Science@School | Book 6B

# Microbes

*Teacher's Guide*

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# The pupil book explained unit by unit

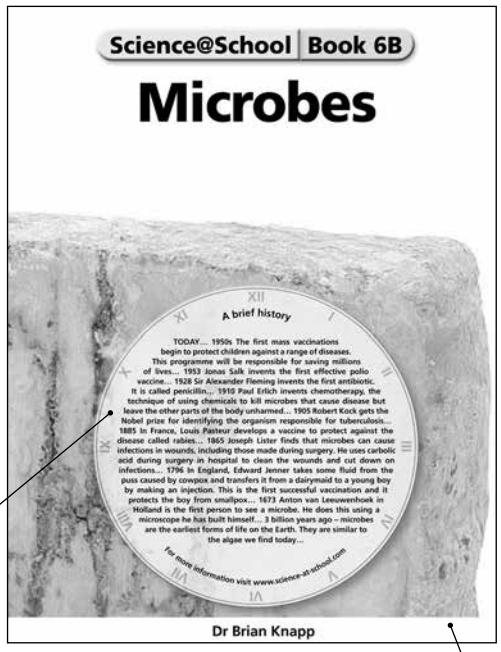
Although the pupil book – *Microbes* – is clear and simple, a great deal of care and thought has been given to the structure and the content of each double page spread or unit. The worksheets and activities in this *Teacher's Guide* also link directly to the pages in *Microbes*.

It is possible to use *Microbes,* and the worksheets and activities, without reading this section, but we would strongly recommend that you take a short time to familiarise yourself with the construction of the pupil book.

The units are arranged in sequence, to help you with your lesson planning. In this section, a brief description of the content of each unit is given, together with hints on how to start or support it. List 1 (Starting a unit with a demonstration) on page 11 sets out the resources that you could use to do the demonstrations where suggested. The activity associated with each unit is also briefly described to help you see how the unit and activity work together.

## Title page

The book begins on the title page (page 1). Here you will find information about science and technology in the form of a clock. You may want to use this to set the scene for the study of the book's contents. You may choose to focus on an event which ties in with your work in history, before moving onto the rest of the book. Alternatively, you may wish to skip over this page and return to it later. It is not a core part of the book, but helps the children see how the work they are doing now fits in with the work of scientists and engineers in the past. It may also be used to stimulate more able pupils to research the people and events that are described here.




A time clock giving additional historical information about the topic.

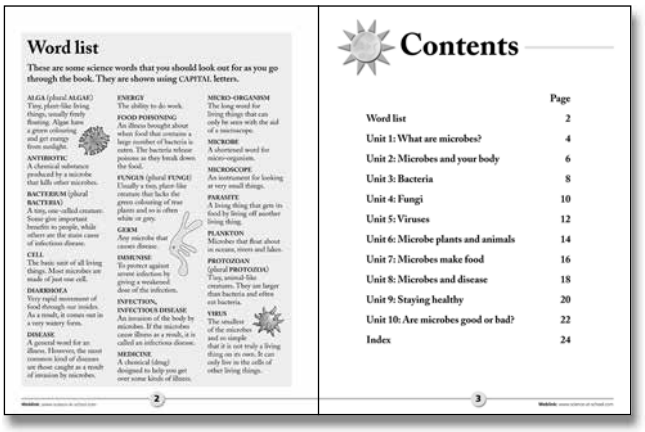
The picture shows a cheese that has blue veins of mould in it. The mould grows in natural openings in the cheese.

# Word list and contents

The core content of the book begins with a word list on page 2. This is a glossary, brought to the front for the pupils' attention. Pupils could be encouraged to look at the list and see how many of the words they already recognise.

One of the important things about science is the precision with which words are used. However, many scientific words are also common words, often used in a slightly different way from how they would be used in science. The word list presents the opportunity for pupils to consider the words they already know, and the meanings they are familiar with.

When your teaching unit has been completed, you may want to invite pupils to revisit this list and see if their understanding of the words has been enhanced or changed in any way. A visual dictionary is also given on the CD.




The entire contents are shown on page 3. It shows that the book is organised into double page spreads. Each double page spread covers one unit.

# The units

## Heading and introduction

Each unit has a heading, below which is an introductory sentence that sets the scene and draws out the most important theme of the unit.

## Body

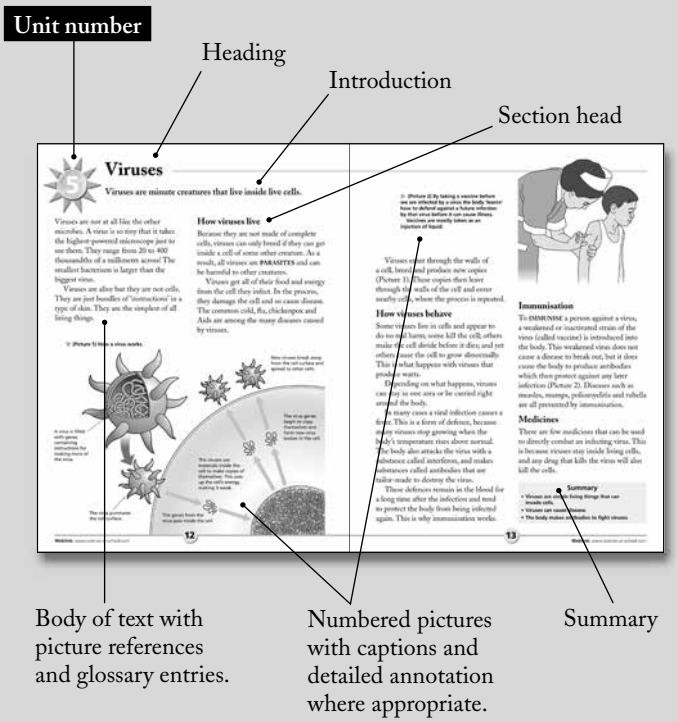
The main text of the page then follows in a straightforward, easy-to-follow, double column format.

Words highlighted in bold capitals in the pupil book are defined in the word list on page 2. A visual dictionary is also given on the CD.

The glossary words are highlighted on the first page on which they occur. They may be highlighted again on subsequent pages if they are regarded as particularly important to that unit.

## Summary

Each unit concludes with a summary, highlighting and reinforcing the main teaching objectives of the unit.

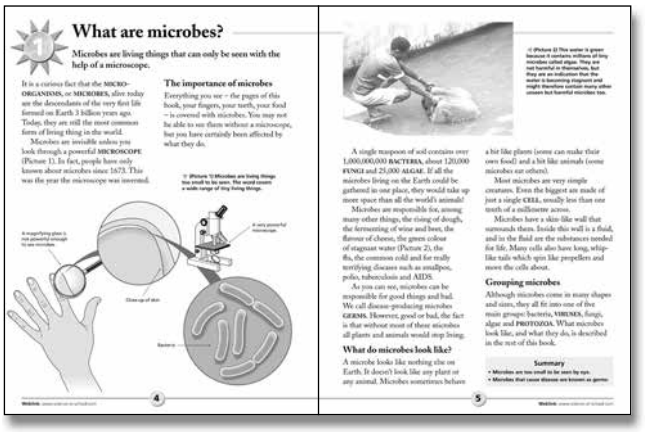


# 1 What are microbes?

You may like to begin by telling the children that a human body is made from billions of tiny structures called cells. Each cell is so small that you need a microscope to see it. Tell the children that many microbes are even smaller than cells and the following demonstration may help them think about how small microbes are.

Ask the children what it would be like if you could take one cell from their body and increase its size to that of a football. Put a football on your desk and say that if you were to increase the size of a bacterium by the same amount it would be the size of a tennis ball. Put the tennis ball on the table and tell the children that if you were to increase the size of a virus by the same amount it would be the size of a lentil. Let the children look at the three objects and compare the sizes of 'microbes' with the 'cell'.

The unit opens by explaining that the first forms of life on the planet are still around today and that they were first seen by humans in 1673, when microscopes were invented. The text moves on to describe how everything is covered with microbes, and that we are all affected by what they do. The



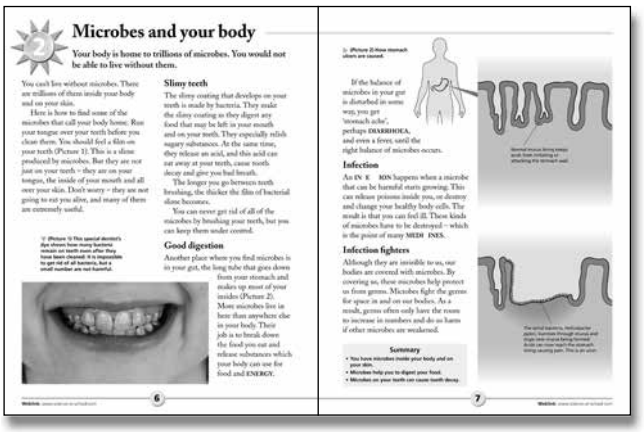

huge numbers of microbes living in a teaspoon of soil is described, and the actions of microbes in food production and disease are briefly introduced. The concept of the germ is established and the text then discusses the size and structure of microbes. The unit ends by dividing microbes into five groups.

In the complementary work, the children can use secondary sources to find out about the origin of microbes. In the activity, the children investigate the spores made by a mushroom, and the moulds that grow on fruit and vegetables.

# 2 Microbes and your body

Give the children magnifying glasses and ask them to look at the skin on the back of their hands and on their arms. Tell them to think of their skin as an alien planet, but the aliens are too small to see. They should notice cracks and folds in the skin and holes from which hairs emerge. Tell the children that the skin is coated in a very thin layer of water and oil, called sweat, and this is the food of the microbes living there. Now take a square of cardboard and place a marble on it. Tell the children that the marble represents a microbe. Keep adding marbles and ask the children to stop you when they think your model shows the number of microbes on a piece of skin. Cover the cardboard in marbles to show them how thickly the microbes may be packed together.

This unit follows on from Unit 1 by taking an immediate look at how microbes affect the body. The unit opens by introducing the surprising fact that you cannot live without microbes. The text moves on to invite the reader to investigate the slimy surfaces in the mouth and explains that they are the home to microbes. The role of bacteria in tooth decay is




explained and the gut is described as the place in the body where most microbes live. The concept of infection is explored and the unit ends by describing the work of infection-fighting bacteria on the skin.

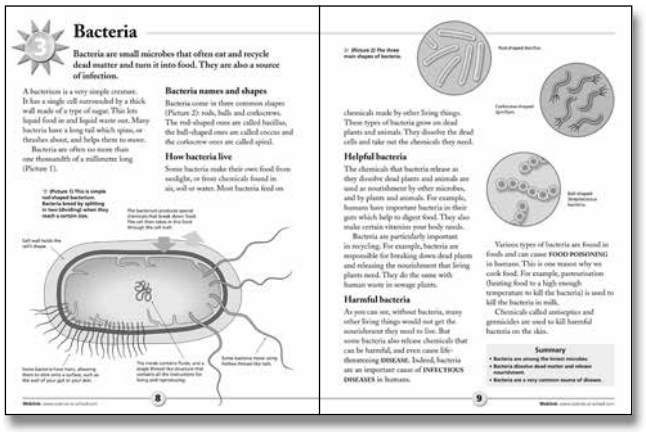
In the complementary work, the children can use secondary sources to find out about keeping teeth and gums healthy. In the activity, the children examine the microbes on their teeth.


# Bacteria

You may like to begin by showing the children a large picture of a tree in leaf (or a woodland in leaf) and put next to it a large picture of the tree without leaves (or a woodland in winter). Tell the children that every year the tree produces leaves, makes food with them, then discards them in the winter and makes new leaves in the following spring. This process goes on every year for a hundred years or more. Tell the children that you would expect a large, thick layer of leaves to build up beneath the tree and challenge them to look for it in the photograph. Tell the children it is not there because of the activity of bacteria.

This unit builds on the previous two units by looking more closely at one of the major groups of microbes. The unit opens by describing the structure of a bacterium. The text is supported by a large, clear diagram of the major features of a bacterium's body.

The way bacteria feed is clearly described and the role bacteria play in recycling materials is explained. The way harmful bacteria produce poisons that cause disease is also featured. The unit ends by showing


Bacteria

Bacteria are small microbes that often eat and recycle dead matter and turn it into food. They are also a source of infection.

A bacterium is a very simple creature. It has a single cell surrounded by a thick wall made of a type of sugar. This lets liquid food in and liquid waste out. Many bacteria have a long tail which spins, or thrashes about, and helps them to move.

Bacteria are often no more than one thousandth of a millimetre long (Picture 1).

Bacteria names and shapes

Bacteria come in three common shapes (Picture 2): rods, balls and corkscrews. The rod-shaped ones are called bacillus, the ball-shaped ones are called coccus and the corkscrew ones are called spiral.

How bacteria live

Some bacteria make their own food from sunlight, or from chemicals found in air, soil or water. Most bacteria feed on

Helpful bacteria

Harmful bacteria

Summary

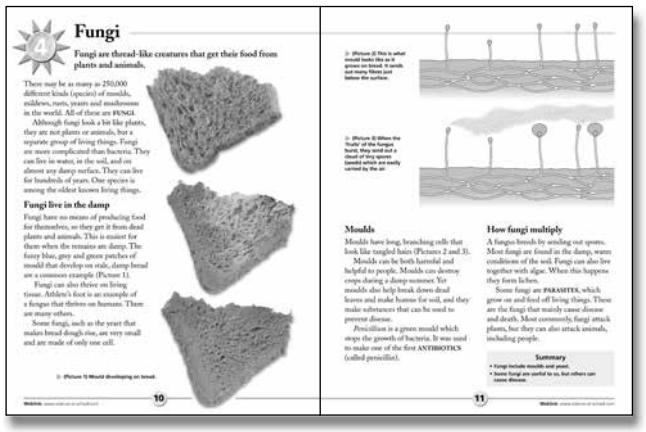
that cooking, pasteurisation and the use of antiseptics help to protect us from harmful bacteria.

In the complementary work, the children could study a compost heap in the school grounds, receive a visit from a gardener to talk about the making and use of compost or visit a garden to take photographs of activities involving composting. In the activity, the children devise and carry out a plan to compare how different kinds of leaves rot.


# Fungi

Remind the children of the introduction to Unit 2, where you talked about the skin being like the surface of an alien planet. Remind them also of the activity in Unit 1 in which they saw the spores of a mushroom. Ask them now to think of the tiny spores moving through the air like millions of alien spaceships, and in each one is a tiny fungus just waiting to get out for a meal. Now draw the surface of a piece of bread on the board, and a spore that has landed on it. Tell the children that when the spaceship lands in suitable conditions, it opens and its passenger grows out. Draw a thread growing out of the spore and into the bread. Draw branches on the thread and tell the children that as the threads grow and branch they form a mould that can be seen. Ask the children for anecdotes about the mouldy food that they have seen.

This unit allows the children to compare fungi with the bacteria featured in the previous unit. The unit opens by making the point that not all fungi are micro-organisms. The text then moves on to identify moulds, mildews, rusts and yeasts as microbes. Fungi are shown to be more complicated than bacteria


Fungi

Fungi are thread-like creatures that get their food from plants and animals.

There may be as many as 250,000 different kinds (species) of moulds, mildews, rusts, yeasts and mushrooms in the world. All of these are FUNGI.

Although fungi look a bit like plants, they are not plants or animals, but a separate group of living things. Fungi are more complicated than bacteria. They can live in water, in the soil, and on almost any damp surface. They can live for hundreds of years. One species is among the oldest known living things.

Fungi live in the damp

Fungi have no means of producing food for themselves, so they get it from dead plants and animals. This is easiest for them when the remains are damp. The fuzzy blue, grey and green patches of mould that develop on stale, damp bread are a common example (Picture 1).

Fungi can also thrive on living tissue. Athlete's foot is an example of a fungus that thrives on humans. There are many others.

Some fungi, such as the yeast that makes bread dough rise, are very small and are made of only one cell.

Moulds

How fungi multiply

Summary

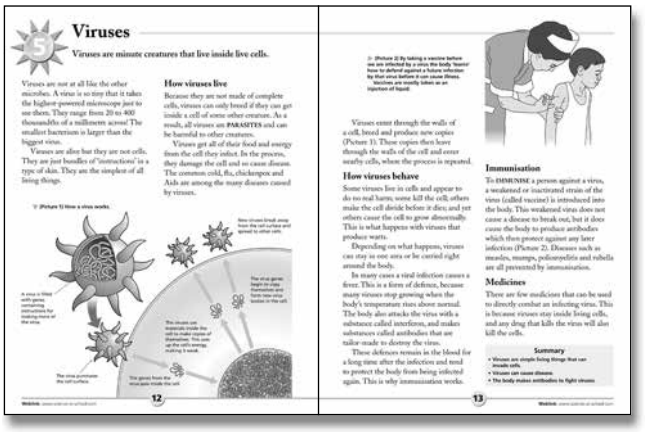
but, like them, they live in a very wide range of habitats. The text covers a wide range of topics including athlete's foot, the action of yeast in bread-making, the role of Penicillin as an antibiotic and the combination of fungi and algae to produce lichens.

In the complementary work, the children can make a fair test to see how temperature affects mould growth, and make a lichen survey in the school surroundings. In the activity, the children investigate how dampness affects mould growth.

# Viruses

Tell the children that you want some of them to demonstrate what happens when a virus attacks the body. Give one child a large card with the letter V on it, and six similar cards, and tell the class that he or she is a virus. Mark out a large circle on the floor and tell the class that this is the wall of a cell. Ask six children to stand in the middle of the circle. Tell the class that the group represents the materials inside the cell. Tell the 'virus' to enter the 'cell' and give a card to each child. While this is taking place, tell the class that the virus uses cell material to make copies of itself. When all the new 'viruses' have received their cards tell them to leave the cell. At this point, tell the other children to imagine that they are cells and the viruses are coming to attack them.

This unit allows the children to compare viruses with the bacteria and fungi that were featured in the two previous units. The unit begins by explaining that viruses are different from other microbes. In addition to being much smaller, they do not have a cell structure. They are described as a bundle of instructions in a type of skin. The many ways in which a virus attacks a cell are described, and the


Viruses

Viruses are minute creatures that live inside live cells.

How viruses live

Immunisation

Medicines

Summary

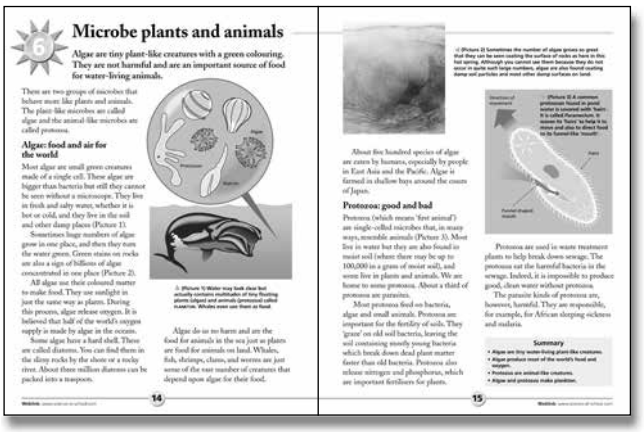
relationship between viruses and disease is firmly established. The concept of immunity is introduced, and the action of a vaccine is described. The unit ends by explaining why there are few medicines which can be used to fight a viral infection.

In the complementary work, the children can use secondary sources to find out about diseases caused by viruses. In the activity, the children construct a bar chart from data in a table and make models to show how immunisation works.

# Microbe plants and animals

You could begin by asking the children if they have ever paddled in a stream or river. If they have, ask them about how the stones felt. When you receive the answer that the stones were slimy, tell them that the slime was produced by huge numbers of plant-like microbes called algae. Tell the children that some of these algae form bodies which have long threads that can be easily seen. Show the children a jar of thread-like algae, pour some into a saucer and let the children examine them with a magnifying glass. The children may also see some animals swimming about. Tell the children that small animals in water are related to shrimps, insects, spiders or worms. Also tell the children that there are probably some animal-like microbes called protozoa swimming in the water but they are too small to see even with a magnifying glass.

This unit complements the three previous units to give the children a broad overview of microbe life. It begins by formally introducing the plant-like microbes as algae and the animal-like microbes as protozoa. The way algae make food using sunlight is described along with their range of habitats. The


Microbe plants and animals

Algae are tiny plant-like creatures with a green colouring. They are not harmful and are an important source of food for water-living animals.

Algae: food and air for the world

Protozoa: good and bad

Summary

protozoa are compared with the algae and a third of them are described as being parasitic. The unit ends with a striking picture of a protozoan which has a huge number of hairs to help it move and feed.

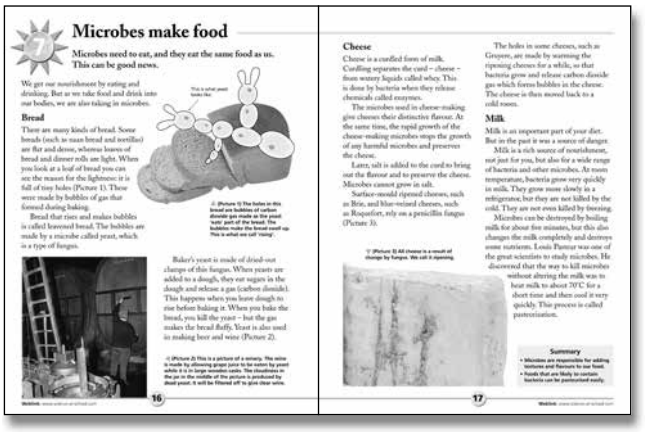
In the complementary work, the children could use secondary sources to find out about amoeba. In the activity, the children make a survey of algae in the local environment and observe how algal colonies grow and behave.

# 7 Microbes make food

You could begin by asking the children "Who is eating microbes for lunch"? If the children have brought their meals in lunch boxes, ask them to open them and say what they will be eating. Set up a tally chart to find out how many people will be eating bread, cheese, yoghurt. Reassure the children that although microbes have been used in the production of the food, they will not cause any harm. Use the information to show how microbes make an important contribution to our diet.

You could extend the introduction by making some bread. Mix flour, and a small amount of sugar and salt; mix some fresh yeast with water and add that to the bread mixture. Stir up the dough for a few minutes then put it on a board, knead it until the mixture is smooth, make a loaf shape, let the children measure its height then leave it in a warm place for the children to measure again later.

This unit builds on Units 3 and 4 to show how fungi and bacteria are used in food production, and how milk has to be treated to avoid contamination with harmful bacteria. The unit opens by saying that when we eat and drink, we also take in microbes.


Microbes make food

Microbes need to eat, and they eat the same food as us. This can be good news.

We get our nourishment by eating and drinking. But as we take food and drink into our bodies, we are also taking in microbes.

Bread

There are many kinds of bread. Some breads (such as naan bread and tortillas) are flat and dense, whereas loaves of bread and dinner rolls are light. When you look at a loaf of bread you can see the reason for the lightness: it is full of tiny holes (Picture 1). These were made by bubbles of gas that formed during baking.

Bread that rises and makes bubbles is called leavened bread. The bubbles are made by a microbe called yeast, which is a type of fungus.

Baker's yeast is made of dried-out clumps of this fungus. When yeasts are added to a dough, they eat sugars in the dough and release a gas (carbon dioxide). This happens when you leave dough to rise before baking it. When you bake the bread, you kill the yeast – but the gas makes the bread fluffy. Yeast is also used in making beer and wine (Picture 2).

Cheese

Cheese is a curdled form of milk. Curdling separates the curd – cheese – from watery liquids called whey. This is done by bacteria when they release chemicals called enzymes.

The microbes used in cheese-making give cheeses their distinctive flavour. At the same time, the rapid growth of the cheese-making microbes stops the growth of any harmful microbes and preserves the cheese.

Later, salt is added to the curd to bring out the flavour and to preserve the cheese. Microbes cannot grow in salt.

Surface-mould ripened cheeses, such as Brie, and blue-veined cheeses, such as Roquefort, rely on a penicillin fungus (Picture 3).

The holes in some cheeses, such as Gruyere, are made by warming the ripening cheeses for a while, so that bacteria grow and release carbon dioxide gas which forms bubbles in the cheese. The cheese is then moved back to a cold room.

Milk

Milk is an important part of your diet. But in the past it was a source of danger.

Milk is a rich source of nourishment, not just for you, but also for a wide range of bacteria and other microbes. At room temperature, bacteria grow very quickly in milk. They grow more slowly in a refrigerator, but they are not killed by the cold. They are not even killed by freezing.

Microbes can be destroyed by boiling milk for about five minutes, but this also changes the milk completely and destroys some nutrients. Louis Pasteur was one of the great scientists to study microbes. He discovered that the way to kill microbes without altering the milk was to heat milk to about 70°C for a short time and then cool it very quickly. This process is called pasteurisation.

Summary

- Microbes are responsible for adding textures and flavours to our food.
- Foods that are likely to contain bacteria can be pasteurised easily.

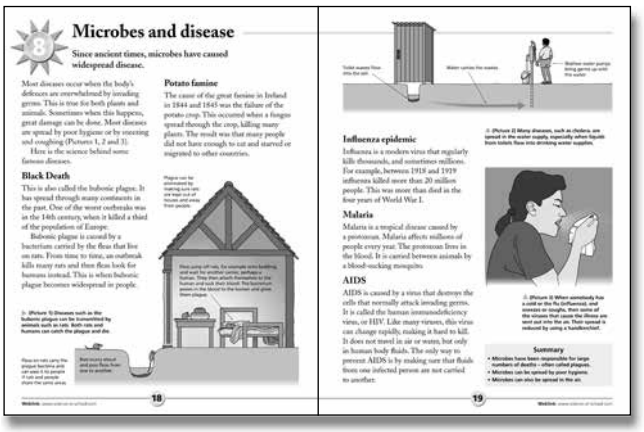
The text then moves on to describe how yeast is used to make bread rise. This is followed by an account of how microbes are used in cheese, wine and beer making. The unit ends by explaining how bacteria can thrive in milk and how pasteurisation is used to kill them.

In the complementary work, the children can make and bake bread. In the activity, the children compare bread yeast with wine yeast.

# 8 Microbes and disease

You may like to begin by giving each child a number from 1 to 30. Tell the children that they are going to see what it is like when a germ invades the body and begins to increase in number. Tell the children that when you call out their number they should stand up. That means that they have turned into a germ. Ask the child who is number 1 to stand up. Ask for 2 to stand up, then 3 to 6, then 7 to 14, then 15 to 30. From this, the children should see how quickly the numbers of germs can build up.

This unit builds on the previous units to show how bacteria, viruses, fungi and protozoa cause disease. The unit begins by explaining that most diseases occur when the body's defences are overwhelmed by an invading germ. The main ways of spreading disease are listed and illustrated, then the text moves on to explain the science behind the bubonic plague, the potato famine, influenza and malaria. The role of rats in the spread of the plague, and the role of the mosquito in the spread of malaria, are explained, while the role of poor hygiene


Microbes and disease

Since ancient times, microbes have caused widespread disease.

Most diseases occur when the body's defences are overwhelmed by invading germs. This is true for both plants and animals. Sometimes when this happens, great damage can be done. Most diseases are spread by poor hygiene or by sneezing and coughing (Pictures 1, 2 and 3).

Here is the science behind some famous diseases.

Black Death

This is also called the bubonic plague. It has spread through many continents in the past. One of the worst outbreaks was in the 14th century, when it killed a third of the population of Europe.

Bubonic plague is caused by a bacterium carried by the fleas that live on rats. From time to time, an outbreak kills many rats and then fleas look for humans instead. This is when bubonic plague becomes widespread in people.

Potato famine

The cause of the great famine in Ireland in 1844 and 1845 was the failure of the potato crop. This occurred when a fungus spread through the crop, killing many plants. The result was that many people did not have enough to eat and starved or migrated to other countries.

Influenza epidemic

Influenza is a modern virus that regularly kills thousands, and sometimes millions. For example, between 1918 and 1919 influenza killed more than 20 million people. This was more than died in the four years of World War I.

Malaria

Malaria is a tropical disease caused by a protozoan. Malaria affects millions of people every year. The protozoan lives in the blood. It is carried between animals by a blood-sucking mosquito.

AIDS

AIDS is caused by a virus that destroys the cells that normally attack invading germs. It is called the human immunodeficiency virus, or HIV. Like many viruses, this virus can change rapidly, making it hard to kill. It does not travel in air or water, but only in human body fluids. The only way to prevent AIDS is by making sure that fluids from one infected person are not carried to another.

Summary

- Microbes have been responsible for large numbers of deaths – often called plagues.
- Microbes can be spread by poor hygiene.
- Microbes can also be spread in the air.

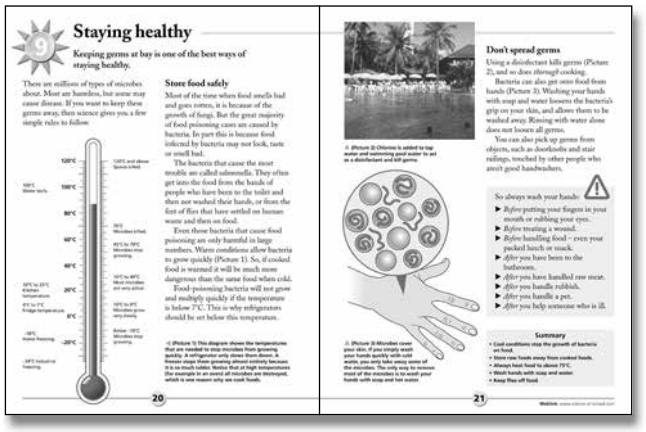
is shown to be a major contributory factor to many diseases. The unit ends by explaining how the AIDS virus destroys a major defence system of the body.

In the complementary work, the children can use secondary sources to find out how people suffering from microbial diseases can be nursed back to health. In the activity, the children study how the number of bacteria increase in an infection.

# 9 Staying healthy

If the class performed the activity in the introduction to Unit 8, you may like to remind them of it now and say that they were modelling germs growing in the warmth of the human body. Give the children numbers as in the previous introduction and say that they are now going to model how a colony of harmful bacteria on food grows when the food is kept cool. Ask child 1 to stand up. Then a few moments later ask 2 to stand up, and a few more moments later ask 3 to 6 to stand up. Wait longer until asking the next eight to stand up, then ask the children how they think the cold is affecting the way the colony is growing. Look for an answer that the cold is slowing down the growth.

The unit begins by stating that there are millions of microbes and that harmful microbes, called germs, can be reduced by following simple rules. The text moves on to explain that fungi often causes rotten food to smell bad, but food poisoning is caused by bacteria. The role of poor hygiene and flies, in causing food poisoning, is described. Contaminated meat is



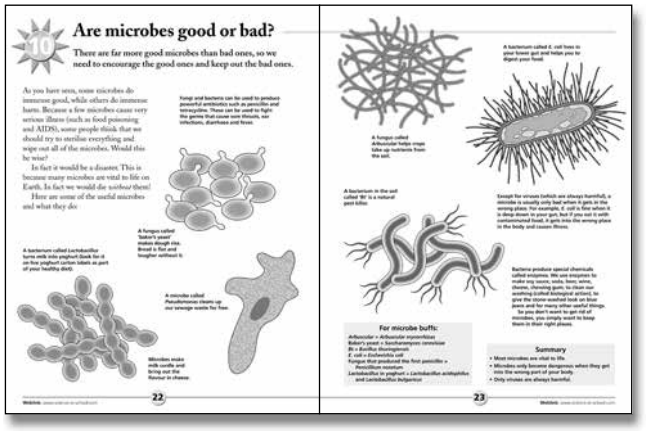

also identified as a major cause of food poisoning. The importance of temperature in controlling microbes is clearly illustrated, using a thermometer.

In the complementary work, the children can make a survey about personal hygiene. In the activity, the children use previous knowledge to plan and carry out a fair test on how temperature affects the activity of yeast.

# 10 Are microbes good or bad?

You may like to begin by telling the children that most people do not have accurate ideas about microbes and think all microbes are bad. Remind the children that from their work in the rest of the book, they should know this isn't true, and ask them if they can remember some good things and some bad things about yeasts, moulds, algae and protozoa. Record the results on the board. This can also serve as a review of what they have learned about microbes.

The unit begins by explaining that, because a few kinds of microbes can cause great harm, all microbes are thought to be harmful. The question is raised about what the world would be like if all the microbes were removed. This is answered by showing that many microbes are needed to help us survive. The unit is highly illustrated, and many of the helpful roles of a range of fungi and bacteria are described. There is also a section on a useful protozoan which cleans up sewage. The unit ends by providing those




children who love complicated scientific names with some examples from the fungi and bacteria that have been studied in the book.

In the complementary work, the children could examine limestone and chalk and find out about fermenters. In the activity, the children use a microscope to look at microbes in pond water.

# Index

There is an index on page 24.

# Using the pupil book and photocopiable worksheets

## Introduction

There is a wealth of material to support the topic of microbes in the pupil book and in the *Teacher's Guide*. On this and the following three pages, suggestions are made on how to use the worksheets and their associated teacher's sheets, and how to integrate them for lesson planning. On the page opposite you will find the resource lists for introductory demonstrations, the complementary work and the activity worksheets. The learning objectives are shown on pages 12 and 13.

## Starting a unit

Each unit in the pupil book forms the basis for a lesson. You may like to start by reading it with the class, or begin with a demonstration (see List 1). Always begin the unit by reading the introductory sentences in bold type. This helps focus the class on the content of the unit and to prepare them for the work.

The first part of the main text introduces the content, which is then developed in the headed sections. The illustrations are closely keyed to the main text, and the captions of the illustrations develop the main text content.

With less skilled readers, you may prefer to keep to the main text and discuss the illustrations when they are mentioned. With more skilled readers, you may want to let them read the captions for themselves. Each unit ends with a summary. The children can use this for revision work. They can also use it to test their understanding by trying to explain the points made in the summary.

You can find the learning objectives for each unit of this *Teacher's Guide*.

The style and content of the unit also make it suitable for use in literacy work, where the needs of both English and science are met. You may wish to use the unit as a topic study in literacy work, or you may want to perform an activity in science time and follow it up with a study of the unit during literacy work.

## Using the comprehension worksheets

Each unit in the pupil book has one photocopiable comprehension worksheet in this *Teacher's Guide* to provide a test. The learning objectives r these comprehension worksheets relate directly to the knowledge and understanding component of the science curriculum.

The comprehension worksheets begin with simple questions and have harder questions towards the end.

The worksheets may be used singly, after each unit has been studied, or they may be used along with other worksheets to extend the study.

The teacher's sheet, which is opposite the comprehension worksheet, shows the answers and background information to the unit. This teacher's sheet also carries a section on work complementary to the study topic. This work may feature research using other sources. It may also have value in literacy work.

## Using the activity worksheets

The activities are designed to develop skills in scientific enquiry. The learning objectives for practical skills associated with each unit are given here. The activities may be small experiments, may focus on data handling or comprise a whole investigation.

Each activity section is a double page spread in this *Teacher's Guide*. On the left hand page is a photocopiable activity worksheet to help the children in practical work, or it may contain data for the children to use or interpret. The page opposite the worksheet is a teacher's sheet providing a step-by-step activity plan to help you organise your work. Each plan has a set of notes which provide hints on teaching or on the use of resources. The activity plan ends with a conclusion, which you may like to read first, to help you focus on the activity in your lesson planning.

## Planning to use a unit

The materials in this pack are very flexible and can be used in a variety of ways. First, look at the unit and activity objectives. Next, read the unit in the pupil book, and the associated worksheet and activity units in this *Teacher's Guide*. Finally, plan how you will integrate the material to make one or more lessons. You may wish to add more objectives, or replace some of the activity objectives with some of your own.

## Safety

The practical activities feature equipment made from everyday materials or available from educational suppliers. However, make sure you carry out a risk assessment, following the guidelines of your employer, before you do any of the practical activities in either the pupil's book or the *Teacher's Guide*.

## Resources

The three lists below show the resources needed to support the photocopiable worksheets.

- List 1 shows resources for demonstrations suggested for starting a unit.
- List 2 gives resources needed for the complementary work featured on the teacher's sheet associated with each comprehension worksheet.
- List 3 details those resources needed for the 10 activity worksheets.

### List 1 (Starting a unit with a demonstration)

▼ UNIT

1. A football, a tennis ball, a lentil.
2. A piece of card and a large number of marbles.
3. Large picture of a tree in leaf (or a woodland in leaf), a large picture of a tree (possibly the same one) without leaves (or a woodland in winter).
4. Board and chalk.
5. Seven large cards with the letter 'V' on them.
6. Pond water containing thread-like algae such as *Spirogyra*. This algae can also be seen growing on stones.
7. Optional: bread-making using flour (about 200g), fresh yeast (about 15g), a teaspoon of salt, a teaspoon of sugar, about 130cm$^3$ of water. This is only to demonstrate that yeast makes bread rise. If you wish to bake the bread for children to eat, use your own recipe and make sure the bread is prepared in accordance with your school's policies.
8. –
9. –
10. –

### List 2 (Complementary work)

*Each group will need the following items:*

▼ UNIT

1. Secondary sources about the origins of microbes.
2. Secondary sources about the best way to keep the teeth and gums clean.
3. A compost heap could be set up in a school garden which the children could visit. A gardener could visit and talk about the role of compost in gardening, or a visit to a garden could be made where photographs of a compost heap could be taken, and uses of compost discussed.
4. (a) Slices of bread, measuring cylinder, thermometer, clear plastic bags, sticky tape. (b) Access to area around the school to look for lichens, a secondary source showing common lichens.
5. Secondary sources about diseases caused by viruses.
6. Secondary sources about amoeba.
7. Ingredients for making bread according to a recipe in a cookery book, access to an oven, strict hygienic conditions in accordance with your school's policies.
8. Secondary sources about how people suffering from certain microbial diseases can be nursed back to health.
9. Access to many people in school for a survey.
10. (a) A piece of limestone, a piece of chalk, a geological map of Britain. (b) Secondary sources about fermenters in industry.

### List 3 (Activity worksheets)

*Each group will need the following items:*

▼ UNIT

1. A mushroom cap, a piece of paper, a selection of fruit and vegetables, plastic bags, sticky tape. Make sure the bags are disposed of according to your school's policies.
2. A mirror, a disclosing tablet, children's own toothbrush, safe water supply for cleaning teeth.
3. Access to area around school, clear plastic bags with ties, samples of leaves, weighing scales (optional), thermometer (optional), space to store bags for two weeks. Make sure the bags are disposed of according to your school's policies.
4. A piece of cucumber, carrot, cheese and biscuit, four clear plastic bags, sticky tape, space to store bags for two weeks. Make sure the bags are disposed of according to your school's policies.
5. Graph paper, two lumps of Plasticine which are different colours.
6. A piece of wood with a covering of algae, access to the area around the school, compass, jar of clear pond water, jar of green pond water, brown paper, sticky paper, scissors to cut a slit in the brown paper.
7. Bread yeast and wine yeast, two plastic bottles (small drink size), sugar, teaspoon, two balloons (blow them up first to stretch them). You should try out the experiment before the lesson to check that the quantities work in the size of bottle you are using.
8. Graph paper.
9. Plastic bottles (small drink size) balloons, sugar, yeast, teaspoon, thermometer, measuring cylinder (optional), several places at different temperatures in which the bottles can be kept for the day but inspected regularly.
10. A microscope (with or without built-in light), lamp, (alternatively, a microscope which links to a computer), a microscope slide, cover slip, pipette, pond water, pencil.

# Learning objectives

## Comprehension worksheets

The table below shows the learning objectives for knowledge and understanding associated with each unit in the pupil book, using the comprehension worksheets in this *Teacher's Guide*:

### Unit 1

- Microbes are too small to be seen by the naked eye.
- Microbes exist in huge numbers.
- Some microbes can be used in food production.
- Some microbes are harmful.

### Unit 2

- Micobes are on the surface of the body and inside it.
- Some microbes help to keep the body healthy.
- Some microbes can cause disease.

### Unit 3

- Bacteria have three main shapes.
- Bacteria play an important part in the recycling of materials.
- There are ways to control harmful bacteria in food and on the skin.

### Unit 4

- Fungi are a group of living things that are neither plants nor animals.
- Fungi get their food from plants and animals.
- Some tiny fungi are considered to be microbes.
- Fungi breed by producing spores.

### Unit 5

- Viruses are the smallest microbes.
- Viruses use cells to breed.
- A body can be protected from a virus disease with a vaccine.

### Unit 6

- Algae have some features of plants.
- Protozoa have some features of animals.
- Algae and protozoa live in water and damp places.

### Unit 7

- Microbes can be used to give texture and flavour to foods.
- Pasteurisation is used to kill germs in milk and some foods.

### Unit 8

- Some microbes can cause deadly diseases.
- Microbes are spread by poor hygiene, air, water and some insects.
- Large numbers of human deaths are due to microbial diseases.

### Unit 9

- High and low temperatures are important in controlling microbes.
- The spread of disease is reduced by washing hands after a range of activities.
- Flies must be controlled to prevent the spread of diseases.

### Unit 10

- Most microbes are vital for life on Earth.
- Some microbes become dangerous if they get into the wrong part of the body.
- Viruses are always harmful.

# Learning objectives

## Activity worksheets

The table below shows the learning objectives for practical skills associated with each unit in the pupil book, using the activity worksheets in this *Teacher's Guide*:

### Unit 1

- Make a prediction and compare it with a result.
- Carry out an ivestigation over an extended period of time.
- Record results appropriately.

### Unit 2

- Make careful observations.
- Record observations in the form of a diagram.
- Draw conclusions from results.

### Unit 3

- Plan a fair test.
- Construct a table in which to record results.
- Use simple equipment safely.

### Unit 4

- Plan and carry out a fair test.
- Make a prediction and provide an explanation for it.
- Compare a prediction with a result.

### Unit 5

- Construct a bar graph from information in a table.
- Extract information from a table.
- Use simple materials safely.

### Unit 6

- Make a survey.
- Look for patterns in results.
- Make careful observations.

### Unit 7

- Make comparisons.
- Follow instructions.
- Use simple materials safely.

### Unit 8

- Make simple calculations.
- Produce a line graph from data in a table.
- Extract information from a line graph.

### Unit 9

- Use prior knowledge in the planning of an investigation.
- Plan and carry out a fair test.
- Draw conclusions from results.

### Unit 10

- Use equipment safely.
- Make careful observations.
- Record observations in words and pictures.

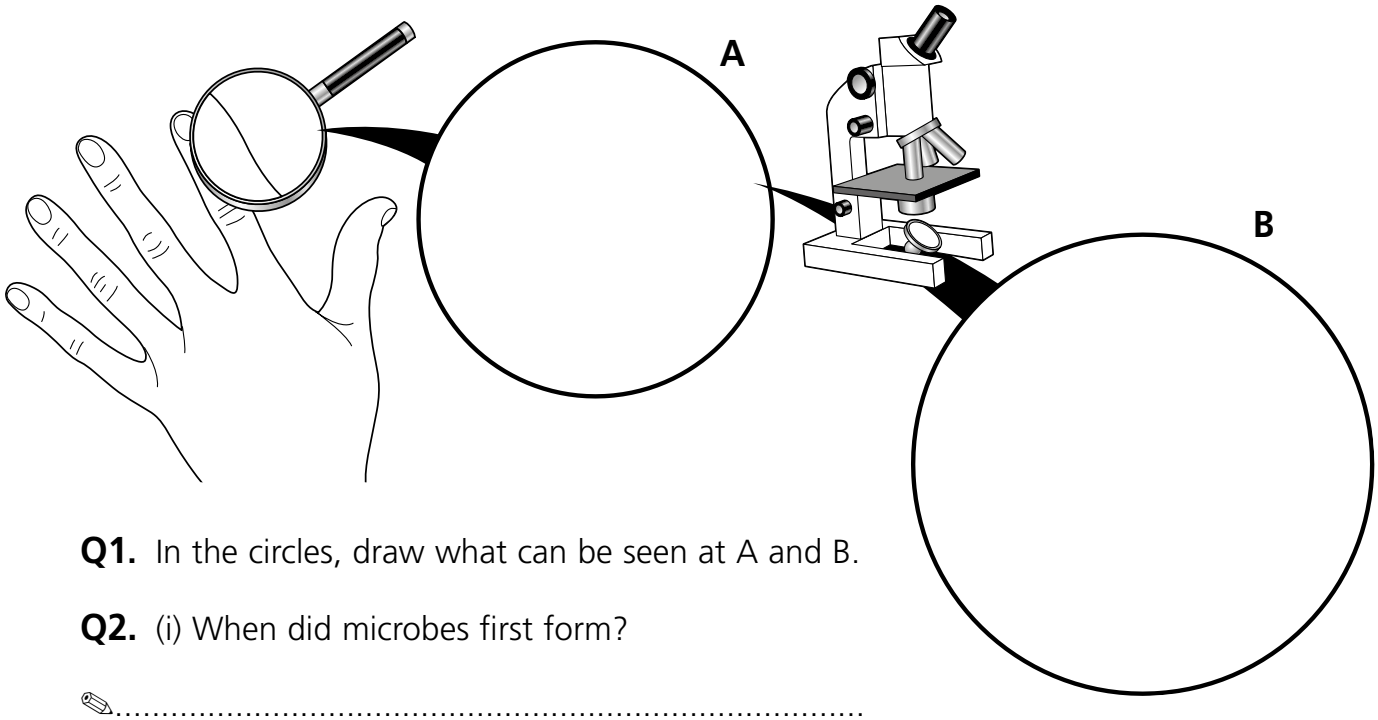
1

**Name:** ..... **Form:** .....

See **pages 4 and 5** of *Microbes*

# What are microbes?

**Microbes are living things that can only be seen with the help of a microscope.**




**Q1.** In the circles, draw what can be seen at A and B.

**Q2.** (i) When did microbes first form?

✎.....

(ii) When did people first know that microbes existed? ✎.....

**Q3.** Name three kinds of microbe found in soil.

✎..... ✎..... ✎.....

**Q4.** Name three things which microbes are responsible for.

✎.....

✎.....

✎.....

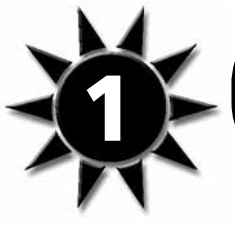
**Q5.** What are germs? ✎.....

**Q6.** Describe a microbe. ✎.....

✎.....

✎.....

✎.....




# Teacher's sheet: comprehension

See **pages 4 and 5** of *Microbes*

## Answers

1. **A = close up of the skin, B = bacteria.**
2. **(i) 3 billion years ago; (ii) 1673.**
3. **Bacteria, fungi, algae.**
4. **Rising of dough, fermenting of wine and beer, flavour of cheese, green colour of stagnant water, diseases.**
5. **Microbes that cause disease.**
6. **Made from one cell, less than a tenth of a millimetre across, skin-like wall, fluid inside the wall, substances needed for life, some have whip-like tails.**

## Complementary work

The children could use secondary sources to find out about the origins of microbes. They may find that scientists believe them to have formed from a kind of 'nutrient soup' in the sea, or from chemicals which fell to Earth on meteorites.

## Teaching notes

Microbes are simple forms of life which have been on the Earth for billions of years. Many microbes have become highly evolved to live in the ways that they do today.

Many scientists believe that the first microbes evolved from chemicals in the ancient seas. Some of the chemicals came together to form amino acids and proteins and in time they were enveloped by other chemicals that formed cell membranes. As this structure evolved, it became the more complicated cell structure that we see today in microbes such as algae and protozoa. Indeed, it is from creatures like these that multicellular living things – the plants and animals – are believed to have evolved.

The classification of microbes has been reviewed many times over the years. The classification used here is a traditional one used in many introductory courses. For children who will be studying biology as a separate subject in Key Stage 3, they will find that the classification used there is to place bacteria and blue-green algae in a group, or Kingdom, called the Monera, and the other algae and protozoa are placed in a group called the Protista. Fungi are placed in their own group. Many scientists also place viruses in their own group.

1

**Name:** ..... **Form:** .....

Based on **pages 4 and 5** of *Microbes*

# Spores and microbes

**Try this...**

**1.** Take a mushroom cap which has opened its gills and examine the gills. On the gills are tiny spores which are too small for you to see.

**2.** Place the mushroom cap on a piece of paper with its gills facing down. Leave the mushroom cap for 24 hours.

**3.** While the mushroom cap is on the paper, some of the spores will fall off and land on the paper. The spores will be in such large numbers that you will be able to see where they have landed on the paper. In this space draw how you think the spores will look when you lift up the mushroom cap.

**4.** When the 24-hour period is over, lift up the mushroom cap and look at how the spores are arranged. Describe how it compares with your prediction.

✎.....

✎.....

**5.** Spores float in the air. When some types of spores land on suitable food, they grow into moulds. Put samples of fruit and vegetables in separate plastic bags.

**6.** Look at the sample regularly over the next two weeks (but never open the bags).

**7.** Make a table to record your observations on a separate sheet of paper.

**Looking at the results.**

**8.** What did your results show?

✎.....

✎.....

# Teacher's sheet: activity

Based on **pages 4 and 5** of *Microbes*

## Introducing the activity

(a) You may like to remind the children that some fungi are also considered to be microbes. You can tell them that some fungi are much larger but they still have features in common with many kinds of microbes and they produce spores (see note (i)). Even though the spores are small, if a large number gather together they can be seen without a microscope.

## Using the sheet

(b) Give out the sheet, let the children fill in their names and form, then go through task 1 and let the children try it (see note (ii)).

(c) Go through task 2, then let the children try it (see note (iii)).

(d) Go through task 3, then let the children try it (see note (iv)).

(e) Go through task 4, then let the children try it.

(f) Go through task 5, then let the children try it (see note (v)).

(g) Go through task 6, then let the children try it (see note (vi)).

(h) Go through task 7, then let the children try it (see note (vii)).

## Completing the activity

(i) Let the children compare their results.

(j) If the school has a microscope you may like to remove a gill from the mushroom cap and place it on a microscope slide. Put the slide under the microscope. You should be able to see some spores (round structures) on the edge of the gill.

## Conclusion

The spores fall from the gills and make lines which radiate out from the centre of the cap.

Some foods may grow the same kind of mould and some foods may grow different moulds.

## Teaching notes

(i) Spores are microscopic capsules. Each one has a thick wall that protects the inside from heat and from drying out.

(ii) If appropriate, the children can cut the mushroom cap from the stalk. They should see that the gills radiate out from the centre of the cap like the spokes from the hub of a bicycle.

(iii) The cap must not be moved on the paper during this time, otherwise the spores will not settle in lines.

(iv) Some children may need help to link the arrangement of the gills with the way the spores will fall and form lines on the paper.

(v) Tell the children that there are microbe spores all around them, but they are too small to be seen.

(vi) You may like to tell the children that the bags are kept closed to keep in the large numbers of spores that the moulds produce. This is done because some people may be allergic to breathing large numbers of spores all at once.

(vii) The table should have a column for the dates and a row for each food.

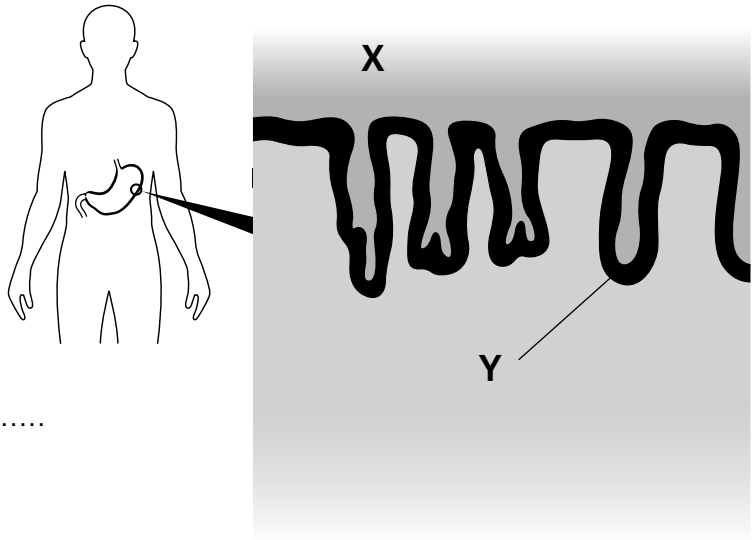
2

**Name:** ..... **Form:** .....

See **pages 6 and 7** of *Microbes*

# Microbes and your body

**Your body is home to trillions of microbes. You would not be able to live without them.**




**Q1**. (i) What part of the body is shown in the diagram?

✎.....

(ii) What kind of liquid is found at X?

✎.....

(iii) What is the substance labelled Y? ✎.....

(iv) What happens if the substance labelled Y is attacked by spiral bacteria?

✎.....

**Q2.** Where do microbes live in your mouth?

✎.....

**Q3.** Where are most microbes found inside your body? ✎.....

**Q4.** How are these microbes helpful?

✎.....

✎.....

**Q5.** State two ways in which a germ can harm the body.

✎..... ✎.....

**Q6.** Why can germs have difficulty attacking our body surface?

✎.....

✎.....


# Teacher's sheet: comprehension

See **pages 6 and 7** of *Microbes*

## Answers

1. **(i) Stomach wall; (ii) Acid; (iii) Mucus lining; (iv) An ulcer forms.**
2. **On the teeth, tongue and inside of the mouth.**
3. **In the gut.**
4. **They break down food and release substances the body uses for energy.**
5. **Make poisons, destroy cells, change cells.**
6. **It is already covered with other microbes so there is little room for them.**

## Complementary work

The children can use secondary sources to find out about the best way to keep the teeth and gums clean.

## Teaching notes

You may use this unit as part of a health and safety programme. The children will have studied the role of microbes in causing tooth damage earlier in the course, and you may like to remind them of it before you begin this unit. Here, the presence of microbes on the teeth is presented in a different context – that of the body being a natural home, or habitat, for many different kinds of microbes.

It is important to point out that it is not the microbes themselves which destroy the surface of the teeth, but the acids that are produced when the microbes feed on sugar.

All of our food has microbes on it, but the body is adapted to cope. The lining of the stomach produces an acid (hydrochloric acid) which kills them. The acid also helps chemicals, called enzymes, to break down proteins in food. Microbes which are taken in with the food are killed and digested along with the food. Substances in the microbes, such as proteins, are used by the body.

The living microbes in our intestines form a community of living things, just like the living things in a woodland or a pond. For most of the time, the populations of the different microbes in the intestine are balanced, but if we travel to a different country we may take in different microbes which destroy the balance and produce 'stomach ache'. However, in many countries there are also microbes which cause deadly diseases, such as typhoid or cholera, and precautions must be taken against them before travel.

2

**Name:** ..... **Form:** .....

Based on **pages 6 and 7** of *Microbes*

# Microbes on your teeth

**Try this...**

**1.** Look in a mirror at the teeth in your upper jaw and compare them with the teeth in Diagram 1.

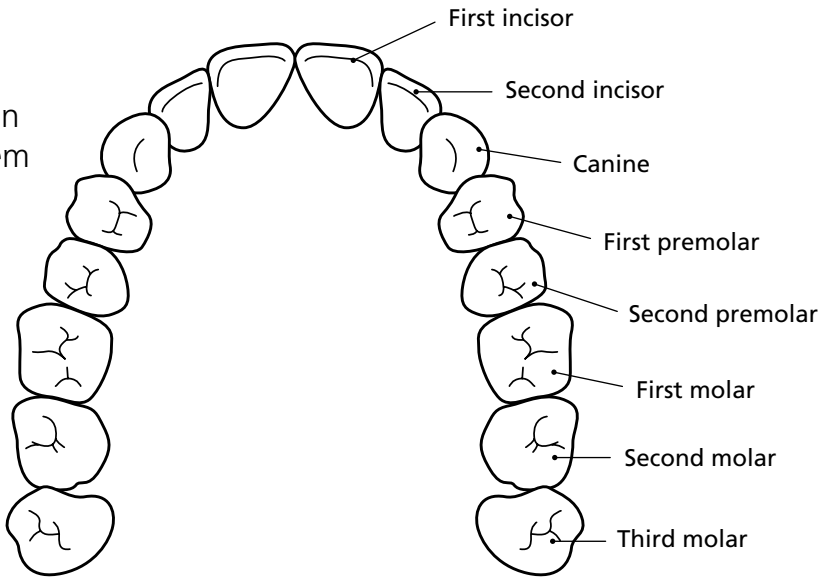



**Diagram 1**

**2.** Draw the arrangement of the teeth in your upper jaw in the top half of Diagram 2.

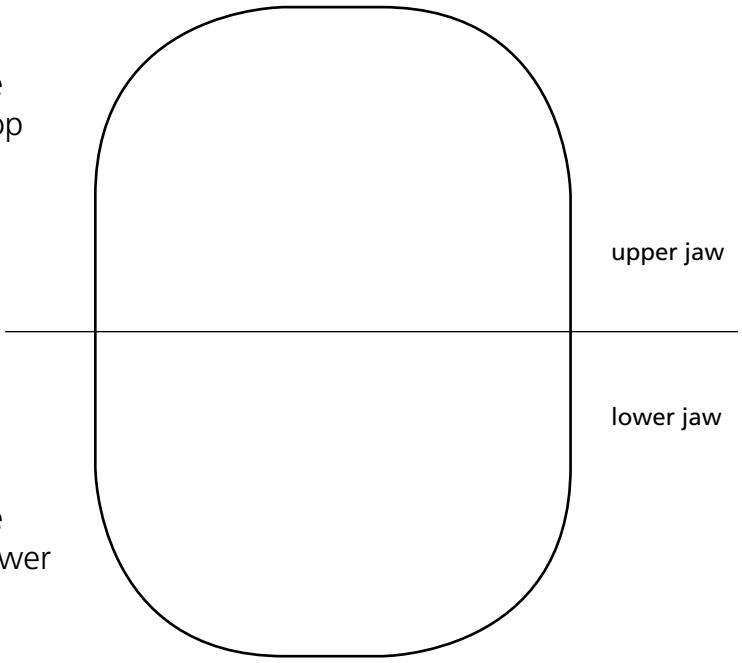



**Diagram 2**

**3.** Draw the arrangement of the teeth in your lower jaw in the lower half of Diagram 2.

**4.** Chew a disclosing tablet.

**5.** Look in the mirror again. The purple stain shows where microbes are living in your teeth.

**6.** Colour in the teeth in Diagram 2 to show where microbes are living on them.

**7.** Clean your teeth with a toothbrush. How does this affect your teeth?

✎.....

# Teacher's sheet: activity

Based on **pages 6 and 7** of *Microbes*

## Introducing the activity

(a) Use this activity after the children have studied pages 6 and 7 in the pupil book. Remind them of the picture showing the places where microbes are found on the teeth, and tell the children that they are going to find out where the microbes live on their own teeth.

## Using the sheet

(b) Give out the sheet, let the children fill in their names and form, then go through task 1 and let the children try it (see note (i)).

(c) Go through task 2, then let the children try it (see note (ii)).

(d) Go through task 3, then let the children try it (see note (iii)).

(e) Go through task 4, then let the children try it.

(f) Go through tasks 5 and 6, then let the children try them.

(g) Go through task 7, then let the children try it.

## Completing the activity

(h) Let the children compare their results.

(i) Ask the children if they were surprised at the amount of microbes on their teeth.

(j) Ask the children what happened to the microbes when they cleaned their teeth.

(k) Ask the children if this investigation will alter the way in which they clean their teeth.

## Conclusion

The places where microbes live on the teeth can be shown by chewing a tablet which contains a dye. The dye shows where the microbes are.

The microbes may be found on the fronts, backs and between the teeth. Brushing removes the dye and the microbes from the teeth.

Some children may clean their teeth more thoroughly as a consequence of taking part in this activity.

## Teaching notes

(i) The diagram shows the teeth in the upper jaw of an adult. The children should have their first and second incisors and their first molar. They may have got their adult canines and may be getting their premolars, and maybe their second molars. The third molars will appear when they are in their late teens.

Some children may need help in identifying some of their teeth.

(ii) Some children may need help in transposing onto paper what they see in the mirror. They should open their mouths as wide as possible to make their drawings.

(iii) The arrangement of the teeth in the lower jaw follows the same pattern as in the upper jaw so the children can use Diagram 1 for references to both jaws.

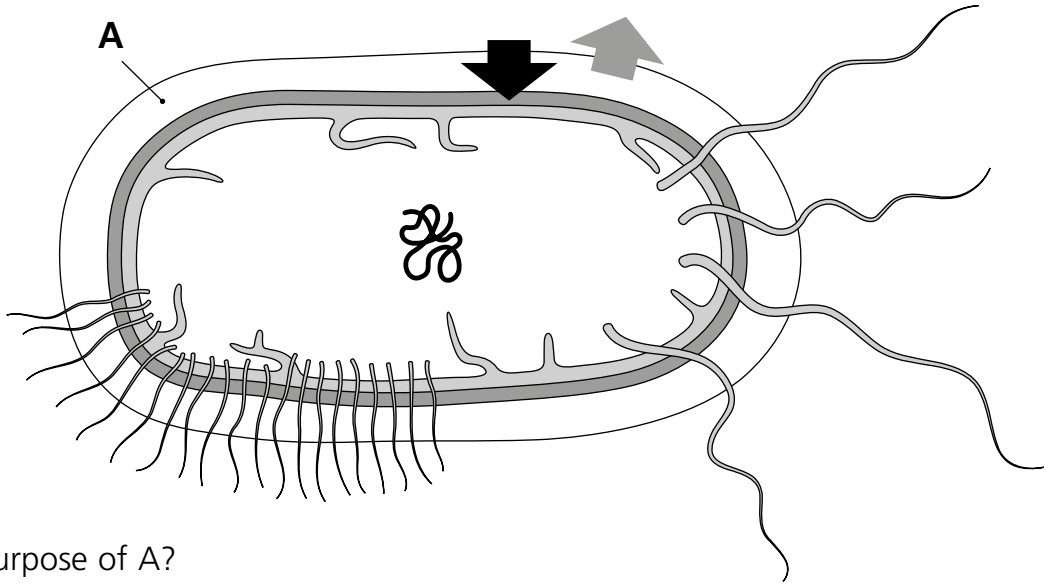
3

**Name:** ..... **Form:** .....

See **pages 8 and 9** of *Microbes*

# Bacteria

**Bacteria are small microbes that often eat and recycle dead matter and turn it into food. They are also a source of infection.**




**Q1**. (i) What is the purpose of A?

✎.....

(ii) Write an X on the part which contains instructions for living and reproducing.

**Q2.** (i) What liquid passes into a bacterium? ✎.....

(ii) What liquid passes out of a bacterium? ✎.....

**Q3.** What kind of shape does a *Bacillus* bacterium have?

✎.....

**Q4.** What do most bacteria feed on?

✎.....

✎.....

**Q5.** Name two chemicals which can kill bacteria on the skin.

✎..... ✎.....

**Q6.** How are bacteria important in recycling?

✎.....

✎.....

✎.....


# Teacher's sheet: comprehension

See **pages 8 and 9** of *Microbes*

## Answers

1. **(i) To hold the cell's shape; (ii) X is put on the coil of thread in the centre of the cell.**
2. **(i) Food; (ii) Wastes.**
3. **Rod-shaped.**
4. **Chemicals made by other living things.**
5. **Germicide, antiseptic.**
6. **They break down dead plants and sewage to release nourishment that plants can use.**

## Complementary work

(a) If the school has a garden in a secure area, a compost heap could be set up using garden waste and vegetable scraps. On a cold day the temperature inside the compost heap could be taken. It will be higher than the surroundings due to the energy released by the bacteria as they feed on the dead plant material.

(b) A gardener could make a visit and talk about how compost heaps are made and how the compost is used to grow new plants.

(c) The class could visit a garden and take photographs of a compost heap and discuss the use of compost.

## Teaching notes

Children sometimes first hear about bacteria in a medical context, when a doctor or nurse may mention names such as *Staphylococci* in connection with an infection. You may remind the children of this to help introduce the different shapes of bacteria.

Cocci are spherical bodies. *Staphylococci* are groups of cocci which look like a microscopic bunch of grapes, *Streptococci* are groups of bacteria which form long chains like the beads in a necklace. *Staphylococci* form boils. The term bacillus, as in the anthrax bacillus, refers to bacteria which are rod-shaped. The corkscrew-shaped bacteria are less well known by the general population, but a member of this group causes cholera.

It is important for the children to realise that most bacteria are *not* harmful and play a vital role in recycling materials. The reason why the Earth is not littered with dead plants and animals is due largely to the action of bacteria in the soil. Bacteria feed on the bodies and release the simple chemicals from which they are made. These chemicals form the nutrients and minerals in the soil which plants then use for nourishment.

Some plants, such as legumes (peas and beans), have lumps on their roots called nodules. In the nodules are bacteria which take nitrogen from the air, and materials from the plant, to make proteins which both the bacteria and plant can use. These crops are grown in soils where the nitrogen content is low. Clover is one such plant. It is often grown on nitrogen-poor soil, then ploughed in to enrich the nitrogen content of the soil so other crops can then be grown.


**Name:** ..... **Form:** .....

Based on **pages 8 and 9** of *Microbes*

# Investigating dead leaves

**Try this...**

**1.** Where do dead leaves collect in the area around the school?

✎.....

✎.....

**2.** Do all kinds of leaves rot at the same rate? Plan an investigation to test this.

✎.....

✎.....

✎.....

✎.....

✎.....

✎.....

✎.....

✎.....

✎.....

✎.....

**3.** Show your plan to your teacher. If your teacher approves, try it.

**Looking at the results.**

**4.** What do your results show?

✎.....

✎.....

# Teacher's sheet: activity

Based on **pages 8 and 9** of *Microbes*

## Introducing the activity

(a) Remind the children of the introduction to this unit, when you showed them pictures of a tree in leaf and without its leaves. Tell the children they are going to look more closely at how microbes break down leaves.

## Using the sheet

(b) Give out the sheet and let the children fill in their names and form, then go through task 1 (see note (i)).

(c) Let the children try task 1 and then go through their answers with them (see note (ii)).

(d) Go through task 2, then let the children try it (see note (iii)).

(e) Let the children try task 3 (see note (iv)).

(f) Go through task 4.

## Completing the activity

(g) Let the children compare their results.

## Conclusion

The way different kinds of leaves rot can be compared by performing a fair test.

The results will depend on the leaves used in the investigation. Grass leaves may rot before the leaves of broad-leaved trees, and the leaves of evergreen trees may rot even more slowly.

## Teaching notes

(i) If appropriate, let the children walk around outside the school and note places where leaves are rotting. They may be able to find some even in summer, especially under evergreen trees. These trees produce and lose leaves all year round and the leaves take longer to rot than the leaves of broad-leaved trees.

(ii) The children may make observations such as the leaves seemed to be rotting best in a damp place or in a place which gets a lot of the Sun's heat. These observations may help them in planning their investigation in task 2.

(iii) The children should be told that if they put their leaves in bags, the bags should be loosely sealed with a tie so any gases that form can escape into the air.

(iv) The children should have the same amounts of different leaves, or the same number of different leaves. Some children may suggest breaking large leaves down to the same size as smaller leaves (but the breaking up of the larger leaves may cause damage which increases the speed at which bacteria get into larger leaves).

The bags should have the same amount of moisture in them (avoid large amounts of water, but the leaves should be damp). The bags should all be kept in the same place and subjected to the same temperature and amount of light. The investigation should take two weeks.

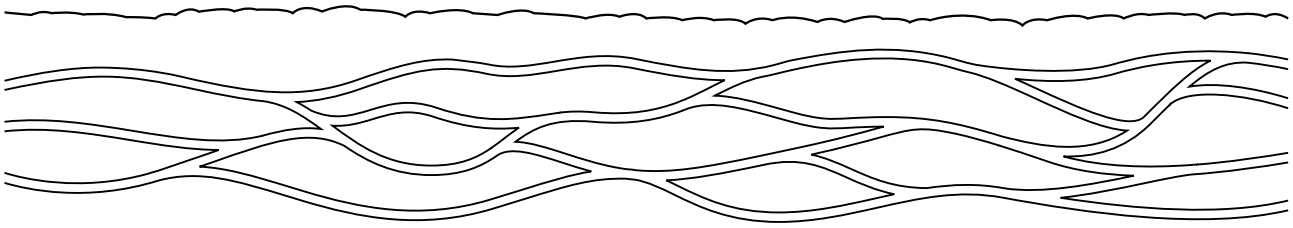
4

**Name:** ..... **Form:** .....

See **pages 10 and 11** of *Microbes*

# Fungi

**Fungi are thread-like creatures that get their food from plants and animals.**



**Q1**. (i) Draw four fibres branching out from this mould.

(ii) Draw one ripe 'fruit' that is releasing spores.

(iii) Name a place where this mould could grow. ✎.....

**Q2.** A mould is one kind of fungus. Name three other kinds of fungus.

✎..... ✎..... ✎.....

**Q3.** Name three places where fungi live.

✎..... ✎..... ✎.....

**Q4.** Name a fungus which thrives on people. ✎.....

**Q5.** (i) What is *Penicillium*? ✎.....

(ii) How does *Penicillium* affect bacteria?

✎.....

(iii) What medicine is *Penicillium* used to make? ✎.....

**Q6.** What is lichen made from?

✎.....


# Teacher's sheet: comprehension

See **pages 10 and 11** of *Microbes*

## Answers

1. **(i) Four fibres as in Picture 2 on page 11; (ii) One of the fibres to have dots around the 'fruit', or dots following the path of an air current as in Picture 3 on page 11; (iii) Bread.**
2. **Mildew, rust, yeast, mushrooms.**
3. **In water, in soil, on damp surfaces.**
4. **Athlete's foot.**
5. **(i) It is a green mould; (ii) It stops bacteria growing; (iii) Penicillin.**
6. **Fungi and algae growing together.**

## Complementary work

(a) The children could plan a fair test to see if temperature affects the rate at which slices of damp bread go mouldy. If their plans are suitable, they could carry out the investigation in accordance with school policies.

(b) Lichens form crust bodies which grow close to rocks and on roofing tiles and bricks and even concrete. The children could look for them in the area around the school and place them on a school map. This could be kept for use with future classes to show how the lichen population changes over the years.

## Teaching notes

Fungi are a large group of living things which were once placed in the Plant Kingdom but now are placed in a kingdom of their own. The reason for this is that although many have a texture similar to some plants, none of them can make food using sunlight. They must get their food as an animal does by feeding on other things.

Fungi play an important role in the decomposition of dead plant and animal bodies. Most fungi grow threads which ooze digestive chemicals called enzymes from their surfaces. These break food down into simple chemicals, just as the enzymes in our own digestive system break down food. The simple chemicals are then drawn into the thread and used for growth and reproduction.

The reproductive part of a fungus is called a fruiting body. It is important to realise that this structure is not really a fruit, and the fungus produces spores and not seeds. A spore differs from a seed in that it does not contain a tiny plant with a food store, but a piece of the parent fungus which is ready to start growing if given the right conditions.

In a lichen, the fungus forms the attachment to a surface. It takes in minerals from the surface which the algae can use. The fungus provides the support for the algae, and the algae makes food using sunlight and provides some for the lichen. This is a mutualistic relationship – both organisms benefit.

One common lichen is a powdery blue-green coating sometimes seen on trees. It should not be confused with the bright green slime which is a kind of algae.


**Name:** ..... **Form:** .....

Based on **pages 10 and 11** of *Microbes*

# Investigating moulds

**Try this...**

**1.** Does mould grow better on damp bread or dry bread? Plan an investigation to test this idea.

✎.....

✎.....

✎.....

**2.** Show your plan to your teacher. If your teacher approves, try it.

**3.** Collect a piece of cheese, a biscuit, a piece of cucumber, a piece of carrot.

**4.** Predict the order in which you think they will go mouldy.

✎.....

**5.** Give a reason for your prediction.

✎.....

**6.** Plan an investigation to test your prediction.

✎.....

✎.....

✎.....

**7.** Show your plan to your teacher. If your teacher approves, try it.

**Looking at the results.**

**8.** What do the results of the first investigation show?

✎.....

**9.** What do the results of the second investigation show?

✎.....


# Teacher's sheet: activity

Based on **pages 10 and 11** of *Microbes*

## Introducing the activity

(a) Remind the children of your introduction to this unit, and of their experiences of mouldy food. Tell them that they are going to plan and carry out two investigations about mould and food.

## Using the sheet

(b) Give out the sheet and let the children fill in their names and form, then go through tasks 1 and 2 and let the children try them (see note (i)).

(c) Let the children try task 3.

(d) Go through tasks 4 and 5, then let the children try them.

(e) Let the children try tasks 6 and 7 (see note (ii)).

(f) Go through tasks 8 and 9 and let the children try them.

(g) Ask the children to compare their results with their predictions.

## Completing the activity

(h) Let the children compare their results from the two investigations.

## Conclusion

Mould grows better on damp bread than on dry bread.

Mould may grow better on foods with a high water content than on foods which have a low water content or are dry. The order in which the foods go mouldy could be cucumber, cheese, carrot, biscuit.

## Teaching notes

(i) The children should have a piece of dry bread sealed in one clear plastic bag, and a piece of damp bread enclosed in another sealed bag. Some children may wish to investigate different degrees of dampness and may set up three or more bags. The bags should all be stored at the same temperature and in the same amount of light.

(ii) The children should put each sample in a separate bag and not add extra water. The bags should all be stored at the same temperature and in the same amount of light.

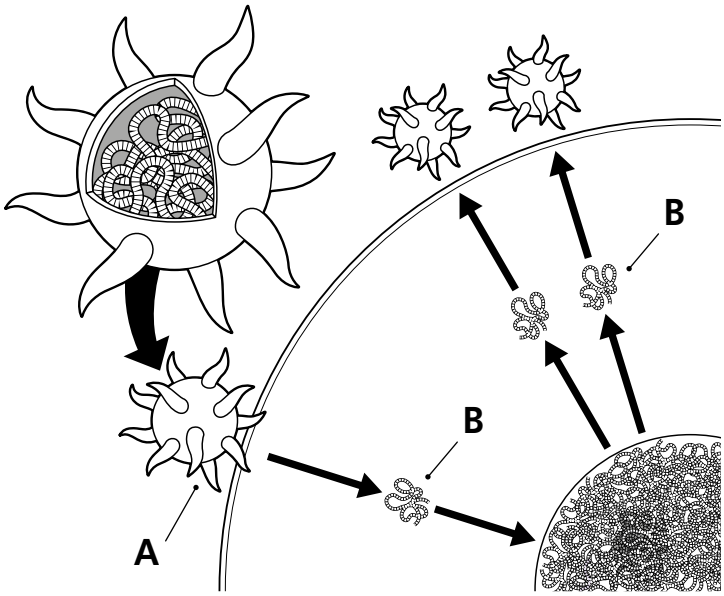
5

**Name:** ..... **Form:** .....

See **pages 12 and 13** of *Microbes*

# Viruses

**Viruses are minute creatures that live inside live cells.**




**Q1**. (i) What is virus A doing?

✎.....

✎.....

(ii) What are the parts labelled B?

✎.....

**Q2.** How does the size of a virus compare with the size of a bacterium?

✎.....

**Q3.** Name three diseases caused by viruses.

✎..... ✎.....

✎.....

**Q4.** (i) How can a virus infection affect the body temperature?

✎.....

(ii) Why does the body temperature change?

✎.....

**Q5.** Name two substances that the body uses to attack viruses.

✎..... ✎.....

**Q6.** What is a vaccine and how does it work?

✎.....

✎.....

✎.....

✎.....


# Teacher's sheet: comprehension

See **pages 12 and 13** of *Microbes*

## Answers

1. **(i) It is puncturing the skin of the cell; (ii) Virus genes.**
2. **A virus is much smaller than a bacterium.**
3. **Common cold, flu, chickenpox, AIDS, measles, mumps, poliomyelitis, rubella.**
4. **(i) The body temperature may rise; (ii) To stop the viruses growing.**
5. **Interferon, antibodies.**
6. **A vaccine is a liquid which contains a weakened or inactive strain of a virus. This makes the body produce immune cells and antibodies, which protect against later infection.**

## Complementary work

The children can use secondary sources to find out about the diseases caused by viruses.

## Teaching notes

A virus has two parts – a case and a message. The case is a tough protein coat which can be any shape. The message is in the form of a chemical called DNA. The message carries instructions on how to make a copy of itself and a new coat.

When a virus enters a cell, the coat of the virus breaks open and its DNA commands part of the cell to make new strands of DNA and new coats. Each new strand of DNA is enclosed in a new coat and becomes a new virus. The new viruses then leave the cell and raid others to increase their population even further.

Outside the cell a virus shows no characteristics of life and can even be stored in a jar, like crystals. They only show characteristics of life when they are in a cell making copies of themselves.

Each kind of bacteria and virus has substances on its surface called antigens. When the microbe invades the body, the body reacts by producing substances called antibodies. They attach to the antigens and destroy the microbe. If a person is not immunised, the microbes may enter the body and breed faster than the body can produce antibodies. This results in a person suffering the full force of the disease, perhaps with fatal results.

In a vaccine, a weakened or dead microbe (or in some cases the poison it produces) is given to the body. The body responds by making antibodies. This primes the body's infection-fighting cells, so that if a further microbe infection occurs, they can produce antibodies more quickly to destroy the microbe population before it causes the disease.

Plants can also be attacked by viruses.

5

**Name:** ..... **Form:** .....

Based on **pages 12 and 13** of *Microbes*

# Immunisation

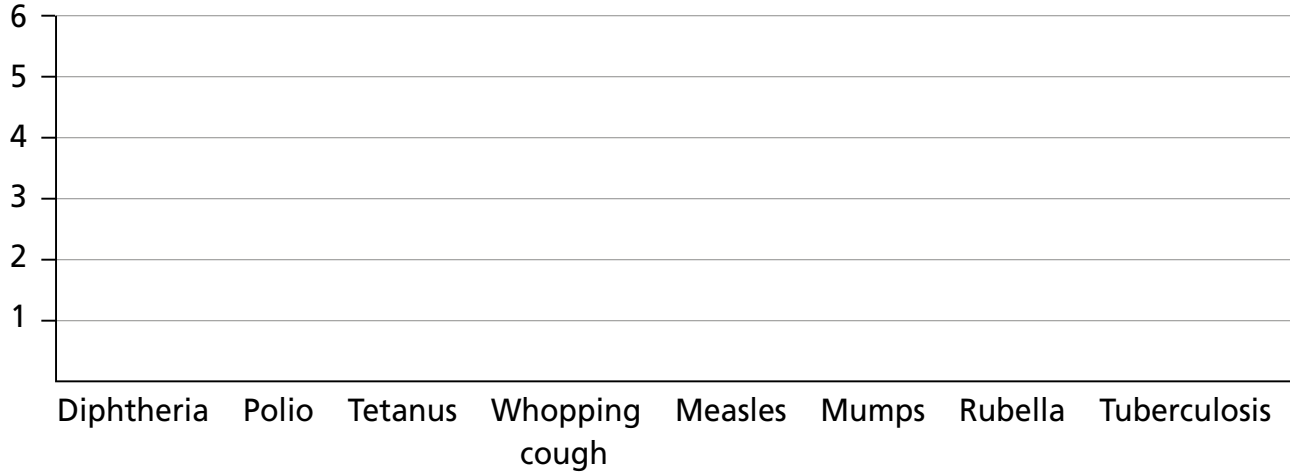
**Try this...**

**1.** This table shows the ages at which people are immunised for certain diseases in the United Kingdom. Read it then move to step 2.

| Age when immunised | Disease immunised against |
|---|---|
| 2 months | diphtheria, polio, tetanus, whooping cough |
| 3 months | diphtheria, polio, tetanus, whooping cough |
| 4 months | diphtheria, polio, tetanus, whooping cough |
| 12-18 months | measles, mumps, rubella |
| 3-5 years | diphtheria, measles, mumps, rubella, polio, tetanus, whooping cough |
| 10-14 years | tuberculosis |
| 13-18 years | diphtheria, polio, tetanus |

**2.** Make a bar chart to show how many times each disease was immunised against.

**Number of immunisations**




**3.** At what ages are people immunised against tetanus?

✎.....

**4.** When are people immunised against measles?

✎.....

# Teacher's sheet: activity

Based on **pages 12 and 13** of *Microbes*

## Introducing the activity

(a) Use this activity after the children have studied the unit in the pupil book. Tell them that immunisation is a powerful process to fight disease and is used for both fighting viruses and bacteria (see note (i)). You may ask the children if they can remember any of their younger brothers and sisters going for immunisation (see note (ii)).

## Using the sheet

(b) Give out the sheet, let the children fill in their names and form. Go through tasks 1 and 2 with the children.

(c) Let the children try task 2.

(d) Let the children try tasks 3 and 4.

(e) Review the bar charts made by the children and let them display their work.

## Conclusion

The bar chart should show that each disease was immunised against as follows: diphtheria 5 times, tetanus 5 times, whooping cough 4 times, polio 5 times, measles twice, mumps twice, rubella twice, tuberculosis once.

People are immunised against tetanus at ages 2 months, 3 months, 4 months, 3-5 years and 13-18 years. People are immunised against measles at 12-18 months and between 3-5 years.

## Teaching notes

(i) In the table, the diseases caused by viruses are mumps, measles and rubella. Diphtheria, polio, tetanus, tuberculosis and whooping cough are caused by bacteria.

(ii) For simplicity, some aspects of the full immunisation programme are not shown in the table. Some features of the full programme are deemed controversial by some people so the topic should be handled with care. Girls are also immunised against rubella again between the ages of 10 and 13. This is so, in later life, should they have babies, they will not contract the disease and pass it on to their babies as they are developing in the womb. Rubella can cause babies to be born with eye, ear and heart defects.

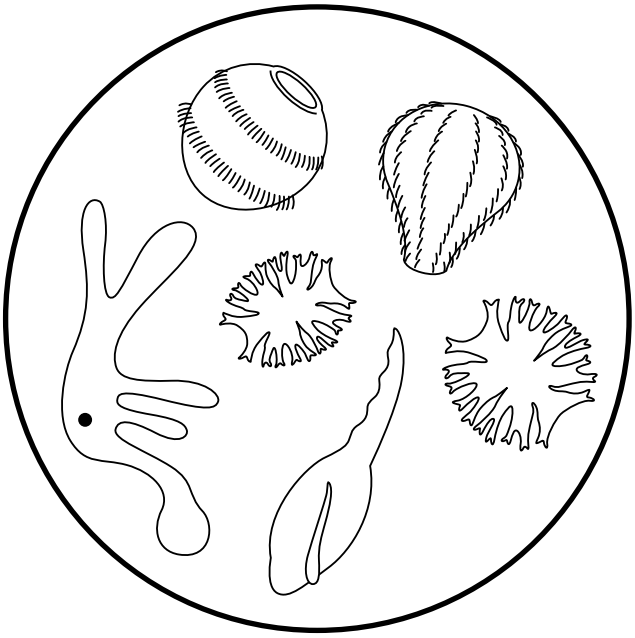
6

**Name:** ..... **Form:** .....

See **pages 14 and 15** of *Microbes*

# Microbe plants and animals

**Algae are tiny plant-like creatures with a green colouring. They are not harmful and are an important source of food for water-living animals.**



**Q1**. (i) Label a protozoan with a P.

(ii) Label an alga with an A.

**Q2.** Where do algae live?

✎.....

✎.....

**Q3.** (i) What do algae use their green colouring for?

✎.....

(ii) What do algae make that escapes into the air?

✎.....

**Q4.** What are hard-shelled algae called? ✎.....

**Q5.** Where do protozoa live?

✎.....

**Q6.** How do protozoa make soil more fertile for plants to grow in it?

✎.....

✎.....

✎.....

✎.....

✎.....

✎.....


# Teacher's sheet: comprehension

See **pages 14 and 15** of *Microbes*

## Answers

1. **(i) Any of the three protozoa – one with 'limbs' and two with bands of hairs; (ii) Any of the two 'Sun'-shaped algae or the diatom.**
2. **Fresh and salty water.**
3. **(i) Making food; (ii) Oxygen.**
4. **Diatoms.**
5. **Water, moist soil, in plants and animals, including humans.**
6. **They eat old bacteria, leaving space for young bacteria to break down dead plant matter quickly so plants can use it. They release nitrogen and phosphorus (or minerals or nutrients) which are fertilisers.**

## Complementary work

The children could use secondary sources to find out about amoeba. This is the 'classic' protozoan which has been traditionally studied by all biologists. It will give the children an insight into the protozoan way of life and complement the activity in this unit, which deals with algae.

## Teaching notes

In the past, the plant-like microbes were grouped in the Plant Kingdom and formed a group within it called the algae. In a similar way, the animal-like microbes were placed in the Animal Kingdom but put in a sub-group called protozoa, meaning first animals. Today, the algae and protozoa are put together into their own group, which is called Protista. The children do not need to know about the way microbes are grouped, but children who go on to study biology as a separate subject at Key Stage 3 will be introduced to the group so it may be useful to be aware of what they will find.

There is a group of living things called blue-green algae which, as their name suggests, were once grouped with the algae. Today they are considered to have more in common with bacteria, and the two groups of microbes are placed in their own group, called Monera. Again, the children do not need to know this, but it may help when looking at secondary sources as some may use this method of grouping. At this level it is more important to establish that some microbes have plant-like and animal-like features and not to dwell on classification.

Taking this approach, it is more convenient simply to group the blue-green algae with the algae. The algae shown in the photograph of the hot spring are blue-green algae.

You may like to link this unit with Unit 10 and use a microscope to show the children algae and protozoa in pond water.


**Name:** ..... **Form:** .....

Based on **pages 14 and 15** of *Microbes*

# Looking at algae

**Try this…**

**1.** Algae makes a green covering on fences, walls and on the bark of trees. Does it cover the whole of a fence or wall, and both of their sides, or is it found in a small area and not on both sides? Does algae growing on a tree grow all the way round its trunk, or just on one side? Work out a plan to test these ideas. In your plan, you should use a compass to work out the direction in which the surface of the wall, fence or tree is facing.

✎.....

✎.....

✎.....

✎.....

**2.** Show your plan to your teacher. If your teacher approves, try it.

**3.** What do your results show?

✎.....

**4.** Set up a jar of pond water in a sunny window.

**5.** Look at the jar regularly over two weeks and record what you see on a separate sheet of paper.

**6.** How did the water in the jar change?

✎.....

**7.** Set up a jar which contains green pond water and cover the sides in brown paper. Make a slit at one place in the paper so that light may enter the jar. Leave the jar in a sunny place for 24 hours.

**8.** Take the brown paper from the jar. Write down what you see.

✎.....

**9.** Explain your observation.

✎.....

# 6 Teacher's sheet: activity

Based on **pages 14 and 15** of *Microbes*

## Introducing the activity

(a) Remind the children of the introduction to this unit and of the green, slimy covering of algae on stones in streams and rivers. Show them a piece of wood with a coating of bright green algae on it and ask them if they have seen similar colonies of algae in other surroundings away from rivers and streams. When the children mention walls and fences tell them that they are going to make some investigations about algae.

## Using the sheet

(b) Give the children the sheet, let them write their names and form on it, then go through tasks 1 and 2 and let the children try them (see note (i)).

(c) Go through task 3 and let the children try it (see note (ii)).

(d) Go through tasks 4 and 5 with the children (see note (iii)).

(e) Let the children try tasks 4 and 5.

(f) Let the children try task 6.

(g) Go through tasks 7 and 8 with the children (see note (iv)).

(h) Let the children try tasks 7 to 9.

## Completing the activity

(i) Let the children compare their results.

## Conclusion

Algae does not cover all surfaces on land. It may be found on damp surfaces or on surfaces which face a particular way. This way may be facing the direction from which the prevailing wind blows. If this is the case, the surface will be exposed to wet conditions while other surfaces are more sheltered and drier and so have fewer algae or none at all.

If pond water is left in the light and the warmth, the algae may breed so fast that their numbers make the water green. When there is only a slit of light shining into green pond water, algae move to the light and make a green line on the glass where the slit is located.

## Teaching notes

(i) The plan must show that the children are going to look at a number of fences, walls and trees (perhaps six of each). In their report of each surface, they should say whether algae were present or not, and the direction in which the surface was facing.

(ii) The children should have sampled some surfaces which do not have algae on them, and this should lead them to conclude that algae are not found everywhere. They may find there is a relationship between the direction in which the surface faces and the presence of algae.

(iii) The children should construct a table or keep a diary in which to record their results.

(iv) You may like to keep this part of the activity until task 6 is completed. You may find that the jar is full of green water, but that algae will be concentrated at the slit.

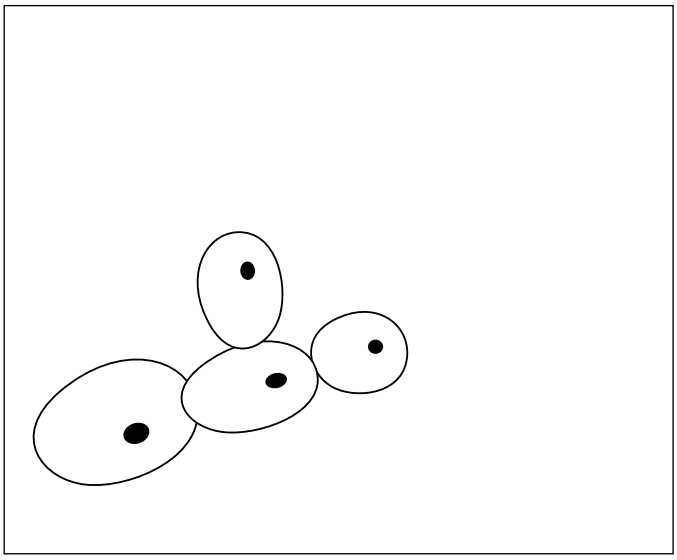
7

**Name:** ..... **Form:** .....

See **pages 16 and 17** of *Microbes*

# Microbes make food

**Microbes need to eat, and they eat the same food as us. This can be good news.**



**Q1**. Here are four yeast cells. Draw in some more cells to show how the group may look a little later when reproduction has taken place.

**Q2.** (i) What is leavened bread?

✎.....

✎.....

(ii) Name an unleavened bread.

✎.....

(iii) In the box draw a small ball of dough. Then draw what you think the ball of dough might look like after cooking if it contained yeast.

**Q3.** What happens when yeast is added to dough? ✎.....

✎.....

**Q4.** What two substances are formed when milk is curdled?

✎..... ✎.....

**Q5.** What is the microbe that makes the blue veins in some kinds of cheese?

✎.....

**Q6.** (i) Name a drink that is pasteurised. ✎.....

(ii) What happens to this drink when it is pasteurised?

✎.....

✎.....

# 7 Teacher's sheet: comprehension

See **pages 16 and 17** of *Microbes*

## Answers

1. **Cells added as shown in the picture on page 16 of the pupil book.**
2. **(i) Bread that rises and makes bubbles; (ii) Naan, tortilla; (iii) It would have swollen up to several times the volume.**
3. **Yeast feeds on the dough and makes a gas called carbon dioxide.**
4. **Curds and whey.**
5. **Fungus.**
6. **(i) Milk; (ii) The milk is heated to about 70°C for a short time and then cooled.**

## Complementary work

If strict hygienic conditions can be maintained, and there is access to an oven, the children could make bread from a recipe in a cookery book.

## Teaching notes

It may seem strange that yeast can be used to produce both bread and alcohol. This often raises the question of why there is no alcohol in bread. Yeast will not produce alcohol in the presence of oxygen. This is why wine and beer, for example, are made in containers that allow gases to escape, but do not allow air in. In the presence of oxygen, as in bread-making, the yeast produces mostly carbon dioxide gas, which is what makes bread rise. There are also many yeasts which cannot make alcohol.

Yeasts die off when the alcoholic content reaches about 14%. Alcoholic drinks with more than this amount have undergone extra processes to concentrate the alcohol.

Pasteurisation is named after Louis Pasteur who was the scientist who invented it. He was asked to find out why wine often went sour when it was stored, and discovered that a yeast could form in it which caused the souring. He found that if the wine was heated gently to 48°C the yeast was killed and the stored wine did not go sour. There are two main kinds of pasteurisation used today. They are high temperature, short time (HTST), in which a food is heated to 71.7°C for 15 seconds, and low temperature holding (LTH), in which the food is heated to 66.8°C for 30 minutes.

Ultra-heat treated (UHT) milk has been heated to 135°C for 2 seconds.

7

**Name:** ..... **Form:** .....

Based on **pages 16 and 17** of *Microbes*

# Observing yeasts

**Try this…**

**1.** Examine some fresh bread yeast and compare it with wine yeast. Write down your observations here.

✎.....

✎.....

✎.....

**2.** Add water to a bottle until it reaches two centimetres up the side.

**3.** Add a level teaspoon of sugar to the water.

**4.** Carefully swirl the water round to help the sugar dissolve.

**5.** Put a quarter of a teaspoon of bread yeast in the bottle.

**6.** Carefully swirl the bottle to mix up the yeast in the water.

**7.** Place a balloon over the top of the bottle neck.

**8.** Take a second bottle and repeat steps 2 to 4.

**9.** Repeat steps 5 to 7 with the second bottle, using the wine yeast this time.

**10.** Put both bottles in a warm place.

**11.** Observe the bottles regularly over the next few hours and record what you see.

✎.....

✎.....

✎.....

**12.** Explain your observations.

✎.....

✎.....

# Teacher's sheet: activity

Based on **pages 16 and 17** of *Microbes*

## Introducing the activity

(a) You will need to set up this activity early in the school day so the children can look at it regularly over a few hours and be able to finish the activity by the end of the day. Remind the children that yeast is a fungus, and tell them that they are going to compare two types of yeast and see what happens when you give them some sugar.

## Using the sheet

(b) Give out the sheet and let the children fill in their names and form, then go through task 1 (see note (i)).

(c) Let the children try task 1.

(d) Go through task 2, then let the children try it (see note (ii)).

(e) Go through tasks 3 and 4, then let the children try them.

(f) Go through tasks 5 to 7, then let the children try them (see note (iii)).

(g) Go through tasks 8 and 9, then let the children try them.

(h) Go through tasks 10 and 11, then let the children try them (see note (iv)).

## Completing the activity

(i) Let the children compare their results then try task 12.

## Conclusion

Bread yeast and wine yeast look similar.

When yeast is in water with sugar and kept in a warm place it produces bubbles of gas on the water surface and in time can produce so much gas that it can partially inflate a balloon.

The yeast feeds on the sugar and produces carbon dioxide gas. As the yeast feeds, it breeds, so more individuals are produced which in turn feed and produce more gas.

## Teaching notes

(i) They could compare granular and cake yeast, or wine and bread yeast.

(ii) Make sure that you have tried the experiment in advance, as suggested in the resource list on page 15.

(iii) If using cake yeast, you may wish to cut up the yeast for the children so they can put it in their spoons.

(iv) The children could look at the bottle every hour. They should look for signs of bubbles on the liquid surface and signs that the balloon is inflating.

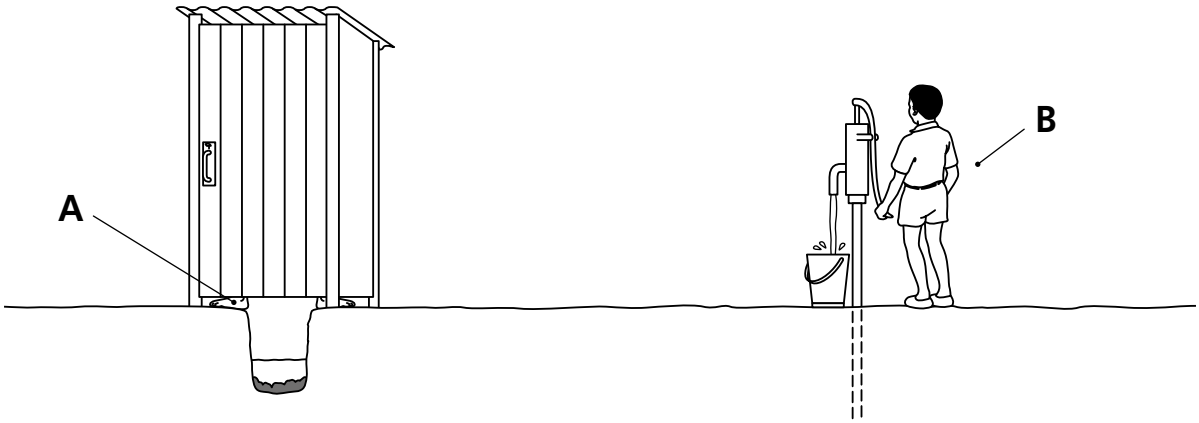
8

**Name:** ..... **Form:** .....

See **pages 18 and 19** of *Microbes*

# Microbes and disease

**Since ancient times, microbes have caused widespread disease.**




**Q1**. Add words and an arrow to the diagram to explain how person B may receive a disease from person A.

(ii) Name a disease which is spread as shown in the diagram. ✎.....

**Q2.** When do most diseases occur?

✎.....

**Q3.** (i) What disease is spread by fleas? ✎.....

(ii) How does the disease get from fleas to humans?

✎.....

✎.....

✎.....

**Q4.** (i) What kind of microbe caused the potato famine? ✎.....

(ii) In which country did the worst potato famine occur? ✎.....

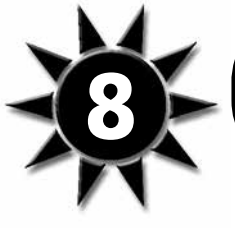
**Q5.** (i) What kind of microbe causes malaria? ✎.....

(ii) What animal spreads malaria? ✎.....

**Q6.** How does the use of handkerchiefs stop the spread of disease?

✎.....

✎.....




# Teacher's sheet: comprehension

See **pages 18 and 19** of *Microbes*

## Answers

1. **(i) Arrow and annotation similar to that used in Picture 2 of the pupil book; (ii) Cholera.**
2. **When a body's defences are overwhelmed by an invading germ.**
3. **(i) Black Death, or the bubonic plague; (ii) The fleas live on rats. When too many rats die, the fleas look for a new home, and live on humans instead. They bite the humans and pass on the disease.**
4. **(i) A fungus; (ii) Ireland.**
5. **(i) A protozoan; (ii) Mosquitos.**
6. **They catch and hold some of the viruses which leave the body when a person sneezes or coughs.**

## Complementary work

The children could use secondary sources to find out how people with particular microbial diseases are nursed back to health.

## Teaching notes

Bacteria, viruses and fungi cause disease in different ways. Bacteria release poisons (called toxins) which attack the cells and damage them This can cause death. Viruses enter cells and breed in them. The breeding process destroys the cells. If enough cells are destroyed, this can cause death. Fungi attack cells on the surface of the body, such as skin cells.

When cells are damaged they release a chemical into the blood. This chemical affects the temperature-controlling mechanism in the body and results in inflammation of the damaged area and a general raising of the body temperature, called a fever. The purpose of raising the temperature is to try and kill off the invading microbes.

The following diseases are caused by viruses: chickenpox, the common cold, mumps, measles, rabies, rubella and smallpox. The following diseases are caused by bacteria: cholera, diphtheria, food poisoning, leprosy, plague, polio, tetanus, tonsillitis, tuberculosis, typhoid, whooping cough. Boils and pimples are also caused by bacteria. Athlete's foot, ringworm and thrush are diseases caused by fungi.

Malaria, bilharzia and sleeping sickness are diseases caused by protozoa. Diarrhoea may be a symptom of some diseases caused by bacteria, viruses or protozoa. Pneumonia may be caused by either bacteria or viruses.

It is important that the children realise that some diseases, such as heart disease, are not caused by microbes.

Some animals can carry diseases that affect humans without getting the disease themselves.

8

Name: ..... Form: .....

Based on **pages 18 and 19** of *Microbes*

# Building up an infection

**Try this…**

**1.** Read the following paragraph.

**In ideal conditions, a bacterium can produce one offspring every 20 minutes. Each offspring can then produce an offspring in 20 minutes. This means that every 20 minutes, a colony of bacteria can double in size.**

**2.** Imagine that 10 bacteria drifted into a person's throat and settled on its surface. Show how the numbers of bacteria built up over four hours by completing this table.

| Time from bacteria arriving (mins) | Size of colony (number of bacteria) |
|---|---|
| 0 | 10 |
| 20 | 20 |
| 40 | 40 |
| 60 | |
| 80 | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

**3.** On your graph paper, make a line graph to show how the size of the bacterial colony increased in the first 80 minutes of the infection.

**4.** Use the graph to find how many bacteria were present 50 minutes after the infection started.

✎.....

# 8 Teacher's sheet: activity

Based on **pages 18 and 19** of *Microbes*

## Introducing the activity

(a) If you used the activity in the introduction to show how a colony of germs increases in size, remind the children of it now. Tell them that they are going to work out how an infection builds up after a small group of harmful bacteria land in a person's throat.

## Using the sheet

(b) Give out the sheet and let the children fill in their names and form, then go through task 1 with the children (see note (i)).

(c) Go through task 2 with the children (see note (ii)).

(d) Let the children try task 2.

(e) Go through the answers in the table and check that they are correct before moving on to task 3.

(f) Give out the graph paper and let the children try task 3 (see note (iii)).

(g) Go through task 4, then let the children try it (see note (iv)).

## Completing the activity

(h) Ask the children if they could work out how many bacteria there would be five hours after the infection.

(i) Ask the children to estimate when a million bacteria would be present.

## Conclusion

The table should be filled in as the example given opposite.

After 50 minutes there were 60 bacteria.

After 260 minutes there would be 81,920 bacteria, after 280 minutes there would be 163,840 bacteria, and after 300 minutes there would be 327,680 bacteria.

There would be a million bacteria between 320 and 340 minutes after the infection started.

## Teaching notes

(i) Make sure the children can see that the colony doubles. You may like to draw some bacteria on the board or use Plasticine models.

(ii) Make sure that the children know to increase the time in minutes by 20 and that the number of bacteria doubles each time. Some children may have spotted an early relationship between the time in minutes and the number of bacteria and think that it holds all the way through the table.

(iii) The children should be encouraged to make as large a line graph as possible because it is easier to read. Make sure that 'Time' is on the X axis and the 'Number of bacteria' is on the Y axis. Both the X and Y axis should be labelled appropriately and the graph should have a title such as 'Growth of a colony of bacteria'.

(iv) Some children may need help with reading the graph.

| Time from bacteria arriving (mins) | Size of colony (number of bacteria) |
|---|---|
| 0 | 10 |
| 20 | 20 |
| 40 | 40 |
| 60 | 80 |
| 80 | 160 |
| 100 | 320 |
| 120 | 640 |
| 140 | 1,280 |
| 160 | 2,560 |
| 180 | 5,120 |
| 200 | 10,240 |
| 220 | 20,480 |
| 240 | 40,960 |

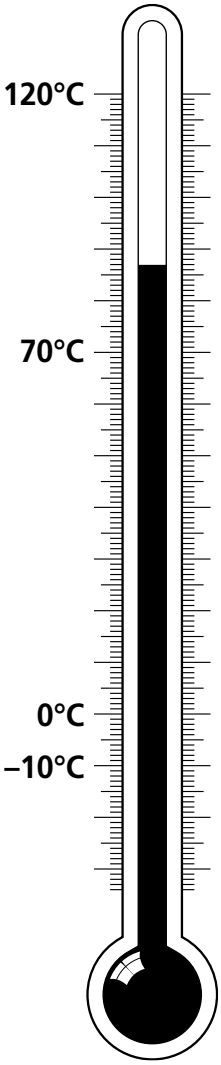
9

**Name:** ..... **Form:** .....

See **pages 20 and 21** of *Microbes*

# Staying healthy

**Keeping germs at bay is one of the best ways of staying healthy.**




**Q1.** Look at the temperatures marked on the thermometer.

(i) At which temperature are most microbe spores killed? ✎.....

(ii) At which temperature do most microbes stop growing? ✎.....

**Q2.** (i) Which microbes are the main cause of food rotting and smelling?

✎.....

(ii) Which microbes are the major cause of food poisoning?

✎.....

**Q3.** Why are meat and eggs sources of food poisoning?

✎.....

**Q4.** One piece of meat was left out in the kitchen and one piece was put in a refrigerator.

(i) Which piece of meat would have most microbes on it after a day?

✎.....

(ii) Explain your answer. ✎.....

✎.....

**Q5.** What is the disinfectant added to water in a swimming pool? ✎.....

**Q6.** Why is washing your hands with soap better than just swilling them with water?

✎.....

✎.....

✎.....

✎.....

✎.....


# Teacher's sheet: comprehension

See **pages 20 and 21** of *Microbes*

## Answers

1. **(i) 120°C; (ii) –10°C.**
2. **(i) Fungi; (ii) Bacteria (salmonella).**
3. **Because they contain protein on which bacteria thrive.**
4. **(i) The meat left out in the kitchen; (ii) The low temperature in the refrigerator slows down the growth. (Note: It does not kill the microbes.)**
5. **Chlorine.**
6. **The soap lifts the microbes off the skin and rolls them into balls which are then easy to wash away with water. Swilling hands with water removes fewer microbes.**

## Complementary work

(a) The children could do a survey of other people in the school to find out some aspects of personal hygiene. They could do this by asking the following questions: Do you always wash your hands before eating, rubbing your eyes or putting your fingers in your mouth? Do you always wash your hands after handling a pet? The respondents could answer using a five point scale (1 = I always do, 5 = I never do). The children could also ask how often each person cleaned their fingernails.

## Teaching notes

Foods can be attacked by microbes. When this happens the food spoils and is dangerous to eat. From early times people have practised various methods to preserve food. These methods include drying, salting, smoking, making jams and pickling. Freezing and canning are relatively new methods of food preserving.

Food preservation methods can be divided into two groups. In one group the micro-organisms are killed. This includes cooking and sterilisation, as carried out on canned foods. In the second group the micro-organisms are prevented from growing. This includes dehydration, as in drying fruits and making powdered soups and milk, the use of chemicals, such as smoke, salt, sugar and vinegar, and the practice of freezing.

In pasteurisation, the active microbes in the food are killed but the spores are not. Pasteurised milk still goes bad after a few days because the bacteria have emerged from their spores and begun to breed.

The area of personal hygiene must be treated with some sensitivity, as the circumstances of some children may prevent them from keeping as clean as they would wish. However, all should be able to follow some regime to reduce risks of poor health through bad hygiene.

The children may not be aware that sweat left on the body encourages the growth of microbes which produce wastes that give the smell known as body odour, or BO. Clothes next to the skin also collect sweat and become a breeding ground for germs. They must be changed frequently, preferably daily, to prevent the build up of microbes. If a person with dirty skin and dirty clothes receives a cut the microbes may enter the body and cause an infection.


**Name:** ..... **Form:** .....

Based on **pages 20 and 21** of *Microbes*

# Can temperature affect the activity of yeast?

**Try this…**

**1.** Think back to when you observed yeast in Unit 7. How did you set up the bottles of feeding yeast?

✎.....

✎.....

**2.** How could you adapt the experiment you did in Unit 7 to investigate how temperature affects feeding yeast? Write out a plan and draw a table on a separate piece of paper in which to record your results.

✎.....

✎.....

✎.....

✎.....

✎.....

✎.....

✎.....

✎.....

**3.** Show your plan to your teacher. If your teacher approves, try it.

**Looking at the results.**

**4.** What did the results show?

✎.....

✎.....

# 9 Teacher's sheet: activity

Based on **pages 20 and 21** of *Microbes*

## Introducing the activity

(a) Tell the children that the effect of temperature on microbes can be studied by using yeast. It is important that the children have tried the activity in Unit 7 before they try this one. They will need the prior knowledge to help them with their plan.

You may wish the children to work out the plan the day before the investigation, as it needs setting up early in the school day for completion by the end of the day.

Remind the children of the activity in Unit 7. Ask them what might have happened if they had set up the bottles in a cold place. Look for an answer stating that none of the balloons would have inflated. Tell the children that they must test the answer scientifically to make sure.

## Using the sheet

(b) Give out the sheet and let the children write their names and form, then go through task 1.

(c) Let the children try task 1 (see note (i)).

(d) Go through task 2, then let the children try it (see note (ii)).

(e) Let the children try task 3.

(f) Let the children try task 4.

## Completing the activity

(g) Let the children compare their observations.

(h) Ask the class how their results support or do not support the answer given in the introduction.

## Conclusion

The activity of yeast is affected by the temperature of its surroundings. Generally, the cooler the temperature the less active the yeast, and the warmer the temperature the more active the yeast. If the yeast was to be kept in very hot surroundings (not to be tried in this activity) it would die.

## Teaching notes

(i) It may help the children to write down the list of equipment and materials they used.

(ii) There should be evidence of a fair test. Two or more bottles should be set up with the same amount of water, sugar and yeast. Balloons should be put on them and each one put in a place at a different temperature from the other. The children should measure the temperature at each place. The bottles should be inspected at the same time regularly over the day. The different cultures of yeast (i.e. at 4°C, 10°C and 20°C) could be in the left hand column of the table. The columns to the right could be headed: after one hour, two hours, and so on. The children could write in the boxes about the amount of bubbles produced or draw the balloon in its uninflated or inflated state.

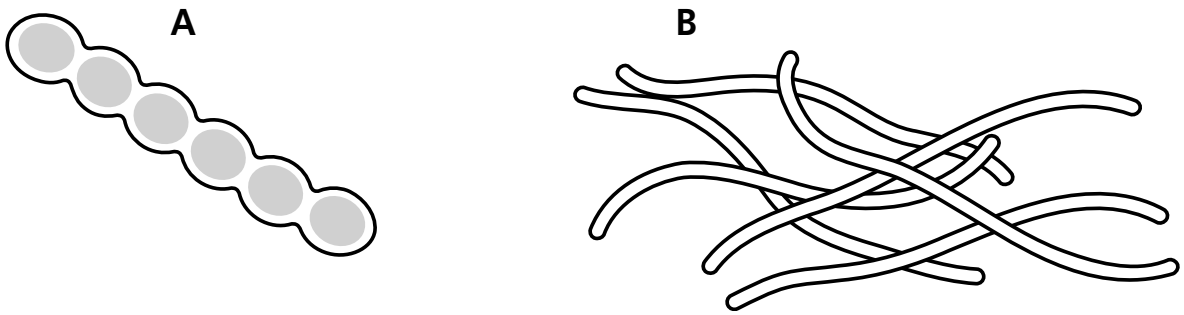
10

Name: ..... Form: .....

See **pages 22 and 23** of *Microbes*

# Are microbes good or bad?

**There are far more good microbes than bad ones, so we need to encourage the good ones and keep out the bad ones.**




**Q1**. Three microbes are shown in the diagram. Which one is:

(i) A bacterium? ✎..... (ii) A fungus? ✎.....

**Q2.** What would happen to us if all the microbes on Earth were destroyed?

✎.....

**Q3.** What kind of microbe is used to make yoghurt? ✎.....

**Q4.** How does a fungus called *Arbuscular* help crops?

✎.....

**Q5.** Which microbes are always harmful? ✎.....

**Q6.** (i) What are the special chemicals that bacteria produce?

✎.....

(ii) Name two uses for these special chemicals.

✎.....

✎.....


# Teacher's sheet: comprehension

See **pages 22 and 23** of *Microbes*

## Answers

1. **(i) A; (ii) B.**
2. **We would die.**
3. **A bacterium.**
4. **It helps them take up nutrients from the soil.**
5. **Viruses.**
6. **(i) Enzymes; (ii) To make soy sauce, soda, beer, wine, cheese, chewing gum, washing powder, give stone washed look to blue jeans.**

## Complementary work

(a) You could show the children a piece of limestone rock and a piece of chalk rock (not chalkboard chalk). You can tell them that chalk is made mostly from the minute 'shells' (coccoliths) of microbes (algae and protozoa). Limestone can also contain a large proportion of coccoliths. You could show the children a geological map of Britain and point out the limestone and chalk regions.

(b) The children could use secondary sources to find out how microbes are cultivated to use as fermenters in industry.

## Teaching notes

The importance of microbes in recycling nutrients should have been made earlier, but it will do no harm to mention it again in this unit. You may like to say that there is only a certain amount of material on the planet which living things can use, so they have to be recycled. Microbes, along with some animals, help in decomposition and play a key part in making sure that nutrients (minerals) are available for the next generation of living things.

The children can also be reminded of the importance of marine algae in providing half the oxygen in the atmosphere. The children can appreciate the sheer numbers of microbes in the ancient seas by learning about the shells of microbe bodies which form chalk and limestone. Diatoms are a kind of algae with shells made of silica (unlike the calcium carbonate shells of chalk and limestone building microbes). These also form deposits which are mined and used in industry. Diatom shells are used in some toothpastes as abrasives.

The children may wonder if yeast occurs naturally. It does. Yeasts are found on the skins of juicy fruits such as grapes.

Some animals, such as cows and termites, depend on microbes in their guts to help break down their food. Without these microbes the animals would die.

The children may wonder how microbes are grown in industry. They are grown in huge containers called fermenters. These are scaled-up versions of the fermentation vessels used in wine-making at home.

10

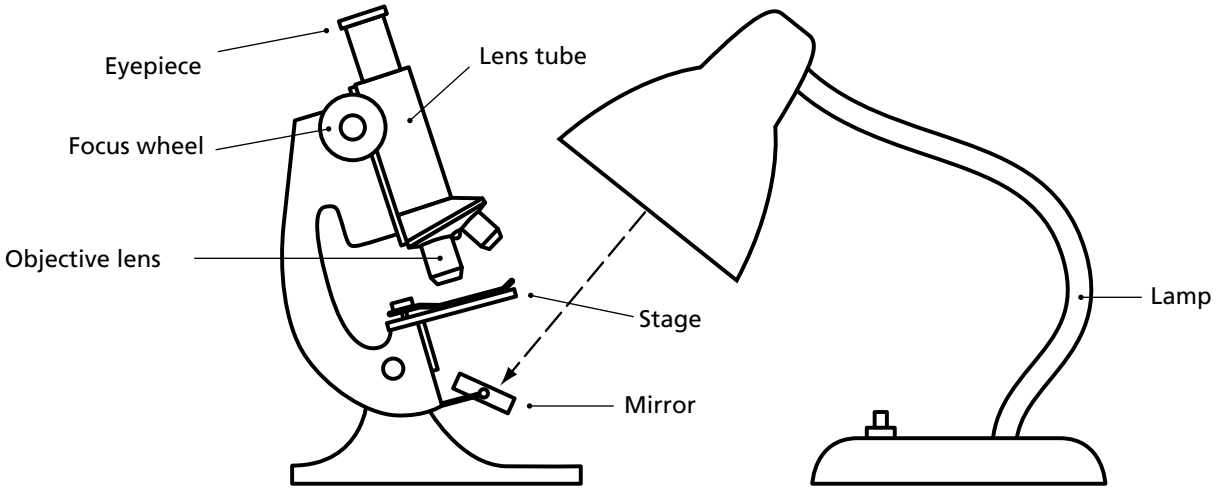
**Name:** ..... **Form:** .....

Based on **pages 22 and 23** of *Microbes*

# Looking at microbes with a microscope

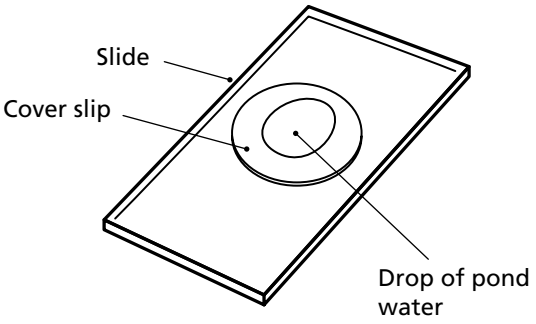
**Try this…**

**1.** Set up a microscope as shown in the diagram.



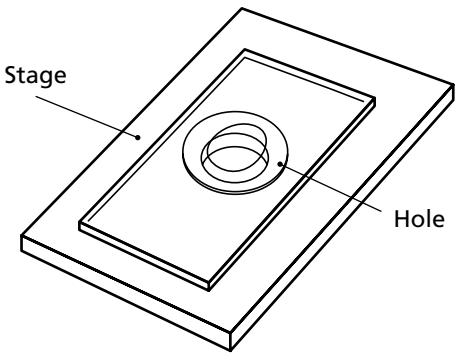

**2.** Take a pipette and draw some pond water into it.

**3.** Put a drop of pond water on a microscope slide and cover it with a cover slip.




**4.** Place the slide on the microscope stage with the drop of pond water over the hole in the stage.

**5.** Look at the side of the microscope and turn the focus wheel so that the objective lens moves close to the top of the cover slip.




**6.** Look down the microscope and turn the focus wheel slowly, so the objective lens moves away from the cover slip. If you do this carefully some microbes may come into view.

**7.** On a separate piece of paper, draw and write about what you saw.

# Teacher's sheet: activity

Based on **pages 22 and 23** of *Microbes*

## Introducing the activity

(a) Many scientists would say that there is no real substitute for looking at microbes through a microscope to gain some impression of their minute size. Tell the children that they are going to learn how to use a microscope to see microbes (see note (i)).

## Using the sheet

(b) Give out the sheet and let the children fill in their names and form, then go through task 1 (see note (ii)).

(c) Let the children try task 1.

(d) Go through task 2, then let the children try it (see note (iii)).

(e) Go through task 3, then let the children try it (see note (iv)).

(f) Go through task 4, then let the children try it.

(g) Go through task 5, then let the children try it (see note (v)).

(h) Go through task 6, then let the children try it (see note (vi)).

(i) Let the children try task 7.

## Completing the activity

(j) Let the children compare their diagrams and descriptions.

## Conclusion

The microscope allows some microbes to be seen. Algae are green and have many different shapes. Protozoa may move quickly and be more difficult to observe. They are covered in tiny hairs (see note (vii)).

## Teaching notes

(i) You could demonstrate this activity in the first instance, then let each group of children in the class use the microscope in turn. Alternatively, you may adapt this activity for use with a microscope linked to a computer.

(ii) The structure of your microscope may be different from the one shown in the diagram, but it will have the same key elements as illustrated here. Some microscopes have an in-built light source. If your microscope has a mirror, you may use it to collect light from a lamp, as recommended here, or from the sky, provided that the Sun is not shining directly on it. Never shine sunlight into a microscope. When setting up the mirror, look down the microscope and move the mirror about on its mounting until a bright disc of light is seen in the microscope.

(iii) Only a small amount of pond water needs to be drawn into the pipette.

(iv) The cover slip may be lowered over the drop of pond water by placing one end onto the slide and lowering the other end with the tip of a pencil.

(v) As soon as the slide is on the stage, most people immediately look down the microscope. Rather than do this, move the objective and cover slip close together first.

(vi) As the objective moves away some objects may come into focus. Beware of black rings. They are just air bubbles. You may see grains of sand and green specks of algae. Some microbes may be moving about. These will most probably be protozoa which are related to the *Paramecium* on page 15 of the pupil book.

(vii) Despite the fact that amoebas are a well-known type of microbe, they are not common or easy to spot.

# QUESTIONS

**Name:** ..... **Form:** .....

**Q1.** When did microbes first appear on the Earth?

*Tick one box*:

10 billion years ago ☐ 6 billion years ago ☐

3 billion years ago ☐ 1 billion years ago ☐

**Q2.** Which scientific instrument allows scientists to look at microbes?

**Q3.** How large are the largest microbes?

*Tick one box*:

about a centimetre across ☐ about a millimetre across ☐

about a tenth of a millimetre across ☐ about a hundredth of a millimetre across ☐

**Q4.** (i) What kinds of microbes live on teeth? ✎.....

(ii) When Arif eats a sweet, what happens to the sugar on his teeth?

✎.....

(iii) Name two things that will happen to Arif if he never cleans his teeth.

✎.....

**Q5.** Jane is drinking a glass of pasteurised milk.

(i) What happened to the milk when it was pasteurised?

✎.....

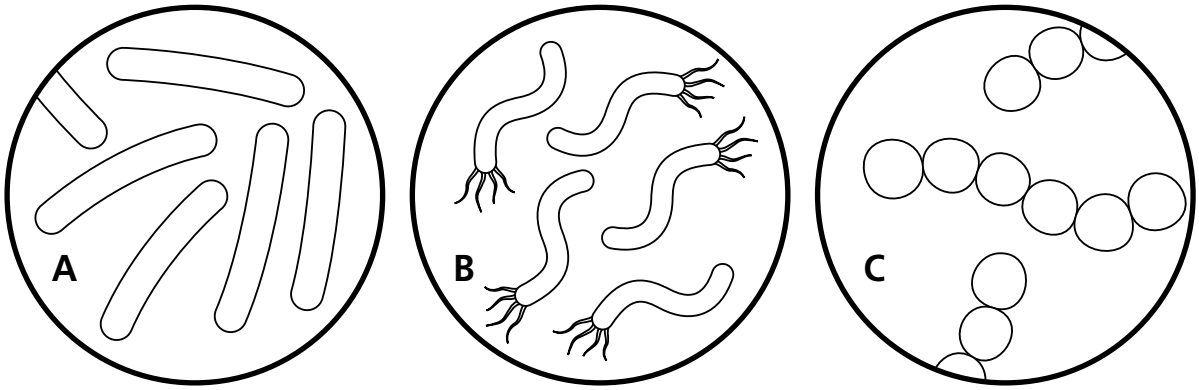
(ii) What may happen to Jane if she drank unpasteurised milk?

✎.....

# QUESTIONS

**Name:** ..... **Form:** .....

**Q6.**




Here are the names of three kinds of bacteria – *Bacillus*, *Spirillum* and *Streptococcus*.

Identify each one in the pictures by filling in the table.

| Bacterium | Letter |
|---|---|
| *Bacillus* | |
| *Streptococcus* | |
| *Spirillium* | |

**Q7.** What do fungi produce when they breed?

*Tick one box*: Seeds ☐ Roots ☐ Spores ☐ Fruits ☐

**Q8.** Paul has two slices of bread and two sealable clear plastic bags. He wants to see if mould needs dampness to grow.

(i) What must he do to make a fair test?

✎.....

✎.....

✎.....

(ii) How will he know if mould has grown?

✎.....

(iii) Predict what his test will show.

✎.....

# QUESTIONS

**Name: ..... Form: .....**

**Q9.** The *Penicillium* fungus makes a substance to fight disease. What kind of substance is it?

*Tick one box*: Antiseptic ☐ Vaccine ☐ Soap ☐ Antibiotic ☐

**Q10.** Which is the smallest microbe?

*Tick one box*: Bacteria ☐ Virus ☐ Fungus ☐ Protozoan ☐

**Q11.** Jane has a cold.

(i) What kind of microbe is causing the cold? ✎.....

(ii) Where does the microbe breed?

✎.....

(iii) How does Jane's body destroy the microbe?

✎.....

✎.....

✎.....

(iv) How could Jane spread the microbe to other people?

✎.....

**Q12.** Which microbe makes oxygen?

*Tick one box*: Algae ☐ Protozoan ☐ Virus ☐ Fungus ☐

# QUESTIONS

**Name: ..... Form: .....**

**Q13.** Mina sets up a jar of clear pond water on a sunny windowsill. Paul tells her that there may be microbes in it but she cannot see any.

(i) Why can't Mina see any microbes, even though they are there?

✎.....

After a few days the pond water turns green.

(ii) What kind of microbes have made the water change colour?

✎.....

(iii) Why has the water become green? ✎.....

✎.....

✎.....

(iv) What would happen to the pond water if Mina put the jar in a dark cupboard for a long time? Explain your answer.

✎.....

✎.....

**Q14.** (i) What is formed when milk curdles? ✎.....

(ii) Which kind of microbe is used to curdle milk? ✎.....

(iii) Some cheeses have holes in them. How do the holes get there?

✎.....

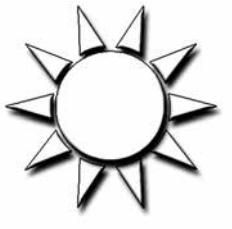
✎.....

**Q15.** (i) What fruit is most often used to make wine?

✎.....

(ii) What is the microbe that is used to make wine?

✎.....



# QUESTIONS

**Name:** ..... **Form:** .....

**Q16.** Paul made some dough and added yeast to it. He measured the height of the lump of dough and then put the dough in a warm place. He measured the height of the dough during the following half hour. The table shows his results.

| Time (mins) | Height (cm) |
|---|---|
| 0 | 3.0 |
| 10 | 3.3 |
| 20 | 3.8 |
| 30 | 4.5 |

(i) How much did the dough rise in 30 minutes? ✎.....

(ii) When did the greatest increase in height occur?

✎.....

(iii) What caused the dough to increase in height?

✎.....

Paul put the dough in an oven and baked it into bread.

(iv) Did the bread: (a) rise more; (b) stay the same; or (c) shrink?

✎.....

**Q17.** Match each disease to the kind of microbe that causes it by drawing a line between them.

| | |
|---|---|
| **Black Death** | **protozoan** |
| **Potato famine** | **bacterium** |
| **Influenza** | **fungus** |
| **Malaria** | **virus** |

# QUESTIONS

**Name: ..... Form: .....**

**Q18.** Between which temperatures are microbes most active?

*Tick one box*: Below –10°C ☐ Between 0°C and 10°C ☐

Between 10°C and 40°C ☐ Between 45°C and 70°C ☐

**Q19.** (i) How does a disinfectant affect microbes?

✎.....

(ii) What disinfectant is added to tap water?

✎.....

**Q20.** (i) What is the raw material for making yoghurt?

✎.....

(ii) What kind of microbe is used to make yoghurt?

✎.....

(iii) What does the microbe do in the yoghurt-making process?

✎.....

**Q21.** (i) Name two kinds of microbes which make antibiotics.

✎.....

(ii) What are antibiotics used for?

✎.....

# ANSWERS

**1.** 3 billion years ago. *1 mark*

**2.** The microscope. *1 mark*

**3.** About a tenth of a millimetre across. *1 mark*

**4.** (i) Bacteria. *1 mark*
(ii) The bacteria feed on the sugar and make acid. *2 marks*
(iii) He will have bad breath and tooth decay. *2 marks*

**5.** (i) It was heated and the bacteria were killed. *2 marks*
(ii) She could get food poisoning. *1 mark*

**6.** Bacillus = A; Streptococcus = C; Spirillum = B. *3 marks*

**7.** Spores. *1 mark*

**8.** (i) Put water on one slice to make it damp. Put a slice in each bag and seal the bags. Keep the bags at the same temperature and in the same amount of light (or dark). *4 marks*
(ii) There would be a white, blue or green covering develop on the bread. *1 mark*
(iii) The mould only grows on the damp bread. *1 mark*

**9.** Antibiotic. *1 mark*

**10.** Virus. *1 mark*

**11.** (i) Virus. *1 mark*
(ii) Inside cells. *1 mark*
(iii) It makes interferon and antibodies, it may raise its temperature. *3 marks*
(iv) By coughing and sneezing without using a handkerchief. *2 marks*

**12.** Algae. *1 mark*

**13.** (i) They are too small to see without a microscope. *1 mark*
(ii) Algae. *1 mark*
(iii) The bodies of algae contain a green substance and the algae have bred into such large numbers that the green substance colours the water. *2 marks*
(iv) It would go clear again. Algae need light to make food and without light they will die. *2 marks*

**14.** (i) Curds and whey. *2 marks*
(ii) Bacteria. *1 mark*
(iii) Cheese is warmed and bacteria feed and produce carbon dioxide. This gas makes the holes. *4 marks*

**15.** (i) Grapes. *1 mark*
(ii) Yeast. *1 mark*

**16.** (i) 4.5cm. *1 mark*
(ii) Between 20 and 30 minutes. *1 mark*
(iii) Yeast feeding on the dough and producing carbon dioxide gas. *1 mark*
(iv) (a) Rise more. *1 mark*

**17.** Black Death ➔ bacterium; Potato famine ➔ fungus; Influenza ➔ virus; Malaria ➔ protozoan. *4 marks*

**18.** Between 10°C and 40°C. *1 mark*

**19.** (i) It kills them. *1 mark*
(ii) Chlorine. *1 mark*

**20.** (i) Milk. *1 mark*
(ii) A bacterium. *1 mark*
(iii) It turns the milk sour. *1 mark*

**21.** (i) Fungi and bacteria. *1 mark*
(ii) To kill some germs which cause disease. *1 mark*

***Total marks: 62***