



Key Stage 4

# Teacher Refresher

## Information

### Introduction to Microbes

Micro-organisms are living organisms too small to be seen with the naked eye; they are microscopic. Micro-organisms are found almost everywhere on Earth and can be both useful and harmful to humans. It is important to clarify that microbes are not innately “useful” or “harmful”. Rather, that some microbes can be useful to humans whilst others can be harmful depending on the situation. For example, the mould *Aspergillus* is used to help make chocolate, however can cause harm to humans if inhaled into the lungs. Although extremely small, microbes come in many different shapes and sizes. The three groups of microbes covered in this resource are viruses, bacteria and fungi.

**Viruses** are the smallest of the three and are generally harmful to humans. Viruses cannot survive by themselves. They require a ‘host’ cell in which to live and reproduce. Once inside the host cell, they rapidly multiply destroying the cell in the process. There are over 250 different kinds of virus causing the common cold. One of the most common of these is *Rhinovirus*.

**Bacteria** are single celled organisms that, under the right conditions, can multiply exponentially, on average once every 20 minutes. During their normal growth, some produce substances (toxins) which can be harmful to humans and cause disease (*Staphylococcus aureus*). Some bacteria are completely harmless and can be extremely useful (such as *Lactobacillus* in the food industry), or even necessary for human life (such as *Rhizobacterium*, which is involved in plant growth). When bacteria are harmless, they are called non-pathogenic, while bacteria that cause harm are known as pathogenic. Over 70% of bacteria are non-pathogenic (harmless) micro-organisms.

Bacteria can be divided into three groups by their shapes – cocci (balls), bacilli (rods) and spirals. Cocci can also be broken down into three shapes -clusters, chains, or groups of two. Scientists can use these shapes to help identify the microbes and tell which infection a patient has.

**Fungi** are generally multi-cellular organisms that can be both useful and harmful to humans. Fungi obtain their food by either decomposing dead organic matter or by living as parasites on a host. Fungi range in size from being microscopic to very

large and include mould, mushrooms and mildew. While fungi can be harmful by causing an infection or being poisonous to eat; others can be useful or harmless e.g., *Penicillium* produces the antibiotic penicillin and *Agaricus bisporus* can be eaten (the common button mushroom). Fungi spread through the air in small hard seed-like spores. When these spores land on bread or fruit, they can open and grow under the right conditions (such as dampness).

## Useful microbes

One of the main ways in which bacteria are beneficial is in the food industry. The natural by-products created during normal microbial growth can be used to make many of the food products we eat.

Fermentation is a process by which bacteria break down complex sugars into simple compounds like carbon dioxide and alcohol. Optional background information on each of the pack topics are included to help you plan your lessons and introduce the topic to students.

There are different types of fermentation, acetic acid fermentation produces vinegar and lactic acid fermentation produces yoghurt and cheese. Some fungi are also used to make blue cheese. The yeast, *Saccharomyces cerevisiae*, is used to make bread and dough products through fermentation. Wine and beer are also produced in the same manner although alcohol is produced following fermentation when the microbes are grown without oxygen. The chocolate industry also relies on bacteria and fungi. These organisms produce acid through fermentation which eats away at the hard pod and makes it easier to get at the cacao beans.

When the bacteria *Streptococcus thermophilus* or *Lactobacillus bulgaricus* are added to milk they consume the sugars during fermentation, turning it into yoghurt. So much acid is produced in fermented milk products that few potentially harmful microbes can survive there.

*Lactobacillus* bacteria are generally referred to as useful or 'friendly' bacteria. They help us digest food and have been termed probiotic bacteria that we find in our yoghurts and probiotic drinks. Although even 'friendly bacteria' can cause infection in people who are immunocompromised.

## Harmful Microbes

Some microbes can be harmful to humans and can cause disease: the *Influenza* virus causes the "flu" (short for "Influenza"), *Campylobacter* bacteria can cause food poisoning and the dermatophyte fungi, such as *Trichophyton*, can cause diseases such as athlete's foot and ringworm. Microbes like these are known as pathogens. Each pathogenic microbe can make us ill in different ways.

Bacterial toxins can damage tissues and organs and make us very unwell, fortunately this is rare.

Viruses need to live within a cell in order to survive. Once inside a cell, they multiply until fully grown and leave the host cell. Dermatophytes generally prefer to grow or

colonise under the skin. The products they produce while feeding cause swelling and itching.

Someone who is ill because of a harmful disease-causing microbe is said to be infected. Many harmful microbes can pass from one person to another by a number of different routes – air, touch, water, food, aerosols (such as sneezes and water vapour), animals, etc. Diseases caused by such microbes are said to be infectious diseases.

In some cases, infectious diseases can spread in communities or large areas, this is called an epidemic. When the disease spreads to over an entire country or around the world this is known as a pandemic. The COVID-19 pandemic started when a new virus SARS-CoV-2 caused the disease COVID-19, infecting a population in China. Because this virus was very infectious, and global travel is so commonplace, it was able to spread quickly and infect people all over the world.

It is important to remember that not all microbes are harmful, and some microbes are only harmful when taken out of their normal environment. For example, *Salmonella* and *Campylobacter* live in the gut of chickens usually without causing them any harm. However, when they enter the human gut, the toxins they release through their normal growth can make us very ill.

Our bodies have also adapted to help us get rid of these infections; this may be in the form of

- **Fever:** Microbes prefer to live at normal body temperature at 37°C. A fever or increase in body temperature is one of the body's immune responses to eliminate the perceived threat (microbe) inside the body.
- **Swelling:** A cut on the hand may result in swelling; this is our body responding in a similar way to a fever only in a more localised way.
- **Rash:** This is our body's reaction to microbial toxins.