

NUTRITION SCIENCE & FOOD STUDIES

Food Systems & Sustainable Agriculture

A 3-Week Project-Based Unit for Grades 7–11

Exploring how food is grown, processed, distributed, and wasted — from industrial farming to sustainable alternatives, food justice, supply chains, composting, and local food movements.

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UM Printables

Premium Teaching Resources for Educators

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- Local Food Research Project (Guidelines & Rubric)
- Documentary Discussion Guides (2 Films)

Assessment

Unit Assessment — Multiple Choice, Short Answer, and Essay
Answer Key with Scoring Rubric

UNIT OVERVIEW

Unit Summary & Rationale

This three-week unit examines the complex systems that bring food from farm to table — and the many points along the way where those systems create inequities, environmental damage, and waste. Students in grades 7–11 will explore the differences between industrial and sustainable agriculture, analyze real data on food access in the United States, investigate the concept of food justice, trace the intricate paths of global supply chains, and discover how local food movements and composting systems offer practical alternatives. Through project-based learning, simulations, data analysis, and critical discussions, students will develop the analytical tools to evaluate the food systems they participate in every day and envision more just and sustainable alternatives.

The unit is designed around three thematic weeks. **Week 1** builds foundational knowledge of food systems, comparing industrial and sustainable models. **Week 2** shifts focus to issues of equity and access, examining food deserts, food justice, and supply chain dynamics through hands-on data analysis and a documentary film. **Week 3** turns toward solutions — composting, local food systems, and student-driven research projects — culminating in presentations that synthesize the unit's core ideas.

Essential Questions

- *How does the way we grow, process, distribute, and dispose of food shape human health, environmental sustainability, and social equity?*
- *What are the key differences between industrial agriculture and sustainable agriculture, and what are the trade-offs of each system?*
- *Why do food deserts exist in one of the wealthiest nations on Earth, and who is most affected by limited food access?*
- *What does food justice mean, and how do race, class, and geography determine the quality of food available to communities?*
- *How do global supply chains influence the environmental footprint, cost, and nutritional quality of the food we eat?*
- *What role can individuals and communities play in building more sustainable and equitable food systems?*

Learning Objectives

By the end of this unit, students will be able to:

- Define and diagram the components of a food system (production, processing, distribution, consumption, disposal) and explain how these components interact.
- Compare and contrast industrial agriculture and sustainable agriculture in terms of scale, methods, environmental impact, and social consequences.

- Map the journey of a specific food product from farm to table, identifying key stakeholders, transportation stages, and points of waste or inefficiency.
- Analyze real United States data on food deserts, interpreting patterns related to geography, income, race, and health outcomes.
- Define food justice and food sovereignty and explain how systemic inequalities shape food access in American communities.
- Evaluate the environmental, economic, and nutritional consequences of long global supply chains versus short local supply chains.
- Explain the scale and causes of food waste in the United States and propose evidence-based strategies for reducing waste at individual, community, and systemic levels.
- Describe the science and practice of composting as a closed-loop alternative to the linear waste model.
- Research and present on a local food initiative, evaluating its effectiveness and potential for community impact.
- Articulate a personal position on food system sustainability supported by evidence from unit activities, readings, and discussions.

Standards Alignment

This unit aligns with the following standards frameworks:

Framework	Relevant Standards
NGSS (MS/HS)	MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing human impact; HS-ESS3-4: Evaluate or refine a technological solution that reduces impacts of human activities on natural systems; MS-LS2-1: Analyze cause and effect relationships in ecosystems
C3 Framework (Social Studies)	D2.Geo.6.9-12: Evaluate the impact of human settlement activities on the environmental and cultural characteristics of specific places; D2.Eco.1.6-8: Explain how economic decisions affect the well-being of individuals; D2.Civ.10.9-12: Analyze justice and diversity movements
National Health Education Standards	Standard 2: Analyze the influence of family, peers, culture, media, and technology on health behaviors; Standard 8: Advocate for personal, family, and community health
Common Core ELA (Literacy in Science)	WHST.6-8.1: Write arguments focused on discipline-specific content; RST.9-10.7: Translate quantitative information expressed in words into visual form; SL.9-12.4: Present information and findings clearly and concisely

Unit Materials & Resources

General Supplies

- Student notebooks or journals for daily reflections and notes
- Chart paper and markers for group work and visual mapping
- Sticky notes (multiple colors) for sorting and categorizing activities
- Access to internet-enabled devices (laptops, tablets, or computer lab) for research and data analysis
- Projector or smartboard for film screenings and presentations
- Printed handouts of data sets, rubrics, and activity sheets (included in this resource)

Films and Media

- *A Place at the Table* (2012, directed by Kristi Jacobson and Lori Silverbush) — Documentary examining food insecurity in America. Rated PG. Available on major streaming platforms.
- *Kiss the Ground* (2020, directed by Josh Tickell and Rebecca Harrell Tickell) — Documentary on regenerative agriculture and soil health. Rated PG. Available on Netflix and for educational licensing.

Recommended Supplementary Texts (Teacher Reference)

- *The Omnivore's Dilemma* by Michael Pollan (young readers edition available)
- *Food Justice* by Robert Gottlieb and Anupama Joshi
- *American Wasteland* by Jonathan Bloom
- USDA Economic Research Service reports (free online): www.ers.usda.gov
- EPA Food Waste data and resources: www.epa.gov/sustainable-management-food

Three-Week Pacing Guide

Week	Day	Lesson / Activity	Focus
	1	Lesson 1: What Is a Food System?	Introduction & Foundations
1	2	Lesson 2: Industrial Agriculture	Scale, Efficiency & Consequences
	3	Lesson 3: Sustainable Agriculture	Principles & Practices
	4	Lesson 4: Food System Mapping Activity	Hands-On Mapping
	5	Lesson 5: Processing & Distribution	Supply Chain Analysis
	1	Lesson 6: Food Deserts	Geography of Inequality
2	2	Lesson 7: Food Desert Data Analysis Lab	Real US Data Analysis
	3	Lesson 8: Food Justice & Sovereignty	Equity & Activism
	4	Lesson 9: Documentary — <i>A Place at the Table</i>	Film & Discussion
	5	Lesson 10: Supply Chain Simulation Game	Interactive Simulation

	1	Lesson 11: The Food Waste Crisis	Causes & Scale of Waste
3	2	Lesson 12: Composting & Closed-Loop Systems	Solutions & Soil Science
	3	Lesson 13: Local Food Movements	Community Resilience
	4	Lesson 14: Local Food Research — Work Session	Project Work Day
	5	Lesson 15: Research Presentations & Reflection	Synthesis & Assessment

Key Vocabulary

The following vocabulary terms are central to this unit. Introduce terms as they arise in lessons; students should define and use them in context throughout the three weeks.

Food System

The interconnected network of activities involved in producing, processing, distributing, consuming, and disposing of food.

Industrial Agriculture

Large-scale, mechanized farming that relies on synthetic fertilizers, chemical pesticides, monocropping, and concentrated animal feeding operations (CAFOs) to maximize yield and profit.

Sustainable Agriculture

Farming practices that meet current food needs without compromising the ability of future generations to meet their own needs, emphasizing soil health, biodiversity, and ecological balance.

Monoculture / Monocropping

The agricultural practice of growing a single crop species over a wide area for consecutive seasons, which reduces biodiversity and increases vulnerability to pests and disease.

CAFO (Concentrated Animal Feeding Operation)

A large-scale industrial facility where animals are kept in confined spaces at high density, often with limited access to the outdoors.

Regenerative Agriculture

A holistic approach to farming that focuses on restoring soil health, increasing biodiversity, improving water cycles, and sequestering carbon from the atmosphere.

Food Desert

A geographic area where residents have limited or no access to affordable, nutritious food, typically defined as living more than 1 mile (urban) or 10 miles (rural) from a supermarket.

Food Insecurity

The state of being without reliable access to a sufficient quantity of affordable, nutritious food. The USDA classifies food insecurity as low or very low food security.

Food Justice

A movement and framework that examines how race, class, and geography create inequities in the food system and seeks to ensure that all communities have access to healthy, culturally appropriate food produced in environmentally sound ways.

Food Sovereignty

The right of communities to define their own food and agriculture systems, controlling the production, distribution, and consumption of food rather than being subject to international market forces.

Supply Chain

The sequence of processes, organizations, and activities involved in moving a product from its raw material stage to the final consumer, including production, processing, packaging, transportation, and retail.

Food Miles

The distance food travels from where it is produced to where it is consumed, used as a measure of the environmental impact of food transportation.

Food Waste

Edible food that is discarded, lost, or uneaten at any point in the food supply chain, from farm to consumer. The USDA estimates 30–40% of the US food supply is wasted annually.

Composting

The biological decomposition of organic materials (food scraps, yard waste) under controlled conditions to produce a nutrient-rich soil amendment called compost.

Closed-Loop System

A system in which outputs (waste products) are recycled back as inputs, minimizing waste and the need for new raw materials. In food systems, this means food waste is composted and returned to the soil to grow more food.

Local Food Movement

A collaborative effort to build more locally based, self-reliant food economies in which sustainable food production, processing, distribution, and consumption are integrated to enhance economic, environmental, and social health.

CSA (Community Supported Agriculture)

A system in which consumers purchase shares of a farm's harvest in advance, receiving regular deliveries of seasonal produce and sharing both the risks and rewards of farming with the grower.

Food Security

The condition in which all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs for an active and healthy life.

WEEK 1: UNDERSTANDING FOOD SYSTEMS

(LESSONS 1–5)

Week 1 establishes the foundational concepts of the unit. Students learn to define and map food systems, then explore the two dominant paradigms of modern food production: industrial agriculture and sustainable agriculture. The week culminates in a hands-on food system mapping activity.

Lesson 1: What Is a Food System?

Duration: 50 minutes

Objective

Identify and describe the five components of a food system (production, processing, distribution, consumption, disposal) and trace the journey of a common food item.

Duration

50 minutes

Key Vocabulary: food system, production, processing, distribution, consumption, disposal

Materials: Chart paper, markers, sticky notes, student notebooks

Lesson Procedure

1. Warm-Up (5 minutes)

Display the question: *"Where does your lunch come from?"* Ask students to write down everything they ate for lunch yesterday and identify where they think each item originated before it reached their plate. Have 2–3 students share their lists.

2. Direct Instruction: Defining a Food System (15 minutes)

Introduce the concept of a **food system** as the interconnected network of activities that bring food from farm to table and beyond. Explain that food systems are not just about farming; they encompass every step and every actor involved in feeding people. Detail the five main components:

- **Production:** Growing crops and raising animals (farming, fishing, ranching). This is where the raw ingredients are created.
- **Processing:** Transforming raw ingredients into edible products (milling wheat into flour, canning tomatoes, making cheese, packaging frozen dinners).
- **Distribution:** Transporting and selling food (trucking, shipping, warehousing, grocery stores, farmers markets, food banks).
- **Consumption:** Eating the food—whether at home, in restaurants, in schools, or on the go.
- **Disposal:** What happens to food waste, byproducts, and packaging (landfills, composting, recycling, anaerobic digestion).

Emphasize that these components are deeply interconnected. A change in one part of the system—such as a drought affecting production—ripples through processing, distribution, and consumption.

3. Guided Practice: Tracing a Food Journey (20 minutes)

Lesson 8: Food Justice and Food Sovereignty

Duration: 50 minutes

Objective

Differentiate between food justice and food sovereignty, and analyze how community-led initiatives address systemic food inequities.

Duration

50 minutes

Key Vocabulary: food justice, food sovereignty, food apartheid, food policy council, community-based food system

Materials: Case study handouts (provided below), chart paper, markers, student notebooks

Lesson Procedure

1. Warm-Up (5 minutes)

Write the word "desert" on the board. Ask: *"When you hear the word desert, what comes to mind?"* (Students will likely say sand, empty, natural, hot, lack of water). Then write "apartheid." Explain that apartheid means "separateness" and refers to systemic segregation and discrimination. Introduce the term **food apartheid**. Explain that many advocates prefer this term over "food desert" because deserts are natural ecosystems, but the lack of grocery stores in certain neighborhoods is not natural—it is the result of deliberate political, economic, and racial decisions.

2. Direct Instruction: Justice vs. Sovereignty (15 minutes)

Define two critical frameworks for addressing food inequity:

- **Food Justice:** The belief that healthy, culturally appropriate food is a human right. The food justice movement examines how race, class, and geography create inequities in the food system and seeks to ensure that all communities have access to healthy food produced in environmentally sound ways. It focuses on *equitable access* and dismantling systemic barriers.
- **Food Sovereignty:** A step beyond food justice. It is the right of communities to define their own food and agriculture systems—to control the production, distribution, and consumption of food rather than being subject to international market forces or corporate control. It focuses on *community power and self-determination*.

Explain the distinction: Food justice asks, *"How do we ensure everyone has access to good food?"* Food sovereignty asks, *"Who decides what food is grown, how it is grown, and who profits from it?"*

3. Jigsaw Activity: Community Solutions (20 minutes)

Divide the class into three "expert" groups. Each group reads one of the brief case studies below and prepares to teach it to the class, answering: (1) What problem does this initiative address? (2) How does it demonstrate food justice or food sovereignty? (3) What makes this approach different from simply opening a supermarket?

Case 1: Soul Fire Farm (Petersburg, NY)

Soul Fire Farm is an Afro-Indigenous-centered community farm committed to uprooting racism and seeding sovereignty in the food system. Founded in 2010, it raises vegetables, fruits, and livestock using regenerative practices. The farm delivers fresh food directly to food-insecure households in Albany and Troy, NY, through a sliding-scale CSA (Community Supported Agriculture) program. They also train the next generation of BIPOC (Black, Indigenous, and People of Color) farmers, offering programs that reconnect communities of color to the land and teach sustainable farming skills that were historically used by their ancestors but disrupted by colonization and displacement.

Case 2: Detroit Black Community Food Security Network (Detroit, MI)

The Detroit Black Community Food Security Network (DBCFSN) operates D-Town Farm, a 7-acre regenerative urban farm in Detroit. More than just a farm, DBCFSN organizes the Detroit Food Commons, a cooperatively owned grocery store and community kitchen. This initiative is a model of food sovereignty because the community itself owns and governs the food retail space, keeping capital circulating within the neighborhood rather than extracting it to corporate headquarters. They prioritize sourcing from local Black farmers and producers, creating a closed-loop economic and food system that directly addresses the historical disinvestment in Detroit's Black neighborhoods.

Case 3: Zuni Youth Enrichment Project (Zuni Pueblo, NM)

The Zuni Youth Enrichment Project (ZYEP) addresses food sovereignty in the Zuni Pueblo, where the community has historically relied on government commodity foods that are highly processed and contribute to high rates of diabetes. ZYEP runs community gardens and a farmers market that specifically prioritizes traditional Zuni crops like blue corn, squash, and beans. By saving and sharing traditional seeds and teaching youth indigenous agricultural methods, ZYEP is reclaiming food sovereignty—restoring the community's ability to feed themselves on their own terms, using foods that are culturally significant and nutritionally appropriate.

After expert groups finish, regroup into mixed teams so each case study is represented. Students teach their case studies to their new group members.

4. Closure and Reflection (10 minutes)

Facilitate a whole-class discussion: *"How do these community-based solutions address problems that simply opening a corporate supermarket cannot?"* Guide students to see that food sovereignty addresses economic ownership, cultural connection, and self-determination, while a corporate store extracts profits.

Exit Ticket: In your own words, explain the difference between food justice and food sovereignty using one example from today's lesson.

Supply Chain Simulation Game

Complete Rules & Play Mat

Game Scenario: Your team is a supply chain company tasked with delivering a shipment of fresh strawberries from a farm in Michoacán, Mexico, to a grocery store in Chicago, Illinois. The journey is over 1,800 miles and takes several days. Fresh strawberries are highly perishable; if the journey takes too long or the refrigeration fails, the crop is lost.

Game Economy

Each team starts with **30 Resource Points (RP)** and **10 Food Units (FU)** of strawberries. Your goal is to deliver as many FU to the final consumer as possible while keeping your company financially solvent (RP > 0).

Action	Cost / Income	Description
Production Cost	-1 RP per FU	Paid by the Farmer each round to maintain the crop.
Transport Cost	-2 RP per FU	Paid by the Transporter each round to move the shipment.
Border / Customs Fee	-3 RP (flat fee)	Paid once to the Exporter/Importer when crossing the border.
Cold Storage / Retail Fee	-1 RP per FU	Paid by the Retailer each round to keep unsold berries refrigerated.
Sell to Consumer	+5 RP per FU	Earned when a FU successfully reaches the end of the supply chain.

Game Rules

- The Journey:** The supply chain has 4 stages: Farm → Border → Transport → Retail. You must move your FU through all 4 stages to sell them.
- Rounds:** The game lasts 5 rounds. Each round, you **MUST** pay the costs for any FU still in your supply chain (Production, Transport, Storage).
- Moving Inventory:** Each round, you automatically move your FU one stage forward, **UNLESS** an event stops you.
- Spoilage:** If a single FU spends more than 3 rounds in the supply chain without being sold, it spoils and must be discarded (lost forever, no money earned).
- Random Events:** At the start of each round, the Logistics Manager rolls a standard 6-sided die. The number corresponds to an Event on the Event Matrix. Apply the event immediately.
- Bankruptcy:** If your team's RP drops to 0 or below, your supply chain collapses. You must sit out the remaining rounds and calculate your final score as 0.
- Winning:** At the end of Round 5, the team with the most RP is the most resilient and profitable supply chain.

Event Matrix (Roll a 6-sided die)

Die Roll	Event Name	Effect on Your Supply Chain
1	Smooth Sailing	No disruptions. All transport and border crossings proceed on schedule. Pay standard costs only.

2	Fuel Price Spike	Diesel prices double. Transport costs increase by 2 RP per FU for this round ONLY.
3	Border Delay	Customs holds your truck for inspection. Your FU do NOT move forward this round. You must still pay transport and storage costs, but you do not pay the border fee again.
4	Refrigeration Failure	The truck's A/C breaks. 2 FU of strawberries spoil immediately and must be removed from your inventory.
5	Extreme Weather	A heatwave damages the crop at the farm. If you have not yet moved FU past the Farm stage, lose 3 FU immediately.
6	Consumer Demand Surge	A health trend goes viral! If you have FU at the Retail stage, you sell them for 7 RP per FU this round instead of 5 RP.

- B) Intensive tilling
- C) Cover cropping with plants like clover and rye
- D) Using synthetic herbicides

6. In the EPA Food Recovery Hierarchy, what is the most preferred action for managing food waste?

- A) Composting
- B) Feeding hungry people
- C) Source reduction
- D) Feeding animals

7. What is the primary greenhouse gas emitted when food decomposes in an anaerobic landfill environment?

- A) Carbon dioxide
- B) Methane
- C) Nitrous oxide
- D) Oxygen

8. The "hunger-obesity paradox" describes a situation where:

- A) People eat too much and waste too much food
- B) Individuals experience both food insecurity and high rates of obesity because the most affordable foods are highly processed and calorie-dense
- C) Obesity is caused by a lack of hunger signals in the brain
- D) People in food deserts cannot find fast food

9. Food sovereignty differs from food justice in that food sovereignty emphasizes:

- A) The right of communities to define and control their own food and agriculture systems
- B) Ensuring equal access to grocery stores
- C) Reducing the price of organic food
- D) Building more food banks

10. In a compost pile, "Greens" (like food scraps and grass clippings) provide which essential element for microbial decomposition?

- A) Carbon
- B) Oxygen
- C) Nitrogen
- D) Hydrogen