Time: 25-30 minutes

Materials:
- Printed diagram of compost pile zones (aerobic surface, anaerobic pockets, leachate layer)
- One-page article summary: "Composting in Closed-Loop Urban Agriculture"
- Markers / poster paper or digital whiteboard tool
- Quick-reference chart of compost gases and their sources (CO_2, CH_4, NH_3, VOCs)

Objective:
To evaluate how specific composting practices impact greenhouse gas emissions and environmental safety. Students will design intervention strategies and explain their chemical effects within a working compost system.

Instructions:
1. On the compost diagram, mark 2 major problem areas where emissions / risks occur (e.g., low oxygen, too much nitrogen, odors)
2. Choose 3 management strategies to improve the system (e.g., mix materials, balance inputs, add filters)
3. Show on the diagram where each strategy works and how it changes the flow of gases or nutrients
4. In 1–2 sentences each, explain what process changes and how it makes the system safer or more sustainable

Your Task:

Design an improved compost system that reduces harmful emissions:
- Mark on the diagram where your interventions would occur
- List at least 3 management strategies (e.g. maintaining moisture, adding bulking agents, using biofilters)
- Explain how each strategy changes the gas pathways (e.g. reduces anaerobic pockets → CH4)

Step 1: Identify Two Problem Zones ☐ Anaerobic pockets (CH_4 + VOCs): ☐ Excess nitrogen (NH_3 volatilization) ☐ Leachate and runoff ☐ Odor & pathogen risk	**Step 2: Choose Three Management Strategies** ☐ Add bulking agents (wood chips, straw) → improves aeration ☐ Monitor moisture → prevents anaerobic pockets ☐ Adjust C/N ratio → balances microbial activity ☐ Add biochar → adsorbs NH_3 and reduces leaching ☐ Install biofilter → scrubs odor & VOCs
1. **Anaerobic Pockets (CH_4 + VOCs)** **Strategy: Add bulking agents (wood chips, straw, shredded branches).**	See left

Why it works: Improves aeration, preventing oxygen-free zones and shifting microbes to aerobic respiration.

Impact: Reduces methane (CH_4) and odor-causing VOCs.

2. Excess Nitrogen (NH_3 volatilization)

Strategy: Adjust the carbon-to-nitrogen (C/N) ratio by layering food scraps (“greens”) with leaves or paper (“browns”).

Why it works: Provides microbes with a balanced diet, keeping nitrogen locked into biomass instead of escaping.

Impact: Cuts ammonia (NH_3) emissions and improves compost quality.
4. Odor & Pathogen Risk

Strategy: Maintain thermophilic composting temperatures (55–65 °C) through regular turning and monitoring.

Why it works: Heat destroys harmful microbes and reduces odor-causing anaerobic zones.

Impact: Ensures compost is safe for food use and minimizes nuisance smells.

Step 3: Map Interventions
On your compost diagram, show:

- Draw arrows for gas pathways (CO_2, CH_4, NH_3)
- Show your intervention points (where your chosen strategies act)
- Label each intervention point (e.g. “biofilter here”, “bulking agents here”)

CO_2 ↑ (arrow going upward — safe aerobic release)

CH_4 → (arrow moving sideways from anaerobic pockets — methane loss)

NH_3 → (arrow moving sideways from excess nitrogen — ammonia loss)

Intervention Points

Bulking agents here ↓ (inside the pile — add straw/wood chips to improve airflow and reduce CH_4)

C/N balance here ↓ (at the input layer — mix greens and browns to keep nitrogen bound and lower NH_3 loss)

Biofilter here ↑ (on top of pile — traps odors, VOCs, and NH_3 before release)

Step 4: Explain the Chemistry
Pick one key strategy and explain in 1–2 sentences:

1. What chemical/biological process is changed?

Adding bulking agents increases oxygen flow, shifting microbes from anaerobic fermentation to aerobic respiration.

2. Why does this lower emissions or improve safety?

Aerobic microbes produce CO_2 instead of CH_4, reducing potent greenhouse gas emissions and cutting odor problems.

Step 5: Prepare Your Pitch
Prepare a 1-minute group explanation of:

1. Where you intervened in the compost pile:

We placed bulking agents inside the pile, balanced the C/N ratio at the input layer, and installed a biofilter cap on top.

2. How your strategies reduce harmful gas:

The added airflow prevents methane buildup, the balanced inputs keep nitrogen locked in compost (reducing ammonia), and the biofilter traps odors and VOCs before they escape.

Reflection Prompt:
How did urban constraints (space, energy, transport) affect your compost reuse model? What part of the loop (carbon, nutrient, water) was most difficult to close?

Urban constraints required a compact design with minimal added energy, so we relied on passive aeration, local waste inputs, and a small biofilter instead of large machinery.The nutrient loop was hardest to close, since nitrogen easily escapes as ammonia, while carbon cycling (CO_2 release) and water reuse were easier to manage with biofilters and moisture control.

Skills You'll Use:

- Systems thinking
- Linking biology & chemistry to sustainability
- Visual communication of interventions
- Critical evaluation of environmental trade-offs

Example:

- Anaerobic pockets → add straw for aeration → more O_2 = microbes produce CO_2 (less harmful) instead of CH_4
- Excess nitrogen → adjust C/N ratio and add biochar → keeps N in compost, less NH_3 lost to air
- Odor & VOCs → biofilter layer of wood chips → traps smelly gases and pathogens.