# Micro-organisms: Introduction to Microbes



**Key Stage 4**

# Lesson 1: Introduction to Microbes

Students are introduced to the exciting world of microbes. In this lesson they will learn about bacteria, viruses and fungi, their different shapes and the fact

that they are found everywhere.

## Learning Outcomes

### All students will:

* Understand that useful bacteria are found in our body.
* Understand that microbes come in different sizes.
* Understand the key differences between the three main types of microbe

### Most students will:

* Understand using a variety of scientific concepts and models, how to develop scientific explanations.

## Curriculum Links

### PHSE/RHSE

* Health and prevention

### Science

* Scientific thinking
* Analysis and evaluation
* Experimental skills and strategies

### Biology

* Development of medicines
* Cells
* Health and disease

### English

* Reading
* Writing

### Art and design

* Graphic communication

 **Lesson 1: Introduction to Microbes**

## **Resources Required**

### Introduction

#### Per student

* Copy of SH1

### Main Activity: Microbe Mayhem

#### Per group

* Copy of SH2
* Copy of SH3
* Copy of SH4
* Copy of SH5

### Extension Activity: Posters

#### Per student

* Pens/pencils
* Paper

### Alternative Main Activity: Peer Education

#### Per group

* Groups of 3 or 4 students

## Supporting Materials

* SH1 How Big is a Microbe?
* SH2 Microbe Mayhem
* SH3 Microbe Mayhem
* SH4 Microbe Mayhem
* SH5 Microbe Mayhem
* SW1 Quiz

## Advanced Preparation

Cut out and laminate a set of playing cards (SH2 – SH5) for each group.

 **Lesson 1: Introduction to Microbes**

## Key Words

Bacteria

Cell

Fungi

Microbe

Microscope

Pathogen

Virus

## **Health & Safety**

For safe microbiological practices in the classroom consult CLEAPPS

[www.cleapps.org.uk](http://www.cleapps.org.uk)

## **Weblinks**

e-bug.eu/eng/KS4/lesson/ Introduction-to-Microbes

## Introduction

1. Begin the lesson by asking students what they already know about microbes. Most students will already know that microbes can cause illness but may not know that microbes can also be good for us. Ask the class where they would look if they wanted to find microbes. Do they think microbes are important to us?
2. Explain that microbes are the smallest living creatures on Earth and that the word micro-organism literally translates into micro: small and organism: life. Microbes are so small they cannot be seen without the use of a microscope. Antonie van Leeuwenhoek created the first microscope in 1676. He used it to examine various items around his home and termed the living creatures (bacteria) he found on scrapings from his teeth ‘animalcules’.
3. Show the class that there are three different types of microbe: bacteria, viruses and fungi. Use SH1 to demonstrate how these three microbes vary in shape and structure.
4. Highlight to the class that microbes can be found EVERYWHERE – floating around in the air we breathe, on the food we eat, in the water we drink and on the surface of and in our bodies. Emphasise that although there are harmful microbes that can make us ill, there are many more useful microbes that we can use.
5. Emphasise that although microbes cause disease, there are also useful microbes. Ask students to identify some benefits of useful microbes. If they cannot, provide examples for them e.g. *Lactobacillus* in yoghurt, probiotic bacteria in our gut which aid digestion and the fungus *Penicillium* which produces the antibiotic Penicillin.

## Activity

### Main Activity: Microbe Mayhem

In this activity groups of 3-4 students play a card game which helps them remember some of the technical words relating to microbes as well as familiarising students with a variety of microbial names, the differences in size, capability of causing harm and if antibiotic resistance occurs. Microbe size and number of species are correct at the time of resource development; however as new microbes are continuously being discovered and reclassified, these numbers may be subject to change.

The remaining numbers presented are only to be used as a guide and are illustrative only. There is no formulae to create these and they may also be subject to change i.e. bacterial species may develop resistance to more antibiotics resulting in them having a higher number being more dangerous to humans.

Hand out a set of Microbe Mayhem playing cards SH2 - SH5 to each group. Let the students know that ‘nm’ on the playing cards stands for nanometres. There are ten million nanometres in a centimetre.

#### **Game rules**

1. The dealer should shuffle the cards well and deal all the cards face down to each player. Each player holds their cards face up so that they can see the top card only.
2. The player to the dealer’s left starts by reading out the name of the microbe on the top card and chooses an item to read (e.g. Size 50). In a clockwise direction, the other players then read out the same item. The player with the highest value wins, taking the other players top cards and placing them to the bottom of their pile. reads out the name of the microbe on their next card and selects the item to compare.
3. If two or more players have the same top value then all the cards are placed in the middle and the same player chooses again from the next card. The winner then takes the cards in the middle. The person with all the cards at the end is the winner.

### Alternative Main Activity: Peer Education

Divide the class into groups of 3 – 4 students. Explain to the students that they will be creating a presentation to teach a group of their younger peers about microbes. Allow the students to choose the level at which they want their presentation to be aimed – EY, KS1, KS2 or KS3.

Ask student to design an engaging presentation to teach their younger peers the following:

1. What are microbes?
2. Where are microbes found?
3. Microbial shapes and structures
4. Microbes that are good or bad for humans

Suggest to students that their presentations should include amazing microbe facts, interactive elements or activities and they should make the presentation visually engaging for a younger audience.

## Extension Activities

Divide the class into groups of 3 – 4 students. Each group should research and create a poster to reinforce learning on one of the following topics:

1. Choose a specific type of bacterium, virus or fungus e.g. *Salmonella, Influenza A* or *Penicillium*. The poster should include:
   1. Structure of that microbe
   2. The different places they can be found
   3. How they affect humans in either a good or bad way
   4. Any specific growth requirements of that group of microbes

OR

1. A timeline poster on the history of microbes. This poster may include:
   1. 1676: van Leeuwenhoek discovers ‘animalcules’ using homemade microscope
   2. 1796: Jenner discovers smallpox vaccination
   3. 1850: Semmelweis advocated washing hands to stop the spread of disease
   4. 1861: Pasteur publishes germ theory: the concept that germs cause disease
   5. 1892: Ivanovski discovers viruses
   6. 1905: Koch awarded Nobel Prize in Medicine for his work understanding tuberculosis and its causes
   7. 1929: Fleming discovers antibiotics

## Learning Consolidation

Check for understanding by asking students if the following statements are true or false.

1. **There are two main types of microbes: bacteria and fungi?**

**Answer**: False, there are three main types: bacteria, viruses and fungi.

1. **Bacteria have three main shapes, cocci (balls), bacilli (rods) and spirals.**

**Answer**: True.

1. **Microbes are only in the food we eat.**

**Answer**: False, there are microbes everywhere, floating around in the air we breathe, on the food we eat, in the water we drink and on the surface of and in our bodies, even inside volcanoes.

1. **Microbes can be useful, harmful or both**.

**Answer**: True



## SH1 - How Big is a Microbe?

Viruses



Glycoproteins

Nucleic acid

Capsid

Viruses are NOT free living – they MUST live inside another living cell/organism

Capsid

Double lipid layer holding the cells

genetic material.

Glycoproteins

These serve 2 purposes:

1. Anchor the virus to the host cell.
2. Transport genetic material from the  
   virus to the host cell.

Nucleic acid

Either DNA or RNA material, but viruses rarely contain both. Most viruses contain RNA material.

Bacteria



Chromosome

Cytoplasm

Cell membrane

Cell wall

Bacteria are free living and are found everywhere

Chromosome:

Genetic material (DNA) of the cell.

Cell wall:

The cell wall is made of peptidoglycan and maintains the overall shape of a bacterial cell.

Cell membrane:

Lining the inside of the cell wall providing a boundary for the contents of the cell and a barrier to substances entering and leaving.

Cytoplasm:

Jelly like substance inside of the cell

holding the contents.

Fungi



Sporangi-ophore

Sporangia

Rhizoids

Sporangia:

Spore producing body.

Sporangiophore:

Filamentous stalk on which the

sporangium forms.

Rhizoids:

The sub-surface hyphae are specialized for food absorption.

Microbe size



Viruses 1x

Fungi 100x

Bacteria 20x

Max size (nm)

1,000

Number of species

Danger to humans

Usefulness to humans

Antibiotic resistance

21

50

75

50



*Streptococcus*

*Strep-Toe-Coccus*

Bacterium

Many *Streptococcus* species are harmless to humans and are the normal flora of the mouth and hands. However, Group A *Streptococcus* bacteria cause about 15% of sore throats.



*Treponema*

*Trep-O-Nee-Ma*

Bacterium

Syphilis is an extremely contagious disease, caused by Treponema bacteria. In severe cases syphilis can lead to brain damage or death. Syphilis can be cured with antibiotics however resistant strains are becoming more frequent.

Max size (nm)

2,000

Number of species

Danger to humans

Usefulness to humans

Antibiotic resistance

3

115

8

50



*Chlamydia*

*Clam-id-E-A*

Bacterium

Chlamydia is a sexually transmitted infection (STI) that is caused by the bacteria *Chlamydia trachomatis*. Although symptoms are generally mild i.e. discharge from the penis or vagina, it can lead to infertility.

Max size (nm)

1,000

Number of species

Danger to humans

Usefulness to humans

Antibiotic resistance

3

37

1

70



*Escherichia coli*

*Esh-Er-lc-E-Ah*

Bacterium

Many strains of *E. coli* are harmless, and huge numbers are present in the human and animal gut. In some cases, however, *E. coli* cause both urinary infections and food poisoning.

Max size (nm)

2,000

Number of species

Danger to humans

Usefulness to humans

Antibiotic resistance

7

70

184

80



Max size (nm)

90

Number of species

Danger to humans

Usefulness to humans

Antibiotic resistance

1

146

12

n/a

*Influenza A*

*In-Flu-En-Za A*

Virus

The flu is an infection caused by Orthomyxoviridae. Every year 5 – 40% of the population get the flu but most people recover completely in a couple of weeks.



*Simplex Virus*

*Sim-Plex Virus*

Herpes simplex is one of the oldest known sexually transmitted infections. In many cases, Herpes infections produce no symptoms, but scab-like symptoms do occur in about one third of people infected.

Max size (nm)

200

Number of species

Danger to humans

Usefulness to humans

Antibiotic resistance

2

64

2

n/a



*Tobamovirus*

*Tob-A-Mo-Virus*

Virus

Tobamovirus are a group of viruses that infect plants, the most common being tobacco mosaic virus, which infects tobacco and other plants. This virus has been very useful in scientific research.

Max size (nm)

18

Number of species

Danger to humans

Usefulness to humans

Antibiotic resistance

125

12

34

n/a



*Lyssavirus*

*Lice-A-Virus*

Virus

The Lyssavirus infect both plants and animals. The most common Lyssavirus is the Rabies virus and is usually associated with dogs. Rabies results in over 55,000 deaths worldwide every year but can be prevented by vaccination.

Max size (nm)

180

Number of species

Danger to humans

Usefulness to humans

Antibiotic resistance

10

74

5

n/a



Max size (nm)

35

Number of species

Danger to humans

Usefulness to humans

Antibiotic resistance

8

25

0

n/a

*Norovirus*

*Nor-o-virus*

Virus

The flu is an infection caused by Orthomyxoviridae. Every year 5 – 40% of the population get the flu but most people recover completely in a couple of weeks.



*Papillomavirus*

*Pap-ill-O-Ma-virus*

Virus

Herpes simplex is one of the oldest known sexually transmitted infections. In many cases, Herpes infections produce no symptoms, but scab-like symptoms do occur in about one third of people infected.

Max size (nm)

55

Number of species

Danger to humans

Usefulness to humans

Antibiotic resistance

170

130

0

n/a



*Varicellovirus*

*Var-E-Cell-O-Virus*

Virus

Tobamovirus are a group of viruses that infect plants, the most common being tobacco mosaic virus, which infects tobacco and other plants. This virus has been very useful in scientific research.

Max size (nm)

200

Number of species

Danger to humans

Usefulness to humans

Antibiotic resistance

2

21

7

n/a



*Zika*

*Zee-ka*

Virus

The Lyssavirus infect both plants and animals. The most common Lyssavirus is the Rabies virus and is usually associated with dogs. Rabies results in over 55,000 deaths worldwide every year but can be prevented by vaccination.

Max size (nm)

40

Number of species

Danger to humans

Usefulness to humans

Antibiotic resistance

1

98

0

n/a



Max size (nm)

4,000

Number of species

Danger to humans

Usefulness to humans

Antibiotic resistance

5

150

0

100

*Mycobacterium*

*My–co–back–tear–e–um*

Bacteria

Tuberculosis (TB) is caused by the bacterium Mycobacterium tuberculosis and is one of the top 10 causes of death worldwide. Although treatable with antibiotics, many strains of TB are becoming resistant to multiple antibiotics.



*Lymphocryptovirus*

*Lim-Foe-Cryp-Toe Virus*

Virus

The Epstein-Barr virus, a type of Lymphocryptovirus, causes an illness known as the Kissing Disease or Glandular fever. Symptoms include sore throats and extreme tiredness. Transmission requires close contact such as kissing.

Max size (nm)

110

Number of species

Danger to humans

Usefulness to humans

Antibiotic resistance

7

37

2

n/a



*Neisseria*

*Nai–sheer–e-a*

Bacterium

Neisseria meningitidis is a bacterium that can cause meningitis, a life threatening disease. A vaccine is available to protect against the 4 main types of this bacteria A, C, W and Y.

Max size (nm)

800

Number of species

Danger to humans

Usefulness to humans

Antibiotic resistance

13

120

0

20



*Filovirus*

*File-o-vi-rus*

Virus

Filovirus causes a disease more commonly known as Ebola. It is one of the more dangerous viruses known to humans. 25 – 90% of victims died from the disease before the development and approval of a vaccine in 2019.

Max size (nm)

1,500

Number of species

Danger to humans

Usefulness to humans

Antibiotic resistance

1

200

0

n/a



Max size (nm)

25

Number of species

Danger to humans

Usefulness to humans

Antibiotic resistance

2

28

14

n/a

*Rhinovirus*

*Rhino-virus*

Virus

There are over 250 different kinds of cold viruses but Rhinovirus is by far the most common. Rhinovirus can survive three hours outside someone’s nose. If it gets on your fingers and you rub your nose, you’ve caught it!



*HIV*

*HIV*

Virus

The human immunodeficiency virus (HIV) is a sexually transmitted infection (STI) which leads to acquired immunodeficiency syndrome (AIDS). Individuals with this condition are more at risk of infection and cancer.

Max size (nm)

120

Number of species

Danger to humans

Usefulness to humans

Antibiotic resistance

2

150

0

n/a



Max size (nm)

1,000

Number of species

Danger to humans

Usefulness to humans

Antibiotic resistance

19

1

184

n/a

*Saccharomyces*

*Sac-A-Row-My-Sees*

Fungus

For at least 6,000 years, Saccharomyces cerevisiae (Brewers yeast) has been used to make beer and bread! It is also used to make wine and it is widely used in biomedical research. One yeast cell can turn into 1,000,000 in only six hours.



*Candida*

*Can-Did-a*

Fungus

Candida is naturally found living in the human mouth and gastrointestinal tract. Under normal circumstances these fungi live in 80% of the human population with no harmful effects, although overgrowth results in candidiasis (Thrush).

Max size (nm)

10,000

Number of species

Danger to humans

Usefulness to humans

Antibiotic resistance

44

74

175

n/a



*Penicillium*

*Pen-Ee-Sil-Ee-Um*

Fungus

Penicillium is a fungus that naturally produces the antibiotic penicillin. Since this discovery, the antibiotic has been mass produced to fight bacterial infections. Unfortunately, due to its overuse many bacterial species have become resistant to this antibiotic.

Max size (nm)

332,000

Number of species

Danger to humans

Usefulness to humans

Antibiotic resistance

16

64

198

n/a



*Cryptococcus*

*Cryp-Toe-Coccus*

Fungus

*Cryptococcus* is a fungus which grows as a yeast. It is known for causing a severe form of meningitis in people with HIV/AIDS. The majority of Cryptococci live in the soil and are not harmful to humans.

Max size (nm)

7,500

Number of species

Danger to humans

Usefulness to humans

Antibiotic resistance

37

98

37

n/a



Max size (nm)

1,000

Number of species

Danger to humans

Usefulness to humans

Antibiotic resistance

19

174

20

90

*Staphyloccus*

*Staff-ill-O-coccus*

Bacterium

Meticillin resistant Staphylococcus aureus (MRSA) are a type of Staphylococcus aureus that have mutated to become resistant to most antibiotics. They can cause severe infection in humans.



*Lactobacillus*

*Lac-Toe-Ba-Sil-Us*

Bacterium

Lactobacilli are very common and usually harmless to humans; they make up a small portion of the gut flora. These bacteria have been extensively used in the food industry - in yoghurt and cheese making.

Max size (nm)

1,500

Number of species

Danger to humans

Usefulness to humans

Antibiotic resistance

125

0

195

10



*Salmonella*

*Sam-on-ella*

Bacterium

Salmonella are most commonly known for causing food poisoning. Symptoms range from vomiting to diarrhoea. Salmonella is becoming resistant to antibiotics with an estimated 6,200 resistant cases per year in the US.

Max size (nm)

1,000

Number of species

Danger to humans

Usefulness to humans

Antibiotic resistance

3

89

15

60



*Pseudomonas*

*Sued-O-Moan-Us*

Bacterium

Pseudomonas are one of the most common microbes found in almost all environments. Although some may cause disease in humans, other species are involved in decomposition. Some Pseudomonas species are becoming resistant to multiple antibiotic treatment.

Max size (nm)

5,000

Number of species

Danger to humans

Usefulness to humans

Antibiotic resistance

126

50

150

90



Max size (nm)

72,000

Number of species

Danger to humans

Usefulness to humans

Antibiotic resistance

2

83

2

n/a

*Stachybotrys*

*Stack-Ee-Bo-Trys*

Fungus

Stratchybotrys (or straw mould) is a black toxic fungus that although itself is not pathogenic, it does produce a number of toxins that can cause rashes or life-threatening reactions for those with respiratory problems.



*Aspergillus*

*Ass-Per-Gill-Us*

Fungus

Aspergillus is both beneficial and harmful to humans. Many are used in industry and medicine. It accounts for over 99% of global citric acid production and is a component of medications which manufacturers claim can decrease flatulence!

Max size (nm)

101,000,000

Number of species

Danger to humans

Usefulness to humans

Antibiotic resistance

200

47

124

n/a



*Tinea*

*Tin-Ea-A*

Fungus

Although a variety of fungi can cause foot rashes, Tinea cause the itchy, cracked skin between toes known as Athlete’s foot, which is the most common fungal skin infection. Athlete’s foot affects nearly 70% of the population.

Max size (nm)

110,000

Number of species

Danger to humans

Usefulness to humans

Antibiotic resistance

12

43

14

n/a



*Verticillium*

*Ver-Tee-Sil-Ee-Um*

Fungus

*Verticillium* is a widely distributed fungus that inhabits decaying vegetation and soil. Some may be pathogenic to insects, plants, and other fungi but very rarely cause human disease.

Max size (nm)

8,500,000

Number of species

Danger to humans

Usefulness to humans

Antibiotic resistance

4

1

18

n/a