Module 1 – Foundations of Sustainable Agri-Food Systems & Circular Economy

Think-Pair-Share Activity: Food-Print Snapshot

Red Notes

Lesson A

Grouping: Pairs or small groups (3–4)

Time: 25-40 minutes

Materials:

Pens/markers; optional ruler or highlighters, Device or printed labels for ingredient origin info (optional), Scratch paper for drafting cause-and-effect loops

Objective:

Every meal you eat has an environmental footprint. Ingredients require land, water, and energy to produce. Some create waste by-products like packaging, bones, or methane from livestock. These impacts affect the planet's health, known as Planetary Boundaries, such as climate change, freshwater use, or land-system change.

Meals also connect to Sustainable Development Goals (SDGs), global goals for a fair and sustainable future. For example:

- Climate Action (SDG 13): Reducing greenhouse gas emissions.
- Responsible Consumption & Production (SDG 12): Using resources wisely and reducing waste.
- Life on Land (SDG 15): Protecting forests and biodiversity.

Your task is to investigate a meal, map its environmental impacts, and propose a circular or sustainable solution. Analyze a recent lunch meal by mapping two main components to food miles, resource use, and waste outputs. Connect impacts to two planetary boundaries and two Sustainable Development Goals (SDGs), and propose at least one circular solution. Use reasoning and examples — don't just guess!

Instructions:

1. Pick a Meal – Choose a recent lunch, dinner, or favorite food. Write down its main ingredients.
2. Find Its Journey – For each ingredient, guess where it came from, how far it traveled (food miles), what resources it needed (land, water, energy), and what waste or leftovers it made.
3. Match the Impacts – Connect your meal to Planetary Boundaries and Sustainable Development Goals (SDGs) that it affects.
4. Draw the Chain – Show how your meal goes from being made → transported → impacting the environment and people. Use arrows and keywords.
5. Fix It! – Think of at least one way to make the meal more sustainable (swap an ingredient, change packaging, reduce waste, etc.).
6. Share – Give your group's quick (1–2 minute) presentation of your findings and ideas.

Your Task:

You're going to be a meal investigator — figuring out where your food comes from, what resources it uses, and how to make it better for the planet.

Goal: Spot the ingredient with the biggest footprint and come up with a smart, realistic way to make it better — even if there's a trade-off.

Key Terms Refresher:

- Food Miles – the distance food travels to you.
- Planetary Boundaries – environmental limits for a safe Earth.
- Circular Economy – waste becomes a resource.
- SDGs – UN Sustainable Development Goals.
- Trade-Off – gaining one benefit at another's cost.

Step 1: Pick a Meal to Model

Meal Name: Classic cheeseburger with fries
(e.g. Cheeseburger, Bean Burrito, Sushi Roll)

List main ingredients:

Beef patty, bun (wheat), cheddar cheese, lettuce, tomato, fries (potato + frying oil), ketchup; paper wrap + cup with lid/straw for a drink

Step 2: Break Down the Meal

Component	Likely Origin/Food Miles *(circle one)*	Land/Water/Energy Notes *(choose any)*	Waste/By-products	Packaging Type *(circle one)*
Beef patty	Local (0–100 mi) / Regional (100–500 mi) / National (500–1500 mi) / International (1500+ mi)	High Land / High Water / High Energy / Low Use	Manure (N,P runoff), bones/fat trimmings	Plastic / Paper / Cardboard / None
Bun (wheat)	Local (0–100 mi) / Regional (100–500 mi) / National (500–1500 mi) / International (1500+ mi)	High Land / High Water / High Energy / Low Use	Bakery waste/bread ends	Plastic / Paper / Cardboard / None
Cheddar cheese	Local (0–100 mi) / Regional (100–500 mi) / National (500–1500 mi) / International (1500+ mi)	High Land / High Water / High Energy / Low Use	Whey by-product	Plastic / Paper / Cardboard / None
Lettuce & tomato	Local (0–100 mi) / Regional (100–500 mi) / National (500–1500 mi) / International (1500+ mi)	High Land / High Water / High Energy / Low Use	Field trimmings	Plastic / Paper / Cardboard / None

Fries (potatoes + oil)	Local (0–100 mi) / Regional (100–500 mi) / National (500–1500 mi) / International (1500+ mi)	High Land / High Water / High Energy / Low Use	Spent oil; peels	Plastic / Paper / Cardboard / None
Ketchup / drink	Local (0–100 mi) / Regional (100–500 mi) / National (500–1500 mi) / International (1500+ mi)	High Land / High Water / High Energy / Low Use	Plastic cap/straw	Plastic / Paper / Cardboard / None

Step 3: Map Impacts

Planetary Boundaries (check all that apply):

☐ Climate change
☐ Biosphere integrity
☐ Land-system change
☐ Freshwater change
☐ Biogeochemical flows (N, P)
☐ Novel entities (pollutants, plastics)
☐ Ocean acidification
☐ Stratospheric ozone
☐ Atmospheric aerosols

Related SDGs (check all that apply):

☐ 2 Zero Hunger
☐ 3 Good Health & Well-being
☐ 6 Clean Water & Sanitation
☐ 7 Affordable & Clean Energy
☐ 8 Decent Work & Economic Growth
☐ 12 Responsible Consumption & Production
☐ 13 Climate Action
☐ 14 Life Below Water
☐ 15 Life on Land

Step 4: Build Your Cause-and-Effect Chain

(Use arrows and key words to show the path from production → processing/transport → environmental & social impacts → feedback effects.)

Pasture & feed crops → methane & fertilizer runoff_→ processing & cold-chain transport → CO_2 + packaging waste → climate, water quality, biodiversity & equity impacts (who can afford healthy food; wages along the chain) → feedback: hotter/drier conditions stress agriculture; higher costs

Step 5: Circular / Sustainable Solutions

Idea (swap, redesign, policy)	What it changes	Expected benefit (GHG, water, waste, equity)

Swap beef patty → bean patty (or chicken)	Cuts land, water, methane; improves protein/CO_2e ratio	Beef has 10–20× CO_2e per gram of protein vs beans; cattle use ~⅔ of ag land yet supply ~3% of calories → big GHG & land wins.
Compost food scraps + biodigest used oil	Keeps organics/toil out of landfill; makes soil amendment/biogas	Waste → resource; reduces methane & returns nutrients.
Upcycle dairy whey into snacks/animal feed	Valorizes cheese by-product	Less waste; extra revenue → SDG8 + SDG12. (Approach mirrors waste-to-value case studies.)
Rethink packaging (paper boats, recyclable lids; encourage reusables)	Cut novel entities (plastics); design for cycling	Lowers plastic leakage; supports SDG12
Local greens / urban farming tie-in	Shorter cold-chains; year-round produce	Fewer food miles; pairs with compost loops.
Food-waste app / donation policy for unsold items	Rescue surplus; align with SDG 12.3 “halve food waste”	Less landfill waste; more food access; policy precedent exists.

Reflection: Which component had the largest footprint, and why? Which SDG connection surprised you the most? Which circular solution seems most realistic, and what is the expected benefit?

Largest footprint? The beef patty — because of land use, water needs, and methane emissions from cattle.

Most surprising SDG link? SDG 8 (Decent Work & Economic Growth): the burger supply chain raises questions about farmer incomes and wage gaps, not just environmental impacts.

First circular step I’ll try: Swap to the bean burger + compost the scraps at home/school. Together that cuts GHGs and returns nutrients to soil — exactly the “close the loop” pattern from the slides.

Skills You'll Use

- Systems thinking

- Cause-and-effect reasoning
- SDG & planetary boundary mapping
- Evidence-based justification

Example:
For example, if you choose a cheeseburger, you might find that the beef patty has a very large environmental footprint because of the land and water needed for cattle and the methane they produce. By swapping the beef patty for a bean patty, the greenhouse gas emissions per gram of protein would drop by around 90 percent, and much less land and water would be required. The dairy used to make the cheese could also have its by-products, such as whey, turned into snacks or animal feed so that nothing goes to waste. The main trade-off might be differences in taste or the need to adjust the supply chain to include more legumes.