



Health and Disease

BIOLOGY • HEALTHY LIVING • HEALTH AND DISEASE

Section 1: Keeping Healthy

• Why is personal hygiene important?

Every day we are exposed to millions of microorganisms, some are harmless while others are disease-causing (pathogens). We have evolved a variety of defence systems to block pathogens from entering our bodies. Skin provides a thick, strong barrier, while hairs in our lungs (cilia) sweep away pathogens trapped in mucus. However, we also need to make sure that we keep ourselves clean, as this helps to minimise or prevent the spread of disease. For example, not brushing your teeth regularly has been linked to an increase in heart disease. It is thought that oral bacteria can enter the blood stream through inflamed gums, where they produce protein that causes platelets in the blood to clot; this can lead to heart attacks and strokes. It is also a good idea to wash all over daily. You should wash your hands more frequently and certainly after using the lavatory and before preparing or eating food.

• Suggested Films

- Germs and Hygiene
- Healthy Teeth



Brushing your teeth helps prevent tooth decay and gum disease

Extension Question

Q1. Who was Ignaz Semmelweis?

Ignaz Semmelweis was a doctor in the mid-1850s who was concerned by the number of women dying shortly after giving birth. He realised that doctors were passing on infections to their patients because they weren't washing their hands in between seeing patients. Perhaps surprisingly, Semmelweis was mocked when he suggested that doctors should wash their hands, and it took years before his ideas were accepted.

• Why is food hygiene important?

If food is not handled, washed, cooked and stored properly, illnesses such as food poisoning can occur. Your hands are the main way pathogens are spread, so it is important that you wash them thoroughly with soap and water before and after food preparation. Bacteria grow best between 5°C-65°C, so cooking or reheating food to this temperature range can encourage bacterial growth and potentially cause food poisoning. For example, raw rice grains often carry the bacteria *Bacillus cereus*, which can survive boiling. If the cooked rice is cooled slowly or stored above 5°C, the bacteria will multiply rapidly and still survive reheating. Therefore, it is always best to cook fresh rice.

• Suggested Film

- Germs and Hygiene



Washing your hands removes pathogens from your skin

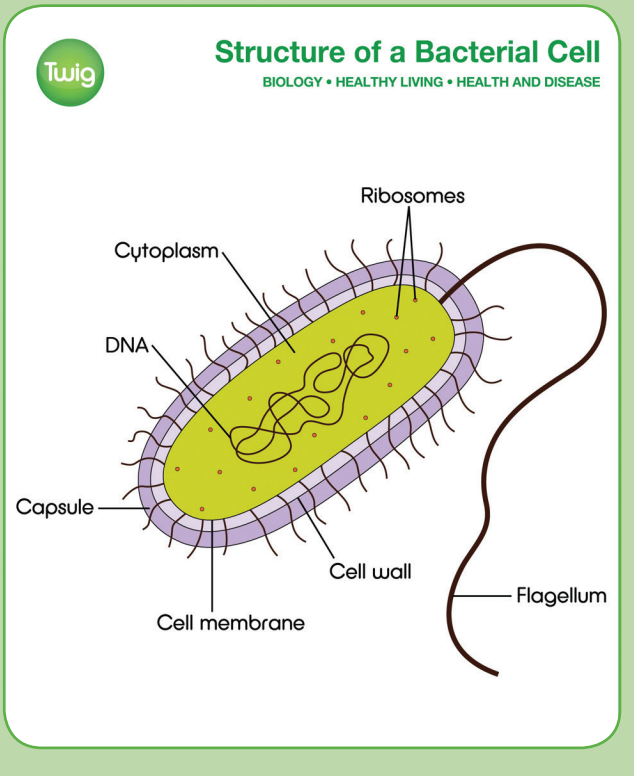
Extension Question

Q2. What is food poisoning?

Eating food contaminated with bacteria or a virus can cause food poisoning. The general symptoms of food poisoning include stomach pains, vomiting and diarrhoea. Some strains of bacteria can be extremely dangerous, such as *E. coli* 0157, which can cause kidney failure, and *Clostridium botulinum*, which causes botulism, a rare but serious illness that results in paralysis.

- How can you tell if someone is unwell?

DIAGRAM 01:



If someone becomes infected with a pathogen the white blood cells from the immune system will start to attack. However, it is likely that the infected individual will exhibit symptoms of the infection. Common symptoms of disease include a high temperature, headaches and rashes, which are caused by the toxins produced by the pathogens. However, there are symptoms that are specific to the type of pathogen that has caused the infection.

If someone has a bacterial infection, localised redness, heat, swelling and pain are evident. If bacteria have infected a cut, then pus (sticky, yellow fluid) is likely to be present.

Viral infections usually involve many different parts of the body or more than one body system at the same time. For example, the common cold might include a runny nose, a cough and a headache.

- **Suggested Film**
- Germs and Hygiene

Section 2: Spread of Disease

- What is a pathogen?

Infectious diseases are the result of microscopic, disease-causing microorganisms entering and attacking your body. These microorganisms are called pathogens and include bacteria and viruses.

Bacteria are single-celled organisms which, unlike animal and plant cells, do not contain a nucleus. Instead, they contain strands of DNA that control what happens in the bacterium and how it reproduces. Bacteria need a food supply to provide them with enough energy to grow and reproduce.

Viruses are much smaller than bacteria, and they do not have any of the structures found in normal cells. Rather, they contain a strand of DNA and have a protein or lipid shell. They do not need food to supply them with energy, except when they replicate, and can exist for thousands of years unchanged and inactive. They must enter a cell of another organism to reproduce.



- **Suggested Film**
- Germs and Hygiene

Extension Questions

Q3. What are fungal infections?

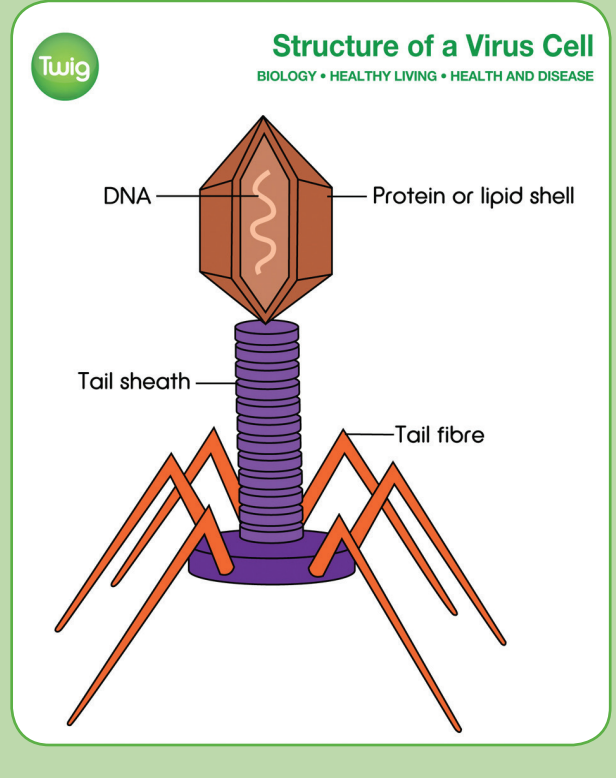
Pathogenic fungi can cause diseases such as athlete's foot, ringworm and thrush. Fungal infections are passed on by person-to-person contact and growth is encouraged by moist skin. As these sorts of infections are usually found on the skin, creams or lotions applied topically (directly onto the infected skin) can be used to treat them.

Q4. What was 'Spanish Flu'?

The 1918 flu pandemic, also known as the Spanish Flu, was a pandemic caused by the H1N1 influenza virus, which lasted from June 1918 to December 1920. Flu typically affects the very young, elderly and immune-compromised, but, unusually, the victims of the Spanish flu were mostly healthy young adults. A third of the world's population was infected and between 50 and 100 million people died, making it one of the deadliest natural disasters in human history.

Research on tissue samples taken from victims has shown that the virus proved fatal due to an overreaction of the body's immune system. The strong immune system reactions of healthy, young adults actually hastened their death, whereas those of the weaker immune systems of children and middle-aged adults resulted in fewer deaths.

DIAGRAM 02:



• How are diseases spread?

Pathogens and the diseases they cause are spread (transmitted) via person-to-person contact, food, water, air and insects. Not all pathogens use all available transmission routes:

- Sexually transmitted infections, such as chlamydia or gonorrhoea, are example of pathogens that are transmitted by person-to-person contact.
- Food poisoning can be caused by not heating contaminated food to a high enough temperature, which provides the perfect environment for bacteria to multiply. Symptoms of food poisoning involve stomach pain and vomiting.
- Waterborne diseases are caused by drinking contaminated water. Cholera and typhoid are both spread in this way.
- The common cold is an example of an airborne infection, which is easily passed from person to person via airborne droplets released during coughing or sneezing.
- Mosquitoes pass a malaria-causing parasite between humans when they feed on human blood.

• Suggested Film

- Sexually Transmitted Infections

• What is the difference between an epidemic and a pandemic?

An epidemic occurs when the number of people with a particular disease rises above what would normally be expected, based on previous outbreaks. If the epidemic is global it is called a pandemic. Usually, common diseases such as the common cold would not be classified as either an epidemic or pandemic. Due to an increase in urbanisation, overcrowded conditions and more frequent international travel, epidemics are able to become pandemics more quickly.

• Suggested Film

- Eradication of Polio

Section 3: Treatment and Prevention

• How do antibiotics work?

Antibiotics are medicinal drugs that have been developed to kill bacteria or stop their growth. For example, amoxicillin targets certain bacterial cells and prevents them from building cell walls. Without the cell wall the bacterium bursts open.

Antibiotics are not effective in treating viruses and should not be prescribed to treat a viral infection, such as the common cold. Viruses can only reproduce inside another organism's living cells. Therefore it is hard to develop drugs that will kill a virus without damaging the cells it inhabits.

• Suggested Film
- Antibiotics

Extension Question

Q5. What is MRSA?

Bacteria can mutate to become resistant to antibiotic treatment. Methicillin-Resistant Staphylococcus Aureus (MRSA) is one such bacterium. In most people MRSA does not do any harm. However, if someone with a weak immune system becomes infected, it is very serious as the bacterium cannot be treated with antibiotics and it can prove fatal.

• How do vaccines work?

Doctors try to prevent bacterial or viral disease using vaccines. Vaccines contain a dead or weakened form of the pathogen which is usually injected into your body, although the polio vaccine is given by mouth (orally). Pathogens have substances called antigens on their surfaces. Each white blood cell in the immune system has just one antigen it responds to. If it detects that antigen, it starts dividing to form hundreds of identical white blood cells. These white blood cells then start producing antibodies that exactly fit their particular antigen, destroying the pathogen. Once your white blood cells have produced antibodies against a particular pathogen, they can produce them very quickly if that pathogen invades again.

Extension Question

Q6. Why is the MMR vaccine controversial?

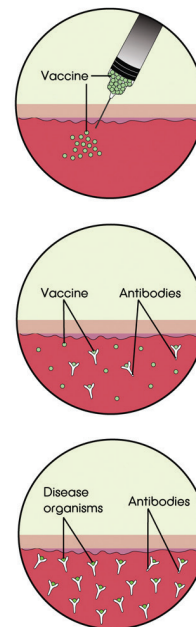
The MMR vaccine protects children against measles, mumps and rubella, three diseases that can have long-lasting effects or even kill those that contract them. However, a research scientist suggested there might be a link between the MMR vaccine and developing autism. He had a very small sample group of 12 children and no evidence to support his claims. Despite other research from scientists saying there is no link, many parents have decided not to have their children vaccinated, and there has been an increase in incidences of measles, mumps and rubella.

DIAGRAM 03:



How Do Vaccines Work?

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• Suggested Film
- Eradication of Polio

• Can diseases be eradicated?



Vaccines provide immunity from particular diseases

Extension Question

Q7. Should we keep samples of smallpox?

Although smallpox has been eradicated, samples of it still exist in laboratories in the USA and Russia for specific research purposes, for example, in the development of new vaccines, antiviral drugs and diagnostic tests. However, there are many who feel that these samples serve no real purpose and they should be disposed of to minimise the risk of smallpox being released into the human population once more.

Scientists around the world are working hard to bring about disease eradication. Eradication involves human intervention to bring about the total removal of a disease from a global population, usually by preventing it from occurring in nature or by getting rid of the disease-causing pathogen altogether. The eradication of disease is very difficult to achieve and only two diseases have ever been fully eradicated: smallpox in 1977 and rinderpest in 2011.

Smallpox is an extremely contagious disease caused by the variola virus. It is believed to have originated 3000 years ago and is one of the most devastating diseases encountered by humans, killing up to 30% of those infected. Although no effective treatment was ever developed, vaccination helped to prevent its spread. Even so, the World Health Organisation launched an intensified plan to eradicate smallpox in 1967 and was successful 10 years later.

Rinderpest is an infectious viral disease that affects cattle, with a high mortality rate. Efforts to eradicate it are thought to have started in the early 1900s and its success was confirmed on 25th May 2011 by the World Organisation for Animal Health.

There are ongoing programmes which scientists are hopeful will eradicate poliomyelitis, a viral infection which can cause paralysis, and dracunculiasis or guinea worm disease, a parasitic infection caused by drinking water containing guinea worm larvae.

• Suggested Film

- Eradication of Polio

• Quizzes

Healthy Teeth

Basic

• What causes the build-up of plaque on teeth?

- A – bad breath
- B – bacteria and food debris
- C – drinking water
- D – using a toothbrush

• What will help you avoid getting plaque?

- A – brushing your teeth
- B – eating more often
- C – drinking fruit juice
- D – drinking milk

• Why are fizzy drinks bad for teeth?

- A – they are fizzy
- B – they contain water
- C – they are acidic
- D – they are brightly coloured

• Which does no damage to teeth?

- A – milk
- B – lemonade
- C – coffee
- D – orange juice

Advanced

• What part of the tooth is first attacked by acid excreted by bacteria in plaque?

- A – crown
- B – enamel
- C – root
- D – nerve

• Which is NOT a symptom of gum disease?

- A – inflamed gums
- B – bleeding when teeth are brushed
- C – loosened teeth
- D – braces

• What is NOT a way to minimise the harm done to teeth by fizzy drinks?

- A – drink them in the evening
- B – drink at meal times
- C – don't sip them continually
- D – avoid them altogether

• How often should you brush your teeth to keep healthy teeth and gums?

- A – every other day
- B – at least twice a day
- C – once a week
- D – once a day

• Answers

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