Module 3: Soil Science and Soil Health

Think-Pair-Share Activity B: Make a Compost Cake

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

Materials:

- One worksheet per student (or pair)
- Colored pencils/markers (brown, green, gray/black, blue)
- Whiteboard or chart paper for class synthesis

Objective:
Students will learn how organic inputs ("browns," "greens," soil/compost, and water) interact in decomposition and connect them to the Build–Maintain–Consume framework for soil carbon. They will evaluate whether composting leads to carbon storage or sequestration, and apply systems thinking to design compost strategies for different goals.

Instructions:

1. Color and label the compost cake diagram.
2. Add arrows to show carbon and nutrient flows.
3. Discuss prompts with your group and answer questions.
4. Work together to redesign your compost cake for a specific goal.
5. Share your design and reasoning with the class.

Your Task:
Your task is to model how decomposition works in a compost cake and connect it to soil carbon cycling. Then, evaluate trade-offs and propose compost strategies that balance Build, Maintain, and Consume.

Step 1: Color & Label the Compost Cake (Individual Work)

Circle and color each layer:

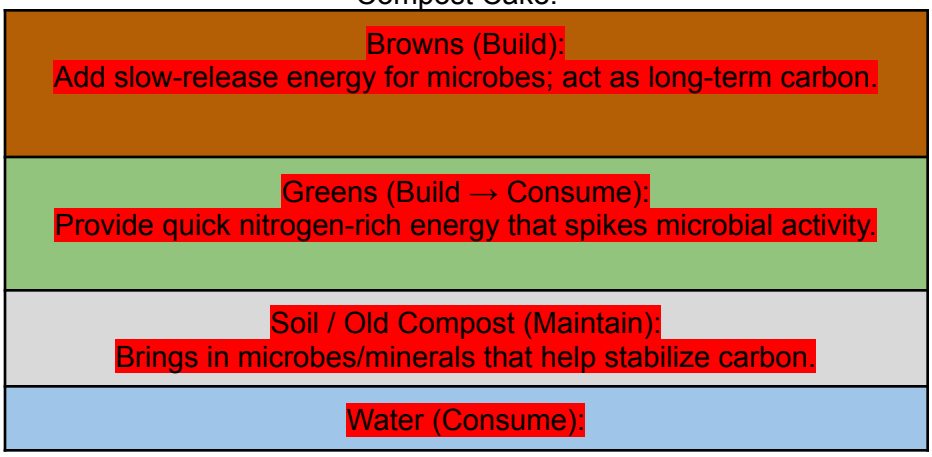
- Browns = carbon-rich (Build)
- Greens = nitrogen-rich (Build → Consume)
- Soil/old compost = microbes + minerals (Maintain)
  Water = microbial activity (Consume)

Add arrows to show:

- CO_2 released (Consume)
- Organic matter → humus/SOM (Maintain)
- Nutrients recycled to plants (Build)

(Draw arrows on the diagram provided)

Compost Cake:



Necessary for microbial respiration, but too much can cause anaerobic loss.

Step 2: Discussion Prompts (Group Work)

1. Is this compost pile adding storage or sequestration? Why?

Storage, because if compost is purchased it's just relocating carbon. True sequestration requires increasing soil carbon stocks over time through management.

2. Which part of the triad (Build, Maintain, Consume) does each layer emphasize?

- Browns = Build
- Greens = Build → Consume
- Soil = Maintain
- Water = Consume

3. What happens if the pile is too wet/dry, or has too much green vs. brown?

- Too wet: anaerobic conditions, possible methane/N_2O release.
- Too dry: microbes slow, little decomposition.
- Too much green: pile overheats, rapid respiration (carbon loss).
- Too much brown: pile decomposes too slowly.

Step 3: Redesign the Compost Cake (Group Challenge)

Choose one goal and adjust your "cake." Label changes on your diagram in Step 1.

- Goal A: Maximum long-term carbon storage (sequestration)
- Goal B: Fast nutrient release for crops

Notes on Our Design:

Goal A (Sequestration):

- Browns layer → thicker / more frequent.
  Representing woody, carbon-dense inputs like stalks, leaves, straw.
- Soil/compost layer → emphasized.
  Thicker bands to show protection of carbon by microbes, minerals, and aggregates.
- Greens layer → thinner.
  Still needed for microbial activity, but less dominant to slow down respiration.
- Water → moderate.
  Just enough for decomposition, but avoid excess (which can cause N_2O or CH_4 losses).
- Extra arrows: add more arrows showing "stable humus/SOM" → soil storage. (In the drawing: make browns and soil layers larger, greens smaller, and emphasize arrows leading into SOM storage.)

Goal B (Fast nutrient release):

- Greens layer → thicker / more frequent.
  More nitrogen-rich inputs (food scraps, grass clippings) to feed microbes quickly.
- Water layer → emphasized.
  Moisture helps speed microbial respiration.
- Browns layer → thinner.
  Less woody material, so pile breaks down faster.
- Soil/compost layer → moderate.
  Enough to inoculate but not the main focus.

- Extra arrows: add stronger arrows from greens → CO_2 release and nutrients recycled to plants. (In the drawing: make greens and water layers larger, browns smaller, and highlight arrows showing nutrient release back to plants.)

Reflection

1. What was the hardest part about balancing Build, Maintain, and Consume?

Finding the right balance between Build (inputs) and Consume (losses). Too much of one side reduces efficiency.

2. Which compost strategy would work best at our school or community garden? Why?

A mix of browns and greens from cafeteria waste, layered with soil. Add water when needed but avoid soggy piles. This balances nutrient release with moderate carbon storage.

3. How does this activity connect to bigger sustainability goals (e.g., climate action, food systems)?

Composting links directly to SDG 13 (Climate Action) by lowering methane from landfills, supporting soil health (SDG 15: Life on Land), and closing nutrient cycles in food systems.

Skills You'll Use:

- Systems thinking (nutrient cycling + soil carbon)
- Problem-solving (trade-offs in compost management)
- Visual modeling (diagramming flows)
- Collaboration & synthesis (moving from individual diagrams to group redesigns)

Example:

Our compost cake shows how browns and greens work together to fuel microbes, with soil adding inoculants and water helping maintain microbial activity. When we mapped arrows, we saw that some carbon leaves as CO_2 (Consume), but some stabilizes as humus (Maintain), and nutrients cycle back to plants (Build). We decided our cake represents storage more than sequestration, since purchased compost mainly relocates carbon. To redesign for maximum sequestration, we would emphasize thicker browns and cover-crop residues to keep inputs coming, while reducing excess greens that drive fast respiration. This connects to climate action because managing decomposition carefully can tip the balance toward long-term carbon storage in soils.