

Saffronlab — Activity Book

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

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

1. food-science

Circle the correct answer

1. What gas is produced when baking soda and vinegar are mixed together?
(A) Hydrogen (B) Nitrogen (C) Oxygen (D) Carbon dioxide
2. Which of these kitchen ingredients is an acid?
(A) Dish soap (B) Baking soda (C) Lemon juice (D) Egg whites
3. What does pH measure in a substance?
(A) How heavy it is (B) How acidic or basic it is (C) How hot or cold it is (D) How much water it contains
4. Baking soda is a base. What is its scientific name?
(A) Sodium bicarbonate (B) Citric acid (C) Sodium chloride (D) Calcium carbonate
5. Explain why adding lemon juice to milk causes it to curdle.
(A) The lemon juice freezes the milk (B) The lemon juice adds sugar to the milk (C) The acid changes the milk proteins' shape (D) The lemon juice removes water from the milk
6. Describe what happens to red cabbage juice when you add a base like baking soda to it.
(A) It turns bright red (B) It becomes clear like water (C) It stays the same purple color (D) It changes to a blue or green color

Write the answer

7. Why does bread dough rise when baking soda is combined with buttermilk in a recipe?
Answer: _____
8. Explain why a recipe for pancakes might include both baking soda and cream of tartar.
Answer: _____

9. Why does adding vinegar to water when poaching eggs help the egg whites firm up faster?

Answer: _____

10. A recipe calls for 1 teaspoon of baking powder. You only have baking soda. What should you use instead?

Answer: _____

Match each question to its answer

1. You are making a cake and accidentally add too much baking soda. How could you fix the batter? →

2. You want to test whether a kitchen liquid is an acid or a base. Which tool would you use? →

3. A recipe for Irish soda bread uses buttermilk instead of regular milk. Use your knowledge of acids and bases to explain why. →

4. You notice that your cookie dough spread out flat and has a soapy taste. Which ingredient was most likely added in the wrong amount? →

5. Your friend claims that mixing baking soda with water creates a new substance. You disagree. Use evidence to explain who is correct. →

(A) Your friend is mostly wrong — baking soda dissolves in water with only a very minor reaction, unlike mixing it with vinegar which creates a vigorous chemical change

(B) Add a small amount of acid like lemon juice or vinegar

(C) Buttermilk is acidic and reacts with baking soda to create gas for rising

(D) Too much baking soda

(E) pH test strips or red cabbage juice indicator

2. food-science

Circle the correct answer

11. What are the three common states of matter found in a kitchen?

(A) Hot, warm, and cold (B) Frozen, melted, and boiled (C) Heavy, medium, and light (D) Solid, liquid, and gas

12. At what temperature does pure water boil at sea level?

(A) 0 degrees Celsius (32 degrees Fahrenheit) (B) 150 degrees Celsius (302 degrees Fahrenheit) (C) 50 degrees Celsius (122 degrees Fahrenheit) (D) 100 degrees Celsius (212 degrees Fahrenheit)

13. What is the process called when a solid changes directly into a liquid by adding heat?

(A) Condensation (B) Freezing (C) Melting (D) Evaporation

14. What process occurs when steam from a boiling pot hits a cold lid and water droplets form?

(A) Sublimation (B) Melting (C) Evaporation (D) Condensation

15. Explain why chocolate must be melted slowly over gentle heat rather than directly over a high flame.

(A) High heat can burn the cocoa solids and cause the chocolate to seize (B) Chocolate cannot melt at high temperatures (C) High heat makes chocolate melt too quickly to use (D) Gentle heat adds a better flavor to the chocolate

16. Describe what happens to the water molecules inside a pot as the water heats from room temperature to boiling.

(A) The molecules combine into larger molecules (B) The molecules stop moving when the water boils (C) The molecules shrink in size as they get hotter (D) The molecules move faster and farther apart until they escape as steam

Write the answer

17. Why does salt added to water raise its boiling point?

Answer: _____

18. Explain why a popsicle melts faster on a hot day than in a cool room.

Answer: _____

19. Why do cooks sometimes put a lid on a pot when they want water to boil faster?

Answer: _____

20. You are making ice cream at home. Why does adding salt to the ice surrounding the cream container help freeze the cream faster?

Answer: _____

Match each question to its answer

1. A recipe says to bring soup to a 'simmer' rather than a 'full boil.' What is the difference and why does it matter? →

2. You want to cool down a hot bowl of soup quickly for a child. Which method would work fastest? →

3. When you take a tray of ice cubes out of the freezer and leave them on the counter, the ice eventually becomes a puddle of water. Use what you know about states of matter to explain what happened. →

4. A recipe tells you to 'reduce the sauce by half.' What does this mean in terms of

states of matter? →

5. You leave butter on the counter on a warm day and it becomes very soft. Then you put it in the fridge and it becomes firm again. What kind of change is this? →

(A) A reversible physical change — the butter can go back and forth between soft and firm

(B) A simmer has small gentle bubbles; a full boil has large vigorous bubbles that can overcook food

(C) Heat from the room transferred to the ice, giving molecules enough energy to change from solid to liquid

(D) Pour the soup into a wide, shallow container and stir it

(E) Boil or simmer the sauce so that half the water evaporates as steam

3. food-science

Circle the correct answer

21. What two types of molecules react together in the Maillard reaction?

(A) Vitamins and minerals (B) Starch and salt (C) Fats and water (D) Amino acids and reducing sugars

22. At approximately what temperature does the Maillard reaction begin?

(A) About 50 degrees C (122 degrees F) (B) About 100 degrees C (212 degrees F) (C) About 140 degrees C (280 degrees F) (D) About 250 degrees C (482 degrees F)

23. What are melanoidins?

(A) The skin pigment that causes sunburn (B) A preservative added to baked goods (C) Brown-colored compounds produced during the Maillard reaction (D) A type of vitamin found in browned food

24. At what temperature does caramelization of table sugar (sucrose) begin?

(A) About 140 degrees C (280 degrees F) (B) About 300 degrees C (572 degrees F) (C) About 100 degrees C (212 degrees F) (D) About 170 degrees C (340 degrees F)

25. Explain why boiled meat does not develop a brown crust the way grilled or seared meat does.

(A) Boiled meat lacks amino acids needed for browning (B) Water keeps the surface temperature below the Maillard threshold of 140 degrees C (C) The meat cooks too slowly in water to brown (D) Water washes away the brown compounds as they form

26. Describe the difference between the Maillard reaction and caramelization. How can you tell which one is occurring?

(A) Maillard happens at higher temperatures than caramelization (B) Maillard requires proteins and sugars together; caramelization involves only sugar heated above 170 degrees C (C) They are the same reaction with different names (D) Caramelization requires proteins while Maillard does not

Write the answer

27. Why does the Maillard reaction produce hundreds of different flavor compounds while caramelization produces a more limited set?

Answer: _____

28. Explain why onions become sweet when caramelized for a long time over low heat.

Answer: _____

29. Why does brushing bread dough with an egg wash before baking produce a more golden-brown crust?

Answer: _____

30. A chef pats a steak dry with paper towels before searing it in a hot pan. How does this step help the Maillard reaction?

Answer: _____

Match each question to its answer

1. You are making French toast. How would you modify the egg mixture to maximize Maillard browning? →

2. A recipe for caramel sauce says to heat sugar without stirring until it turns amber. Why is it important not to stir? →

3. You are roasting vegetables and want maximum browning. What would you do to the oven and the vegetable arrangement? →

4. A baker notices that cookies made with honey brown much faster than cookies made with white sugar. Use your knowledge of the Maillard reaction to explain why. →

5. A student claims that the Maillard reaction and burning are the same thing because both involve heat and browning. Evaluate this claim. →

(A) Add a pinch of baking soda to raise the pH toward alkaline

(B) Stirring introduces air and can cause sugar crystals to form, making it grainy instead of smooth

(C) They are different — Maillard creates desirable flavors at moderate heat; burning is destructive decomposition at excessive heat

(D) Use high heat (425 degrees F) and spread vegetables in a single layer with space between them

(E) Honey contains glucose and fructose (reducing sugars) that react with amino acids faster than sucrose

4. food-science

Circle the correct answer

31. What is an emulsion?

(A) A gas trapped inside a solid (B) A stable mixture of two liquids that normally do not mix, like oil and water (C) A liquid that has been frozen and melted (D) A solid dissolved in a liquid

32. What molecule in egg yolks acts as a natural emulsifier?

(A) Cellulose (B) Sodium chloride (C) Lecithin (D) Glucose

33. When you dissolve sugar in hot tea, what type of mixture have you created?

(A) A suspension (B) A solution (C) An emulsion (D) A compound

34. What is the term for a liquid that does another substance dissolve in, like water dissolving salt?

(A) Solvent (B) Emulsifier (C) Solute (D) Catalyst

35. Explain why oil and vinegar in a salad dressing separate into two layers after sitting.

(A) Vinegar dissolves the oil over time (B) Oil and water molecules have different polarities and are not attracted to each other (C) The container changes the temperature of the mixture (D) Oil is heavier than vinegar so it sinks

36. Describe how an emulsifier molecule works to keep oil and water mixed together.

(A) It breaks oil into a gas that dissolves in water (B) It removes the water molecules so only oil remains (C) One end bonds with water and the other end bonds with oil, acting as a bridge between them (D) It heats both liquids to the same temperature so they blend

Write the answer

37. Why does hot water dissolve sugar faster than cold water?

Answer: _____

38. Explain the difference between a suspension and a solution using kitchen examples.

Answer: _____

39. Explain why mustard is added to many vinaigrette recipes even when the cook does not want mustard flavor.

Answer: _____

40. You are making mayonnaise by slowly drizzling oil into egg yolks while whisking. Why must the oil be added slowly?

Answer: _____

Match each question to its answer

1. A recipe for a cheese sauce tells you to add cheese to a warm roux (butter and flour mixture) rather than directly to hot milk. Why does this prevent the sauce from becoming grainy? →

2. You are making a salad dressing and want it to stay mixed for several hours without separating. Which ingredient would you add? →

3. Your hollandaise sauce suddenly separates into a greasy, curdled mess. What most likely caused this and how could you rescue it? →

4. A cook stirs cornstarch into cold water before adding it to hot soup. Why is mixing with cold water first important? →

5. When you make pasta water very starchy by cooking many batches of pasta, chefs call it 'liquid gold.' How does this starchy water help create creamy pasta sauces? →

(A) Starch acts as an emulsifier, helping bind fat from butter or cheese with the water in the sauce

(B) Cold water separates the starch granules evenly; adding dry starch to hot liquid causes instant clumping

(C) The starch in the roux coats the cheese proteins, preventing them from clumping together

(D) Egg yolk, because the lecithin acts as an emulsifier

(E) The sauce got too hot, breaking the emulsion; whisk a fresh egg yolk and slowly add the broken sauce to it

5. food-science

Circle the correct answer

41. What is fermentation?

(A) A process where microorganisms break down sugars without oxygen (B) Freezing food to preserve it (C) Heating food to kill bacteria (D) Mixing ingredients together quickly

42. Which microorganism causes bread dough to rise?
(A) Mold (B) Algae (C) Yeast (D) Virus
43. What gas does yeast produce that makes bread dough rise?
(A) Nitrogen (B) Hydrogen (C) Carbon dioxide (D) Oxygen
44. What other substance besides carbon dioxide does yeast produce during alcoholic fermentation?
(A) Citric acid (B) Baking soda (C) Vinegar (D) Ethanol (alcohol)
45. Why does warm water help yeast become active faster than cold water?
(A) Warm water dissolves the yeast's outer shell (B) Warmth speeds up the yeast's metabolic reactions (C) Cold water kills the yeast cells (D) Warm water contains more oxygen for the yeast
46. How does the sour taste of yogurt develop during fermentation?
(A) Bacteria convert lactose into lactic acid, which tastes sour (B) Cold temperatures make milk proteins taste sour (C) Yogurt cultures add citrus flavoring naturally (D) The milk absorbs sourness from the air

Write the answer

47. Why does bread dough need time to rest during the rising process?
Answer: _____
48. What is the role of salt in bread dough fermentation?
Answer: _____
49. Why does sourdough bread taste tangier than bread made with commercial yeast?
Answer: _____
50. Explain why adding sugar to a yeast mixture causes it to bubble.
Answer: _____

Match each question to its answer

1. A recipe says to proof yeast in warm water before adding it to dough. If you accidentally use boiling water, what would happen? →
2. You are making pizza dough and realize you have no sugar. Could you still get the dough to rise with yeast? Why? →
3. If you wanted to make homemade yogurt, which step would be most important for successful fermentation? →
4. You notice that your jar of homemade sauerkraut has bubbles forming on the surface during its first week. Should you be concerned? →
5. A baker wants to make bread with larger air holes, similar to ciabatta. How should

they adjust their fermentation process? →

- (A) Use a longer, slower fermentation with higher hydration dough
 - (B) Cooling heated milk to about 43 degrees Celsius before adding the bacterial culture
 - (C) No, bubbles indicate active fermentation by lactic acid bacteria, which is normal
 - (D) The extreme heat would kill the yeast, and the dough would not rise
 - (E) Yes, because yeast can also feed on the natural sugars and starches in flour
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6. food-science

Circle the correct answer

51. Which nutrient is the body's main source of quick energy?
(A) Vitamins (B) Water (C) Minerals (D) Carbohydrates
52. What nutrient is most important for building and repairing muscles?
(A) Protein (B) Sugar (C) Fat (D) Fiber
53. What unit is used to measure the energy content of food?
(A) Calories (B) Grams (C) Degrees (D) Liters
54. Which vitamin is your body able to produce when your skin is exposed to sunlight?
(A) Vitamin A (B) Vitamin D (C) Vitamin B12 (D) Vitamin C
55. Why does your body need dietary fiber even though it cannot digest it?
(A) Fiber provides the most calories of any nutrient (B) Fiber is converted into protein by stomach acid (C) Fiber dissolves in the blood to clean your arteries (D) Fiber helps food move through the digestive system and keeps the gut healthy
56. Why do athletes often eat pasta or rice the night before a big race?
(A) These foods are rich in carbohydrates, which the body stores as energy for endurance (B) Pasta and rice contain extra oxygen for the muscles (C) These foods make athletes weigh more so they run faster (D) Pasta and rice have no calories, so they do not slow athletes down

Write the answer

57. How does the body use fat that you eat?

Answer: _____

58. Why is it important to eat foods from different food groups rather than just one type of food?

Answer: _____

59. What is the difference between simple carbohydrates and complex carbohydrates?

Answer: _____

60. Why do nutrition labels list a percent daily value next to each nutrient?

Answer: _____

Match each question to its answer

1. You are packing a lunch and want to include all three macronutrients. Which combination would best accomplish this? →

2. A nutrition label shows a cereal has 12 grams of sugar per serving. If you eat two servings, how many grams of sugar have you consumed? →

3. Your friend says they are getting enough calcium by drinking only orange juice. Using your knowledge of nutrition, how would you respond? →

4. A food label lists the ingredients as: wheat flour, sugar, palm oil, salt, artificial flavor. Which ingredient makes up the largest portion of the food? →

5. You want to create a smoothie that is high in vitamin C. Which combination of ingredients would give you the most vitamin C? →

(A) Strawberries, kiwi, and orange juice

(B) A turkey sandwich on whole wheat bread with avocado slices

(C) Wheat flour, because ingredients are listed in order from most to least by weight

(D) 24 grams

(E) Only fortified orange juice contains added calcium; regular orange juice does not naturally have much calcium

7. food-science

Circle the correct answer

61. What are the four main conditions that bacteria and mold need to grow on food?

(A) Salt, fat, protein, and carbon dioxide (B) Food, moisture, warmth, and time (C) Sugar, acid, darkness, and pressure (D) Light, oxygen, cold, and sweetness

62. What is the term for the amount of water available in a food for microbial growth, often written as 'aw'?

(A) Hydration index (B) Moisture content (C) Water activity (D) Osmotic pressure

63. Which preservation method works by heating sealed containers of food to kill microorganisms and then creating a vacuum seal?

(A) Freeze-drying (B) Smoking (C) Canning (D) Fermentation

64. What is the name of the dangerous, potentially fatal toxin produced by Clostridium botulinum bacteria in improperly canned low-acid foods?

(A) Salmonella toxin (B) Botulinum toxin (C) Aflatoxin (D) Ergot toxin

65. Explain why adding large amounts of salt to meat (such as making jerky or salt cod) prevents bacterial growth.

(A) Salt raises the pH of the meat to levels toxic to bacteria (B) Salt draws water out of bacteria by osmosis, lowering the food's water activity so bacteria cannot survive (C) Salt kills bacteria by reacting with their cell walls chemically (D) Salt generates heat inside the meat that kills microorganisms

66. Why does pickling food in vinegar prevent spoilage?

(A) Vinegar kills bacteria by coating them in a thick liquid they cannot breathe through (B) Vinegar is acidic and most spoilage bacteria cannot survive in a low-pH environment (C) Vinegar removes all water from the food so bacteria have nothing to drink (D) Vinegar raises the temperature of the food above the danger zone permanently

Write the answer

67. How does freezing food slow spoilage without necessarily killing the microorganisms on it?

Answer: _____

68. In fermentation, how do the bacteria or yeasts that humans intentionally add to food help preserve it from harmful pathogens?

Answer: _____

69. Why does drying food preserve it more effectively in hot, sunny, dry climates than in humid tropical climates?

Answer: _____

70. What is the 'temperature danger zone' for food safety, and why is it significant for food preservation?

Answer: _____

Match each question to its answer

1. You want to make jam at home that will be safe to store on a shelf without refrigeration. Which preservation method should you use after cooking the jam? →
2. You are making homemade beef jerky. What internal temperature must the meat reach during drying to ensure it is safe from pathogens like Salmonella and E. coli? →
3. A farmer has a large harvest of tomatoes that will spoil within a week. Apply your knowledge of preservation methods to suggest TWO different techniques the farmer

could use to extend their shelf life. →

4. You find a jar of home-canned green beans with a bulging lid. Apply your knowledge of food safety to explain what you should do. →

5. Use your knowledge of food preservation to explain why honey found in ancient Egyptian tombs (over 3,000 years old) is still edible. →

(A) Honey has extremely low water activity, high sugar concentration, and is naturally acidic and antimicrobial, preventing microbial growth

(B) Canning whole or crushed tomatoes in a pressure canner, and sun-drying or oven-drying them to make dried tomatoes

(C) 74°C (165°F) to kill pathogens before the drying process lowers the water activity

(D) Discard the jar without opening or tasting it, as bulging indicates gas-producing bacteria may have grown inside

(E) Hot water bath canning to heat-seal the jars and kill remaining microorganisms

8. food-science

Circle the correct answer

71. What two proteins in wheat flour combine when mixed with water to form gluten?

(A) Albumin and globulin (B) Glutenin and gliadin (C) Casein and whey (D) Amylose and amylopectin

72. What gas is produced when baking soda reacts with an acid in a batter or dough?

(A) Hydrogen (B) Nitrogen (C) Oxygen (D) Carbon dioxide

73. What is the Maillard reaction in baking?

(A) The expansion of water vapor that causes bread to rise in the oven (B) The process by which yeast converts sugar to alcohol and carbon dioxide (C) A chemical reaction between amino acids and reducing sugars that causes browning and creates complex flavors when food is heated (D) The melting of fat and sugar together to form a golden caramel

74. What is the main difference between baking soda and baking powder as leavening agents?

(A) Baking soda is pure sodium bicarbonate and needs an acid in the recipe to activate; baking powder contains both sodium bicarbonate and a dry acid so it can act without added acid (B) They are chemically identical and can always be substituted for each other in equal amounts (C) Baking powder requires heat to activate and baking soda works only in cold mixtures (D) Baking soda is a liquid and baking powder is a solid

75. Explain why bread dough must be kneaded for several minutes rather than just briefly stirred.

(A) Kneading only distributes the ingredients evenly and has no effect on the dough's structure (B) Kneading aligns and stretches gluten proteins, developing a strong, elastic network that can trap carbon dioxide and support the bread's structure (C) Kneading removes excess water from the dough so it dries out properly before baking (D) Kneading heats the dough enough to activate yeast that would otherwise stay dormant

76. Why does fat (butter or shortening) added to cookie dough make the cookies tender and crumbly rather than chewy?

(A) Fat softens cookies by adding moisture that makes the gluten more flexible and stretchy (B) Fat coats flour proteins and starches, preventing gluten networks from fully forming and limiting the development of a tough, elastic structure (C) Fat causes a chemical reaction with the leavening agent to produce extra gas bubbles (D) Fat has no effect on gluten — it only adds flavor and calories to cookies

Write the answer

77. How do eggs contribute to the structure of a baked cake, beyond just adding moisture?

Answer: _____

78. Why does sugar do more than just add sweetness in baking — what physical effect does it have on a cake's texture?

Answer: _____

79. Why is exact measurement critical in baking in a way that is less important when making a stew or stir-fry?

Answer: _____

80. How does yeast leaven bread differently from baking powder?

Answer: _____

Match each question to its answer

1. A recipe calls for bread flour but you only have cake flour. Apply your knowledge of gluten to predict what will happen if you substitute cake flour in a bread recipe. →

2. You are making buttermilk pancakes and the recipe calls for 1 teaspoon of baking soda. You accidentally use 1 tablespoon (three times as much). Apply your knowledge of leavening chemistry to predict what the pancakes will taste and look like. →

3. Apply the concept of gluten development to explain why you should stir muffin batter only until just combined, even if lumps remain, but you should knead bread dough extensively. →

4. A baker notices her cookies always spread out flat during baking. Apply your knowledge of baking chemistry to identify which of the following changes would most likely help the cookies hold their shape. →

5. A student adds extra flour to a bread recipe hoping to make the loaf taller. Using your knowledge of gluten and gas retention, predict whether this will work and explain why. →

(A) Adding extra flour will likely make the bread denser and taller only if there is also more yeast and liquid, because more flour means more gluten but also more structure to hold against — the ratios all matter together

(B) Chill the dough before baking so the fat is cold and solid, slowing the spread before structure sets

(C) Muffins need minimal gluten for a tender crumb — overmixing develops too much gluten, making them tough and rubbery; bread needs strong gluten to support its structure

(D) The pancakes will taste soapy or bitter and may have a greenish tint because excess unreacted sodium bicarbonate creates an alkaline taste

(E) The bread will be less chewy and structured because cake flour has lower protein content, producing weaker, less developed gluten than bread flour

9. Applied Research Methods

Circle the correct answer

81. Sauerkraut is made by packing shredded cabbage tightly with salt and leaving it at room temperature for weeks. Analyze the sequence of microbial changes that occur during this fermentation.

(A) Salt draws out cabbage juice, early bacteria begin fermentation producing lactic acid, rising acidity eliminates less acid-tolerant microbes, and Lactobacillus bacteria dominate the final stable product (B) All bacteria grow equally throughout fermentation and the process is complete when all sugar is gone (C) Salt kills all bacteria immediately, then the cabbage breaks down on its own through enzyme reactions with no microbial involvement (D) Mold grows first to break down the cabbage, then beneficial bacteria take over from the mold

82. Explain why a recipe for pancakes might include both baking soda and cream of tartar.

(A) They cancel each other out for a neutral taste (B) Baking soda adds sweetness while cream of tartar adds sourness (C) Cream of tartar prevents the pancakes from burning (D) Cream of tartar provides the acid that baking soda needs to react

83. What is the term for a liquid that does another substance dissolve in, like water dissolving salt?

(A) Catalyst (B) Solvent (C) Emulsifier (D) Solute

84. Which microorganism causes bread dough to rise?

(A) Algae (B) Yeast (C) Mold (D) Virus

85. What are melanoidins?

(A) Brown-colored compounds produced during the Maillard reaction (B) A preservative added to baked goods (C) A type of vitamin found in browned food (D) The skin pigment that causes sunburn

86. Baking soda is a base. What is its scientific name?

(A) Calcium carbonate (B) Sodium bicarbonate (C) Citric acid (D) Sodium chloride

Write the answer

87. Your hollandaise sauce suddenly separates into a greasy, curdled mess. What most likely caused this and how could you rescue it?

Answer: _____

88. Coffee beans, bread crust, and seared steak all develop brown color and complex flavors through heating. Analyze what these three foods have in common that allows the Maillard reaction.

Answer: _____

89. Design a controlled experiment to test whether the Maillard reaction produces different flavors with different amino acids. Describe your setup.

Answer: _____

90. Iron is an important mineral found in red meat, spinach, and beans. Why does the body need iron?

Answer: _____

Match each question to its answer

1. What are the three common states of matter found in a kitchen? →

2. What gas does yeast produce that makes bread dough rise? →

3. Sugar is used in large quantities in jams and jellies. Analyze how sugar functions as a preservative in these products. →

4. Which preservation method works by heating sealed containers of food to kill microorganisms and then creating a vacuum seal? →

5. Explain why adding large amounts of salt to meat (such as making jerky or salt cod) prevents bacterial growth. →

- (A) Salt draws water out of bacteria by osmosis, lowering the food's water activity so bacteria cannot survive
- (B) Carbon dioxide
- (C) Canning
- (D) Solid, liquid, and gas
- (E) High sugar concentrations lower water activity by binding free water molecules through osmosis and hydrogen bonding, making water unavailable for microbial growth
-

10. Real-World Applications

Circle the correct answer

91. You want to make jam at home that will be safe to store on a shelf without refrigeration. Which preservation method should you use after cooking the jam?

- (A) Hot water bath canning to heat-seal the jars and kill remaining microorganisms
- (B) Freeze the jars immediately to kill bacteria
- (C) Add extra salt to the jam to lower its water activity
- (D) Simply put the hot jam in a jar and close the lid — the heat will seal it safely

92. A student claims that the Maillard reaction and burning are the same thing because both involve heat and browning. Evaluate this claim.

- (A) They are different — Maillard creates desirable flavors at moderate heat; burning is destructive decomposition at excessive heat
- (B) This is correct — both produce the same chemical compounds
- (C) They are different only because burning happens faster
- (D) This is correct — all browning is a form of burning

93. Compare what happens when you melt butter versus when you cook an egg. Why can you re-solidify butter but not un-cook an egg?

- (A) Both are the same type of change but eggs are more sensitive
- (B) Melting butter is a physical change that reverses; cooking an egg is a chemical change that does not reverse
- (C) Eggs are liquid so they cannot return to their original state
- (D) Butter contains water which helps it re-solidify

94. What is fermentation?

- (A) Freezing food to preserve it
- (B) Mixing ingredients together quickly
- (C) Heating food to kill bacteria
- (D) A process where microorganisms break down sugars without oxygen

95. How does yeast leaven bread differently from baking powder?

(A) Baking powder requires hours of time to work while yeast activates immediately
(B) Yeast produces oxygen gas while baking powder produces carbon dioxide (C)
Yeast and baking powder both rely on the same acid-base chemical reaction and work
in identical ways (D) Yeast is a living organism that ferments sugars over time,
producing CO₂ and ethanol; baking powder is a chemical leavener that reacts almost
immediately when moistened or heated

96. Some people claim that fermented foods are healthier than unfermented foods.
Evaluate the scientific basis for this claim.

(A) There is no scientific difference between fermented and unfermented foods (B)
All fermented foods are proven to cure diseases (C) There is evidence that
fermentation can increase nutrient availability and add beneficial probiotics, but
effects vary by food (D) Fermentation removes all nutrients from food

Write the answer

97. A family wants to preserve fresh fish caught on a weekend trip but has no
electricity for freezing. Apply your knowledge of preservation to recommend two
methods that could work without refrigeration.

Answer: _____

98. Compare the browning of a marshmallow over a campfire with the browning of
onions in a pan. Which reactions are occurring in each case?

Answer: _____

99. A recipe says to proof yeast in warm water before adding it to dough. If you
accidentally use boiling water, what would happen?

Answer: _____

100. You are making homemade beef jerky. What internal temperature must the meat
reach during drying to ensure it is safe from pathogens like Salmonella and E. coli?

Answer: _____

Match each question to its answer

1. What molecule in egg yolks acts as a natural emulsifier? →

2. Why is it important to eat foods from different food groups rather than just one
type of food? →

3. Your friend says they are getting enough calcium by drinking only orange juice.
Using your knowledge of nutrition, how would you respond? →

4. You find a jar of home-canned green beans with a bulging lid. Apply your
knowledge of food safety to explain what you should do. →

5. Some ice cream brands advertise 'no emulsifiers or stabilizers.' Evaluate whether

this makes their ice cream better or worse from a food science perspective. →

(A) It may result in icier texture and faster melting, since emulsifiers help create small ice crystals and smooth texture

(B) Discard the jar without opening or tasting it, as bulging indicates gas-producing bacteria may have grown inside

(C) Only fortified orange juice contains added calcium; regular orange juice does not naturally have much calcium

(D) Lecithin

(E) No single food contains all the nutrients your body needs, so variety ensures complete nutrition

11. Cross-Disciplinary Connections

Circle the correct answer

101. How does the body use fat that you eat?

(A) Fat only makes you gain weight and has no other function (B) Fat passes through the body without being used (C) Fat is immediately converted to muscle (D) Fat provides long-lasting energy, cushions organs, and helps absorb certain vitamins

102. Risotto gets its creamy texture without any cream. Explain how stirring releases starch from the rice and what role this starch plays in the final dish.

(A) Stirring adds air bubbles that make the risotto fluffy (B) Stirring heats the rice faster which melts it into cream (C) Stirring breaks the rice into tiny pieces that look creamy (D) Stirring breaks starch granules off the rice surface; the starch acts as an emulsifier binding butter, cheese, and broth together

103. Design a simple experiment to test whether different types of sugar (white sugar, brown sugar, honey) affect how quickly yeast produces carbon dioxide.

(A) Add yeast to cold water with white sugar and observe for five minutes (B) Mix all three sugars together and see if the yeast bubbles (C) Put sugar in three bottles without yeast and check for bubbles (D) Set up three identical bottles with warm water and yeast, add a different sugar to each, cover with balloons, and measure which balloon inflates fastest

104. A recipe calls for 1 teaspoon of baking powder. You only have baking soda. What should you use instead?

(A) 1/4 teaspoon baking soda plus 1/2 teaspoon cream of tartar (B) 2 teaspoons baking soda to make up for it (C) 1 teaspoon baking soda with no changes (D) 1/4 teaspoon baking soda with no acid added

105. Compare the fermentation that produces bread with the fermentation that produces yogurt. How do the end products differ?

(A) Bread fermentation produces lactic acid and yogurt produces alcohol (B) Bread fermentation produces alcohol and CO₂, while yogurt fermentation produces lactic acid (C) Both processes produce the exact same end products (D) Bread fermentation uses bacteria and yogurt uses yeast

106. Examine these two reactions: (1) dissolving salt in water and (2) mixing baking soda with lemon juice. Which one is a chemical reaction and why?

(A) Neither is a chemical reaction (B) Both are chemical reactions (C) Only reaction 2 — new substances (gas and salt) are formed (D) Only reaction 1 — because the salt disappears

Write the answer

107. Why does salt added to water raise its boiling point?

Answer: _____

108. You notice that your jar of homemade sauerkraut has bubbles forming on the surface during its first week. Should you be concerned?

Answer: _____

109. Compare the nutritional benefits of eating a whole orange versus drinking a glass of orange juice. What important nutrient does the whole orange provide that the juice mostly lacks?

Answer: _____

110. When you take a tray of ice cubes out of the freezer and leave them on the counter, the ice eventually becomes a puddle of water. Use what you know about states of matter to explain what happened.

Answer: _____

Match each question to its answer

1. Explain why boiled meat does not develop a brown crust the way grilled or seared meat does. →

2. A baker notices her cookies always spread out flat during baking. Apply your knowledge of baking chemistry to identify which of the following changes would most likely help the cookies hold their shape. →

3. Compare what happens when you mix baking soda with vinegar versus mixing baking soda with plain water. What is the key difference? →

4. What are the four main conditions that bacteria and mold need to grow on food? →

5. What is the main difference between baking soda and baking powder as leavening agents? →

- (A) Water keeps the surface temperature below the Maillard threshold of 140 degrees C
 - (B) Chill the dough before baking so the fat is cold and solid, slowing the spread before structure sets
 - (C) Food, moisture, warmth, and time
 - (D) Vinegar causes a chemical reaction with gas production; water only dissolves it
 - (E) Baking soda is pure sodium bicarbonate and needs an acid in the recipe to activate; baking powder contains both sodium bicarbonate and a dry acid so it can act without added acid
-

12. Advanced Concepts & Critical Thinking

Circle the correct answer

111. The brown crust on bread has a very different flavor from the soft white interior. Analyze what chemical difference explains this.

- (A) The crust has different ingredients than the interior (B) The interior was protected by steam which added flavor (C) The crust was exposed to air which changed its flavor (D) The crust reached Maillard temperatures above 140 degrees C; the moist interior stayed near 100 degrees C

112. Which vitamin is your body able to produce when your skin is exposed to sunlight?

- (A) Vitamin B12 (B) Vitamin C (C) Vitamin A (D) Vitamin D

113. Evaluate the following claim: 'Brown sugar can always be substituted for white sugar in equal amounts in any baking recipe without changing the outcome.'

- (A) This is true because the extra moisture in brown sugar simply evaporates during baking (B) This is false only if you are making candy; for cookies and cakes, they are interchangeable (C) This is false; brown sugar contains molasses which adds moisture, acidity, and distinct flavor, affecting spread, browning, and chewiness compared to white sugar (D) This is true; brown and white sugar are chemically identical and always interchangeable

114. Examine why carbonated drinks go flat faster when warm than when cold. How does temperature affect gas dissolved in a liquid?

- (A) Cold temperature creates more carbon dioxide inside the drink (B) Warm bottles expand and let gas leak through the plastic (C) Warm drinks have more bubbles so the gas runs out faster (D) Warm liquid holds less dissolved gas — CO₂ escapes faster as temperature increases

115. Analyze why Dutch-processed cocoa powder behaves differently from natural cocoa powder in a recipe that uses baking soda as the leavening agent.

(A) Dutch-processed cocoa dissolves better in water so it produces more carbon dioxide with baking soda (B) The two types of cocoa are chemically identical and behave exactly the same in all recipes (C) Dutch-processed cocoa is alkalized (high pH) and cannot activate baking soda, which needs acid; natural cocoa is acidic and does react with baking soda (D) Dutch-processed cocoa is darker in color so it absorbs more heat and bakes faster

116. A cooking blog claims that 'searing meat seals in the juices.' Based on your understanding of the Maillard reaction, evaluate this common claim.

(A) This is correct — the brown crust forms a waterproof barrier (B) This is correct — the high heat closes the pores in the meat (C) This is partially true — searing seals in about half the juices (D) This is a myth — seared meat actually loses more moisture; searing is valued for its Maillard flavor compounds

Write the answer

117. Describe the difference between the Maillard reaction and caramelization. How can you tell which one is occurring?

Answer: _____

118. Your friend says that steam and water vapor are the same thing. Evaluate whether this is accurate.

Answer: _____

119. Gelatin dissolves in hot water but sets into a wobbly solid when cooled. Analyze what type of mixture gelatin dessert is and why it behaves this way.

Answer: _____

120. What two types of molecules react together in the Maillard reaction?

Answer: _____

Match each question to its answer

1. What is the difference between simple carbohydrates and complex carbohydrates?
→

2. Why does hot water dissolve sugar faster than cold water? →

3. A chef uses tenderizer powder (which contains an enzyme from papaya) on tough steak before cooking. Analyze how this is similar to how acid curdles milk. →

4. Examine why pretzel dough is traditionally dipped in a lye (sodium hydroxide) solution before baking. How does this relate to the Maillard reaction? →

5. Why do athletes often eat pasta or rice the night before a big race? →

- (A) Simple carbs are short sugar chains that give quick energy; complex carbs are long chains that give sustained energy
 - (B) These foods are rich in carbohydrates, which the body stores as energy for endurance
 - (C) Both break down proteins, but one uses enzymes and the other uses acid
 - (D) Higher temperature gives water molecules more energy to break apart sugar crystals
 - (E) Lye raises the surface pH to strongly alkaline, dramatically accelerating the Maillard reaction for a deep brown crust
-

13. food-science

Circle the correct answer

121. What is the role of salt in bread dough fermentation?

- (A) Salt slows yeast activity and strengthens the gluten structure (B) Salt prevents all bacteria from growing in dough (C) Salt feeds the yeast and speeds up rising (D) Salt is only added for flavor and has no effect on fermentation

122. A recipe for a cheese sauce tells you to add cheese to a warm roux (butter and flour mixture) rather than directly to hot milk. Why does this prevent the sauce from becoming grainy?

- (A) The butter melts the cheese more evenly than milk does (B) The roux is cooler than milk so the cheese melts more slowly (C) The flour absorbs excess water that makes cheese grainy (D) The starch in the roux coats the cheese proteins, preventing them from clumping together

123. Compare mayonnaise and vinaigrette. Both contain oil and an acidic liquid, but one stays emulsified and the other separates. Analyze why.

- (A) Mayonnaise contains egg yolk emulsifier and has much more oil, creating a stable emulsion; vinaigrette lacks a strong emulsifier (B) Mayonnaise is heated during preparation which bonds the ingredients (C) Mayonnaise is stored in sealed containers which prevents separation (D) Vinaigrette uses olive oil which separates faster than other oils

124. What nutrient is most important for building and repairing muscles?

- (A) Fat (B) Sugar (C) Fiber (D) Protein

125. Analyze why low-acid vegetables like green beans and carrots must be processed in a pressure canner rather than a boiling-water bath canner, while high-acid tomatoes and fruits can use the simpler water bath method.

- (A) Pressure canning reaches 121°C (250°F), destroying heat-resistant botulism

spores that survive the 100°C maximum of a water bath, which is safe only when food acid prevents spore germination (B) Pressure canning simply cooks the food faster and has no safety benefit over water bath canning (C) The difference is only about convenience — both methods are equally safe for all foods (D) Low-acid vegetables contain more water so they need more heat to reach boiling point

126. A recipe calls for bread flour but you only have cake flour. Apply your knowledge of gluten to predict what will happen if you substitute cake flour in a bread recipe.

(A) The bread will be denser because cake flour has a higher protein content that traps less gas (B) The bread will be identical because all wheat flours behave the same way in baking (C) The bread will be less chewy and structured because cake flour has lower protein content, producing weaker, less developed gluten than bread flour (D) The bread will taste sweeter because cake flour contains added sugar

Write the answer

127. Professional candy makers use a candy thermometer with specific temperature stages: thread, soft ball, firm ball, hard crack. Analyze why temperature control is critical during caramelization.

Answer: _____

128. Why does sourdough bread taste tangier than bread made with commercial yeast?

Answer: _____

129. Why does bread dough rise when baking soda is combined with buttermilk in a recipe?

Answer: _____

130. Explain why oil and vinegar in a salad dressing separate into two layers after sitting.

Answer: _____

Match each question to its answer

1. Why do some recipes call for both baking soda and baking powder? Analyze the purpose of using both leaveners together. →

2. Which nutrient is the body's main source of quick energy? →

3. A recipe tells you to 'reduce the sauce by half.' What does this mean in terms of states of matter? →

4. Compare freeze-drying and regular air-drying as preservation methods. What advantage does freeze-drying offer in terms of food quality? →

5. You are packing a lunch and want to include all three macronutrients. Which combination would best accomplish this? →

- (A) A turkey sandwich on whole wheat bread with avocado slices
 - (B) Freeze-drying removes water while the food is frozen, preventing cell damage and retaining original shape, color, flavor, and most nutrients better than hot-air drying
 - (C) Baking soda neutralizes acid in the recipe while baking powder adds extra lift
 - (D) Boil or simmer the sauce so that half the water evaporates as steam
 - (E) Carbohydrates
-

14. food-science

Circle the correct answer

131. A cook stirs cornstarch into cold water before adding it to hot soup. Why is mixing with cold water first important?

- (A) Cold water dissolves cornstarch completely (B) Cold water activates the starch's thickening power (C) Cold water prevents the cornstarch from cooking too fast (D) Cold water separates the starch granules evenly; adding dry starch to hot liquid causes instant clumping

132. A chef pats a steak dry with paper towels before searing it in a hot pan. How does this step help the Maillard reaction?

- (A) It adds paper fibers that help browning (B) It cools the steak so it browns more evenly (C) Removing surface moisture lets the meat reach browning temperatures faster (D) It removes bacteria that block the Maillard reaction

133. What is the 'temperature danger zone' for food safety, and why is it significant for food preservation?

- (A) Below -10°C ; this is where ice crystals damage food quality (B) Above 100°C ; food in this range boils and destroys all nutrients (C) Between 0°C and 20°C ; this is where food tastes best and is safest to eat (D) Between 4°C and 60°C (40°F – 140°F); bacteria multiply rapidly in this range, doubling as fast as every 20 minutes

134. Explain why adding sugar to a yeast mixture causes it to bubble.

- (A) Yeast consumes the sugar as food and releases CO_2 gas as a waste product (B) Sugar traps air that was already in the mixture (C) Sugar reacts with water to form bubbles (D) Sugar makes the water boil at a lower temperature

135. Design a balanced one-day meal plan for a 10-year-old that includes all five food groups at least once and meets the need for carbohydrates, protein, fat, vitamins, and minerals.

- (A) Breakfast: candy; Lunch: soda and chips; Dinner: ice cream, and this principle applies across similar situations (B) Breakfast: nothing; Lunch: a vitamin pill; Dinner:

only protein shake, which is why this approach is recommended by experts (C) Breakfast: toast; Lunch: toast; Dinner: toast; Snack: more toast, as this is what research and standard practice suggests (D) Breakfast: oatmeal with berries and milk; Lunch: grilled chicken wrap with vegetables; Dinner: salmon, brown rice, and steamed broccoli; Snack: apple with peanut butter

136. Why does warm water help yeast become active faster than cold water?

(A) Warm water contains more oxygen for the yeast (B) Cold water kills the yeast cells (C) Warmth speeds up the yeast's metabolic reactions (D) Warm water dissolves the yeast's outer shell

Write the answer

137. A student places a balloon over a bottle containing warm water, sugar, and yeast. After 30 minutes the balloon inflates, but a second bottle with warm water and yeast but no sugar does not inflate. What can the student conclude?

Answer: _____

138. You leave butter on the counter on a warm day and it becomes very soft. Then you put it in the fridge and it becomes firm again. What kind of change is this?

Answer: _____

139. A student adds extra flour to a bread recipe hoping to make the loaf taller. Using your knowledge of gluten and gas retention, predict whether this will work and explain why.

Answer: _____

140. A recipe for Irish soda bread uses buttermilk instead of regular milk. Use your knowledge of acids and bases to explain why.

Answer: _____

Match each question to its answer

1. A student tests three liquids with red cabbage juice and gets these colors: Liquid A turns pink, Liquid B stays purple, Liquid C turns green. Which liquid is the strongest acid? →

2. A food blog claims that 'adding salt to water makes oil dissolve in it.' Evaluate this claim using your knowledge of solutions and mixtures. →

3. Examine why commercially produced bread often contains added enzymes like amylase alongside yeast. What advantage does this provide? →

4. You are making French toast. How would you modify the egg mixture to maximize Maillard browning? →

5. A food label lists the ingredients as: wheat flour, sugar, palm oil, salt, artificial flavor. Which ingredient makes up the largest portion of the food? →

- (A) Add a pinch of baking soda to raise the pH toward alkaline
 - (B) Liquid A (pink)
 - (C) This is false — salt dissolves in water but does not make oil mix with water because oil is nonpolar
 - (D) Amylase breaks down starch into simple sugars, giving yeast more food for faster and more consistent fermentation
 - (E) Wheat flour, because ingredients are listed in order from most to least by weight
-

15. food-science

Circle the correct answer

141. A recipe blog says 'baking soda and baking powder are interchangeable — just use the same amount of either one.' Evaluate whether this advice is accurate.

- (A) This is correct — they are the same chemical
- (B) This is incorrect — they work differently and substituting equally would ruin the recipe
- (C) This is mostly correct — you only need a tiny adjustment
- (D) This is correct for cookies but not for cakes

142. A food company wants to market a new product as 'naturally preserved' without chemical additives. Evaluate whether traditional preservation methods like fermentation, salting, and drying qualify as truly 'natural.'

- (A) Only fermentation is natural; all other methods use chemicals
- (B) These methods can be considered natural because they use physical removal of water, naturally occurring salts and acids, or beneficial microorganisms rather than synthetic chemical preservatives
- (C) The term 'natural' has a strict legal definition that excludes all forms of food processing
- (D) No preservation method can be called natural because all preservation interferes with nature

143. A food company wants to sell shelf-stable yogurt that does not need refrigeration. They propose heat-treating the yogurt after fermentation to kill all bacteria. Evaluate whether this is a good approach.

- (A) Heat treatment would make the yogurt more nutritious
- (B) You cannot heat yogurt after fermentation because it would explode
- (C) This is a perfect approach with no trade-offs
- (D) It would extend shelf life but destroy the live probiotic cultures that provide health benefits

144. A classmate claims that skipping breakfast helps you lose weight. Based on nutrition science, evaluate this claim.

- (A) Skipping breakfast is the best way to lose weight quickly
- (B) Skipping breakfast may lead to overeating later and provides no guaranteed weight loss benefit
- (C) Breakfast has zero impact on weight because only dinner matters
- (D) Skipping breakfast makes your metabolism permanently faster

145. Why does your body need dietary fiber even though it cannot digest it?

- (A) Fiber helps food move through the digestive system and keeps the gut healthy
(B) Fiber provides the most calories of any nutrient (C) Fiber is converted into protein by stomach acid (D) Fiber dissolves in the blood to clean your arteries

146. What unit is used to measure the energy content of food?

- (A) Degrees (B) Calories (C) Grams (D) Liters

Write the answer

147. A friend says that all chemical reactions in the kitchen are dangerous. Evaluate this claim using examples.

Answer: _____

148. You are making buttermilk pancakes and the recipe calls for 1 teaspoon of baking soda. You accidentally use 1 tablespoon (three times as much). Apply your knowledge of leavening chemistry to predict what the pancakes will taste and look like.

Answer: _____

149. Why does sugar do more than just add sweetness in baking — what physical effect does it have on a cake's texture?

Answer: _____

150. You are making a cake and accidentally add too much baking soda. How could you fix the batter?

Answer: _____

Match each question to its answer

1. Explain why mustard is added to many vinaigrette recipes even when the cook does not want mustard flavor. →

2. When you make pasta water very starchy by cooking many batches of pasta, chefs call it 'liquid gold.' How does this starchy water help create creamy pasta sauces? →

3. What gas is produced when baking soda reacts with an acid in a batter or dough? →

4. Analyze why a cake baked at too high a temperature may have a cracked, domed top even though the recipe calls for a flat or gently rounded top. →

5. Evaluate the following decision: A student wants to keep homemade salsa fresh for six months without refrigeration and decides to simply store it in a sealed jar at room temperature without any canning process. Is this safe? →

(A) No; without heat processing, salsa stored at room temperature can support growth of dangerous bacteria including *Clostridium botulinum*, especially if it contains low-acid vegetables

(B) Carbon dioxide

(C) Starch acts as an emulsifier, helping bind fat from butter or cheese with the water in the sauce

(D) High heat causes the outer crust to set and harden before the interior has finished rising, so the still-rising batter cracks through the already-set crust

(E) Mustard contains natural emulsifiers that help keep the oil and vinegar from separating

16. food-science

Circle the correct answer

151. Explain why adding lemon juice to milk causes it to curdle.

(A) The acid changes the milk proteins' shape (B) The lemon juice adds sugar to the milk (C) The lemon juice removes water from the milk (D) The lemon juice freezes the milk

152. Use your knowledge of food preservation to explain why honey found in ancient Egyptian tombs (over 3,000 years old) is still edible.

(A) Egyptian tomb air preserves all foods due to the lack of sunlight (B) Ancient Egyptians added unknown chemicals to their honey as preservatives (C) Honey has extremely low water activity, high sugar concentration, and is naturally acidic and antimicrobial, preventing microbial growth (D) The honey crystallized completely, trapping all bacteria in solid crystal so they could not multiply

153. You are roasting vegetables and want maximum browning. What would you do to the oven and the vegetable arrangement?

(A) Use high heat and cover them tightly with foil (B) Use medium heat and add water to the pan (C) Use high heat (425 degrees F) and spread vegetables in a single layer with space between them (D) Use low heat (250 degrees F) and pile them together

154. A student says: 'Stirring is the only way to keep a vinaigrette from separating.' Evaluate this statement and suggest a better approach.

(A) This is correct — there is no other way to mix oil and water (B) This is incorrect — refrigerating the dressing prevents separation (C) This is correct — vinaigrettes always need constant stirring (D) This is incorrect — adding an emulsifier like mustard or egg yolk would keep it mixed without constant stirring

155. You are making ice cream at home. Why does adding salt to the ice surrounding the cream container help freeze the cream faster?

(A) Salt creates a chemical reaction that produces cold (B) Salt lowers the melting point of ice, making the ice bath colder than 0 degrees C (C) Salt prevents the ice

from melting too quickly (D) Salt makes the ice harder so it absorbs more heat

156. Why is exact measurement critical in baking in a way that is less important when making a stew or stir-fry?

(A) Exact measurement is required in baking only to count calories accurately (B) Baking involves precise chemical reactions where ratios of leavening agents, proteins, fats, and liquids determine the outcome; unlike cooking, you cannot easily adjust after mixing (C) Baking measurements are important only because oven temperatures are unreliable (D) The measurements in baking are a tradition rather than a scientific necessity

Write the answer

157. Compare the role of gluten in a flaky pie crust versus a chewy bagel. Why do bakers use opposite techniques — minimal handling for pie crust and extensive kneading for bagels?

Answer: _____

158. Design a kitchen experiment to demonstrate all three states of water using only a pot, water, ice, and a stove.

Answer: _____

159. At approximately what temperature does the Maillard reaction begin?

Answer: _____

160. A new snack bar claims to be a 'superfood' that provides all the nutrients you need. Evaluate whether any single food can truly be a complete source of nutrition.

Answer: _____

Match each question to its answer

1. Design a preservation plan for a school garden that produces excess tomatoes, basil, and green beans each summer, intending to enjoy the produce in winter. Which different preservation method would you recommend for each ingredient, and why?

→

2. What process occurs when steam from a boiling pot hits a cold lid and water droplets form? →

3. A food scientist claims that white sugar is better than brown sugar for achieving deep Maillard browning in cookies. Evaluate this claim. →

4. When you take a cold drink out of the refrigerator, water droplets form on the outside of the glass. Analyze where these droplets come from. →

5. What does pH measure in a substance? →

- (A) Can or freeze the tomatoes; dry or freeze the basil; pressure-can or freeze the green beans — each method matches the ingredient's acidity, texture needs, and safety requirements
 - (B) Condensation
 - (C) Water vapor in the warm air condenses when it touches the cold glass surface
 - (D) How acidic or basic it is
 - (E) This is incorrect — brown sugar contains molasses with amino acids and reducing sugars that enhance the Maillard reaction
-

Riddle & Joke Break

Guess the answer, then check the key!

161. I start out wet, you add heat, and I become something you can eat. I rise in the oven and turn golden brown. What am I?

162. I'm invisible, but I make your bread rise, your soda fizz, and your cake fluffy. What am I?

163. I turn brown when you cook me at high heat, I make food taste richer, and I'm named after a French chemist. What reaction am I?

164. I'm a cooking technique where food sits in hot oil and comes out crispy. But if the oil isn't hot enough, I come out greasy instead. What am I?

165. I'm used in the kitchen, I'm alive, I eat sugar and burp gas, and I make bread dough rise. What am I?

166. I can be scrambled, poached, boiled, or fried. My white turns from clear to opaque when heated. What scientific process is happening to my proteins?

167. I'm a temperature zone between 40 and 140 degrees Fahrenheit. Bacteria love me. Food should never sit in me for more than 2 hours. What am I called?

168. I keep oil and water mixed together when they'd normally separate. Egg yolks have a lot of me, which is why they're used to make mayonnaise. What am I?

169. Why did the baker stop making bread?

170. What did the pasta say to the tomato sauce?

171. Why did the mushroom get invited to every potluck?

172. What do you call a fake noodle?

173. Why did the egg fail its test?

174. What do you call cheese that isn't yours?

Fun Facts

- Did you know? Honey never spoils! Archaeologists found roughly 3,000-year-old honey in Egyptian tombs, and it was still perfectly edible. Its low moisture and high acidity make it hostile to bacteria.
 - Did you know? Chocolate was originally a bitter drink, not a sweet treat! The ancient Aztecs mixed cacao beans with water and chili peppers. Sugar wasn't added until Europeans got hold of it in the 16th century.
 - Did you know? Carrots were originally purple, not orange! Orange carrots were developed by Dutch growers in the 17th century, possibly to honor William of Orange. The original purple and yellow varieties still exist.
 - Did you know? The Maillard reaction -- the browning that makes toast, seared steak, and roasted coffee taste so good -- involves over 1,000 different chemical compounds! That's why browned food has such complex flavor.
 - Did you know? Bananas are berries, but strawberries aren't! Botanically, a berry comes from a single flower with one ovary. Bananas, grapes, and even avocados count. Strawberries are "accessory fruits."
 - Did you know? Adding salt to pasta water raises the boiling point by only about 1 degree Fahrenheit per tablespoon. The real reason to salt the water is for flavor -- the pasta absorbs the salty water as it cooks!
 - Did you know? A chef's hat (called a "toque") traditionally had 100 pleats. Legend says each pleat represented one way the chef could cook an egg!
 - Did you know? Capsaicin -- the chemical that makes chili peppers spicy -- doesn't actually burn you. It tricks your nerve receptors into thinking they're on fire! That's why it "hurts" but causes no actual damage.
-

Answer Key

1. D — Carbon dioxide
2. C — Lemon juice
3. B — How acidic or basic it is
4. A — Sodium bicarbonate
5. C — The acid changes the milk proteins' shape

6. D — It changes to a blue or green color
7. An acid-base reaction produces gas bubbles
8. Cream of tartar provides the acid that baking soda needs to react
9. The acid helps the egg proteins coagulate more quickly
10. 1/4 teaspoon baking soda plus 1/2 teaspoon cream of tartar
Matching (food-science): 1→B, 2→E, 3→C, 4→D, 5→A
11. D — Solid, liquid, and gas
12. D — 100 degrees Celsius (212 degrees Fahrenheit)
13. C — Melting
14. D — Condensation
15. A — High heat can burn the cocoa solids and cause the chocolate to seize
16. D — The molecules move faster and farther apart until they escape as steam
17. Salt particles get between water molecules, making it harder for them to escape as steam
18. Higher temperatures transfer more heat energy to the popsicle, speeding up melting
19. The lid traps heat and steam, reducing energy loss
20. Salt lowers the melting point of ice, making the ice bath colder than 0 degrees C
Matching (food-science): 1→B, 2→D, 3→C, 4→E, 5→A
21. D — Amino acids and reducing sugars
22. C — About 140 degrees C (280 degrees F)
23. C — Brown-colored compounds produced during the Maillard reaction
24. D — About 170 degrees C (340 degrees F)
25. B — Water keeps the surface temperature below the Maillard threshold of 140 degrees C
26. B — Maillard requires proteins and sugars together; caramelization involves only sugar heated above 170 degrees C
27. The combination of 20 different amino acids with various sugars creates many unique reaction pathways

28. Long cooking breaks down complex sugars and drives off sharp sulfur compounds, concentrating sweetness
29. The egg adds proteins and sugars to the surface, enhancing the Maillard reaction
30. Removing surface moisture lets the meat reach browning temperatures faster
Matching (food-science): 1→A, 2→B, 3→D, 4→E, 5→C
31. B — A stable mixture of two liquids that normally do not mix, like oil and water
32. C — Lecithin
33. B — A solution
34. A — Solvent
35. B — Oil and water molecules have different polarities and are not attracted to each other
36. C — One end bonds with water and the other end bonds with oil, acting as a bridge between them
37. Higher temperature gives water molecules more energy to break apart sugar crystals
38. A solution is evenly mixed at the molecular level (sugar water); a suspension has visible particles that settle (flour in water)
39. Mustard contains natural emulsifiers that help keep the oil and vinegar from separating
40. Adding oil slowly allows the emulsifier to coat each tiny oil droplet before more oil is added
Matching (food-science): 1→C, 2→D, 3→E, 4→B, 5→A
41. A — A process where microorganisms break down sugars without oxygen
42. C — Yeast
43. C — Carbon dioxide
44. D — Ethanol (alcohol)
45. B — Warmth speeds up the yeast's metabolic reactions
46. A — Bacteria convert lactose into lactic acid, which tastes sour
47. Yeast needs time to ferment sugar and produce enough CO₂ to expand the dough
48. Salt slows yeast activity and strengthens the gluten structure

49. Sourdough contains lactic acid bacteria that produce acids alongside the wild yeast
50. Yeast consumes the sugar as food and releases CO₂ gas as a waste product
Matching (food-science): 1→D, 2→E, 3→B, 4→C, 5→A
51. D — Carbohydrates
52. A — Protein
53. A — Calories
54. B — Vitamin D
55. D — Fiber helps food move through the digestive system and keeps the gut healthy
56. A — These foods are rich in carbohydrates, which the body stores as energy for endurance
57. Fat provides long-lasting energy, cushions organs, and helps absorb certain vitamins
58. No single food contains all the nutrients your body needs, so variety ensures complete nutrition
59. Simple carbs are short sugar chains that give quick energy; complex carbs are long chains that give sustained energy
60. It shows what fraction of your recommended daily intake one serving provides
Matching (food-science): 1→B, 2→D, 3→E, 4→C, 5→A
61. B — Food, moisture, warmth, and time
62. C — Water activity
63. C — Canning
64. B — Botulinum toxin
65. B — Salt draws water out of bacteria by osmosis, lowering the food's water activity so bacteria cannot survive
66. B — Vinegar is acidic and most spoilage bacteria cannot survive in a low-pH environment
67. Low temperatures slow or stop microbial metabolic processes and enzyme reactions, putting microbes into dormancy
68. Beneficial microbes produce acids or alcohol that lower pH or create a toxic

environment for harmful bacteria

69. High humidity means the air already contains much water vapor, so moisture evaporates from the food more slowly and incompletely
70. Between 4°C and 60°C (40°F–140°F); bacteria multiply rapidly in this range, doubling as fast as every 20 minutes
Matching (food-science): 1→E, 2→C, 3→B, 4→D, 5→A
71. B — Glutenin and gliadin
72. D — Carbon dioxide
73. C — A chemical reaction between amino acids and reducing sugars that causes browning and creates complex flavors when food is heated
74. A — Baking soda is pure sodium bicarbonate and needs an acid in the recipe to activate; baking powder contains both sodium bicarbonate and a dry acid so it can act without added acid
75. B — Kneading aligns and stretches gluten proteins, developing a strong, elastic network that can trap carbon dioxide and support the bread's structure
76. B — Fat coats flour proteins and starches, preventing gluten networks from fully forming and limiting the development of a tough, elastic structure
77. Egg proteins denature and coagulate when heated, setting the cake's structure and providing stability that flour and fat alone cannot
78. Sugar competes with gluten proteins for water, tenderizes the crumb, delays starch gelatinization, and helps retain moisture so the cake stays soft longer
79. Baking involves precise chemical reactions where ratios of leavening agents, proteins, fats, and liquids determine the outcome; unlike cooking, you cannot easily adjust after mixing
80. Yeast is a living organism that ferments sugars over time, producing CO₂ and ethanol; baking powder is a chemical leavener that reacts almost immediately when moistened or heated
Matching (food-science): 1→E, 2→D, 3→C, 4→B, 5→A
81. A — Salt draws out cabbage juice, early bacteria begin fermentation producing lactic acid, rising acidity eliminates less acid-tolerant microbes, and Lactobacillus bacteria dominate the final stable product
82. D — Cream of tartar provides the acid that baking soda needs to react
83. B — Solvent

84. B — Yeast
85. A — Brown-colored compounds produced during the Maillard reaction
86. B — Sodium bicarbonate
87. The sauce got too hot, breaking the emulsion; whisk a fresh egg yolk and slowly add the broken sauce to it
88. All three contain both amino acids and reducing sugars, the two reactants needed
89. Heat identical sugar solutions with different individual amino acids and compare the aromas and colors produced
90. Iron is essential for making hemoglobin, which carries oxygen in red blood cells
Matching (Applied Research Methods): 1→D, 2→B, 3→E, 4→C, 5→A
91. A — Hot water bath canning to heat-seal the jars and kill remaining microorganisms
92. A — They are different — Maillard creates desirable flavors at moderate heat; burning is destructive decomposition at excessive heat
93. B — Melting butter is a physical change that reverses; cooking an egg is a chemical change that does not reverse
94. D — A process where microorganisms break down sugars without oxygen
95. D — Yeast is a living organism that ferments sugars over time, producing CO₂ and ethanol; baking powder is a chemical leavener that reacts almost immediately when moistened or heated
96. C — There is evidence that fermentation can increase nutrient availability and add beneficial probiotics, but effects vary by food
97. Salt the fish heavily to lower water activity and dry it in the sun or wind, or smoke the fish over a low fire which combines heat, drying, and antimicrobial smoke compounds
98. Marshmallow: primarily caramelization of sugar; Onions: both Maillard reaction and caramelization
99. The extreme heat would kill the yeast, and the dough would not rise
100. 74°C (165°F) to kill pathogens before the drying process lowers the water activity
Matching (Real-World Applications): 1→D, 2→E, 3→C, 4→B, 5→A
101. D — Fat provides long-lasting energy, cushions organs, and helps absorb certain

vitamins

102. D — Stirring breaks starch granules off the rice surface; the starch acts as an emulsifier binding butter, cheese, and broth together
103. D — Set up three identical bottles with warm water and yeast, add a different sugar to each, cover with balloons, and measure which balloon inflates fastest
104. A — 1/4 teaspoon baking soda plus 1/2 teaspoon cream of tartar
105. B — Bread fermentation produces alcohol and CO₂, while yogurt fermentation produces lactic acid
106. C — Only reaction 2 — new substances (gas and salt) are formed
107. Salt particles get between water molecules, making it harder for them to escape as steam
108. No, bubbles indicate active fermentation by lactic acid bacteria, which is normal
109. Fiber, which is found in the pulp and membranes of the whole fruit
110. Heat from the room transferred to the ice, giving molecules enough energy to change from solid to liquid
Matching (Cross-Disciplinary Connections): 1→A, 2→B, 3→D, 4→C, 5→E
111. D — The crust reached Maillard temperatures above 140 degrees C; the moist interior stayed near 100 degrees C
112. D — Vitamin D
113. C — This is false; brown sugar contains molasses which adds moisture, acidity, and distinct flavor, affecting spread, browning, and chewiness compared to white sugar
114. D — Warm liquid holds less dissolved gas — CO₂ escapes faster as temperature increases
115. C — Dutch-processed cocoa is alkalized (high pH) and cannot activate baking soda, which needs acid; natural cocoa is acidic and does react with baking soda
116. D — This is a myth — seared meat actually loses more moisture; searing is valued for its Maillard flavor compounds
117. Maillard requires proteins and sugars together; caramelization involves only sugar heated above 170 degrees C
118. They are closely related — both are water in gas form, but visible 'steam' is actually tiny water droplets

119. It is a colloid (gel) — protein molecules form a network that traps water, creating a semi-solid
120. Amino acids and reducing sugars
Matching (Advanced Concepts & Critical Thinking): 1→A, 2→D, 3→C, 4→E, 5→B
121. A — Salt slows yeast activity and strengthens the gluten structure
122. D — The starch in the roux coats the cheese proteins, preventing them from clumping together
123. A — Mayonnaise contains egg yolk emulsifier and has much more oil, creating a stable emulsion; vinaigrette lacks a strong emulsifier
124. D — Protein
125. A — Pressure canning reaches 121°C (250°F), destroying heat-resistant botulism spores that survive the 100°C maximum of a water bath, which is safe only when food acid prevents spore germination
126. C — The bread will be less chewy and structured because cake flour has lower protein content, producing weaker, less developed gluten than bread flour
127. Each temperature stage produces different sugar structures and textures, from chewy to brittle
128. Sourdough contains lactic acid bacteria that produce acids alongside the wild yeast
129. An acid-base reaction produces gas bubbles
130. Oil and water molecules have different polarities and are not attracted to each other
Matching (food-science): 1→C, 2→E, 3→D, 4→B, 5→A
131. D — Cold water separates the starch granules evenly; adding dry starch to hot liquid causes instant clumping
132. C — Removing surface moisture lets the meat reach browning temperatures faster
133. D — Between 4°C and 60°C (40°F–140°F); bacteria multiply rapidly in this range, doubling as fast as every 20 minutes
134. A — Yeast consumes the sugar as food and releases CO₂ gas as a waste product
135. D — Breakfast: oatmeal with berries and milk; Lunch: grilled chicken wrap with vegetables; Dinner: salmon, brown rice, and steamed broccoli; Snack: apple with peanut butter

136. C — Warmth speeds up the yeast's metabolic reactions
137. Yeast requires sugar as a food source to produce CO₂ gas
138. A reversible physical change — the butter can go back and forth between soft and firm
139. Adding extra flour will likely make the bread denser and taller only if there is also more yeast and liquid, because more flour means more gluten but also more structure to hold against — the ratios all matter together
140. Buttermilk is acidic and reacts with baking soda to create gas for rising
Matching (food-science): 1→B, 2→C, 3→D, 4→A, 5→E
141. B — This is incorrect — they work differently and substituting equally would ruin the recipe
142. B — These methods can be considered natural because they use physical removal of water, naturally occurring salts and acids, or beneficial microorganisms rather than synthetic chemical preservatives
143. D — It would extend shelf life but destroy the live probiotic cultures that provide health benefits
144. B — Skipping breakfast may lead to overeating later and provides no guaranteed weight loss benefit
145. A — Fiber helps food move through the digestive system and keeps the gut healthy
146. B — Calories
147. This is false — many kitchen reactions are safe and useful, like bread rising
148. The pancakes will taste soapy or bitter and may have a greenish tint because excess unreacted sodium bicarbonate creates an alkaline taste
149. Sugar competes with gluten proteins for water, tenderizes the crumb, delays starch gelatinization, and helps retain moisture so the cake stays soft longer
150. Add a small amount of acid like lemon juice or vinegar
Matching (food-science): 1→E, 2→C, 3→B, 4→D, 5→A
151. A — The acid changes the milk proteins' shape
152. C — Honey has extremely low water activity, high sugar concentration, and is naturally acidic and antimicrobial, preventing microbial growth
153. C — Use high heat (425 degrees F) and spread vegetables in a single layer with

space between them

- 154. D — This is incorrect — adding an emulsifier like mustard or egg yolk would keep it mixed without constant stirring
- 155. B — Salt lowers the melting point of ice, making the ice bath colder than 0 degrees C
- 156. B — Baking involves precise chemical reactions where ratios of leavening agents, proteins, fats, and liquids determine the outcome; unlike cooking, you cannot easily adjust after mixing
- 157. Pie crust needs minimal gluten for flakiness and tenderness; bagels need maximum gluten development for their signature dense, chewy texture
- 158. Start with ice (solid), heat it to melt into water (liquid), then boil it to produce steam (gas)
- 159. About 140 degrees C (280 degrees F)
- 160. No single food provides all essential nutrients in the right amounts; a varied diet is necessary
Matching (food-science): 1→A, 2→B, 3→E, 4→C, 5→D
- 161. Bread dough! Heat causes the yeast's CO₂ bubbles to expand, and then the proteins set.
- 162. Carbon dioxide gas! It's produced by yeast fermentation or by baking soda reacting with acid.
- 163. The Maillard reaction! It happens between amino acids and sugars above about 280 degrees F.
- 164. Deep frying! The right oil temperature (usually 325-375 degrees F) is the key.
- 165. Yeast! It's a single-celled fungus that ferments sugar into carbon dioxide and alcohol.
- 166. Denaturation! Heat causes the protein strands to unfold and bond together in a new shape.
- 167. The Danger Zone! That's where bacteria grow fastest.
- 168. An emulsifier! The lecithin in egg yolks does this job.
- 169. They ran out of dough!
- 170. "Don't get saucy with me!"
- 171. Because it's a fungi!

172. An impasta!

173. It couldn't crack the questions -- but it did crack itself!

174. Nacho cheese!

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