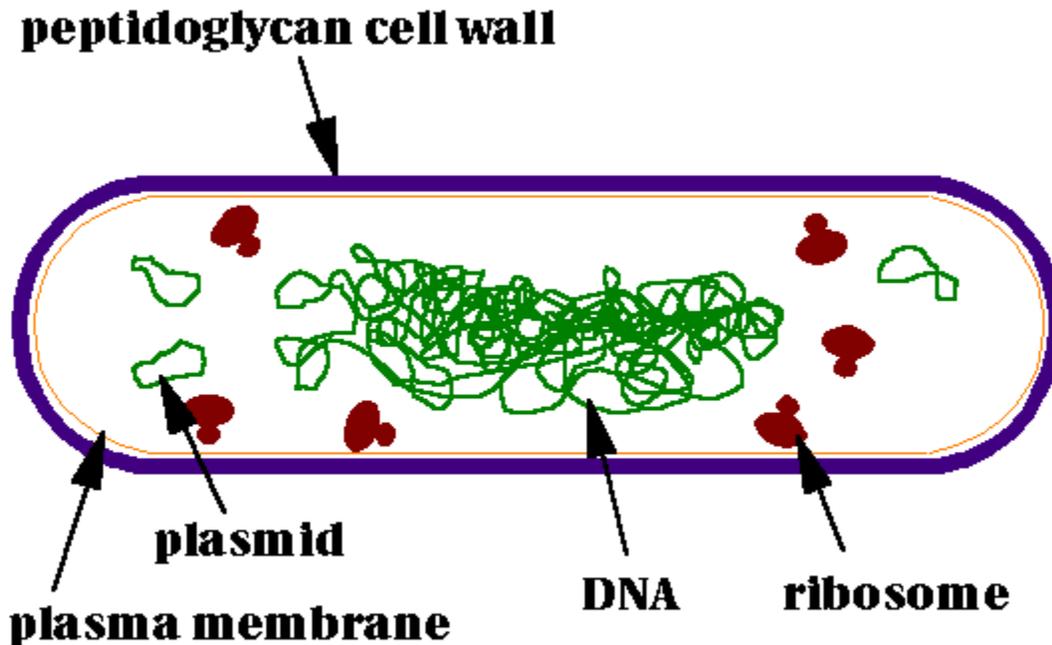


Introduction to the Bacteria

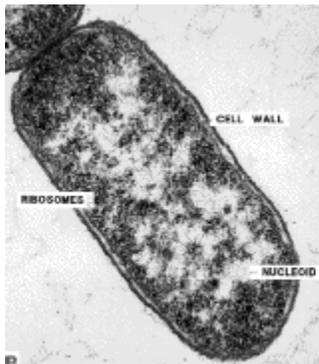


Bacteria are often maligned as the causes of human and animal disease (like this one, *Leptospira*, which causes serious disease in livestock). However, certain bacteria, the actinomycetes, produce antibiotics such as streptomycin and nocardicin; others live symbiotically in the guts of animals (including humans) or elsewhere in their bodies, or on the roots of certain plants, converting nitrogen into a usable form. Bacteria put the tang in yogurt and the sour in sourdough bread; bacteria help to break down dead organic matter; bacteria make up the base of the food web in many environments. Bacteria are of such immense importance because of their extreme flexibility, capacity for rapid growth and reproduction, and great age - the oldest fossils known, nearly 3.5 billion years old, are fossils of bacteria-like organisms.

More on Morphology



A more or less typical bacterium, shown here, is comparatively much simpler than a typical eukaryotic cell. View the transmission electron micrograph of a typical bacterium, *E. coli*, below and compare it with the diagram above.



Bacteria lack the membrane-bound nuclei of eukaryotes; their DNA forms a tangle known as a **nucleoid**, but there is no membrane around the nucleoid, and the DNA is not bound to proteins as it is in eukaryotes. Whereas eukaryote DNA is organized into linear pieces, the chromosomes, bacterial DNA forms loops. Bacteria contain **plasmids**, or small loops of DNA, that can be transmitted from one cell to another, either in the course of sex (yes, bacteria have sex) or by [viruses](#). This ability to trade genes with all comers makes bacteria amazingly adaptable; beneficial genes, like those for antibiotic resistance, may be spread very rapidly through bacterial populations. It also makes bacteria favorites of molecular biologists and genetic engineers; new genes can be inserted into bacteria with ease.

Bacteria do not contain membrane-bound organelles such as mitochondria or chloroplasts, as eukaryotes do. However, photosynthetic bacteria, such as cyanobacteria, may be filled with tightly packed folds of their outer membrane. The effect of these membranes is to increase the potential surface area on which photosynthesis can take place.

The cell membrane is surrounded by a **cell wall** in all bacteria except one group, the Mollicutes, which includes pathogens such as the mycoplasmas. The composition of the cell wall varies among species and is an important character for identifying and classifying bacteria. In this diagram, the bacterium has a fairly thick cell wall made of **peptidoglycan** (carbohydrate polymers cross-linked by proteins); such bacteria retain a purple color when stained with a dye known as crystal violet, and are known as **Gram-positive** (after the Danish bacteriologist who developed this staining procedure). Other bacteria have double cell walls, with a thin inner wall of peptidoglycan and an outer wall of carbohydrates, proteins, and lipids. Such bacteria do not stain purple with crystal violet and are known as **Gram-negative**.

How bacteria enter the body

To cause disease, pathogenic **bacteria** must gain access into the body. The range of access routes for bacteria includes:

- Cuts
- Contaminated food or water
- Close contact with an infected person
- Contact with the faeces of an infected person
- Breathing in the exhaled droplets when an infected person coughs or sneezes
- Indirectly, by touching contaminated surfaces – such as taps, toilet handles, toys and nappies.

Bacteria types

Bacteria that cause disease are broadly classified according to their shape. The four main groups include:

- **Bacilli** – shaped like a rod with a length of around 0.03mm. Illnesses such as typhoid and cystitis are caused by bacilli strains.
- **Cocci** – shaped like a sphere with a diameter of around 0.001mm. Depending on the sort, cocci bacteria group themselves in a range of ways, such as in pairs, long lines or tight clusters. Examples include *Staphylococci* (which cause a host of infections including boils) and *Gonococci* (which cause the sexually transmissible infection gonorrhoea).
- **Spirochaetes** – as the name suggests, these bacteria are shaped like tiny spirals. Spirochaetes bacteria are responsible for a range of diseases, including the sexually transmissible infection syphilis.
- **Vibrio** – shaped like a comma. The tropical disease cholera, characterised by severe diarrhoea and dehydration, is caused by the vibrio bacteria.

Characteristics of the bacterium

Most bacteria, apart from the cocci variety, move around with the aid of small lashing tails (flagella) or by whipping their bodies from side to side. Under the right conditions, a bacterium reproduces by dividing in two. Each ‘daughter’ cell then divides in two and so on, so that a single bacterium can bloom into a population of some 500,000 or more within just eight hours.

If the environmental conditions don’t suit the bacteria, some varieties morph into a dormant

state. They develop a tough outer coating and await the appropriate change of conditions. These hibernating bacteria are called spores. Spores are harder to kill than active bacteria because of their outer coating.

Curing a bacterial infection

The body reacts to disease-causing bacteria by increasing local blood flow (inflammation) and sending in cells from the immune system to attack and destroy the bacteria. Antibodies produced by the immune system attach to the bacteria and help in their destruction. They may also inactivate toxins produced by particular pathogens, for example tetanus and diphtheria.

Serious infections can be treated with antibiotics, which work by disrupting the bacterium's metabolic processes, although antibiotic-resistant strains are starting to emerge. Immunisation is available to prevent many important bacterial diseases such as Hemophilus influenza Type b (Hib), tetanus and whooping cough..

1. Gastroenteritis – salmonellosis

Summary

Salmonellosis is a form of gastroenteritis caused by Salmonella bacteria. Eating undercooked poultry or undercooked eggs may lead to a person getting salmonellosis. Symptoms of salmonellosis include diarrhoea which may contain blood or mucous, fever, headache, stomach cramps, nausea, vomiting and dehydration. Antibiotics are not usually required.

Salmonellosis is a form of gastroenteritis caused by the germ (bacterium) *Salmonella*. Salmonellosis can affect anyone; however, most cases occur in children and young adults. The severity of symptoms depends on the number of bacteria you ingest, your age and your general health. You may be more prone to salmonellosis if you are elderly, have another medical condition (such as a weakened immune system) or are malnourished.

The symptoms of salmonellosis

Symptoms of salmonellosis usually occur between 6 to 72 hours after you ingest the bacteria. The most common symptoms include:

- Diarrhoea, which may contain blood or mucous
- Fever
- Headache
- Stomach cramps
- Nausea
- Vomiting
- Dehydration, especially among infants and the elderly.

In rare cases, septicaemia (local infection) may develop as a complication of salmonellosis.

Salmonellosis is spread by mouth

Salmonellosis occurs when *Salmonella* bacteria are taken in by mouth. This may happen in any of the following ways:

- Eating undercooked meat, especially poultry, and raw or undercooked eggs.
- Eating cooked or ready to eat food that has been contaminated with *Salmonella* bacteria from raw food, such as raw chicken. This is called **cross-contamination** and can also happen when food comes into contact with contaminated kitchen surfaces, such as chopping boards and utensils that have been used with raw food.
- People with salmonellosis have *Salmonella* bacteria in their faeces. If these people do not wash their hands properly after going to the toilet, their contaminated hands can spread the bacteria to surfaces and objects that may be touched by others or food that will be eaten by others. Hands can also become contaminated when changing the nappy of an infected infant.
- Pets and farm animals may have *Salmonella* bacteria in their faeces without having any symptoms. People can get salmonellosis from these animals if they do not wash their hands after handling them.

You may be infectious for several weeks

Although the illness usually only lasts for a few days, the bacteria may be present in your faeces for several weeks. One per cent of adults and five per cent of children may carry the bacteria for more than a year.

If you develop gastroenteritis

To find out if you have salmonellosis, the doctor will ask you for a stool (faeces) sample for testing. If the results show that you have salmonellosis, the doctor will be able to provide advice and appropriate treatment, and will notify the Department of Health Victoria.

If you think you got the infection from contaminated food, contact the health department of your local council. Keep any leftover food that you believe may have caused you to become ill as this will help trace the source of the bacteria.

Food-borne outbreaks of salmonellosis do occur, and tracing the source is an important public health responsibility.

How to avoid getting salmonellosis

To help protect yourself and others from salmonellosis:

- Thoroughly cook food derived from animal products - especially poultry, pork, eggs and meat dishes.
- Don't use dirty or cracked eggs.
- Keep your kitchen clean. Raw foods can contaminate surfaces.
- Store raw and cooked foods separately.
- Wash hands thoroughly with soap and hot running water for 10 seconds before handling food.

- Store high risk foods at or below 5°C or at or above 60°C to prevent growth of bacteria.
- Do not handle cooked foods with the same utensils used for raw foods, unless they have been thoroughly washed between use.

To prevent the spread of infection:

- Keep children home from school, child care or kindergarten until symptoms have stopped.
- Food handlers, childcare workers and health care workers must not work until symptoms have stopped.
- Clean bathrooms and other surfaces regularly.

Where to get help

- Your doctor
- The health department of your local council
- Communicable Disease Prevention and Control Unit, Department of Health Victoria Tel. 1300 651 160
- Public Health, Department of Health Victoria Tel. (03) 9096 0000

Things to remember

- Eating undercooked animal products, such as poultry and eggs, can cause salmonellosis.
- Safe food handling and thorough hand washing can help prevent Salmonellosis.

2. Tetanus

Summary

Tetanus is a serious bacterial disease that causes muscle spasms and breathing problems. Some wounds are more likely to encourage the growth of tetanus bacteria, such as a compound fracture, animal bite, burn or any wound contaminated with soil, horse manure or fragments of foreign objects.

Tetanus is a serious bacterial disease that causes muscle spasms and breathing problems. The tetanus bacillus is called *Clostridium tetani*. The bacteria produce toxins that affect the nervous system. Around one in 10 people infected with tetanus will die.

Tetanus is uncommon in Australia because of the widespread use of the tetanus vaccine. However, anyone who hasn't been immunised is at risk.

Symptoms

The signs and symptoms of tetanus may include:

- Muscle spasms that begin in the jaw and neck
- Inability to open the mouth (lockjaw)

- Swallowing problems
- Breathing difficulties
- Painful convulsions
- Abnormal heart rhythms.

Treatment

Tetanus is a life-threatening disease and sometimes, a person dies despite prompt medical attention.

Treatment for tetanus may include:

- Antitoxin called tetanus immunoglobulin to neutralise the tetanus toxin
- Hospitalisation
- Anti-convulsive medications
- Antibiotics
- Life support – for example, the person may be placed on an artificial respirator if they have severe breathing problems
- Vaccination, if the adult hasn't had a booster shot in the previous five years.

Prevention

The best prevention against tetanus is immunisation. Avoid skin injuries to reduce the risk of tetanus, for example wear gloves while gardening.

Seek medical advice for dirty wounds or wounds where the skin has been penetrated. The doctor may advise a tetanus booster shot depending on how long it is since your last tetanus dose.

If you have not had any previous immunisation against tetanus, a full course of three doses should be given. If the wound is deemed 'tetanus-prone', tetanus immunoglobulin should be given as well.

Vaccination is available

In Victoria, the tetanus vaccine is available in a combined vaccine that also contains vaccines against other serious and potentially fatal diseases. Different vaccine combinations are available depending on the person's age.

The recommended vaccination schedule where vaccine is provided free is:

- Children at age two, four and six months and four years of age.
- Year 10 of secondary school as a booster
- Age 50 to 59 years (inclusive) as a booster
- Catch-up to seven years of age (inclusive).

Where to get help

- Your doctor
- Emergency department of your nearest hospital
- Your local council immunisation service

Things to remember

- Tetanus is a serious bacterial disease that causes muscle spasms and breathing problems.
- The best prevention against tetanus is immunisation.

3. Tuberculosis (TB)

Summary

Tuberculosis (TB) is an infectious disease that typically affects the lungs but may infect any other organ of the body. TB can only be passed from person to person when someone with active TB of the lungs coughs or sneezes. It can be effectively treated with medications.

Tuberculosis, commonly known as TB, is an infectious disease caused by infection with the *Mycobacterium tuberculosis* bacterium. Typically TB affects the lungs but it also can infect any other organ of the body. It is spread from person to person through the air when someone with 'active' TB of the lungs or throat coughs or sneezes.

Not everyone with TB infection develops active TB

Only about ten per cent of people infected with TB develop 'active' TB disease that makes the person sick and causes symptoms. Medications can help reduce the risk of a person developing active disease.

How TB is spread

TB is spread when a person with the active disease of the lungs or upper airways coughs or sneezes. People nearby may breathe in these bacteria and become infected. The bacteria can settle in the lungs and begin to grow. From there, they can move through the blood or lymphatic system to other parts of the body such as the kidney, spine and brain. TB in the lungs or throat can be spread to other people. TB in other parts of the body is usually not infectious.

An infected person who does not have active disease cannot transmit TB to another person. Only people with 'active' disease of the lungs or upper airways can pass on the infection.

Sometimes a mother who has active TB disease that has not yet been treated can pass the germ to her baby before or during birth (congenital tuberculosis); however, this is extremely rare. There have been very few reported cases of this in the world.

Active TB disease makes you ill

Some of the symptoms of TB disease include:

- Persistent cough
- Tiredness
- Night sweats
- Weight loss
- Coughing up blood.

There is a vaccine against TB

The vaccine against TB is called BCG.

Testing for TB is simple

If your doctor thinks you have been infected with the TB germ, a skin test can be done. The Tuberculin Skin Test (Mantoux test) is one of the tests that can show if you are likely to have been infected. A new blood test called Quantiferon TB – Gold is now also available. You should be tested if you:

- Are infected with HIV/AIDS
- Live and work in close contact with someone who has recently been diagnosed with active TB of the lungs
- Have any TB symptoms.

Other common tests for TB include:

- A chest x-ray – to show whether TB has affected the lungs
- A sputum test – to see if TB germs are present in coughed-up sputum.

Treatment

If you have TB infection, your doctor may prescribe a course of tablets or follow up with regular chest x-rays. Active TB disease can be treated with medication, usually at a major public hospital or with a specialist physician. It will take at least six months to cure TB, sometimes longer.

It is very important that you take the full course of treatment. If you don't, TB can return and may be harder to cure because it may become resistant to the medication.

TB medications can cause side effects

The medications can cause side effects including:

- Itchiness
- Upset stomach
- Pins and needles
- Skin rash
- Blurred vision
- Dark urine (orange/red colored urine is a normal side effect and is **not** harmful)
- Yellow eyes.
- You should discuss any side effects with your doctor.

Things to remember

- Only people with active TB of the lungs can pass on infection.
- TB can be treated with medication.