e-Bug:
An international educational resource covering the world of microbes and disease.

e-Bug

operated by UK Health Security Agency

Lesson plans, worksheets and activities

2021 evaluated

Key Stage 3 (11-14yrs)

www.e-bug.eu

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. It is a curriculum supplement series (Early Years, Key Stage 1, 2, 3 and 4) that complies with the Department for Education educational standards for junior and senior schools.

This resource has been created by the UK Health Security Agency (formerly Public Health England) in collaboration with 17 EU partner countries to foster an interest in science and to improve young people's knowledge and understanding about microbes, infection prevention and control, and prudent antibiotic use, thereby empowering them to be proactive in looking after their own health. Lesson plans can be used in sequence or as individual activities designed to fit into 50-minute classroom slots. These tools can be used freely by educators and may be copied for classroom use but may not be sold.

Over 27 international countries are involved in the e-Bug project, and the resources have been evaluated with 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, images and additional activities can be downloaded (www.e-bug.eu).

Each section of the pack contains detailed lesson plans, student worksheets and handouts; some of which are available in MS PowerPoint format for whiteboard use:

- **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**

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, and Europe who participated in focus groups and the evaluation process and helped ensure that these materials are not only fun and exciting but also effective.

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

If you would like to keep up to date with our latest resources, or the research and development that we undertake please register for our quarterly newsletter at: www.e-bug.eu/uk-newsletter

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 and contact us at www.e-bug.eu/uk-contact-us

The e-Bug Team

Take our teacher survey!

To celebrate the launch of the new e-Bug packs in England, every teacher that completes our new survey will be entered into a prize draw to win a set of giant microbes (www.giantmicrobes.com) for your school.*
Your feedback will help us improve e-Bug.

Winners will be announced at the end of January 2022

To enter please scan the QR code below:

**One entry per person*

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www.e-bug.eu/ukpacksurvey

An international educational resource covering the world of microbes and disease

e-Bug resources are available in the following languages

Basque Country - Basque, Spanish

Belgium - French

Bulgaria - Bulgarian

Cyprus - Cypriot

Czech Republic* - Czech

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England* - English

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Saudi Arabia - Arabic

Scotland - English, Gaelic

Spain* - Spanish

The Netherlands - Dutch

Turkey - Turkish

Ukraine - Ukrainian

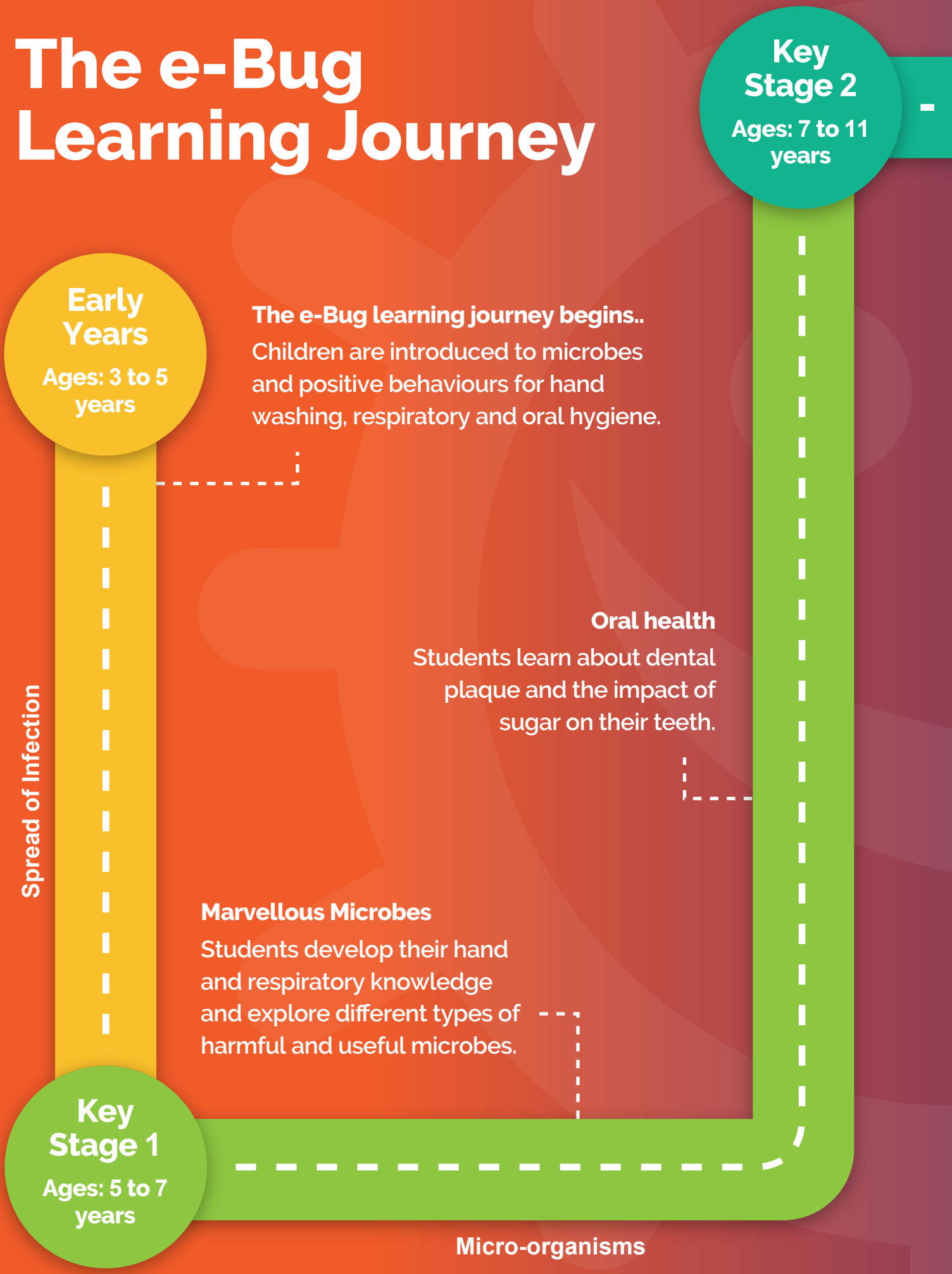
Wales* - English, Welsh

Original partner countries

Visit www.e-bug.eu to view our partner profiles and translated versions of the resources.

e-Bug is operated by UK Health Security Agency

The e-Bug Learning Journey



e-Bug

Discovery

Students are introduced to vaccines, antibiotics and the transmission of microbes from and to food and animals.

Empowered

Students increase their knowledge of antimicrobial resistance, understand how to communicate important scientific messages within the community and strengthen their self-care techniques.

Infection control

Students apply their problem-solving skills to outbreaks and are introduced to herd immunity and infectious diseases.

Sexual Health

Students learn how easily infection can spread through sexual contact and how to protect themselves.

Infection Prevention and Control

Treatment of Infection

Key Stage 3

Ages: 11 to 14 years

Key Stage 4

Ages: 14 to 16 years

Contents

Key Stage 3

Infection Prevention and Control (IPC)

Lesson 6 – SafeConsume Food Hygiene and Safety

A series of lesson plans on food hygiene have been developed as part of the SafeConsume project (www.safeconsume.eu), a European collaboration to reduce health burden from foodborne illnesses.

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Infection Prevention and Control (IPC)

Lesson 7 – Sexually Transmitted Infections (STIs)

A classroom-based activity demonstrates how easily STIs can be transmitted. Using chlamydia as an example, this lesson helps students to understand an individual's susceptibility to sexually transmitted infection and the potential severity of its consequences.

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Infection Prevention and Control (IPC)

Lesson 8 – Vaccinations

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

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Treatment of Infection

Lesson 9 – Antibiotic Use and Antimicrobial Resistance

Students are introduced to the growing global public health threat of antimicrobial resistance (AMR) through an interactive bacteria flash card game.

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Key Stage 3 National Curriculum Links

Micro-organisms

Lesson 1 – Introduction to Microbes

Science:
Working scientifically, Scientific attitudes, Experimental skills and investigations

Biology:
Structure and function of living organisms, Cells and organisation

Genetics and evolution:
Inheritance, Chromosomes, DNA and genes

PHSE/ RSHE:
Health and prevention

English:
Reading, Writing

Micro-organisms

Lesson 2 – Useful Microbes

Science:
Working scientifically, Scientific attitudes, Experimental skills and investigations

Biology:
Structure and function of living organisms, Cells and organisation, Nutrition and digestion

Material cycles and energy:
Cellular respiration

PHSE/ RSHE:
Health and prevention

English:
Reading, Writing

Micro-organisms

Lesson 3 – Harmful Microbes

Science:
Working scientifically, Scientific attitudes, Experimental skills and investigations

Biology:
Structure and function of living organisms, Cells and organisation, Nutrition and digestion

PHSE/ RSHE:
Health and prevention

English:
Reading

Infection Prevention and Control (IPC)

Lesson 4 – Hand Hygiene

Science:
Working scientifically, Biology

PHSE/ RSHE:
Health and prevention

English:
Reading, Writing

Infection Prevention and Control (IPC)

Lesson 5 – Respiratory Hygiene

Science:
Working scientifically,
Biology

PHSE/ RSHE:
Health and prevention

English:
Reading, Writing

Infection Prevention and Control (IPC)

Lesson 6 – Safeconsume Food Hygiene and Safety

Science:
Living things and their habitats

PHSE/ RSHE:
Health and prevention
Healthy eating

Food preparation and nutrition GCSE:
Cooking and food preparation - the scientific principles underlying the preparation and cooking of food

Infection Prevention and Control (IPC)

Lesson 7 – Sexually Transmitted Infections (STIs)

Science:
Working scientifically

PHSE/ RSHE:
Health and prevention,
Intimate and sexual relationships,
Sexual health

English:
Reading, Writing

Infection Prevention and Control (IPC)

Lesson 8 – Vaccinations

Science:
Working scientifically,
Cells and organisation,
Experimental skills and investigations,
Analysis and evaluation

PHSE/ RSHE:
Health and prevention

English:
Reading, Writing

Geography:
Human and physical geography,
Geographical skills and fieldwork

Treatment of Infection

Lesson 9 – Antibiotic Use and Antimicrobial Resistance

Science:
Working scientifically,
Scientific attitudes,
Experimental skills and investigations,
Analysis and evaluation

PHSE/ RSHE:
Health and prevention

Teacher Refresher Information

Optional background information for each of the topics has been included to help you plan your lessons and introduce the topic to students.

Micro-organisms: Introduction to Microbes

Micro-organisms are living organisms too small to be seen with the naked eye; they are microscopic. Micro-organisms are found almost everywhere on Earth and can be both useful and harmful to humans. It is important to clarify that microbes are not innately "useful" or "harmful". Rather, that some microbes can be useful to humans whilst others can be harmful depending on the situation. For example, the mould *Aspergillus* is used to help make chocolate, however can cause harm to humans if inhaled into the lungs.

Although extremely small, microbes come in many different shapes and sizes. The three groups of microbes covered in this resource are viruses, bacteria and fungi.

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

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

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

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

Useful Microbes

Bacteria are single-celled organisms and although some of these cause illness and disease, others are helpful and useful. 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 yoghurt 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 yoghurt. So much acid is produced in fermented milk products that few potentially harmful microbes can survive there.

Lactobacillus bacteria are generally referred to as useful or 'friendly' bacteria. They help us digest food and have been termed probiotic bacteria, literally meaning 'for life'. It is these bacteria that we find in our yoghurts and probiotic drinks. Although, in those that are immunocompromised even friendly bacteria can cause infection.

Harmful Microbes

Some microbes can be harmful to humans and can cause disease: the *Influenza* virus causes the 'flu' (short for 'Influenza' – other respiratory tract infections (RTIs) that cause similar symptoms are the 'common cold' or 'influenza-like illness'), *Campylobacter* bacteria can cause food poisoning and the dermatophyte fungi, such as *Trichophyton*, can cause diseases such as athlete's foot and ringworm. Microbes like these are known as pathogens. Each microbe 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. Bacteria and toxins can damage tissues and organs and make us very unwell, fortunately this is rare.

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

Dermatophytes generally prefer to grow or colonise under the skin. The products they produce while feeding cause swelling and itching.

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

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

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

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

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

Infection Prevention and Control (IPC) Hand Hygiene

Why is hand hygiene so important?

Our hands are naturally covered by useful bacteria – *Staphylococcus* is a common example. However, we can pick up harmful microbes from the things we touch. Hand hygiene is possibly the single most effective way of reducing and preventing the spread of these microbes and any associated infection.

Schools and community groups are a relatively crowded and closed environment where microbes can spread easily and rapidly from child to child via direct contact or via surfaces. Some of these microbes can be harmful and cause illnesses. Washing our hands with soap and water at key moments removes any harmful microbes we pick up on our hands from our surroundings (e.g. home, school, garden, animals, pets, food). Effective hand washing has been shown to reduce absenteeism rates in schools.

Washing our hands also helps prevent the spread of antibiotic resistance which can make infections more difficult to treat.

Why is soap needed for effective hand washing?

Our skin naturally secretes oil (called 'sebum') which helps to keep our skin moist, stops it getting too dry and keeps our skin microbiome (micro-organisms that live on our skin) healthy. This oil, however, is also a perfect place for potentially harmful microbes to grow and multiply as the sebum helps microbes 'stick' to our skin.

Soap is required to break up the oils on the surface of the hands and should be applied well to all surfaces of the hand, producing a lather which helps to lift the dirt and microbes. It is important to rinse our hands to help remove the dirt and microbes. It is important to rinse our hands properly to help remove the dirt and microbes.

Where possible liquid soap should be used instead of bars of soap, especially if used by multiple people.

If soap is unavailable, hand sanitisers, with at least 60% alcohol can also be effective as long as there is no visible dirt/other substance on hands (these need washing with soap and water). Sanitiser should be applied to all parts of the hands and rubbed until dry (about 20 seconds - the length of the happy birthday song twice). Hand sanitisers with ingredients like alcohol work by destroying microbes as they dry, but don't kill all types of harmful microbes and don't remove visible dirt or other substances from our skin.

Therefore, hand sanitisers should not be generally used after using the toilet.

When are the key moments for hand washing?

- Before, during and after preparing food
- Before eating or handling ready to eat food
- After using the toilet or changing a soiled nappy/underwear
- After exposure to animals or animal waste
- After coughing, sneezing or blowing your nose
- If you are ill or have been around ill people
- When you get home or go into another place like work, school, or another household (especially in an outbreak situation)

Respiratory Hygiene

Colds and flu's are the most common illnesses in the classroom and perhaps one of the most contagious. Coronavirus is a respiratory illness that is transmitted in a similar way to colds and flu's. The most common mode of transmission for RTIs is through close contact with respiratory droplets in the air from coughs and sneezes or through contact with contaminated surfaces. Most droplets are heavy and only fall within 1m – to 1.5m of people. However, there are smaller droplets that last in the air for longer (airborne) and travel further. Examples: the common cold (droplet) and measles (airborne). Microbes can also be spread more directly, through person-to-person contact and contact with contaminated surfaces or objects. The virus can be spread by getting into the non-infected person's nose or eyes because they touch their face with contaminated hands.

Sneezing is a way in which our body tries to get rid of any harmful microbes and particles we might inhale from getting deeper into our respiratory tract. 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, millions of viral particles rush out and contaminate the surfaces on which they land; this could be our food or hands. While a sneeze can travel at 100mph through the air and spread cold/flu virus over 20 feet away from the infected person, particles from a cough can travel up to 3m in a matter of seconds and could linger in the air for more than a minute.

Good respiratory hygiene is especially important in the approach to the winter cold/flu season each year, and when there is an outbreak of some kinds of infection. Common symptoms of RTIs include a headache, sore throat and fever, and sometimes a runny or blocked nose. These infections can also cause sneezing and/or coughing, loss of taste or smell, and rarely nausea/vomiting or diarrhoea.

How to prevent the spread of harmful microbes from coughs or sneezes:

- **Catch it**: cover your mouth and nose with a tissue. If you don't have a tissue, cover with your upper sleeve or elbow (not your hands).
- **Bin it**: throw away the used tissue at once to avoid spreading infection to surfaces, or other people.
- **Kill it**: wash your hands well with soap and water, or hand sanitiser if soap and water are not available, immediately after having binned the tissue.

Another way of preventing the spread of respiratory illness is learning how to successfully practice good respiratory hygiene when we cough or sneeze. It is a natural reflex to put our hands towards our faces when we sneeze, but it is important to replace this action with new habits of respiratory hygiene to reduce the spread of infection. We can prevent some of these infections (like the flu and coronavirus) by getting vaccinations.

Where there is an outbreak of infection it is important that you wash your hands more often and for 20 seconds and follow key guidance on respiratory hygiene. You may also be asked to wear a facemask and keep a certain distance from people.

Food Hygiene

Food can contain useful and harmful microbes, as well as those associated with food spoilage. It is harmful microbes that can be associated with foodborne illness or 'food poisoning'. The top five foodborne microbes in Europe account for about 70% of the health burdens related to foodborne illness and these include; *Norovirus, Toxoplasma gondii, Campylobacter jejuni* and *Campylobacter coli*, *Salmonella enterica* and *Listeria monocytogenes*. Other microbes such as *Bacillus cereus* and *Escherichia coli* have also been associated with serious cases of foodborne illness.

These microbes can be found in raw meats, in eggs without a British Lion mark or equivalent quality marking outside of the UK, some dairy products, on the surface of fruits and vegetables, in dried food like pasta and rice or in ready to eat foods such as sandwiches and desserts. Symptoms can include diarrhoea, stomach cramps, fever and vomiting and some foodborne illness may even result in death – though this is rare. The symptoms of foodborne illness usually start within a few days of eating the food that caused the infection and can usually be treated at home with rest and fluids.

Not all microbes associated with food are harmful. Useful microbes can be used to make food and drink, e.g. the yeast *Saccharomyces cerevisae* is used to make bread and beer. *Lactobacilli* bacteria are used in yoghurt and cheese making.

Food spoilage is the deterioration of the colour, texture and flavour of food. It can be caused by many things, including microbes. For example, the fungus *Rhizopus stolonifer* causes bread mould. Microbes that cause foodborne illness may or may not cause food spoilage.

There are important steps you can take to prevent foodborne illness and spoilage that apply at all stages in the journey of food, from the shop to our plates:

1. Keep clean; maintaining hand and surface hygiene is the best way for avoiding foodborne microbes entering our food. Tools, equipment and surfaces should be regularly cleaned to remove harmful microbes.
2. Maintain the cold chain; keeping food in the fridge or freezer slows the growth of bacteria but does not stop it. To keep food safe for longer, care should be taken to minimise the time food spends outside of the fridge or freezer, this include leftovers which should be stored in the fridge soon after cooling. Refrigerators should be kept ≤4˚C.
3. Prevent cross-contamination; preventing harmful microbes found on food from spreading to other foods (for example via our hands or kitchen utensils) and causing illness when those foods are eaten. This can include taking care not to wash chicken or other meats as this can splash microbes around the kitchen.
4. Cook food such as meat thoroughly; one way of checking is to cut the thickest part of the meat to check that none of the meat is pink and that any juices run clear. A temperature probe can also be used; the temperature should reach one of the following combinations to make sure it has been cooked properly:
    - 60˚C for 45 minutes
    - 65˚C for 10 minutes
    - 70˚C for 2 minutes
    - 75˚C for 30 seconds
    - 80˚C for 6 seconds

Labels placed on foods are used to determine when it is safe to eat the food,

or when the quality of the food is at its best. 'Use by' refers to when the food is still safe to eat. Food should not be consumed after this date. 'Best before' refers to when the food will be at its best quality, but it is worth noting that consumption after this date should still be safe.

Detailed background information and training to support educators has been developed and can be found at www.e-bug.eu alongside the KS3 Food Hygiene lessons.

These sessions include:

- Session 1: Teaching food hygiene - An introduction
- Session 2: Microbiological aspects
- Session 3: Food labels
- Session 4: Infection transmission

Sexually Transmitted Infections (STIs)

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 prescribed by a Doctor.

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 (depending on the viral infection) 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. It is important to note that an HIV positive person who is on treatment and their viral load is undetectable cannot transmit HIV to another person.

Details of the most common STIs are available in the MS 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 had sexual contact with was infected.

When discussing sexual health with students, it is important everyone feels comfortable, safe, and heard. Here are some suggested ground rules to follow:

- No one (teacher or student) 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 (you may wish to ask pupils to use the correct word if they can but if not, to use the word they know and then provide them with the more appropriate word)
- Meanings of words will be explained in a sensible and factual way
- Others (as agreed by class)

Chlamydia

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 a one-week course 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.

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 and to provide students with the opportunity to explore the issues around negotiating safer sex.

Vaccinations

Our immune system generally fights any pathogenic microbes that may enter our bodies and helps keep 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.

We can help our immune system fight microbes by getting vaccinated. 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 WBCs create lots of antibodies to attach to the antigens on the surface of the vaccine. Because the vaccine is an inactivated or 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 or by a sufficient proportion of the population becoming infected and developing natural immunity leading to herd immunity. However, vaccination can be preferential because of the long-term side effects of having certain diseases.

Treatment of Infection: Antibiotic Use and Antimicrobial Resistance

We have already learned in the vaccinations lesson plans that the majority of the time, the immune system defeats any harmful microbes entering the body, however, in some cases the immune system needs help. Antimicrobials are medicines used to kill or slow the growth of microbes and 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, flu and COVID-19, which are caused by viruses. Examples of antibiotics are penicillin, clarithromycin, doxycycline and amoxicillin.

Before antibiotics were invented, harmful bacteria were life threatening e.g. bacteria picked up during childbirth or routine surgery. Today, however, many bacterial infections are easily treated with antibiotics – but 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.

There are a number of ways in which we can help prevent this happening:

- Only use antibiotics prescribed for you by your doctor or healthcare professional, because the antibiotic and dose would have been specifically chosen for the type of infection you have and for your body.
- Always finish the course prescribed otherwise the bacteria are not completely destroyed and the infection is more likely to come back.
- Don't use antibiotics for common coughs and colds because these are usually caused by viruses and antibiotics do not kill viruses. Using antibiotics when they are not needed increases the chance of bacteria developing resistance which could later harm you and others.

Infections caused by antibiotic resistant bacteria pose a serious health risk. These bacteria may have resistance to one or more antibiotics, meaning that the first and/or second choice of antibiotic may not work. This results in fewer options for treating you or your family or friends or someone else and the infection may be more difficult to control and risk overwhelming our immune system. Resistant bacteria can pass their resistance on to other bacteria.

There are several ways our bodies can be exposed to infection and many things that we can do to help prevent the spread of infection. The teacher refresher section provides supporting information for each of the activities contained in this pack.

Public Health England

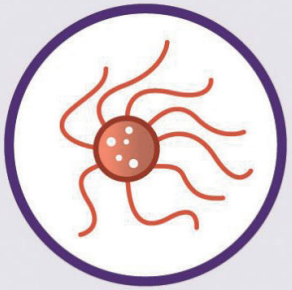
Antimicrobials: a simple overview

Antimicrobials

are medicines used to prevent and treat infections caused by microorganisms in humans, animals and plants

Antibiotics (also known as antibacterials)

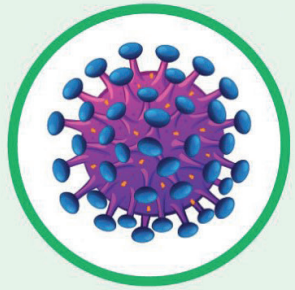
Prevent or treat infections caused by **Bacteria**



such as cellulitis, Urinary Tract Infection, tuberculosis (TB), Sexually Transmitted Infections (STIs) like gonorrhoea

Antivirals

Prevent or treat infections caused by **Viruses**



such as colds, flu, chickenpox/shingles, COVID-19 or HIV

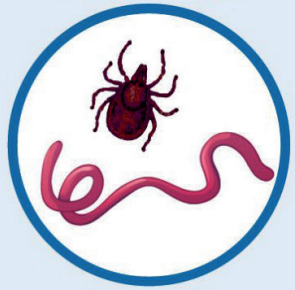
Antifungals

Prevent or treat infections caused by **Fungi**

such as thrush, ring worm and athlete's foot

Antiparasitics

Prevent or treat infections caused by **Parasites**



such as malaria, threadworm and headlice

An antimicrobial drug works against **only one** type of organism

Antimicrobial Resistance:

when the microorganisms change or mutate over time and get to a point where they no longer respond to medicines previously used to treat them

https://antibioticguardian.com/antimicrobials-amr-ams/

KEY STAGE 3 - LESSON 1

Micro-organisms: Introduction to Microbes

Students learn about the different types of microbes – bacteria, viruses and fungi. They learn that microbes have different shapes and that they are found everywhere.

Curriculum Links

Science

- Working scientifically
- Scientific attitudes
- Experimental skills and investigations

Biology

- Structure and function of living organism,
- Cells and organisation

Genetics and Evolution

- Inheritance
- Chromosomes
- DNA and genes

PSHE/RSHE

- Health and prevention

English

- Reading
- Writing

@ Weblink

e-bug.eu/eng/KS3/lesson/Introduction-to-Microbes

Key Words

Bacteria, Cell, Disease, Fungi, Germ, Microbe, Microscope, Pathogen, Virus

Learning Outcomes

All students will:

- Understand there are three different types of microbe.
- Understand that microbes are found everywhere.
- Understand that useful bacteria are found in our body.
- Understand that microbes come in different sizes.

Most students will:

- Understand the key differences between the three main types of microbe.

Resources Required

Introduction
Per student

- [ ] Copy of SH1

Main Activity: Microbe Mayhem
Per group

- [ ] Copy of SH2
- [ ] Copy of SH3
- [ ] Copy of SH4
- [ ] Copy of SH5

Extension Activity: Posters
Per student

- [ ] Pens/pencils
- [ ] Paper

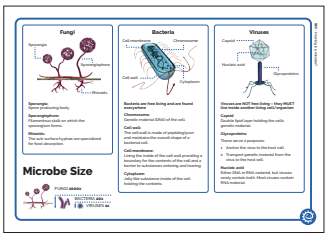
Extension Activity: Intro to Microbes Quiz
Per group

- [ ] Copy of SW1

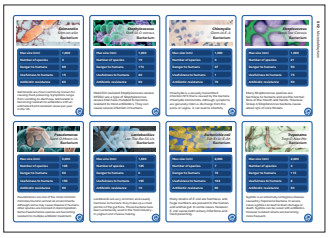
Advance Preparation

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

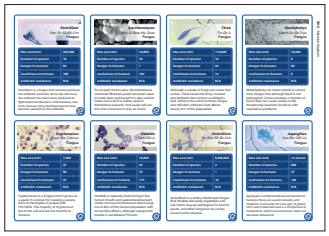
Supporting Materials



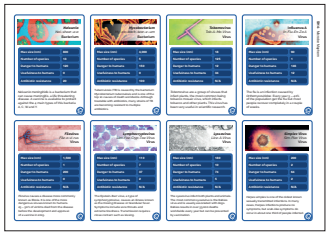
SH1 How Big is a Microbe?



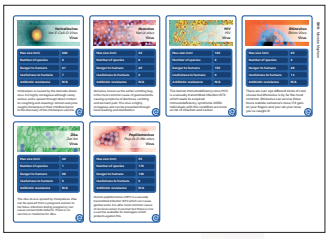
SH2 Microbe Mayhem



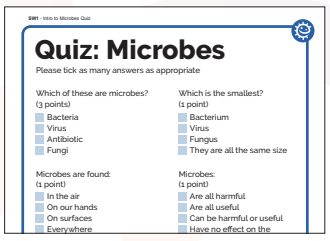
SH3 Microbe Mayhem



SH4 Microbe Mayhem



SH5 Microbe Mayhem



SW1 Quiz

Lesson Plan

Introduction

1. Begin the lesson by asking students what they already know about micro-organisms. Explain that micro-organisms, sometimes called microbes, germs or bugs, are living things but are too small to be seen with our eyes; they can only be seen through a microscope.

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. Tell the class that we will focus on three different types of microbe: bacteria, viruses and fungi. Use the factsheet (SH1) to demonstrate how these three microbes vary in shape and structure.

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 yoghurt, 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.

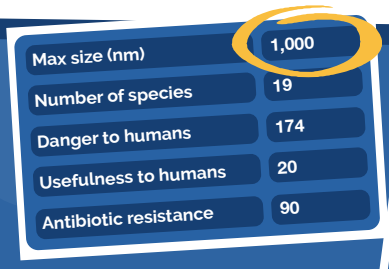
Main Activity: Microbe Mayhem

1 Shuffle the cards and deal cards to players

2 Make sure only you can see your cards

3 Take turns to choose which microbe characteristic you would like to battle others with

4 The player with the highest characteristic score wins the round



Microbe Mayhem

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

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

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

Game rules

1 The dealer should shuffle the cards well and deal all the cards face down to each player. Each player holds their cards face up so that they can see the top card only.

2 The player to the dealer's left starts by reading out the name of the microbe on the top card and chooses an item to read (e.g. Size 50). In a clockwise direction, the other players then read out the same item. The player with the highest value wins, taking the other players top cards and placing them to the bottom of their pile. reads out the name of the microbe on their next card and selects the item to compare.

3 If two or more players have the same top value then all the cards are placed in the middle and the same player chooses again from the next card. The winner then takes the cards in the middle. The person with all the cards at the end is the winner.

Discussion

At the end of the activity, explain to the students that microbes are found everywhere, even on your text books and flashcards. Stress that microbes are found all over our skin, mouths, gut and especially hands. Most are completely harmless that we carry without knowing.

Discuss that the bacteria on our bodies are important as they act as a barrier to stop other more harmful bacteria entering your body and making you ill.

Extension Activities

This activity will give students the opportunity to expand their understanding by undertaking a brief research exercise.

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

1 Choose a specific type of bacteria, 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 useful or harmful way

   d. Any specific growth requirements of that group of microbes

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 publishes germ theory: the concept that germs cause disease

   e. 1892: Ivanovski discovers viruses

   f. 1905: Koch awarded the Nobel Prize in Medicine for his work understanding tuberculosis and its causes

   g. 1929: Fleming discovers antibiotics

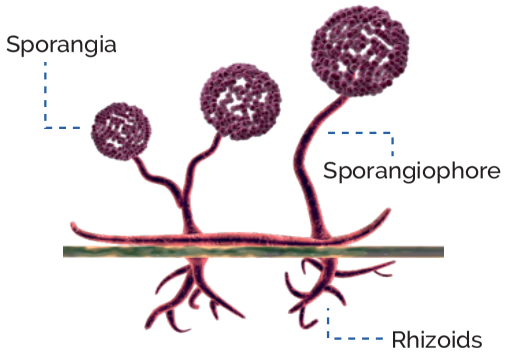
Microbes Quiz

SW1 provides a fun way to consolidate learning. Allocate students to groups of 3 or 4 and provide one quiz sheet per team. The team with the most points wins. Answers are available on the e-Bug website.

Learning Consolidation

To consolidate learning you may wish to encourage students to present their poster to the class or consider creating a display in your classroom, or on a common notice board.

Fungi

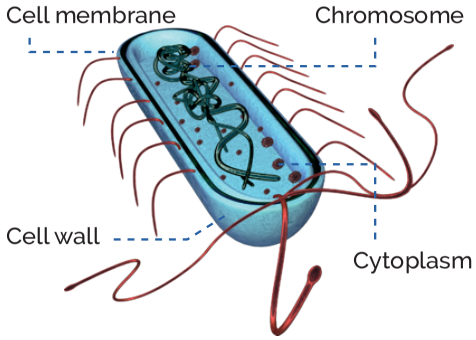


Sporangia:
Spore producing body.

Sporangiophore:
Filamentous stalk on which the sporangium forms.

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

Bacteria



Bacteria are free living and are found everywhere

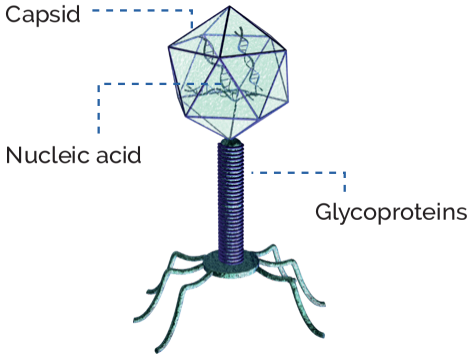
Chromosome:
Genetic material (DNA) of the cell.

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.

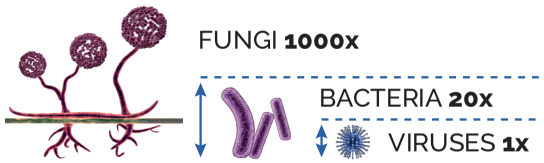
Glycoproteins

These serve 2 purposes:

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

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

Microbe Size



Salmonella
Sam-on-ella
Bacterium

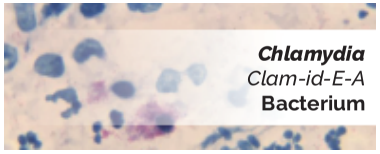
Max size (nm)	1,000
Number of species	3
Danger to humans	89
Usefulness to humans	15
Antibiotic resistance	60

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

Staphylococcus
Staff-ill-O-coccus
Bacterium

Max size (nm)	1,000
Number of species	19
Danger to humans	174
Usefulness to humans	20
Antibiotic resistance	90

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



Chlamydia
Clam-id-E-A
Bacterium

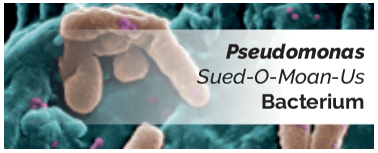
Max size (nm)	1,000
Number of species	3
Danger to humans	37
Usefulness to humans	1
Antibiotic resistance	70

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

Streptococcus
Strep-Toe-Coccus
Bacterium

Max size (nm)	1,000
Number of species	21
Danger to humans	50
Usefulness to humans	75
Antibiotic resistance	50

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



Pseudomonas
Sued-O-Moan-Us
Bacterium

Max size (nm)	5,000
Number of species	126
Danger to humans	50
Usefulness to humans	150
Antibiotic resistance	90

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

Lactobacillus
Lac-Toe-Ba-Sil-Us
Bacterium

Max size (nm)	1,500
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 make up a small portion of the gut flora. These bacteria have been extensively used in the food industry - in yoghurt and cheese making.

Escherichia coli
Esh-Er-Ic-E-Ah
Bacterium

Max size (nm)	2,000
Number of species	7
Danger to humans	70
Usefulness to humans	184
Antibiotic resistance	80

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

Treponema
Trep-O-Nee-Ma
Bacterium

Max size (nm)	2,000
Number of species	3
Danger to humans	115
Usefulness to humans	8
Antibiotic resistance	50

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

Penicillium
Pen-Ee-Sil-Ee-Um
Fungus

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

Saccharomyces
Sac-A-Row-My-Sees
Fungus

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
Fungus

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 between 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
Fungus

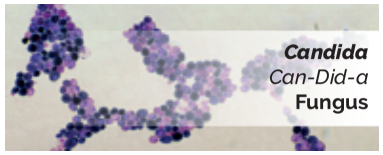
Max size (nm)	72,000
Number of species	2
Danger to humans	83
Usefulness to humans	2
Antibiotic resistance	N/A

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 rashes or life threatening reactions for those with respiratory problems.

Cryptococcus
Cryp-Toe-Coccus
Fungus

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 known for causing a severe form of meningitis in people with HIV/AIDS. The majority of Cryptococci live in the soil and are not harmful to humans.



Candida
Can-Did-a
Fungus

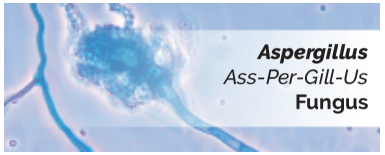
Max size (nm)	10,000
Number of species	44
Danger to humans	74
Usefulness to humans	175
Antibiotic resistance	N/A

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

Verticillium
Ver-Tee-Sil-Ee-Um
Fungus

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 may be pathogenic to insects, plants, and other fungi but very rarely cause human disease.



Aspergillus
Ass-Per-Gill-Us
Fungus

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. It accounts for over 99% of global citric acid production and is a component of medications which manufacturers claim can decrease flatulence!

Neisseria
Nai–sheer–e–a
Bacterium

Max size (nm)	800
Number of species	13
Danger to humans	120
Usefulness to humans	0
Antibiotic resistance	20

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

Mycobacterium
My–co–back–tear–e–um
Bacterium

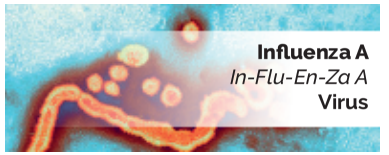
Max size (nm)	4,000
Number of species	5
Danger to humans	150
Usefulness to humans	0
Antibiotic resistance	100

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

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

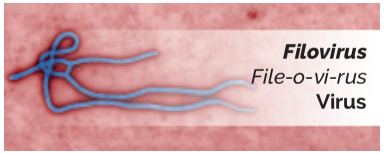
Tobamovirus are a group of viruses that infect plants, the most common being tobacco mosaic virus, which infects tobacco and other plants. This virus has been very useful in scientific research.



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

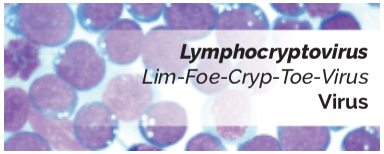
The flu is an infection caused by *Orthomyxoviridae*. Every year 5 – 40% of the population get the flu but most people recover completely in a couple of weeks.



Filovirus
File-o-vi-rus
Virus

Max size (nm)	1,500
Number of species	1
Danger to humans	200
Usefulness to humans	0
Antibiotic resistance	N/A

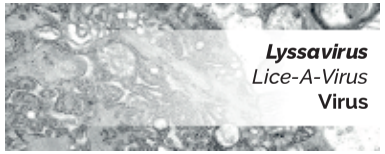
Filovirus causes a disease more commonly known as Ebola. It is one of the more dangerous viruses known to humans. 25 – 90% of victims died from the disease before the development and approval of a vaccine in 2019.



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



Lyssavirus
Lice-A-Virus
Virus

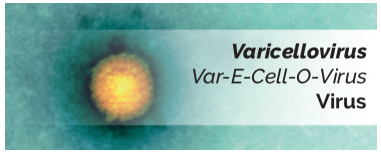
Max size (nm)	180
Number of species	10
Danger to humans	74
Usefulness to humans	5
Antibiotic resistance	N/A

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

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

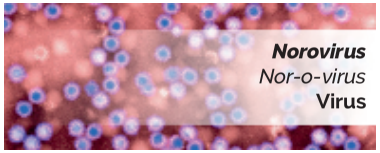
Herpes simplex is one of the oldest known sexually transmitted infections. In many cases, Herpes infections produce no symptoms, but scab-like symptoms do occur in about one third of people infected.



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

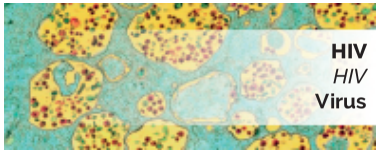
Chickenpox is caused by the *Varicella-Zoster* virus. It is highly contagious although rarely serious and is spread through direct contact (or coughing and sneezing). Almost everyone caught chickenpox in their childhood prior to the discovery of the chickenpox vaccine.



Norovirus
Nor-o-virus
Virus

Max size (nm)	35
Number of species	8
Danger to humans	25
Usefulness to humans	0
Antibiotic resistance	N/A

Norovirus, known as the winter vomiting bug, is the most common cause of gastroenteritis causing symptoms of diarrhoea, vomiting and stomach pain. The virus is highly contagious and can be prevented through hand washing and disinfection.



HIV
HIV
Virus

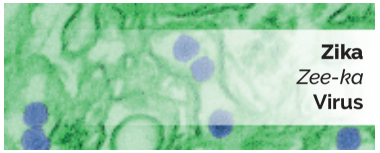
Max size (nm)	120
Number of species	2
Danger to humans	150
Usefulness to humans	0
Antibiotic resistance	N/A

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

Rhinovirus
Rhino-Virus
Virus

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

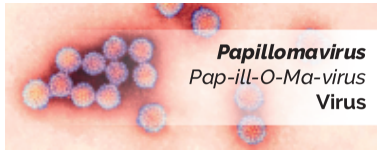
There are over 250 different kinds of cold viruses but *Rhinovirus* is by far the most common. *Rhinovirus* can survive three hours outside someone's nose. If it gets on your fingers and you rub your nose, you've caught it!



Zika
Zee-ka
Virus

Max size (nm)	40
Number of species	1
Danger to humans	98
Usefulness to humans	0
Antibiotic resistance	N/A

The zika virus is spread by mosquitoes. Zika can be passed from a pregnant woman to her fetus. Infection during pregnancy can cause certain birth defects. There is no vaccine or medicine for Zika.



Papillomavirus
Pap-ill-O-Ma-virus
Virus

Max size (nm)	55
Number of species	170
Danger to humans	130
Usefulness to humans	0
Antibiotic resistance	N/A

Human papillomavirus (HPV) is a sexually transmitted infection (STI) which can cause genital warts. It is athe most common cause of cervical cancer in women but there is now a vaccine available for teenagers which protects against this.

Quiz: Microbes

Please tick as many answers as appropriate

Which of these are microbes?
(3 points)

- [ ] Bacteria
- [ ] Virus
- [ ] Antibiotic
- [ ] Fungi

Which is the smallest?
(1 point)

- [ ] Bacterium
- [ ] Virus
- [ ] Fungus
- [ ] They are all the same size

Microbes are found:
(1 point)

- [ ] In the air
- [ ] On our hands
- [ ] On surfaces
- [ ] Everywhere

Microbes:
(1 point)

- [ ] Are all harmful
- [ ] Are all useful
- [ ] Can be harmful or useful
- [ ] Have no effect on the human body

Which foods or drinks are produced through the growth of microbes?
(4 points)

- [ ] Cheese
- [ ] Bread
- [ ] Yogurt
- [ ] Fizzy drinks

Which of these microbes causes the common cold?
(1 point)

- [ ] Bacteria
- [ ] Virus
- [ ] Fungi

What is another word for a harmful microbe?
(1 point)

- [ ] Infectious
- [ ] Antibiotic
- [ ] Pathogen
- [ ] Flora

Which of these are shapes of microbes?
(1 point)

- [ ] Rods
- [ ] Balls
- [ ] Spirals
- [ ] All of the above

Micro-organisms: Introduction to Microbes

See www.e-bug.eu for the answers

KEY STAGE 3 - LESSON 2

Micro-organisms: Useful Microbes

Students learn that microbes can be useful, experimenting with *Lactobacillus* and *Streptococcus* to make their own yoghurt.

Curriculum Links

Science

- Working scientifically
- Scientific attitudes
- Experimental skills and investigations

Biology

- Structure and function of living organisms
- Cells and organisation
- Nutrition and digestion

Material cycles and energy

- Cellular respiration

PSHE/RSHE

- Health and prevention

English

- Reading
- Writing

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e-bug.eu/eng/KS3/lesson/Useful-Microbes

Key Words

Culture, Contamination, Fermentation, Pasteurise,

Learning Outcomes

All students will:

- Understand that some microbes can be put to good use.
- Understand that we need bacterial colonisation to live a healthy life.

Most students will:

- Understand that we need to protect our normal microbial flora.

Resources Required

Main Activity: Yoghurt Experiment

Per student

- [ ] Copy of SH1 and SW1
- [ ] Sterile Beaker
- [ ] Cling film/foil
- [ ] Dried/Powdered milk
- [ ] Whole milk
- [ ] Live natural yoghurt
- [ ] Sterile teaspoon

Per group

- [ ] Hot plate
- [ ] Water bath set at 20°C
- [ ] Water bath set at 40°C

Extension Activity: Microscopic Yoghurt

Per class/group

- [ ] Copy of SW2
- [ ] Bunsen burner
- [ ] Cover slips
- [ ] Methylene blue microscope
- [ ] X40 resolution microscope slides
- [ ] Sterile droppers
- [ ] Yoghurt

Extensions activity: Poster

Per student

- [ ] Paper
- [ ] Pens/pencils

Advance Preparation

1. Copy of TS1 teacher answer sheet.
2. Purchase a carton of fresh plain yoghurt and powdered milk.
3. Boil at least 1 teaspoon of yoghurt per group to sterilise.

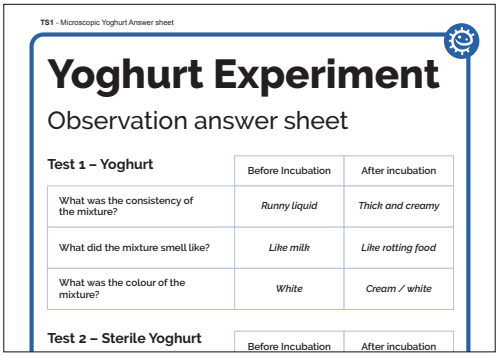
Health and Safety

Yoghurt experiment: During cooking students should wear an apron and goggles.

Microscopic Yoghurt: Stain the slides over a sink.

For safe microbiological practices in the classroom consult CLEAPPS www.cleapps.org.uk

Supporting Materials



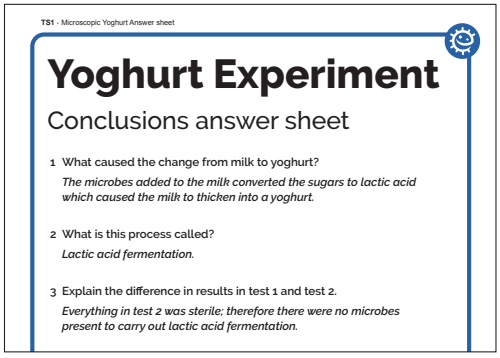
TS1 - Microscopic Yoghurt Answer sheet

Yoghurt Experiment

Observation answer sheet

Test 1 – Yoghurt	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 Yoghurt	Before Incubation	After incubation



TS1 - Microscopic Yoghurt Answer sheet

Yoghurt Experiment

Conclusions answer sheet

1 What caused the change from milk to yoghurt?

The microbes added to the milk converted the sugars to lactic acid which caused the milk to thicken into a yoghurt.

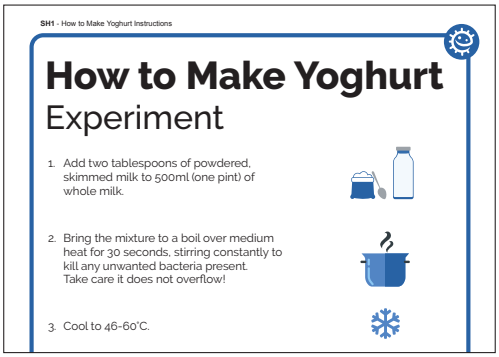
2 What is this process called?

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.

TS1 Microscopic Yoghurt Teacher Sheets

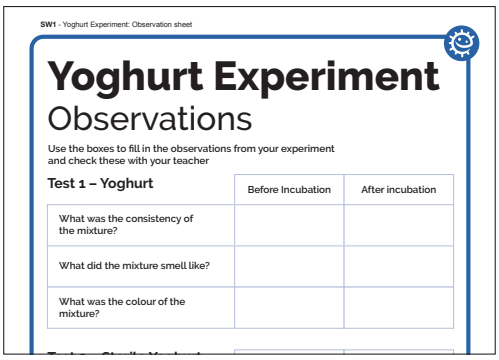


SH1 - How to Make Yoghurt Instructions

How to Make Yoghurt Experiment

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.

SH1 How to Make Yoghurt Instructions



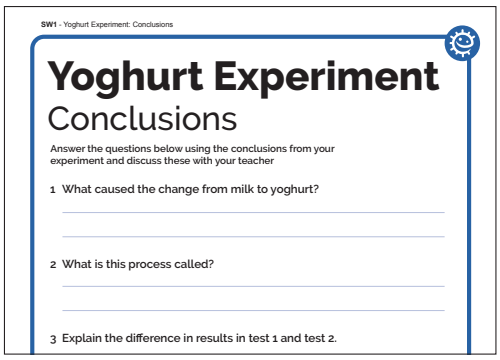
SW1 - Yoghurt Experiment: Observation sheet

Yoghurt Experiment

Observations

Use the boxes to fill in the observations from your experiment and check these with your teacher

Test 1 – Yoghurt	Before Incubation	After incubation
What was the consistency of the mixture?		
What did the mixture smell like?		
What was the colour of the mixture?		



SW1 - Yoghurt Experiment: Conclusions

Yoghurt Experiment

Conclusions

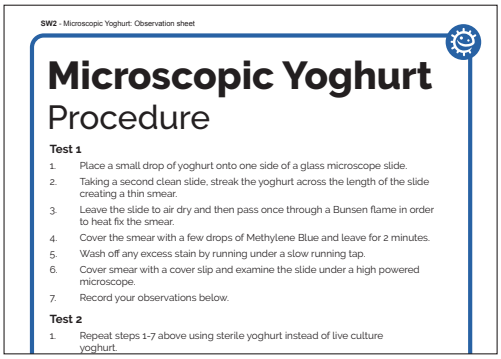
Answer the questions below using the conclusions from your experiment and discuss these with your teacher

1 What caused the change from milk to yoghurt?

2 What is this process called?

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

SW1 Yoghurt Experiment: Observation Sheet



SW2 - Microscopic Yoghurt: Observation sheet

Microscopic Yoghurt

Procedure

Test 1

1. Place a small drop of yoghurt onto one side of a glass microscope slide.
2. Taking a second clean slide, streak the yoghurt 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 yoghurt instead of live culture yoghurt.

SW2 Microscopic Yoghurt: Observation Sheet

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 useful to 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 yoghurt, 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 yoghurt.

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, yoghurt and many more foodstuffs. When making yoghurt, 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 yoghurt. Tell the class that they are going to make their own yoghurt and see the fermentation process for themselves.

Main Activity: Yoghurt Experiment

1 Add 2 tablespoons of powdered milk to a pint of whole milk

2 Stir the mixture while heating

3 Cool mixture down

4 Divide mixture into 2 labelled sterile beakers and add live yoghurt to one and sterile yoghurt to the other

5 Heat and stir mixtures

6 Cover top of container and wait at least 9 hours

Yoghurt Experiment

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 yoghurt recipe (SH1). 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 you 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 yoghurt, 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 yoghurt in step 4 would result in killing the 'yoghurt-making' microbes.

d. Yoghurt contains the microbes *Lactobacillus* or *Streptococcus* required to make yoghurt. We add the yoghurt to the milk mixture so that these microbes will convert the mixture to yoghurt 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.

3. Explain each of the tests to the class:
   a. Test 1 - carry out the experiment following the recipe (SH1) using the yoghurt in step four.
   b. Test 2 - carry out the experiment following the recipe (SH1) using sterilised (boiled) yoghurt in step four.
   c. Test 3 - Carry out the experiment using the recipe (SH1), however, at step six incubate half the samples at the recommended temperature and the other half at 20°C or in the fridge.
4. Highlight that the *Lactobacillus* bacteria found in yoghurt 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.
5. Students should record their observations on the student worksheet (SW1). Answers are available on TS1.

Students will learn that not all microbes are harmful and that they can be put to good use, for example, to make yoghurt.

Discussion

Check for understanding by asking students the following questions:

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

What changes occurred as the mixture changed from milk to yoghurt 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.

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 yoghurt.

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

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

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

Extension Activities

Microscopic Yoghurt

1. Provide students with a copy of SW2. Follow the procedure outlined and examine the microbes under a microscope. Students may need to dilute the yoghurt with water if the yoghurt is particularly thick. You may want students to try this test using yoghurt only and yoghurt diluted with water.
2. Remember that the more dilute the yoghurt is the further the bacteria will spread out making them more difficult to find on the slide. Students should be able to see bacteria under the microscope from the yoghurt made with live culture.

Poster Design

Divide the class into groups of 3 or 4 students. Ask each group to create a poster. Choose a type of food that utilises microbes during production e.g. yoghurt, bread, beer, soy sauce, kombucha, salami, cheese, chocolate. Ask students to include

1. Type and name of the microbe used.
2. History of when this food was first produced.
3. How this food is produced?
4. Are there associated health benefits?

Class visit

As a fun alternative to the classroom experiment, students could visit a food room to observe fermentation in the making of ginger beer, bread, kombucha or even kimchi. This will support student understanding by providing further examples of how microbes can be useful.

Learning Consolidation

To consolidate learning you may wish to encourage students to present their poster to the class or consider creating a display in your classroom or on a common notice board.

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

1. Many microbes are useful and help us make foods like yoghurt or bread.

   Answer: True

2. Fermentation happens when microbes digest sugars, this is the process by which milk changed to yoghurt.

   Answer: True

3. Yoghurt contains bacteria including *Lactobacilli* and *Streptococcus*, meaning eating yoghurt is good for your gut health.

   Answer: True

Yoghurt Experiment

Observation answer sheet

Test 1 – Yoghurt	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 Yoghurt	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 yoghurt, 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 yoghurt when the mixture was incubated at:

20°C - approx 3-5 days
40°C - overnight

Yoghurt Experiment

Conclusions answer sheet

1 What caused the change from milk to yoghurt?

The microbes added to the milk converted the sugars to lactic acid which caused the milk to thicken into a yoghurt.

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 yoghurt?

Bacteria of the genus Lactobacillus and Streptococcus.

5 Why did it take longer to make yoghurt at 20°C than at 40°C?

Bacteria prefer to grow at body temperature i.e. approx 37°C, at 20°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 yoghurt may be contaminated with harmful microbes.

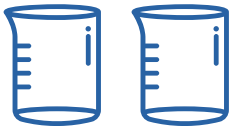
How to Make Yoghurt Experiment

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

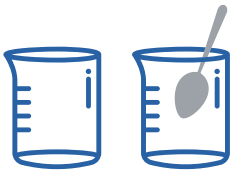
2. Bring the mixture to a boil over medium heat for 30 seconds, stirring constantly to kill any unwanted bacteria present. Take care it does not overflow!

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 yoghurt
   Test 2 : add 1-2 teaspoons of sterile yoghurt



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.

Yoghurt Experiment
Observations

Use the boxes to fill in the observations from your experiment and check these with your teacher

Test 1 – Yoghurt	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 Yoghurt	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 yoghurt when the mixture was incubated at:

20°C - _____ 40°C - _____

Yoghurt Experiment
Conclusions

Answer the questions below using the conclusions from your experiment and discuss these with your teacher

1 What caused the change from milk to yoghurt?

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 yoghurt?

5 Why did it take longer to make yoghurt at 20°C than at 40°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?

Microscopic Yoghurt

Procedure

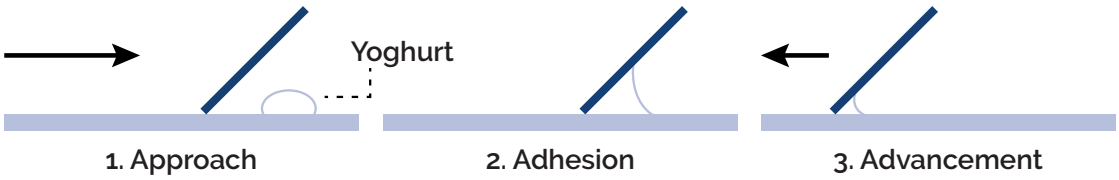
Test 1

1. Place a small drop of yoghurt onto one side of a glass microscope slide.
2. Taking a second clean slide, streak the yoghurt 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 yoghurt instead of live culture yoghurt.

How to prepare a smear:



Observations

What did you see in the yoghurt smear?

What did you see in the sterile yoghurt smear?

What, in your opinion, caused the difference?

KEY STAGE 3 - LESSON 3

Micro-organisms: Harmful Microbes

In this lesson students will learn about some infectious diseases that cause problems in the world today.

Curriculum Links

Science

- Working scientifically
- Scientific attitudes
- Experimental skills and investigations

Biology

- Structure and function of living organisms
- Cells and organisation
- Nutrition and digestion

PSHE/RSHE

- Health and prevention

English

- Reading
- Writing

Key Words

Bacteria, Dermatophytes, Fungi, Infection, Pathogens, Toxin, Virus

Learning Outcomes

All students will:

- **Understand that sometimes microbes can make us ill and cause infection.**
- **Understand that harmful microbes can pass from person to person.**
- **Understand that different infections cause different symptoms.**
- **Understand how global travel has influenced the spread of disease.**

Most students will:

- **Understand how individuals, groups, and organisations work together when responding to infectious diseases outbreaks.**

Resources Required

Main activity: Infectious Disease Group Discussion

Per Class/Group

- ☐ Copy of SH1, SH2, SH3
- ☐ Copy of SW1
- ☐ Differentiated versions for students of different abilities SH4, SH5, SW2

Advance Preparation

1. Cut out the disease cards in SH1 - SH3, one set per group. Laminate or stick on to stiff card for future use. (Differentiated version: SH4 – SH5).
2. Copy SW1 for each group. (Differentiated version: SW2).
3. Copy TS1 - TS2 teacher answers.

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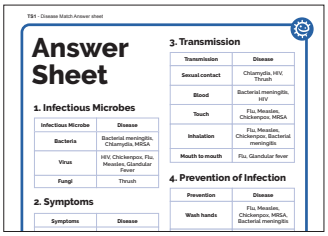
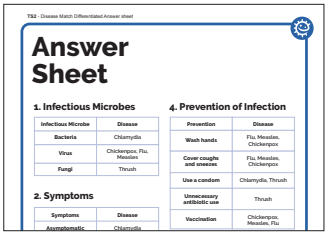
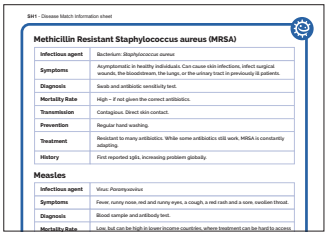
Supporting Materials



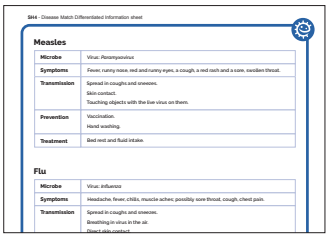
TS1 Disease Match Answer sheet



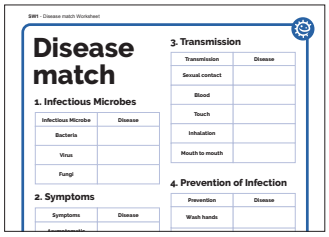
TS2 Disease Match Differentiated Answer sheet



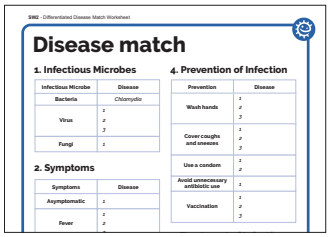
SH1-3 Disease Match Information sheets



SH4-5 Disease Match Differentiated Information sheets



SW1 Disease match worksheet



SW2 Differentiated Disease match Worksheet to match SH4 and TS2

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 enter the body and stick to the cell surface 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 students know 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 then died of the disease. Thankfully today we now have a vaccine to prevent this.

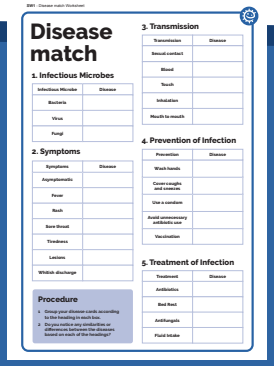
3. Tell the class that bacteria and other microbes that can cause infection and which can spread easily from person to person are called infectious. Discuss the difference between an infectious microbe and a non-infectious one. An example of a non-infectious microbe is the *Lactobacilli* bacteria we learned about in lesson 2. Discuss with students the various routes of transmission, i.e. touch, water, food, body fluid and air. Identify any infectious diseases mentioned in the brainstorming session and how they are transmitted.

Main Activity: Infectious Disease Group Discussion

1 Discover the different types of infectious diseases caused by harmful microbes and their characteristics

2 By working in groups, fill in the various subheadings (symptoms, transmission, treatment)

3 Present your results to the class


Disease match

1. Infectious Microbes

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	

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?

Infectious Disease Group Discussion

1. This activity should be carried out in groups of 3 – 5 people. Explain that during this activity students 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 SH1 – SH3. (Differentiated version: SH4 – SH5)
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 SW1. (Differentiated version: SW2)
4. Ask each group to complete SW1 (Differentiated version: SW2) for the first heading – Infectious microbe. 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 SW1/2 has been completed, discuss the class results.

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 lesson 9 of the 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 employing 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. Vaccines are used to prevent certain infections, many of which were once more common than today.

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.

Fascinating Fact

According to the WHO, the top 10 causes of death in 2019 accounted for 55% of the 55.4 million deaths worldwide. Four out of ten were caused by infectious diseases.

Learning Consolidation

Ask students to write a paragraph or three statements to summarise what they have learned during the lesson.

Discussion

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!!! You may want to discuss how quickly the virus causing the disease COVID-19 spread around the world.

What is an infectious disease?

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

What is a disease?

An illness or sickness characterised by specific signs or symptoms.

Answer Sheet

1. Infectious Microbes

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

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
Whitish discharge	Chlamydia, Thrush

Points to Note

MRSA is an antibiotic resistant bacterium, it is specifically resistant to methicillin and some other commonly used antibiotics. 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 to these as well.

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
Fluid Intake	Chickenpox, Glandular fever, Measles, Flu

Answer Sheet

1. Infectious Microbes

Infectious Microbe	Disease
Bacteria	Chlamydia
Virus	Chickenpox, Flu, Measles
Fungi	Thrush

2. Symptoms

Symptoms	Disease
Asymptomatic	Chlamydia
Fever	Flu, Measles, Chickenpox
Rash	Chickenpox, Measles
Sore throat	Flu
Whitish discharge	Chlamydia, Thrush

3. Transmission

Transmission	Disease
Sexual contact	Chlamydia, Thrush
Touch	Flu, Measles, Chickenpox
Inhalation	Flu, Measles, Chickenpox
Mouth to mouth	Flu

4. Prevention of Infection

Prevention	Disease
Wash hands	Flu, Measles, Chickenpox
Cover coughs and sneezes	Flu, Measles, Chickenpox
Use a condom	Chlamydia, Thrush
Unnecessary antibiotic use	Thrush
Vaccination	Chickenpox, Measles, Flu

5. Treatment of Infection

Treatment	Disease
Antibiotics	Chlamydia
Bed Rest	Chickenpox, Measles, Flu
Antifungals	Thrush
Fluid Intake	Chickenpox, Measles, Flu

Methicillin Resistant Staphylococcus aureus (MRSA)

Infectious agent	Bacterium: *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 can be high in lower income countries, where treatment can be hard to access
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 high and middle income countries in recent years although small epidemics do occur. Still a pandemic problem for low income 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 agent	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 agent	Bacterium: *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 agent	Bacterium: *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 low income 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 where access to HIV testing and anti-HIV drugs is limited.
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.

Measles

Microbe	Virus: *Paramyxovirus*
Symptoms	Fever, runny nose, red and runny eyes, a cough, a red rash and a sore, swollen throat.
Transmission	Spread in coughs and sneezes. Skin contact. Touching objects with the live virus on them.
Prevention	Vaccination. Hand washing.
Treatment	Bed rest and fluid intake.

Flu

Microbe	Virus: *Influenza*
Symptoms	Headache, fever, chills, muscle aches; possibly sore throat, cough, chest pain.
Transmission	Spread in coughs and sneezes. Breathing in virus in the air. Direct skin contact.
Prevention	Vaccination against current strains.
Treatment	Bed rest and fluid intake. Antivirals in the elderly.

Thrush

Microbe	Fungus: *Candida albicans*
Symptoms	Itching. Burning. Soreness. White coating in the mouth or irritation of the vagina with a whitish discharge.
Transmission	Person to person contact.
Prevention	The fungus that causes symptoms can grow better when our natural bacteria are killed off. Therefore, avoid unnecessary antibiotic use.
Treatment	Antifungals

Chlamydia

Microbe	Bacterium: *Chlamydia trachomatis*
Symptoms	In many cases there are no symptoms but sometimes there is a discharge from the vagina or penis. Swollen testicles. Inability to have children can also occur.
Transmission	Sexual contact.
Prevention	Use a condom during sexual intercourse.
Treatment	Antibiotics

Chickenpox

Microbe	Virus: *Varicella-zoster*
Symptoms	Blistering rash on the body and head.
Transmission	Direct skin contact. Spread in coughs and sneezes. Breathing in virus in the air.
Prevention	Prevention by vaccine. Handwashing.
Treatment	Bed rest and fluid intake, antivirals in some adult cases.

Disease match

1. Infectious Microbes

Infectious Microbe	Disease
Bacteria	
Virus	
Fungi	

2. Symptoms

Symptoms	Disease
Asymptomatic	
Fever	
Rash	
Sore throat	
Tiredness	
Lesions	
Whitish discharge	

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?

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	

Disease match

1. Infectious Microbes

Infectious Microbe	Disease
Bacteria	*Chlamydia*
Virus	*1* *2* *3*
Fungi	*1*

2. Symptoms

Symptoms	Disease
Asymptomatic	*1*
Fever	*1* *2* *3*
Rash	*1* *2*
Sore throat	*1*
Whitish discharge	*1* *2*

3. Transmission

Transmission	Disease
Sexual contact	*1* *2*
Touch	*1* *2* *3*
Inhalation	*1* *2* *3*
Mouth to mouth	*1*

4. Prevention of Infection

Prevention	Disease
Wash hands	*1* *2* *3*
Cover coughs and sneezes	*1* *2* *3*
Use a condom	*1* *2*
Avoid unnecessary antibiotic use	*1*
Vaccination	*1* *2* *3*

5. Treatment of Infection

Treatment	Disease
Antibiotics	*1*
Bed Rest	*1* *2* *3*
Antifungals	*1*
Fluid Intake	*1* *2* *3*

Procedure

1. Use the information sheets to find out which disease should go in each empty box below. This has been started for you.
2. Do you notice any similarities or differences between the diseases

KEY STAGE 3 - LESSON 4

Infection Prevention and Control (IPC):

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.

Curriculum Links

Science

- Working scientifically
- Biology

PSHE/RSHE

- Health and prevention

English

- Reading
- Writing

Key Words

Hygiene, Infection, Soap, Transfer

Weblink

e-bug.eu/eng/KS3/lesson/Hand-Hygiene

Learning Outcomes

All students will:

- Understand that infection can be spread through unclean hands.
- Understand that sometimes microbes can make us ill.
- Understand how, when and why to wash their hands.
- Understand that hand washing can prevent the spread of infection.

Most students will:

- Understand why we should use soap to wash our hands.
- Understand that prevention of infection, where possible, is better than cure.

Resources Required

Main Activity:
Hand shaking experiment

Per student

- [ ] Copy of SW1
- [ ] Copy of SW2
- [ ] Petri dishes of nutrient agar (or bread and food storage bags)

Per group

- [ ] Copy of SH1
- [ ] Copy of SH2
- [ ] Copy of SH3
- [ ] Basin (or sink)
- [ ] Hand dryer/paper towels
- [ ] Permanent marker pen
- [ ] Soap
- [ ] Water

Extension activity:
Stomach Bug Chain of Infection

Per group

- [ ] Copy of SH1
- [ ] Copy of SH2
- [ ] Copy of PP1 (available from e-bug.eu)

Extension activity:
Hand Hygiene Quiz

Per group

- [ ] Copy of SW3

Advance Preparation

Section A

1. Copy SW1, SW2, SH1 and SH2 for each student, or group.
2. Copy of TS1 teacher answer sheet.
3. Have hand washing facilities available, (soap, warm water, a means to dry hands).
4. Prepare 2/3 Petri dishes of nutrient agar (or slice of bread and storage bag) per student.

Section B

1. Copy of SW1 and 2 for each student and SH1 for each group
2. Arrange four desks side by side for the 4 stations. Each desk should contain one of the following:
    a. A sign reading 'No hand washing'
    b. A basin of water, paper towels and a sign reading 'Wash for 3 seconds'
    c. A basin of water, paper towels and a sign reading 'Wash for 20 seconds'
    d. A basin of water, hand soap, paper towels and a sign reading 'Wash in Water and Hand Soap for 20 seconds'

Health and Safety

If social distancing does not allow students to shake hands, you can find alternative experiments in Key Stages 2 and 4.

Ensure that the students do not have soap allergies or sensitive skin conditions.

Take care when using sanitiser, risks include splashes.

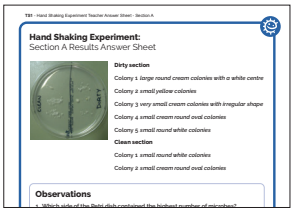
Ensure to wash hands thoroughly.

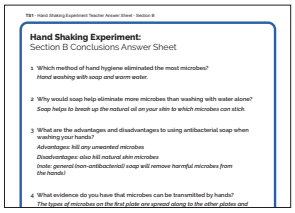
Petri dishes - lids must be secured with two small strips of clear tape. Plates must be inverted before incubation. When plates are examined 2 days later, students must not open the plates. Plates must be autoclaved before disposal.

For safe microbiological practices in the classroom consult CLEAPPS www.cleapps.org.uk

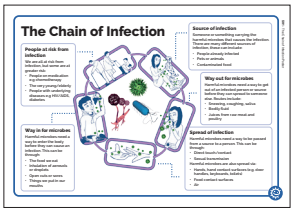
NB: If slices of bread are used instead of nutrient agar plates, bags must not be opened to provide a closer look at the surface of the bread; this could release fungal spores which could be inhaled and cause respiratory distress. The three bags should be placed, unopened, in the normal waste or in a food waste-recycling collection.

Supporting Materials

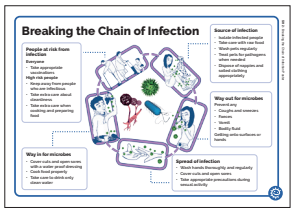




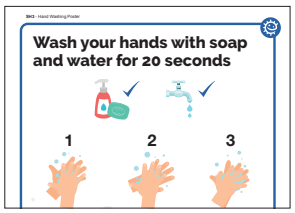
TS1 Answer Sheets



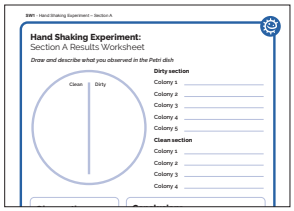
SH1 The Chain of Infection Poster



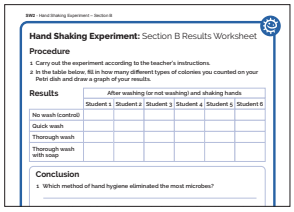
SH2 Breaking the Chain of Infection Poster



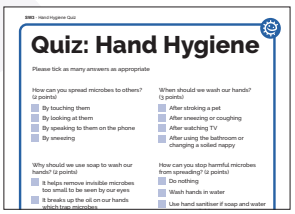
SH3 Hand washing Poster



SW1 Hand Shaking Experiment – Section A



SW2 Hand Shaking Experiment – Section B



SW3 Hand Hygiene Quiz

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 SH1 The chain of Infection and SH2 Breaking the Chain of Infection (also available in PP1) to help explain this.
2. Highlight that there are different ways in which microbes can be transmitted to people. Ask students if they can think of any. Examples could 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 that we spread our microbes to our friends and others through touch, and therefore we need to wash our hands regularly.
6. Explain to students that they are going to carry out an activity to help understand the best to wash their hands to remove any of the harmful microbes.

Main Activity: Hand Shaking Experiment

1. Draw a line on the base on the petri dish to divide it in half
2. Label one side 'Clean' and the other 'Dirty'
3. Make a fingerprint on the dirty side
4. Wash your hands then make a fingerprint on the clean side
5. Wait at least 2 days

Hand shaking experiment

NOTE 1: Slices of white bread can be used as alternatives to Petri dishes of nutrient agar if necessary. Students should put a fingerprint 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. 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.

NOTE 2: If students are using Petri dishes, they should label the base of the dish.

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 two plates, one for clean hands and one for dirty hands, may help prevent this problem.

NOTE 4: If time does not permit to carry out the full activity, results can be viewed on the website, www.e-bug.eu. Both section A and B can be carried out in the same lesson, with results reviewed 48 hours later

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.
2. Each student should put a fingerprint on the side labelled 'dirty'. Students should then wash their hands thoroughly and place a fingerprint 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 SW1.

   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.

Section B

1. Divide the class into 4 even groups of students.
2. Ask each group to choose a lead person who is NOT going to wash their hands. The other students in the group are going to:

   a. quickly wash their hands

   b. thoroughly wash their hands without soap

   c. thoroughly wash their hands with soap

   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 in each group to stand one behind the other as follows:

   Student 1: No hand washing
   Control group

   Student(s) 2: Quick wash
   Hands in water and rub quickly

   Student(s) 3: Thorough wash without soap

   Student(s) 4: Thorough wash with soap

   Reference the six steps hand washing poster (SH3)
4. Provide each student in the class with 2 new nutrient agar plates and a copy of SW2.
5. Each student should put a fingerprint on one of their agar plates and label appropriately.
6. The lead student (student 1) should then wash their hands. Student 1 should then turn around and shake hands with student(s) 2, making sure to have as much hand contact with the person as possible Student(s) 2 in turn should shake hands with student(s) 3 and so on until they reach the end of the row.
7. Each student should now make a fingerprint 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 SW2.
9. Optional: If time permits, add the following extra row to compare the effectiveness of hand sanitiser with soap:

   Wash hands with hand sanitiser *(cover completely and allow to dry)*

   Answers and expected results to SW1 and SW2 can be found on TS1.

Discussion

Discuss the results with the students. What results did they find the most surprising?

Discuss where the microbes on their hands may have come from. Emphasise to students that not all the microbes on their hands are harmful; there may also be normal body microbes which is why useful microbes may increase following hand washing.

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.

Explain that hand sanitiser kills microbes when it dries on our hands. It is important that we cover our hands completely with it and allow it to dry when we use it and use soap and water when hands are visibly soiled.

Discuss the pros and cons of using hand sanitiser when soap is not available.

a Pros: Hand sanitiser, when used correctly can kill some dangerous microbes without the need for hand washing. It is readily available and easy to use.

b Cons: Hand sanitiser does not destroy all microbes that can cause illness and does not remove other substances like dirt or chemicals from our hands. Important to note there are situations where only soap/water can be used such as after using the toilet or when visibly contaminated.

Extension Activities

Stomach Bug Chain of Infection

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 'stomach bug'. With the help of SH1 and SH2, ask students to imagine the spread of gastroenteritis (a stomach bug) in their school from a single infected student.
3. Ask the class to take into account the situations of everyday life within school (going to the toilet 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 the way the infection could spread, and how quickly it could spread in their class or in the school.
5. Ask students to think about and discuss the difficulties they may have with hand hygiene in school and how they could improve their use of existing hygiene facilities.

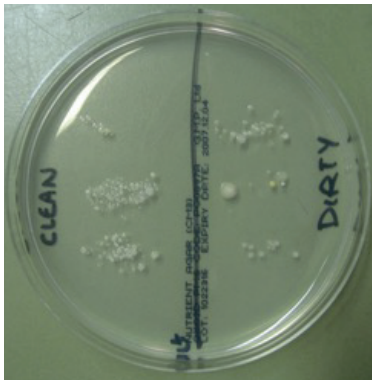
Hand Hygiene Quiz

Provide SW3 to groups of 3 or 4 students. The group with the most points wins. Alternatively the quiz can be completed at the beginning of the lesson and end to measure understanding.

Hand washing Poster

SH3 Hand washing poster can be used throughout the lesson, displayed in the classroom or given to students to take home.

Hand Shaking Experiment:
Section A Results Answer Sheet



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.

Hand Shaking Experiment:
Section B Conclusions Answer Sheet

1 Which method of hand hygiene 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

(note: general (non-antibacterial) soap will remove harmful microbes from the hands)

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

b. After touching pets

c. After using the toilet

d. Before eating

e. After sneezing into them

The Chain of Infection

People at risk from infection

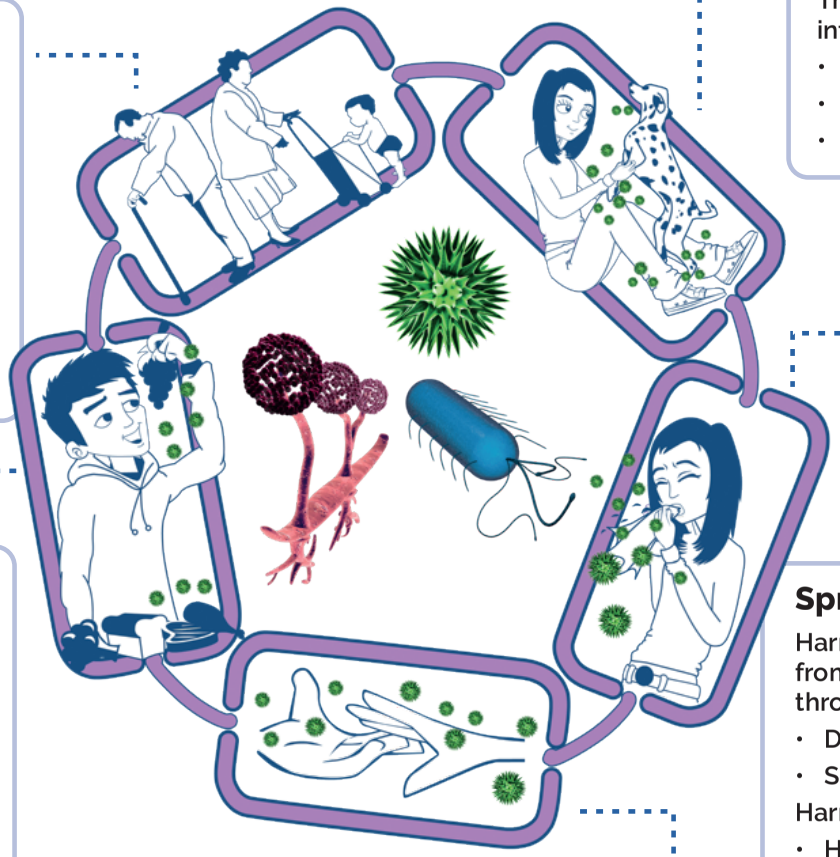
We are all at risk from infection, but some are at greater risk:

- People on medication e.g chemotherapy
- The very young/elderly
- People with underlying diseases e.g HIV/AIDS, diabetes

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
- Contaminated food



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, coughing, saliva
- Bodily fluid
- Juices from raw meat and poultry

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 or droplets
- Open cuts or sores
- Things we put in our mouths

Spread of infection

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

- Direct touch/contact
- Sexual transmission

Harmful microbes are also spread via:

- Hands, hand contact surfaces (e.g. door handles, keyboards, toilets)
- Food contact surfaces
- Air

Breaking the Chain of Infection

People at risk from infection

Everyone

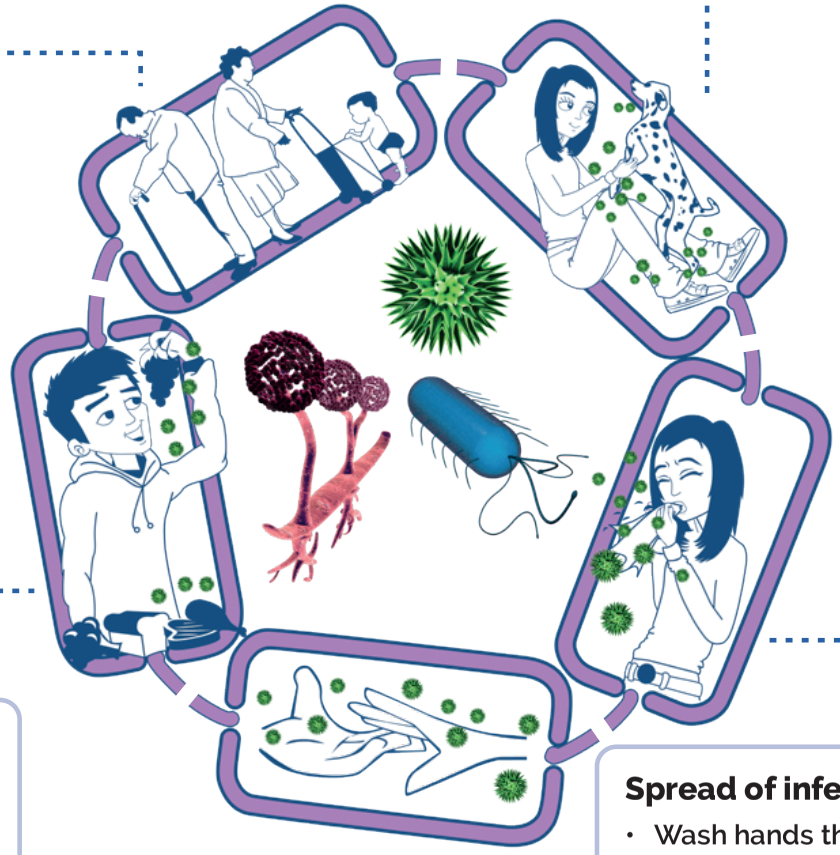
- Take appropriate vaccinations

High risk people

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

Source of infection

- Isolate infected people
- Take care with raw food
- Wash pets regularly
- Treat pets for pathogens when needed
- 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

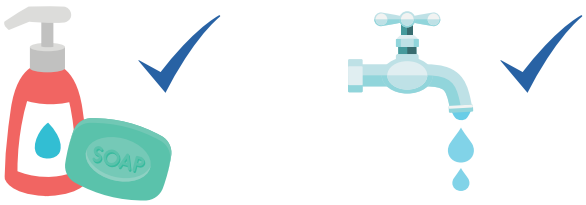
Way in for microbes

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

Spread of infection

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

Wash your hands with soap and water for 20 seconds



1

Palm to palm

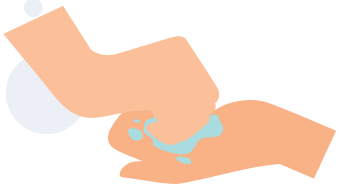
2

Backs of hands

3

Between fingers

4



Backs of fingers

5

Thumbs

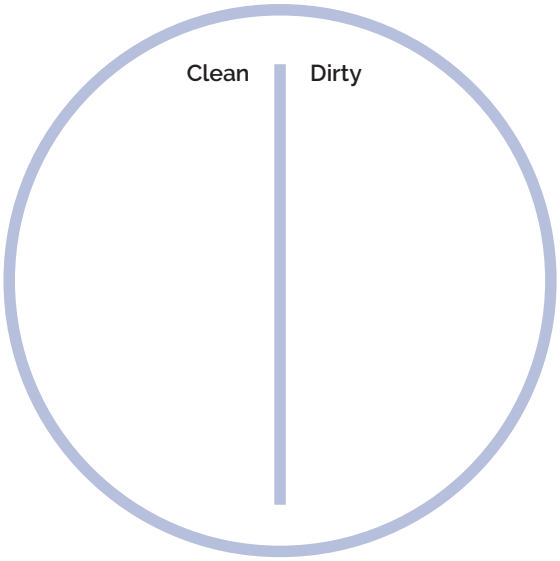
6

Tips of fingers

To help keep time, sing ‘Happy Birthday’ twice

Hand Shaking Experiment:
Section A Results Worksheet

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 _____

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 Shaking Experiment: Section B Results Worksheet

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 with soap						

Conclusion

1 Which method of hand hygiene 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.

Quiz: Hand Hygiene

Please tick as many answers as appropriate

How can you spread microbes to others? (2 points)

- [ ] By touching them
- [ ] By looking at them
- [ ] By speaking to them on the phone
- [ ] By sneezing

When should we wash our hands? (3 points)

- [ ] After stroking a pet
- [ ] After sneezing or coughing
- [ ] After watching TV
- [ ] After using the bathroom or changing a soiled nappy

Why should we use soap to wash our hands? (2 points)

- [ ] It helps remove invisible microbes too small to be seen by our eyes
- [ ] It breaks up the oil on our hands which trap microbes
- [ ] It keeps our hands moist
- [ ] It doesn't matter if we use soap or not

How can you stop harmful microbes from spreading? (2 points)

- [ ] Do nothing
- [ ] Wash hands in water
- [ ] Use hand sanitiser if soap and water are not available
- [ ] Wash your hands with running water and soap

Which is NOT one of the 6 steps of handwashing? (1 point)

- [ ] Palm to palm
- [ ] The thumbs
- [ ] Arms
- [ ] In between fingers

After we sneeze into our tissue, we should: (2 points)

- [ ] Wash our hands immediately
- [ ] Dry our hands on our clothes
- [ ] Take antibiotics
- [ ] Put the tissue straight into the bin

Who might be at risk as a result of you not washing your hands properly? (1 point)

- [ ] You
- [ ] Your family
- [ ] Your friends
- [ ] All of the above

How long should we wash our hands for? (1 point)

- [ ] 10 seconds
- [ ] 20 seconds (length of Happy birthday song twice)
- [ ] 1 minute
- [ ] 5 minutes

KEY STAGE 3 - LESSON 5

Infection Prevention and Control (IPC):

Respiratory Hygiene

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

Curriculum Links

Science

- Working scientifically
- Biology

PSHE/RSHE

- Health and prevention

English

- Reading
- Writing

Key Words

Aerosol, Contamination, Experiment, Infection Prevention, Transmission

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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 your mouth and nose with a tissue or your sleeve (not your hands) when you cough, or sneeze helps prevent the spread of infection.

Most students will:

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

Resources Required

Main Activity: Snot Gun

Per student

- [ ] Copy of SW1
- [ ] Paper disk (10cm)

Per group

- [ ] Measuring tape
- [ ] Spray bottle
- [ ] Water
- [ ] Food dye (optional)
- [ ] Large tissue
- [ ] Gloves
- [ ] Mask

Extension Activity: Respiratory Hygiene Quiz

Per group

- [ ] Copy of SW2
- [ ] Copy of SH1

Advance Preparation

1. Copy SW1 for each student.
2. Copy of TS1 teachers answers.
3. Fill one spray bottle per group with water and food colouring. A different colour for each part of the experiment prevents mixing up results.
4. Create a large tissue from a section of kitchen roll.

Modifications

If there is an outbreak of respiratory illness and mask wearing is recommended, you can include a step to show how a mask can block the microbes from a sneeze/cough. Always include tissue as a step and re-enforce the message to catch it, bin it, kill it and wash hands afterwards.

This activity can be simplified for a larger or mixed group demonstration. See the spreading bug section of the 'Antibiotic Guardian Youth Badge' lesson plans for ideas www.e-bug.eu.

Health and Safety

Students may be required to wear aprons and gloves.

Ensure that the food colouring is diluted.

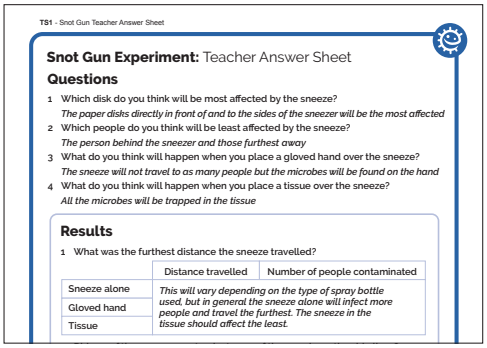
Ensure that all spray bottles have been thoroughly cleaned and rinsed prior to use.

Students may need to wear safety goggles.

In the event of an infectious disease outbreak, you may need to modify this activity to ensure social distancing or other criteria according to your school's policy and government guidance.

For safe microbiological practices in the classroom consult CLEAPPS www.cleapps.org.uk

Supporting Materials



TS1 - Snot Gun Teacher Answer Sheet

Snot Gun Experiment: Teacher Answer Sheet

Questions

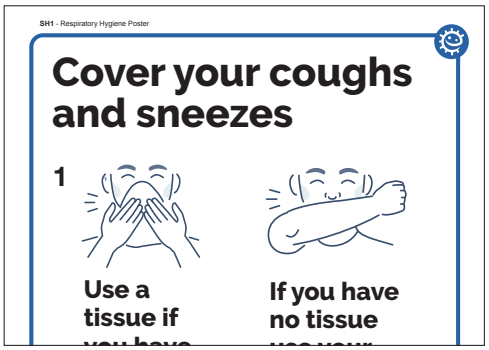
1 Which disk do you think will be most affected by the sneeze?
The paper dishs directly in front of and to the sides of the sneezer will be the most affected
2 Which people do you think will be least affected by the sneeze?
The person behind the sneezer and those furthest away
3 What do you think will 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		

TS1 Snot Gun Teacher Answer Sheet



SH1 - Respiratory Hygiene Poster

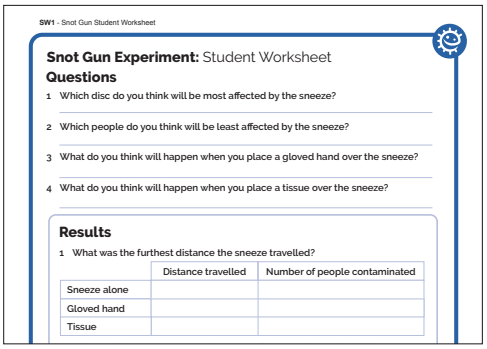
Cover your coughs and sneezes

1

Use a tissue if

If you have no tissue

SH1 Respiratory Hygiene Poster



SW1 - Snot Gun Student Worksheet

Snot Gun Experiment: Student Worksheet

Questions

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?

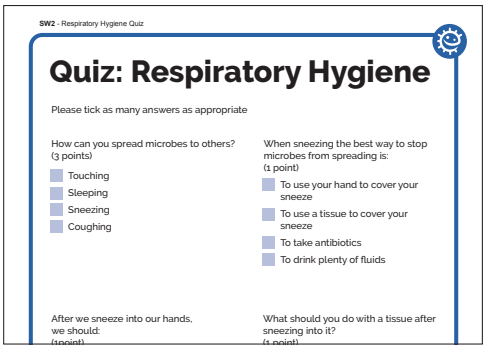
4 What do you think will happen when you place a tissue over the sneeze?

Results

1 What was the furthest distance the sneeze travelled?

	Distance travelled	Number of people contaminated
Sneeze alone		
Gloved hand		
Tissue		

SW1 Snot Gun Student Worksheet



SW2 - Respiratory Hygiene Quiz

Quiz: Respiratory Hygiene

Please tick as many answers as appropriate

How can you spread microbes to others? (3 points)

- ☐ Touching
- ☐ Sleeping
- ☐ Sneezing
- ☐ Coughing

When sneezing the best way to stop microbes from spreading is: (1 point)

- ☐ To use your hand to cover your sneeze
- ☐ To use a tissue to cover your sneeze
- ☐ To take antibiotics
- ☐ To drink plenty of fluids

After we sneeze into our hands, we should: (1point)

What should you do with a tissue after sneezing into it? (1 point)

SW2 Respiratory Hygiene Quiz

Lesson Plan

Introduction

1. Explain to students that many diseases are airborne and spread in tiny droplets of water, which are coughed and sneezed into the air by people.
2. 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.
3. 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.
4. 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. You may wish to discuss basic respiratory hygiene practices using SH1 Respiratory Hygiene Poster.

Discussion

Discuss with students the experiment, the hypothesis and their results. Were they surprised by the results in the activity?

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 preferably sneeze into a tissue and throw it away and wash your hands after.

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?

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.

Main Activity: Shot Gun

1 Write your name or draw your face on the circular paper (disk)

2 Place the paper faces in front of the spray bottle as if they are passengers on a bus

3 Spray the bottle and count how many people got sprayed

4 Repeat the experiment with hand then a kitchen towel covering the nozzle

Shot Gun Activity

1. Divide the class into groups of 8 – 10 students.
2. Provide each student in the class with a circular disk of paper. Ask them to draw a face and write their name on the paper. Tell the class that these disks 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 SW1 prior to the activity (answers provided on TS1).
3. Explain to the class that the 'people' are in a crowded place, which could be a school bus. Each student should place their disk in one of the positions as if they are on a bus. It is important that the central positions are roughly aligned at set distances. These disks will represent how far the sneeze has travelled and who it has affected en route. The other disks should be placed at varying distances away from each side of the central line these disks will represent how wide the sneeze has travelled and how many people it has affected en route. Write the distance on each disk.
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.

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.

Extension Activities

Spread of Infection on a Cruise Discussion

This activity can be used to demonstrate to students how infectious agents can easily spread globally, and that methods of prevention can be better than a cure.

In groups or as a class discussion explain:

1. They are going to predict how many people can become infected and how far influenza can travel in a week by one infected person.
2. Tell the class that they are on a Mediterranean cruise that will call at ports in Spain, France, Italy, Malta and Greece. At each port-of-call passengers can get off for shore excursions. On the cruise there are:
    a. A family of 4 on their way back to Australia.
    b. 12 passengers planning an onward journey from Greece to Turkey.
    c. 4 passengers planning an inter-railing excursion through Hungary, Czech Republic and Germany.
    d. The remaining passengers plan to return to the USA
3. On this cruise one man has a new strain of the influenza virus and it is very contagious.
    a. Hypothesise and consider 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?

Respiratory Hygiene Best Practise Discussion

In groups, individually or as a class discussion explain:

1. Three school friends, Sara, Elisa and Chloe, have all caught a cold and are coughing a lot. As you can see from the picture below, each student has adopted a different way of covering their coughs and sneezes.
2. 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

Respiratory Hygiene Quiz

Provide SW2 to groups of 4 - 5 students. This can be used before and after the lesson to test student's knowledge. The group with the most points wins the quiz.

Students can also create some simple rules or messages to reduce the spread of coughs, colds and flu in their school, for example:

- Coughs and sneezes spread diseases
- Catch it, bin it, kill it
- Cover my coughs and sneezes with a tissue or cough/sneeze into the crook of my elbow or sleeve (not my hand).
- Wash my hands after a cough or a sneeze or use hand sanitiser

Germ Defence

The website germdefence.org can be used as a tool to help students reduce the likelihood of getting colds, flu and stomach upsets, and from transmitting them on to other people. Students follow simple steps and can print or download a summary of the information they have reviewed.

Fascinating Fact

Lower respiratory infections remain the world's most deadly communicable (infectious) disease, ranked as the 4th leading cause of death. In 2019 it claimed 2.6 million lives.

Snot Gun Experiment: Teacher Answer Sheet

Questions

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

The paper disks 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 any of the sneezes contaminate any of the people on the side lines? If so, how many?

Sneeze alone	*As above*
Gloved hand	
Tissue	

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

Conclusions

1 Based on this experiment what have you learnt 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

Cover your coughs and sneezes

1

Use a tissue if you have one

If you have no tissue use your sleeve

2

Wash your hands for 20 seconds with soap and water.

To help keep time - sing 'Happy Birthday' twice

Snot Gun Experiment: Student Worksheet

Questions

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?

	Distance travelled	Number of people contaminated
Sneeze alone		
Gloved hand		
Tissue		

2. Did any of the sneezes contaminate any of the people on the side lines? If so, how many?

Sneeze alone	
Gloved hand	
Tissue	

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

Conclusions

1 Based on this experiment what have you learnt 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?

Quiz: Respiratory Hygiene

Please tick as many answers as appropriate

How can you spread microbes to others?
(3 points)

- [ ] Touching
- [ ] Sleeping
- [ ] Sneezing
- [ ] Coughing

When sneezing the best way to stop microbes from spreading is:
(1 point)

- [ ] To use your hand to cover your sneeze
- [ ] To use a tissue to cover your sneeze
- [ ] To take antibiotics
- [ ] To drink plenty of fluids

After we sneeze into our hands, we should:
(1point)

- [ ] Wash our hands
- [ ] Dry our hands on our clothes
- [ ] Take antibiotics
- [ ] None of the above is necessary

What should you do with a tissue after sneezing into it?
(1 point)

- [ ] Put it in your pocket for next time
- [ ] Put it straight in the bin
- [ ] Put it up your sleeve for next time
- [ ] Any of the above

If you do not have a tissue available, the best option from the following is to sneeze
(1 point)

- [ ] Into your hands
- [ ] Into your sleeve
- [ ] Into an empty space
- [ ] Onto your desk

What might happen if we don't wash our hands after sneezing into them?
(1 point)

- [ ] Nothing
- [ ] Transfer harmful microbes to other people
- [ ] Help protect our microbes

KEY STAGE 3 - LESSON 6

SAFECONSUME

Food Hygiene and Safety Resources

These resources have been funded by the European Union's SafeConsume project, which is an EU-wide project to reduce illness caused by foodborne pathogens. Find out more information at safeconsume.eu/.

The resources have been developed following research with students and teachers from across Europe and have been tested with schools during development.

Using these resources

Please find a summary of the SafeConsume lessons below. To access full information and resources, including teacher sheets, MS PowerPoints, student worksheets and answer sheets, please navigate to the e-Bug website using the link below.

Curriculum Links

PSHE/RSHE

- Health and prevention
- Healthy eating

Science

- Living things and their habitats

Key Words

Microbes, Foodborne illness, Bacteria, Use by, Best before, Refrigeration, Parasites

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e-bug.eu/eng/KS3/lessons/Food-Hygiene

The next series of food hygiene lesson plans have been developed as part of the SafeConsume project (safeconsume.eu), a European collaboration to reduce health burden from foodborne illnesses.

Lesson 1: Food Safety Scenarios

Lesson Content

Following research with consumers across Europe, several food related risk behaviours have been identified and we seek to improve education on these. This activity includes the key misconceptions surrounding date labels and food wastage.

Learning Outcomes

All students will:

- **Understand types of food labels and why these are important**
- **Understand the difference between food safety and food quality**
- **Understand how to store and use different types of food**
- **Understand the consequences of not following food labels properly**

Lesson 2: Useful and Harmful Microbes

Lesson Content

This activity includes the three main microbes and introduces a fourth microbe, parasites. Students learn how parasites might be found in food. Students will also learn how useful microbes are used in the food industry, and how harmful microbes can lead to foodborne illness. This lesson also includes the top five foodborne pathogens in Europe: *Salmonella*, *Campylobacter*, *Toxoplasma, Norovirus*, and *Listeria monocytogenes*.

Learning Outcomes

All students will:

- **Understand foodborne illness is caused by microbes, of which there are four different types**
- **Understand the difference between viruses, bacteria, parasites and fungi**
- **Understand there are useful microbes in food**
- **Understand the importance of handling food correctly to avoid foodborne illness**

Lesson 3:
The User Journey

Lesson Content

This activity includes the journey of food and the various food safety and cross-contamination risks from buying, to preparing, cooking and consuming food, and managing leftovers.

This lesson includes a helpful animation which highlights some key points within the user journey.

Learning Outcomes

All students will:

- **Understand that there are harmful microbes in food that can cause food poisoning, where they can be found, and risks and consequences of food poisoning.**
- **Understand cross-contamination and how it occurs and develop and normalise skills for good hand and food hygiene and preparation in everyday life to remain in good health.**
- **Understand the chain of infection and critical points for food hygiene.**

Food Safety Debate Kit

Extension Activity

In collaboration with 'I'm a Scientist', the food safety debate kit aims to help students understand the issues surrounding food hygiene and safety, and to practice their debating skills.

Debate question:
'Is it safer to eat at home or out at a restaurant?'

The different rounds of the debate help students think through the issues and reconsider their opinions. The structure also shows them how to build a discussion and back up their opinions with facts.

Where to find full information and resources

All information and resources related to the lesson plans summarised here can be found at e-bug.eu/eng/KS3/lessons/Food-Hygiene

KEY STAGE 3 - LESSON 7

Infection Prevention and Control (IPC):

Sexually Transmitted Infections (STIs)

A classroom-based activity demonstrates how easily STIs can be transmitted. Using chlamydia as an example, this lesson helps students to understand an individuals' susceptibility to STIs and the potential severity of its consequences.

Curriculum Links

Science

- Working scientifically

PSHE/RSHE

- Health and prevention
- Intimate and sexual relationships
- Sexual Health

English

- Reading
- Writing

Key Words

Chlamydia, Condom, Contraception, Safe sex, Sexually Transmitted Infections (STI)

Learning Outcomes

All students will:

- Understand that infection can be spread easily through sexual contact.
- Understand what students can do to protect themselves against STIs.
- Know that not everyone with an STI has symptoms.
- Understand how easily infections like chlamydia can spread among young people.

Most students will:

- Understand that non-barrier forms of contraception do not protect against STI.
- Begin to explore effective communication about condom use.

Resources Required

Main Activity:
Test tube experiment

Per student

- [ ] 3 clean test tubes
- [ ] Copy of SW1

Per class

- [ ] Test tube rack
- [ ] Iodine
- [ ] Starch
- [ ] Water
- [ ] Gloves
- [ ] Cling film or cotton balls

Activity 2: Safer sex: risks, communication and information

Per student

- [ ] Post-it notes
- [ ] Pens/pencils

Per class

- [ ] 4 A3 sheets of paper

Extension Activity:
If Chlamydia could talk

Per student

- [ ] Copy of SH1

Extension Activity: STI Quiz

Per group

- [ ] Copy of SW2

Advance Preparation

Section A

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

b. Replace one of the student's test tubes with starch

Section B

a. Half-fill a second set of test tubes with milk

b. Replace one of the test tubes with starch

Section C

a. Fill 4 test tubes with milk

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

c. Fill an extra test-tube with starch

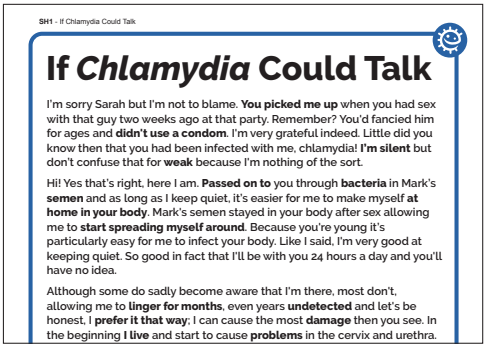
Health and Safety

For safe microbiological practices in the classroom consult CLEAPPS www.cleapps.org.uk

@ Weblink

e-bug.eu/eng/KS3/lesson/STIs

Supporting Materials



SH1 - If Chlamydia Could Talk

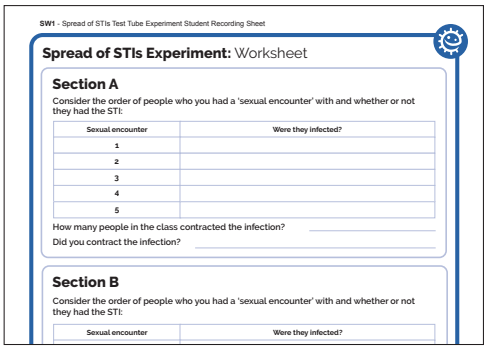
If *Chlamydia* Could Talk

I'm sorry Sarah but I'm not to blame. **You picked me up** when you had sex with that guy two weeks ago at that party. Remember? 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 that 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.

SH1 If Chlamydia Could Talk



SW1 - Spread of STIs Test Tube Experiment Student Recording Sheet

Spread of STIs Experiment: Worksheet

Section A

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

Sexual encounter	Were they infected?
1	
2	
3	
4	
5	

How many people in the class contracted the infection? _____

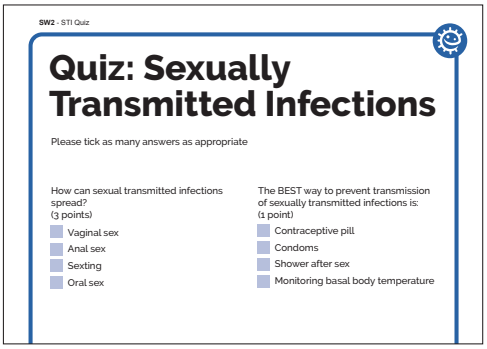
Did you contract the infection? _____

Section B

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

Sexual encounter	Were they infected?

SW1 Spread of STIs Test Tube Experiment Student Recording Sheet



SW2 - STI Quiz

Quiz: Sexually Transmitted Infections

Please tick as many answers as appropriate

How can sexual transmitted infections spread?
(3 points)

- ☐ Vaginal sex
- ☐ Anal sex
- ☐ Sexting
- ☐ Oral sex

The BEST way to prevent transmission of sexually transmitted infections is:
(1 point)

- ☐ Contraceptive pill
- ☐ Condoms
- ☐ Shower after sex
- ☐ Monitoring basal body temperature

SW2 STI Quiz

Lesson Plan

Introduction

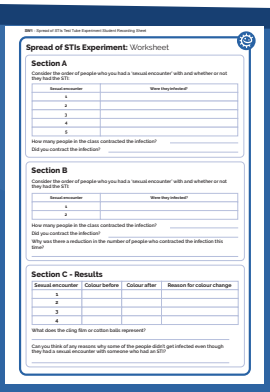
1. Recap on your sex education ground rules or use the suggested rules provided in the teacher refresher section at the start of the pack.
2. Begin the lesson by explaining to students that there are many ways in which microbes can be transmitted, e.g. touch, sneezing or through contaminated food or drinking water. Highlight that another important route of transmission is through the exchange of bodily fluid, i.e. unprotected sexual intercourse.
3. To prevent students being shy about the topic, ask if they have ever heard of any STIs and if they know what causes them.
4. Explain that STIs are generally transmitted through unprotected sexual contact i.e. not using a condom, although some of the infections can be transmitted in other ways such as shared needles and syringes, or skin to 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.
5. EMPHASISE that non-barrier forms of contraception, e.g. the contraceptive pill, DO NOT protect against STIs.
6. Note that the terms STI (Sexually Transmitted Infection) and STD (Sexually Transmitted Disease) are equivalent terms. An infection is defined as the invasion of the body by a microbe. While an infection can cause symptoms and complications, altering the normal function of the body, it does not depend upon this by definition. A disease, by contrast, causes specific health complications. STI is used as a broader term.

Main Activity: Test Tube Experiment

1 Pass liquid filled test tubes around, one of them will contain starch

2 Mix the fluids from your test tube with 5 other people

3 Find out who has the test tube with starch (STI) by testing everyone with iodine


Spread of STIs Experiment: Worksheet

Section A

Consider the order of people who you had a 'sexual encounter' with and whether or not they had the STI

Sexual encounter	Were they infected?
s	
1	
2	
3	
4	
5	

How many people in the class contracted the infection?

Did you contract the infection?

Section B

Consider the order of people who you had a 'sexual encounter' with and whether or not they had the STI

Sexual encounter	Were they infected?
s	
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?

Section C - Results

Sexual encounter	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 of the people didn't get infected even though they had a sexual encounter with someone who had an STI?

Test tube experiment

This activity is best carried out as a class exercise.

Section A

1. Explain to the students that they will be simulating sexual contact by exchanging milk (representing bodily fluid) between the two test tubes.
2. 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.
3. Tell each student that they must exchange fluid by mixing the contents of their test tubes with five other students (for a class smaller than 25 reduce exchanges to three or four). They will write this down later on SW1. Prompt students to mix outside their normal group of friends.
4. When finished, provide students with a copy of SW1. Tell the class that one of them carried fluid which contained a simulated STI. 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.

Section B

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

   This experiment reinforces how easily and inconspicuously and STI can spread from person to person.

Section C

1. Choose five people from the class to carry out a demonstration. Show the class which student has the 'infected'

test tube. Provide the other four students with the remaining test tubes, two of which are covered in cling film.

2. Ask the student with the 'infected' tube to have a 'sexual encounter' with each of the five other students in turn.

NOTE 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.

3. Test each of the student samples for an STI using the iodine.

4. Indicate that during these sexual encounters the cling film represented a condom and that these students didn't contract the infection.

Possible discussion points with students after this experiment include:

a. The ease of transmission:

Discuss with the students how easy the STI was spread from one person to the next. Were they surprised about any of the ways STIs can spread from person to person?

b. Reducing the risk of infection:

Talk about how far and quickly STIs can spread and how reducing the number of contacts automatically reduces the risk of infection.

c. Personal responsibility for your own health:

It is important that young people are responsible for and feel empowered to look after their own health, this includes their sexual health. We should avoid discussions around 'blame' of sexual partners.

d. Difficult conversations:

Imagining a difficult conversation where you have to advise a sexual partner to get checked/treated for an STI - better to prevent infection instead.

Activity 2: Brainstormer: Safer sex, Risks and Communication and Information

1. Put five large sheets of paper up around the room, with the following questions written on each sheet:

   - What are the risks of having unprotected sex?
   - What does safe sex mean to you?
   - How can we communicate with each other to make sex safer?
   - How can we become more comfortable talking about safer sex with partners and in general?
   - Where can we find trusted sources of information about safer sex?

2. Provide students with post-it notes. Ask students to write their thoughts and suggestions on the post-it notes and then stick their answers onto the relevant sheets.

3. Building on the discussion, depending on how confident the class are, ask students to rehearse some of the skills that will help them to overcome problems they may experience e.g. overcoming embarrassment of buying condoms or resisting pressure to have unprotected sex.

Extension Activities

If *Chlamydia* Could Talk

Explain to students that if a chlamydia infection is not treated it can lead to serious problems for both men and women. In this activity students will understand what happens inside our bodies when a person becomes infected with *Chlamydia trachomatis* - from the bacterium's point of view.

Provide students with a copy of SH1 – 'If *Chlamydia* Could Talk' to read. Explain that Sarah has been infected with chlamydia and the bacterium *Chlamydia trachomatis* is telling Sarah its story.

Now ask students to work in groups of 2-3 using their knowledge of STIs including chlamydia, to design a visual representation for the school i.e. an infographic, to consolidate their knowledge and educate their peers. Ask students to use government, NHS and UK Health Security Agency websites to add key official statistics (if website access is available).

Guest Speaker

Invite a guest speaker from a local young persons' clinic or a school nurse to give a talk about the free and confidential services available. Write a list of questions you/students would like to ask in advance.

STI Quiz

Provide SW2 to groups of 3 or 4 students. The group with the most points wins. Alternatively the quiz can be completed at the beginning and end of the lesson to measure understanding. Answers are available on the e-bug website.

Discussion

Check for understanding by asking the students the following questions:

Who can contract STIs?

Anyone who has had unprotected sex with someone who has an STI can contract an STI. ANYONE can contract an STI. You only need to have a sexual encounter with an infected person once to contract the infection, and anyone can be infected- they might not know it.

How can we reduce the risk of contracting an STI?

There are several ways to prevent contracting an STI. These include:

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. People should get tested and have regular check-ups: When sexually active, especially if you change sexual partners, 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.

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.

Do other forms of contraception, other than the condom, protect against STIs?

NO. The other methods of contraception only protect against pregnancy, they will NOT protect against contracting an STI.

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, bleeding between periods and/or an unusual discharge from the genital region.

Does everyone who contracts an STI show symptoms?

NO, STIs are a common problem because many people are infected without realising it. In some cases, women do not realise they have an infection until they show infertility problems in later life.

Where can I go for further advice and be tested?

Ask your school nurse or General Practitioner (GP), or visit a GUM clinic.

Ordering a home testing kit online is now much more widely available.

Spread of STIs Experiment: Worksheet

Section A

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

Sexual encounter	Were they infected?
1	
2	
3	
4	
5	

How many people in the class contracted the infection? _____

Did you contract the infection? _____

Section B

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

Sexual encounter	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?

_____

Section C - Results

Sexual encounter	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 of the people didn't get infected even though they had a sexual encounter with someone who had an STI?

_____

Quiz: Sexually Transmitted Infections

Please tick as many answers as appropriate

How can sexual transmitted infections spread?
(3 points)

- ☐ Vaginal sex
- ☐ Anal sex
- ☐ Sexting
- ☐ Oral sex

The BEST way to prevent transmission of sexually transmitted infections is:
(1 point)

- ☐ Contraceptive pill
- ☐ Condoms
- ☐ Shower after sex
- ☐ Monitoring basal body temperature

Who can contract an STI?
(1 point)

- ☐ Anyone who has had unprotected sex
- ☐ Only single people
- ☐ Only older people
- ☐ Only men

Which of the following are STIs?
(2 points)

- ☐ Chlamydia
- ☐ Gonorrhoea
- ☐ Influenza
- ☐ Malaria

Do sexually transmitted infections have symptoms
(1 point)

- ☐ Always
- ☐ Never
- ☐ It depends on the infection
- ☐ Yes, but only in females

Infection Prevention and Control (IPC): Sexually Transmitted Infections (STIs)
See www.e-bug.eu for the answers

If *Chlamydia* Could Talk

I'm sorry Sarah but I'm not to blame. **You picked me up** when you had sex with that guy two weeks ago at that party. Remember? 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 that 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**. 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, 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**?! 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... On the other hand, **I may just decide** to **keep quiet** 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.....

KEY STAGE 3 - LESSON 8

Infection Prevention and Control (IPC): Vaccinations

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

Curriculum Links

Science

- Working scientifically
- Cells and organisation
- Experimental skills and investigations
- Analysis and evaluation

PSHE/RSHE

- Health and prevention

English

- Reading
- Writing

Geography

- Human and physical geography
- Geographical skills and fieldwork

Key Words

Antibody, Antigen, Immune system, Immunity, Vaccines, White blood cell

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e-bug.eu/eng/KS3/lesson/Vaccinations

Learning Outcomes

All Students will:

- Understand that the human body has many natural defences to fight infection, including the 3 main lines of defence.
- Understand that both vaccines and becoming infected and developing natural immunity help prevent a range of bacterial and viral infections.
- Understand that the most common infections such as the common cold or sore throat are not prevented by vaccines.

Resources Required

Main Activity:
Herd Immunity Class Stimulation
Per Student

- [ ] One of each coloured cards taken from SH1 through SH5
- [ ] Copy of SW1

Extension Activity:
World Map Activity
Per student

- [ ] Copy of SW2

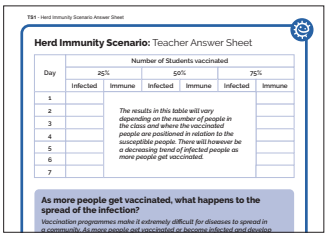
Advance Preparation

1. Laminate or stick a copy of SH1-SH5 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 SW1 and SW2 for each student.
3. Copy of TS1 Teacher Answers

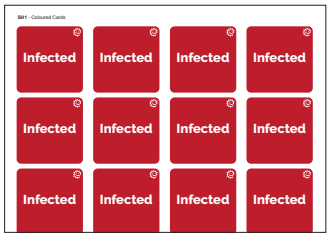
Fascinating fact

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

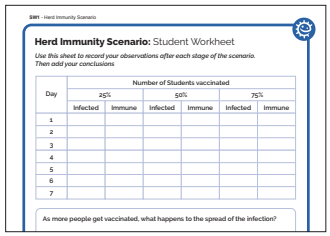
Supporting Materials



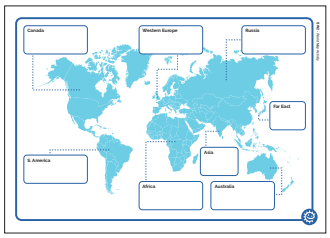
TS1 Herd Immunity Scenario Answers



SH1-5 Coloured cards



SW1 Herd Immunity Scenario



SW2 World Map

Lesson Plan

Introduction

1. Begin the lesson by asking students which vaccines/immunisations they have had, e.g. polio, MMR 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, inactive and harmless amount of the microbe/disease which teaches our body how to fight the harmful microbe when or if we get attacked by the disease.
4. Explain how vaccines work. Explain that antibodies pass from mother to child through the placenta in the womb and breast milk after birth helping to protect new-born babies from disease. However, this doesn't work for all diseases, e.g. women are given a vaccine when they are pregnant to protect their unborn baby from whooping cough. This will provide protection from when the baby is born until they are old enough to have their own vaccine (8 weeks old).
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: Herd Immunity Class Simulation

1 Make sure everyone has a red, white, blue and yellow card

2 25% of the class will be provided with a piece of paper saying 'vaccinated' and the rest with 'susceptible' – don't let anyone see what card you have

3 The person in the middle of the class raises their hand with the red card

4 The people next to the red card 'infected' person are now infected, and so on

5 Only 'vaccinated' people are not infected

6 Continue the game by holding blue recovering cards to mark day 2

7 Now, we will repeat the game with 50% and 75% vaccinated

Herd Immunity Class Stimulation

Scenario 1 – Demonstration of the spread of infection and immunity through vaccination

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.

Provide everyone in the class with a red (infected), white (immune), blue (recovering but still infectious) and yellow (vaccinated) card (SH1 – SH5).

1. Ensure that each student has a set of cards. Explain to the class that in this scenario they are going to observe what happens during vaccination programmes.
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. 25% vaccinated: 75% susceptible

   Give 25% of the students the paper with the word vaccination (yellow card) and the rest of the class the paper with the word susceptible (purple card).
3. 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 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. This marks the end of day one. We say the end of day one because it takes that long for the infection to incubate and for the first symptoms of the infection to manifest themselves.

4. After a few seconds tell the class it is now day two. Student one should now be holding a blue card i.e. s/he is recovering but still infectious. Student two 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.
5. After a few seconds tell the class it is now day three.
    a. Student one 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 two should now be holding a blue card, i.e. s/he is recovering but still infectious.

    c. Student three and four should be holding red cards i.e. they are now infected.
6. Continue steps 1 – 3 for up to 7 days and ask students to complete the Scenario section of their worksheets (SW1, answers on TS1).
    a 50% vaccinated: 50% susceptible

      As above, however, give 50% of the students the yellow 'vaccinated' card and the rest of the class the purple 'susceptible' card.

    b 75% vaccinated: 25% susceptible

      As above, however, give 75% of the students the yellow 'vaccinated' card and the rest of the class the purple 'susceptible' card.

      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 or infection of a portion of a population provides protection to unprotected individuals.

Extension Activity

World Map Activity

Provide the class with a copy of SW2.

Ask students to study the world map and record the vaccines that are required for specific countries in each region. Students should also name the disease that the vaccine provides protection for and the microbe that causes the disease. Ask students to use government, NHS, World Health Organisation and UK Health Security Agency websites (if website access is available) to help them to investigate current vaccine information.

Learning Consolidation

Ask students to write a paragraph or three statements to summarise what they have learned during the lesson.

Discussion

Check for student understanding by discussing these points.

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.

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.

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.

Herd Immunity Scenario: Teacher Answer Sheet

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 or become infected and develop natural immunity 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 vaccination of a portion of the population or becoming infected and developing natural immunity 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.


Infected

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

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

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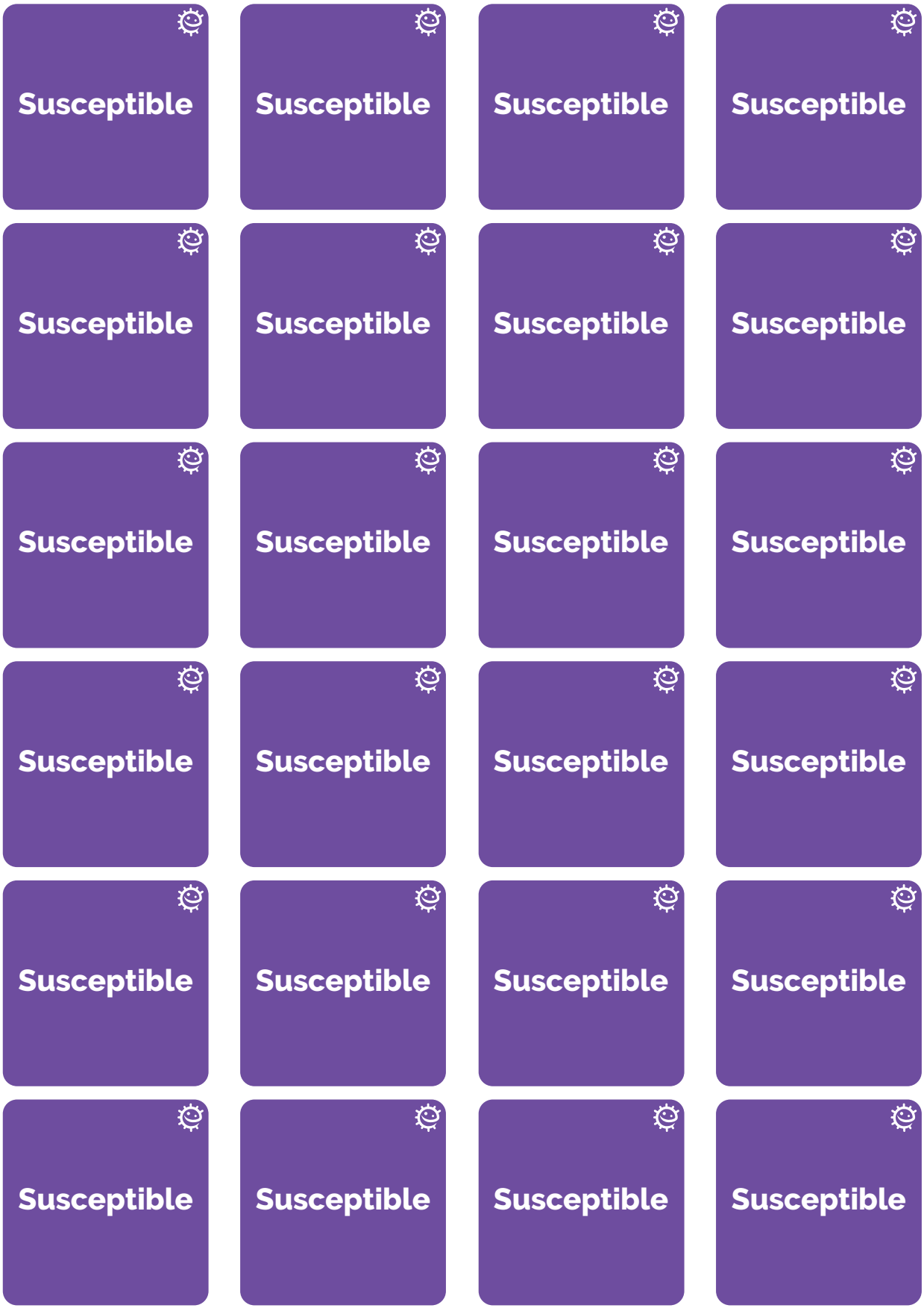

Susceptible

Herd Immunity Scenario: Student Workheet

Use this sheet to record your observations after each stage of the scenario. Then add your conclusions

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

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

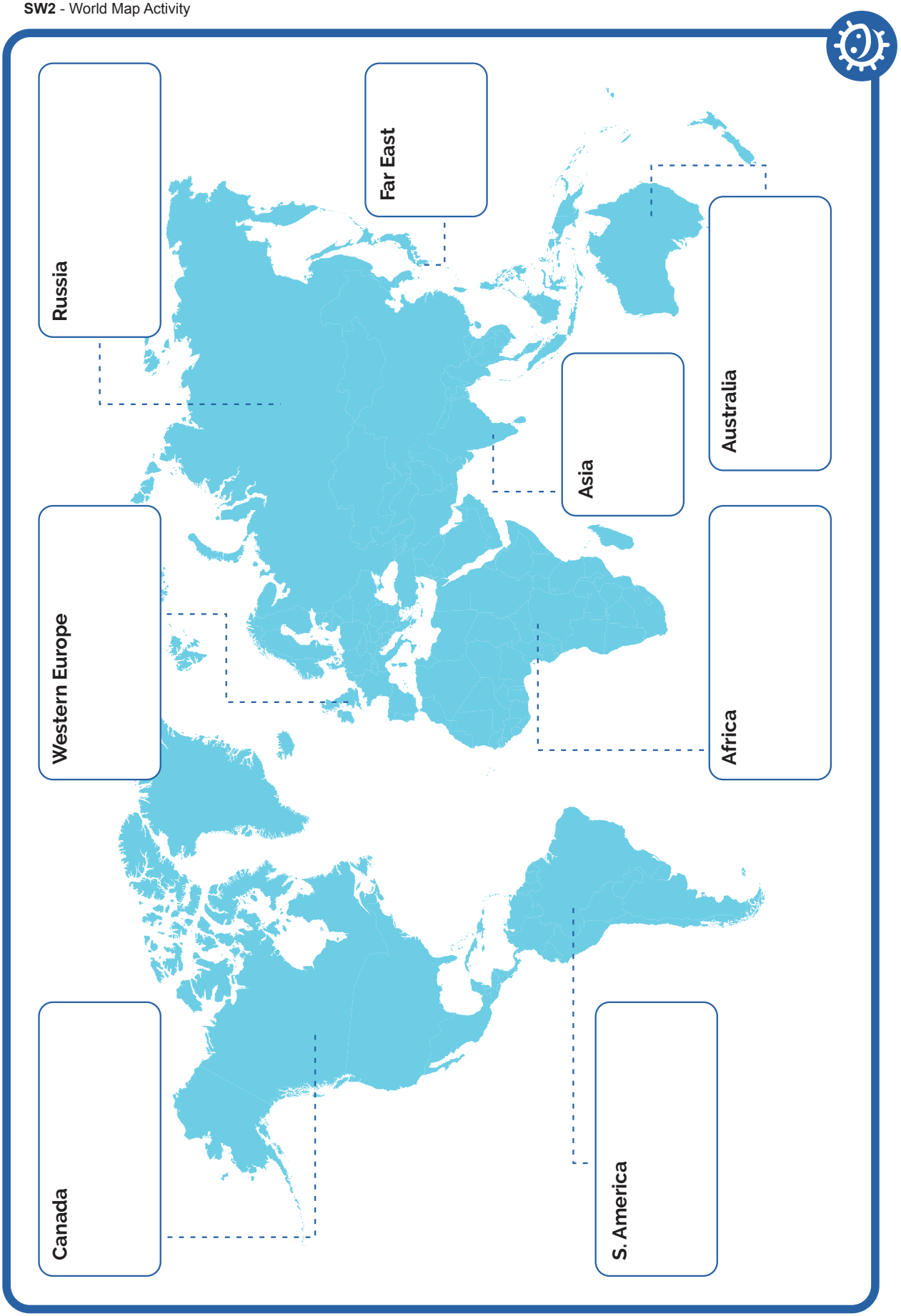
Draw a graph to illustrate the results.

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?


Russia
Far East
Australia
Asia
Western Europe
Africa
Canada
S. America

KEY STAGE 3 - LESSON 9

Treatment of Infection:

Antibiotic Use and Antimicrobial Resistance

This lesson introduces students to the growing global public health threat of antimicrobial resistance (AMR) through an interactive bacteria flash card game.

Curriculum Links

Science

- Working scientifically
- Scientific attitudes
- Experimental skills and investigations
- Analysis and evaluation

PSHE/RSHE

- Health and prevention

English

- Reading
- Writing

Key Words

Antibiotic, Antimicrobial, Immune system, Infection, Natural selection

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e-bug.eu/eng/KS3/lesson/Antibiotic-Antimicrobial-Resistance

Learning Outcomes

All students will:

- Understand that antibiotics only work on bacterial infections.
- Understand that most common infections will get better by themselves through time, bed rest, hydration and healthy living.
- Understand that if you have antibiotics prescribed, finish the course. If, for whatever reason you have leftover antibiotics, you should dispose of them by returning these to your local pharmacy.
- Understand that you must not use leftover antibiotics from a previous course or antibiotics prescribed for other people.
- Understand that overuse of antibiotics can damage our normal/useful bacteria.
- Understand that bacteria are becoming resistant to antibiotics due to overuse.

Resources Required

Main Activity: Antibiotics can/can't:

Per pair

- [ ] A pair of scissors for cutting out
- [ ] Paper glue/sticky tape
- [ ] Copy of SW1

Activity 2: Antimicrobial Resistance Flash Card Game

Per group

- [ ] Copy of SH1-4

Discussion

- [ ] Copy of SW2 (SW3 Differentiated Worksheet adaptable for students of different abilities)

Extension Activity: Bacterial Lawn Growth

Per class

- [ ] A variety of antibiotic/ antiseptic solutions e.g. antibacterial soap, honey
- [ ] A pack of 5mm filter paper disks

Per student/pair

- [ ] Agar plates

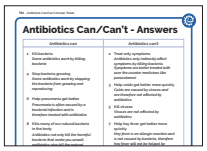
Extension Activity: Antibiotic Resistance Debate Kit

- [ ] Download from: debate.imascientist.org.uk/antibiotic-resistance-resources/

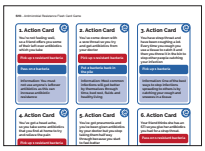
Advance Preparation

1. Download the e-Bug Antibiotics Discovery and Resistance presentation (e-bug.eu/eng/KS3/lesson/AntibioticAntimicrobial-Resistance)
2. Copy of TS1 Antibiotics Can/Can't Teacher answers
3. Download the TS2 Agar Plate preparation teacher sheet available from (e-bug.eu/eng/KS3/lesson/AntibioticAntimicrobial-Resistance)

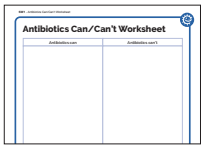
Supporting Materials



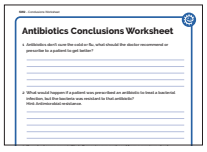
TS1 Antibiotics Can/Can't Answers



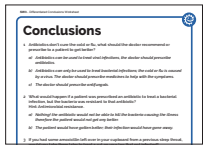
SH1-4 AMR Flash Card Game



SW1 Antibiotics Can/Can't Game



SW2 Conclusions worksheet



SW3 Differentiated Conclusions

Lesson Plan

Introduction

1. Start the lesson by asking students if they've ever had an antibiotic and if they know what antibiotics are used for. Then explain what an antibiotic is – that it is a type of medicine that kills or stops bacteria increasing in number.

2. Tell students the story of how antibiotics were discovered by Alexander Fleming. In 1928 Alexander Fleming went on holiday and left some laboratory agar plates from an unrelated experiment out on his desk. When he came back from holiday he discovered that the bacteria growing in his agar plates couldn't grow near the mould that was also growing on the plate, he concluded that the mould had produced a chemical to protect itself from the bacteria using an antibacterial agent. Scientists used this new chemical to develop antibiotics.

3. Explain that before the development of antibiotics, such as during World War 2, people with injuries died from bacterial infections. Once antibiotics were being produced many deaths and diseases were prevented and surgeons were able to perform much more difficult operations, like hip replacements.

4. Explain how antibiotics kill our body's useful bacteria (commensals) leaving our body open to harmful microbes (pathogens). One or two bacteria may change (mutate) so the antibiotic cannot kill them – these are antibiotic resistant bacteria.

5. Explain that overuse and misuse of antibiotics has led to bacteria developing resistance to antibiotics through natural selection (survival of the fittest).

6. Emphasise that everyone can help prevent antibiotic resistance getting worse by:

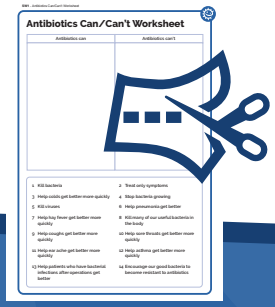
    - only using antibiotics when prescribed by a health care professional (HCP)
    - finishing your course of antibiotics as recommended by your HCP
    - not using left over antibiotics (if for any reason you don't finish your course of antibiotics, any left over should be given to your local pharmacy to dispose of)
    - not using antibiotics for most ear aches, sore throats or any colds or flu which are usually caused by viruses.

Main Activity: Antibiotics Can/Can't Game

1 Cut out the series of statements

2 Decide whether to stick the statement under 'Antibiotics can' or 'Antibiotics can't'

3 Go thorough your answers with the class



Activity 2: Antimicrobial Resistance Flash Card Game

1 Place the resistance bacteria card deck and action cards facing down

2 Make sure each player has 4 normal bacteria cards

3 Take turns to pick up an action card and read it aloud to the group

4 The player with the most normal bacteria cards wins!

Main Activity: Antibiotics Can/Can't Game

1. This activity should be carried out in pairs.
2. Provide each pair with SW1 and a pair of scissors for cutting out the statements on the bottom half of the page.
3. Explain to students that they need to cut out each of the statements. They then need to work together to decide whether the statement suggests something which is true to antibiotics or not, by placing each statement within the chart provided.
4. Once each group has completed the activity go through the correct answers and their reasons for the way they have categorised the statements, and explain each statement if necessary, using TS1.
5. As you go through the correct answers ask students to stick the statements into the correct side of the chart. By the end, students will have an understanding of what antibiotics can/can't treat.

Activity 2: Antimicrobial Resistance Flash Card Game

1. Ask students to get into groups of two, three or four.
2. Provide each group with a set of cards from SH1, SH2, SH3 and SH4. Explain to the class that this activity will demonstrate how bacteria can be spread and how bacteria can develop antibiotic resistance.
3. Explain to the class that the aim of the game is to keep as many 'normal bacteria' as possible and to avoid the 'resistant bacteria'. The player at the end of the game with only a hand of 'resistant bacteria' loses and ends the game.
   a. Explain that 'resistant bacteria' are bacteria that have been exposed to too many antibiotics and have developed resistance – antibiotics won't work on these bacteria now.
   b Explain that 'bacteria' haven't developed resistance and can still be treated with antibiotics.

Instructions

1. Place the 'resistant bacteria' deck facing upwards on the table within reach of each player.
2. Place the 'action cards' face down on the table within reach of each player.
3. Each player starts the game with four 'bacteria' cards in their hand, the rest should be placed in a separate deck on the table facing upwards.
4. The first player to start picks up an 'action card' and reads the instruction aloud to their group.
   a. If the instruction is to 'pass a card' the player must pass the relevant bacteria card to their opponent or the person on their left and place the 'action card' to the bottom of the deck.
   b. If the instruction is to 'return a card' the player must return the relevant bacteria card to the corresponding deck and place the 'action card' to the bottom of the deck.
   c. If the player isn't holding the relevant bacteria card, they must return the 'action card' to the bottom of the 'action card' deck and miss a go.
5. The game ends when a player has only 'resistant bacteria' cards in their hand. In groups of 2 the winner is the one still with 'bacteria'. If three or more people are playing, the winner is the person with the most 'bacteria' cards in their hand at the end.

Extension Activities

Growth of Bacterial Lawn

Students can investigate the effect of antibiotics/antiseptics on bacterial growth.

1. Prepare the agar plates of colony bacteria in advance of the lesson using aseptic technique throughout preparation. See website (e-bug.eu/eng/KS3/lesson/AntibioticAntimicrobial-Resistance) for TS2 agar plate preparation with guidance.
2. Distribute a plate per student or between pairs depending on the number of agar plates prepared and available.
3. Ask the students to soak 5mm filter paper disks in a variety of solutions e.g. antibacterial soap, antiseptic solution, honey.
4. Ask students to add the disks to the surface of the agar plate and seal the plates. Make sure the students also add a control disk to their plate (a paper disk not soaked in anything).
5. Incubate the plates and allow for sufficient time (overnight in an incubator) to allow bacterial growth.
6. After incubation, ask students to examine the pattern of bacterial growth around each paper disk.
7. Ask students to observe the clear area around the paper disk (this is called the zone of inhibition). Students can compare how the zone of inhibition varies for the different antibacterial/antiseptic solutions that the disks were soaked in. Students should observe larger zones of inhibition with antibiotics and antiseptic solutions compared to honey and other solutions.

Antibiotic Resistance Debate Kit

In collaboration with 'I'm a Scientist', e-Bug has developed debate kits on antibiotic resistance and vaccinations. Full teacher instructions are provided for how to use the kits. The kits can be used in different school and community settings to encourage young people to discuss topical issues surrounding antibiotics and vaccines.

Kits can be downloaded from Download from https://debate.imascientist.org.uk/antibioticresistance-resources

Discussion

Discuss the questions on the student worksheets (SW2/3) with the class:

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

Antibiotics can only treat bacterial infections and the cold or flu is caused by a virus. In many cases the body's own natural defences will fight coughs, colds and the flu however other medicines from the pharmacist can help with the symptoms of coughs and cold e.g. pain killers to help reduce the pain and fever associated with the infection.

Differentiated answer: b

What would happen if a patient was prescribed an antibiotic to treat a bacterial infection, but the bacteria was resistant to that antibiotic?

Nothing. The antibiotic would not be able to kill the bacteria causing the illness therefore the patient would not get any better.

Differentiated answer: a

If you had some amoxicillin left over in your cupboard from a previous chest infection, 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.

If for any reason you do have left over antibiotics, you should take these to the pharmacist for disposal

Differentiated answer: a

A patient doesn't want to take the prescribed flucloxacillin 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.

Differentiated answer: c

Antibiotics Can/Can't - Answers

Antibiotics can	Antibiotics can't
1 Kill bacteria *Some antibiotics work by killing bacteria*	2 Treat only symptoms *Antibiotics only indirectly affect symptoms by killing bacteria. Symptoms are better treated with over the counter medicines like paracetamol*
4 Stop bacteria growing *Some antibiotics work by stopping the bacteria from growing and reproducing*	3 Help colds get better more quickly *Colds are caused by viruses and are therefore not affected by antibiotics*
6 Help pneumonia get better *Pneumonia is often caused by a bacterial infection and is therefore treated with antibiotics*	5 Kill viruses *Viruses are not affected by antibiotics*
8 Kills many of our natural bacteria in the body *Antibiotics not only kill the harmful bacteria that make you unwell, antibiotics also kill the natural bacteria (commensal) that help keep you healthy*	7 Help hay fever get better more quickly *Hay fever is an allergic reaction and is not caused by bacteria, therefore hay fever will not be helped by antibiotics*
13 Help patients who have bacterial infections after operations get better *A person can easily catch a bacterial infection after they have had an operation if they have stitches or an open wound. Antibiotics are important to treat any infections so they can recover more quickly*	9 Help coughs get better more quickly *Most coughs are caused by viruses and are therefore not helped by antibiotics*
14 Encourage our natural bacteria to become resistant to antibiotics *The bacteria in our bodies can become resistant to antibiotics through natural selection.*	10 Help sore throats get better more quickly *Most sore throats are caused by viruses and are therefore not helped by antibiotics*
	11 Help ear ache get better more quickly *Most ear infections are caused by viruses and are therefore not helped by antibiotics*
	12 Help asthma get better more quickly *Asthma is caused by inflammation of the lungs and is not caused by bacteria, therefore asthma will not be helped by antibiotics*

Resistant Bacteria

Bacteria that can no longer be killed by some or all antibiotics. This is called antibiotic resistance.

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Bacteria

Bacteria haven't developed resistance, therefore they can still be killed by antibiotics

1. Action Card

You're not feeling well, so a friend offers you some of their left over antibiotics which you take

Pick up 1 resistant bacteria

Pass on 2 bacteria

Information: You must not use anyone's leftover antibiotics as this can increase antibiotic resistance

2. Action Card

You've come down with a sore throat so you try and get antibiotics from your doctor

Pick up 1 resistant bacteria

Put 2 bacteria back in the pile

Information: Most common infections will get better by themselves through time, bed rest, fluids and healthy living

3. Action Card

You have strep throat and have been coughing a lot. Every time you cough you use a tissue to catch it and then you throw it in the bin to stop other people catching your infection

Pick up 1 bacteria

Information: One of the best ways to stop infections spreading to others is by catching your cough and sneezes in a tissue

4. Action Card

You've got a head ache, so you take some antibiotics that you find at home to try and relieve the pain

Pick up 1 resistant bacteria

Put 2 bacteria back in the pile

Information: Antibiotics only treat bacterial infections, they will not help your headache get better

5. Action Card

You've got pneumonia and you've been given antibiotics by your doctor but you stop taking them half way through because you start to feel better

Pick up 1 resistant bacteria

Put 2 bacteria back in the pile

Information: Take the course of antibiotics exactly as told to by your doctor or pharmacist

6. Action Card

Your friend thinks she has an STI so you give her antibiotics you had for a strep throat.

Pass on 1 resistant bacteria

Pass on 1 bacteria

Information: antibiotics should only be taken
- for the illness for which it was prescribed
- by the patient it was prescribed to
- when it was prescribed, not at a later date

7. Action Card

You cook lunch for you and your friends but you forget to wash your hands after you cut up the raw chicken before you cook it

Pass on 1 resistant bacteria

Pass on 1 bacteria

Information: You should always remember to wash your hands to stop harmful bacteria spreading, especially after touching raw meat

8. Action Card

You visit a friend in hospital but you forget to wash your hands when you leave

Pick up 1 resistant bacteria

Put 2 bacteria back in the pile

Information: Always remember to wash your hands to prevent the spread of infection, especially in hospitals where microbes may be harmful

9. Action Card

You're cooking lunch for yourself and handle raw chicken. You wash your hands thoroughly afterwards

Put 1 resistant bacteria back in the pile

Take 1 bacteria from the person to your left

Information: You should always remember to wash your hands, especially before and after making food

10. Action Card

Your friend offers you some of their left over antibiotics for your cough. You say no and suggest they take them to a pharmacy for safe disposal

Put 1 resistant bacteria back in the pile

Information: You must not use anyone's antibiotics as this can increase antibiotic resistance in your gut

11. Action Card

You go on holiday abroad and buy antibiotics at a chemist to use the next time you are ill

Pick up 1 resistant bacteria

Put 2 bacteria back in the pile

Information: It is important to only take antiotics prescribed for you by a healthcare professional; some may cause harm

12. Action Card

Your mother has a bad chest infection and is on antibiotics. You develop a cough and use some of her antibiotics

Pick up 1 resistant bacteria

Put 1 bacteria back in the pile

Information: You must not use anyone's antibiotics as this can increase antibiotic resistance

13. Action Card

You are given antibiotics as you have huge swollen tonsils with pus on them and you have a fever.
But you forget to take the antibiotics four times a day

Pick up 1 resistant bacteria

Put 1 bacteria back in the pile

Information: Take antibiotics exactly as told to by your doctor or pharmacist

14. Action Card

You have bad spots but the cream you are using isn't working. You ask your doctor for antibiotics

Pick up 1 resistant bacteria

Put 1 bacteria back in the pile

Information: Antibiotics aren't the only way to treat acne, speak to your doctor about all of your options

15. Action Card

You have a really bad cold and runny nose. You go to bed and take paracetamol to help the fever

Pick up 1 bacteria

Information: The only way to treat a cold and runny nose is to get plenty of rest, drink plenty of fluids and use paracetamol to manage symptoms

16. Action Card

You have diarrhoea and vomiting, you stay at home to stop it spreading and you wash your hands regularly

Pick up 1 bacteria

Information: When you are ill you should always remember to wash your hands to prevent the spread of infection. Staying at home and resting will help you recover

17. Action Card

You notice that there are left over antibiotics in your medicine cabinet from when you had an infected wound. You take them back to the pharmacy for disposal.

Put 1 resistant bacteria back in the pile

Information:
antibiotics should only be taken
- for the illness for which it was prescribed
- by the patient it was prescribed to
- when it was prescribed, not at a later date

It is important to return any leftover medicine to the pharmacy for disposal to prevent harming the environment

18. Action Card

You're at a friend's house and your friend is making lunch. You remind your friend to wash their hands when they finish scrubbing the potatoes

Put 1 resistant bacteria back in the pile

Information: You should always remember to wash your hands to prevent the spread of bacteria, especially before and after making food

Antibiotics Can/Can't Worksheet

Antibiotics can	Antibiotics can't

1 Kill bacteria

2 Treat only symptoms

3 Help colds get better more quickly

4 Stop bacteria growing

5 Kill viruses

6 Help pneumonia get better

7 Help hay fever get better more quickly

8 Kill many of our useful bacteria in the body

9 Help coughs get better more quickly

10 Help sore throats get better more quickly

11 Help ear ache get better more quickly

12 Help asthma get better more quickly

13 Help patients who have bacterial infections after operations get better

14 Encourage our good bacteria to become resistant to antibiotics

Antibiotics Conclusions Worksheet

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

2 What would happen if a patient was prescribed an antibiotic to treat a bacterial infection, but the bacteria was resistant to that antibiotic?
Hint: Antimicrobial resistance.

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

4 A patient doesn't want to take the prescribed flucloxacillin 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?

Conclusions

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

a) Antibiotics can be used to treat viral infections, the doctor should prescribe antibiotics.

b) Antibiotics can only be used to treat bacterial infections; the cold or flu is caused by a virus. The doctor should prescribe medicines to help with the symptoms.

c) The doctor should prescribe antifungals.

2 What would happen if a patient was prescribed an antibiotic to treat a bacterial infection, but the bacteria was resistant to that antibiotic?
Hint: Antimicrobial resistance.

a) Nothing! the antibiotic would not be able to kill the bacteria causing the illness therefore the patient would not get any better.

b) The patient would have gotten better; their infection would have gone away.

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

a) 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.

b) No, you should get some new medicine.

c) Yes.

4 A patient doesn't want to take the prescribed flucloxacillin 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?

a) The patient should not have taken their medicine.

b) The patient should only have taken one pill.

c) It is very important to finish a course of prescribed antibiotics, not just stop halfway through. Failure to finish the course may result in not all the bacteria being killed and possibly becoming resistant to that antibiotic in future.

Glossary

Acquired immunity	**Immunity developed over your lifetime as a result of exposure to pathogens.**
Aerosol	**A suspension of fine solid particles or liquid droplets in air or another gas.**
AIDS (Acquired Immune Deficiency Syndrome)	**The name used to describe a number of potentially life-threatening infections and illnesses that happen when your immune system has been severely damaged by the HIV virus.**
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	**A special marker or part of a microbe that when introduced into the body stimulates the production of an antibody by white blood cells.**
Antimicrobial	**An agent that kills or prevents the growth of microbes.**
Antimicrobial Resistance (AMR)	**When bacteria, viruses, fungi and parasites change over time and no longer respond to medicines (antimicrobials), making infections harder to treat and increasing the risk of disease spread, severe illness and death.**
Bacteria	**Microscopic single celled microbes that can be useful or harmful to humans. Bacterium is the singular of bacteria**
Binary fission	**A type of asexual reproduction that involves the splitting of a body unit to two units. In the process, the organism duplicates it's genetic material.**
Cell	**The smallest structural unit of an organism that is capable of working independently.**

Chlamydia	**A common sexually transmitted infection caused by a bacteria.**
Colony	**A group of microbes grown from a single parent cell.**
Colonise	**Ability to survive and grow on humans without necessarily causing harm.**
Condom	**Sheath-shaped barrier to practice safe sex and a form of contraception.**
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.**
COVID-19	**An illness caused by a virus that can cause flu-like symptoms.**
Cross Contamination	**Cross-contamination is the transfer of harmful microbes from one item of food to another via a non food surface such as human hands, equipment, or utensils. It may also be a direct transfer from a raw to a cooked food item.**
Culture	**The growth of microbes in a specially prepared growth medium.**
Dentine	**Hard substance under the top layer of teeth (enamel) which surrounds the pulp (nerve) in the centre.**
Dermatophytes	**A group of fungi that like to grow in or on the skin and scalp.**
Disease	**An illness that has a group of signs or symptoms.**
Epidemic	**Wide-spread occurrence of an infectious disease in a community over a certain time.**
Experiment	**A test carried out to observe whether or not an idea or theory is true.**
Fermentation	**A process by which microbes break down complex sugars into simple compounds such as carbon dioxide and alcohol.**
Fungi	**The largest of the microbes. Unlike bacteria or viruses, fungi are multi cellular.**
Genetic modification	**A technique to change the characteristics of a plant, animal or micro-organism by transferring a piece of DNA from one organism to a different organism.**

Germs	**Another word for harmful or pathogenic microbes.**
Gonorrhoea	**A sexually transmitted infection caused by a bacteria (*Neisseria gonorrhoeae*).**
Herpes	**A sexually transmitted infection caused by the Herpes simplex virus (HSV).**
Herd immunity	**Occurs when a large proportion of a community (the herd) develops immunity to a certain disease. As a result, the whole community is protected.**
HIV (Human Immunodeficiency Virus)	**A virus that damages the cells in your immune system and weakens your ability to fight everyday infections.**
HPV (Human papillomavirus)	**A common sexually transmitted infection caused by a virus.**
Hygiene	**Conditions and practices that serve to promote and preserve health and reduce spread of infection.**
Illness	**Poor health resulting from disease.**
Immunise	**Perform vaccinations or produce immunity by inoculation of a substance that is similar to part of the microbe you want to protect against.**
Immune system	**The collection of organs, tissues, cells, and cell products such as antibodies that helps to remove microbes or substances from the body.**
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 protective attempt by the body to remove the microbe or unknown substance as well as initiate the healing process for the tissue.**
Innate immunity	**The first immunological, non-specific mechanism for fighting infections.**
Inoculation	**Process of producing immunity and method of vaccination**

Medicine	**A substance, used to treat disease or injury.**
Microbe	**A shortened form of 'micro-organism'.**
Microbiome	**The human microbiome is made up of communities of bacteria, viruses and fungi.**
Micro-organism	**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.**
Natural Barrier	**The body's natural barriers to infection include the skin, sticky substances in the nose and nasal hair, various enzymes produced in the body and stomach acid.**
Natural Defence	**The way the body protects itself from illness such as a rise in body temperature during infection to make the body inhospitable to invading microbes and the creation of antibodies in response to microbial invasion.**
Natural selection	**The process through which populations of living organisms adapt and change.**
Pandemic	**An epidemic that occurs on a scale that crosses international boundaries.**
Pasteurise	**Process of partial sterilization, especially one involving heat treatment or irradiation, thus making the product safe for consumption and improving its keeping quality.**
Pathogen	**A microbe that can cause an illness.**
Phagocytes	**White blood cells which attack any foreign objects which enter the blood stream.**
Phagocytosis	**The method by which phagocytes engulf and swallow unwanted microbes.**
Plasma	**The yellow coloured liquid of the blood in which the blood cells are suspended.**
Prediction	**A statement suggesting what will happen in the future based on observation, experience or a hypothesis.**

Probiotic	**Literally means 'for life'. Probiotics are bacteria that aid human digestion.**
Results	**The outcome or effect of an experiment.**
Safe Sex	**Having sexual contact while protecting yourself and your sexual partner against sexually transmitted infections and unplanned pregnancy.**
Sexually Transmitted Infections (STI)	**Infections/ diseases that are usually spread by having vaginal, oral or anal sex.**
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.**
Virus	**The smallest of the microbes, viruses cannot survive on their own and need to live in the nucleus of other living organisms.**
Vaccination	**Inoculation with a vaccine in order to protect against a particular infection.**
Vaccine	**A weakened or killed microbe, such as a bacterium or virus, or of a portion of the microbe's structure that when injected into a person leads to antibody production against the microbe. The vaccine cannot cause infection itself.**
White blood cell (WBC)	**Cells found in the blood which help protect the body against infection and disease.**
Zone of inhibition	**A circular area around the spot of the antibiotic in which the bacteria colonies do not grow. The zone of inhibition can be used to measure the susceptibility of the bacteria towards the antibiotic.**

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Educating students in the areas of microbiology, hygiene and appropriate antibiotic use will help prevent antibiotics being exhausted in the future.

Young People will grow up knowing when antibiotics should and shouldn't be used and understand effective hand and respiratory hygiene.

This resource pack has information, suggested lesson plans that can be adapted, and includes activities for you to use in your classroom to help you inspire and inform your pupils.

These resources cover topics in the Key Stage 3 National Curriculum such as "PSHE/ RSHE" and "Science" including "Working scientifically" and "Living things and their habitats".

This resource can be shared with PSHE teachers for use with Core Theme 1 – Health and prevention, which is part of the PSHE Association programme of study supported by the Department for Education.

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