Operated by
Public Health England

e-BUG

www.e-bug.eu

Key Stage 3 / Science

Welcome to e-Bug

e-Bug has been designed to bring the world of microbes and antibiotics to life for children in the school environment. The resource has been created by Public Health England (formally the Health Protection Agency) to improve young people's knowledge and to foster an interest in science. These tools can be used freely by educators, and may be copied for classroom use but may not be sold.

e-Bug is a curriculum supplement series (Key Stage 1, 2, 3 and 4) that complies with the Department of Education and QCA educational standards for Junior and Senior schools. Its main aim is to teach young people about microbes, appropriate use of antibiotics, how microbial infections are spread and can be prevented through improved hygiene and vaccine use. The packs teach that antibiotics are a valuable resource that should not be misused. Over 27 European and international countries are involved in the e-Bug project, and the resources were evaluated by more than 3000 children in England, France and the Czech Republic. The e-Bug pack is supported by a website from which all the pack resources, videos demonstrating the activities and additional activities can be downloaded (**www.e-Bug.eu**). The website contains complimentary interactive games which teach the key messages of e-Bug while children have fun.

The pack consists of 10 topics divided into four main sections which can be used in sequence or as individual activities designed to fit into 50 minute classroom slots.

Each of these sections contain background information for teachers, detailed lesson plans, modifiable student worksheets and handouts, as well as

- Creative inquiry based activities to promote active learning
- Highlighted learning outcomes which deepen students understanding of the importance of microbes, their spread, treatment and prevention
- Activities that encourage students to take more responsibility for their own health
- Activities that highlight the importance of responsible antibiotic use

The pack may be used in isolation or in conjunction with the presentations, images, videos and extra activities on the e-Bug website.

We would like to thank everyone involved in the development of this resource which will help the next generation of adults to use antibiotics more wisely. We would especially like to thank the teachers and students across the UK, France and the Czech Republic who participated in focus groups and the evaluation process and helped ensure that these materials are not only fun and exciting but also effective!

As educators, your feedback is invaluable to us. Your comments will help the e-Bug resource grow and evolve. Please send any comments, queries and suggestions to

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Or alternatively visit the e-Bug website at **www.e-Bug.eu** or e-mail us at **e-Bug@phe.gov.uk**

We do hope you enjoy using e-Bug and will find this an in invaluable addition to your classroom.

Dr Cliodna AM McNulty
Head of Primary Care Unit
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England

e-Bug

An International education resource covering the world of microbes and disease.

e-Bug partnership and collaboration consists of the following countries:

- Belgium
- Bulgaria
- Croatia
- Czech Republic
- Cyprus
- Denmark
- Finland
- France
- Germany
- Greece
- Hungary
- Ireland
- Italy
- Latvia
- Lithuania
- Norway
- Poland
- Portugal
- Romania
- Russia
- Saudi Arabia
- Slovak Republic
- Slovenia
- Spain
- The Netherlands
- Turkey
- United Kingdom

Visit our website to view our partner profiles and translated versions of the resources.

e-Bug is operated by Public Health England.

Pack Content

1. Micro-organisms

1.1 An Introduction

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

1.2 Useful Microbes

A yogurt making experiment is the key to this activity in which students learn that microbes can be useful.

1.3 Harmful Microbes

Close examination of various illnesses illustrates to students how and where bad microbes cause disease. Students test their knowledge of disease causing microbes by researching various illnesses.

2. Spread of Infection

2.1 Hand Hygiene

Through a classroom experiment students learn how microbes can spread from one person to another by touch and why it is important to wash hands properly.

2.2 Respiratory Hygiene

In this interesting experiment students learn how easily microbes can be spread through coughs and sneezes by recreating a giant sneeze.

2.3 Sexually Transmitted Infections

A classroom based activity demonstrates how easily STIs can be transmitted.

2.4 Chlamydia

Using chlamydia as an example, this section helps students to understand an individuals' susceptibility to sexually transmitted infection and the potential severity of its consequences.

3. Prevention of Infection

3.1 The Body's Natural Defences

This section includes a detailed presentation and animations showing how the body fights harmful microbes on a daily basis. This section provides the basic knowledge requirements for the next two sections on vaccinations and antibiotics.

3.2 Vaccinations

In this activity, students take part in a simulation to see how vaccines are used to prevent the spread of infections and discover the significance of herd immunity.

4. Treatment of Infection

4.1 Antibiotics

Students take on the role of a laboratory technician and help diagnose patient illnesses based on antibiotic susceptibility tests on agar plates.

Additional Web Resources Available

1. Micro-organisms

1.1 An Introduction

- ✓ Microbes card game demonstration film.
- ✓ A variety of microbial photographs.
- ✓ SH 1 in MS PowerPoint format.
- ✓ Animation to demonstrate the differences in microbial size

1.2 Useful Microbes

- ✓ Yoghurt activity demonstration film.
- ✓ Magnified microbial photographs associated with useful microbes.
- ✓ Useful microbes SH 1 in MS PowerPoint format.
- ✓ Magnified images of the yogurt smear.

1.3 Harmful Microbes

- ✓ Magnified microbial photographs associated with harmful microbes

2. Spread of Infection

2.1 Hand Hygiene

- ✓ Hand hygiene demonstration film.
- ✓ SH 1 and SH 2.
- ✓ Images of expected results.
- ✓ 6 steps of handwashing poster.
- ✓ Chain of infection presentation.

2.2 Respiratory Hygiene

- ✓ Sneezing activity demonstration film.
- ✓ The photograph accompanying Alternative Activity 2.

2.3 Sexually Transmitted Infection

- ✓ A STI demonstration film.
- ✓ A MS PowerPoint presentation on spread of infection.
- ✓ STI comic strip in MS PowerPoint.

2.4 Chlamydia

- ✓ Animations listed under 'advance preparation' illustrating (a) the rate of infection amongst young people, (b) how infection damages the body, (c) how easily infection is spread.

3. Prevention of Infection

3.1 The Body's Natural Defences

- ✓ A MS PowerPoint presentation of SH 1.
- ✓ An animation illustrating how the immune system functions.

3.2 Vaccinations

- ✓ An alternative vaccine activity including lesson plans and worksheets.

4. Treatment of Infection

4.1 Antibiotic Use and Medicine

- ✓ Antibiotic activity demonstration film.
- ✓ A presentation on antibiotic use and resistance.
- ✓ A list of other common acids / alkalis and indicators which may be used as alternatives.
- ✓ SH 1, images of the correct results and SH 1 in MS PowerPoint format for whiteboard use.
- ✓ An alternative antibiotics activity including lesson plan and worksheets.

Contents

National Curriculum Links
Key Stage 3

e-Bug Pack Content	Biology	PSHE*
1. Introduction to Microbes **1.1 An Introduction**	Working Scientifically Experimental skills and investigations Structure and Function of Living organisms Cells and Organisation Nutrition and digestion Genetics and Evolution Inheritance, chromosomes, DNA and Genes	Core Theme 1: Health and Wellbeing
1. Micro-organisms **1.2 Useful Microbes**	Working Scientifically Scientific Attitudes Experimental Skills and investigations Analysis and Evaluation Structure and Function of Living Organisms Nutrition and digestion Material cycles and energy Cellular respiration	
1. Micro-organisms **1.3 Harmful Microbes**	Working Scientifically Experimental skills and investigations Analysis and Evaluation	Core Theme 1: Health and Wellbeing
2. Spread of Infection **2.1 Hand Hygiene**	Working Scientifically Scientific Attitudes Experimental skills and investigations Analysis and Evaluation	Core Theme 1: Health and Wellbeing
2. Spread of Infection **2.2 Respiratory Hygiene**	Working Scientifically Experimental skills and investigations Analysis and Evaluation	Core Theme 1: Health and Wellbeing
2. Spread of Infection **2.3 Sexually Transmitted Infections (STI's)**	Working Scientifically Experimental skills and investigations Analysis and Evaluation	Core Theme 1: Health and Wellbeing
2. Spread of Infection **2.4 Chlamydia**	Working Scientifically Experimental skills and investigations	Core Theme 1: Health and Wellbeing
3. Prevention of Infection **3.1 The Body's Natural Defences**	Cells and Organisation	
3. Prevention of Infection **3.2 Vaccines**	Working Scientifically Experimental skills and investigations Analysis and evaluation	Core Theme 1: Health and Wellbeing
4. Treatment of Infection **4.1 Antibiotic Use and Medicine**	Working Scientifically Scientific Attitudes Experimental skills and investigations Analysis and evaluation	Core Theme 1: Health and Wellbeing

*Taken from PSHE Association Programme of Study (Key Stages 1-4), supported by the Department for Education.

A complete, non-condensed version of the e-Bug curriculum links can be downloaded from the teachers pages of the e-Bug website,

1.1 Introduction to Microbes

Section 1.1, In this section students are introduced to the world of microbes, firstly by exploring the different types and shapes of microbes and later, by close examination of useful and harmful microbes.

In this introductory activity, students become familiar with the various types and shapes of microbes through an interactive learning card game.

The accompanying extension activity reinforces student knowledge of microbial structure through the preparation of research posters. Alternatively, students may prefer to research the history of microbiology by developing a poster on the timeline of microbiology.

Campylobacter

Learning Outcomes

All students will:

- understand that there are three different types of microbe.
- understand that they are found everywhere.

More able students will:

- understand that useful bacteria are found in our body.
- understand that microbes come in different sizes.

National Curriculum Links

Key Stage 3
Science
Working Scientifically
Experimental skills and investigations
Structure and Function of Living organisms
Cells and Organisation
Nutrition and digestion
Genetics and Evolution
Inheritance, chromosomes, DNA and Genes
PSHE
Core Theme 1: Health and Wellbeing
Estimated Teaching Time
50 minutes

1.1 Micro - organisms
An Introduction

Key Words
Bacteria
Bug
Cell
Cilia
Cytoplasm
Disease
DNA
Flagella
Fungi
Germ
Microbe
Micro-organism
Microscope
Pathogen
RNA
Viruses

Materials Required

Per student
A copy of SH 1
A copy of SH 2
A copy of SH 3
A copy of SH 4

Advance Preparation

Cut out and laminate a set of playing cards (SH 2 – SH 4) for each group.

Available Web Resources

- A film of the activity.
- A variety of microbial photographs.
- SH 1 in MS PowerPoint format.
- Animation to demonstrate the differences in microbial size.

INTRO TS 1

Background Information

Micro-organisms are living organisms too small to be seen with the naked eye; they are microscopic. Micro-organisms are found almost everywhere on earth and can be both beneficial and harmful to humans (this will be explored in later sections). Although extremely small, microbes come in many different shapes and sizes. There are three main groups of microbes:

Viruses are the smallest of the microbes and are generally harmful to humans. Viruses cannot survive by themselves. They require a 'host' cell in which to live and reproduce. Once inside the host cell, they rapidly multiply destroying the cell in the process!

Fungi are generally multi-cellular organisms that can be both beneficial and harmful to humans. Fungi obtain their food by either decomposing dead organic matter or by living as parasites on a host. Fungi range in size from being microscopic to very large and include mould, mushrooms and mildew! Harmful fungi can cause an infection and some are poisonous to eat; others can be beneficial or harmless e.g. *Penicillium* produces the antibiotic penicillin and *Agaricus* can be eaten (the button mushroom). Fungi spread through the air in small hard seed-like spores. When these spores land on bread or fruit they open and grow under the right conditions (dampness).

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

Bacteria can be divided into three groups by their shapes – cocci (balls), bacilli (rods) and spirals. Cocci can also be broken down into three groups based on how the cocci are arranged: staphylococci (clusters), streptococci (chains) and diplococci (pairs). Scientists can use these shapes to tell which infection a patient has.

As living creatures, microbes have certain growth requirements but these vary depending on where the microbe is found. For example, microbes which live in humans prefer a temperature of 37^{o}C, microbes living in deep sea thermal vents prefer much higher temperatures whereas microbes living in arctic regions prefer much lower temperatures. Microbes also vary in their nutrient requirements. A sudden change in the environment can kill many microbes although it is important to remember that microbes are extremely adaptable and gradual changes can result in microbes adapting to suit their environment e.g. antibiotic resistant bacteria.

1.1 Micro - organisms
An Introduction

Lesson Plan

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 **SH 1** to demonstrate how these three microbes vary in shape and structure. The web activity found at **www.e-bug.eu** can be used to help demonstrate the varying sizes of bacteria, viruses and fungi in relation to each other.

4. 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 yogurt, probiotic bacteria in our gut which aid digestion and the fungus *Penicillium* which produces the antibiotic penicillin.

5. 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.

Main Activity

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 numbers in the other headings used on the cards are only to be used as a guide, they are not accurate as there is no formulae to create these and they may be subject to change i.e. bacterial species may develop resistance to more antibiotics resulting in them having a higher number in this column and being more dangerous to humans.

Game rules (this game is based upon Top Trumps)

1. The dealer should mix 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 an item from the top card (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. The winner then selects the item to read out from the next card.
3. If 2 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 as well. The person with all the cards at the end is the winner.

INTRO TS 2

1.1 Micro - organisms
An Introduction

Lesson Plan

Plenary

1. Check for understanding by asking the students:
    a. What are microbes?
    Microbes are living organisms too small to be seen with the naked eye
    b. Where are microbes found?
    Microbes are found everywhere
    c. What are the three different shapes of bacteria?
    Bacilli (rods), cocci (balls) and spirals
    d. What is the main difference between bacteria and viruses?
    Bacteria are much more complex than viruses and can live virtually ANYWHERE whereas viruses need to live in a host cell in order to survive.
    e. With the students, sort the microbes from the game into useful and dangerous to humans. Check for understanding as to why these microbes may be useful or dangerous or sometimes both.
    Microbes which are dangerous to humans are generally those which can cause us harm through infection. Sometimes however, these microbes can also be viewed as being useful e.g. certain strains of E. coli and Salmonella can cause severe diarrhoea if ingested in humans however these strains of bacteria have also been extensively researched. This research has told us a lot about microbes in general and how we can utilise them to our advantage i.e. genetic engineering, vaccination development, etc.

Extension Activity

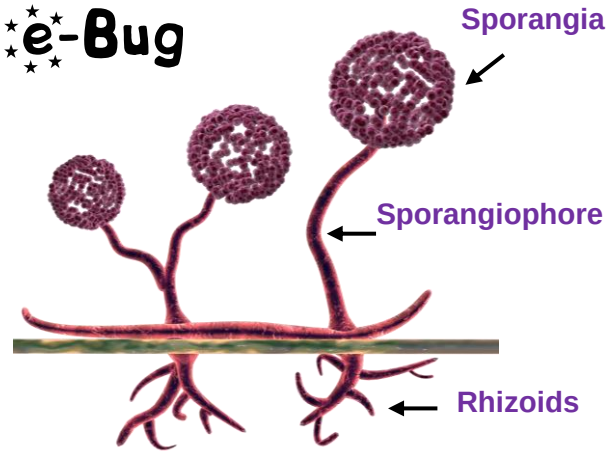
Divide the class into groups of 3 – 4 students. Each group should create a poster on one of the following topics:

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

OR

2. A timeline poster on the history of microbes. This poster may include:
    a. 1676: **van Leeuwenhoek** discovers ‘animalcules’ using homemade microscope
    b. 1796: **Jenner** discovers smallpox vaccination
    c. 1850: **Semmelweis** advocated washing hands to stop the spread of disease
    d. 1861: **Pasteur** discovers that bacteria do not arise via spontaneous regeneration
    e. 1884: **Koch** publishes his postulates, the criteria designed to establish a causal relationship between a causative microbe and a disease
    f. 1892: **Ivanovski** discovers viruses
    g. 1929: **Fleming** discovers antibiotics

Fungi

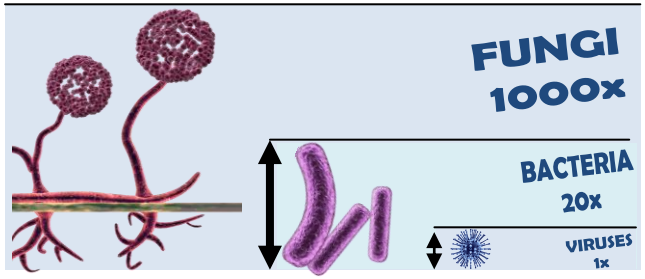


Sporangia:
Spore producing body.

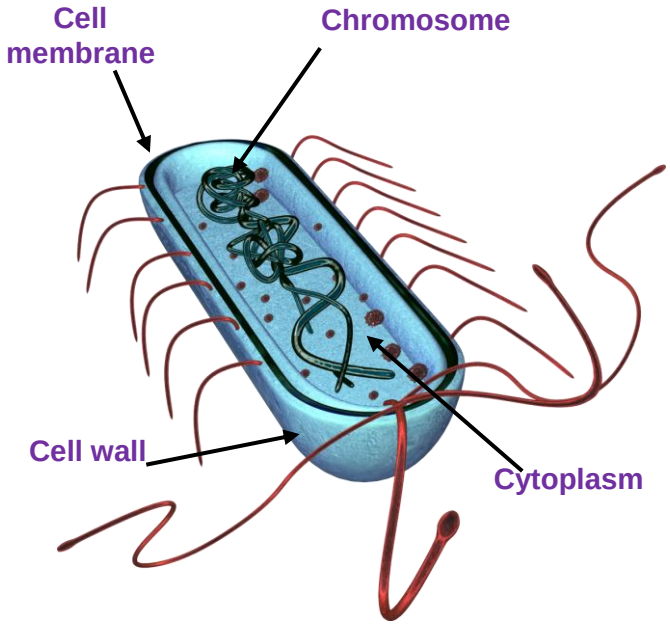
Sporangiophore:
Filamentous stalk on which the sporangium forms.

Rhizoids:
The sub-surface **hyphae** are specialized for food absorption.

Microbe Size



Bacteria



Bacteria are free living and are found everywhere

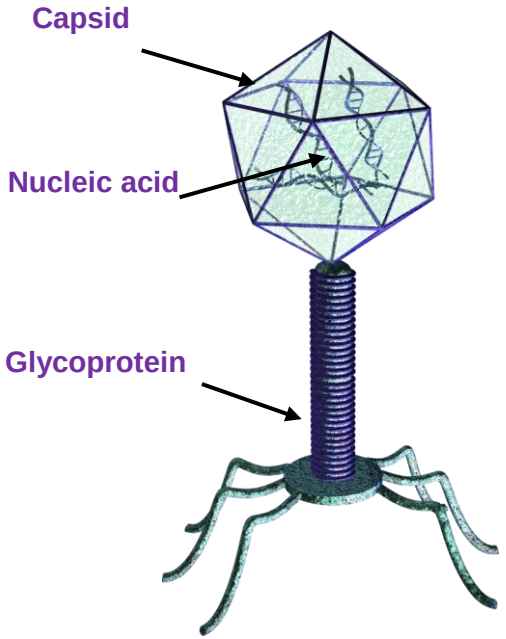
Chromosome:
Genetic material (DNA) of the cell.

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.

Viruses



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:

- Anchor the virus to the host cell.
- 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.

INTRO SH 1

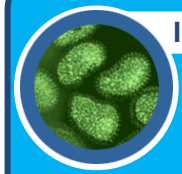
Tobamovirus

Tob-A-Mo-Virus
Virus

Max Size (nm)	18
Number of species	125
Danger to humans	12
Usefulness to humans	34
Antibiotic resistance	N/A

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

Influenza A



In-Flu-En-Za A
Virus

Max Size (nm)	90
Number of species	1
Danger to humans	146
Usefulness to humans	12
Antibiotic resistance	N/A

The flu is an infection caused by *Orthomyxoviridae*40% of the population get the flu but most people recover completely in a couple of weeks. In 1918, before there were any vaccines for the flu, twenty million people were killed!

Lyssavirus

Lice-A-Virus
Virus

Max Size (nm)	180
Number of species	10
Danger to humans	74
Usefulness to humans	5
Antibiotic resistance	N/A

The *Lyssavirus* infect both plants and animals. The most common *Lyssavirus* is the Rabies virus and is usually associated with dogs. Rabies has been responsible for over 55,000 deaths worldwide but can be prevented by vaccination.

Ebola

E-Bowl-Ah
Virus

Max Size (nm)	1500
Number of species	1
Danger to humans	200
Usefulness to humans	0
Antibiotic resistance	N/A

Filovirus causes a disease more commonly known as Ebola. It is one of the more dangerous viruses known to humans due to the fact that there is no known preventative vaccine or treatment. 50 – 90% of victims die from the disease!

Lymphocryptovirus

Lim-Foe-Cryp-Toe-Virus
Virus

Max Size (nm)	110
Number of species	7
Danger to humans	37
Usefulness to humans	2
Antibiotic resistance	N/A

The Epstein-Barr virus is a type of *Lymphocryptovirus* causing an illness known as the Kissing Disease or Glandular fever. Patients suffer from sore throats, swollen lymph glands, and extreme tiredness. Transmission requires close contact such as kissing or sharing drinks.

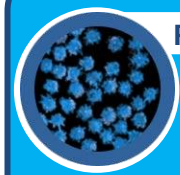
Simplex Virus

Sim-Plex Virus
Virus

Max Size (nm)	200
Number of species	2
Danger to humans	64
Usefulness to humans	2
Antibiotic resistance	N/A

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

Rhinovirus

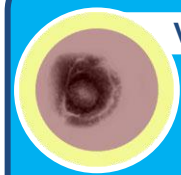


Rhino-Virus
Virus

Max Size (nm)	25
Number of species	2
Danger to humans	28
Usefulness to humans	14
Antibiotic resistance	N/A

There are over 250 different kinds of cold viruses! But *Rhinovirus* is by far the most common. *Rhinoviruses* are responsible for almost 35% of colds. *Rhinovirus* can survive three hours outside someone's nose. If it gets on your fingers and you rub your nose, you've caught it!

Varicellovirus



Var-E-Cell-O-Virus
Virus

Max Size (nm)	200
Number of species	2
Danger to humans	21
Usefulness to humans	7
Antibiotic resistance	N/A

Chickenpox is caused by the *Varicella-Zoster* virus. It is highly contagious although rarely serious and is spread through direct contact (or coughing and sneezing). Almost everyone caught chickenpox in their childhood prior to the discovery of the chickenpox vaccine.

INTRO SH 2

Penicillium

Pen-Ee-Sil-Ee-Um

Fungi

Max Size (nm) **332, 000**
Number of species **16**
Danger to humans **64**
Usefulness to humans **198**
Antibiotic resistance ..... **N/A**

Penicillium is a fungus that has literally changed the world! 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.

Saccharomyces

Sac-A-Row-My-Sees

Fungi

Max Size (nm) **10,000**
Number of species **19**
Danger to humans **1**
Usefulness to humans **184**
Antibiotic resistance ..... **N/A**

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.

Tinea

Tin-Ee-A

Fungi

Max Size (nm) **110,000**
Number of species **12**
Danger to humans **43**
Usefulness to humans **14**
Antibiotic resistance ..... **N/A**

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

Stachybotrys

Stack-Ee-Bo-Trys

Fungi

Max Size (nm) **72,000**
Number of species **2**
Danger to humans **83**
Usefulness to humans **2**
Antibiotic resistance ..... **N/A**

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 a variety of health problems ranging from rashes to life threatening reactions for those with respiratory problems.

Aspergillus

Ass-Per-Gill-Us

Fungi

Max Size (nm) **101, 000, 000**
Number of species **200**
Danger to humans **47**
Usefulness to humans **124**
Antibiotic resistance ..... **N/A**

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

Cryptococcus

Cryp-Toe-Coccus

Fungi

Max Size (nm) **7, 500**
Number of species **37**
Danger to humans **98**
Usefulness to humans **37**
Antibiotic resistance ..... **N/A**

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

Candida

Can-Did-A

Fungi

Max Size (nm) **10,000**
Number of species **44**
Danger to humans **74**
Usefulness to humans **175**
Antibiotic resistance ..... **N/A**

Candida is among the natural flora 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).

Verticillium

Ver-Tee-Sil-Ee-Um

Fungi

Max Size (nm) **8,500,000**
Number of species **4**
Danger to humans **1**
Usefulness to humans **18**
Antibiotic resistance ..... **N/A**

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

INTRO SH 3

Chlamydia

Clam-id-E-A Bacteria

Max Size (nm)	1000
Number of species	3
Danger to humans	37
Usefulness to humans	1
Antibiotic resistance	5

Chlamydia, a sexually transmitted infection (STI) caused by the bacteria *Chlamydia trachomatis*. It can cause mild symptoms such as discharge from the vagina or penis to more serious complications, i.e. inability to have children or swollen testicles.

Salmonella

Sam-on-ella Bacteria

Max Size (nm)	1000
Number of species	3
Danger to humans	89
Usefulness to humans	15
Antibiotic resistance	40

Salmonella are rod shaped bacteria most commonly known for causing food poisoning and typhoid fever. Symptoms range from vomiting to diarrhoea and even death, in worse case scenarios.

Staphylococcus

Staff-ill-O-coccus Bacteria

Max Size (nm)	1000
Number of species	19
Danger to humans	174
Usefulness to humans	20
Antibiotic resistance	90

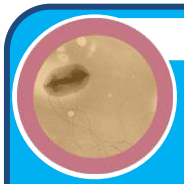
Meticillin Resistant Staphylococcus aureus (MRSA) are the bacteria responsible for causing difficult to treat infections in hospitals. They are a variation of the common *Staphylococcus aureus* that have evolved to become resistant to many common antibiotics.

Streptococcus

Strep-Toe-Coccus Bacteria

Max Size (nm)	1000
Number of species	21
Danger to humans	50
Usefulness to humans	75
Antibiotic resistance	20

Many *Streptococcus* are harmless to humans and are the normal flora of the mouth and hands. However, some *Streptococcus* bacteria cause about 15% of sore throats. Strep throat symptoms include sudden fever, stomach aches, and swollen glands.



Escherichia

Esk-Er-Ic-E-A Bacteria

Max Size (nm)	2000
Number of species	7
Danger to humans	54
Usefulness to humans	184
Antibiotic resistance	N/A

Many strains of *E. coli* are harmless, and huge numbers are present in the human and animal gut. In addition, *E. coli* is among the most studied of all creatures great and small. In some cases, however, *E. coli* cause both urinary and serious abdominal infections and food poisoning.

Pseudomonas

Sued-O-Moan-Us Bacteria

Max Size (nm)	5000
Number of species	126
Danger to humans	50
Usefulness to humans	150
Antibiotic resistance	80

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 and bioremediation.

Lactobacillus

Lac-Toe-Ba-Sil-Us Bacteria

Max Size (nm)	1500
Number of species	125
Danger to humans	0
Usefulness to humans	195
Antibiotic resistance	10

Lactobacilli are very common and usually harmless to humans. They are present in the vagina and the gastrointestinal tract, and make up a small portion of the gut flora. These bacteria have been extensively used in the food industry - in yogurt and cheese making.

Treponema

Trep-O-Nee-Ma Bacteria

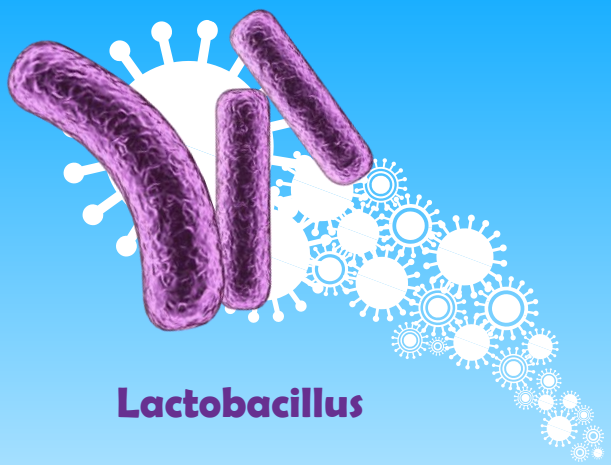
Max Size (nm)	2000
Number of species	3
Danger to humans	115
Usefulness to humans	8
Antibiotic resistance	10

Syphilis is an extremely contagious disease, caused by *Treponema* bacteria. Symptoms start with a skin rash and flu-like symptoms and can lead to brain damage and death. Syphilis can be cured with antibiotics however resistant strains are becoming more frequent.

INTRO SH 4

1.2 USEFUL MICROBES

Section 1.2: Useful Microbes highlights the benefits of some microbes by examining the various ways and means we can utilise them for our benefit.
Through a yogurt making activity, students observe first hand how microbes can be put to good use in the food industry.
The extension activity encourages students to question their experiments by examining a yogurt culture under a microscope and observe the presence of useful bacteria for themselves.



Lactobacillus

LEARNING OUTCOMES

All students will:

- understand that useful microbes can help keep us healthy
- understand that most microbes are beneficial to us
- understand that microbes can be put to good use

More able students will:

- understand that we need bacterial colonisation to live a healthy life
- understand that we need to protect our normal microbial flora

NATIONAL CURRICULUM LINKS

Key Stage 3
Science
Working Scientifically
Scientific Attitudes
Experimental Skills and investigations
Analysis and Evaluation
Structure and Function of Living Organisms
Nutrition and digestion
Material cycles and energy
Cellular respiration
Estimated Teaching Time
50 minutes

1.2 Micro-organisms
Useful Microbes

Key Words

Culture
Colonisation
Contamination
Fermentation
Incubate
Natural flora
Pasteurisation
Probiotic

Materials Required

Per student
- ☐ Beaker
- ☐ Cling film/foil
- ☐ Copy of SH 1 and SW 1
- ☐ Dried/Powdered milk
- ☐ Whole milk
- ☐ Live natural yogurt
- ☐ Sterile teaspoon

Per group
- ☐ Hot plate
- ☐ Water bath set at 20°C
- ☐ Water bath set at 40°C

Extension Activity
- ☐ Copy of SW 2
- ☐ Bunsen burner
- ☐ Cover slips
- ☐ Methylene blue
- ☐ Microscope X40 resolution
- ☐ Microscope slides
- ☐ Sterile droppers

Health and Safety

- During cooking students should wear a lab coat or apron and goggles
- Stain slides over a sink

USE TS 1

Background Information

Bacteria are single-celled organisms and although some of these cause illness and disease, others are helpful and beneficial. One of the main ways in which bacteria are beneficial is in the food industry. The natural by-products created during normal microbial growth are used to make many of the food products we eat everyday.

Fermentation causes a chemical change in foodstuffs. It is a process by which the bacteria break down the complex sugars into simple compounds like carbon dioxide and alcohol. Fermentation changes the product from one food to another.

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

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

Lactobacillus bacteria are generally referred to as useful or 'friendly' bacteria. The friendly bacteria that help us digest food have been termed probiotic bacteria, literally meaning 'for life'. It is these bacteria that we find in our yogurts and probiotic drinks.

Advance Preparation

1. Copy SH 1, SW 1 and SW 2 for each student.
2. Purchase a carton of fresh plain yogurt and powdered milk.
3. Boil at least 1teaspoon of yogurt per group to sterilise.

Available Web Resources

- A demonstration film of the activity.
- Magnified microbial photographs associated with useful microbes.
- SH 1 in MS PowerPoint format.
- Magnified images of the yogurt smear.

1.2 Micro-organisms
Useful Microbes

Lesson Plan

Introduction

1. Begin the lesson by explaining that there are millions of different species of microbes and that most of these are completely harmless to humans; some are actually very good for us. Ask the class if they know of any ways in which we use microbes to our advantage. Examples may include *Penicillium* (fungus) to make antibiotics; some microbes break down dead animals and plant material to make compost; some microbes help us digest foods and some are even used to turn milk into yogurt, cheese and butter.
2. Remind the class that bacteria and fungi, like us, are alive – they need a food source to grow and multiply. They vary in their food requirements but generally anything we consider food can be used as food by many microbes. Microbes also produce waste products and it is these waste products that can either be beneficial or harmful to humans. Ask students if they have ever seen milk turn sour; although this may be seen as a problem to us, industry uses this process (fermentation) in making yogurt.
3. Explain that fermentation is a chemical change/process by which bacteria 'eat' sugars and produce acids and gas as waste. We use this process in the food industry to create wine, beer, bread, yogurt and many more foodstuffs. When making yogurt, the bacteria added to milk consume the milk sugars, and through fermentation convert these sugars to lactic acid which causes the milk to thicken into a yogurt. Tell the class that they are going to make their own yogurt and see the fermentation process for themselves.

Main Activity

1. This activity consists of 3 different tests and can be done as an entire class or in groups.
2. Supply the class or groups with the yogurt recipe (**SH 1**). It is important to go through each step of the recipe with the class, having a group discussion as to why each of the steps are carried out.
    a. Powdered milk helps to thicken the mixture
    b. Boiling the milk helps eliminate any unwanted microbes, later we will be incubating the mixture at a temperature favourable for microbial growth. Other unwanted organisms may interfere with the fermentation process or if found in yogurt may cause food poisoning.
    NOTE 1 if boiling the milk is not an option in the classroom it is possible to use UHT or sterile milk.
    c. Not cooling the mixture before adding the yogurt in step 4 would result in killing the 'yogurt-making' microbes.
    d. Yogurt contains the microbes *Lactobacillus* or *Streptococcus* required to make yogurt. We add the yogurt to the milk mixture so that these microbes will convert the mixture to yogurt through fermentation.
    e. Stirring the mixture helps to evenly distribute the *Lactobacillus* through the mixture. It is important to use a sterile spoon to prevent contaminating the mixture with unwanted microbes such as moulds.
    f. Again sterilised containers with lids help prevent contamination with unwanted microbes which may disrupt the fermentation process.
    g. 32°C - 43°C is the ideal growth temperature range for *Lactobacilli* or *Streptococcus*. The mixture can be left at room temperature but it will take up to 5 days longer for the microbes to multiply and produce the lactic acid required.
    NOTE 2 This activity can be carried out using smaller quantities of milk if required.

1.2 Micro-organisms
Useful Microbes

Lesson Plan

Main Activity

1. Explain each of the tests to the class
   a. Test 1 - carry out the experiment following the recipe (SH 1) using the yogurt in step 4.
   b. Test 2 - carry out the experiment following the recipe (SH 1) using sterilised (boiled) yogurt in step 4.
   c. Carry out the experiment using the recipe, (SH 1), however at step 7 incubate half the samples at the recommended temperature and the other half at 20°C or in the fridge.
2. Highlight that the *Lactobacillus* bacteria found in yogurt are useful or 'friendly' bacteria known as probiotics. These bacteria help us by
   a. Defending us against the harmful bacteria that can cause disease
   b. Helping us digest some food types
3. Students should record their observations on the student worksheet (SW 1).

Plenary

Check for understanding by asking students the following questions:

a. What is the process that caused a change in the milk?
Fermentation is the process by which the milk changed to yogurt. During fermentation microbes consume simple sugars and convert them to acids, gas and alcohol.

b. Why was it important to add some yogurt to the milk mixture?
The live yogurt contains the bacteria which carry out fermentation.

c. What happens when sterile yogurt is added to the milk, and why?
No change occurs because the yogurt has been boiled so that all the microbes are killed. Fermentation cannot occur when this sterile yogurt is added to the milk.

d. What changes occurred as the mixture changed from milk to yogurt and why did these changes occur?
The lactic acid produced by the bacteria caused the milk to sour resulting in a thickening and slight colour change.

e. Why was it important to keep the mixture warm overnight?
Bacteria prefer to grow at approximately 37°C, temperatures outside this range will either kill microbes or reduce the rate at which they multiply. It is important for the bacteria to grow and multiply quickly in order to produce enough lactic acid to cause the milk to change to yogurt.

f. What happens when the experiment goes wrong?
If the sterile milk turns to yogurt – the milk may not have been boiled properly or the samples may have got contaminated.

Extension Activity

Provide students with a copy of SW 2. Follow the procedure outlined and examine the microbes under a microscope. Students may need to dilute the yogurt with water if the yogurt is particularly thick. You may want students to try this test using yogurt only and yogurt diluted with water.

Remember that the more dilute the yogurt is the farther the bacteria will spread out making them more difficult to find on the slide.

USE TS 3

1.2 Micro-organisms
Useful Microbes

Teacher Answer Sheet

Test 1 – Yogurt

	Before Incubation	After incubation
What was the consistency of the mixture?	*Runny liquid*	*Thick and creamy*
What did the mixture smell like?	*Like milk*	*Like rotting food*
What was the colour of the mixture?	*White*	*Cream / white*

Test 2 – Sterile Yogurt

	Before Incubation	After incubation
What was the consistency of the mixture?	*Runny liquid*	*Runny liquid (no change)*
What did the mixture smell like?	*Like milk*	*Like milk(no change)*
What was the colour of the mixture?	*White*	*White (no change)*

How did the mixture change during fermentation?
During test 1 the mixture changed to a thicker creamier texture consistent with yogurt, this was due to the lactic acid fermentation of the microbes present. No change was observed in the second test due to the lack of microbes present.

Test 3

How long did it take to make the yogurt when the mixture was incubated at:

$20^{o}C$ *approx 3-5 days* $40^{o}C$ *overnight*

Conclusions

1. What caused the change from milk to yogurt?
   The microbes added to the milk converted the sugars to lactic acid which caused the milk to thicken into a yogurt.

2. What is this process called?
   Lactic acid fermentation.

3. Explain the difference in results in test 1 and test 2.
   Everything in test 2 was sterile; therefore there were no microbes present to carry out lactic acid fermentation.

4. What is the type and name of microbes which can be used to make yogurt?
   Bacteria of the genus Lactobacillus and Streptococcus.

5. Why did it take longer to make yogurt at $20^{o}C$ than at $40^{o}C$?
   Bacteria prefer to grow at body temperature i.e. approx $37^{o}C$. At $20^{o}C$ it takes the bacteria longer to multiply therefore they are slower to produce the lactic acid.

6. A sterile spoon is used to stir the mixture (step 5) before incubating, what do you think might happen if a dirty spoon was used?
   The resulting yogurt may be contaminated with harmful microbes.

USE TS 4

How to Make Yogurt

1. Add two tablespoons of powdered, skimmed milk to 500ml (one pint) of whole milk.

2. Bring the mixture to a boil over medium heat for 30 seconds, stirring constantly to kill any unwanted bacteria present. Take care it does not overflow!

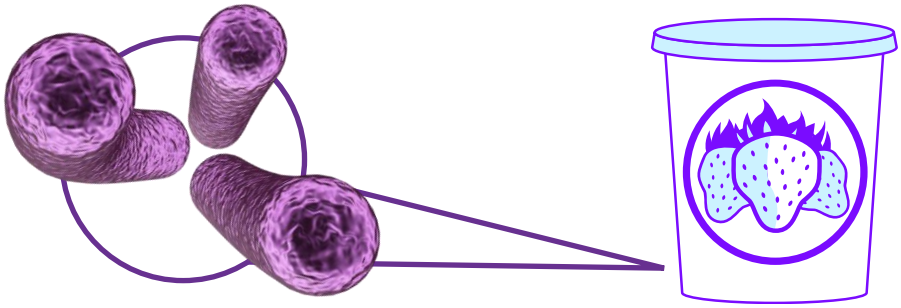
3. Cool to 46-60°C.

4. Divide the cooled mixture into 2 sterile beakers and label test 1 and test 2.
   Test 1 : add 1-2 teaspoons of live yogurt
   Test 2 : add 1-2 teaspoons of sterile yogurt

5. Stir both mixtures well using a spoon previously sterilised by standing it in boiling water.

6. Cover each container with aluminium foil.

7. Incubate the mixtures at 32-43°C in a hot water bath, for 9-15 hours until desired firmness is reached.



USEFUL MICROBES

Observations

Test 1 – Yogurt

	Before Incubation	After incubation
What was the consistency of the mixture?		
What did the mixture smell like?		
What was the colour of the mixture?		

Test 2 – Sterile Yogurt

	Before Incubation	After incubation
What was the consistency of the mixture?		
What did the mixture smell like?		
What was the colour of the mixture?		

How did the mixture change during fermentation?

_____

_____

Test 3

How long did it take to make the yogurt when the mixture was incubated at:

$20^{o}C$ $40^{o}C$

Conclusions

1. What caused the change from milk to yogurt?

   _____

2. What is this process called?

   _____

3. Explain the difference in results in test 1 and test 2?

   _____

4. What is the type and name of microbes which can be used to make yogurt?

   _____

5. Why did it take longer to make yogurt at $20^{o}C$ than at $40^{o}C$?

   _____

6. A sterile spoon is used to stir the mixture (step 5) before incubating, what do you think might happen if a dirty spoon was used?

   _____

USE SW 1

USEFUL MICROBES

Procedure

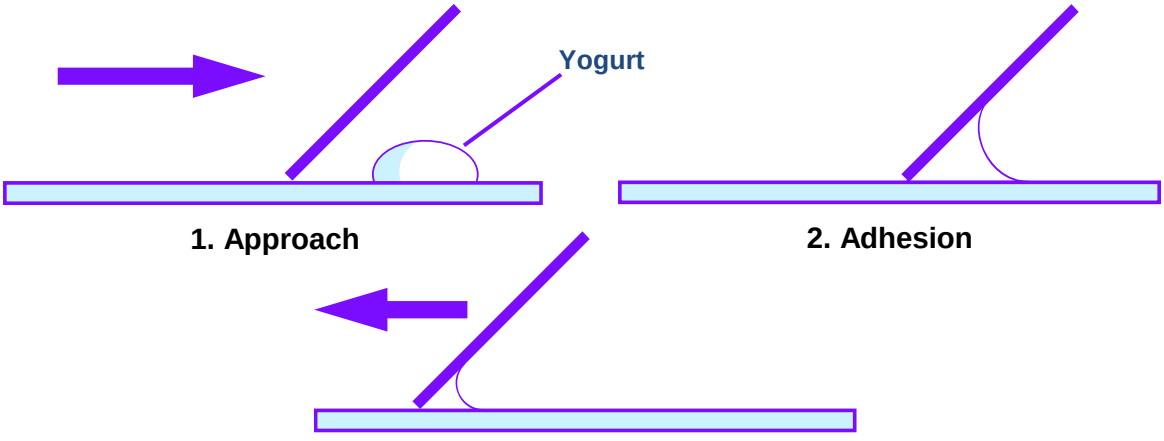
Test 1

1. Place a small drop of ***yogurt*** onto one side of a glass microscope slide.
2. Taking a second clean slide, streak the yogurt across the length of the slide creating a thin smear.
3. Leave the slide to air dry and then pass once through a Bunsen flame in order to heat fix the smear.
4. Cover the smear with a few drops of Methylene Blue and leave for 2 minutes.
5. Wash off any excess stain by running under a slow running tap.
6. Cover smear with a cover slip and examine the slide under a high powered microscope.
7. Record your observations below.

Test 2

1. Repeat steps 1-7 above using ***sterile yogurt*** instead of live culture yogurt.

How to prepare a smear:



Observations

1. What did you see in the yogurt smear?

   _____
   _____
   _____

2. What did you see in the sterile yogurt smear?

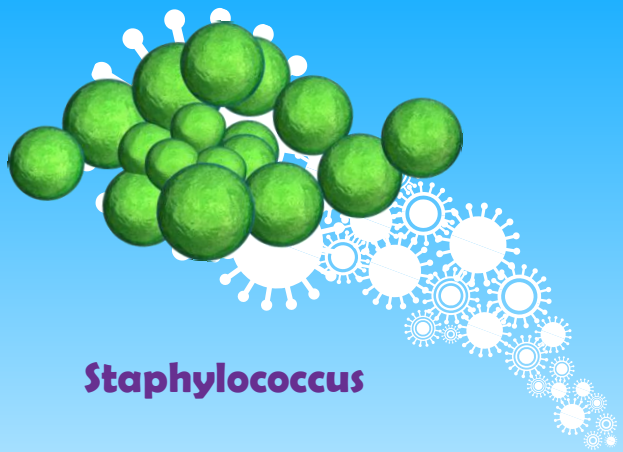
   _____
   _____
   _____

3. What, in your opinion, caused the difference?

   _____
   _____
   _____

1.3 Harmful Microbes

Section 1.3: Harmful Microbes, introduces students to the variety of infectious diseases caused by harmful microbes.
Students are required to act as scientists and group a range of diseases under different headings in order to address a range of problems which may arise. By carrying out this activity students learn that it is not always easy to identify and treat a disease.
A classroom debate is the focus of this extension activity. Students research either side of the following debate 'are we too clean or not clean enough?'



Staphylococcus

Learning Outcomes

All students will:

- understand that sometimes microbes can make us ill

National Curriculum Links

Key Stage 3
Science
Working Scientifically
Experimental skills and investigations
Analysis and Evaluation
PSHE
Core Theme 1: Health and Wellbeing

Estimated Teaching Time
50 minutes

1.3 Micro-organisms
Harmful Microbes

Key Words

Bacteria
Colonise
Dermatophytes
Fever
Fungi
Germs
Hygiene
Infectious
Pathogens
Rash
Swelling/Inflammation
Toxin
Virus

Materials Required

Per group
A copy of
SH 1, SH 2, SH 3
SW 1

Available Web Resources

- Magnified microbial photographs associated with harmful microbes.
- www.who.int
- www.cdc.gov

FASCINATING FACT

Globally, infectious diseases were the leading cause of death in 1999, causing 25% of all known deaths.
Infectious diseases were responsible for 63% of deaths in children under 5 years of age!

HARM TS 1

Background Information

Some microbes can be harmful to humans and can cause disease; the *Influenza* virus can cause the flu, *Campylobacter* bacteria can make us ill through food poisoning and the dermatophyte fungi such as *Trichophyton* can cause diseases such as Athlete's foot and Ringworm. Microbes such as these are known as **pathogens**. Each pathogen can make us ill in different ways.

When harmful bacteria reproduce in our bodies, they can produce harmful substances called **toxins** which can make us feel ill or, in worse case scenario, damage tissues and organs. An example is cholera; the cholera toxin causes severe diarrhoea and as a result, dehydration.

Viruses act like parasites. On entering our bodies they require a host cell to survive. Once inside a cell, they multiply and burst free when fully grown and in doing so destroy the host cell. Fungi generally do not kill their host. **Dermatophytes** prefer to grow or colonise under the skin. It is the secondary products they produce while feeding that cause swelling and itching.

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

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

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

- **Fever**: Microbes prefer to live at normal body temperature at 37^{o}C. A fever is considered one of the body's immune mechanisms to attempt a neutralisation of a perceived threat inside the body, be it bacterial or viral.
- **Swelling**: A cut in the hand will generally result in swelling around the cut; this is our body responding in a similar way to a fever only in a more localised way.
- **Rash**: This is our body's reaction to microbial toxins.

This will be discussed in more detail in later sections.

Advance Preparation

Cut out the disease cards in SH 1 - SH 3, one set per group. Laminate these or stick onto stiff card for future use.

1. Copy SW 1 for each group.

1.3 Micro-organisms
Harmful Microbes

Lesson Plan

Introduction

1. Begin the lesson by explaining to the class that sometimes microbes can be harmful to humans. Bacteria can produce toxins when they reproduce which are harmful to the body. Viruses act like parasites multiplying inside our cells and destroying them. Some fungi like to grow on our skin making it itchy and sore. Find out how many different words they have for microbes – germs, bugs, etc.
2. Ask the class to create a list of infections (infectious diseases) by brainstorming any diseases they have heard of. Do they know what microbes cause the diseases? Ask the students what disease they think poses a threat to students in the class today? Tell them that in the early 1900s the disease of greatest threat was measles; many children who caught measles died!
3. Tell the class that bacteria and other microbes that can cause infection and which can spread easily from person to person are called infectious. Discuss the difference between an infectious microbe and a non infectious one. Discuss with students the various routes of transmission, i.e. touch, water, food, body fluid and air.
4. Identify any infectious diseases mentioned in the brainstorming session and how they are transmitted.

Main Activity

1. This activity should be carried out in groups of 3 – 5 people. Explain that during this activity they are going to learn about some infectious diseases that cause problems in the world today.
2. Provide each group with the disease cards found in **SH 1** – **SH 3**.
3. Tell the class that sometimes scientists need to group diseases under different headings to address different problems. Each group should examine the headings on **SW 1**.
4. Ask each group to complete **SW 1** for the first heading – Infectious agent. After a few minutes, ask a spokesperson in each group to read out their results. Write all the results on a white board for discussion.
5. After each heading in **SW 1** is complete, discuss the class results as a whole.
    a. Infectious organism
    Remind students that there are three main types of microbes. It is important to identify the microbe causing the disease in order to treat the disease properly, e.g. antibiotics cannot be used to treat viruses (this will be covered in section 4 of this resource).
    b. Symptoms
    Students may notice that some diseases exhibit similar symptoms, e.g. fever or rash. You may wish to discuss how important it is for people to visit their doctor when they are ill to receive a correct and accurate diagnosis.
    c. Transmission
    Many diseases are transmitted very easily through touch or by inhalation. Other diseases are quite specific and require the transfer of blood or other bodily fluids.
    d. Preventative measures
    People can prevent the spread of, and protect themselves against, infection by a few simple steps. Regular hand washing and covering our coughs and sneezes has been shown to reduce the incidence of many common infections. The correct use of a condom can reduce the transmission of many STIs.

Lesson Plan

Main Activity contd

e. Treatment
It is important to note here that not all illnesses require medical treatment; some require bed rest and an increased fluid intake; however painkillers may be used to alleviate some of the symptoms. Highlight to the students that antibiotics are only used to treat bacterial infections.

Plenary

Check for understanding by asking the students the following questions:

a. What is a disease?
A disease is defined as an illness characterised by an identifiable group of signs or symptoms.

b. What is an infectious disease?
An infectious disease is a disease that is caused by a microbe and can be spread to other people.

c. Why do we see infectious diseases that used to be found in a single region, all over the world today?
Many infectious diseases start in a specific region or country. In the past the infection could easily be contained or isolated. Today, however, people travel faster, more frequently and further than ever before. A person travelling from Australia to England can make the journey in under a day, stopping off at Hong Kong en route. If this person has a new strain of the flu virus, they could spread it to anyone they came into contact with on the plane, people they come into contact with at Hong Kong airport and people they came into contact with when they landed in England. These people could also carry the flu to other people they come into contact with all over the world. Within a few days, this new strain of influenza virus could be found worldwide!!!

Extension Activity

1. Ask the class to remember what they have been taught about microbes, both good and bad. Explain to the class that there is an ongoing debate between scientists on which they cannot agree. The two sides of the debate are:
    a. We need to clean up our act to get rid of microbes and disease.
    Keep everything, including ourselves, as clean as possible to eliminate harmful microbes.
    b. We are too clean! Our bodies do not know how to fight infection any more.
    Because we are too clean, our bodies have not built up immunity to many harmful microbes therefore we are more prone to get sick!
2. Provide students with research material and ask them to write an essay or prepare a classroom debate on how they feel about the topic based on their individual research. Remind students that there is no right or wrong answer, even scientists cannot agree on this!

1.3 Micro-organisms
Harmful Microbes

Answer Sheet

Points to Note

* MRSA is an antibiotic resistant bacterium, it is specifically resistant to meticillin. Its resistance status is attributed to the overuse and misuse of this and other antibiotics. Treatment is still via antibiotic therapy however MRSA is also developing resistance other antibiotics as well!

1. Infectious Microbe

Infectious Microbe	Disease
Bacteria	Bacterial meningitis, Chlamydia, MRSA
Virus	HIV, Chickenpox, Flu, Measles, Glandular Fever
Fungi	Thrush, Ringworm

2. Symptoms

Symptoms	Disease
Asymptomatic	Chlamydia, MRSA
Fever	Flu, Measles, Chickenpox, Bacterial meningitis
Rash	Bacterial meningitis, Chickenpox, Measles,
Sore throat	Flu, Glandular fever
Tiredness	Glandular fever,
Lesions	HIV, Herpes
Whitish discharge	Chlamydia, Thrush

3. Transmission

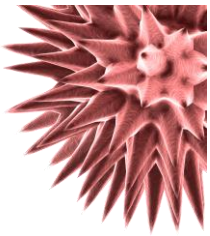
Transmission	Disease
Sexual contact	Chlamydia, HIV, Thrush
Blood	Bacterial meningitis, HIV
Touch	Flu, Measles, Chickenpox, MRSA
Inhalation	Flu, Measles, Chickenpox, Bacterial meningitis
Mouth to mouth	Flu, Glandular fever

4. Prevention of Infection

Prevention	Disease
Wash hands	Flu, Measles, Chickenpox, MRSA, Bacterial meningitis
Cover coughs and sneezes	Flu, Measles, Chickenpox, Bacterial meningitis
Use a condom	Chlamydia, HIV, Thrush
Avoid unnecessary antibiotic use	MRSA*, Thrush
Vaccination	Chickenpox, Measles, Flu

5. Treatment of Infection

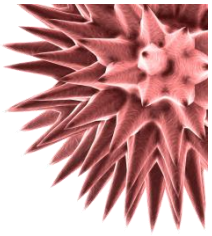
Treatment	Disease
Antibiotics	Chlamydia, Bacterial meningitis, MRSA*
Bed Rest	Chickenpox, Glandular fever, Measles, Flu
Antifungals	Thrush, Ringworm
Fluid Intake	Chickenpox, Glandular fever, Measles, Flu



Meticillin Resistant Staphylococcus aureus (MRSA)	
Infectious agent	Bacteria: *Staphylococcus aureus*
Symptoms	Asymptomatic in healthy individuals. Can cause skin infections, infect surgical wounds, the bloodstream, the lungs, or the urinary tract in previously ill patients.
Diagnosis	Swab and antibiotic sensitivity test`.
Mortality Rate	High – if not given the correct antibiotics.
Transmission	Contagious. Direct skin contact.
Prevention	Regular hand washing.
Treatment	Resistant to many antibiotics. While some antibiotics still work, MRSA is constantly adapting.
History	First reported 1961, increasing problem globally.

Measles	
Infectious agent	Virus: *Paramyxovirus*
Symptoms	Fever, runny nose, red and runny eyes, a cough, a red rash and a sore, swollen throat.
Diagnosis	Blood sample and antibody test.
Mortality Rate	Low but high in Third World countries.
Transmission	Contagious. Droplets from coughs and sneezes, skin contact or contact with objects that have the live virus on them.
Prevention	Prevention via vaccination.
Treatment	Bed rest and fluid intake.
History	Virus first reported 1911, has decreased dramatically in developed countries in recent years although small epidemics do occur. Still a pandemic problem for third world countries.

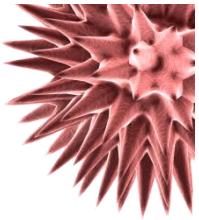
Flu	
Infectious agent	Virus: *Influenza*
Symptoms	Headache, fever, chills, muscle aches; possibly sore throat, cough, chest pain.
Diagnosis	Blood sample and antibody test.
Mortality Rate	Medium but higher in the very young and elderly.
Transmission	Highly contagious. Inhalation of viruses on airborne particles. Direct skin contact.
Prevention	Vaccination against current strains.
Treatment	Bed rest and fluid intake. Antivirals in the elderly.
History	Present for centuries, epidemics occur at regular intervals.



Thrush	
Infectious microbe	Fungi: *Candida albicans*
Symptoms	Itching, burning, soreness and white coating of the mouth or irritation of the vagina with a whitish discharge.
Diagnosis	Swab, microscopic examination and culturing.
Mortality Rate	None.
Transmission	Person to person contact but is a normal part of the flora of the gut.
Prevention	Symptoms are caused by overgrowth of this fungus due to antibiotics killing off the normal protective bacteria. Therefore avoid unnecessary antibiotic use.
Treatment	Antifungals.
History	Almost 75% of all women have had this infection at least once.

Chlamydia	
Infectious Microbe	Bacteria: *Chlamydia trachomatis*
Symptoms	In many cases there are no symptoms but sometimes there is a discharge from the vagina or penis. Swollen testicles and inability to have children can also occur.
Diagnosis	Swab or urine sample for molecular testing.
Mortality Rate	Rare.
Transmission	Contagious through sexual contact.
Prevention	Use a condom during sexual intercourse.
Treatment	Antibiotics.
History	First discovered in 1907. Global problem which is on the increase.

Bacterial Meningitis	
Infectious Microbe	Bacteria: *Neisseria meningitidis*
Symptoms	Headache, neck stiffness, high fever, irritability, delirium, rash.
Diagnosis	Spinal fluid sample and molecular testing.
Mortality Rate	Medium – higher risk in the young and elderly.
Transmission	Contagious, through saliva and inhalation of droplets.
Prevention	Vaccination against many strains, avoid contact with infected patients.
Treatment	Penicillin, oxygen and fluids.
History	First identified as a bacteria in 1887. Regular epidemics in under developed countries



HIV/AIDS	
Infectious agent	Virus: Human immunodeficiency virus (HIV).
Symptoms	Failing immune system, pneumonia, lesions.
Diagnosis	Blood sample and antibody test.
Mortality Rate	Medium – high in countries with no anti-AIDS drugs.
Transmission	Highly contagious. Sexual contact, blood to blood contact, sharing of needles, mother to new born transmission.
Prevention	Always wear a condom during sexual intercourse.
Treatment	There is no cure although anti-HIV drugs can prolong life expectancy.
History	First identified in 1983. Currently a global epidemic.

Glandular fever (Kissing Disease)	
Infectious agent	Virus: *Epstein Barr*
Symptoms	Sore throats, swollen lymph glands, extreme tiredness.
Diagnosis	Blood sample and antibody test.
Mortality Rate	Low.
Transmission	Not very contagious. Direct contact such as kissing and sharing drinks.
Prevention	Avoid direct contact with infected patients.
Treatment	Bed rest and fluid intake, paracetamol can be used to relieve the pain.
History	First described in 1889, 95% population have had the infection, however, only 35% develop symptoms. Occasional isolated outbreaks.

Chickenpox	
Infectious agent	Virus: *Varicella-zoster*
Symptoms	Blistering rash on the body and head.
Diagnosis	Blood sample and antibody test.
Mortality Rate	Low
Transmission	Highly contagious. Direct skin contact or inhalation of droplets from sneezing and coughing.
Prevention	Prevention by vaccine.
Treatment	Bed rest and fluid intake, antivirals in some adult cases.
History	First identified in 1865. Decreased in countries where vaccination programmes have been implemented. No change elsewhere.

HARMFUL MICROBES

Procedure

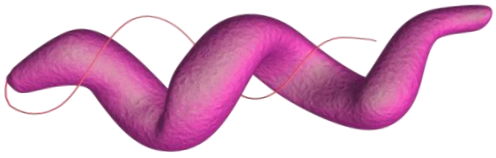
1. Group your disease cards according to the heading in each box.
2. Do you notice any similarities or differences between the diseases based on each of the headings?

1. Infectious Microbe

Infectious Microbe	Disease
Bacteria	
Virus	
Fungi	

2. Symptoms

Symptoms	Disease
Asymptomatic	
Fever	
Rash	
Sore throat	
Tiredness	
Lesions	
Whitish discharge	



3. Transmission

Transmission	Disease
Sexual contact	
Blood	
Touch	
Inhalation	
Mouth to mouth	

4. Prevention of Infection

Prevention	Disease
Wash hands	
Cover coughs and sneezes	
Use a condom	
Avoid unnecessary antibiotic use	
Vaccination	

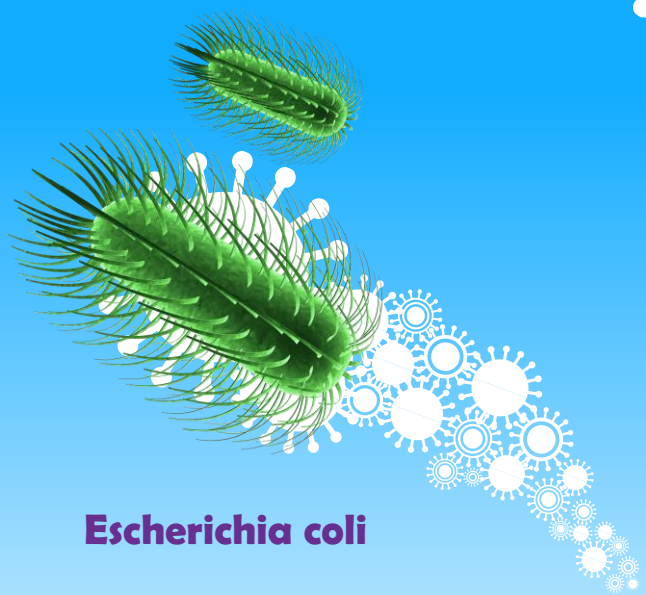
5. Treatment of Infection

Treatment	Disease
Antibiotics	
Bed Rest	
Antifungals	
Fluid Intake	

HARM SW 1

2.1 Hand Hygiene

This section aims to teach students how poor hand hygiene can lead to the spread of microbes and disease. In 2.1 Hand hygiene, students carry out an experiment to observe how microbes can spread from person to person simply by shaking their hands. They will also have to decide which method is best for hand washing.



Escherichia coli

LEARNING OUTCOMES

All students will:

- understand that sometimes microbes can make us ill.
- understand that prevention of infection, where possible, is better than cure.
- understand not to spread their harmful microbes to others.
- understand how, when and why to wash their hands.

NATIONAL CURRICULUM LINKS

Key Stage 3
Science
Working Scientifically
Scientific Attitudes
Experimental skills and investigations
Analysis and Evaluation
PSHE
Core Theme 1: Health and Wellbeing
Estimated Teaching Time
50 minutes

2.1 Spread of Infection
Hand Hygiene

Key Words

Antibacterial soap
Colony
Contagious
Hygiene
Infection
Infectious
Transfer

Materials Required

Per student

- ☐ Copy of SW 1
- ☐ Copy of SW 2
- ☐ 3 Petri dishes of nutrient agar

Per group

- ☐ Copy of SH 1
- ☐ Copy of SH 2
- ☐ Towel/hand dryer/paper towels
- ☐ Permanent marker pen
- ☐ Soap
- ☐ Warm water

Health and Safety

- It is important that the Petri dishes stay closed whilst examining the microbes.
- Ensure that all students wash hands after participating in the activity.

Available Web Resources

- A demonstration film.
- SH 1 and SH 2.
- Images of results.
- Alternative Activity.

HAND TS 1

Background Information

Schools are a haven of harmful microbes which spread rapidly from person to person via touch. Washing our hands is the best way to stop the spread of harmful microbes and prevent people getting sick.

Our hands naturally secrete oil which helps keep our skin moist and stops it getting too dry. This oil provides a perfect place for microbes to grow and multiply and also helps microbes 'stick' to our skin. Our hands are also covered with good bacteria – harmless species of *Staphylococcus*. Washing our hands regularly helps remove the other microbes we collect from our surroundings (e.g. home, school, garden, animals, pets, food). Some of these microbes can make us ill if ingested.

Washing hands in water alone or in cold water eliminates visible dirt and grime, however, soap is required to break up the oil on the surface of the hands which traps microbes.

Hands should be washed:

- before, during and after preparing food, especially raw meat
- After using the bathroom
- After exposure to animals or animal waste
- After coughing, sneezing or blowing your nose
- If you're ill or have been around ill people

Advance Preparation

1. Copy SW 1, SW 2, SH 1 and SH 2 for each student.
2. Have hand washing facilities available, (soap, warm water, a means to dry hands).
3. Prepare 2/3 Petri dishes of nutrient agar per student.

Alternative Suggestions

Slices of white bread can be used as alternatives to Petri dishes of nutrient agar. Students should put a hand print on the bread and place inside a food storage bag with a few drops of water. Store the bags upright in a dark place in a similar fashion to the Petri dishes.

NOTE: This method is not as accurate as using the Petri dish method and fungal colonies will grow as opposed to bacterial colonies. Student worksheets may need to be modified.

2.1 Spread of Infection
Hand Hygiene

Lesson Plan

Introduction

1. Begin the lesson by asking the class 'if there are millions of disease-causing microbes in the world that live everywhere, why aren't we ill all the time?' Provide students with **SH 1** (The chain of Infection) and **SH 2** (Breaking the Chain). Use the MS PowerPoint presentation found at **www.e-bug.eu** to help explain this.
2. Highlight that there are many different ways in which microbes can be transmitted to people. Ask students if they can think of any. Examples include through the food we eat, the water we drink and bathe in, the things we touch and from sneezing.
3. Ask students: How many of you have washed your hands today? Ask why they washed their hands (*to wash away any microbes that might be on their hands*), and what would happen if they didn't wash away the microbes (*they might get ill*).
4. Tell the students that we use our hands all the time, and that they pick up millions of microbes every day. Although many of these are harmless some could be harmful.
5. Explain to the class that we spread our microbes to our friends and others through touch, and this is why we wash our hands.
6. Explain to students that they are going to do an activity to show them how best to wash their hands to remove any of the harmful microbes which may be on their hands.

Main Activity

NOTE 1 If time does not permit to carry out the full activity, results can be viewed on the website, **www.e-bug.eu**.

Section A

1. Provide each student in the class with a copy of **SW 1** and a Petri dish of nutrient agar. Ask each student to divide the dish in half by drawing a line on the **base** of the Petri dish. Label one side clean and the other side dirty. **NOTE 2** Students should not label the lid.

   NOTE 3 Care must be taken not to mix up the dirty and clean side of the plate as this will lead to confusing results. Using 2 plates, one for clean hands and one for dirty hands, may help prevent this problem.

2. Each student should put a hand print on the side labelled 'Dirty'. Students should then wash their hands thoroughly and place a hand print on the side labelled 'clean'.
3. Place the Petri dish in a warm dark place for 48 hours and examine the plates during the next lesson. Students should record their results on **SW 1.**

   On the dirty side of the plate students should observe a range of different bacterial and fungal colonies; each different colony type represents a different bacterial or fungal strain – some natural body flora and some contamination from areas they have touched. Students should examine these carefully and describe their morphology and how many of each type of organism they see.

   On the clean side of the plate students should observe a distinct decrease in the number of different types of colonies observed. This is because hand washing has removed many of the organisms the students have 'picked up' through touch. The organisms left growing on the plate are the body's natural flora. The quantity of these colonies may be higher than on the dirty side of the plate. This is because washing can bring the harmless microbes out of the hair follicles but these are usually one type of microbe. You can tell the difference between harmless and harmful microbes as there tend to be several different species of harmful microbe.

HAND TS 2

2.1 Spread of Infection
Hand Hygiene

Lesson Plan

Main Activity

Section B

1. Divide the class into 4 even groups of students (a, b, c, d).
2. Ask each group to choose a lead person who is NOT going to wash their hands. Everyone else in the group should wash their hands as thoroughly as possible with soap (if available) and water. Students should dry their hands with either an air hand dryer or a clean section of tissue. The student NOT washing his/her hands should touch as many items in the classroom as possible to pick up lots of microbes including door handles, sink taps, shoes, etc.
3. Ask students to stand in 4 rows one behind the other and designate groups as follows

a. No hand washing	*Control group*
b. Wash hands in warm water very quickly	*Dip hands in water and rub quickly*
c. Wash hand in warm water thoroughly	
d. Wash hands in warm water & soap thoroughly	

4. Provide each student in the class with 2 nutrient agar plates and a copy of **SW 2**.
5. Each student should put a hand print on one of their agar plates and label appropriately.
6. The lead student (student 1) should then wash their hands according to the group they are in. Student 1 should then turn around and shake hands with student 2 making sure to have as much hand contact with the person as possible. Student 2 in turn should shake hands with student 3 and so on until they reach the end of the row.
7. Each student should now make a hand print in their second nutrient agar plate and label appropriately.
8. Place the nutrient agar plates in a warm dry place for 48 hours. Ask students to view and record their results on **SW 2**.

Plenary

1. Discuss the results with the students. What results did they find the most surprising? Explain that microbes can stick to the natural oil found on our skin. Washing with water alone flows over this oil and does not wash it away. Soap breaks up this oil so that the water can wash away the microbes.
2. Discuss where the microbes on their hands may have come from. Emphasise to students that not all the microbes on their hands are bad; there may also be normal body microbes which is why good microbes may increase following hand washing.

Extension Activity

Ask students to research the controversy as to the pros and cons of using antibacterial soaps. It may be a good idea to divide the class into groups of 4 people and ask each group to research the topic and have a classroom debate. Alternatively, students can write a short essay outlining the argument for and against and draw their own conclusion from the evidence.

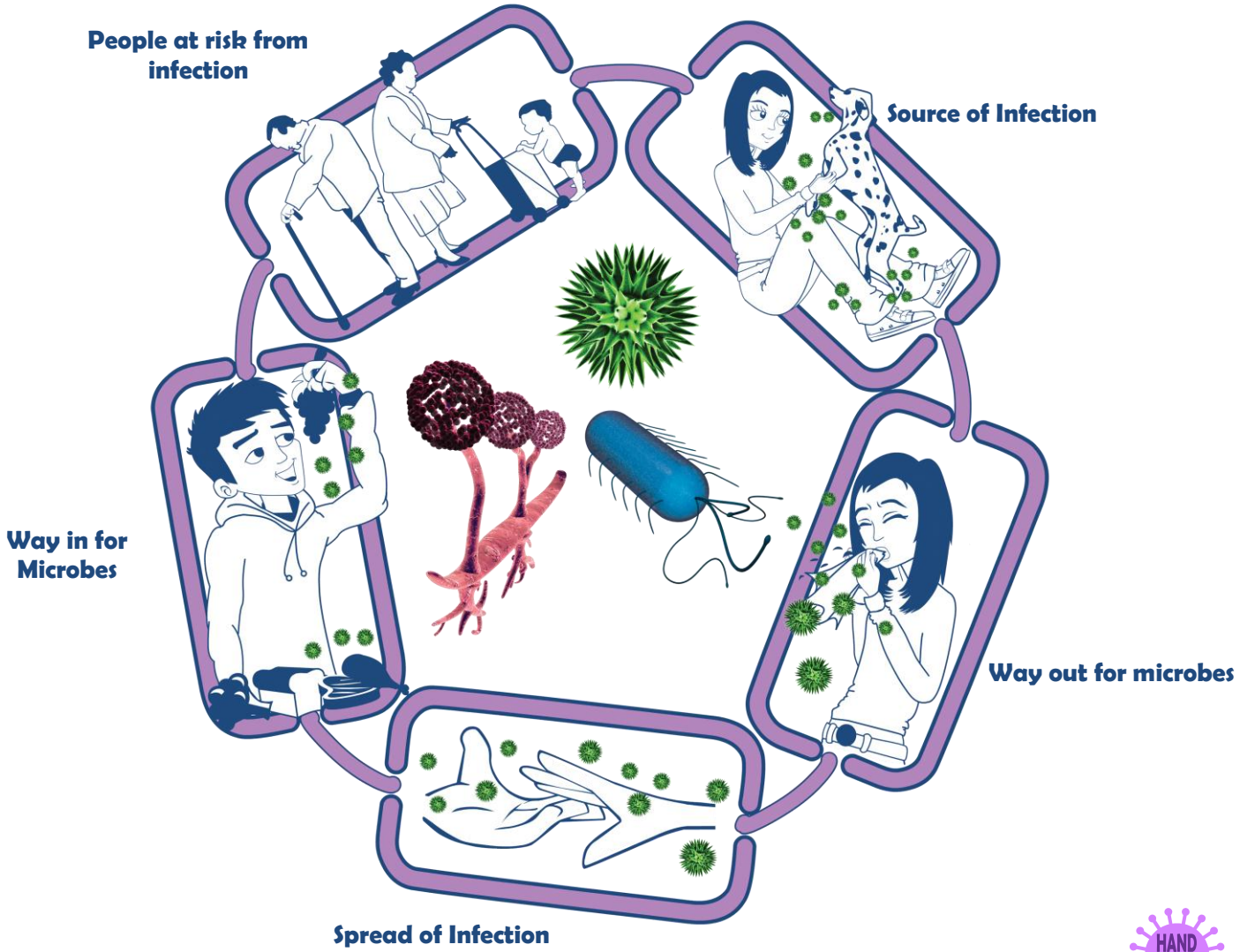
HAND TS 3

2.1 Spread of Infection
Hand Hygiene

Alternative Activity

Activity

1. This activity can be carried out in groups of 2 – 4 students or as a classroom discussion.
2. Ask students if they have ever had a tummy bug. With the help of SH 1 and SH 2, ask students to imagine the spread of gastroenteritis (a tummy bug) in their school from a single infected student.
3. Ask the class to take into account the situations of everyday life in school (going to the toilets without washing hands or washing them without soap, going to eat at the school canteen, borrowing pens or other things from friends, shaking hands, using a computer…).
4. Ask the groups/class to report on ways in which the infection could spread and how quickly it could spread in their class or in the school.
5. Suggest the students think about and discuss the difficulties they encounter with respect to hand hygiene in school and to suggest how to use the existing hygiene facilities better.

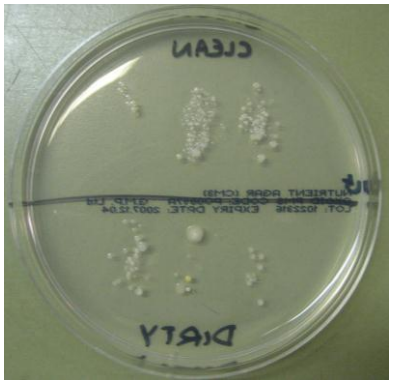


2.1 Spread of Infection
Hand Hygiene

Teacher Answer Sheet

Results

Draw and describe what you observed in the Petri dish



Dirty section

Colony 1 *large round cream colonies with a white centre*

Colony 2 *small yellow colonies*

Colony 3 *very small cream colonies with irregular shape*

Colony 4 *small cream round oval colonies*

Colony 5 *small round white colonies*

Clean section

Colony 1 *small round white colonies*

Colony 2 *small cream round oval colonies*

Observations

1. Which side of the Petri dish contained the highest number of microbes?
   Clean
2. Which side of the Petri dish contained more different colonies of microbes?
   Dirty
3. How many different colony types were there on the:
   Clean *2* Dirty *5*

Conclusions

1. Some people may see more microbes on the clean side of the Petri dish than the dirty side. Why?

*There may be more microbes on the clean side than the dirty side but if students have washed their hands correctly there should be a lower number of **different types** of microbes. The increase in the number of microbes is probably due to microbes from the water or the paper towel used to dry their hands.*

2. Which colonies would you consider the friendly microbes and why?

The microbes on the clean side as they are probably the natural microbes found on our hands.

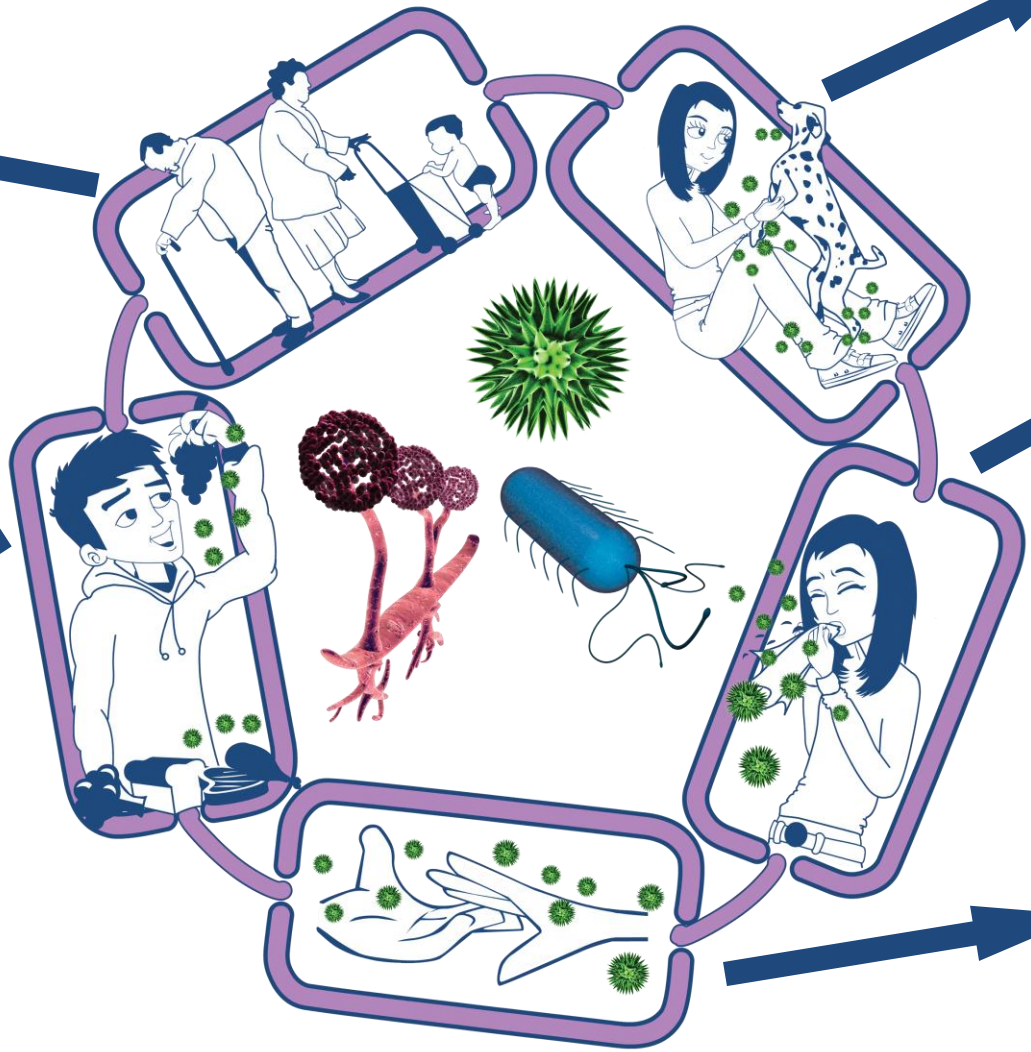
Conclusion

1. Which method of hand washing eliminated the most microbes?
   Hand washing with soap and warm water.
2. Why would soap help eliminate more microbes than washing with water alone?
   Soap helps to break up the natural oil on your skin to which microbes can stick.
3. What are the advantages and disadvantages to using antibacterial soap when washing your hands?
   Advantages: *kill any unwanted microbes* Disadvantages: *also kill natural skin microbes*
4. What evidence do you have that microbes can be transmitted by hands?
   The types of microbes on the first plate are spread along to the other plates and the numbers are gradually decreasing.
5. Which areas of the hand do you think would contain the most microbes and why?
   Under the finger nails, on the thumbs and between the fingers as these are places that people either forget to wash or don't wash very well.
6. List 5 times when it is important to wash your hands
   a. *Before cooking eating* b. *After touching pets* c. *After using the toilet* d. *Before*
   e. *After sneezing into them*

HAND TS 4

Hand Hygiene

The chain of Infection



Source of Infection

Someone or something carrying the harmful microbes that causes the infection. There are many different sources of infection, these can include

- People already infected
- Pets or animals
- Dirty surfaces (e.g. door handles, keyboards, toilets)

Way out for microbes

Harmful microbes need a way to get out of an infected person or source before they can spread to someone else. Routes include

- Sneezing and coughing
- Bodily fluid

Spread of Infection

Harmful microbes need a way to be passed from person to person. This can be through

- Touch
- Sexual transmission

People at risk from infection

We are all at risk from infection. High risk people include

- Those already on medication
- The very young
- The elderly

Way in for microbes

Harmful microbes need a way to enter the body before they can cause an infection. This can be through:

- The food we eat
- Inhalation of aerosols
- Open cuts or sores
- Things we put in our mouths

Hand Hygiene

Breaking the Chain of Infection

Source of Infection

- Isolate infected people
- Take care with raw food
- Wash pets regularly
- Dispose of nappies and soiled clothing appropriately

Way out for microbes

Prevent any

- Coughs and sneezes
- Faeces
- Vomit
- Bodily fluid

Getting onto surfaces or hands

Spread of Infection

- Wash hands thoroughly and regularly
- Cover cuts and open sores
- Take appropriate precautions during sexual activity

People at risk from infection

Everyone

- Take appropriate vaccinations

High risk people

- Keep away from people who are infectious
- Take extra care about cleanliness
- Take extra care when cooking and preparing food

Way in for microbes

- Cover cuts and open sores with a water proof dressing
- Cook food properly
- Take care to drink only clean water

Hand Hygiene

Results

Draw and describe what you observed in the Petri dish

Dirty section

Colony 1 _____

Colony 2 _____

Colony 3 _____

Colony 4 _____

Colony 5 _____

Clean section

Colony 1 _____

Colony 2 _____

Colony 3 _____

Colony 4 _____

Colony 5 _____

Observations

1. Which side of the Petri dish contained the highest number of microbes?

   _____

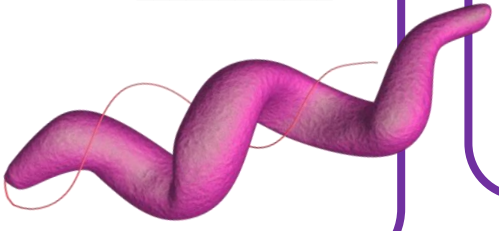
2. Which side of the Petri dish contained more different colonies of microbes?

   _____

3. How many different colony types were there on the:

Clean section _____

Dirty section _____



Conclusions

1. Some people may see more microbes on the clean side of the Petri dish than the dirty side. Why?

   _____

   _____

   _____

   _____

   _____

   _____

2. Which colonies would you consider to be the friendly microbes and why?

   _____

   _____

   _____

   _____

HAND SW 1

Hand Hygiene

Procedure

1. Carry out the experiment according to the teacher's instructions.
2. In the table below, fill in how many different types of colonies you counted on your Petri dish and draw a graph of your results.

Results

	After washing (or not washing) and shaking hands					
	Student 1	Student 2	Student 3	Student 4	Student 5	Student 6
No wash (control)						
Quick wash						
Thorough wash						
Thorough wash w/ soap						

Conclusion

1. Which method of hand washing eliminated the most microbes?

   _____

2. Why would soap help eliminate more microbes than washing with water alone?

   _____

   _____

3. What are the advantages and disadvantages to using antibacterial soap when washing your hands?

   Advantages: _____

   _____

   Disadvantages: _____

   _____

4. What evidence do you have that microbes can be transmitted by hands?

   _____

   _____

5. Which areas of the hand would do you think would contain the most microbes and why?

   _____

   _____

6. List 5 times when it is important to wash your hands

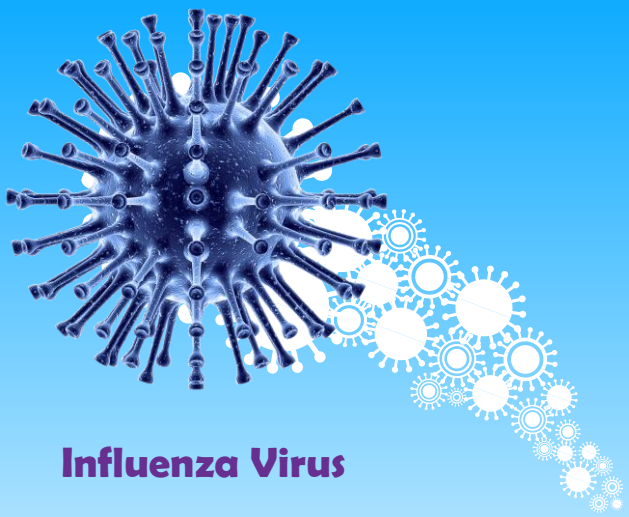
   a. _____ b. _____

   c. _____ d. _____

   e. _____

2.2 Respiratory Hygiene

This section aims to teach students how poor respiratory hygiene can lead to the spread of microbes and disease.
In 2.2 Respiratory Hygiene, students observe on a large scale how far microbes are carried when they sneeze and how many people can be affected. Through a set of trial experiments, students learn that covering your mouth with a tissue when you cough and sneeze helps prevent the spread of infection.
The extension activity asks students to consider how far a virus can spread in 1 week. The results can be astounding!



Influenza Virus

LEARNING OUTCOMES

All students will:

- understand that sometimes microbes can make us ill.
- understand that prevention of infection, where possible, is better than cure.
- understand not to spread their harmful microbes to others.
- understand that infection can spread through sneezing and coughing.
- understand that covering the mouth with a tissue when sneezing or coughing can prevent the spread of infection.

More able students will:

- understand that coughing or sneezing in your hand can still spread infection.

NATIONAL CURRICULUM LINKS

Key Stage 3
Science
Working Scientifically
Experimental skills and investigations
Analysis and Evaluation
PSHE
Core Theme 1: Health and Wellbeing

Estimated Teaching Time
50 minutes

2.2 Spread of Infection
Respiratory Hygiene

Key Words

Aerosol
Contagious
Contaminate
Experiment
Infection
Prediction
Results
Symptom
Transmission

Materials Required

Per student
- ☐ Copy of SW 1

Per group
- ☐ 30 paper discs (10cm)
- ☐ Measuring tape
- ☐ Spray bottle
- ☐ Water
- ☐ Food dye (optional)
- ☐ Large tissue
- ☐ Gloves

Health and Safety

- Students may be required to wear aprons or lab coats and gloves.
- Ensure that the food colouring is EXTREMELY dilute.
- Ensure that all spray bottles have been thoroughly cleaned and rinsed prior to use.
- Students may need to wear safety goggles.

RESP TS 1

Background Information

Colds and flu are the most common illnesses in the classroom and perhaps one of the most contagious. They are caused by viruses and, as such, cannot be cured by antibiotics. Generally bed rest and drinking plenty of fluids are recommended, but you can visit the chemist for medications to help alleviate symptoms. If symptoms persist then a visit to the local doctor is required. Symptoms of colds and flu include headache, sore throat and fever. People with colds can also have runny noses!

The most common mode of transmission is indirectly, through aerosols such as coughs and sneezes. Microbes can also be spread via a more direct route, through human contact (touching, kissing, etc) and eating contaminated food.

Sneezing is a way in which our body tries to get rid of any harmful microbes and dust we might inhale. The harmful microbes and dust get caught on the nose hair and tickle our nose. The nose sends a message to the brain which then sends a message back to your nose, mouth, lungs and chest telling them to blow the irritation away. In the case of colds and flu, millions of viral particles rush out and contaminate the surfaces on which they land; this could be our food or hands.

Advance Preparation

1. Copy SW 1 and SW 2 for each student
2. Fill one spray bottle per group with water and food colouring. A different colour for each part of the experiment prevents mixing up results.
3. Create a large tissue from a section of kitchen roll.

Alternative Suggestions

Fill a balloon with glitter (microbes) and blow it up. Stand on a chair and ask students to stand around the chair below you. Burst the balloon (sneeze) and ask students to observe on to how many of them the glitter (microbes) has landed and may have been infected. Alternative: hole punch circles can be used instead of glitter.

Available Web Resources

- A demonstration film of this activity
- Images of what would happen if the students were spraying real microbes
- The photograph accompanying Alternative Activity 2.

2.2 Spread of Infection
Respiratory Hygiene

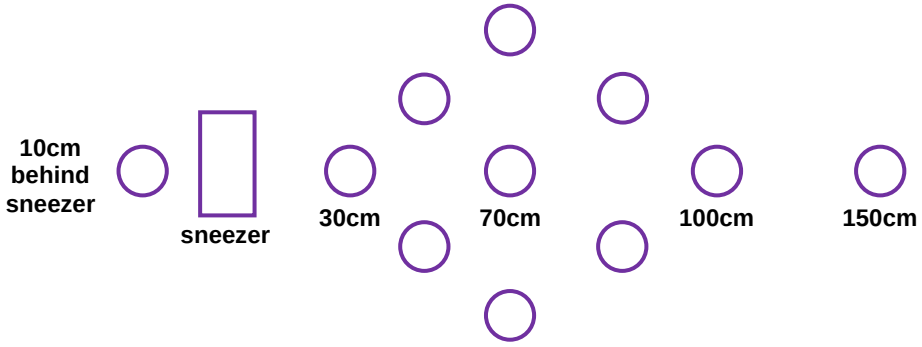
Lesson Plan

Introduction

1. Explain to students that many diseases are airborne and spread in tiny droplets of water, known as aerosols, which are coughed and sneezed into the air by people. Tell students that the diseases that spread in this way range from viral diseases like colds and flu, to rarer, more serious infections like meningitis or tuberculosis (TB) which are caused by bacteria and can result in death.
2. Continue to discuss colds and flu, explaining that they are caused by a virus and not bacteria and, as such, cannot be cured by antibiotics. Explain that it is very important for everyone's health that people cover their mouth and nose when they cough and sneeze as this can reduce the spread of infection.

Main Activity

1. Divide the class into groups of 8 – 10 students.
2. Provide each student in the class with a circular disc of paper. Ask them to draw a face on their disc and write their name on the paper (you could ask them to write the name of a friend or family member to make it more fun). Tell the class that these discs are going to represent real people. Explain to the class what they are about to do (see below) and ask them to fill out the hypothesis section of **SW 1** prior to the activity.
3. Explain to the class that the 'people' are in a crowded place, which could be a disco or a club. Each student should place their disc in one of the positions outlined below. It is important that the central positions are roughly aligned at distances outlined below. These discs will represent how far the sneeze has travelled and who it has affected en route. The other discs should be places at varying distances away from each side of the central line – these discs will represent how wide the sneeze has travelled and how many people it has affected en route. Write the distance on each disc



4. Nominate a student as the sneezer and provide them with the spray bottle of coloured water (you may wish to use coloured water to make the activity more visually interesting). Explain to the class that this person has a new strain of the flu and it is very contagious. Ask the student to hold the spray bottle facing forward and give it a firm tight squeeze – this represents the person sneezing.
5. Students should look at the 'people', how many people did the sneeze contaminate?
6. Ask students to collect the 'people' and draw a circle around each drop of water, they should then count how many drops of water were on each sheet. Explain to the students that each drop of water represents a droplet of snot from a sneeze and that each droplet may contain thousands of bacteria or viruses!

RESP TS 2

Lesson Plan

Main Activity Cont'd

7. Repeat the experiment holding a gloved hand over the nozzle of the spray bottle. Repeat a third time using a piece of kitchen roll, this represents a tissue covering your sneeze.
8. Each student should complete and record their results on a graph.
9. Show students the MS PowerPoint presentation demonstrating what would happen if this were a real sneeze on nutrient agar plates.

Plenary

1. Discuss with students the experiment, the hypothesis and their results. Were they surprised by the results in the activity?
2. Ask students to remember the gloved hand and notice that it was very wet with the spray 'microbes'. Ask them to imagine that this was someone's hand after sneezing on it and how many things or people they would have touched when their hand was covered in infectious microbes. Highlight that while sneezing onto your hand is good and stops the germs spreading far, it is important to wash hands immediately after sneezing into them or to sneeze into a tissue and throw it away.
3. Discuss in detail what this experiment has taught the students about the transmission of microbes. How many students would have been infected by a sneeze?
4. Would there be a change in the results if the experiment was carried out outside on a windy day?

   Note: Microbes also spread through coughing, it is just as important to cover our mouths with a tissue when coughing!

Extension Activity

1. This can be carried out as a group or individual activity.
2. Explain that they are going to predict how many people can become infected and how far influenza can travel in a week by an infected person. A flight seating plan may be used to help illustrate the activity.
3. Tell the class that they are on a long haul flight from Sydney, Australia to London, England. The flight takes 23.5 hours with a 5-hour stop over in Hong Kong where passengers change plane and can walk around the airport terminal for refreshments. On the plane there are:
   a. A family of 8 getting off in Hong Kong to go home
   b. 12 passengers boarding a different flight in Hong Kong and going on to Turkey
   c. 4 passengers catching a connecting flight from Hong Kong to South Africa
   d. The remaining passengers going to London
4. On this flight one man has a new strain of the influenza virus and it is very contagious.
   a. How many people will he infect and how far will this virus travel in 24 hours, and in 1 week.
   b. What could have been done to prevent the infection travelling so far?

RESP TS 3

2.2 Spread of Infection
Respiratory Hygiene

Teacher Answer Sheet

Hypothesis

1. Which disc do you think will be most affected by the sneeze?
   The plates directly in front of and to the sides of the sneezer will be the most affected
2. Which people do you think will be least affected by the sneeze?
   The person behind the sneezer and those furthest away
3. What do you think will happen when you place a gloved hand over the sneeze?
   The sneeze will not travel to as many people but the microbes will be found on the hand
4. What do you think will happen when you place a tissue over the sneeze?
   All the microbes will be trapped in the tissue

Results

1. What was the furthest distance the sneeze travelled?

	Distance travelled	Number of people contaminated
Sneeze alone	*This will vary depending on the type of spray bottle used, but in general the sneeze alone will infect more people and travel the furthest. The sneeze in the tissue should affect the least.*	
Gloved hand		
Tissue		

2. Did either of the sneezes contaminate any of the people on the side lines?

	Distance travelled	Number of people contaminated
Sneeze alone	*As above*	
Gloved hand		
Tissue		

3. How many 'microbes' landed on the person behind the sneezer?

   None

Conclusion

1. Based on this experiment what have you learned about microbial transmission?
   Microbes can pass very easily from person to person through sneezing and touch.

2. If we don't wash our hands after sneezing into them, what might happen?
   We can still transfer the harmful microbes found in a sneeze to other people when we touch them.

3. Which method is best for preventing the spread of infection, sneezing into your hand or sneezing into a tissue? Why?
   Sneezing into a tissue; this causes the microbes to get trapped and we can then throw the tissue away.

RESP TS 4

2.2 Transfer of Infection
Respiratory Hygiene

Alternative Extension Activity

Extension Activity 2

1. This activity can be carried out either individually, in small groups or as a class discussion.
2. Three school friends, Sara, Elisa and Chloe, have all caught a cold and are coughing a lot! As you can see on the picture below, each student has adopted a different way of covering their coughs and sneezes.
3. Ask students to discuss the advantages and disadvantages of each method in the context of
    a. Their daily life
    b. Reducing the spread of infection

Note: This picture is also in PowerPoint format on the e-Bug website for your convenience.

NOTE

The activity in section 2.3 can be modified as follows and used as a respiratory hygiene activity.

1. Follow the set up instructions as outlined in section 2.3 but also add green food colouring to all test tubes to represent snot

Main Activity

1. Explain to the students that they will be simulating a sneeze by exchanging fluid (representing the aerosol created when someone sneezes) between the two test tubes. Pass the test tubes around the class making sure that each student gets a test tube full of fluid. DO NOT let the students know that one of the test-tubes contains starch, although the teacher should know who has the test tube.
2. Tell each student that they must exchange fluid with 5 other students (for a class smaller than 25 reduce the number of exchanges to 3 or 4) as this is could be the amount of people standing around them when they sneeze. Emphasise to students that they must remember who they exchanged fluids with and in what order. Prompt students to mix outside their normal group of friends and encourage mixing between boys and girls.
3. Tell the class that one of them carried fluid which contained a flu virus. The teacher should go around the class testing for the infection by adding a drop of iodine to each test tube. If the fluid turns black that person was infected. Can the class figure out who the original infected person was? Were the students surprised at how quickly the flu virus could spread around the class through sneezing?

RESP TS 5

Respiratory Hygiene

Hypothesis

1. Which disc do you think will be most affected by the sneeze?

_____

2. Which people do you think will be least affected by the sneeze?

_____

3. What do you think will happen when you place a gloved hand over the sneeze?

_____

4. What do you think will happen when you place a tissue over the sneeze?

_____

Results

1. What was the furthest distance the sneeze travelled (Length)?

	Distance travelled	Number of People contaminated
Sneeze alone		
Gloved hand		
Tissue		

2. Did either of the sneezes contaminate any of the people on the side lines (Width)?

	Distance travelled	Number of People contaminated
Sneeze alone		
Gloved hand		
Tissue		

3. How many 'microbes' landed on the person behind the sneezer?

_____

Conclusion

1. Based on this experiment what have you learned about microbial transmission?

_____

_____

2. If we don't wash our hands after sneezing into them, what might happen?

_____

_____

3. Which method is best for preventing the spread of infection, sneezing into your hand or sneezing into a tissue? Why?

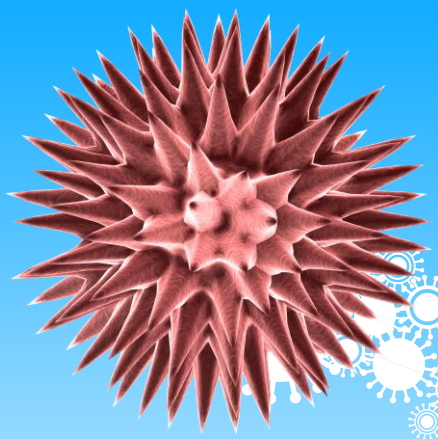
_____

_____

RESP SW 1

2.3 Sexually Transmitted Infections

This section aims to teach students how sexual activity can lead to the spread of microbes and disease.
Section 2.3, Sexually Transmitted Infections, teaches students how easily potentially harmful microbes can transfer to the person you care about without either of you knowing. Students carry out a chemical experiment to see how many people can be infected unknowingly by unprotected sexual intercourse and how we can prevent this from happening.
A comic strip forms the basis of the extension activity. Each scene of the comic strip sees our two main characters, Amy and Harry, making some good and bad decisions. The students then discuss how wise these decisions are and how relevant they are to them.



Herpes virus

LEARNING OUTCOMES

All students will:

- understand that infection can be spread easily through sexual contact.
- understand what they can do to protect themselves against STIs.

NATIONAL CURRICULUM LINKS

Key Stage 3
Science
Working Scientifically
Experimental skills and investigations
Analysis and Evaluation
PSHE
Core Theme 1: Health and Wellbeing

Estimated Teaching Time
50 minutes

2.3 Spread of Infection
Sexually Transmitted Infections (STIs)

Key Words

AIDS
Anal sex
Chlamydia
Genital warts
Gonorrhoea
Hepatitis B
Herpes
HIV
Oral sex
Sex
STI
Syphilis
Transmission

Materials Required

Per student
- ☐ 3 clean test tubes
- ☐ Copy of SW 1
- ☐ Copy of SH 1
- ☐ Copy of SH 2

Per class
- ☐ Test tube rack
- ☐ Iodine
- ☐ Starch
- ☐ Water
- ☐ Gloves
- ☐ Cling film or cotton balls

Health and Safety

Ensure that the starch or iodine does not get in the eyes and that students wash their hands after handling these liquids.

Available Web Resources

- A demonstration film of this activity.
- A MS PowerPoint presentation to aid the teaching of this topic.
- SH 1 and SH 2 as MS PowerPoint.

STI TS 1

Background Information

STIs are infections contracted by having close sexual contact with someone who is already infected. Some STIs can be treated and cured with antibiotic medicine whereas others cannot. Many symptoms of incurable STIs can be treated to make them easier to live with. There are over 25 different STIs.

Bacterial STIs are caused when bacteria are spread through vaginal, oral or anal sexual contact with an infected person. These infections include chlamydia, gonorrhoea and syphilis and are generally cured through antibiotic therapy.

Viral infections can be spread via the same routes as bacterial infections but can also be spread through direct contact with infected skin or bodily fluids such as blood, semen or saliva from an infected person entering into the bloodstream of an uninfected person. Viral infections include genital warts, hepatitis B, herpes and HIV which although they can be treated, are NOT curable.

Although most STIs are generally transmitted through sexual encounters, some STIs can be spread to others by sharing needles and syringes, through skin to skin contact (in the same way that bacteria can spread from one person's hand to another) or are transferred from mother to unborn baby during pregnancy and childbirth. HIV can also be spread through breast milk.

Details on the most common STIs are available in the PowerPoint presentation on the e-Bug web page. It is important to note that people can have an STI but have NO obvious symptoms; they themselves may not know they are infected.

Anyone can contract an STI. It has nothing to do with how 'clean' someone is or how the person dresses and acts. Most people who contract an STI do not know that the person they have sexual intercourse with is infected.

Advance Preparation

1a. Half-fill a test-tube with water – one per student

1b. Replace one of the test-tubes with starch

2a. Half-fill a second set of test-tubes with water

2b. Replace one of the test-tubes with starch

3a. Fill 4 test-tubes with water

3b. Place cotton plugs or cling film over the top of 2 of the test tubes

4. Photocopy SW 1 for each student

NOTE This activity can be used to demonstrate the spread of other types of infection. Visit Section 2.2 to see how it can be used to demonstrate the spread of a flu virus!

2.3 Transfer of Infection
Sexually Transmitted Infections (STIs)

Lesson Plan

Introduction

1. Begin the lesson by explaining to students that there are many ways in which microbes can be transmitted, e.g. touch, sneezing or through contaminated food or drinking water. Highlight that another important route of transmission is through the exchange of bodily fluid, i.e. unprotected sexual intercourse.
2. To prevent students being shy about the topic, ask if they have ever heard of any STIs and if they know what causes them. Use the PowerPoint activity found at **www.e-bug.eu** to help explain this.
3. Explain that STIs are generally transmitted through unprotected sexual contact i.e. not using a condom, although in some instances transmission can be through used 'dirty needles', skin contact, or from mother to unborn child and through breast milk. This is because some STIs are carried in the blood and transmission of this bodily fluid can also transmit the infection.
4. EMPHASISE that non-barrier forms of birth control, e.g. the contraceptive pill, DO NOT protect against STIs.

Main Activity

1. This activity is best carried out as a class exercise.

Section A

2. Explain to the students that they will be simulating sexual contact by exchanging fluid (representing bodily fluid) between the two test tubes. Pass the test tubes around the class making sure that each student gets a test tube full of fluid. DO NOT let the students know that one of the test-tubes contains starch, although the teacher should know who has the test tube. **NOTE** It may be important to select a student to take the test tube who will not be 'picked on' by the other students when they realise they have been the 'carrier'.
3. Tell each student that they must exchange fluid with 5 other students (for a class smaller than 25 reduce the number of exchanges to 3 or 4). Emphasise to students that they must remember who they exchanged fluids with and in what order; they will then need to write this down later on **SW 1**. Prompt students to mix outside their normal group of friends and encourage mixing between boys and girls.
4. When finished, provide students with a copy of **SW 1**. Tell the class that one of them carried fluid which contained a simulated STI. The teacher should go around the class testing for the STI by adding a drop of iodine to each test tube. If the fluid turns black that person was infected. Can the class figure out who the original infected person was?

Section B

5. Repeat the activity by reducing the number of times students exchange fluid (have sexual encounters) to 1 or 2. Does the class notice the decrease in the number of infected people?

Section C

6. Choose 5 people from the class to do a demonstration. Show the class which student has the 'infected' test tube. Provide the other 4 students with the remaining test tubes, 2 of which are covered in cling film.
7. Ask the 'infected' student to have a 'sexual encounter' with each of the five other students in turn. **NB** Do not mix fluids this time, simply let the infected student drop some of their fluid into the other test tubes using a dropper, the recipient must mix the sample well.
8. Test each of the student samples for an STI using the iodine.
9. Indicate that during these sexual encounters the cling film represented a condom and that these students didn't contract the infection.

STI TS 2

2.3 Transfer of Infection
Sexually Transmitted Infections (STIs)

Lesson Plan

Plenary

Check for understanding by asking the students the following questions:

a. **What is an STI?**
Sexually Transmitted Infections (STIs) are infections which are mainly passed from one person to another (that is transmitted) during sexual contact. There are at least 25 different STIs with a range of different symptoms. These diseases may be spread through vaginal, anal or oral sex.

b. **Who can contract STIs?**
Anyone who has had unprotected sex with someone who has an STI can contract an STI. STIs are NOT exclusive to people who you may consider to be 'easy', prostitutes, homosexuals or drug addicts. You only need to have a sexual encounter with an infected person once to contract the infection.

c. **How can we reduce the risk of contracting an STI?**
There are a number of ways to prevent contracting an STI.

i. Abstinence: The only sure way to prevent contracting an STI is not to have oral, anal or vaginal sexual contact.
ii. Use condoms: Condoms are the recommended preventative measure, however, condoms only protect the skin they cover, any sores or warts found on the genital region not covered by the condom can still spread to another person's skin.
iii. Talk to your partner: Talk to your partner about safer sex practices, for example, using a condom. If you have a new partner discuss the option of you both being tested for an STI before committing to a sexual relationship.
iv. Get yourself tested and have regular check ups: When sexually active, even if you do not appear to have any symptoms, it is still very important to have regular tests and check ups to make sure you do not have an infection. Not all STIs show symptoms at first, if at all.

d. **Do other birth control measures, other than the condom, protect against STIs?**
NO. The birth control measures only protect against pregnancy, they will NOT protect against contracting an STI.

e. **What are the symptoms of an STI?**
Symptoms of sexually transmitted infections vary, but the most common are soreness, unusual lumps or sores, itching, pain when urinating, and/or an unusual discharge from the genital region.

f. **Does everyone who contracts an STI show symptoms?**
NO, STIs are a common problem because many people are carriers of the infection without realising it. In some cases, women do not realise they have been carriers until they show infertility problems in later life.

g. **Where can I go for further advice and be tested?**
Ask your school nurse or General Practitioner (GP), or visit a GUM clinic.

Extension Activity

1. Produce posters educating the general public on STIs.

OR

2. Provide students with a copy of **SH 1** and **SH 2** and ask them to comment on the statement being made in each of the cartoons. This can be completed as either an individual or group activity or a classroom discussion.

STI TS 3

Extension Activity Discussion Points

If Harry has had unprotected sex with other people there is a possibility that he may have contracted a sexually transmitted infection. Many STIs do not show any obvious symptoms and as such, Harry may not know whether or not he has contracted a STI. He may love Amy but only through regular screening and having protected sex can he be sure not to give her an infection.

Amy and Harry are making a very bad decision. Using a condom helps not only in reducing the risk of pregnancy but also in reducing the risk of contracting an STI. Many pregnancies and STIs have happened to people who thought, “It’ll be all right just this once.”

In this scene Amy and Harry appear to be very sensible by using the contraceptive pill to help prevent unwanted pregnancies. It must however be remembered that the pill and implants are only a contraceptive medication, they will not help prevent contracting an STI.

Many people, no matter what age, may feel embarrassed about attending their GP, school nurse or GUM clinic. It is important to emphasise to students that there is NOTHING to be embarrassed about. Contracting an STI and not getting treated, or transferring an STI to someone you care about could be a lot more embarrassing and have painful results.

This is a common myth amongst teenagers and many adults. Anyone can contract an STI at any time from someone who is already infected if they don’t use the proper precautions.

It is important to emphasise to students that STIs are an increasing problem. Unfortunately Chlamydia is one of the most common STIs amongst young people today, mainly because those infected show little or no symptoms at the beginning. Chlamydia can still cause infertility in later life.

STI TS 4

Sexually Transmitted Infections

Examine each of the scenarios. What is your opinion of the conversations taking place?

1

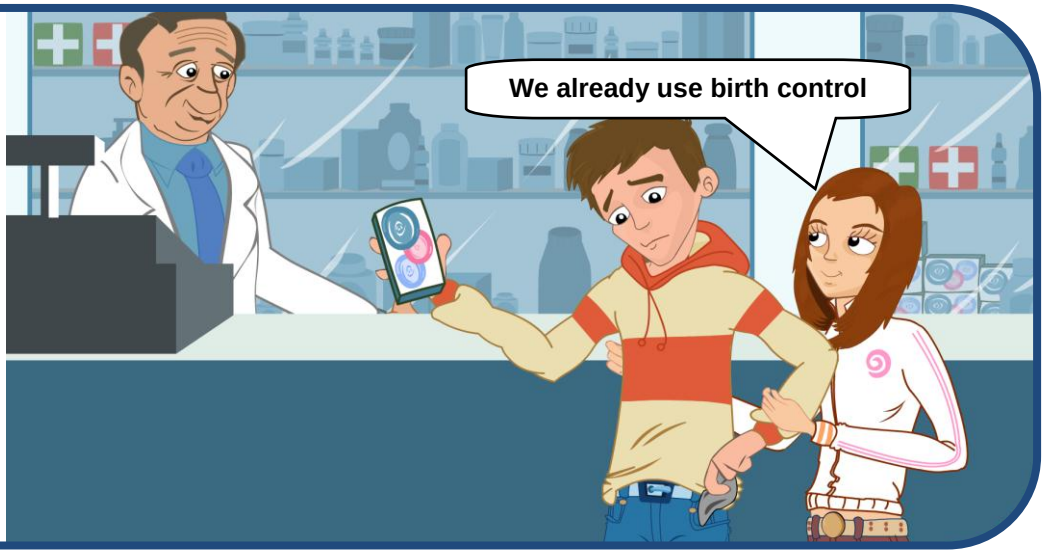
Amy and Harry are discussing their potential sex life. Harry has had other partners and Amy is slightly concerned about the possibility of contracting an STI.

2

Harry and Amy are worried that they don't have a condom.

3

Do Amy and Harry need to buy condoms?



STI SH 1

Sexually Transmitted Infections

Examine each of the scenarios. What is your opinion of the conversations taking place?

4

Harry is extremely embarrassed about visiting the GUM (Genito Urinary Medicine) clinic with Amy.

5

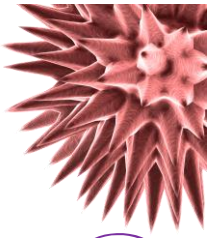
Amy and Julia are discussing what it would be like the first time, and are worried about herpes.

6

Harry and Sandy are talking about their sexual education class and are discussing Chlamydia.

STI SH 2

Sexually Transmitted Infections



Section A

List the people who you had a 'sexual encounter' with and whether or not they had the STI:

Sexual encounter	Name of person	Were they infected?
1		
2		
3		
4		
5		

How many people in the class contracted the infection? _____

Did you contract the infection? _____

Who was the carrier of the infection? _____

Section B

List the people who you had a 'sexual encounter' with and whether or not they had the STI:

Sexual encounter	Name of person	Were they infected?
1		
2		

How many people in the class contracted the infection? _____

Did you contract the infection? _____

Why was there a reduction in the number of people who contracted the infection this time?

_____

Who was the carrier of the infection? _____

Section C – Results

Person	Colour before	Colour after	Reason for colour change
1			
2			
3			
4			

What does the cling film or cotton balls represent?

_____

Can you think of any reasons why some people didn't get infected even though they had a sexual encounter with someone who had an STI?

_____

STI SW1

2.4

Judging the risk of sexually transmitted infections: chlamydia

This section aims to encourage students to develop accurate perceptions of the risk of sexually transmitted infections. Using chlamydia as an example, it helps students to understand an individuals' susceptibility to infection and the potential severity of its consequences. This is done through powerful stories and visual demonstrations. To help students develop skills in negotiating sex and condom use, they are also presented with common problems faced by young people and asked to suggest ways of overcoming these. Rehearsing these skills forms the basis of an extension activity.

Chlamydia bacteria

LEARNING OUTCOMES

All students will:

- understand the rate of chlamydia infection amongst young people.
- understand that most people don't experience any symptoms.
- understand the physiological link between infection and its long-term health consequences.
- understand how easily infection can be spread.
- understand how to protect themselves against infection.
- understand how and where chlamydia can be tested for and treated.

NATIONAL CURRICULUM LINKS

Key Stage 3
Science
Working Scientifically
Experimental skills and investigations
PSHE
Core Theme 1: Health and Wellbeing

Estimated Teaching Time
50 minutes

2.4 Spread of Infection
STIs: Chlamydia

Key Words

Chlamydia
Transmission
Risk

Materials Required

- ☐ Copy of SH 1
- ☐ Copy of SH 2
- ☐ Copy of SH 3 & SH 4

Available Web Resources

- Animations listed under 'advance preparation' illustrating (a) the rate of infection amongst young people, (b) how infection damages the body, (c) how easily infection is spread

Background Information

Chlamydia is a sexually transmitted infection (STI) caused by bacteria called *Chlamydia trachomatis*.

The highest incidence of chlamydia is amongst 16-24 year olds. Of this group approximately one in ten is thought to be infected.

About 70% of females and 50% of males with chlamydia don't experience any symptoms at all which means that many infected people don't realise they carry the infection. For women who do experience symptoms these might include abnormal discharge, pain and/or bleeding during sex and pain when urinating. In men these include a cloudy or watery discharge from the tip of the penis, pain when urinating and testicular pain.

Diagnosis can be made using a sample of urine (males and females) or vaginal swab (females only). Infection is treatable with one dose of antibiotics.

Untreated chlamydia is a well established cause of pelvic inflammatory disease (serious inflammation of the ovaries and fallopian tubes), ectopic pregnancy (when a foetus grows in a fallopian tube) and infertility in women. In men infection can cause prostate and testicular problems, and a growing body of evidence also links chlamydia to infertility in men.

Why a lesson on chlamydia?
Although chlamydia is a serious and growing public health problem, there are a number of characteristics of this infection which may mean that young people may not find it particularly threatening.

In making a decision about whether to use condoms, young people most likely weigh up the consequences. Some of these will be positive such as protecting against STIs but there are likely to be many more negative ones (such as "it interrupts the mood"). Often the negative consequences can outweigh the positive ones, so that motivations to use condoms are not particularly strong.

To counteract this and bolster intentions to use condoms, it is very important that young people have accurate perceptions of the threat caused by sexually transmitted infections. This lesson has been designed to encourage strong and realistic perceptions of the threat caused by chlamydia.

Advance Preparation

1. Gather information on local facilities offering STI testing
2. Download the following animations from www.e-bug.eu
   a. 'Pants'
   b. 'Chlamydia – the movie'
   c. 'Jeopardy'

STI TS 1

2.4 Spread of Infection
STIs: Chlamydia
Lesson Plan

Introduction

1. Recap on your sex education ground rules or use those provided (see **SH 1**)
2. Begin by explaining that you are going to discuss a specific type of sexually transmitted infection known as chlamydia. Ask the class what they already know about this STI. At this point you might want to highlight the **lesson objectives** using the PowerPoint provided. Explain that

    a) chlamydia is a type of sexually transmitted infection caused by bacteria
    b) it is most common amongst young people (16 – 24 year olds).
    c) many people don't realise they have the infection because, for many people, there are no symptoms
    d) but some people do have symptoms and these include... (see **TS 1**)

3. Show the class the **Pants** animation. ***Click play***

    a) Explain this is a group of young people (50 girls, 50 boys) aged between 16 - 24. Ask the class to guess, from the 100 people, how many are likely to be infected with chlamydia? ***Click next***
    b) Ten teenagers are highlighted and have flashing pants. Explain that 1 in 10 young people have a *Chlamydia* infection. ***Click next***
    c) Ask how many are likely to know they have a *Chlamydia* infection. ***Click next X2***
    d) One female and two males will change to look unhappy (i.e. just 3 of our group) indicating most young people with a *Chlamydia* infection do not know they have it. Explain this is why some people refer to it as the **'silent disease'**.

4. Discuss with the class that many people don't know they have chlamydia and that those who do know, generally don't tell anyone they have it. Explain that it is very likely that they know people with or who have had chlamydia.

Main Activity

1. Explain that if a chlamydia infection is not treated it can lead to serious problems for both men and women. Tell students that they are going to hear about what happens inside the body once a person becomes infected with *Chlamydia* bacteria – from the bacteria's point of view!

2. Provide students with a copy of **SH 2 – If *Chlamydia* could talk**. Explain that a girl Chloe has been infected with *Chlamydia* bacteria and the bacterium is telling Chloe their story. Select 5 students to read a paragraph each.

3. At the end ask the students what, if anything, they have learned from the *Chlamydia* bacteria.

4. It may now be helpful for students to actually **see** how *Chlamydia* bacteria spread through the female body. Either show the class group the animation **'Chlamydia – the movie'** or allow students to watch it individually.

5. Discuss with the class how the chlamydia infection can lead to permanent, irreversible damage if left undetected and untreated. Remind students that most people won't know they have the infection, so they won't get tested (therefore getting tested after unprotected sex is vital).

6. Emphasise that anyone who has ever had unprotected sex should get tested for chlamydia and other STIs. Provide local information on the nearest testing facility and how to access it. Explain that under-16s have the right to confidentiality i.e. health professionals are not allowed to tell anyone, including their parents/guardians of their visit. Explain that treatment is a single dose of antibiotics. Also provide information on where they can access free condoms locally.

2.4 Spread of Infection
STIs: chlamydia

Lesson Plan

Main Activity cont'd

7. So now students know how *Chlamydia* bacteria cause the disease, ask them how easily they think chlamydia can be spread from one person to another.

8. Divide the class into smaller groups of 5 – 7 people and provide each group with **SH 3** and **SH 4**. HINT: you may want to cut SH1-2 into laminated cards and give these to each group.

9. Ask each group to watch the animation **'Jeopardy'**. The animation shows a network of eight characters. Each person has a story to tell and they are linked through sexual contact. A pink line shows chlamydia has spread and a green line shows that it has not. By moving the cursor over the characters we learn about character contact with chlamydia and how this has passed through the group. Move around the network until you have covered all stories (students can decide in what order they want to hear stories).

10. If time permits, each group should discuss and answer the questions provided – alternatively assign each group to a particular character. After a few minutes, ask each group to feedback to the class on their discussion. In turn, click on the 'comments' button to see our advice. Discuss as a whole class.

11. To end, 1) show the image of the 100 young people from the 'pants' exercise. Discuss how easily chlamydia can be spread through unprotected sex, 2) emphasise that it's not just their own partner they need to be able to know and trust but also everyone else in the network (which of course they can't) – their partner may have been unwittingly exposed 3) reinforce the message that anyone can get chlamydia - the only way to be sure they aren't exposed to it is to avoid sex or use a condom, 4) And 'it's OK to wait' – despite impressions that other young people may give, most people their age have not had sex yet (about 75% of 13-16 year olds have not).

Plenary

Reinforce the following messages:

- Chlamydia can cause irreversible damage if left untreated.
- There is a very real possibility that it could mean that they are unable to have a child of their own in the future.
- Young women are at higher risk than older women (over 30) because their internal tissue is softer making it easier for the bacteria to attack it.
- Chlamydia can be inside you without any symptoms at all.
- As most people don't know that they have chlamydia (even when it spreads) there is nothing to prompt them to get checked out, which can allow the infection to cause damage.

Extension Activity

a. Building on the 'jeopardy' exercise, ask students to rehearse some of the skills needed to overcome the problems experienced by the characters e.g. overcoming embarrassment of buying condoms or resisting pressure to have unprotected sex. Depending on your class and how confident they are, develop an activity that allows them to practice having these conversations e.g. using role-play or drama.

b. Run the 'Spread of Infection' activity from the senior e-Bug pack to reinforce how easily an STI can be spread amongst a group.

Sexually Transmitted Infections

Ground Rules

- No one (teacher or pupil) will have to answer a personal question
- No one will be forced to take part in a discussion
- Only the correct names for body parts will be used
- Meanings of words will be explained in a sensible and factual way
- *Others (as agreed by class)*

Sexually Transmitted Infections

If chlamydia could talk

I'm sorry Sarah, but I'm not to blame. I didn't pick you up. **You picked me up** when you had sex with that guy two weeks ago at that party. Don't you remember, no of course not, why would you? You'd fancied him for ages and **didn't use a condom**. I'm very grateful indeed. Little did you know then that you had been infected with me, chlamydia! **I'm silent** but don't confuse that for **weak** because I'm nothing of the sort.

Hi! Yes that's right, here I am. **Passed on to** you through **bacteria** in Mark's **semen** and as long as I keep quiet, it's easier for me to make myself **at home in your body**. Mark's semen stayed in your body after sex allowing me to **start spreading myself around**. Because you're young it's particularly easy for me to infect your body. Like I said, I'm very good at keeping quiet. So good in fact that I'll be with you 24 hours a day and you'll have no idea.

Although some do sadly become aware I'm there, most don't, allowing me to **linger for months**, even years **undetected** and let's be honest, I **prefer it that way**; I can cause the most **damage** then you see. In the beginning **I live** and start to cause **problems** in the cervix and urethra. Once I've entered your body I **multiply massively**. I'm always so proud of my **little ones**, all going off **spreading further** than I could go just on my own. Together we're **strong**, like an **army**, making our way to your **fallopian tubes**, they're our favourite. Yes that right, an important part of your reproductive system where **babies** are formed. Oh yes, I know you're **not worried** about babies right now, you're more interested in **being young and having fun**, well that's just **perfect for me** because that way I'll have **plenty of time** to get on with my work. I'm really good at **blocking** the tubes at both ends by causing a build up of scar tissue. **The result?** You could experience **painful** inflammation of your fallopian tubes and ovaries, and **struggle** to have children in the **future**.

So now you know the **reality** of living with me **undetected** and untreated. **Another bonus** of you not knowing about me is that the **next time** you have **unprotected sex** you'll **pass me on**. More of me! Isn't that just **great news?!** Bad news for that **poor fella** though... I can stay a **secret** in men too you know, but sometimes I like to show them I am there every **now and again**. He might find a **nasty discharge** coming from the tip of the penis. **Hi, yes that's me!** I can cause pain too while he's peeing... **OUCH**... Oh and **just for fun,** I can even cause his **testicles to swell up**! To walk around like that feeling so bad... and he'll have **you to thank** for that. On the other hand **I may just decide** to **keep quite** inside him too and then in the **future** he might find he **can't have children either**.

Anyway, must go. I've got important work to be getting on with.....

Hi I'm Chloe

I have a boyfriend called Chris, he's 17 and we've been going out for 5 months.

Lately though things have been weird between us.

It's embarrassing to say but we were kinda fighting about sex. I was a virgin see and he wasn't. He wanted to have sex. At first we were ok with touching each other and kissing but then last month he really had a go at me over the phone about having sex.

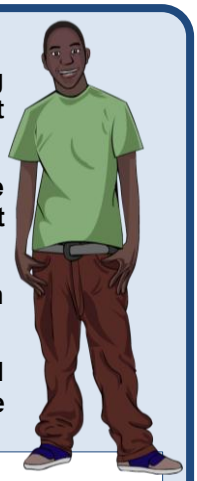
To me it is a big deal but I got well nervous to say anything in case he got angry and dumped me or something. He said that if I loved him I would do it to make him happy but what about me? I'm not that happy.

He said I was acting like a stupid child so I just did it in the end. He still dumped me a few weeks later.

Chloe was pressured into having sex by Chris and although she doesn't know it, she has been infected with chlamydia.

How did Chris make her feel? How else could she have handled the situation? How else could Chris have handled the situation? What should Chloe do now?

I'm Ash, you alright?



Fashion photography is my passion. So many hot women in fashion! I'm starting a course in college in September. Before meeting my Kate Moss though I met this girl Chloe.

She's shy, it's cute. She told me her last fella was an idiot; I wanna make sure I treat the girl right. So when we started getting it on I say "I gotta get a condom" she says it doesn't matter. I thought HOLD UP LOVE!

I like you but I don't want your babies, I can't take care of you and a kid if I'm off on fashion week! Plus I don't wanna catch a disease and I don't want my penis to fall off!

We talked it over and she said she thought I wouldn't want to use 'em cuz her ex didn't. I thought nah not for me, I gotta use them. So we talked some more then we waited till we had some. Then it was all great man.

Although Chloe has chlamydia, Ash didn't get it because they used a condom.

How had Chloe's previous experience affected her attitude towards condom use? What do you think of Ash's approach to condom use? Can you think of any good ways of bringing up condom use?

I'm Anna

I went to a party at Chris' house last week. I didn't know him really well before but I do now, I had sex with him.

We clicked when we started chatting, talked for ages. 'Cuz of the noise we went upstairs to his room. We just kissed and I honestly liked it. Then, before I knew it, he took his top off, then so did I, then we kissed more and then we had sex.

I've had sex before but I used condoms, I'm shocked at myself for not using one with Chris but it happened so quickly. I kept thinking, I'll say something in a minute.

But there was never a right time. He pulled out before he came though. Does that even count as proper sex? I gave myself a good wash after too to make sure I was clean.

I feel a bit stupid now though, how could I have let that happen?

Anna has been infected by Chris with Chlamydia because they didn't use a condom.

Why do you think Chris 'pulling out' (also known as the withdrawal method) didn't work? Why do you think washing didn't work? At what point should Anna have brought up condom use? What could she have said?

I'm Immi

I went to Spain with my parents and met this girl Anna. She's gorgeous. We were together the whole holiday. On the last night we had sex.

When I told my best mate Rocky he said I should have used a condom but he's always been a stress head. He said I should do a test but... forget that, I'm fit, I'm fine.

I wouldn't even know where to find a test or anything; would they have to look at my penis? No way then, I'm not doing it! It'll be fine.

Immi has picked up chlamydia from Anna.

How might being on holiday change how people normally behave? If you were Immi's mate how would you respond to what he says?

Name's Jamie

It's harder than it looks ok! This buying condoms thing.

I went in the shop, eye of the tiger baby I was ready!! I grabbed some razors and got some mints. I'm meeting Anna again next week and this time we're defs gonna do it!

I want everything to be spot on, I really like her! We talked about using protection and both agreed we should get some condoms.

So I went to the pharmacy THREE times but I just can't do it! It's either that horrible old woman behind the counter STARING AT ME, sweat beads running down my face! Or that guy who knows my mum, what if he told her?!!?

AAHHHGGGHHHH man I'm saying we just do it without condoms!

Although Anna has chlamydia, Jamie didn't get it because they used a condom

Why do you think Jamie might find buying condoms difficult?

What advice would you give him to make it easier?

Where can young people get hold of condoms in your local area?

Hi! I'm Alisha

I've started seeing Immi. He's a little older than me and all my friends are dead jealous. He's so hot... Wears dead nice clothes and picks me up from school in his car.

I think we're going to have sex. We've been going down on each other. I can tell he wants to go further though.

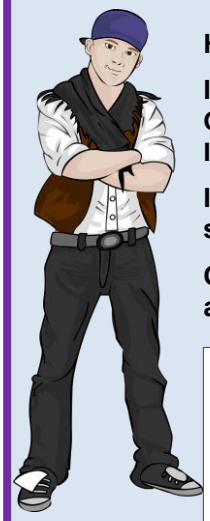
All I'm worried about is if he'll like me 'cuz Immi's not the type to have diseases or anything.

Alisha has picked up oral chlamydia from Immi

What is it about a person that would make you think they **were** the type to have an STI

What is it about a person that would make you think they **were not** the type to have an STI

Why might people use these 'clues' to help them decide if a person has an STI? What is the problem with this approach?



Hey guys I'm Mark

I'm gay and came out about 6 months ago. I've had sex a few times, anal sex that is. Once with this guy I met through friends and once more recently with a guy called Immi.

I've known him for ages, would never have thought he was gay though – although he said he wasn't sure. It's no bother to me, you fancy who you fancy right?

Obviously there's no worries about anyone getting pregnant but there's still concerns about diseases and stuff so I always use a condom. If not, I won't even go there.

Although Immi has chlamydia, Mark didn't get it because they used a condom.

Mark is very clear in his mind that he will always use a condom when having sex.
In what ways do you think having a firm plan can help?
Have a go at writing a plan for condom use i.e. when (every time? When might this be more difficult?), with who (everyone or just some people?), under what circumstances (would you bring condom use up, get one out?)

Hey I'm Chris

I had a party at my house last night… things look blurry today… end of exams… messy night… loads of people… whoa… I had sex with Anna, I HAD SEX WITH ANNA! What the hell, I don't even know how that happened!… It was great!!!... oh but what about… I mean I have a girlfriend… Chloe… damn it…

Oh well she won't give it up so what can I do?

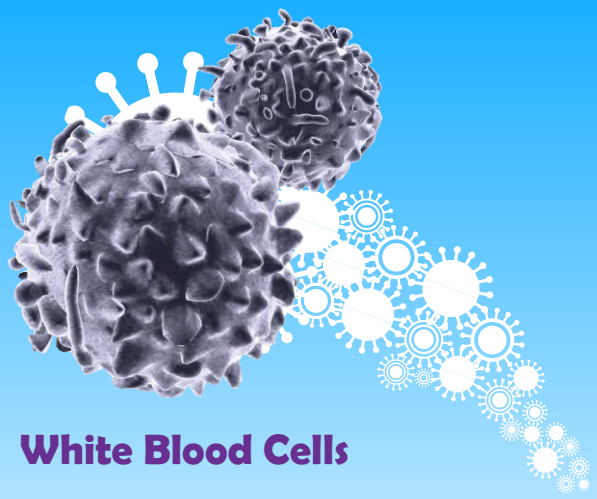
Chris has Chlamydia. Last night Chris had unprotected sex with Anna and passed it on.

How do you think Chris will be feeling today? What will be his range of emotions (positive and negative)?
If you were Chris's friend, what advice would you give him?

3.1 THE BODY'S NATURAL DEFENSES

Section 3.1 covers the topic of disease prevention through the body's own natural defences.

A detailed presentation and animations shows how the body fights harmful microbes on a daily basis. This section provides the basic knowledge requirements for the next sections in this resource about vaccinations and antibiotics.



White Blood Cells

LEARNING OUTCOMES

All students will:

- understand that the human body has many natural defences to fight infection.
- understand that there are 3 main lines of defence.
- understand that sometimes our body needs help to fight infection.

NATIONAL CURRICULUM LINKS

Key Stage 3
Science
Cells and Organisation

Estimated Teaching Time
50 minutes

3.1 Prevention of Infection
The Body's Natural Defences

Key Words

Antibodies
Antigen
Immune
Inflammation
Pathogen
Phagocytes
Phagocytosis
Plasma
White blood cells

Materials Required

☐ Download the presentation from www.e-bug.eu

Per student

☐ Copy of SH 1

Available Web Resources

- A MS PowerPoint presentation of SH 1.
- An animation illustrating how the immune system functions.

Background Information

Our body is extremely efficient at keeping us healthy. It has three major lines of defence:

1. Stopping pathogens entering the body

   Our skin is the first line of defence stopping many harmful microbes entering our body.

   The mucus and cilia (tiny hairs) in our nose trap any microbes and stop them entering our lungs.

   Our stomach contains acid which may kill some harmful microbes and keep us healthy.

   Even the tears in our eyes produce enzymes (although this is a chemical, not a physical barrier) that kill bacteria.

2. Non-specific White Blood Cells (WBC)

   These WBCs are known as **phagocytes** and are non-specific because they will literally try to engulf and kill anything, they are not fussy! They engulf and digest foreign bodies by a process known as **phagocytosis**. They also trigger an **inflammatory response** by causing blood (makes the area red and hot) and **plasma** (makes the area swell up) to flow to the infected area. All this enables the right cells to get to the area and fight the infection.

3. Specific White Blood Cells (WBC)

   These WBCs are specific in that they target microbes only. All invading microbes have a unique molecule on their surface called an **antigen**. When these WBCs come across an antigen they don't recognise they start to produce proteins called **antibodies**. The antibodies then attach to the antigens marking them for destruction by other WBCs. The antibody will ONLY attach to the specific antigen for which it was created. Antibodies are created rapidly by the WBCs and flow around the blood attaching themselves to the invading microbe or **pathogen**. When all the pathogens are destroyed the antibodies stay in the blood ready to fight the disease should it return. In this way, the body maintains a memory of the disease making you **immune** to many diseases you have already had. If the pathogen attacks again the body is ready and quickly produces antibodies to fight the infection.

Advance Preparation

1. Copy SH 1 for each student.
2. Download the animation illustrating how the immune system works from www.e-bug.eu.

IMM TS 1

The Body's Defence System

You don't always need medicine to help fight infection. Did you know your body works hard every day to fight harmful microbes without you even knowing? The body has three lines of defence to stop microbes causing disease.

First Line of Defence - Stops Microbes Entering the Body

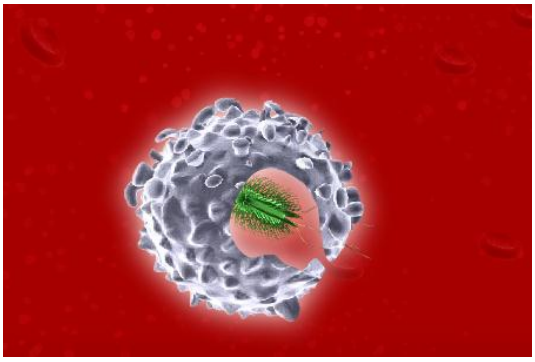
1. The Skin
   The skin stops microbes entering the body unless it is cut or damaged. Even when damaged the blood clots quickly sealing the cut with a scab, stopping microbes getting in.

2. The Respiratory System
   Mucus and tiny hairs in the nose stop microbes from entering the lungs.

3. The Eyes
   Tears produce chemicals called enzymes which kill bacteria on the surface of the eye.

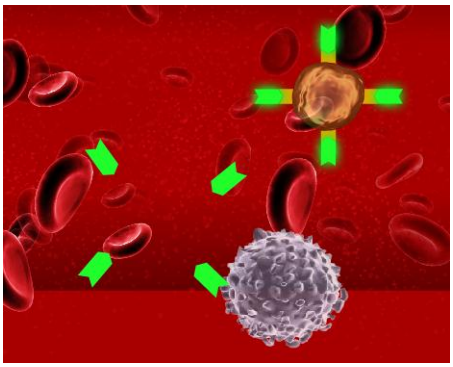
Second Line of Defence – Non-Specific White Blood Cells

1. White blood cells called phagocytes
   a. These usually pick up anything 'foreign' that get through the first line of defence
   b. They engulf microbes and digest them
   c. They are known as non specific because they will attack ANYTHING that is foreign to the body
   d. They also trigger swelling and redness by
      i. Increasing blood flow to the area.
      ii. Causing fluid to leak into the damaged area.



Third Line of Defence - Specific White Blood Cells

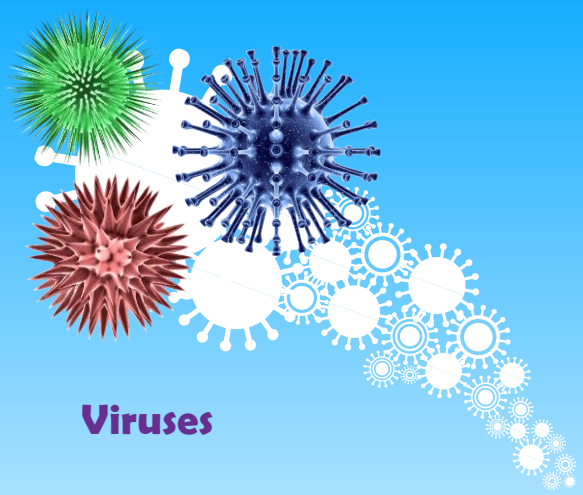
1. Some produce Antibodies
   a. All invading cells have distinctive markers called antigens on their surface
   b. When specific white blood cells come across a foreign marker/antigen they produce antibodies which lock onto the invading cells marking them for destruction. These antibodies will ONLY target these specific markers/antigens and no others.
   c. Once the white blood cells know which antibodies to make, they produce them very quickly. These antibodies then either
      i. Immediately start marking invading microbes for destruction
      ii. Stay in the blood after the infection has gone so that they are ready to fight if the infection returns. This is why your body is immune to most diseases you have already had – it remembers how to make the antibodies quickly.



IMM SH 1

3.2 Vaccines

Section 3.2 covers the topic of disease prevention through vaccinations.
In this activity students take part in a simulation to see how vaccines are used to prevent the spread of infections and discover the significance of herd immunity.
The extension activity asks students to assess which vaccines are necessary to have had when visiting certain countries of the world and why.



Viruses

LEARNING OUTCOMES

All students will:

- understand that vaccines help prevent a range of bacterial and viral infections.
- understand that there are not vaccines for all infections.

More able students will:

- understand that previously common infections are now rare due to vaccines.
- understand that the most common infections such as the common cold or sore throat are not prevented by vaccines.

NATIONAL CURRICULUM LINKS

Key Stage 3
Science
Working Scientifically
Experimental skills and investigations
Analysis and evaluation
PSHE
Core Theme 1: Health and Wellbeing

Estimated Teaching Time
50 minutes

3.2 Prevention of Infection
Vaccinations

Key Words

Antibodies
Antigen
Epidemic
Herd immunity
Immune
Immunisation
Vaccine
White blood cells

Materials Required

Per student

- ☐ One of each coloured cards taken from SH 1 through SH 5
- ☐ Copy of SW 1
- ☐ Copy of SW 2

Available Web Resources

www.who.int
www.traveldoctor.co.uk

FASCINATING FACT

In the 1918 flu pandemic, commonly known as the Spanish Flu, 20 million people died prior to the discovery of the flu vaccine.

Background Information

Our immune system generally fights any pathogenic microbes that may enter our bodies. Getting plenty of rest, eating the correct foods and getting lots of sleep all help our immune system to work properly so preventing infection.

Another means of assisting our immune system is through **vaccinations**. Vaccines are used to prevent, NOT treat infection. A **vaccine** is usually made from weak or inactive versions of the same microbes that make us ill. In some cases, the vaccines are made from cells which are similar to, but not exact copies of, the microbe cells that make us ill. Some diseases are caused by a toxin the microbe produces so some vaccines contain a substance that is similar to the toxin known as a toxoid. Examples are: Cholera and Diphtheria.

When the vaccine is introduced into the body the immune system attacks it as if harmful microbes were attacking the body. The **white blood cells (WBC)** create lots of **antibodies** to attach to the **antigens** on the surface of the vaccine. Because the vaccine is an extremely weakened version of the microbe the WBCs successfully eliminate all the microbial cells in the vaccine and the vaccine will not make you ill. By successfully eliminating all the vaccine antigens, the immune system remembers how to combat those microbes. The next time microbes carrying the same antigen enter the body, the immune system is ready to fight it before it has a chance to make you ill.

In some cases, the immune system needs reminding and this is why some vaccinations require booster jabs. Some microbes such as the influenza virus are tricky and change their antigens. This means that the immune system is no longer equipped to fight them. For this reason, we have annual flu vaccinations.

The use of vaccines has meant that some previously common diseases, e.g. smallpox, have now been eradicated. The re-emergence of other diseases in a population, e.g. measles, may be due to not vaccinating a large enough proportion of the population. Epidemics can be prevented by vaccinating a large enough part of the population leading to herd immunity.

Advance Preparation

1. Laminate or stick a copy of SH 1, SH 2, SH 3 and SH 4 to some thick card and cut out a coloured square for each student. These can be collected at the end of the class for future use.
2. Copy SW 1 and SW 2 for each student.

VAC TS 1

3.2 Prevention of Infection
Vaccinations

Lesson Plan

Introduction

1. Begin the lesson by asking students which vaccines/immunisations they have had, e.g. polio, MMR, TB or any holiday vaccinations and if they know what the vaccines were for.
2. Explain that immune means that you are protected from the serious effects of infection and that 'immunisation' is a way of increasing the body's protective immunity to both bacterial and viral diseases.
3. Explain that vaccines are a small and harmless amount of the microbe/disease which teaches our body how to fight the bad microbe when or if we get attacked by the disease.
4. Explain how vaccines work with the help of section 3.1. Explain that antibodies pass from mother to child through the placenta in the womb and breast milk after birth helping to protect newborn babies from disease.
5. Remind students that each type of microbe has an outer coating which is unique to the microbe, but because some microbes change their outer coats so quickly it is difficult for scientists to make vaccines for these infections, or, like the flu vaccine, a new one has to be made each year.

Main Activity

1. This activity is best completed with the entire class. Explain to the class that they are going to simulate how vaccinations stop people getting ill.
2. Provide everyone in the class with a red (infected), white (immune), blue (recovering but still infectious) and yellow (vaccinated) card (SH 1 – SH 5).

Scenario 1 (Demonstration of the spread of infection and immunity)

1. Select a person in the middle of the class and ask them to hold up their red card. Explain that they are now infected by a disease. Ask them to touch one person in their vicinity. This person is now infected and they must hold up a red card. This marks the end of day one. *We say the end of day 1 because it takes that long for the infection to incubate and for the first symptoms of the infection to manifest themselves.*
2. After a few seconds tell the class it is now day 2. Student 1 should now be holding a blue card i.e. s/he is recovering but still infectious. Student 2 should now be holding a red card. Ask each of these students to touch someone different in their vicinity. These two people are now infected and they must hold up a red card. This marks the end of day two.
3. After a few seconds tell the class it is now day 3.
    a. Student 1 should now be holding a white card i.e. s/he is now immune
    This person is a normal healthy individual with a healthy immune system therefore they were able to fight off the disease and develop immunity.
    b. Student 2 should now be holding a blue card, i.e. s/he is recovering but still infectious
    c. Student 3 and 4 should be holding red cards i.e. they are now infected
4. Continue steps 1 – 3 for up to 7 days and ask students to complete the Scenario 1 section of their worksheets.

Lesson Plan

Main Activity

Scenario 2 (Demonstration of the spread of infection and immunity through vaccination)

1. Ensure that each student has a set of cards (as for scenario 1). Explain to the class that in this scenario they are going to observe what happens during vaccination programmes. The process will be the same only this time some of the class will be vaccinated (immune).
2. Explain that you are going to give each of them a piece of paper that will either say 'vaccinated' or 'susceptible'. They must not show their paper to anyone else and must not hold up their vaccinated card unless touched by an infected person.
   a. <u>25% vaccinated : 75% susceptible</u>
   Give **25%** of the students the paper with the word vaccinated and the rest of the class the paper with the word susceptible. Repeat steps 1–4 in Scenario 1, however, when a vaccinated person is exposed to the infection they will hold up their yellow card (vaccinated) and will not transmit the infection onto anyone else.
   b. <u>50% vaccinated : 50% susceptible</u>
   As above, however, give **50%** of the students the paper with the word vaccinated and the rest of the class the paper with the word susceptible.
   c. <u>75% vaccinated : 25% susceptible</u>
   As above, however, give **75%** of the students the paper with the word vaccinated and the rest of the class the paper with the word susceptible.
   Students will observe a downward trend in infection as more people get vaccinated. It may be beneficial at this point to explain the term 'herd immunity'. Herd Immunity is a type of immunity which occurs when the vaccination of a portion of a population (or herd) provides protection to unvaccinated individuals.

3.2 Prevention of Infection
Vaccinations

Lesson Plan

Plenary

Check for student understanding by discussing the points below.

a. Why is vaccination not only a personal health issue but also a public health issue?

Many infectious diseases are extremely contagious, we can vaccinate ourselves against the disease but other people who are not vaccinated can contract the disease and spread it further to unvaccinated people. If more people are vaccinated the disease is prevented from circulating. This is why herd immunity prevents epidemics. In today's society where global travel is relatively cheap and easy, an infected person can carry a disease across the world within 24 hours.

b. What needs to be done to completely eliminate an infectious disease?

A vaccination programme which reaches all target groups on a widespread continual basis is the only means to completely eliminate a disease. However, it is not possible to eliminate all diseases in this manner as some infectious diseases e.g. avian flu, have other reservoirs (places where they can live and multiply) outside humans.

c. Why hasn't the flu vaccine eliminated the influenza virus?

A vaccine works by tricking the body into making specific antibodies to combat a particular infectious disease, these antibodies then attach themselves to the antigens in the outer coat of the virus. The influenza virus has the ability to mutate and modify their outer coat quickly meaning that scientists need to create a new vaccine every year.

Extension Activity

1. Provide the class with a copy of **SW 2.**
2. Each student should study the world map provided and write on it which vaccines are required when visiting which countries. Students should also name the disease the vaccine protects against and the microbe that causes this disease. Information can be found at **www.who.int**, **www.traveldoctor.co.uk** or by visiting their local medical centre.

3.2 Prevention of Infection

Vaccinations

Teacher Answer Sheet

Scenario 1 - Results

Day	Number of Students		
	Infected	Recovering but Infectious	Immune
1	1	0	0
2	1	1	0
3	2	1	1
4	3	2	2
5	5	3	4
6	8	5	7
7	13	8	12

Can you predict how many people would be infected after 2 weeks?

377 infected *233 recovering* *342 immune*

What do you think would happen to the results if the second person infected had a weakened immune system?

A weakened immune system may result in the second person's immune system being slower to develop antibodies to fight the infection and develop immunity. This in turn, would result in person 2 being infectious for more than two days thereby increasing the number of infected people every day.

Draw a graph of the number of infected people over time

Scenario 2 - Results

Day	Number of Students vaccinated					
	25%		50%		75%	
	Infected	Immune	Infected	Immune	Infected	Immune
1		The results in this table will vary depending on the number of people in the class and where the vaccinated people are positioned in relation to the susceptible people. There will however be a decreasing trend of infected people as more people get vaccinated.				
2						
3						
4						
5						
6						
7						

As more people get vaccinated, what happens to the spread of the infection?

Vaccination programmes make it extremely difficult for diseases to spread in a community. As more people get vaccinated they become immune to the disease therefore the disease cannot spread.

Conclusions

1. What is herd immunity?
   Herd immunity (or community immunity) describes a type of immunity that occurs when the vaccination of a portion of the population (or herd) provides protection to unprotected individuals.

2. What happens when vaccination drops to a low level within a community?
   When the vaccination drops to a low level, people start contracting the disease again leading to a re-emergence of the disease.

3. Why is a vaccine regarded as a preventative measure and not a treatment?
   Vaccines are used to boost the body's immunity so that when a microbe does enter the body, the immune system is ready to fight it preventing the microbe causing a serious infection.

VAC TS 5

vaccines

Infected	Infected	Infected	Infected
Infected	Infected	Infected	Infected
Infected	Infected	Infected	Infected
Infected	Infected	Infected	Infected
Infected	Infected	Infected	Infected
Infected	Infected	Infected	Infected

VAC SH 1

vaccines

Recovering but still Infectious	Recovering but still Infectious	Recovering but still Infectious	Recovering but still Infectious
Recovering but still Infectious	Recovering but still Infectious	Recovering but still Infectious	Recovering but still Infectious
Recovering but still Infectious	Recovering but still Infectious	Recovering but still Infectious	Recovering but still Infectious
Recovering but still Infectious	Recovering but still Infectious	Recovering but still Infectious	Recovering but still Infectious
Recovering but still Infectious	Recovering but still Infectious	Recovering but still Infectious	Recovering but still Infectious
Recovering but still Infectious	Recovering but still Infectious	Recovering but still Infectious	Recovering but still Infectious

vaccines

Immune	Immune	Immune	Immune
Immune	Immune	Immune	Immune
Immune	Immune	Immune	Immune
Immune	Immune	Immune	Immune
Immune	Immune	Immune	Immune
Immune	Immune	Immune	Immune

VAC SH 3

vaccines

Vaccinated	Vaccinated	Vaccinated	Vaccinated
Vaccinated	Vaccinated	Vaccinated	Vaccinated
Vaccinated	Vaccinated	Vaccinated	Vaccinated
Vaccinated	Vaccinated	Vaccinated	Vaccinated
Vaccinated	Vaccinated	Vaccinated	Vaccinated
Vaccinated	Vaccinated	Vaccinated	Vaccinated

VAC SH 4

vaccines

Susceptible	Susceptible	Susceptible	Susceptible
Susceptible	Susceptible	Susceptible	Susceptible
Susceptible	Susceptible	Susceptible	Susceptible
Susceptible	Susceptible	Susceptible	Susceptible
Susceptible	Susceptible	Susceptible	Susceptible
Susceptible	Susceptible	Susceptible	Susceptible

VAC SH 5

vaccines

Scenario 1 - Results

Day	Number of Students		
	Infected	Recovering but Infectious	Immune
1	1	0	0
2	1	1	0
3	2	1	1
4	3	2	2
5	5	3	4
6	8	5	7
7	13	8	12

Can you predict how many people would be infected after 2 weeks?

_____

What do you think would happen to the results if the second person infected had a weakened immune system?

_____

_____

Draw a graph of the number of infected people over time

Scenario 2 - Results

Day	Number of Students vaccinated					
	25%		50%		75%	
	Infected	Immun	Infected	Immune	Infected	Immune
1						
2						
3						
4						
5						
6						
7						

As more people get vaccinated, what happens to the spread of the infection?

_____

_____

_____

_____

Draw a graph to illustrate the results.

Conclusions

1. What is herd immunity?

_____

_____

2. What happens when vaccination drops to a low level within a community?

_____

_____

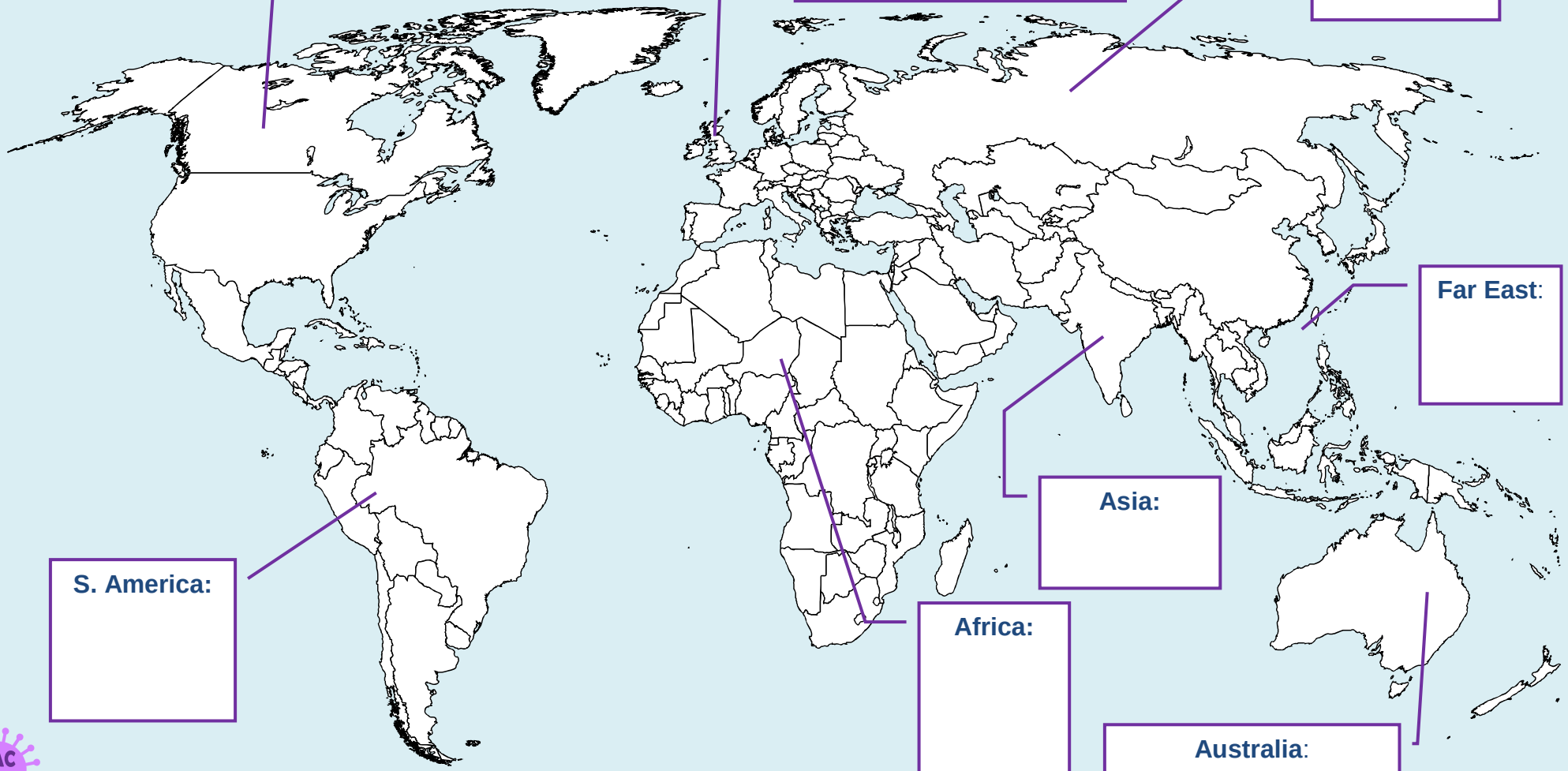
3. Why is a vaccine regarded as a preventative measure and not a treatment?

_____

_____

VAC SW 1

In the boxes provided, compile a list of vaccines required, if any, to visit each of the regions on the map.



Canada:

Western Europe:

Russia:

Far East:

Asia:

S. America:

Africa:

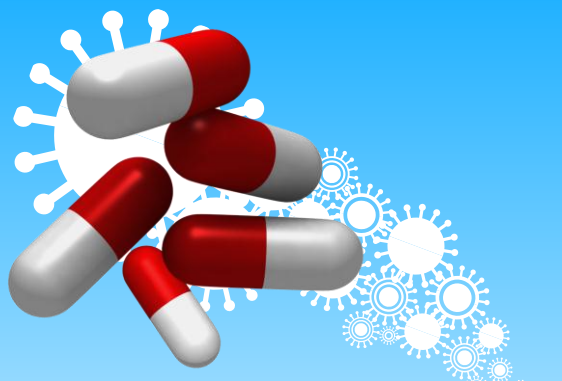
Australia:

e-Bug

4.1

ANTIBIOTICS

Section 4, Treatment of Infection, explores the use of antibiotics and medicine in treating various illnesses and infectious diseases.
In this practical activity acids and bases in agar plates are used to represent bacteria and antibiotics. As groups, students test a range of antibiotics (acid solutions) on bacteria (indicator in agar base) cultured from patient samples and determine which illness the patients have from a list provided.
The extension activity encourages students to research relevant 'hot topics' related to antibiotic use today.



Antibiotic Capsules

LEARNING OUTCOMES

All students will:

- understand that most common infections will get better by themselves through time, bed rest, liquid intake and healthy living.
- understand that if you have antibiotics, finish the course.
- understand that you must not use other peoples or leftover antibiotics.

More able students will:

- understand that overuse of antibiotics can damage our normal/useful bacteria.
- understand that bacteria are becoming resistant to antibiotics due to overuse.

NATIONAL CURRICULUM LINKS

Key Stage 3
Science
Working Scientifically
Scientific Attitudes
Experimental skills and investigations
Analysis and evaluation
PSHE
Core Theme 1: Health and Wellbeing

Estimated Teaching Time
50 minutes

4.1 Treatment of Infection
Antibiotics and Medicine

Key Words

Antibiotic
Broad spectrum
Disease
Illness
Immune system
Infection
Medicine
Narrow spectrum
Natural selection
Symptom

Materials Required

Per student

- ☐ Copy of SW1
- ☐ Copy of SW2
- ☐ Gloves

Lab technician

- ☐ Petri dishes
- ☐ Base Agar
- ☐ Hot plate
- ☐ Phenol Red*
- ☐ Wax Crayon/marker
- ☐ Disposable droppers
- ☐ Hydrochloric acid
- ☐ Cork borer
- ☐ Test tubes
- ☐ Test tube rack

* for other indicators see www.e-bug.eu

Available Web Resources

- A demonstration film of the activity.
- A presentation on antibiotic use and resistance.
- A list of other common acids / alkalis and indicators which may be used as alternatives.
- SH 1, images of the correct results and SH 1 in MS PowerPoint format for whiteboard use.

Background Information

The body has many **natural defences** to help fight against bad microbes that can cause infection – the skin stops microbes entering the body, the nose has a sticky membrane trapping microbes if they are inhaled, tears contain substances which kill bacteria and the stomach produces acid which can kill many microbes if ingested. Generally by living a healthy life (eating the right food, drinking plenty of water and getting lots of rest), these natural barriers work on a daily basis to keep us healthy. However, in some cases, microbes can cross these barriers and enter our bodies.

The majority of the time the immune system defeats any harmful microbes entering the body, however, in some cases the immune system needs help. **Antibiotics** are special medicines used by doctors to kill harmful **bacteria**. Some antibiotics stop the bacteria reproducing and others kill the bacteria. Antibiotics treat infectious diseases caused by bacteria, such as meningitis, tuberculosis and pneumonia. They do **not** harm viruses, so antibiotics cannot treat diseases such as colds and flu, which are caused by viruses. Examples of antibiotics are penicillin, erythromycin and tetracycline.

Before antibiotics were invented, harmful bacteria were life threatening. Today, however, many bacterial infections are easily treated with antibiotics – but the bacteria are fighting back! Through increased exposure to the antibiotics, bacteria are becoming resistant to them. This means that bacterial infections are once again becoming life threatening. We can help prevent this from happening through a number of ways:

- only use antibiotics prescribed for you by your doctor because it is important that the prescription is adapted to the patient and the infection
- always finish the course once prescribed otherwise the bacteria are not completely destroyed and the infection can come back
- don't use antibiotics for simple coughs and colds because antibiotics do not kill viruses. This could cause bacterial resistance

Infections caused by antibiotic resistant bacteria pose a serious health risk. Patients are at a much higher risk as they are immuno-compromised and it is more difficult to control the infection with antibiotics. Resistant bacteria can pass their resistance on to other bacteria.

Health and Safety

- Ensure that students do not touch the liquid and that they wash their hands following the activity.
- Some schools may require that lab coats, gloves and safety goggles be worn.

4.1 Treatment of Infection
Antibiotics and Medicine

Lesson Plan

Advance Preparation

1. Collect a variety of items which are considered medicines, these may include painkillers, aspirin, cough and cold remedies, honey, antibiotics, antiseptic creams, peppermint tea, vitamins, orange juice, ginger, probiotic drinks, etc.
2. Download the e-Bug Antibiotics: Discovery and Resistance presentation at **www.e-bug.eu**.

Introduction

1. Display the range of food and medicine on the counter. Ask students what they think medicine is. Explain that the term medicine has been defined as *a substance or preparation affecting well being, used in maintenance of health and prevention, alleviation or cure of disease*.
2. Ask the students to divide the items into 2 groups, one which they think is medicines and one which isn't. The class will probably divide the items into commercial medication and food stuffs. Explain that many food stuffs can also have medicinal properties (honey can be used as an antibacterial agent – many people believe that honey helps cure a sore throat. Peppermint tea aids in digestion, ginger and garlic also have antibacterial properties, orange juice contains high quantities of vitamin C) and many commercial medicines are based on these food sources.
3. Highlight that eating a healthy diet can help prevent us being ill and avoid having to visit the doctor, e.g. it is thought that regular intake of fruit and vegetables containing vitamin C can help reduce the chances of being ill with the common cold.
4. Emphasise to the class that medicines should only be used for the illness for which they were intended. Ask students what they think antibiotics should be used for. Highlight that antibiotics are ONLY used for bacterial infections and that they do not work on viral or fungal infections.
5. A presentation has been provided at **www.e-bug.eu** on the discovery and resistance of antibiotics.

Main Activity

1. This activity should be carried out in small groups of 3 - 5 students.
2. A workbench should be set up for each group containing:
   a. 4 agar culture plates with indicator, each labelled with a patients name.
   b. 4 test tube racks, each containing 5 antibiotic solutions (**TS 4**), one beside each agar plate.
3. Provide students with a copy of **SW 1** and **SW 2**.
4. Explain that Amy is working in a hospital lab and it is her job to grow microbial cultures from swabs taken from patients at a doctor's surgery. Amy then tests whether the microbes are killed by a range of antibiotics. The results help the doctor decide what microbe is causing the illness and which antibiotics, if any, to prescribe.
5. Highlight that the red colour represents the microbes growing in the agar; it may help here to show them an agar plate with no indicator (yellow), i.e. no growth.
6. Place plates on a sheet of white paper. Students should label each bore hole and drop antibiotics, one drop at a time, into the appropriately labelled hole until the hole is filled with the antibiotic.
7. Replace the lid of the petri dish and leave for 5 minutes.
8. After 5 minutes, students should measure the size of the decolourised zone (inhibition) if present.
9. Students should complete their worksheets in groups and discuss with the teacher.

ATB TS 2

4.1 Treatment of Infection
Antibiotics and Medicine

Lesson Plan

Plenary

1. Discuss the questions on the students worksheet with the class:
   a. Antibiotics don't cure the cold or flu, what should the doctor recommend or prescribe to patient A to get better?
   Antibiotics can only treat bacterial infections and the flu is caused by a virus. Coughs and colds are caused by viruses and in many cases the body's own natural defences will fight these infections. Other medicines from the pharmacist help with the symptoms of coughs and colds. Doctors can prescribe pain killers to help reduce the pain and fever associated with the infection.
   b. Meticillin is normally the drug of choice for treating a Staphylococcal infection, what would happen to Patient C's infection if they had been prescribed Meticillin?
   *Nothing! MRSA (**M**eticillin **R**esistant **S**taphylococcus **a**ureus) has developed a resistance to Meticillin and as such this antibiotic has no effect on MRSA. MRSA infections are becoming increasingly difficult to treat and Vancomycin is one of the last effective antibiotics.*
   c. If you had some Penicillin left over in your cupboard from a previous sore throat, would you take them later to treat a cut on your leg that got infected? Explain your answer.
   No, you should never use other people's antibiotics or antibiotics which have been prescribed for a previous infection. There are many different types of antibiotics which treat different bacterial infections. Doctors prescribe specific antibiotics for specific illnesses and at a dose suitable for that patient. Taking someone else's antibiotics may mean your infection does not get better.
   d. Patient D doesn't want to take the prescribed Meticillin for their wound infection.

   'I took more than half of those pills the doc gave me before and the infection went away for a while but came back worse!'

   Can you explain why this happened?
   It is very important to finish a course of prescribed antibiotics, not just stop half way through. Failure to finish the course may result in not all the bacteria being killed and possibly becoming resistant to that antibiotic in future.

Extension Activity

1. Divide the class into groups. Ask each group to create a poster on one of the following topics
   a. Due to media attention, MRSA is one of the most commonly known antibiotic resistant bacteria. What is being done in hospitals to tackle this problem?
   b. *Clostridium difficile* has been described as the new 'superbug'. What is *C. difficile* and how is it being treated?
   c. How have antibiotics been used in areas outside human health?

4.1 Treatment of Infection
Antibiotics and Medicine

Advance Preparation

The following preparation is for 1 group of 5 students
For a visual of workbench set up visit **www.e-bug.eu**

Materials Required

- ☐ Petri dishes
- ☐ Base Agar
- ☐ Hot plate
- ☐ Phenol Red
- ☐ Hydrochloric acid
- ☐ 20 Test tubes
- ☐ 5 Test tube racks
- ☐ Wax Crayon/marker
- ☐ Disposable droppers
- ☐ Cork borer

Agar Plate Preparation

1. Make up 100ml of base agar following the manufacturer's instructions.
2. When cooled slightly, but not solid, pour 1 agar plate (to demonstrate no growth). When complete add enough (~10 drops) 2 – 4% Phenol Red to turn the agar a deep red/dark orange and mix well.
3. Pour approx 20ml into each petri dish and leave to cool.
4. When solidified, make 5 evenly spaced bore holes in each agar plate.
5. Label each petri dish with one the following 4 names:

    a. Jean Smith b. Tom Harris
    c. Anne Jones d. Raj Nedoma

Antibiotic (test-tube) Preparation

1. Set up a test tube rack of 5 test tubes for each patient. Label each test tube with one of the following labels

    a. Penicillin b. Meticillin c. Oxacillin d. Vancomycin e. Amoxicillin

2. Transfer 5ml of the following solutions into the appropriately labelled test tube

	Penicillin	Meticillin	Erythromycin	Vancomycin	Amoxicillin
Jean Smith	Water	Water	Water	Water	Water
Tom Harris	10% HCl	5% HCl	1% HCl	0.05% HCl	5% HCl
Anne Jones	Water	Water	1% HCl	0.05% HCl	Water
Raj Nedoma	Water	0.05% HCl	0.05% HCl	0.05% HCl	Water

NB: It is extremely important to have the correct concentrations of HCl (antibiotics) for each patient.

3. Set up a work bench for the group as follows:
    a. Place the appropriate patient's agar plate next to each corresponding rack of test tubes at 4 stations across the bench
    b. A dropper for each test tube
    c. A ruler with mm markings
    d. It may be easier for students if they place each patient's agar plate on a piece of white paper and label the paper next to each bore hole with the antibiotic name.

ATB TS 4

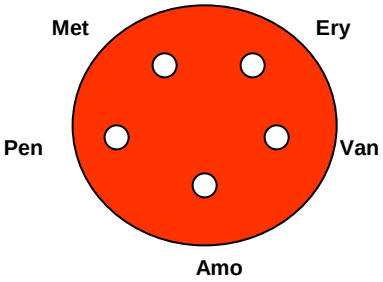
4.1 Treatment of Infection
Antibiotics and Medicine

Teacher Answer Sheet

Plate Results

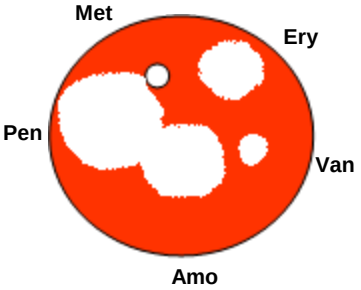
Patient	Organism sensitivity to antibiotics					Diagnosis
	Penicillin	Meticillin	Erythromycin	Vancomycin	Amoxocillin	
Jean Smith	×	×	×	×	×	Influenza
Tom Harris	✓	✓	✓	✓	✓	Strep throat
Anne Jones	×	×	×	✓	×	MRSA
Raj Nedoma	×	✓	✓	✓	×	Staphylococcus infection

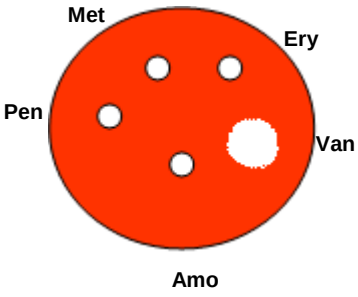
Plate Results Explained



Jean Smith:
Influenza is caused by a virus and as such none of the antibiotics will have an effect as antibiotics can only be used on bacterial infections.

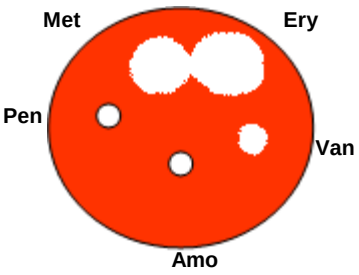
Tom Harris:
Sore throat infections are quite common and generally get better on their own. In severe cases, most antibiotics will treat this infection. Penicillin is the antibiotic of choice for this infection as the group of bacteria responsible (*Streptococcus*) have yet to develop a mechanism of resistance. Antibiotics should not be given unnecessarily for mild sore throats as 80% of sore throats are due to viruses and other bacteria can develop resistance during treatment.





Anne Jones:
Meticillin Resistant *Staphylococcus aureus* (MRSA) infections are becoming increasingly difficult to treat. These *S. aureus* bacteria have developed resistance to Meticillin, the previous antibiotic of choice. Vancomycin is one of the last lines of defence against these potentially fatal bacteria however some organisms have been detected which also show resistance to this antibiotic!

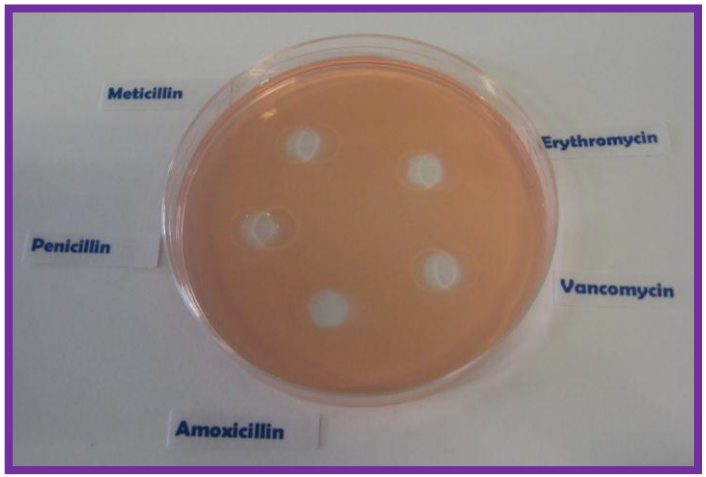
Raj Nedoma:
Penicillin was the first antibiotic discovered and produced, unfortunately many people viewed it as a 'wonder drug' and used it to treat many common infections. This resulted in the majority of *Staphylococcal* bacteria quickly developing resistance to this antibiotic. As Ampicillin is a derivative of penicillin *Staphylococcus* bacteria are resistant to it as well. Meticillin is the drug of choice for this sensitive Staphylococcus infection.



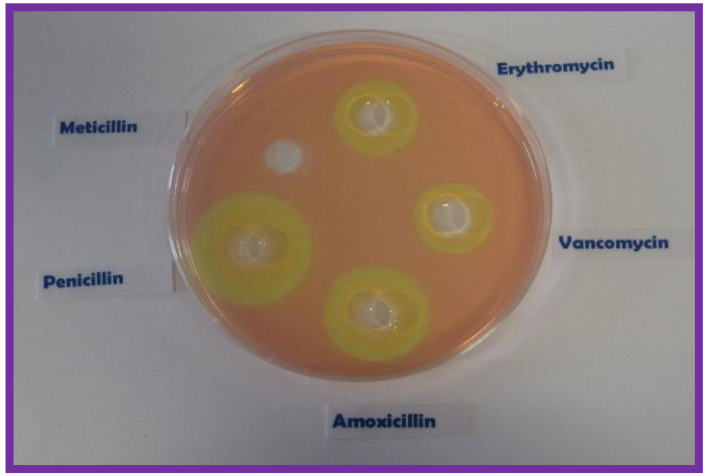
ATB TS 5

ANTIBIOTICS

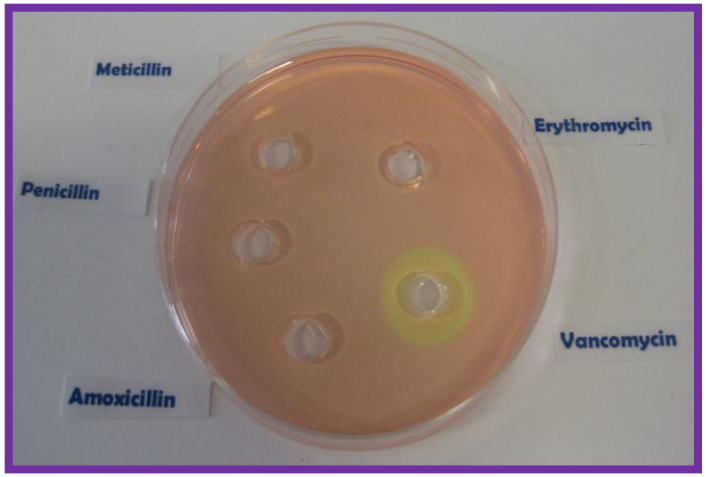
Antibiotic Sensitivity Test Results



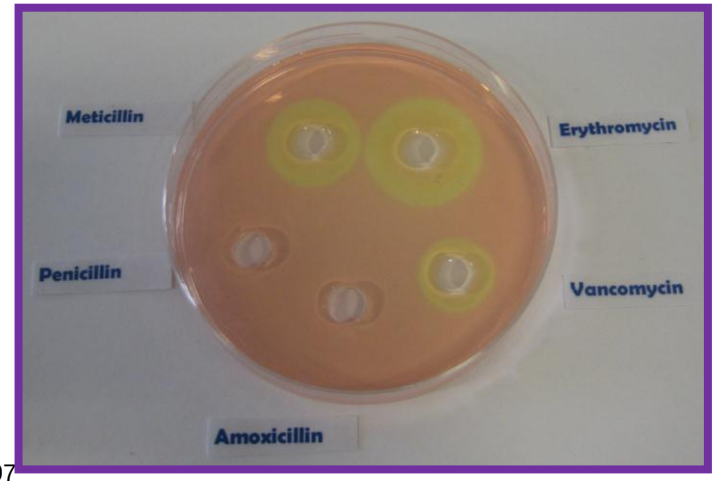
JEAN SMITH



TOM HARRIS



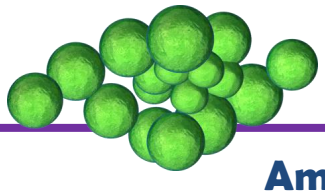
ANNE JONES

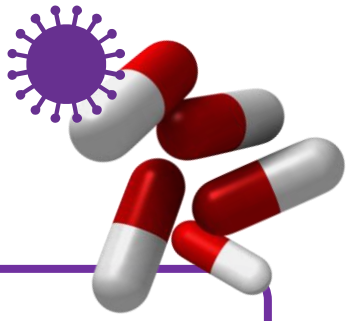


RAJ NEDOMA

ATB SH 1

ANTIBIOTICS





Amy's Problem

Amy is on a summer work placement at the local hospital laboratory. It is her job to read the test results and fill in the paperwork for the doctor. Unfortunately Amy has mixed up some of the test results. Her results sheet shows the following:

Patient Name	Organism sensitivity to antibiotics					Diagnosis
	Penicillin	Meticillin	Erythromycin	Vancomycin	Amoxicillin	
Anne Jones						
Tom Harris						
Jean Smith						
Raj Nedoma						

(✓ sensitive – zone visible, × not sensitive – no zone visible)

She has grown up the infectious organism isolated from each of the patients on agar plates. Can you repeat the antibiotic sensitivity test and identify which diagnosis is for which patient? In the results section below fill in the name of the patient that matches each diagnosis and which antibiotic you would recommend the doctor to prescribe.

Results

Patient A: _____

Flu (Influenza virus)	Zone of Inhibition Size (mm)
Penicillin	
Meticillin	
Erythromycin	
Vancomycin	
Amoxicillin	

Recommended antibiotic:

_____

Patient B: _____

Strep Throat (Streptococcus)	Zone of Inhibition Size (mm)
Penicillin	
Meticillin	
Erythromycin	
Vancomycin	
Amoxicillin	

Recommended antibiotic:

_____

Patient C: _____

MRSA (Methicillin Resistant Staphylococcus aureus)	Zone of Inhibition Size (mm)
Penicillin	
Meticillin	
Erythromycin	
Vancomycin	
Amoxicillin	

Recommended antibiotic:

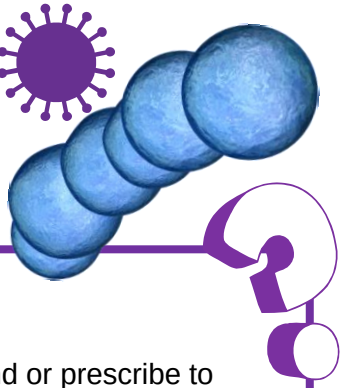
_____

Patient D: _____

Staph Wound Infection (Staphylococcus aureus)	Zone of Inhibition Size (mm)
Penicillin	
Meticillin	
Erythromycin	
Vancomycin	
Amoxicillin	

Recommended antibiotic:

_____



Conclusions

1. Antibiotics don't cure the cold or flu, what should the doctor recommend or prescribe to patient A to get better?

_____
_____
_____
_____

2. Meticillin is normally the drug of choice for treating a Staphylococcal infection, what would happen to Patient C's infection if they had been prescribed Meticillin?

_____
_____
_____
_____

3. If you had some Penicillin left over in your cupboard from a previous sore throat, would you take them later to treat a cut on your leg that got infected? Explain your answer.

_____
_____
_____
_____

4. Patient D doesn't want to take the prescribed Meticillin for their wound infection.

   '*I took more than half of those pills the doc gave me before and it went away for a while but came back worse!*'

   Can you explain why this happened?

_____
_____
_____
_____

Word Glossary

Aerosol	An airborne liquid droplet.
AIDS	Acquired immune deficiency syndrome is a collection of symptoms and infections resulting from the specific damage to the immune system caused by the human immunodeficiency virus (HIV) in humans.
Anal sex	A form of sexual behaviour involving anal intercourse; the insertion of the erect penis into the rectum.
Antibacterial soap	A soap that kills some bacteria. Antibacterial soaps are being increasingly marketed but they have no added value over soap in the school setting.
Antibiotic	A type of medicine which is used to destroy or prevent the growth of bacteria.
Antibody	A protein produced by white blood cells which binds to the microbe it recognises making the microbes easier to destroy by the white blood cells.
Antigen	Part of a microbe that when introduced into the body stimulates the production of an antibody by white blood cells.
Bacteria	Microscopic single celled organism that can be beneficial or harmful to humans.
Bacteriophage	A virus that infects bacteria.
Broad spectrum antibiotic	Antibiotics that kill a large range of bacteria.
Bug	Another word for a microbe.
Cell	The smallest structural unit of an organism that is capable of independent functioning.
Cell membrane	A soft, flexible, thin layer of fats and protein that surround every living cell.
Cell wall	A stiff covering that surrounds plant and bacteria cells
Chlamydia	A sexually transmitted infection (STI) caused by the bacterium, *Chlamydia trachomatis.*
Cilia	Hair-like structures on some cells which beat rapidly to move the cell.
Cocci	Ball-shaped bacteria.
Colony	A group of microbes grown from a single parent cell.
Colonise	Ability to survive and grow on humans without necessarily causing harm.
Contagious	Able to be spread to others through direct or indirect contact.
Contamination	Impurity or uncleanness when an area or thing is covered with microbes.
Culture	The growth of microbes in a specially prepared growth medium.
Cytoplasm	A watery or jelly like environment inside a cell.
Dermatophytes	A group of fungi that like to grow in or on the skin and scalp.
Disease	A pathological condition characterized by an identifiable group of signs or symptoms.
DNA	Deoxyribonucleic acid. A twisted ladder shape molecule that carries genetic material in the nucleus of the cell.
Envelope	A layer of fats and proteins that surround some viruses.

Word Glossary

Epidemic	The rapid spreading of an infectious disease to many individuals in an area.
Experiment	A test carried out to observe whether or not an idea is true.
Fermentation	The anaerobic conversion of sugar to carbon dioxide and alcohol by yeast.
Fever	The body's reaction to an infection which causes a rapid rise in body temperature.
Flagella	Whip-like structures on some bacterial cells that help them swim.
Fungi	The largest of the microbes. Unlike bacteria or viruses, fungi are multi cellular.
Genital Warts	A sexually transmitted condition caused by the human papilloma virus (HPV).
Germs	Another word for harmful or pathogenic microbes.
Gonorrhoea	One of the most common sexually transmitted diseases caused by the bacterium *Neisseria gonorrheae.*
Herd Immunity	A type of immunity that occurs when the vaccination of a portion of the population (or herd) provides protection to unvaccinated individuals.
Hepatitis B	A virus which infects the liver of humans and causes an inflammation called hepatitis.
Herpes	A double-stranded DNA virus called *herpes simplex virus* which can be transmitted sexually or orally.
HIV	A retrovirus that can lead to acquired immunodeficiency syndrome (AIDS).
Hygiene	Conditions and practices that serve to promote and preserve health and reduce spread of infection.
Illness	Poor health resulting from disease.
Immune system	The collection of organs, tissues, cells, and cell products such as antibodies that differentiates self from non-self and helps to remove microbes or substances from the body.
Immunise	Perform vaccinations or produce immunity by inoculation of a substance that is similar to part of the microbe you want to protect against.
Incubate	To maintain at the best temperature and conditions for growth and development.
Infection	A disease caused by a microbe.
Infectious	Capable of causing an infection. A person, animal or thing that can pass microbes on.
Inflammation	A basic way in which the body reacts to infection, irritation or other injury, the key features being redness, warmth, swelling and pain.
Medicine	A substance, used to treat disease or injury.
Microbe	A shortened form of 'micro-organism'.
Micro-organisms	Living organisms that are too small to be seen with the naked eye.
Microscope	An optical instrument that uses a lens or a combination of lenses to produce magnified images of small objects, especially of objects too small to be seen by the unaided eye.
Narrow Spectrum Antibiotic	A type of antibiotic which kills only one or a few different types of bacteria.

Word Glossary

Natural Selection	The process by which favourable traits that are heritable become more common in successive generations of a population of reproducing organisms, and unfavourable traits that are heritable become less common.
Natural flora	Microbes which are naturally found in the body.
Oral Sex	Consists of all sexual activities that involve the use of the mouth, which may include use of the tongue, teeth, and throat, to stimulate genitalia.
Pathogen	A microbe that can cause an illness.
Pasteurise	To heat food for the purpose of killing harmful organisms such as bacteria, viruses, protozoa, molds, and yeasts.
Phagocytes	White blood cells which attack any foreign objects which enter the blood stream.
Phagocytosis	The method by which phagocytes engulf and digest unwanted microbes.
Plasma	The yellow coloured liquid of the blood in which the blood cells are suspended.
Prediction	An educated guess about future events.
Probiotic	Literally means 'for life'. Probiotics are bacteria that aid human digestion.
Rash	A rash is a change in skin which affects its colour, appearance, or texture.
Results	A concrete outcome or effect.
RNA	Ribonucleic acid is a nucleic acid, consisting of many nucleotides that form a polymer, usually single stranded.
Rods	A capsule shaped bacterium.
Sex	Refers to the male and female duality of biology and reproduction.
Spirals	Curly shaped bacteria.
STI	Sexually Transmitted Infection.
Symptom	A sign of illness, e.g. headaches, fever and diarrhoea.
Syphilis	A curable sexually transmitted disease caused by the *Treponema pallidum* spiral shaped bacterium.
Swelling	The enlargement of organs, skin, or other body structures.
Toxin	A harmful substance produced by some harmful microbes.
Transfer	To move from one place to another. Spread of a microbe.
Transmission	Movement from one place to another.
Vaccination	Inoculation with a vaccine in order to protect against a particular disease.
Vaccine	A weakened or killed microbe, such as a bacterium or virus, or of a portion of the microbes structure that when injected into a person leads to antibody production against the microbe. The vaccine cannot cause infection itself.
Virus	The smallest of the microbes, viruses cannot survive on their own and need to live in the cells of other living organisms.
White blood cell (WBC)	Cells found in the blood which help protect the body against infection and disease.

This project has been led by the Primary Care Unit, Public Health England with assistance from the following schools:

Junior Schools

Brimscombe Church of England Primary School, Gloucestershire
Clearwell Church of England Primary School, Gloucestershire
Cirencester Junior School, Gloucestershire
Elmbridge Junior School, Gloucestershire
Latymer Prep School, London
Mere School, Gloucestershire
Nailsworth Junior School, Gloucestershire
Powell's Junior School, Gloucestershire
Stow on the Wold Junior School, Gloucestershire
Swell Church of England Primary School, Gloucestershire
Siddington Church of England Primary School, Gloucestershire
Uplands Community Primary School, Stroud

Senior Schools

Barnwood Park Arts College, Gloucestershire
Bishops College, Gloucestershire
Chipping Sodbury School, Bristol
The Cotswold School, Gloucestershire
Deerpark School, Gloucestershire
Hayesfield School, Bath
Heywood Community School, Gloucestershire
Kingsfield School, Bristol
Lakers School, Gloucestershire
Ralph Allen School, Bath
Ribston Hall High School, Gloucestershire
The Ridings High School, Bristol
Smithycroft Secondary School, Glasgow
Thorntree Primary School, Glasgow
Trinity Catholic School, London

The resource has been produced in collaboration with the following bodies:

City University, London
International Scientific Forum on Home Hygiene
The Society for General Microbiology
The Department of Health

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Educating children in the areas of microbiology, hygiene and appropriate antibiotic use will stop antibiotic being 'worn out' in the future. Children will grow up knowing when antibiotic should and shouldn't be used.

This resource pack has information, suggested lesson plans and possible activities for you to use in your classroom to help you inspire and inform your pupils.

The resources cover topics in the National Curriculum for Science such as 'Working Scientifically', 'The Structure and Function of Living Organisms' and 'Material Cycles and Energy'.

This resource can be shared with PSHE teachers for use with 'Core Theme 1: Health and Wellbeing', part of the PSHE Association Programme of Study which is supported by the Department for Education.

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CITY UNIVERSITY LONDON

IFH International Federation for Hygiene Research on Home Hygiene

Home Hygiene & Health
The Portal Dedicated Exclusively to the Science and Practice of Home Hygiene

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DH Department of Health