



ServSafe© Food Safety Manager Exam Study Guide

Chapter 2: The Microworld

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Chapter 2: The Microworld

Pathogens

- Microorganisms are small, living organisms that can be seen only through the microscope, many are harmless but there are some microorganisms that can make you sick.
- Harmful microorganisms are called pathogens.
- Some pathogens can make you sick when you eat them, while other pathogens produce toxins (also known as poisons) that make you sick.
- There are four (4) types of pathogens that can contaminate food and cause foodborne illness: 1. Viruses 2. Bacteria 3. Parasites 4. Fungi
- Many viruses, bacteria, and parasites make people sick, but they can not be seen, smelled or tasted.
- Some fungi, like mold, change appearance, smell or taste of the food, but they may not make you sick.

What Pathogens Need to Grow

- Pathogens need six (6) conditions to grow.
- You can remember the six conditions that pathogens need to grow by the acronym FAT TOM.
- **F**ood. Pathogens need an energy source such as carbohydrates or protein to grow.
- **A**cidity. Pathogens grow best in foods that have little or no acid. Neutral PH is at 7 – meaning that it is neither acidic or alkaline. Anything below 7 on the ph scale is considered acidic and anything about 7 is considered alkaline.
- **T**emperature. Pathogens grow well in food held between the temperatures of 41°F and 135°F (5°C and 57°C). This temperature range is also known as the Temperature Danger Zone.
- **T**ime. Pathogens need time to grow. When they are in the Temperature Danger Zone, pathogens start to grow. From there, after four (4) hours, they will grow to a level high enough to make someone sick.
- **O**xygen. Some pathogens need oxygen to grow. Others will grow even without oxygen.
- **M**oisture. Pathogens need the moisture in food on order to grow.

Food Most Likely to Become Unsafe

- Any type of food can become contaminated. But the following types of food are especially susceptible to becoming contaminated by pathogens.
- Milk and dairy products
- Meat: beef, pork and lamb
- All poultry
- Fish
- Shellfish and crustaceans
- Eggs (except those treated to eliminate *Salmonella spp.*)

- BAKED potatoes
- Tofu or other soy protein
- Synthetic ingredients, such as textured soy protein in meat alternatives
- SLICED melons
- CUT tomatoes
- CUT leafy greens (fresh leafy greens that have been cut, shredded, sliced, chopped or torn)
- Heat treated plant food, such as cooked rice, beans, and vegetables
- Sprouts and sprout seeds
- Untreated garlic and oil mixtures
- All of the above types of foods have the right FAT TOM conditions that pathogens need to grow.

Controlling the Growth of Pathogens

- You can help keep food safe in your operation by controlling FAT TOM conditions.
- Time and temperature are the two conditions which you will most likely be able to best control.
- Time and temperature are therefore so IMPORTANT, that the foods listed above are known as foods that need time and temperature control for safety or TCS food for short.
- To control temperature, you must keep TCS food out of the temperature danger zone - which is the temperature between 41°F and 135°F (5°C and 57°C).
- To control time, you must limit how long the TCS food is out in the temperature danger zone.
- Ready to eat food: Food that is exactly what it sounds like – food that can be eaten without further preparation, washing, or cooking. Some examples of ready to eat foods include: Washed fruits and vegetables (whole or cut), deli meats, bakery items, sugar, spices and seasonings, and cooked food.
- Like TCS food, ready to eat food also requires careful handling to prevent contamination.

Foodborne Illnesses - Viruses

- Viruses are the leading cause of foodborne illness.
- Temperature: Viruses can survive cooler and freezer temperatures.
- Growth: Viruses can't grow in food. But once eaten, they grow inside the person's intestines.
- Contamination: Viruses can contaminate both food and water.
- Transfer: Viruses can be transferred from person to person, from people to food, and from people to surfaces that come in contact with food.
- When customers at an establishment get sick because of food contaminated with a virus, it's usually because their food was handled by an employee who has a virus. This person might be one of the establishment's staff members, an employee of the food manufacturer, or anyone who has the virus and then handles the food.

- People carry viruses in their feces and can transfer the virus to their hands after using the bathroom. Ready to eat food can then become contaminated if hands are not washed the right way.
- Virus prevention measures: Keep food handlers who are vomiting or have diarrhea or jaundice from working, make sure food handlers wash their hands correctly, minimize bare hand contact with ready to eat food (wear disposable gloves) – Practice good personal hygiene.
- Virus: Hepatitis A. Illness: Hepatitis A.
 - Associations: Ready to eat foods. Shellfish from contaminated water.
 - Most Common Symptoms: Fever (mild), general weakness, nausea, abdominal pain, jaundice (appears later).
 - Other Prevention Measures: Keep employees who have jaundice entirely out of the food operation. Keep employees who have been diagnosed with Hepatitis A entirely out of the food operation. Wash hands frequently and correctly. Minimize bare hand contact with food. Purchase shellfish from approved, reputable suppliers.
- Virus: Norovirus. Illness: Norovirus Gastroenteritis
 - Associations: Ready to eat foods. Shellfish from contaminated water.
 - Most Common Symptoms: Vomiting, diarrhea, nausea, abdominal pains.
 - Other Prevention Measures: Keep employees who have diarrhea and/or vomiting entirely out of the food operation. Keep employees who have been diagnosed with Norovirus entirely out of the food operation. Wash hands frequently and correctly. Minimize bare hand contact with food. Purchase shellfish from approved, reputable suppliers.

Foodborne Illnesses – Bacteria

- Bacteria that cause foodborne illness have some common characteristics:
 - Temperature: Most bacteria are controlled by keeping food out of the temperature danger zone (41°F and 135°F) (5°C and 57°C).
 - Growth: If FAT TOM conditions are right, bacteria will grow quickly:

Number of Bacteria Cells	Time
1 cell	0 minute
2 cells	20 minutes
4 cells	40 minutes
8 cells	1 hour
16 cells	1 hour, 20 minutes
Over 1 billion cells	10 hours
 - Form: Some bacteria change to a different form, called spores, to keep from dying when they don't have enough food. They can change back and grow again when the food they are on has been time temperature abused.
 - Toxin Protection: Some bacteria make toxins in food as they grow and die. People who eat the toxins can become sick, even if the food as been cooked – since cooking may not destroy the toxins.
- Bacteria: Bacillus cereus. Illness: Bacillus cereus Gastroenteritis

- Associations: Cooked vegetables, meat products, milk. Vomiting Illness: Cooked rice dishes, including fried rice and rice pudding.
- Most Common Symptoms: Diarrhea Illness: Watery diarrhea, no vomiting. Vomiting Illness: Nausea, vomiting.
- Other Prevention Measures: Cook food to minimum internal temperatures. Hold food at the right temperatures. Cool food correctly. Avoid time and temperature abuse.
- Bacteria: *Listeria monocytogenes*. Illness: Listeriosis
 - Associations: Raw meat, unpasteurized dairy products, ready to eat foods such as deli meats, hot dogs, and soft cheeses.
 - Most Common Symptoms: Pregnant Women: Miscarriage. Newborns: Sepsis, pneumonia, meningitis.
 - Other Prevention Measures: Throw out any product that has reached its use-by or expiration date. Cook raw meat to minimum internal temperatures. Prevent cross contamination between raw or undercooked food and ready to eat food. Avoid using unpasteurized dairy products. Avoid time and temperature abuse.
- Bacteria: Shiga toxin-producing *Escherichia coli* including O157:H7, O26:H11, O111:H8, and O158:NM. Illness: Hemorrhagic colitis
 - Associations: Ground beef (raw and undercooked), contaminated produce.
 - Most Common Symptoms: Diarrhea that eventually becomes bloody, abdominal cramps, kidney failure in severe cases.
 - Other Prevention Measures: Cook food, especially ground beef, to minimum internal temperatures. Purchase produce from approved, reputable suppliers. Prevent cross contamination between raw or undercooked food and ready to eat food. Keep staff with diarrhea completely away from the food operation. Keep staffs that have been diagnosed with hemorrhagic colitis completely away from the food operation. Avoid time and temperature abuse.
- Bacteria: *Clostridium perfringens*. Illness: *Clostridium perfringens* gastroenteritis
 - Associations: Meat, poultry, dishes made with meat and poultry such as stews and gravies.
 - Most Common Symptoms: Diarrhea, severe abdominal pain.
 - Other Prevention Measures: Cool and reheat food correctly, hold food at the right temperatures. Avoid time and temperature abuse.
- Bacteria: *Clostridium botulinum*. Illness: Botulism
 - Associations: Food incorrectly canned, reduced oxygen packaged (ROP) food, temperature abused vegetables – such as BAKED potatoes, untreated garlic and oil mixtures.
 - Most Common Symptoms: Initially: nausea and vomiting. Later: weakness, double vision, difficulty speaking and swallowing.
 - Other Prevention Measures: Cool and reheat food correctly, hold food at the right temperatures. Inspect canned food for damage. Avoid time and temperature abuse.

- Bacteria: Salmonella spp. Illness: Salmonellosis
 - Associations: Poultry and eggs, dairy products, produce.
 - Most Common Symptoms: Diarrhea, abdominal cramps, vomiting, fever.
 - Other Prevention Measures: Cook poultry and eggs to minimum internal temperatures, prevent cross contamination between eggs, poultry and ready to eat foods, keep staff who have been diagnosed with Salmonellosis completely out of the food service operation. Prevent cross contamination.
- Bacteria: Shigella spp. Illness: Shigellosis
 - Associations: Foods that are easily contaminated by hands such as salads containing TCS foods (potato, tuna, shrimp, macaroni and chicken), Food that has made contact with contaminated water, such as produce.
 - Most Common Symptoms: Bloody diarrhea, abdominal pain and cramps, fever (occasionally).
 - Other Prevention Measures: Keep staff who have diarrhea completely out of the food operation, keep staff who have been diagnosed with Shigellosis completely out of the food service operation, wash hands frequently and correctly, control flies inside and outside of the food service operation. Practice good personal hygiene.
- Bacteria: Staphylococcus aureus Illness: Staphylococcal gastroenteritis
 - Associations: Foods that require handling during preparation including salads containing TCS foods (potato, tuna, shrimp, macaroni and chicken), deli meats.
 - Most Common Symptoms: Vomiting and retching, abdominal cramps, nausea.
 - Other Prevention Measures: Wash hands frequently and correctly – especially after touching the hair, face or body, cover wounds on hands and arms, hold, cool and reheat foods correctly. Practice good personal hygiene.
- Bacteria: Vibrio vulnificus and Vibrio parahaemolyticus Illness: Vibrio gastroenteritis and Vibrio vulnificus primary septicemia
 - Associations: Oysters from contaminated water.
 - Most Common Symptoms: Diarrhea, abdominal cramps and nausea, vomiting, low grade fever and chills.
 - Other Prevention Measures: Cook oysters to minimum internal temperature. Purchase only from approved, reputable suppliers.

Foodborne Illnesses – Parasites

- Parasite caused foodborne illnesses are not as common as illnesses caused by viruses and bacteria. However it is still important to know these common characteristics of parasites:
 - Growth: Parasites cannot grow IN food. They need to be in the meat of another animal to survive.
 - Transfer: Eating food contaminated with parasites will cause illness – many animals can be hosts to parasites. These animals include: cows,

pigs, chicken, and fish. Parasites can also be found in the feces of animals and humans.

- Contamination: Parasites can contaminate food and water. Particularly water used to irrigate produce.
- Parasite: *Anisakis simplex*. Illness: Anisakiasis
 - Associations: Foods that are commonly linked with this parasite are raw and undercooked fish, including: herring, cod, halibut, mackerel and pink salmon.
 - Most Common Symptoms: Tingling in the throat and coughing up worms.
 - Other Prevention Measures: Cook fish to minimum internal temperatures, if serving raw or undercooked fish, only purchase sushi grade fish that has been frozen to the right temperature requirements. Purchase only from approved, reputable suppliers.
- Parasite: *Cryptosporidium parvum*. Illness: Cryptosporidiosis
 - Associations: Contaminated water, produce.
 - Most Common Symptoms: Watery diarrhea, abdominal cramps, nausea, weight loss.
 - Other Prevention Measures: Use properly treated water, keep staff with diarrhea completely out of the food service operation, wash hands frequently and correctly. Purchase only from approved, reputable suppliers.
- Parasite: *Giardia duodenalis* also known as *G.lamblia* and *G. intestinalis*. Illness: Giardiasis
 - Associations: Improperly treated water, produce.
 - Most Common Symptoms: Initially: fever. Later: diarrhea, abdominal cramps, nausea.
 - Other Prevention Measures: Use properly treated water, keep staff with diarrhea completely out of the food service operation, wash hands frequently and correctly. Purchase only from approved, reputable suppliers.

Foodborne Illnesses – Fungi

- Fungi are pathogens that only sometimes make people sick. Fungi mostly spoil food. They are found in air, soil, plants, water and in some foods.
- Fungi: Molds – Basic common characteristics:
 - Effects: Molds spoil food and sometimes cause illness.
 - Toxins: Some molds produce toxins, such as aflatoxins.
 - Growth: Molds grow almost under any conditions. However, they grow especially well in acidic foods with little moisture. Examples of these foods include: jams, jellies, and cured, salty meat such as ham, bacon, and salami.
 - Temperature: Cooler or freezer temperatures may slow the growth of molds, but they don't kill them.
 - Prevention Measure: Throw out all mold food unless mold is a natural part of the product (such as Brie cheese, Camembert, and Gorgonzola). The Food and Drug Administration (FDA) recommends cutting away moldy

areas in hard cheese – at least one (1) inch (2.5 centimeters) around them. You can also use this procedure on food such as salami and firm fruit and vegetables.

- Fungi: Yeasts – Basic common characteristics:
 - Signs of Spoilage: Yeasts can spoil food quickly. Signs of spoilage can include the smell or taste of alcohol. The yeast itself may look like a pink or white discoloration or slime, and it may also bubble.
 - Growth: Like molds, yeasts grow well in acidic foods with little moisture. Examples of these foods include: jams, jellies, syrup, honey, and fruit or fruit juice.
 - Prevention Measure: Throw out any food that has been spoiled by yeast.

Foodborne Illnesses – Biological Toxins

- Do not confuse Biological CONTAMINATION *from* Pathogens and Biological TOXINS. Biological Toxins are made *by* pathogens, or they could come from a plant or an animal. Seafood toxins, plant toxins, and mushroom toxins all cause foodborne illnesses.
- Seafood toxins can't be smelled or tasted.
- Seafood toxins cannot be destroyed by freezing or cooking once they form in food.
- Fish Toxins: Some fish toxins are a natural part of the fish while others are made by the pathogens on it. Some fish become contaminated when they eat smaller fish that have eaten a toxin.
- Shellfish Toxins: Shellfish, such as oysters can be contaminated when they eat marine algae that have a toxin.
- Toxin: Histamine. Illness: Scombroid poisoning
 - Associations: Tuna, bonito, mackerel, mahi mahi
 - Most Common Symptoms: Burning, tingling in the throat and mouth, reddening of the face and neck, sweating, headache. Possibly later: diarrhea, vomiting.
 - Other Prevention Measures: Prevent time temperature abuse during storage and preparation. Purchase only from approved, reputable suppliers.
- Toxin: Ciguatera. Illness: Ciguatera fish poisoning
 - Associations: Predatory tropical reef fish from the Pacific Ocean, the western part of the Indian Ocean, and the Caribbean Sea, including: barracuda, grouper, jacks, snapper.
 - Most Common Symptoms: Reversal of hot and cold sensations, nausea, vomiting, tingling in fingers, lips and/or toes, joint and muscle pain.
 - Other Prevention Measures: Purchase predatory tropical reef fish only from approved, reputable suppliers.
- Toxin: Saxitoxin. Illness: Paralytic shellfish poisoning (PSP)
 - Associations: Shellfish found in colder waters such as those found in the Pacific and New England coasts, such as: clam, mussels, oysters, and scallops.

- Most Common Symptoms: Numbness, tingling of the mouth, face, arms and legs, dizziness, nausea, vomiting, diarrhea.
- Other Prevention Measures: Purchase shellfish only from approved, reputable suppliers.
- Toxin: Brevetoxin. Illness: Neurotoxic shellfish poisoning (NSP)
 - Associations: Shellfish found in warmer waters such as those found in the west coast of Florida, the Gulf of Mexico and the Caribbean Sea, such as: clams, mussels, oysters.
 - Most Common Symptoms: Tingling and numbness of the lips, tongue, and throat, dizziness, reversal of hot and cold sensations, vomiting, diarrhea.
 - Other Prevention Measures: Purchase shellfish only from approved, reputable suppliers.
- Toxin: Domoic acid. Illness: Amnesic shellfish poisoning (ASP)
 - Associations: Shellfish found in coastal waters of the Pacific Northwest and in the east coast of Canada, such as: clams, mussels, oysters and scallops.
 - Most Common Symptoms: Initially: Vomiting, diarrhea, abdominal pain. Possibly Later: Confusion, memory loss, disorientation, seizure, coma.
 - Other Prevention Measures: Purchase shellfish only from approved, reputable suppliers.
- Mushroom Toxins
 - Foodborne illnesses linked to mushrooms are almost always caused by accidentally eating toxic, wild mushrooms collected by amateur hunters.
 - The symptoms of illness depend on the type of mushroom ingested.
 - Mushroom toxins are NOT destroyed by freezing or cooking.
 - DO NOT use mushroom products unless you have purchased them from an approved, reputable supplier.
- Plant Toxins
 - Plant toxins are another form of biological contamination.
 - Illnesses from plant toxins sometimes happen when a food operation has purchased plants from an unapproved supplier.
 - Some illnesses are also caused by plants that have not been cooked the right way – for example, undercooked kidney beans.
 - Purchase plants and items only from approved, reputable suppliers.