Instructions Worksheet for Module 1 HOA B
Grouping: Pairs or small groups (3–4)
Time: 40-45 minutes (Day 1), with Day 3 & 6 – Check-ins (10 minutes each), and Day 10-14 – Final Observation & Analysis (~45 minutes)

Overview

In this hands-on challenge, you will **build a mini compost bin inside a clear bottle** to observe how food waste breaks down. Each team will change **one factor** in the composting process to see how it affects decomposition. By turning cafeteria scraps and yard waste into soil-like compost, we'll explore how to shift from a linear "use-and-dump" system to a **circular** one – reusing waste as a resource for growing food again. This activity ties into our study of sustainable food systems: instead of throwing away food scraps, we'll **return nutrients to the soil**, closing the loop from farm to table and back.

What You'll Do: Assemble a bottle composter with layers of "greens" (fresh food scraps) and "browns" (dry leaves or paper) plus a bit of soil. Your group will be assigned one condition to modify (e.g. no air, extra water, etc.) while keeping all other conditions optimal. Over the next 1–2 weeks, you will **monitor changes** – such as temperature, smell, fungi, and the height of the compost – to answer your testable question. By comparing results across groups, we'll learn which factors speed up or slow down decomposition and why.

All images in this document are from westlothian.gov.uk.

Materials (per group)

- **Clear plastic bottle (2-liter)** – empty, clean, label removed (for the compost chamber)
- **Greens (wet, nitrogen-rich scraps):** fruit/veg peelings, food scraps, fresh grass clippings, coffee grounds, etc. (~2–3 cups)
- **Browns (dry, carbon-rich matter):** dry leaves, shredded paper/cardboard, straw, etc. (~6–9 cups)
- **Soil or finished compost:** a small bag or container of garden soil (as a compost "starter" inoculant)
- **Compost activator** powder (2g for 250 ml water, ~1-2 tubes)
- **Water spray bottle:** filled with water (to moisten contents)
- **Scissors or cutter:** to cut the bottle (use carefully under supervision)
- **Markers or tape:** to label the bottle and mark the compost height
- **Thermometer:** compost thermometer or lab thermometer (optional, to track internal temp)
- **Nitrate/Ammonium test strips (optional):** to measure nitrogen compounds at the end
- **Gloves and aprons (optional):** for handling waste and staying clean
- **Notebook/Data sheet:** (provided) to record observations and measurements

- **Optional:** Instructions from westlothian.gov.uk.

Safety Notes

- **Cutting the bottle:** Have an adult start the cut or poke a hole first. Use scissors slowly and carefully; plastic edges can be sharp. Always cut away from yourself.
- **Handling compost materials:** Wear gloves if possible, especially when handling food waste or soil. Avoid touching your face. **Wash your hands thoroughly** after the activity.
- **General cleanliness:** Keep scraps on a tray or newspaper to prevent spills. Wipe up any spills immediately to avoid slips or attracting pests.
- **Smell and mold:** As compost breaks down, some odor or mold can occur. When checking your bottle, **waft** odors towards your nose instead of sniffing directly, and keep the bottle closed if odors are strong. If you have allergies or asthma, let your teacher know and take care when observing mold.
- **Disposal:** Do not eat or taste anything from the composter. After the experiment, we will safely dispose of or compost the contents outdoors.

Forming Your Research Question

Each group will focus on one variable (See table below). With your group, **formulate a testable question** about your assigned condition. Examples:

- *"Does not shredding the scraps slow down decomposition?"*
- *"What happens if we add way more greens than browns – will it decompose faster or start to smell?"*

- *"If the compost is kept too wet, how will that affect the breakdown compared to a normal compost?"*

Your question should compare your group's condition to the "optimal" compost. Identify the **independent variable** (the one thing your group will change) and the **dependent variables** you will observe (rate of decomposition, temperature, odor, etc.). Write down your question (and a hypothesis if instructed) on the Data Collection Sheet before you begin.

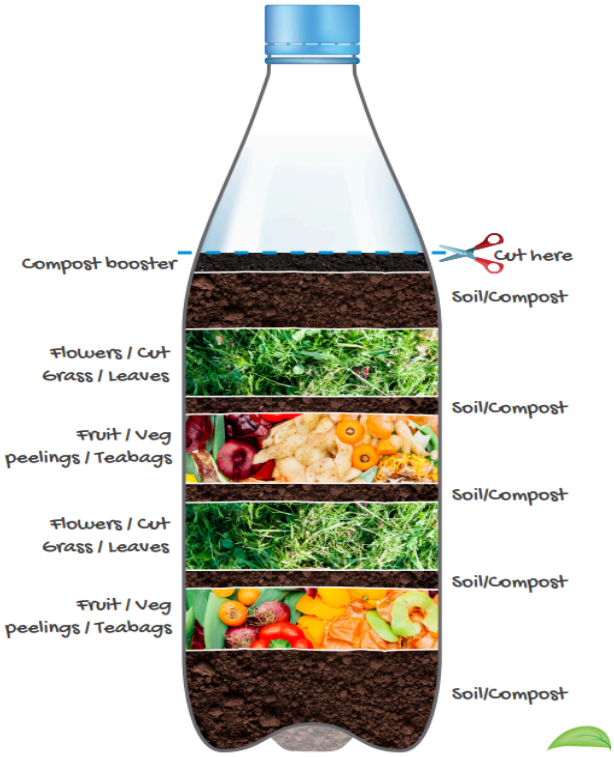
Student Group	Shred/Chop Materials	Greens : Browns Ratio	Moisture Level	Aeration / Turning	Use of Activator
Group 1 – Control (All Optimal)	Optimal – finely chopped	Optimal (≈ 3–4 parts browns : 1 part greens)	Optimal – like a wrung-out sponge	Regular turning (every few days)	No activator added
Group 2 – No Shredding	❌ **Not shredded; large pieces**	Optimal	Optimal	Optimal	No activator
Group 3 – Wrong Ratio	Optimal	❌ **Reversed ratio: ~3 parts greens : 1 part brown**	Optimal	Optimal	No activator
Group 4 – Over-Watered	Optimal	Optimal	❌ **Too wet / waterlogged**	Optimal	No activator
Group 5 – No Aeration	Optimal	Optimal	Optimal	❌ **No turning / completely still pile**	No activator
Group 6 – Activator Added	Optimal	Optimal	Optimal	Optimal	✅ **Uses activator (soil, finished compost, manure, or coffee grounds)**

Procedure – Building & Monitoring Your Bottle Composter

Day 1 – Setup (about 45 minutes):

1. **Prepare the Bottle:** Cut off the top of the 2L bottle about ⅓ from the top (so you have a wide opening). Leave it attached with a "hinge" if possible, or cut it completely off to use as a removable lid. Label your bottle with your group name/number and your experimental condition. (For example, "Group 4 – Overwatered Compost".)
2. **Add Air Holes (if applicable):** Most groups should poke a few small holes around the sides of the bottle and in the lid for airflow. **If your group's variable is "No Aeration," do not add any holes** – you'll keep your bottle sealed to restrict oxygen.

3. **Layer the Materials:** Start with a base layer of soil (~2–3 cm deep) at the bottom of the bottle. Then add a layer of "browns" (dry leaves, shredded paper) about 2–3 cm thick. Next, add a thinner layer of "greens" (food scraps) about 1–2 cm thick. Continue **alternating layers** of browns and greens (westlothian.gov.uk), similar to building a lasagna, until the bottle is about 2/3 to 3/4 full. **Important:**



   - **Piece Size:** Tear or cut waste into small pieces before adding (around 1–2 inches or 2–5 cm). Smaller pieces break down faster by increasing surface area for microbes (joegardener.com). *(The "No Shredding" group will skip cutting their materials as their variable.)*
   - **Browns-to-Greens Ratio:** Use roughly **3 parts browns to 1 part greens** by volume in your layers. This balances carbon and nitrogen – a key to fast, odor-free composting (joegardener.com). *(The "Flipped Ratio" group will do the opposite: more greens than browns.)*
   - **Soil Layers:** Sprinkle a little **soil** in between some layers or at least on the top of the last layer. Soil contains decomposer microbes that act as **compost starters**, helping to inoculate and jump-start the process (joegardener.com). It also filters odor and provides texture.
   - **Compost Activator (Group 6 only):** If you have manure or a special "activator," mix a small handful into your layers. This adds extra microbes and nitrogen to speed up decomposition. *(Other groups do not add this.)*

4. **Mark Initial Height:** Once layered, gently press down **without compacting** (don't smash it tightly; air needs to circulate). Use a marker or tape strip on the outside of the bottle to mark the **initial height** of the contents. This will help you track volume change (settling) over time. Record the height (in cm) in your data sheet.
5. **Moisten the Pile:** Using the spray bottle, mist water into the bottle to dampen the materials. Add enough water so the contents feel like a **wrung-out sponge** – uniformly moist but **not dripping wet** (joegardener.com). **Do NOT flood** the bottle; too much water fills air spaces and can lead to bad odors (joegardener.com). *(The "Overwatered" group, however, will intentionally add excess water until the materials are soggy, as their experimental treatment.)*
6. **Close the Composter:** Fit the top part of the bottle back on as a lid. If you left a hinge, fold it over; otherwise place the cut-off top upside-down or upright as directed. **Aerated groups:** you can leave the bottle cap off (or loosely on) to allow air exchange. **No-Aeration group:** keep the cap tightly closed and tape any seams to prevent air from entering. Use tape to seal the cut edge if needed (especially for the no-air group or to prevent spills).
7. **Placement:** Put your compost bottle in the designated area. Ideally, it should be **warm** (room temperature or a sunny windowsill) but **not in direct blazing sun** (which could overheat or dry it out). Make sure it's in a stable spot where it won't be knocked over. Placing a tray or pan underneath is wise, in case of leaks or condensation.
8. **Clean Up:** Dispose of any extra scraps properly (or add to a class compost bin). Wipe down tables. Remove gloves and wash hands with soap.

Day 3 & 6 – Check-ins (10 minutes each):
On these intermediate days, you will make quick observations and adjust if necessary:

- **Temperature:** If available, check the compost's temperature. Insert a thermometer probe into the center through a hole or opening. Record the reading. (If no thermometer, you can note if the bottle feels warm inside by touch.)
- **Height:** Observe the marked line vs. the current level. Has the pile settled or shrunk? Measure the new height (cm) if notable and record it.
- **Moisture:** Look at the moisture level. Contents should still be like a damp sponge – add a few sprays of water if they seem to be drying out. If there is **condensation** on the walls or if it smells rotten, you may have excess moisture. If you are NOT the overwatered group, open the lid for a moment to let it vent, then skip watering. (Overwatered group: you're supposed to be soggy, so no venting – note the effects.)
- **Odor check:** Quickly and gently waft the air near the bottle opening (don't inhale deeply). Note any smells: Earthy? Sour? Ammonia-like? Rotten eggs? No smell? Keep the lid closed except when briefly checking.
- **Visual changes:** Look for **fungal growth** (fuzzy white molds?), color changes (browns darkening, greens turning mushy or black), and any evidence of insects. Some white spiderweb-like strands can be **actinobacteria** or fungi, helping decomposition. Record what you see.

- **Aeration:** If you are **not** the no-air group, gently stir or shake your compost to mix it (do this only on designated check-in days so all groups have consistent timing). You can use a spoon/stick through the top to turn the materials a bit, or cap it and give a few gentle shakes to introduce oxygen. This helps prevent anaerobic (no-oxygen) pockets and speeds composting (joegardener.com). *(No-Aeration group: Do **not** mix or open your bottle at all.)*
- **Record Data:** Use the Data Collection Sheet to jot down observations for Day 3 and Day 6. Be objective – describe what you see/smell, and quantify where possible (e.g. "temperature 30°C", "1 cm settle", "faint earthy odor").

Day 10-14 – Final Observation & Analysis (~45 minutes):

One day between day 10 to 14 (1½-2 weeks), we'll conduct a final examination and compare results:

1. **Final Measurements:** Open your bottle composter. (Be prepared: some may have strong odors – open outdoors or near a window if needed.) Measure the final height of the compost material and mark it. Remove a little sample to check the temperature one last time (if using a probe thermometer, measure quickly after opening). **Record all final data** (height, temperature, etc.).
2. **Qualitative Observations:** Examine the compost closely (use gloves!). What does it look like now compared to the starting materials? Note the presence of any **undecomposed pieces** (can you still recognize food bits or leaves?), the color and texture of the material (is it turning brown/soil-like? any clumps or slime?), and any living organisms (mold, insects like fruit flies or worms if they appeared). Smell it – is it neutral, earthy, ammonia, or foul? Record these details.
3. **Nitrogen Testing (optional):** If test strips are available, test the compost for **nitrates** (NO_3^-) and **ammonium** (NH_4^+). To do this, you can mix a scoop of compost with some distilled water to make a slurry and dip the test strips, or use soil test kits as instructed by your teacher. Record the readings (in ppm if given). High nitrate levels by the end could indicate active decomposition and nutrient formation. High ammonium or a strong ammonia smell might indicate excess nitrogen that hasn't fully converted (often in low-oxygen conditions).
4. **Group Analysis:** Discuss within your group: **Did your variable make a difference?** Look back at your testable question and hypothesis. For example, if your question was about not shredding, do you observe slower breakdown in the large pieces? If your question was about water, did the soaked compost decompose differently than others? Summarize the effect you

noticed (e.g. “Our no-air compost stayed cooler and smelled like rotten eggs, indicating anaerobic decay”).

5. **Compare Across Groups:** As a class, each group will share their results. Be ready to describe your condition and the key differences you saw compared to the control (optimal) and other groups. Pay attention to patterns: which bottles decomposed fastest? Which had bad odors, and why? Link these to compost science – e.g., lack of oxygen leads to anaerobic bacteria producing foul smells (joegardener.com), or too much nitrogen (not enough browns) causing ammonia odor (joegardener.com). We’ll identify which conditions were best for decomposition and draw conclusions about designing effective compost systems.
6. **Conclude & Connect:** In a short discussion or written reflection, answer: *How does composting illustrate a “circular” model in food systems?* What did this experiment teach you about turning “waste” into a resource? Think about how factors like proper carbon/nitrogen balance, moisture, and air make composting successful – and how this knowledge could be applied to larger-scale composting or waste management to reduce landfill use.

Extension: If time allows, we can continue to monitor the compost longer, or even use the finished compost to plant seeds. In a longer experiment, you might see a further breakdown and even use the compost to grow a plant (demonstrating the loop from food waste to soil to new food).

Cleanup: After final observations, dispose of the compost materials as instructed (they can be added to an outdoor compost pile or buried in soil to finish decomposing). Clean the bottles for recycling if possible. Wash your hands and any equipment thoroughly.