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# Lesson Plan: The Permaculture Detective and the Case of the Carbon Footprint

**Subject:** Environmental Science / Permaculture

**Grade Level:** 4th-5th Grade (Age 10)

**Time Allotment:** 3 Hours

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## Materials Needed:

- Large sheet of paper or whiteboard
  - Markers or colored pencils
  - A few food items from the kitchen with labels showing their country of origin (e.g., a banana from Ecuador, cheese from the USA, olive oil from Italy)
  - A world map or access to an online map
  - String or yarn
  - Calculator
  - "Food Miles Detective" worksheet (can be handmade - see Part 2)
  - Graph paper or plain paper for garden design
  - Ruler
  - Gardening books or websites for kids (for plant research)
  - Large, clear glass jar (like a big pickle jar)
  - Small handful of gravel or small stones
  - Sand
  - Soil/dirt from the yard
  - Dead leaves, shredded newspaper, and small veggie scraps (no meat, dairy, or oily foods)
  - A small container of earthworms (can be purchased from a bait shop or found in the garden)
  - Water in a spray bottle
  - A piece of dark cloth or construction paper to wrap around the jar
  - Tape
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## Learning Objectives:

By the end of this 3-hour lesson, the student will be able to:

1. Define "carbon footprint" and "permaculture" in their own words, explaining how they are connected.
  2. Calculate a simplified "food miles" carbon footprint for several household food items.
  3. Design a small-scale, multi-layered permaculture garden plan on paper that reduces food miles and incorporates at least two permaculture principles.
  4. Construct a simple worm farm in a jar to demonstrate the permaculture principle of nutrient cycling.
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## Lesson Procedure

### Part 1: The Mystery of the Invisible Footprint (30 minutes)

#### 1. Introduction (10 mins):

- Start with a question: "Did you know we all leave footprints everywhere we go, even when we're sitting still? Not just with our feet, but an invisible one called a 'Carbon Footprint'."
- On the large paper/whiteboard, write "Carbon Footprint." Brainstorm together what it might mean. Guide the conversation to the idea that it's a measure of the pollution (specifically carbon dioxide) created by our actions, like driving a car, using electricity, and even eating food.
- Explain that everything we buy has to be made and travel to us, which uses energy and creates a footprint. Today, we're going to be detectives and investigate the footprint of our food.

#### 2. Introducing the Solution: Permaculture! (10 mins):

- Ask: "What if there was a clever way to design our world to have a much smaller footprint? There is! It's called Permaculture."
- Write "Permaculture" on the board. Explain it simply: "It's like being a nature detective and designing gardens and homes that work *with* nature, not against it. The goal is to take care of the Earth, take care of people, and share any extra we have."
- Introduce three simple permaculture ideas:
  1. **Working with nature:** Observing how nature does things (like how forests have tall trees, smaller bushes, and ground cover) and copying it.
  2. **Everything has many jobs:** A chicken gives us eggs, but it also eats pests and creates fertilizer!
  3. **Closing the loop:** Turning waste (like food scraps) into something useful (like healthy soil).

#### 3. Connecting the Concepts (10 mins):

- Ask the student to explain the connection: "How could being a permaculture designer help you shrink your carbon footprint?"
- Guide them to the answer: By growing our own food, we reduce the travel (food miles) and by turning scraps into soil, we create less waste!

### Part 2: The Food Miles Detective Game (45 minutes)

#### 1. The Mission (5 mins): "Detective, your mission is to investigate the secret journey of the food in this kitchen! We need to find out how far it traveled to get here. This is called 'Food Miles'."

#### 2. Investigation (25 mins):

- Lay out the world map. Give the student the "Food Miles Detective" worksheet (a simple sheet with columns: Food Item | Country of Origin | Estimated Miles).
- Have the student choose 3-5 food items from the kitchen. They must read the labels to find the country of origin.
- For each item, they find the country on the map. Using the string, they measure the distance from that country to your home.
- Help them use an online tool (like Google Maps) to get a more accurate mileage for that string length or look up the distance directly. They record this on their worksheet.
- Discuss the findings. "Which food is the biggest traveler? Are you surprised?"

#### 3. Calculating the Footprint (15 mins):

- Explain that planes, ships, and trucks that carry food release carbon dioxide. The more miles, the bigger the footprint.
- Use a simple formula: **Miles traveled x 0.4 = kg of CO<sub>2</sub>** (This is a simplified estimate for teaching purposes).
- Have the student use a calculator to find the carbon footprint for each food item and

then a grand total. This makes the invisible footprint visible with a number!

### --- Short Break (15 minutes) ---

## Part 3: Design Your Permaculture Patch (60 minutes)

1. **The Challenge (10 mins):** "Now you're not just a detective, you're a designer! Your challenge is to design a small garden patch for our yard that will shrink our food footprint. We'll use permaculture ideas to make it awesome and easy to care for."
2. **Introducing Garden Layers (10 mins):**
  - Explain the "forest garden" concept. A forest doesn't just have one layer of plants, it has many! Show a simple drawing or video of a "7-layer garden" (Canopy, Understory, Shrub, Herbaceous, Groundcover, Root, Vine).
  - Challenge the student to design a garden with at least **three** different layers. For example: A small fruit tree (like a dwarf apple), with berry bushes around it, and strawberries as a groundcover underneath.
3. **Design Studio (35 mins):**
  - Give the student the graph paper, ruler, and colored pencils.
  - Have them choose a small, sunny spot in the yard (real or imaginary).
  - They will research and choose plants they like to eat that can grow in your area. They should try to include plants that fill different layers.
  - They will draw their garden plan. It should be a "bird's-eye view." They need to label the plants and show where everything goes. Encourage creativity! Maybe there's a spiraling herb garden or a trellis for beans.
4. **Designer's Presentation (5 mins):** Have the student present their design. They should explain which plants they chose, what layers they included, and how their garden will help reduce the family's carbon footprint.

## Part 4: Create a Worm Farm in a Jar (30 minutes)

1. **The Goal (5 mins):** "Remember the permaculture idea of turning waste into a resource? We're going to build a mini-factory that does just that, starring some amazing workers: earthworms! We're making a vermicomposter."
2. **Construction (20 mins):**
  - Guide the student through layering the materials in the clear glass jar:
    1. A thin layer of gravel at the bottom (for drainage).
    2. A layer of sand.
    3. A thick layer of soil.
    4. A layer of "bedding": moistened shredded newspaper and dead leaves.
    5. Gently add the worms!
    6. Add a few small veggie scraps on top.
    7. Lightly spray with water to keep it moist but not soaking wet.
  - Explain what each layer does. The worms will eat the scraps and bedding, travel through the layers, and turn it all into amazing, nutrient-rich soil called "worm castings," which is a fantastic fertilizer for the garden we designed!
3. **Finishing Touches (5 mins):**
  - Loosely place the lid on top (do not seal it, worms need air!) or poke holes in it.
  - Wrap the dark paper around the jar and tape it. Explain that worms like the dark. Let the student know they can peek every few days to see the worms at work.

## Part 5: Wrap-up & Reflection (15 minutes)

1. **Review and Discuss:**
  - Look back at the whiteboard. Ask the student to define "Carbon Footprint" and "Permaculture" again, but this time using examples from our activities.
  - Ask reflection questions:

- "What was the most surprising thing you learned today?"
  - "What is one small change we could make as a family, starting this week, to shrink our food's carbon footprint?"
  - "How does your worm farm work like a tiny natural factory?"
2. **Next Steps:** Talk about how the garden design could become a real project. The worm castings from the jar could be the first fertilizer for the first plant they decide to grow. This connects the lesson to a tangible, future action.
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## Assessment & Differentiation

- **Assessment:** Success is measured by the student's active participation, the completed Food Miles worksheet, the thoughtful design of their permaculture patch (showing understanding of layers and purpose), and the successfully constructed worm farm. Their answers during the final reflection will demonstrate their grasp of the core concepts.
  - **Differentiation/Support:** If the student struggles with the mileage calculation, focus on the visual representation with the string on the map—the key concept is "far vs. close." For the garden design, provide a pre-drawn patch shape and a list of local, easy-to-grow plants to choose from.
  - **Differentiation/Challenge:** For an advanced student, introduce more permaculture principles like "water harvesting" (how would you add a rain barrel to your design?) or "companion planting" (researching which plants help each other grow). They could also calculate the carbon footprint of non-food items.
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