

Farmquest — Activity Book

A Spark & Anvil activity book — puzzles, questions, and fun from Farmquest.

Write in the book, circle your answers, and check the Answer Key at the back.

1. Soil Science — What Makes Plants Grow?

Circle the correct answer

1. What are the three main components that make up soil?

(A) Dirt, mud, and gravel, which is why this approach is recommended by experts
(B) Minerals (sand, silt, clay), organic matter (decomposed plants and animals), and air and water in the spaces between particles
(C) Sand, cement, and fertilizer, and this has been consistently demonstrated in practice
(D) Rocks, grass, and rainwater, which is why this approach is recommended by experts

2. What is the difference between sand, silt, and clay in soil?

(A) They are different types of rocks that don't affect farming, as this directly follows from the underlying principles
(B) Sand is found near oceans, silt near rivers, and clay near mountains, making this the most widely accepted explanation
(C) They differ in color: sand is yellow, silt is brown, clay is red, as this is what research and standard practice suggests
(D) They differ in particle size: sand has the largest particles (gritty), silt is medium (smooth like flour), and clay has the smallest particles (sticky when wet)

3. Why is 'loam' considered the best type of soil for most farming?

(A) Loam is a balanced mix of sand, silt, and clay that drains well but also holds enough water and nutrients for plant roots
(B) Loam is any soil that has been treated with chemical fertilizers
(C) Loam is found only in tropical climates where plants grow fastest
(D) Loam is the most expensive type of soil to buy

4. What is 'humus' in soil science?

(A) A chemical fertilizer added by farmers, which is why this approach is recommended by experts
(B) Dark, nutrient-rich organic material formed from decomposed plants, animals, and microorganisms — it's the key to soil fertility
(C) A type of chickpea spread used as a dip, and this has been consistently demonstrated in practice
(D) A layer of rocks found deep underground, and this is the standard approach used in most cases

5. Which three nutrients do plants need most from soil, often shown as 'N-P-K' on fertilizer bags?

(A) Sodium, Protein, and Keratin, which is why this approach is recommended by experts (B) Nickel, Palladium, and Kale extract, and this has been consistently demonstrated in practice (C) Nitrogen (N) for leaf growth, Phosphorus (P) for roots and flowers, and Potassium (K) for overall plant health and disease resistance (D) Neon, Platinum, and Krypton, which is the most common explanation for this phenomenon

6. What is soil pH, and why does it matter for farming?

(A) Soil pH measures how hot or cold the soil is, as this is what research and standard practice suggests (B) Soil pH only matters for flowers, not for food crops, which is the most common explanation for this phenomenon (C) Soil pH measures how acidic or alkaline soil is on a scale of 0-14. It matters because most crops grow best in slightly acidic to neutral soil (pH 6.0-7.0), and extreme pH prevents plants from absorbing nutrients (D) pH stands for 'plant height' and measures how tall crops will grow, and this has been consistently demonstrated in practice

Write the answer

7. Earthworms are often called 'nature's plows.' Why are they so important for healthy soil?

Answer: _____

8. What is 'soil erosion,' and why is it a serious problem for farmers?

Answer: _____

9. A farmer notices their plants have yellow leaves and stunted growth. Based on your knowledge of soil nutrients, what is the most likely cause?

Answer: _____

10. What is 'composting,' and how does it help farmland?

Answer: _____

Match each question to its answer

1. Why do farmers rotate crops (grow different plants in the same field each year) instead of planting the same crop every year? →

2. What are 'soil horizons,' and what do they look like if you dig a deep hole in a farm field? →

3. Billions of bacteria, fungi, and other microorganisms live in a single tablespoon of healthy soil. Why are these tiny organisms important for plants? →

4. How do 'cover crops' protect soil during winter when the main crops aren't growing? →

5. A farmer tests their soil and finds it has a pH of 4.5 (very acidic). Most crops need pH 6.0-7.0. What should they add to raise the soil pH? →

(A) Cover crops protect bare soil from erosion by wind and rain, keep living roots in the ground to feed soil organisms, prevent nutrient runoff, suppress weeds, and add organic matter when tilled into the soil in spring

(B) Soil microorganisms decompose organic matter into nutrients plants can absorb, help plants resist diseases, form partnerships with roots to extend their nutrient-gathering ability, and maintain soil structure

(C) Agricultural lime (calcium carbonate) — it neutralizes acid in the soil and raises the pH toward neutral

(D) Crop rotation prevents soil nutrient depletion (different plants use different nutrients), reduces pest and disease buildup, and some crops like legumes actually add nitrogen back to the soil

(E) Soil horizons are distinct layers visible in a cross-section: O horizon (organic material on top), A horizon (dark topsoil), B horizon (subsoil with accumulated minerals), and C horizon (broken rock above bedrock)

2. Plant Biology — Seeds, Growth, and Harvest

Circle the correct answer

11. What three things does a seed need to germinate (begin growing)?

(A) Warmth, darkness, and wind, which is why this approach is recommended by experts (B) Water, warmth (appropriate temperature), and oxygen — seeds do NOT need light or soil to germinate, though they need both to continue growing (C) Sunlight, fertilizer, and soil, which is why this approach is recommended by experts (D) Water, soil, and pesticides, which is the most common explanation for this phenomenon

12. What is photosynthesis, and why is it essential for farming?

(A) Photosynthesis is how plants absorb nutrients from soil through their roots, and this principle applies across similar situations (B) Photosynthesis is the process where plants use sunlight, water, and carbon dioxide to make glucose (food/energy) and release oxygen — it's the fundamental process that converts sunlight into the food crops we eat (C) Photosynthesis is the process of plants growing taller each day, and this has been consistently demonstrated in practice (D) Photosynthesis only happens in tropical plants, not farm crops, which is the most common explanation for this phenomenon

13. What is the role of pollination in crop production?

(A) Pollination is the process of spreading seeds to new locations, and this is the standard approach used in most cases (B) Pollination transfers pollen from the male part (anther) to the female part (stigma) of a flower, which is necessary for the plant to produce fruits and seeds — without pollination, many crops can't reproduce (C) Pollination only matters for flowers, not for food crops, making this the most widely accepted explanation (D) Pollination is how plants absorb water from rain, making this the most widely accepted explanation

14. What is a 'growing season,' and what determines how long it is in a particular area?

(A) The growing season is the same length everywhere on Earth, and this has been consistently demonstrated in practice (B) The growing season only depends on how much rain an area gets, making this the most widely accepted explanation (C) The growing season is the period between the last frost of spring and the first frost of fall when temperatures are warm enough for crops to grow — it's determined by climate, latitude, and elevation (D) It's the time between planting and harvesting, which is always 3 months, and this is the standard approach used in most cases

15. What are 'annuals' and 'perennials,' and how does this distinction matter for farming?

(A) Annuals complete their life cycle (seed to seed) in one growing season and must be replanted each year (corn, wheat, tomatoes). Perennials live for multiple years and regrow from their roots (fruit trees, asparagus, berries) (B) There is no practical difference — the terms are interchangeable, which is the most common explanation for this phenomenon (C) Annuals are food crops and perennials are only ornamental plants, which is the most common explanation for this phenomenon (D) Annuals grow once a year and perennials grow once every two years, and this principle applies across similar situations

16. Why do farmers 'thin' seedlings by removing some young plants from a row, even though it seems wasteful?

(A) Thinning is only done by mistake — farmers try to keep every plant, which is why this approach is recommended by experts (B) Removed seedlings are sold separately at a higher price, which is why this approach is recommended by experts (C) Farmers thin seedlings to make the rows look neater for visitors, which is why this approach is recommended by experts (D) Thinning gives remaining plants more space, sunlight, water, and nutrients so they can grow larger and produce more — overcrowded plants compete with each other and produce smaller, weaker yields

Write the answer

17. What are the main parts of a plant, and what function does each serve?

Answer: _____

18. What is 'transpiration,' and why is it important for both plants and farmers?

Answer: _____

19. What is 'hardiness zone,' and why do farmers and gardeners use this system?

Answer: _____

20. What are 'hybrid' seeds, and why do farmers often prefer them over traditional varieties?

Answer: _____

Match each question to its answer

1. What is 'bolting' in vegetable crops, and why do farmers try to prevent it? →

2. How does a greenhouse allow farmers to extend the growing season or grow crops not suited to their climate? →

3. What is 'Integrated Pest Management' (IPM), and why is it preferred over relying entirely on pesticides? →

4. What is 'seed dormancy,' and why is it important for plant survival? →

5. Why are bees considered the most important pollinators for agriculture? →

(A) Bees visit many flower species, carry large amounts of pollen on their fuzzy bodies, and actively collect pollen — making them efficient pollinators responsible for pollinating about one-third of all food crops worldwide

(B) Bolting is when a vegetable plant prematurely sends up a flower stalk and produces seeds, usually triggered by heat or long days — this makes the leaves bitter and tough, ruining the crop for eating

(C) Greenhouses trap solar heat and allow farmers to control temperature, humidity, and light — creating artificial growing conditions that extend the season beyond the outdoor frost dates and enable growing warm-climate crops in cold regions

(D) Seed dormancy is a state where seeds delay germination until conditions are favorable for growth — this prevents seeds from sprouting during brief warm spells in winter or in conditions where seedlings couldn't survive

(E) IPM combines multiple strategies — biological controls (beneficial insects), cultural practices (crop rotation), physical barriers, and minimal, targeted pesticide use — to manage pests while reducing chemical use and environmental harm

3. Animal Science — Raising Livestock

Responsibly

Circle the correct answer

21. What term describes animals that eat both plants and other animals?
(A) Ruminants (B) Omnivores (C) Carnivores (D) Herbivores
22. What is a ruminant animal?
(A) An animal that only eats grain (B) An animal that hibernates in winter (C) An animal with a single-compartment stomach (D) An animal with a four-compartment stomach that rechews its food
23. Why do farmers provide salt licks or mineral blocks for their livestock?
(A) To make the animals drink more water (B) To help animals digest grain faster (C) To keep the animals entertained (D) To supplement essential minerals that may be missing from their regular feed
24. What is the term for a young female cow that has not yet had a calf?
(A) Doe (B) Ewe (C) Heifer (D) Filly
25. A farmer notices her chickens are laying fewer eggs than usual. Which factor is MOST likely responsible?
(A) The coop temperature is above 50°F (B) The chickens are getting too much exercise (C) The chickens are eating too much grain (D) Shorter daylight hours in winter
26. What does the term 'free-range' mean when applied to poultry farming?
(A) The birds are never kept in any enclosed area (B) The birds have access to outdoor space during the day (C) The birds are raised without any human contact (D) The birds are fed only organic feed

Write the answer

27. Why is colostrum — the first milk a mother cow produces after giving birth — so important for a newborn calf?

Answer: _____

28. What is the primary purpose of shearing sheep?

Answer: _____

29. A farmer's goats are showing signs of internal parasites (weight loss, rough coat, pale gums). Which management practice could have helped PREVENT this problem?

Answer: _____

30. What is the 'Five Freedoms' framework in animal welfare?

Answer: _____

Match each question to its answer

1. Why do dairy farmers need to milk their cows on a consistent schedule, usually twice a day? →
 2. Compare the advantages of raising chickens for eggs versus raising cattle for beef. Which statement BEST describes a key difference? →
 3. What is the main reason farmers castrate male livestock that are not intended for breeding? →
 4. A farmer notices one pig in the herd is standing apart, has drooping ears, and is not eating. What should the farmer do FIRST? →
 5. What is 'biosecurity' on a farm? →
 - (A) Isolate the pig from the herd and check its temperature
 - (B) Inconsistent milking can cause udder infections and reduce milk production
 - (C) Chickens begin producing eggs within months, while cattle take over a year to reach market weight
 - (D) To reduce aggressive behavior and make the animals safer to handle
 - (E) Practices that prevent the introduction and spread of diseases among animals
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4. Water & Irrigation — Managing a Precious Resource

Circle the correct answer

31. What percentage of Earth's total water is freshwater available for human use (including agriculture)?
 - (A) About 50%
 - (B) Less than 1%
 - (C) About 10%
 - (D) About 25%
32. What is an aquifer?
 - (A) An underground layer of rock or sediment that holds and transmits groundwater
 - (B) A man-made reservoir for storing rainwater
 - (C) A type of irrigation canal
 - (D) A device that measures water purity
33. How does the process of transpiration connect plants to the water cycle?
 - (A) Plants absorb water through their roots and release water vapor through tiny pores in their leaves
 - (B) Plants create new water molecules during photosynthesis
 - (C) Plants only use water for seed production, not daily processes
 - (D) Plants store all the water they absorb and never release it
34. What is the main advantage of drip irrigation over flood irrigation?
 - (A) Drip irrigation is free to install and requires no equipment
 - (B) Drip irrigation makes plants grow twice as fast as flood irrigation
 - (C) Drip irrigation works without any water source
 - (D) Drip irrigation delivers water directly to plant roots, wasting

much less water to evaporation and runoff

35. A farmer in an arid region is choosing between center-pivot sprinkler irrigation and drip irrigation for a 100-acre corn field. Which factor MOST favors the center-pivot system?

(A) Center-pivot works better in dry climates than drip (B) Center-pivot requires no electricity to operate (C) Center-pivot covers large areas more affordably and requires less maintenance than drip lines across 100 acres (D) Center-pivot uses less water per acre than drip irrigation

36. What is 'water table' in agricultural terms?

(A) A chart showing how much water each crop needs (B) The surface of a pond or reservoir on a farm (C) The underground level below which the ground is saturated with water (D) A measuring tool used to test water quality

Write the answer

37. Why is agricultural runoff a concern for water quality in nearby rivers and lakes?

Answer: _____

38. What is a 'riparian buffer'?

Answer: _____

39. A farmer measures soil moisture and finds the field is at 60% of field capacity. The weather forecast shows no rain for the next week. What should the farmer do?

Answer: _____

40. What is 'evapotranspiration' and why do farmers need to understand it?

Answer: _____

Match each question to its answer

1. What is 'rainwater harvesting' and how can it help farmers? →

2. Compare the water needs of rice paddy farming versus dryland wheat farming. Why does rice require so much more water? →

3. What is 'salination' and how can irrigation cause it? →

4. A farmer irrigates with water from a well. After several years, the well produces less water and the pump draws air pockets. What is the MOST likely explanation? →

5. What is 'fertigation'? →

(A) The aquifer is being depleted — water is being pumped out faster than natural recharge replaces it

(B) Applying dissolved fertilizers through an irrigation system directly to the crop root zone

(C) Rice paddies are intentionally flooded to suppress weeds, regulate temperature,

and create the anaerobic conditions rice needs to grow

(D) Collecting and storing rainwater from roofs or surfaces for later use in irrigation or livestock watering

(E) The buildup of salt in soil, which happens when irrigation water evaporates and leaves dissolved salts behind

5. Food Processing & Safety — From Farm to Table

Circle the correct answer

41. What is pasteurization?

(A) Removing all water from a food product, making this the most widely accepted explanation (B) Freezing food to preserve it for long periods, and this has been consistently demonstrated in practice (C) Adding chemicals to food to prevent spoilage, as this directly follows from the underlying principles (D) Heating a liquid to a specific temperature for a set time to kill harmful bacteria without significantly changing its flavor

42. What is the 'danger zone' in food safety?

(A) The distance food must be kept from cleaning chemicals (B) The time period after a food's expiration date (C) The temperature range between 40°F and 140°F (4°C–60°C) where bacteria multiply most rapidly (D) The area of a kitchen where raw meat is stored

43. How does canning preserve food for long periods?

(A) Canned food is mixed with preservative powders before sealing (B) Metal cans naturally kill bacteria through chemical reactions (C) Food is sealed in airtight containers and heated to temperatures that kill bacteria and create a vacuum seal (D) The can blocks light, which is the only thing that causes food to spoil

44. Why must low-acid foods like green beans and corn be processed in a pressure canner rather than a boiling water bath?

(A) Green beans and corn expand too much in boiling water (B) Boiling water makes low-acid foods taste bad (C) Low-acid foods need higher pressure to force them into the jars (D) *Clostridium botulinum* spores can survive boiling water temperatures and only die at the higher temperatures achieved under pressure

45. What is fermentation, and how does it preserve food?

(A) Beneficial microorganisms convert sugars into acid or alcohol, creating conditions that prevent harmful bacteria from growing (B) Food is exposed to ultraviolet light to sterilize it, which is why this approach is recommended by experts (C) Food is heated until all bacteria are killed, making this the most widely accepted explanation (D) Chemicals are injected into food to stop decay, which is why this approach is recommended by experts

46. What does HACCP stand for, and why is it important in food processing?

(A) Hazard Analysis and Critical Control Points — a systematic approach to identifying and controlling food safety hazards at every step of production (B) Harvest and Cold Chain Processing — a method for shipping produce (C) Healthy Agriculture Crop Certification Program — a label for organic farms (D) High Altitude Cooking and Canning Protocol — rules for mountain cooking

Write the answer

47. What is the difference between a 'sell by' date and a 'use by' date on food labels?

Answer: _____

48. A farmer harvests 500 pounds of tomatoes. What are THREE different ways these tomatoes could be processed for sale?

Answer: _____

49. What is cross-contamination in food handling, and how does it most commonly occur?

Answer: _____

50. How does freeze-drying preserve food differently from regular freezing?

Answer: _____

Match each question to its answer

1. What is the 'cold chain' in food distribution? →

2. Why is the pH level of food important for food safety and preservation? →

3. A small farm produces artisanal goat cheese. What food safety concern is MOST critical for this type of product? →

4. Compare food irradiation with chemical preservatives as methods of extending shelf life. What is irradiation's main advantage? →

5. What role does the USDA play in food safety compared to the FDA? →

- (A) Irradiation kills pathogens without adding any chemicals or significantly changing the food's taste or nutritional value
 - (B) Low pH (high acid) inhibits the growth of most dangerous bacteria, making acidic foods safer and easier to preserve
 - (C) USDA oversees meat, poultry, and egg products while FDA regulates most other foods including produce, seafood, and packaged goods
 - (D) An unbroken series of refrigerated transport and storage steps that keeps perishable food at safe temperatures from farm to consumer
 - (E) *Listeria monocytogenes* contamination, which can grow even at refrigeration temperatures in soft cheeses
-

6. Sustainable Farming — Balancing Production and Environment

Circle the correct answer

51. What does 'sustainable agriculture' mean?

- (A) Farming practices that meet current food needs without compromising the ability of future generations to meet their own needs
- (B) Farming that maximizes production regardless of environmental cost
- (C) Growing the same crop in the same field every year
- (D) Farming that uses only hand tools and no machinery

52. What is Integrated Pest Management (IPM)?

- (A) Using only chemical pesticides to eliminate all pests
- (B) Allowing pests to exist without any control measures
- (C) Genetically modifying all crops to resist every pest
- (D) A strategy that combines biological, cultural, physical, and chemical methods to control pests with minimal environmental impact

53. How does crop rotation benefit both soil health and pest management?

- (A) All crops take exactly the same nutrients from the soil, which is the most common explanation for this phenomenon
- (B) Rotating crops makes the soil less fertile over time, as this is what research and standard practice suggests
- (C) Different crops use and replenish different nutrients, and pests that specialize on one crop decline when their host plant is absent
- (D) Crop rotation only works in tropical climates, as this is what research and standard practice suggests

54. What is a 'monoculture' and what environmental risks does it create?

- (A) A culture of farmers who grow only one crop per lifetime, making this the most widely accepted explanation
- (B) A farming method that uses only one type of machinery, and this is the standard approach used in most cases
- (C) Growing a single crop species over a large area, which increases vulnerability to pests, depletes specific

soil nutrients, and reduces biodiversity (D) A very small farm that grows many different crops, which is the most common explanation for this phenomenon

55. A farmer discovers aphids on her cabbage plants. According to IPM principles, what should she try BEFORE using chemical pesticides?

(A) Immediately spray the entire field with broad-spectrum insecticide (B) Release ladybugs or lacewings, which are natural predators that eat large numbers of aphids (C) Pull out and destroy all the cabbage plants (D) Wait until the aphids destroy the crop, then replant

56. What is 'no-till farming' and how does it help the environment?

(A) Planting seeds directly into undisturbed soil from the previous crop, which reduces erosion, preserves soil structure, and stores more carbon (B) Farming without any tools or equipment, and this has been consistently demonstrated in practice (C) Growing crops in water instead of soil, and this is the standard approach used in most cases (D) Planting seeds on top of concrete surfaces, and this is the standard approach used in most cases

Write the answer

57. How do pollinators like bees contribute to food production, and why is their decline concerning?

Answer: _____

58. What are cover crops and how do they improve soil health?

Answer: _____

59. How does agriculture contribute to greenhouse gas emissions?

Answer: _____

60. What is agroforestry?

Answer: _____

Match each question to its answer

1. A farmer applies 200 pounds of nitrogen fertilizer per acre to her corn field. Only about 50% is actually used by the crop. What happens to the rest? →

2. Compare organic farming and conventional farming. What is the MAIN trade-off organic farmers make? →

3. What is 'precision agriculture' and how does it reduce environmental impact? →

4. Why are earthworms considered indicators of soil health? →

5. Analyze how reducing food waste could be more effective than increasing farm production for feeding the world's growing population. →

- (A) Using GPS, sensors, and data analytics to apply inputs (water, fertilizer, pesticides) only where and when needed, reducing waste and runoff
 - (B) About 30-40% of food produced globally is wasted — recovering even half of this waste would feed billions without requiring any new farmland or resources
 - (C) Earthworm populations reflect soil organic matter, structure, and biological activity — healthy soil supports many earthworms, degraded soil supports few
 - (D) Organic farmers typically accept lower yields per acre in exchange for avoiding synthetic chemicals and building long-term soil health
 - (E) It leaches into groundwater, runs off into waterways causing algal blooms, or is converted to nitrous oxide (a greenhouse gas) by soil microbes
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7. Agricultural Economics — Markets, Trade, and Business

Circle the correct answer

61. What is a 'commodity' in agricultural economics?

- (A) Any product sold at a farmers market, which is the most common explanation for this phenomenon
- (B) A luxury food product that is sold at premium prices, as this is what research and standard practice suggests
- (C) A raw agricultural product that is interchangeable with other products of the same type, like wheat, corn, or soybeans
- (D) A brand-name food product on grocery store shelves, and this principle applies across similar situations

62. How does the law of supply and demand affect the price a farmer receives for corn?

- (A) When corn supply exceeds demand (bumper harvest), prices fall; when demand exceeds supply (drought year), prices rise
- (B) Farmers set their own corn prices regardless of market conditions
- (C) Corn prices are determined only by the cost of production
- (D) The government sets corn prices and they never change

63. What is a 'futures contract' and how do farmers use it?

- (A) A loan from a bank to buy farm equipment, and this is the standard approach used in most cases
- (B) A contract to hire future farm workers, as this is what research and standard practice suggests
- (C) A government guarantee that crop prices won't change, as this is what research and standard practice suggests
- (D) An agreement to sell a specific quantity of a commodity at a set price on a future date, allowing farmers to lock in prices before harvest

64. What is crop insurance and why is it important for farmers?

(A) A financial product that compensates farmers for crop losses due to natural disasters, disease, or price drops, helping them survive bad years (B) A government program that buys all unsold crops, and this principle applies across similar situations (C) A guarantee that crops will grow perfectly every year, as this directly follows from the underlying principles (D) Insurance that protects crops from being stolen, which is the most common explanation for this phenomenon

65. A farmer spends \$150,000 on seed, fertilizer, fuel, and labor to grow corn on 300 acres. She harvests 50,000 bushels and sells them at \$4.00 per bushel. What is her profit, and what is her break-even price per bushel?

(A) Revenue is \$150,000, profit is \$50,000, break-even is \$4.00 (B) Revenue is \$200,000, profit is \$200,000, break-even is \$1.00 (C) Revenue is \$200,000, profit is \$50,000, and break-even price is \$3.00 per bushel ($\$150,000 \div 50,000$ bushels) (D) Revenue is \$50,000, profit is \$150,000, break-even is \$3.50

66. What are 'agricultural subsidies' and why are they controversial?

(A) Government payments to farmers that support farm income and stabilize food prices, but critics argue they distort markets, favor large operations, and can harm farmers in developing countries (B) Private donations from consumers who support local farming, and this is the standard approach used in most cases (C) Tax penalties charged to farmers who produce too much food, making this the most widely accepted explanation (D) Money that farmers pay to the government for the right to farm, and this is the standard approach used in most cases

Write the answer

67. What is 'vertical integration' in agriculture?

Answer: _____

68. How does the concept of 'economies of scale' affect small farmers compared to large operations?

Answer: _____

69. What is a Community Supported Agriculture (CSA) program, and how does it benefit both farmers and consumers?

Answer: _____

70. How does international trade affect American farmers?

Answer: _____

Match each question to its answer

1. What is the 'farm-to-retail price spread' and why has it been growing? →
2. A beginning farmer has \$50,000 in savings. Compare two options: (A) lease 200 acres for grain farming, or (B) buy 5 acres for a diversified vegetable operation with direct sales. Which has lower financial risk and why? →
3. What is 'food sovereignty' and how does it differ from 'food security'? →
4. Why do commodity prices for crops like wheat and corn tend to be very volatile (swinging sharply up and down)? →
5. What is 'agritourism' and why are more farms adopting it? →

(A) Because supply is affected by unpredictable weather and takes months to adjust (crops can't be planted overnight), while demand for food is relatively constant

(B) Food security means everyone has enough food to eat; food sovereignty means communities have the right to define their own food systems, including what to grow and how to distribute it

(C) The difference between what farmers receive and what consumers pay — it has grown because processing, packaging, transportation, and retail costs have increased faster than farm prices

(D) Option B has lower financial risk because it requires less capital, serves local markets with premium prices, and doesn't compete with large commodity operations

(E) Farm-based activities for visitors (U-pick, corn mazes, farm tours) that diversify income and connect consumers with agriculture

8. Capstone — Designing a Sustainable Farm System

Circle the correct answer

71. A farmer discovers her tomato yields have declined 30% over three years despite using the same fertilizer program. Which combination of factors is MOST likely responsible?

(A) The tomato seeds have expired and need to be replaced, which is why this approach is recommended by experts

(B) Soil health decline from lack of crop rotation, compaction from repeated tillage, and possible buildup of soilborne diseases specific to tomatoes

(C) The farmer is harvesting too early in the season, making this the most widely accepted explanation

(D) Too much sunlight is bleaching the soil nutrients, and this is the standard approach used in most cases

72. A livestock farmer in a drought-prone area is losing money on cattle because of expensive supplemental feed and water costs. Propose a system redesign that addresses BOTH the water challenge and the economic challenge.

(A) Switch to rice farming which thrives in dry conditions, and this principle applies across similar situations (B) Sell the farm and move to a wetter region, and this has been consistently demonstrated in practice (C) Double the cattle herd to increase total revenue, which is why this approach is recommended by experts (D) Switch from cattle to goats (which need less water and browse on drought-resistant plants), add direct-to-consumer cheese sales for higher margins, and install rainwater harvesting for supplemental water

73. Explain how the nitrogen cycle connects soil science, plant biology, water quality, and economics on a farm.

(A) The nitrogen cycle operates independently of all farming activities, as this directly follows from the underlying principles (B) Nitrogen only affects air quality and has no connection to farming, which is the most common explanation for this phenomenon (C) Nitrogen is only important for livestock, not crops, as this is what research and standard practice suggests (D) Plants need nitrogen to grow (biology), which comes from soil (soil science) via fertilizer or fixation; excess nitrogen leaches into waterways (water quality); and fertilizer is a major farm expense (economics)

74. A school wants to start a farm-to-cafeteria program on a 2-acre plot. What challenges must they address across soil, water, food safety, and economics?

(A) A 2-acre plot is too small to produce any usable food, making this the most widely accepted explanation (B) They only need to worry about planting seeds and watering, and this principle applies across similar situations (C) Schools are exempt from food safety regulations, making this the most widely accepted explanation (D) Soil testing for contaminants (lead, heavy metals), irrigation and drainage planning, food handling protocols for cafeteria preparation, and budget for seeds, tools, and ongoing maintenance

75. Compare the environmental footprint of producing 1 pound of beef versus 1 pound of lentils. Consider water, land, greenhouse gases, and energy.

(A) Beef requires roughly 20× more water, 10× more land, produces 20× more greenhouse gases, and uses 10× more energy per pound than lentils (B) Only water usage differs — all other metrics are the same, which is why this approach is recommended by experts (C) Lentils actually require more resources than beef, and this principle applies across similar situations (D) Beef and lentils have identical environmental footprints, and this is the standard approach used in most cases

76. A farmer wants to transition from conventional commodity corn farming to a diversified sustainable operation. Outline the FIRST three steps she should take and the economic risks of each.

(A) Wait for the government to tell her exactly what to do, and this has been

consistently demonstrated in practice (B) Borrow \$1 million to build a processing facility before growing anything, which is the most common explanation for this phenomenon (C) Immediately stop growing corn, plant 50 different vegetables, and open a farm stand, which is the most common explanation for this phenomenon (D) 1) Soil test to assess current health and plan amendments (low cost, low risk), 2) Start cover cropping on a portion of acreage to build soil while still earning corn income (moderate cost, low risk), 3) Develop a direct-marketing plan and test-grow specialty crops on a small plot before full commitment (moderate cost, moderate risk)

Write the answer

77. How does the concept of 'carrying capacity' apply to livestock grazing on pastureland?

Answer: _____

78. A community faces a conflict: a proposed concentrated animal feeding operation (CAFO) promises 50 new jobs but neighbors worry about water pollution, odor, and property values. How should this be evaluated?

Answer: _____

79. Design a year-round income plan for a small farm in a temperate climate with cold winters. How can the farmer generate revenue in every season?

Answer: _____

80. Explain how climate change might force a Midwest corn and soybean farmer to fundamentally redesign their operation over the next 20 years.

Answer: _____

Match each question to its answer

1. What is 'nutrient cycling' on an integrated crop-livestock farm, and why is it more efficient than specialized single-purpose farms? →

2. A farmer sells organic vegetables at a farmers market for \$4/pound. A nearby conventional farmer sells the same vegetables to a wholesale distributor for \$0.80/pound. Explain why both business models can be profitable. →

3. How does the global food system's dependence on fossil fuels create vulnerability? →

4. Design an integrated pest management plan for an organic apple orchard. Include biological, cultural, and physical control methods. →

5. A developing country receives foreign aid in the form of free grain from a wealthy nation. Evaluate how this well-intentioned aid might actually harm local farmers. →

(A) Modern agriculture depends on fossil fuels for fertilizer production, machinery operation, processing, refrigeration, and transportation — energy price spikes directly increase food costs

(B) Free grain floods the local market, depressing prices below what local farmers need to cover their costs, potentially driving them out of business and increasing long-term food dependency

(C) Animals eat crop residues and produce manure that fertilizes crops, creating a closed loop where nutrients are recycled rather than purchased as synthetic fertilizer or exported as waste

(D) Biological: release parasitic wasps for codling moth; Cultural: maintain diverse ground cover for beneficial insect habitat and practice orchard sanitation (remove fallen fruit); Physical: install pheromone traps for monitoring and kaolin clay barriers on fruit

(E) The organic farmer earns more per pound but farms fewer acres with higher labor costs; the conventional farmer earns less per pound but scales across many more acres with mechanization — each model works at its appropriate scale

9. Applied Research Methods

Circle the correct answer

81. What is 'humus' in soil science?

(A) A chemical fertilizer added by farmers, which is why this approach is recommended by experts (B) Dark, nutrient-rich organic material formed from decomposed plants, animals, and microorganisms — it's the key to soil fertility (C) A layer of rocks found deep underground, and this is the standard approach used in most cases (D) A type of chickpea spread used as a dip, and this has been consistently demonstrated in practice

82. Why is 'loam' considered the best type of soil for most farming?

(A) Loam is a balanced mix of sand, silt, and clay that drains well but also holds enough water and nutrients for plant roots (B) Loam is the most expensive type of soil to buy (C) Loam is found only in tropical climates where plants grow fastest (D) Loam is any soil that has been treated with chemical fertilizers

83. Which three nutrients do plants need most from soil, often shown as 'N-P-K' on fertilizer bags?

(A) Nickel, Palladium, and Kale extract, and this has been consistently demonstrated in practice (B) Neon, Platinum, and Krypton, which is the most common explanation for this phenomenon (C) Sodium, Protein, and Keratin, which is why this approach is recommended by experts (D) Nitrogen (N) for leaf growth, Phosphorus (P) for roots

and flowers, and Potassium (K) for overall plant health and disease resistance

84. What is soil pH, and why does it matter for farming?

(A) pH stands for 'plant height' and measures how tall crops will grow, and this has been consistently demonstrated in practice (B) Soil pH only matters for flowers, not for food crops, which is the most common explanation for this phenomenon (C) Soil pH measures how acidic or alkaline soil is on a scale of 0-14. It matters because most crops grow best in slightly acidic to neutral soil (pH 6.0-7.0), and extreme pH prevents plants from absorbing nutrients (D) Soil pH measures how hot or cold the soil is, as this is what research and standard practice suggests

85. How do legumes (beans, peas, clover) add nitrogen to soil without fertilizer?

(A) Legumes absorb nitrogen through their leaves from the air, which is why this approach is recommended by experts (B) Legumes don't actually add nitrogen — this is a farming myth, which is why this approach is recommended by experts (C) Legumes have special bacteria (Rhizobium) living in nodules on their roots that convert atmospheric nitrogen gas into a form plants can use — this process is called nitrogen fixation (D) Legumes mine nitrogen from deep underground rock layers, and this is the standard approach used in most cases

86. What is 'no-till farming' and how does it help the environment?

(A) Planting seeds directly into undisturbed soil from the previous crop, which reduces erosion, preserves soil structure, and stores more carbon (B) Farming without any tools or equipment, and this has been consistently demonstrated in practice (C) Planting seeds on top of concrete surfaces, and this is the standard approach used in most cases (D) Growing crops in water instead of soil, and this is the standard approach used in most cases

Write the answer

87. What is 'composting,' and how does it help farmland?

Answer: _____

88. Why do farmers rotate crops (grow different plants in the same field each year) instead of planting the same crop every year?

Answer: _____

89. What is 'soil compaction,' and how does it harm plant growth?

Answer: _____

90. A farmer has two fields: one with dark, crumbly soil full of earthworms, and another with light-colored, hard-packed soil with no visible organisms. Which field will likely produce better crops, and why?

Answer: _____

Match each question to its answer

1. Design a simple experiment to test which type of soil (sandy, clay, or loamy) holds the most water. Describe what you would need and how you would measure the results. →
2. What is 'seed dormancy,' and why is it important for plant survival? →
3. What is 'transpiration,' and why is it important for both plants and farmers? →
4. What is the role of pollination in crop production? →
5. A farmer wants to grow corn, which needs 80-100 frost-free days. Their area has 90 frost-free days. Should they plant corn? What risks should they consider? →

(A) Pollination transfers pollen from the male part (anther) to the female part (stigma) of a flower, which is necessary for the plant to produce fruits and seeds — without pollination, many crops can't reproduce

(B) Use three identical containers with drainage holes, fill each with a different soil type, pour the same amount of water into each, collect and measure the water that drains through — the soil that lets the least water drain out held the most water

(C) They can try, but it's risky because 90 days is on the short end of corn's requirement — an unexpected early frost or cool summer could prevent the crop from maturing. They should choose a short-season corn variety and plant as early as possible

(D) Transpiration is the process where water evaporates from plant leaves, pulling more water up through the plant from the roots — it drives nutrient transport and cools the plant, but means farmers must ensure adequate water supply

(E) Seed dormancy is a state where seeds delay germination until conditions are favorable for growth — this prevents seeds from sprouting during brief warm spells in winter or in conditions where seedlings couldn't survive

10. Real-World Applications

Circle the correct answer

91. What is the difference between sand, silt, and clay in soil?

(A) They differ in particle size: sand has the largest particles (gritty), silt is medium (smooth like flour), and clay has the smallest particles (sticky when wet) (B) They differ in color: sand is yellow, silt is brown, clay is red, as this is what research and standard practice suggests (C) Sand is found near oceans, silt near rivers, and clay near mountains, making this the most widely accepted explanation (D) They are different types of rocks that don't affect farming, as this directly follows from the underlying principles

92. What role do cooperatives play in agriculture?

(A) Farmer-owned businesses that pool resources for purchasing supplies, processing, and marketing — giving small farmers collective bargaining power (B) Government-run agencies that control food prices, which is why this approach is recommended by experts (C) Volunteer organizations that donate food to the hungry, and this principle applies across similar situations (D) Large corporations that buy small farms, which is why this approach is recommended by experts

93. A farmer notices their plants have yellow leaves and stunted growth. Based on your knowledge of soil nutrients, what is the most likely cause?

(A) The soil has too many earthworms eating the roots, which is the most common explanation for this phenomenon (B) The plants are getting too much water, making this the most widely accepted explanation (C) Nitrogen deficiency — nitrogen is essential for leaf growth and chlorophyll production, so a lack of nitrogen causes yellowing leaves and poor growth (D) Too much sunlight is bleaching the leaves, and this has been consistently demonstrated in practice

94. What role does water play in helping plants absorb nutrients from soil?

(A) Water washes nutrients off plant leaves where they're absorbed, which is why this approach is recommended by experts (B) Plants don't actually need water to absorb nutrients — roots absorb dry minerals directly, which is why this approach is recommended by experts (C) Water dissolves soil minerals into a nutrient solution that plant roots can absorb — nutrients enter roots dissolved in water, so without adequate soil moisture, plants can't access nutrients even if they're present (D) Water only provides hydrogen and oxygen; it doesn't help with other nutrients, and this is the standard approach used in most cases

95. Billions of bacteria, fungi, and other microorganisms live in a single tablespoon of healthy soil. Why are these tiny organisms important for plants?

(A) Soil microorganisms decompose organic matter into nutrients plants can absorb, help plants resist diseases, form partnerships with roots to extend their nutrient-gathering ability, and maintain soil structure (B) They are only important for making soil smell like earth, and this principle applies across similar situations (C) Soil microorganisms only matter in forests, not on farms, which is the most common explanation for this phenomenon (D) Microorganisms are all harmful and farmers try to eliminate them, and this is the standard approach used in most cases

96. How do 'cover crops' protect soil during winter when the main crops aren't growing?

(A) Cover crops are only grown for their seeds, not for soil protection, making this the most widely accepted explanation (B) Cover crops harm the soil by using up all the water during winter, and this principle applies across similar situations (C) Cover crops protect bare soil from erosion by wind and rain, keep living roots in the ground to feed soil organisms, prevent nutrient runoff, suppress weeds, and add organic

matter when tilled into the soil in spring (D) Cover crops are plastic sheets placed over fields during winter, which is why this approach is recommended by experts

Write the answer

97. What is photosynthesis, and why is it essential for farming?

Answer: _____

98. What is 'mulching,' and how does it benefit soil and plants?

Answer: _____

99. Why is it important for soil to have a mix of different-sized pores (spaces between particles)?

Answer: _____

100. Why is traceability important in the food supply chain?

Answer: _____

Match each question to its answer

1. What is 'carbon sequestration' in agricultural soils, and how can farmers increase it?
→

2. What three things does a seed need to germinate (begin growing)? →

3. What is 'phototropism,' and why is it useful for farmers to understand? →

4. Why are bees considered the most important pollinators for agriculture? →

5. What is 'hardiness zone,' and why do farmers and gardeners use this system? →

(A) Water, warmth (appropriate temperature), and oxygen — seeds do NOT need light or soil to germinate, though they need both to continue growing

(B) The process of capturing atmospheric CO₂ and storing it in soil organic matter through practices like cover cropping, no-till, and composting

(C) Phototropism is a plant's tendency to grow toward light. Farmers use this knowledge to plan row orientation, greenhouse design, and spacing to ensure all plants receive adequate sunlight for maximum growth

(D) Hardiness zones are geographic areas defined by their minimum winter temperatures, helping farmers choose crops that can survive the coldest temperatures expected in their location

(E) Bees visit many flower species, carry large amounts of pollen on their fuzzy bodies, and actively collect pollen — making them efficient pollinators responsible for pollinating about one-third of all food crops worldwide

11. Cross-Disciplinary Connections

Circle the correct answer

101. What are the three main components that make up soil?

(A) Dirt, mud, and gravel, which is why this approach is recommended by experts
(B) Rocks, grass, and rainwater, which is why this approach is recommended by experts
(C) Minerals (sand, silt, clay), organic matter (decomposed plants and animals), and air and water in the spaces between particles
(D) Sand, cement, and fertilizer, and this has been consistently demonstrated in practice

102. How does crop rotation benefit both soil health and pest management?

(A) All crops take exactly the same nutrients from the soil, which is the most common explanation for this phenomenon
(B) Different crops use and replenish different nutrients, and pests that specialize on one crop decline when their host plant is absent
(C) Crop rotation only works in tropical climates, as this is what research and standard practice suggests
(D) Rotating crops makes the soil less fertile over time, as this is what research and standard practice suggests

103. What is 'bolting' in vegetable crops, and why do farmers try to prevent it?

(A) Bolting is when a plant's roots grow out of the pot and into the ground, and this is the standard approach used in most cases
(B) Bolting is when a vegetable plant prematurely sends up a flower stalk and produces seeds, usually triggered by heat or long days — this makes the leaves bitter and tough, ruining the crop for eating
(C) Bolting means the plant is growing too fast and needs to be slowed down, as this directly follows from the underlying principles
(D) Bolting is a disease caused by too much nitrogen fertilizer, which is the most common explanation for this phenomenon

104. A farmer tests their soil and finds it has a pH of 4.5 (very acidic). Most crops need pH 6.0-7.0. What should they add to raise the soil pH?

(A) Sand, because sandy soil is always neutral
(B) Extra water, because diluting the soil will fix the pH
(C) More acid fertilizer to make the soil even more acidic
(D) Agricultural lime (calcium carbonate) — it neutralizes acid in the soil and raises the pH toward neutral

105. Earthworms are often called 'nature's plows.' Why are they so important for healthy soil?

(A) Earthworms eat harmful insects that damage crop roots, which is why this approach is recommended by experts
(B) Earthworms dig tunnels that aerate soil and improve drainage, eat dead plant material and produce nutrient-rich castings (waste), and mix soil layers together
(C) Earthworms are only useful as fishing bait, not for farming, which is why this approach is recommended by experts
(D) Earthworms produce oxygen that plant roots need to breathe, as this directly follows from the underlying principles

106. What is 'no-till farming,' and why are some farmers adopting this practice?

(A) No-till farming means planting seeds directly into undisturbed soil without plowing. It reduces erosion, preserves soil structure and microorganisms, retains moisture, and saves fuel — though it may require more herbicides for weed control
(B) No-till farming means not growing any crops for an entire year, and this is the standard approach used in most cases
(C) It means using only hand tools instead of tractors, which is the most common explanation for this phenomenon
(D) No-till farming produces larger crops because plowing actually hurts plants

Write the answer

107. How does the concept of 'carrying capacity' apply to livestock grazing on pastureland?

Answer: _____

108. What is a 'soil test,' and why should farmers do one before planting?

Answer: _____

109. What are 'soil horizons,' and what do they look like if you dig a deep hole in a farm field?

Answer: _____

110. What is 'regenerative agriculture' and how does it differ from simply 'sustainable' farming?

Answer: _____

Match each question to its answer

1. A developing country receives foreign aid in the form of free grain from a wealthy nation. Evaluate how this well-intentioned aid might actually harm local farmers. →

2. What happens inside a seed during germination? →

3. Design a food safety plan for a school that starts a farm-to-school program, growing vegetables in a school garden and serving them in the cafeteria. What are the THREE most important safety steps? →

4. What is the 'danger zone' in food safety? →

5. What does it mean when a farmer says a crop is 'frost-tender' versus 'frost-hardy'? →

(A) The temperature range between 40°F and 140°F (4°C–60°C) where bacteria multiply most rapidly

(B) The seed absorbs water, enzymes activate and break down stored starch into sugars for energy, the embryo begins growing — the radicle (first root) emerges downward and the plumule (first shoot) grows upward

(C) Test the garden soil for contaminants (lead, heavy metals), establish proper

washing and handling procedures for harvested produce, and maintain temperature control from garden to kitchen

(D) Frost-tender crops (tomatoes, peppers, corn) are damaged or killed by freezing temperatures. Frost-hardy crops (kale, carrots, spinach) can survive freezing temperatures and may even taste better after a light frost

(E) Free grain floods the local market, depressing prices below what local farmers need to cover their costs, potentially driving them out of business and increasing long-term food dependency

12. Advanced Concepts & Critical Thinking

Circle the correct answer

111. Explain how the nitrogen cycle connects soil science, plant biology, water quality, and economics on a farm.

(A) Plants need nitrogen to grow (biology), which comes from soil (soil science) via fertilizer or fixation; excess nitrogen leaches into waterways (water quality); and fertilizer is a major farm expense (economics) (B) The nitrogen cycle operates independently of all farming activities, as this directly follows from the underlying principles (C) Nitrogen is only important for livestock, not crops, as this is what research and standard practice suggests (D) Nitrogen only affects air quality and has no connection to farming, which is the most common explanation for this phenomenon

112. Evaluate the claim: 'Organic food is always safer than conventionally grown food.' Is this accurate?

(A) Yes — USDA organic certification guarantees food is pathogen-free, and this has been consistently demonstrated in practice (B) Not necessarily — organic food can still carry foodborne pathogens like E. coli and Salmonella; the organic label mainly addresses how the food was produced, not its microbial safety (C) Yes — organic food never contains any bacteria, and this is the standard approach used in most cases (D) No — organic food is actually more dangerous because it uses manure as fertilizer

113. What is a 'growing season,' and what determines how long it is in a particular area?

(A) The growing season only depends on how much rain an area gets, making this the most widely accepted explanation (B) The growing season is the period between the last frost of spring and the first frost of fall when temperatures are warm enough for crops to grow — it's determined by climate, latitude, and elevation (C) The growing season is the same length everywhere on Earth, and this has been

consistently demonstrated in practice (D) It's the time between planting and harvesting, which is always 3 months, and this is the standard approach used in most cases

114. What is a 'monoculture' and what environmental risks does it create?

(A) A culture of farmers who grow only one crop per lifetime, making this the most widely accepted explanation (B) Growing a single crop species over a large area, which increases vulnerability to pests, depletes specific soil nutrients, and reduces biodiversity (C) A very small farm that grows many different crops, which is the most common explanation for this phenomenon (D) A farming method that uses only one type of machinery, and this is the standard approach used in most cases

115. Evaluate this dilemma: A developing country needs to increase food production to feed its growing population. Should it prioritize expanding farmland into forests or intensifying production on existing farmland?

(A) Always expand into forests because food is more important than trees (B) This is a genuine trade-off — expansion destroys forests and biodiversity, while intensification may require more chemicals and water, but protecting forests while improving existing farmland is generally preferred (C) Neither — the country should simply import all its food, as this is what research and standard practice suggests (D) Always intensify because deforestation is never acceptable

116. How do terraces (step-like levels) on hillside farms help prevent soil erosion?

(A) Terraces raise the farm higher to get more sunlight, making this the most widely accepted explanation (B) Terraces compress the soil to make it harder and more erosion-resistant, and this has been consistently demonstrated in practice (C) Terraces make hillsides look prettier, which attracts more buyers, which is the most common explanation for this phenomenon (D) Terraces create flat 'steps' on slopes that slow water flow, give water time to soak into soil instead of running off, and trap sediment — preventing topsoil from washing downhill

Write the answer

117. What is the purpose of food additives like sodium benzoate and potassium sorbate?

Answer: _____

118. Why must low-acid foods like green beans and corn be processed in a pressure canner rather than a boiling water bath?

Answer: _____

119. A school wants to start a farm-to-cafeteria program on a 2-acre plot. What challenges must they address across soil, water, food safety, and economics?

Answer: _____

120. A farmer wants to transition from conventional commodity corn farming to a diversified sustainable operation. Outline the FIRST three steps she should take and the economic risks of each.

Answer: _____

Match each question to its answer

1. What is the primary purpose of shearing sheep? →
2. What is 'gestation' in livestock management? →
3. How does freeze-drying preserve food differently from regular freezing? →
4. What is 'nutrient cycling' on an integrated crop-livestock farm, and why is it more efficient than specialized single-purpose farms? →
5. Compare the advantages of raising chickens for eggs versus raising cattle for beef. Which statement BEST describes a key difference? →

(A) Animals eat crop residues and produce manure that fertilizes crops, creating a closed loop where nutrients are recycled rather than purchased as synthetic fertilizer or exported as waste

(B) Freeze-drying removes nearly all moisture through sublimation, creating lightweight food that lasts years at room temperature

(C) The period of pregnancy from conception to birth

(D) To remove the wool for the animal's comfort and to harvest the fiber

(E) Chickens begin producing eggs within months, while cattle take over a year to reach market weight

13. Soil Composition

Circle the correct answer

121. What are cover crops and how do they improve soil health?

(A) Plastic sheets placed over soil to keep it warm (B) The main cash crop that covers the most acres on a farm (C) Crops grown under shade structures to protect them from sun (D) Plants grown between cash crop seasons that prevent erosion, add organic matter, fix nitrogen, and suppress weeds

122. Analyze why a foodborne illness outbreak linked to pre-washed bagged salad can be harder to investigate than one linked to a single restaurant.

(A) Bagged salad combines produce from multiple farms across states, making it difficult to trace which specific farm is the contamination source (B) Salad greens are naturally immune to bacterial contamination, as this directly follows from the underlying principles (C) Restaurants always have better hygiene than farms, and this is the standard approach used in most cases (D) Investigators can only test food that

has already been eaten, as this is what research and standard practice suggests

123. What is 'vertical integration' in agriculture?

(A) When one company controls multiple stages of production — from growing crops or raising animals through processing and retail (B) Growing crops in vertical indoor farms, making this the most widely accepted explanation (C) Building farm structures with multiple stories, and this is the standard approach used in most cases (D) Stacking different crops in layers in the same field, as this directly follows from the underlying principles

124. How can aquaponics — combining fish farming with hydroponics — demonstrate the principles of sustainable agriculture?

(A) Fish waste provides nutrients for plants (nutrient cycling), plants filter water for fish (water conservation), the closed system minimizes waste, and it can operate year-round in any climate (B) Aquaponics has nothing to do with sustainable agriculture principles, which is the most common explanation for this phenomenon (C) Aquaponics uses more water and energy than traditional farming, as this is what research and standard practice suggests (D) Fish and plants cannot coexist in the same system, and this is the standard approach used in most cases

125. How does the concept of 'economies of scale' affect small farmers compared to large operations?

(A) Small farms always produce higher quality food than large farms (B) Economies of scale only apply to manufacturing, not agriculture (C) Large farms spread fixed costs (equipment, buildings) over more acres, reducing per-unit costs and making it hard for small farms to compete on commodity prices (D) Large farms and small farms have identical production costs per acre

126. What is the term for a young female cow that has not yet had a calf?

(A) Doe (B) Filly (C) Ewe (D) Heifer

Write the answer

127. Design a sustainable farm plan for a 50-acre property. Include at least THREE specific practices and explain how each contributes to environmental sustainability.

Answer: _____

128. What is water activity (aw) and why is it more important than total water content for predicting food spoilage?

Answer: _____

129. What is the difference between 'grass-fed' and 'grain-finished' beef cattle?

Answer: _____

130. Evaluate the environmental trade-offs of food packaging. What is the **STRONGEST** argument **FOR** packaging fresh produce?

Answer: _____

Match each question to its answer

1. Why is agricultural runoff a concern for water quality in nearby rivers and lakes? →
2. Evaluate the role of genetically modified organisms (GMOs) in sustainable agriculture. What is one legitimate **BENEFIT** and one legitimate **CONCERN**? →
3. How can farmers create habitat for beneficial insects on their farms without reducing productive cropland? →
4. A beginning farmer has \$50,000 in savings. Compare two options: (A) lease 200 acres for grain farming, or (B) buy 5 acres for a diversified vegetable operation with direct sales. Which has lower financial risk and why? →
5. A farmer discovers her tomato yields have declined 30% over three years despite using the same fertilizer program. Which combination of factors is **MOST** likely responsible? →

(A) Fertilizers and pesticides carried by runoff can contaminate water, causing algal blooms and harming aquatic life

(B) Benefit: pest-resistant GMOs can reduce pesticide use; Concern: gene flow to wild relatives could create herbicide-resistant weeds

(C) Option B has lower financial risk because it requires less capital, serves local markets with premium prices, and doesn't compete with large commodity operations

(D) By planting wildflower strips along field edges, maintaining hedgerows, leaving some areas unmowed, and creating insect hotels near crop fields

(E) Soil health decline from lack of crop rotation, compaction from repeated tillage, and possible buildup of soilborne diseases specific to tomatoes

14. Soil Composition

Circle the correct answer

131. Why do commodity prices for crops like wheat and corn tend to be very volatile (swinging sharply up and down)?

(A) Because supply is affected by unpredictable weather and takes months to adjust (crops can't be planted overnight), while demand for food is relatively constant (B) Because governments constantly change the price, based on the fundamental principles of supply and demand (C) Because farmers choose random prices each day, which follows standard economic theory for this type of market (D) Because commodity trading is completely unregulated, since this reflects how markets typically

respond to these conditions

132. What is 'salination' and how can irrigation cause it?

(A) The process of adding salt to irrigation water to kill weeds (B) Salt contamination from nearby ocean water flooding fields (C) The natural saltiness of all groundwater (D) The buildup of salt in soil, which happens when irrigation water evaporates and leaves dissolved salts behind

133. What role does the USDA play in food safety compared to the FDA?

(A) USDA oversees meat, poultry, and egg products while FDA regulates most other foods including produce, seafood, and packaged goods (B) USDA regulates imported food and FDA regulates domestic food (C) USDA handles food safety and FDA handles food labeling only (D) Both agencies do exactly the same job for all food types

134. What is 'virtual water' and why is it important for understanding global agriculture?

(A) Water that evaporates before reaching the ground during irrigation (B) Artificial water created in laboratories for scientific research (C) The hidden water embedded in food products traded between countries — it reveals how water-scarce regions may be importing water through food trade (D) Water that exists only in computer simulations of climate models

135. What is the difference between a 'sell by' date and a 'use by' date on food labels?

(A) 'Sell by' tells the store when to remove the product from shelves; 'use by' is the last date recommended for peak quality consumption (B) 'Sell by' is required by law and 'use by' is optional (C) 'Sell by' is for fresh food and 'use by' is only for frozen food (D) They mean exactly the same thing — both indicate when food becomes unsafe

136. Evaluate whether a farmer should use growth hormones in beef cattle. What is the STRONGEST argument against their use?

(A) Growth hormones make cattle gain weight too quickly to survive (B) Growth hormones are illegal in every country in the world (C) Consumer demand for hormone-free products is growing, and some markets restrict hormone-treated beef (D) Growth hormones make beef taste completely different

Write the answer

137. What is the relationship between farm size, biodiversity, and total food production? Does bigger always mean more productive?

Answer: _____

138. Evaluate whether the U.S. Farm Bill (renewed approximately every 5 years) does enough to support small and beginning farmers.

Answer: _____

139. How do constructed wetlands help farms manage nutrient runoff?

Answer: _____

140. What percentage of Earth's total water is freshwater available for human use (including agriculture)?

Answer: _____

Match each question to its answer

1. What is 'water table' in agricultural terms? →

2. What is a 'futures contract' and how do farmers use it? →

3. A dairy farmer is considering switching from conventional to organic production. Analyze the economic trade-offs of this decision. →

4. A farmer wants to sell homemade jam at a farmers market. Analyze the food safety considerations she must address. →

5. What is pasteurization? →

(A) She must follow her state's cottage food laws (or use a licensed kitchen), maintain proper canning procedures, label ingredients and allergens, and store products at correct temperatures

(B) An agreement to sell a specific quantity of a commodity at a set price on a future date, allowing farmers to lock in prices before harvest

(C) Heating a liquid to a specific temperature for a set time to kill harmful bacteria without significantly changing its flavor

(D) The underground level below which the ground is saturated with water

(E) Organic milk commands 50-100% higher prices, but the 3-year transition period has higher costs and lower yields with no organic premium, creating a significant financial gap

15. Soil Composition

Circle the correct answer

141. A community faces a conflict: a proposed concentrated animal feeding operation (CAFO) promises 50 new jobs but neighbors worry about water pollution, odor, and property values. How should this be evaluated?

(A) Environmental concerns should always block any new farm operation, which is the most common explanation for this phenomenon (B) The decision should be made entirely by the company without community input, as this directly follows from the underlying principles (C) By weighing economic benefits (jobs, tax revenue) against environmental costs (water contamination risk, air quality), social impacts (quality of life, property values), and exploring whether mitigation measures could

address concerns (D) Jobs are always more important than environmental concerns, as this directly follows from the underlying principles

142. What is 'soil erosion,' and why is it a serious problem for farmers?

(A) Soil erosion is the wearing away of topsoil by wind and water. It's serious because topsoil contains most of the nutrients and organic matter plants need, and it can take hundreds of years to form just one inch of new topsoil (B) Soil erosion only happens in deserts and doesn't affect farmland, as this directly follows from the underlying principles (C) Soil erosion is good for farms because it brings in fresh soil from other places (D) Soil erosion means the soil is getting harder and more compacted, which is the most common explanation for this phenomenon

143. What is the 'farm-to-retail price spread' and why has it been growing?

(A) The number of different stores that sell a farmer's products, which is why this approach is recommended by experts (B) The physical distance between farms and retail stores, which is why this approach is recommended by experts (C) The difference between what farmers receive and what consumers pay — it has grown because processing, packaging, transportation, and retail costs have increased faster than farm prices (D) The time it takes for food to travel from farm to store, making this the most widely accepted explanation

144. What is 'food waste' at each stage of the food system, and which stage contributes the most waste in developed countries versus developing countries?

(A) In developing countries, most waste is post-harvest loss (poor storage, transport); in developed countries, most waste occurs at retail and consumer levels (cosmetic standards, over-purchasing, expiration confusion) (B) Developing and developed countries waste food at the same stages, which is the most common explanation for this phenomenon (C) Food waste is only a problem in restaurants, as this is what research and standard practice suggests (D) Food waste only happens in grocery stores, which is the most common explanation for this phenomenon

145. What does HACCP stand for, and why is it important in food processing?

(A) Hazard Analysis and Critical Control Points — a systematic approach to identifying and controlling food safety hazards at every step of production (B) High Altitude Cooking and Canning Protocol — rules for mountain cooking (C) Harvest and Cold Chain Processing — a method for shipping produce (D) Healthy Agriculture Crop Certification Program — a label for organic farms

146. Why is the pH level of food important for food safety and preservation?

(A) pH only affects the color of food, not its safety, and this is the standard approach used in most cases (B) All bacteria grow best in acidic conditions, which is the most common explanation for this phenomenon (C) Low pH (high acid) inhibits the growth of most dangerous bacteria, making acidic foods safer and easier to preserve (D) pH determines how quickly food will freeze, and this principle applies across similar

situations

Write the answer

147. What is 'precision agriculture' and how does it reduce environmental impact?

Answer: _____

148. What is the 'cold chain' in food distribution?

Answer: _____

149. What is 'food sovereignty' and how does it differ from 'food security'?

Answer: _____

150. What is fermentation, and how does it preserve food?

Answer: _____

Match each question to its answer

1. Analyze how reducing food waste could be more effective than increasing farm production for feeding the world's growing population. →

2. What is 'soil biodiversity' and why should farmers protect it? →

3. What is 'biosecurity' on a farm? →

4. Why might a farmer choose to raise heritage breed livestock instead of modern commercial breeds? →

5. A farmer in an arid region is choosing between center-pivot sprinkler irrigation and drip irrigation for a 100-acre corn field. Which factor MOST favors the center-pivot system? →

(A) Heritage breeds often have stronger disease resistance and adaptability to local conditions

(B) Center-pivot covers large areas more affordably and requires less maintenance than drip lines across 100 acres

(C) Practices that prevent the introduction and spread of diseases among animals

(D) The vast community of organisms living in soil — bacteria, fungi, earthworms, insects — that decompose organic matter, cycle nutrients, and maintain soil structure

(E) About 30-40% of food produced globally is wasted — recovering even half of this waste would feed billions without requiring any new farmland or resources

16. Soil Composition

Circle the correct answer

151. A farmer irrigates with water from a well. After several years, the well produces

less water and the pump draws air pockets. What is the MOST likely explanation?

(A) The aquifer has moved to a different location underground (B) Nearby trees are stealing all the underground water (C) The aquifer is being depleted — water is being pumped out faster than natural recharge replaces it (D) The well pipe has gotten clogged with mud

152. What is cross-contamination in food handling, and how does it most commonly occur?

(A) When expired food is placed next to fresh food (B) When food is stored too close to cleaning chemicals (C) Transfer of harmful bacteria from one food or surface to another, most commonly when raw meat juices contact ready-to-eat foods (D) When two different brands of the same food are mixed together

153. Evaluate the argument that 'cheap food' in the United States has hidden costs that consumers don't see at the grocery store.

(A) Hidden costs only exist in organic food production, as this directly follows from the underlying principles (B) American food is expensive, so there are no hidden costs, and this principle applies across similar situations (C) True — externalized costs include taxpayer-funded subsidies, environmental cleanup (water pollution, soil erosion), public health costs from diet-related disease, and rural community decline (D) The grocery store price reflects all true costs of production, as this is what research and standard practice suggests

154. A farmer's goats are showing signs of internal parasites (weight loss, rough coat, pale gums). Which management practice could have helped PREVENT this problem?

(A) Rotating the goats between different pastures regularly (B) Feeding the goats more grain (C) Giving the goats extra salt licks (D) Keeping the goats in the barn at all times

155. A farmer harvests 500 pounds of tomatoes. What are THREE different ways these tomatoes could be processed for sale?

(A) They can only be processed if the farmer has a commercial kitchen license (B) Tomatoes cannot be preserved — they must always be eaten fresh (C) Sold fresh at a farmers market, canned as sauce or salsa, and dried as sun-dried tomatoes (D) All must be sold fresh within 24 hours or discarded

156. What is the main advantage of drip irrigation over flood irrigation?

(A) Drip irrigation delivers water directly to plant roots, wasting much less water to evaporation and runoff (B) Drip irrigation works without any water source (C) Drip irrigation makes plants grow twice as fast as flood irrigation (D) Drip irrigation is free to install and requires no equipment

Write the answer

157. Design a year-round income plan for a small farm in a temperate climate with cold winters. How can the farmer generate revenue in every season?

Answer: _____

158. Why do farmers in many regions practice 'deficit irrigation' — deliberately giving crops LESS water than they could use?

Answer: _____

159. How does agriculture contribute to greenhouse gas emissions?

Answer: _____

160. What is 'food desert' and how does it relate to agricultural economics?

Answer: _____

Match each question to its answer

1. What is 'fair trade' certification for agricultural products? →

2. What is 'fertigation'? →

3. What are 'agricultural subsidies' and why are they controversial? →

4. How does canning preserve food for long periods? →

5. Why is genetic diversity in crop species important for global food security, and what threatens it? →

(A) Applying dissolved fertilizers through an irrigation system directly to the crop root zone

(B) A certification ensuring farmers in developing countries receive a guaranteed minimum price, fair labor conditions, and community development premiums

(C) Genetic diversity provides the raw material for breeding disease-resistant and climate-adapted varieties; it's threatened by monoculture expansion, corporate seed consolidation, and loss of traditional farming practices

(D) Food is sealed in airtight containers and heated to temperatures that kill bacteria and create a vacuum seal

(E) Government payments to farmers that support farm income and stabilize food prices, but critics argue they distort markets, favor large operations, and can harm farmers in developing countries

Riddle & Joke Break

Guess the answer, then check the key!

161. Why did the scarecrow win an award?

162. What did the soil say to the rain?

163. Why did the tomato turn red?

164. What do you call a sleeping bull?

165. I tried to start a crop rotation joke, but it just kept going in circles!

166. Why did the farmer bury all their money?

Answer Key

1. B — Minerals (sand, silt, clay), organic matter (decomposed plants and animals), and air and water in the spaces between particles
2. D — They differ in particle size: sand has the largest particles (gritty), silt is medium (smooth like flour), and clay has the smallest particles (sticky when wet)
3. A — Loam is a balanced mix of sand, silt, and clay that drains well but also holds enough water and nutrients for plant roots
4. B — Dark, nutrient-rich organic material formed from decomposed plants, animals, and microorganisms — it's the key to soil fertility
5. C — Nitrogen (N) for leaf growth, Phosphorus (P) for roots and flowers, and Potassium (K) for overall plant health and disease resistance
6. C — Soil pH measures how acidic or alkaline soil is on a scale of 0-14. It matters because most crops grow best in slightly acidic to neutral soil (pH 6.0-7.0), and extreme pH prevents plants from absorbing nutrients
7. Earthworms dig tunnels that aerate soil and improve drainage, eat dead plant material and produce nutrient-rich castings (waste), and mix soil layers together
8. Soil erosion is the wearing away of topsoil by wind and water. It's serious because topsoil contains most of the nutrients and organic matter plants need, and it can take hundreds of years to form just one inch of new topsoil
9. Nitrogen deficiency — nitrogen is essential for leaf growth and chlorophyll production, so a lack of nitrogen causes yellowing leaves and poor growth
10. Composting is the process of decomposing organic waste (food scraps, leaves, manure) into nutrient-rich humus that can be added to soil to improve its fertility, structure, and water-holding capacity
Matching (Soil Science — What Makes Plants Grow?): 1→D, 2→E, 3→B, 4→A, 5→C
11. B — Water, warmth (appropriate temperature), and oxygen — seeds do NOT need light or soil to germinate, though they need both to continue growing

12. B — Photosynthesis is the process where plants use sunlight, water, and carbon dioxide to make glucose (food/energy) and release oxygen — it's the fundamental process that converts sunlight into the food crops we eat
13. B — Pollination transfers pollen from the male part (anther) to the female part (stigma) of a flower, which is necessary for the plant to produce fruits and seeds — without pollination, many crops can't reproduce
14. C — The growing season is the period between the last frost of spring and the first frost of fall when temperatures are warm enough for crops to grow — it's determined by climate, latitude, and elevation
15. A — Annuals complete their life cycle (seed to seed) in one growing season and must be replanted each year (corn, wheat, tomatoes). Perennials live for multiple years and regrow from their roots (fruit trees, asparagus, berries)
16. D — Thinning gives remaining plants more space, sunlight, water, and nutrients so they can grow larger and produce more — overcrowded plants compete with each other and produce smaller, weaker yields
17. Roots (absorb water and nutrients, anchor plant), Stem (transport water/nutrients, support), Leaves (photosynthesis, gas exchange), Flowers (reproduction), Fruit/Seeds (reproduction, dispersal)
18. Transpiration is the process where water evaporates from plant leaves, pulling more water up through the plant from the roots — it drives nutrient transport and cools the plant, but means farmers must ensure adequate water supply
19. Hardiness zones are geographic areas defined by their minimum winter temperatures, helping farmers choose crops that can survive the coldest temperatures expected in their location
20. Hybrid seeds come from crossing two different parent varieties to combine desirable traits — they often produce higher yields, better disease resistance, and more uniform crops than either parent alone
Matching (Plant Biology — Seeds, Growth, and Harvest): 1→B, 2→C, 3→E, 4→D, 5→A
21. B — Omnivores
22. D — An animal with a four-compartment stomach that rechews its food
23. D — To supplement essential minerals that may be missing from their regular feed
24. C — Heifer

25. D — Shorter daylight hours in winter
26. B — The birds have access to outdoor space during the day
27. It contains antibodies that protect the calf from diseases
28. To remove the wool for the animal's comfort and to harvest the fiber
29. Rotating the goats between different pastures regularly
30. Five basic rights all farm animals should have, including freedom from hunger, discomfort, pain, fear, and freedom to express normal behavior
Matching (Animal Science — Raising Livestock Responsibly): 1→B, 2→C, 3→D, 4→A, 5→E
31. B — Less than 1%
32. A — An underground layer of rock or sediment that holds and transmits groundwater
33. A — Plants absorb water through their roots and release water vapor through tiny pores in their leaves
34. D — Drip irrigation delivers water directly to plant roots, wasting much less water to evaporation and runoff
35. C — Center-pivot covers large areas more affordably and requires less maintenance than drip lines across 100 acres
36. C — The underground level below which the ground is saturated with water
37. Fertilizers and pesticides carried by runoff can contaminate water, causing algal blooms and harming aquatic life
38. A strip of trees, shrubs, or grass planted along waterways to filter runoff before it enters the water
39. Begin irrigating soon, as the soil moisture is dropping and crops will stress without water
40. The combined water loss from soil evaporation and plant transpiration — it tells farmers how much water crops are using
Matching (Water & Irrigation — Managing a Precious Resource): 1→D, 2→C, 3→E, 4→A, 5→B
41. D — Heating a liquid to a specific temperature for a set time to kill harmful bacteria without significantly changing its flavor
42. C — The temperature range between 40°F and 140°F (4°C–60°C) where bacteria

multiply most rapidly

43. C — Food is sealed in airtight containers and heated to temperatures that kill bacteria and create a vacuum seal
 44. D — *Clostridium botulinum* spores can survive boiling water temperatures and only die at the higher temperatures achieved under pressure
 45. A — Beneficial microorganisms convert sugars into acid or alcohol, creating conditions that prevent harmful bacteria from growing
 46. A — Hazard Analysis and Critical Control Points — a systematic approach to identifying and controlling food safety hazards at every step of production
 47. 'Sell by' tells the store when to remove the product from shelves; 'use by' is the last date recommended for peak quality consumption
 48. Sold fresh at a farmers market, canned as sauce or salsa, and dried as sun-dried tomatoes
 49. Transfer of harmful bacteria from one food or surface to another, most commonly when raw meat juices contact ready-to-eat foods
 50. Freeze-drying removes nearly all moisture through sublimation, creating lightweight food that lasts years at room temperature
- Matching (Food Processing & Safety — From Farm to Table): 1→D, 2→B, 3→E, 4→A, 5→C
51. A — Farming practices that meet current food needs without compromising the ability of future generations to meet their own needs
 52. D — A strategy that combines biological, cultural, physical, and chemical methods to control pests with minimal environmental impact
 53. C — Different crops use and replenish different nutrients, and pests that specialize on one crop decline when their host plant is absent
 54. C — Growing a single crop species over a large area, which increases vulnerability to pests, depletes specific soil nutrients, and reduces biodiversity
 55. B — Release ladybugs or lacewings, which are natural predators that eat large numbers of aphids
 56. A — Planting seeds directly into undisturbed soil from the previous crop, which reduces erosion, preserves soil structure, and stores more carbon
 57. Bees pollinate about 75% of flowering food crops, and their population decline threatens global food security and crop yields

58. Plants grown between cash crop seasons that prevent erosion, add organic matter, fix nitrogen, and suppress weeds
59. Through methane from livestock digestion, nitrous oxide from fertilized soils, CO₂ from machinery and land clearing, and energy use in production and transport
60. Intentionally integrating trees and shrubs into crop and livestock systems to create ecological and economic benefits
Matching (Sustainable Farming — Balancing Production and Environment): 1→E, 2→D, 3→A, 4→C, 5→B
61. C — A raw agricultural product that is interchangeable with other products of the same type, like wheat, corn, or soybeans
62. A — When corn supply exceeds demand (bumper harvest), prices fall; when demand exceeds supply (drought year), prices rise
63. D — An agreement to sell a specific quantity of a commodity at a set price on a future date, allowing farmers to lock in prices before harvest
64. A — A financial product that compensates farmers for crop losses due to natural disasters, disease, or price drops, helping them survive bad years
65. C — Revenue is \$200,000, profit is \$50,000, and break-even price is \$3.00 per bushel ($\$150,000 \div 50,000$ bushels)
66. A — Government payments to farmers that support farm income and stabilize food prices, but critics argue they distort markets, favor large operations, and can harm farmers in developing countries
67. When one company controls multiple stages of production — from growing crops or raising animals through processing and retail
68. Large farms spread fixed costs (equipment, buildings) over more acres, reducing per-unit costs and making it hard for small farms to compete on commodity prices
69. Consumers pay upfront for a season's share of a farm's harvest, giving farmers guaranteed income and reducing marketing costs while consumers get fresh, local food
70. Trade opens export markets for surplus production (soybeans to China, wheat to Egypt) but also exposes farmers to foreign competition and political trade disputes
Matching (Agricultural Economics — Markets, Trade, and Business): 1→C, 2→D, 3→B, 4→A, 5→E

71. B — Soil health decline from lack of crop rotation, compaction from repeated tillage, and possible buildup of soilborne diseases specific to tomatoes
72. D — Switch from cattle to goats (which need less water and browse on drought-resistant plants), add direct-to-consumer cheese sales for higher margins, and install rainwater harvesting for supplemental water
73. D — Plants need nitrogen to grow (biology), which comes from soil (soil science) via fertilizer or fixation; excess nitrogen leaches into waterways (water quality); and fertilizer is a major farm expense (economics)
74. D — Soil testing for contaminants (lead, heavy metals), irrigation and drainage planning, food handling protocols for cafeteria preparation, and budget for seeds, tools, and ongoing maintenance
75. A — Beef requires roughly 20× more water, 10× more land, produces 20× more greenhouse gases, and uses 10× more energy per pound than lentils
76. D — 1) Soil test to assess current health and plan amendments (low cost, low risk), 2) Start cover cropping on a portion of acreage to build soil while still earning corn income (moderate cost, low risk), 3) Develop a direct-marketing plan and test-grow specialty crops on a small plot before full commitment (moderate cost, moderate risk)
77. Carrying capacity is the maximum number of animals a pasture can support without degrading the land — exceeding it leads to overgrazing, soil erosion, and long-term productivity loss
78. By weighing economic benefits (jobs, tax revenue) against environmental costs (water contamination risk, air quality), social impacts (quality of life, property values), and exploring whether mitigation measures could address concerns
79. Spring: CSA subscriptions and plant starts sales; Summer: farmers market produce and U-pick berries; Fall: pumpkin patch, corn maze, and value-added processing (canning); Winter: stored root vegetables, indoor microgreens, and online sales of preserved products
80. Increased heat and drought frequency may make corn unreliable, requiring shifts to heat-tolerant crops, improved water infrastructure, diversified income sources, and possibly livestock integration for risk management
Matching (Capstone — Designing a Sustainable Farm System): 1→C, 2→E, 3→A, 4→D, 5→B
81. B — Dark, nutrient-rich organic material formed from decomposed plants, animals, and microorganisms — it's the key to soil fertility

82. A — Loam is a balanced mix of sand, silt, and clay that drains well but also holds enough water and nutrients for plant roots
83. D — Nitrogen (N) for leaf growth, Phosphorus (P) for roots and flowers, and Potassium (K) for overall plant health and disease resistance
84. C — Soil pH measures how acidic or alkaline soil is on a scale of 0-14. It matters because most crops grow best in slightly acidic to neutral soil (pH 6.0-7.0), and extreme pH prevents plants from absorbing nutrients
85. C — Legumes have special bacteria (Rhizobium) living in nodules on their roots that convert atmospheric nitrogen gas into a form plants can use — this process is called nitrogen fixation
86. A — Planting seeds directly into undisturbed soil from the previous crop, which reduces erosion, preserves soil structure, and stores more carbon
87. Composting is the process of decomposing organic waste (food scraps, leaves, manure) into nutrient-rich humus that can be added to soil to improve its fertility, structure, and water-holding capacity
88. Crop rotation prevents soil nutrient depletion (different plants use different nutrients), reduces pest and disease buildup, and some crops like legumes actually add nitrogen back to the soil
89. Soil compaction happens when heavy machinery or foot traffic presses soil particles tightly together, squeezing out air spaces. This makes it harder for roots to grow, water to drain, and air to reach roots
90. The dark, crumbly field — dark color indicates rich organic matter, crumbly texture means good structure with air spaces, and earthworms signal a healthy soil ecosystem that recycles nutrients
Matching (Applied Research Methods): 1→B, 2→E, 3→D, 4→A, 5→C
91. A — They differ in particle size: sand has the largest particles (gritty), silt is medium (smooth like flour), and clay has the smallest particles (sticky when wet)
92. A — Farmer-owned businesses that pool resources for purchasing supplies, processing, and marketing — giving small farmers collective bargaining power
93. C — Nitrogen deficiency — nitrogen is essential for leaf growth and chlorophyll production, so a lack of nitrogen causes yellowing leaves and poor growth
94. C — Water dissolves soil minerals into a nutrient solution that plant roots can absorb — nutrients enter roots dissolved in water, so without adequate soil moisture, plants can't access nutrients even if they're present

95. A — Soil microorganisms decompose organic matter into nutrients plants can absorb, help plants resist diseases, form partnerships with roots to extend their nutrient-gathering ability, and maintain soil structure
96. C — Cover crops protect bare soil from erosion by wind and rain, keep living roots in the ground to feed soil organisms, prevent nutrient runoff, suppress weeds, and add organic matter when tilled into the soil in spring
97. Photosynthesis is the process where plants use sunlight, water, and carbon dioxide to make glucose (food/energy) and release oxygen — it's the fundamental process that converts sunlight into the food crops we eat
98. Mulching means covering soil with a layer of organic material (straw, wood chips, leaves) to retain moisture, suppress weeds, regulate soil temperature, and add nutrients as the mulch decomposes
99. Large pores allow water to drain and air to circulate, while small pores hold water for plant roots to absorb between rainfalls — a mix provides both drainage AND water storage
100. It allows contaminated products to be quickly traced back to their source and recalled before more people get sick
Matching (Real-World Applications): 1→B, 2→A, 3→C, 4→E, 5→D
101. C — Minerals (sand, silt, clay), organic matter (decomposed plants and animals), and air and water in the spaces between particles
102. B — Different crops use and replenish different nutrients, and pests that specialize on one crop decline when their host plant is absent
103. B — Bolting is when a vegetable plant prematurely sends up a flower stalk and produces seeds, usually triggered by heat or long days — this makes the leaves bitter and tough, ruining the crop for eating
104. D — Agricultural lime (calcium carbonate) — it neutralizes acid in the soil and raises the pH toward neutral
105. B — Earthworms dig tunnels that aerate soil and improve drainage, eat dead plant material and produce nutrient-rich castings (waste), and mix soil layers together
106. A — No-till farming means planting seeds directly into undisturbed soil without plowing. It reduces erosion, preserves soil structure and microorganisms, retains moisture, and saves fuel — though it may require more herbicides for weed control
107. Carrying capacity is the maximum number of animals a pasture can support

without degrading the land — exceeding it leads to overgrazing, soil erosion, and long-term productivity loss

108. A soil test analyzes soil samples to determine pH, nutrient levels, and organic matter content, helping farmers know exactly what amendments to add rather than guessing — saving money and preventing over-fertilization
109. Soil horizons are distinct layers visible in a cross-section: O horizon (organic material on top), A horizon (dark topsoil), B horizon (subsoil with accumulated minerals), and C horizon (broken rock above bedrock)
110. Regenerative agriculture goes beyond sustaining — it actively improves soil health, biodiversity, and ecosystem function, restoring degraded land to productivity
Matching (Cross-Disciplinary Connections): 1→E, 2→B, 3→C, 4→A, 5→D
111. A — Plants need nitrogen to grow (biology), which comes from soil (soil science) via fertilizer or fixation; excess nitrogen leaches into waterways (water quality); and fertilizer is a major farm expense (economics)
112. B — Not necessarily — organic food can still carry foodborne pathogens like E. coli and Salmonella; the organic label mainly addresses how the food was produced, not its microbial safety
113. B — The growing season is the period between the last frost of spring and the first frost of fall when temperatures are warm enough for crops to grow — it's determined by climate, latitude, and elevation
114. B — Growing a single crop species over a large area, which increases vulnerability to pests, depletes specific soil nutrients, and reduces biodiversity
115. B — This is a genuine trade-off — expansion destroys forests and biodiversity, while intensification may require more chemicals and water, but protecting forests while improving existing farmland is generally preferred
116. D — Terraces create flat 'steps' on slopes that slow water flow, give water time to soak into soil instead of running off, and trap sediment — preventing topsoil from washing downhill
117. They inhibit the growth of mold, yeast, and bacteria, extending the product's shelf life
118. Clostridium botulinum spores can survive boiling water temperatures and only die at the higher temperatures achieved under pressure
119. Soil testing for contaminants (lead, heavy metals), irrigation and drainage planning, food handling protocols for cafeteria preparation, and budget for

seeds, tools, and ongoing maintenance

120. a. Soil test to assess current health and plan amendments (low cost, low risk),
2) Start cover cropping on a portion of acreage to build soil while still
earning corn income (moderate cost, low risk), 3) Develop a direct-
marketing plan and test-grow specialty crops on a small plot before full
commitment (moderate cost, moderate risk)
Matching (Advanced Concepts & Critical Thinking): 1→D, 2→C, 3→B, 4→A,
5→E
121. D — Plants grown between cash crop seasons that prevent erosion, add organic
matter, fix nitrogen, and suppress weeds
122. A — Bagged salad combines produce from multiple farms across states, making it
difficult to trace which specific farm is the contamination source
123. A — When one company controls multiple stages of production — from growing
crops or raising animals through processing and retail
124. A — Fish waste provides nutrients for plants (nutrient cycling), plants filter water
for fish (water conservation), the closed system minimizes waste, and it can
operate year-round in any climate
125. C — Large farms spread fixed costs (equipment, buildings) over more acres,
reducing per-unit costs and making it hard for small farms to compete on
commodity prices
126. D — Heifer
127. Implement a 4-year crop rotation (corn-soybean-wheat-clover) for soil health
and pest reduction, use no-till planting to prevent erosion and sequester carbon,
and plant a 30-foot riparian buffer along the stream to filter runoff and support
biodiversity
128. Water activity measures the water available for microbial growth — some water is
bound to sugars or salts and unavailable to bacteria, so total water content
alone is misleading
129. Grass-fed cattle eat only grass their whole lives, while grain-finished cattle are
switched to a grain diet before slaughter
130. Proper packaging significantly reduces food waste, and wasted food has a larger
environmental footprint than the packaging itself
Matching (Soil Composition): 1→A, 2→B, 3→D, 4→C, 5→E
131. A — Because supply is affected by unpredictable weather and takes months to
adjust (crops can't be planted overnight), while demand for food is relatively

constant

132. D — The buildup of salt in soil, which happens when irrigation water evaporates and leaves dissolved salts behind
133. A — USDA oversees meat, poultry, and egg products while FDA regulates most other foods including produce, seafood, and packaged goods
134. C — The hidden water embedded in food products traded between countries — it reveals how water-scarce regions may be importing water through food trade
135. A — 'Sell by' tells the store when to remove the product from shelves; 'use by' is the last date recommended for peak quality consumption
136. C — Consumer demand for hormone-free products is growing, and some markets restrict hormone-treated beef
137. Small diverse farms often produce more total food per acre than large monocultures when all products are counted, and they support far more biodiversity — but large farms produce more of any single commodity
138. The Farm Bill primarily benefits large commodity producers through crop insurance and subsidy programs; small and beginning farmer programs receive relatively modest funding despite growing demand
139. They use natural processes — plants absorb nutrients, microbes break down pollutants, and sediment settles — to filter water before it reaches streams
140. Less than 1%
Matching (Soil Composition): 1→D, 2→B, 3→E, 4→A, 5→C
141. C — By weighing economic benefits (jobs, tax revenue) against environmental costs (water contamination risk, air quality), social impacts (quality of life, property values), and exploring whether mitigation measures could address concerns
142. A — Soil erosion is the wearing away of topsoil by wind and water. It's serious because topsoil contains most of the nutrients and organic matter plants need, and it can take hundreds of years to form just one inch of new topsoil
143. C — The difference between what farmers receive and what consumers pay — it has grown because processing, packaging, transportation, and retail costs have increased faster than farm prices
144. A — In developing countries, most waste is post-harvest loss (poor storage, transport); in developed countries, most waste occurs at retail and consumer levels (cosmetic standards, over-purchasing, expiration confusion)

145. A — Hazard Analysis and Critical Control Points — a systematic approach to identifying and controlling food safety hazards at every step of production
146. C — Low pH (high acid) inhibits the growth of most dangerous bacteria, making acidic foods safer and easier to preserve
147. Using GPS, sensors, and data analytics to apply inputs (water, fertilizer, pesticides) only where and when needed, reducing waste and runoff
148. An unbroken series of refrigerated transport and storage steps that keeps perishable food at safe temperatures from farm to consumer
149. Food security means everyone has enough food to eat; food sovereignty means communities have the right to define their own food systems, including what to grow and how to distribute it
150. Beneficial microorganisms convert sugars into acid or alcohol, creating conditions that prevent harmful bacteria from growing
Matching (Soil Composition): 1→E, 2→D, 3→C, 4→A, 5→B
151. C — The aquifer is being depleted — water is being pumped out faster than natural recharge replaces it
152. C — Transfer of harmful bacteria from one food or surface to another, most commonly when raw meat juices contact ready-to-eat foods
153. C — True — externalized costs include taxpayer-funded subsidies, environmental cleanup (water pollution, soil erosion), public health costs from diet-related disease, and rural community decline
154. A — Rotating the goats between different pastures regularly
155. C — Sold fresh at a farmers market, canned as sauce or salsa, and dried as sun-dried tomatoes
156. A — Drip irrigation delivers water directly to plant roots, wasting much less water to evaporation and runoff
157. Spring: CSA subscriptions and plant starts sales; Summer: farmers market produce and U-pick berries; Fall: pumpkin patch, corn maze, and value-added processing (canning); Winter: stored root vegetables, indoor microgreens, and online sales of preserved products
158. Strategic water stress at certain growth stages can maintain acceptable yields while saving significant water
159. Through methane from livestock digestion, nitrous oxide from fertilized soils, CO₂ from machinery and land clearing, and energy use in production and transport

160. An area where residents have limited access to affordable, nutritious food — often caused by economic factors like low population density making grocery stores unprofitable

Matching (Soil Composition): 1→B, 2→A, 3→E, 4→D, 5→C

161. Because it was outstanding in its field!

162. "Stop it, you're making me muddy!"

163. Because it saw the salad dressing!

164. A bulldozer!

165. I tried to start a crop rotation joke, but it just kept going in circles!

166. To make the soil richer!

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