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EVIDEN



# FOOD SCIENCE

In the dangerous world of microbes, everyone must work together to prove your food is innocent.

**Deservet** News

### What's your food's alibi?

### Keeping food safe may seem like a simple task...

But when you think of all the things that can happen to food on its way to your fork—bacteria, bad food handling and processing, and a list of other potential food contaminators—the food system starts to look complicated.

As you look at the food chain, consider all the things that can go wrong at each step. There are hundreds of people whose job it is to make sure that all of the links in this chain stay safe.

Food safety means:

- keeping food the proper temperature,
- preventing foreign objects from getting into food,
- keeping sources of "bad" bacteria away from the food,
- making sure that packaging is sealed,
- making sure that all food handlers and the food handling environment are clean and healthy.

Food for thought: it takes a lot of work to keep our food safe, but whose job **is** it? **EVERYONE'S!** 

### What is food safety?

Food safety is the practice of making sure that people have the healthful food they need for an active, healthy lifestyle. Some foods, particularly fresh fruits and vegetables, are not cooked before we eat them. These foods must be handled correctly to make sure they are safe to eat. Meat and dairy products also require special handling.

Farmers follow Good Agricultural Practices (GAPs) that ensure the cleanliness of equipment and storage containers, the correct use of pesticides and fertilizers to avoid contaminating food, and keeping records so that their crops can be traced through the food system.

Food processors, restaurants and grocery stores also follow specific guidelines that ensure that when the food reaches you, it is clean and safe.

### What is your part in this food chain?

In this issue, you will learn about how scientists, food processors, farmers and more work to keep your food safe, but most importantly, you will investigate what YOU can do to make sure you don't get sick!

From the farm to your fork, everyone who comes into contact with food must do their best to keep it safe.

#### From the farm...

- Fruits and veggies are picked carefully
- Grains are fresh and dry
- Animals are clean and healthy



#### ... to the food company...

- Meat, poultry and fish are cleaned and refrigerated
- Proper temperatures are maintained
- Labels are put on cans and packages

GROCERY

#### to the grocery store..

- Store is clean
- Workers wear plastic gloves
- Cold foods are cold
- Food and packages have no damage

...to your home.

### How might food get contaminated?

There are three types of dangers when it comes to food safety.

**Foreign objects** include things like small pieces of metal, glass, or other items that can be seen and touched and can get into your food. Food is carefully inspected visually and sometimes with metal detectors as a precaution, just in case something gets missed.

**Chemicals** like cleansers can get into food after cleaning processing equipment. Workers are trained on how to keep the chemicals from contaminating the food, and they document all of their chemical uses to make sure they are being safe.

**Biological food** *hazards* are the most common threat. Biological food hazards include bacteria, mold, parasites, and viruses that live in food and may multiply and give people the typical symptoms of a foodborne illness, or **food poisoning**. Some of these *microbes* cause *contamination* that you can see or smell, but many cannot be detected. Bacteria can grow rapidly under certain conditions. It is these nearly invisible threats that people must work hardest to prevent.

### What is a foodborne illness?

Did you ever have an upset stomach that people called the 24-hour flu? If your symptoms lasted less than a day, chances are your brief illness was caused by something you ate. A *foodborne illness* is a disease that is carried to animals or humans by food. These illnesses are caused by microorganisms such as bacteria. Not all bacteria cause disease in humans. In fact, most bacteria don't bother us at all,



and some are even beneficial.

*Microorganisms* that do bother us or cause disease are called *pathogens*. Microorganisms grow rapidly when conditions are right — dark, damp places where temperatures range between 40°F and 140°F. Any type of food can be a source of foodborne illness; however, high protein foods are more suspect as the cause of illness. Examples include milk and milk products, eggs, meats, poultry, fish, seafood, and soy protein foods such as tofu. These products require very careful handling and proper temperatures — keep hot foods hot and cold foods cold! **Contaminate:** to make something unclean; contaminated food is usually unfit to eat

**Foodborne illness:** also known as food poisoning, these illnesses are caused by a wide range of microorganisms and can cause different symptoms

Hazard: risk or danger

GLOSSARY

FOOD SAFETY

**Microbe:** another name for a microorganism, especially one that causes disease

**Microorganisms:** any organism too small to be seen without the help of a microscope

**Pathogen:** any diseasecausing agent like viruses, bacteria, and other microorganisms

**Perishable:** something that can decay or spoil, usually refers to food

### FOOD SAFETY TIMELINE

People haven't always known about microbes, and they weren't discovered overnight. They are so small they have been difficult to detect, but if you follow this food safety timeline, you will see the discoveries and accomplishments that have allowed people in the United States to enjoy an increasingly safe food supply.

### c 6000 BC

#### **Cheese** was first made

when animals' stomachs were used as storage containers for milk. Today we know that the rennet from the stomach separated curd and whey, forming cheese. This preserved milk that would have otherwise spoiled.

### FEAR The truth about microbes

## FACTOR

A few very dangerous bacteria have given all microbes a bad name! Microbes live almost everywhere-in fact, you are covered with them inside and out. Your mouth contains over 600 kinds. There are many beneficial microorganisms, and some of them can even help fight against the "bad guys."

### The good guys

The microscopic world is a tough place, and as microbes compete, good ones can be used to "arrest" the ones that make you sick. There are several ways that good bacteria help fight the bad guys:

- Eating all the food so the bad guys starve to death
- Creating acid environments that kill the bad guys
- Even causing the bad guys to explode!

Many "good guys" are used intentionally in the food system. Some beneficial microorganisms include:

### Yeast

Yeast

These are small, single-celled plants that belong to the fungus family. They are used in making bread rise and creating vinegar.

### Lactic Acid Bacteria

These microbes change carbohydrates into lactic acid, a substance that can kill many other microorganisms! They are most commonly used in yogurt, cheese, sauerkraut, and sausage.



### Penicillium

This incredible mold kills bacteria by weakening their cell walls, causing water to rush in until — BOOM! — the cell gets too full and explodes. It is not only used in making the penicillin that you may have taken for an infection, but different forms are used in making some cheeses.



"good" microbe and was used to make bread in Egypt as early as 4000 BC. The discovery of yeast is generally considered accidental.

### Unfortunately, sometimes the bad microbes can take over...

### The bad guys

While some forms of bacteria and microbes can prevent foods from spoiling, others can grow in food without showing any signs of contamination and cause **food poisoning**. Some of the many harmful bacteria include:

### Salmonella

This is the most commonly reported foodborne illness. It is most commonly found in raw or under-cooked poultry, eggs, and unpasteurized milk, but it can be easily spread to other foods by cross contamination. Symptoms include headache, abdominal pain, diarrhea, fever, and nausea.



Salmonella

#### Campylobacter

Symptoms caused by this spiral-shaped bacteria include muscle pain, headache, and fever followed by diarrhea, abdominal pain, and nausea that begin one to 10 days following ingestion. It is one of the most common causes of diarrhea in the U.S.



#### Campylobacter

Now that you know some of the suspects, it's time to investigate each one at the scene of the crime—your food!

### Profile of an imposter

Name: H1N1 Alias: Swine Flu



**Symptoms:** Tiredness, headache, runny nose, sore throat, shortness of breath or cough, loss of appetite, aching muscles

**Misconception:** This virus is not spread through pigs or pork products, only by human-to-human contact.

### E. coli

Many types of *E. coli* are found in the intestines of warm-blooded animals, and when food or water is contaminated with feces and consumed by humans, severe illness can occur.





Edward Jenner invents vaccine to prevent smallpox after observing that milkmaids who had contracted cow pox, a very similar virus, did not suffer from the disease.





#### Bottled and canned food

is developed in response to Napoleon's need to feed the French army. By inventing a method of preserving food in glass bottles, Nicolas Appert won a 12,000 franc prize. The causes of spoilage were still unknown, so he succeeded by trial and error. Food safety is the practice of making sure that people have the nutritious food they need for an active, healthy lifestyle. Fresh fruits, vegetables, dairy, and meat need to be handled correctly and kept at proper temperatures to make sure they are safe to eat. See if you can get from farm to fork safely!

### FROM FARM TO FORK PROVE YOUR FOOD IS INNOCENT!

You washed your hands, but a towel was not close by so you wiped them on your pants.

> Move forward 2 spaces, then back 3 spaces

You washed the plastic cutting board in the dishwasher after dinner.

BACTERIA

Lose a turn!

You washed the raw meat juices off the platter with warm soapy water before you used it for cooked meat.

You cut up the chicken and then cut the veggies without washing the knife or cutting board.

You washed your

cutting board under

hot soapy water after

cutting raw chicken.

**Move back** 

**3** spaces

soon as dinner was over.

> Move ahead 3 spaces

You put the leftovers

in the refrigerator as



You put the ground beef out to thaw on the counter all day.

**Move back** 

1 space

You understand the importance of keeping hot foods hot and cold foods cold.

#### **NUMBER OF PLAYERS:** 1-5

#### **BEFORE THE GAME:**

Each player needs to obtain a small item (bean seed, eraser, etc.) to use as a game piece. Find a die or create your own by numbering six small pieces of paper from 1-6, folding them up and selecting them from a cup.

You decide not to wash your hands before helping with dinner.

> Move back 1 space



You washed your hands for 20 seconds with warm water and soap before helping make dinner.

The U.S. Food and Drug Administration (FDA) finds a food label incorrectly labeled.

**Move back** 

**1** space

Move ahead 3 spaces

#### **HOW TO PLAY:**

Each player puts his or her game piece on the "start" circle near the farm pitchfork, takes turns rolling the die and moving their game piece, and follows the directions on each circle. If you land on a microbe (bacteria) picture, you lose a turn.

Keep playing until each person gets to "Let's Eat!" near the food fork.

### START

The farmer plants, harvests, and stores the food correctly to help with food safety.

> Move ahead 1 space

The U.S. Department of Agriculture (USDA) inspects your meat. People working at a food packaging plant wash their hands.



A food company makes sure temperatures are cool enough for foods that need to be kept cold.

> Move ahead 3 spaces

ou decide to order a medium rare hamburger.

> Move back 3 spaces

You dried the dinner dishes with the cloth that had been hanging all week on the refrigerator door.

Move back 2 spaces

Restaurant servers handle food with clean hands. A milk processing plant tests milk five times before it is sent to the store.



The local burger restaurant cooks your burger well done.

LET'S

EAT!

Truck drivers check their truck refrigeration to transport the food safely. The food truck breaks down, and the frozen food thaws.

> Move back 3 spaces

## THE FOOD SYSTEM

You may have heard of food safety scares with peanut butter, spinach, beef, and more. Bacteria are everywhere and can sometimes sneak past our defenses, but food producers and processors are always working hard to keep you safe. Follow your food from the farm to your fork, and investigate the risks that have to be managed at each stage.

### The farm

The process of keeping food safe begins before a seed is even planted in the ground.

Farmers work hard to make sure that their soil is healthy and that their farms produce safe, nutritious food. Shown here are just some of the things farmers do. What other possible food safety risks do farmers need to consider?





### **Potential Risk:**

Bruised fruits and vegetables can pick up microbes that will make them spoil. **Safety Measures:** Fruits and vegetables are picked carefully and stored safely in crates or other appropriate containers and handled carefully.

**Potential Risk:** Molds can grow in damp, dark conditions. **Safety Measures:** Grains and other foods are harvested when fresh and dry.



**Potential Risk:** Sick animals can spread disease. **Safety Measures:** Animals are kept clean and receive veterinary checkups to make sure they stay healthy.



**Potential Risk:** Pesticides and fertilizers can leave traces on the food if applied at the wrong time. **Safety Measures:** Pesticides and fertilizers are applied carefully by farmers and licensed specialists who have education and experience in using them.



### **Jacob Perkins**

first describes how to make a refrigerator, which has since allowed people to keep foods safe for longer, by keeping the temperatures lower to slow the growth of bacteria.

### 1862

#### Louis Pasteur

and Claude Bernard first test a method of heating beverages to kill bacteria and extend the time before they spoil. This process is known today as pasteurization.



### Transportation

When food is transported by sea, rail, or over the road by trucks, there are procedures that ensure food has not been tampered with in transit. The safety procedures may involve locks or seals to protect consumers.

Milk and temperature-sensitive products are transported in insulated trailers or refrigerated trucks to ensure that bacterial growth is minimized. The insulated cylinder of a milk truck works a lot like a thermos on wheels — even in hot weather, milk in a "thermos trailer" only rises 1°F in 24 hours.

### The factory

Moving parts and humid conditions in many factories can create the ideal situation for bacteria to grow. To keep this from happening, some food processors will heat their products to a level that will kill the bacteria and stop it from contaminating the product, like pasteurizing milk and heating tin cans to kill the bacteria inside. Others ensure proper refrigeration at all stages of processing, and **everyone** does their best to ensure that facilities are sanitary.

There are other risks in the factory, however, and food processors use Good Manufacturing Processes (GMPs) and preventive maintenance to minimize these risks.

For every food you see in the grocery store, there is a food processing business that takes the product from the farm and sorts, cleans, cooks, and boxes, cans, or bottles it into the familiar products you use every day.

Different food processors deal with different risks. Processing milk for cheese (top right), for example, has very different risks from processing flour from wheat (bottom right). What are some differences that you can think of for the following types of food processing businesses: ------



### The U.S. Department of Agriculture

(USDA) is established by President Lincoln. Its current role in food safety is to provide inspection services to agricultural facilities, but it also provides research and marketing services in the field of agriculture and much more.



Macaroni and cheese processor Cookie maker Tuna fish canner Cranberry packer Applesauce processor Meat processor Ketchup bottler Orange juice processor





### The Food and Drug Administration (FDA)

becomes a regulatory body when the Pure Food and Drug Act is passed, which prohibited interstate commerce of adulterated and misbranded food and drugs. Since that time, the FDA has taken on an increasingly important role in food safety.

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### The restaurant

Workers at restaurants have to get food handler's permits in order to work. These permits are given to people who successfully pass a safe food-handling course. Restaurant employees know to stay home when they are sick, wash their hands often, and cook food to proper temperatures and store them safely.

### The store

Grocery stores also share an important role in keeping food safe. In addition to making sure that foods are kept at the right temperatures, grocery stores also make sure that the food doesn't stay on the shelf after it has expired. To do this, employees watch the labels and remove expired food. BUT...

Grocery store managers and employees can't do everything, and this is the first step in the food system where YOU play a part in making sure your food is safe.

### What can you do?

Following these simple guidelines is a start to making sure you don't make yourself sick.

- 1. Wash your hands after pushing a shopping cart. Germs can be spread easily by unwashed hands.
- 2. Look carefully at the sell-by or expiration date.
- After you have purchased your groceries, make sure that perishable foods are put in the refrigerator as soon as possible. Do not let them sit in your car while you make other stops.
- 4. Avoid canned foods that are swollen or bulging, leaking, rusted, or are dented at the seam or rim. Do not use cans with sharp dents. Products in cans that are only slightly dented can be consumed as long as there are no leaks and the product appears wholesome.

### **Alexander Fleming**

discovers that staphylococcus (bad guy) bacteria will not grow around a certain mold in a petri dish. He was then able to grow more of the mold and safely dilute the active ingredient: penicillin (good guy).

### Ongoing

**Technology** is continually making life better, and thanks to technology like telephones, television, and the Internet, word travels fast. Food recalls can happen quickly when necessary, but are mostly prevented with the increased industry standards and our improved ability to detect and prevent problems.

### **Potential Risk:** Products can go bad when they stay on the shelves too long.

**Safety Measures:** Products that are nearing their "sell by" or "expiration" date are removed from the shelves.





**Potential Risk:** Deli meat and cheese can become contaminated. **Safety Measures:** Workers wear gloves and make sure food contact surfaces are clean.

1928

### Your kitchen

The farmers, food processors, and grocery stores have worked hard to ensure your food is safe. Now that you have the food, what are you going to do?

Bacteria are lurking everywhere. Match each Food Safety Concern listed below with the problems you see in the kitchen by placing the correct number in the circle near the problem.



### How's it growing?

Bacteria grow faster or slower depending on the temperature. Look at a temperature on the thermometer, then look below to find out how long it takes bacteria to double at that temperature.



foods cold!

FOOD SAFETY CONCERNS

Bacteria from meat can contaminate vegetables from the same cutting board. This is known as "cross contamination." After cutting meat, you should wash the board with hot, soapy water. It is also a good idea to keep separate cutting boards for meat and vegetables.

The cat is on the counter. Pets can spread bacteria and should not be allowed in contact with food surface areas. You should also wash your hands after touching pets and before you eat. This stirring spoon is being used to taste the food. This spreads mouth germs to everyone's food. A new spoon should be used every time the food is taste-tested.

This damaged packaging is spilling and microbes could get in. It is also making a mess on the floor.

5 The ice cream has been left out on the counter and is melting. Not only does this create a sticky mess, it may lead to bacterial growth in the ice cream.

- Food scraps have been left on the floor, and bacteria could easily begin to grow on these scraps and then spread to other areas of the kitchen.
- The sink and counter tops are full of dirty dishes. Wherever there are food particles, there could be bacteria growing. It is important to promptly wash dishes and not let them sit.

There is no soap in this kitchen which is necessary for handwashing and cleanup.



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### Food investigators

It is the job of the Utah Department of Agriculture and Food (UDAF) to work as detectives of the food supply. These detectives, called environmental health scientists, follow food from the farm to your fork and make sure that everyone is in compliance (following the rules). UDAF inspects farms, processing facilities and grocery stores.

### Here are just some of their responsibilities:



#### AT THE GROCERY STORES:

(including deli and bakery sections and health food stores)

- Ensure that recalled foods are pulled from shelves
- Check for cleanliness and appropriate temperatures

ON THE FARMS:

- · Check farm records for pesticide use
- Provide advice to farmers on how to reduce pesticides
- Help farmers manage soil runoff · Provide veterinary inspection and services for animal agriculture

### IN THE PROCESSING FACILITIES:

(such as bakeries, mills, cheese makers, meat processors, etc.)

- Provide specialized drop-in inspections for all facilities
- · Check for cleanliness
- · Check for appropriate temperatures (hot foods must be hot, cold foods must be cold)
- Approve labels for packaging

#### AT YOUR HOME:

· Send notices over the Internet and in newspapers about food recalls, so that you can throw away or return unsafe items.

Sponsors: • Utah Foundation for Agriculture in the Classroom Utah State University Extension

Food and Drug Administration

• Utah Department of Agriculture and Food

#### Credits:

- ARS-Agricultural Research Magazine, May/June 2009
- National Cattlemen's Beef Association -Safe Food Journey Poster
- California Foundation for Agriculture in the Classroom - From Farm to Fork

## Build your own food safety story

You woke up this morning to find your family with symptoms of food poisoning like vomiting, diarrhea, and headaches. You are the only person who didn't get sick, so you decide to open an investigation into the causes of your family's illness. Go to a if you want to first investigate the foods your family has eaten. Go to **b** if you recognize the symptoms of salmonella poisoning and want to examine the dinner leftovers.

Αςτινιτγ

**a.** The night before, your mom ordered two kinds of pizza (one sausage, one pepperoni), and served green beans and orange juice as well. You interview each family member to find out what they ate. Here are the results:

- Dad: All
- Mom: No orange juice
- Brother: No pepperoni pizza
- Sister: No green beans
- You: No sausage pizza, no green beans

Since you didn't get sick, you know it has to be one of the things you didn't eat. Go to **c** if you think it's green beans and go to **d** if you think it's the sausage pizza.

**b.** You take a sample of each food but can't tell anything from just looking. When you use a microscope to

examine it, you realize that there are germs on all of the food you look at, but you can't identify anything as salmonella. Go back to **a** to see if you can find the answer.

**c.** Your sister didn't eat the green beans either, and since she still got sick, green beans can't be the cause of the illness. Go back to **a** and try again.

**d.** You are the only person who did not eat the sausage pizza. Everyone who ate the sausage pizza got sick. This is the most likely answer, but you decide to investigate further. Go to **e** if you decide to try a piece of sausage pizza or **f** if you decide to call the pizza restaurant.

e. Congratulations! You get sick and are now sure that the pizza was contaminated.

f. The pizza restaurant manager apologizes after finding that the sausage his employees had used had passed its expiration date. He refunds your parents for the pizza and offers free pizza next time you visit, but now the thought of pizza makes your family feel sick. It may be a while before you eat it again.



Agriculture in the Classroom **UtahState**University COOPERATIVE EXTENSION



Agricultural Research Center (ARS) is working on technology that may make it safe to eat raw cookie dough, which currently should not be consumed due to the potential risk of salmonella in raw eggs. The technology,

called "crossflow microfiltration membrane separation" (CMF), removes more pathogens than pasteurization does. And, it does so without affecting the eggs' quality-meaning that CMFtreated eggs could be safely substituted for pasteurized eggs in products such as angel food

cake and mayonnaise.

The ARS is also experimenting with cold plasma, which is created by introducing electricity into a gas. This may one day keep fresh produce like apples and almonds safe from potentially harmful bacteria such as salmonella, Listeria and E. coli.

Microbiologist George Paoli inspects antibody-coated magnetic beads and biologist Chandi Wijey analyzes DNA samples in their efforts to improve food safety.