Section 4.2 explores improving the appropriate use of antibiotics for treating infections.

By using a simple card game and statement sorting task, students will gain an understanding of what antibiotics are and what they can be used for. Students will also learn the mechanisms for how bacteria can travel from person to person, what students can do to prevent the spread of infection and how bacteria can develop resistance.

All students:
- Antibiotics only work on bacterial infections
- Most viral infections will get better by themselves through time, bed rest, liquid intake and healthy living
- If you have antibiotics, finish the course
- Do not use other peoples or leftover antibiotics
- Prevent the spread of infection through good hygiene

More able students:
- Overuse of antibiotics can damage our normal/useful bacteria
- Bacteria are becoming resistant to antibiotics due to misuse and overuse

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

Estimated Teaching Time
50 minutes
Most of the time the immune system defeats any harmful microbes entering the body, however, in some cases the immune system needs help. **Antibiotics** are special medicines used to treat some **bacterial** infections (Antibacterials). Some antibiotics stop the bacteria dividing (bacteriostatic) and others kill the bacteria (bactericidal). Antibiotics treat infectious diseases caused by bacteria, such as meningitis, tuberculosis and pneumonia. They do **not** harm viruses or fungi, so antibiotics cannot treat infections such as colds and flu, which are caused by viruses, or athlete’s foot caused by fungi.

Antibiotics not only kill harmful bacteria but they can also kill the good bacteria living in our gut (Commensals).

There are very specific antivirals which treat certain viral infections, for example, herpes, chicken pox, HIV and Influenza. There are no specific antivirals for common viruses that cause colds, runny nose, sore throats, coughs, earache or diarrhoea & vomiting. There are also specific antifungal medicines for thrush and athlete’s foot, but none of these antifungals or antivirals are antibiotics.

Before antibiotics were invented harmful bacteria were life threatening. Today, although many bacterial infections are easily treated with antibiotics – the bacteria are fighting back! Through increased exposure to the antibiotics, bacteria are becoming resistant to them. This means that bacterial infections are once again becoming life threatening. Antibiotic resistant bacteria are now spreading across the world due to overuse of antibiotics in many countries. These resistant bacteria spread by people who have travelled to other countries with high resistance and poor water supplies. Once these bacteria are introduced into a new country any antibiotic use will encourage them to spread across that country. Many types of antibiotic resistant bacteria are now present in the UK. Resistant bacteria can pass their resistance on to other bacteria. To stop antibiotic resistance getting worse we all need to act now. We can help by:

1. **only using antibiotics prescribed for you** by your doctor because antibiotics are specific for each infection, and the dose is specific for each patient
2. **taking the antibiotics exactly as prescribed** (For example three times a day) otherwise the bacteria may not be completely cleared and the infection can come back
3. **not using antibiotics for self-limiting infections** such as colds, runny nose, most sore throats and ear ache, because antibiotics won’t make the symptoms get better faster but will encourage bacterial resistance
4. **washing our hands well** to stop the spread of infection

Infections caused by antibiotic resistant bacteria pose a serious health risk. Patients with existing infections are at a much higher risk if they are immuno-compromised as it is more difficult to control the infection with antibiotics.
1. Start the lesson by asking students if they’ve had antibiotics before 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.
   a. 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, 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 good 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 not using antibiotics for most ear ache, sore throats or any colds or flu. Everyone should look after themselves and always wash their hands well and cover coughs and sneezes.

7. A presentation has been provided on www.e-bug.eu on the discovery and resistance of antibiotics.

**Activity 1**

1. This activity should be carried out in groups of 2.

2. Provide each group with SH 1 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 TS 8.

5. As you go through the correct answers ask students to stick the statements into the correct side of the chart.

6. There is an anagram activity at the end of the e-Bug Antibiotics presentation or using SH 6 that can be used if any students finish the task early. Answers can be found on TS 9.
Activity 2

7. Ask students to get into groups of twos, threes or fours for the following activity.

8. Provide each group with a set of cards from SH 2, SH 3, SH 4 and SH 5. Explain to the class that this activity will demonstrate how bacteria can be spread and how bacteria can develop antibiotic resistance.

9. 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 ‘normal bacteria’ haven’t developed resistance and can still be treated with antibiotics.

Instructions

10. Place the ‘resistant bacteria’ deck facing upwards on the table within reach of each player.

11. Place the ‘action cards’ face down on the table within reach of each player.

12. Each player starts the game with 4 ‘normal bacteria’ cards in their hand, the rest should be placed in a separate deck on the table facing upwards.

13. 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.

14. 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 ‘normal bacteria’. If three or more people are playing, the winner is the person with the most ‘normal bacteria’ cards in their hand at the end.

Plenary

Read each ‘action card’ from activity 2 aloud to the class then discuss each card with the class to check their understanding:

1. Why should we never share antibiotics?

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 each illness and at a dose suitable for that patient. Taking someone else’s antibiotics may mean your infection does not get better and by exposing the bacteria to small amounts of antibiotics it could cause them to develop resistance and become difficult to treat.
2. Why don’t antibiotics work on colds?

The common cold is caused by a virus, not bacteria, and therefore antibiotics will not help them to get better faster. Taking antibiotics for a cold can kill the good bacteria in the body, increase resistant bacteria and leave the body more likely to get an infection from bad bacteria.

3. Why is good hygiene important when we have a cold?

Bacteria and other microbes can be spread to others through our coughs and sneezes.

By catching our coughs and sneezes in tissues we are stopping the microbes from spreading to others.

It is important to remember that if we cough or sneeze into our hands that we should wash them with soap and warm water to make sure we get rid of any harmful microbes.

4. Are antibiotics effective at relieving pain?

Antibiotics are only used to treat bacteria. If you have a head ache with a cold and runny nose then antibiotics won’t help the headache. Paracetamol will help headaches or fever.

If your headache is very bad or you have a rash, speak to your doctor.

5. Why is it a bad idea to stop taking antibiotics half way through the course?

It is very important to take all your antibiotics, not just stop half way through. If you do not take them all, some bacteria may not be killed and they may become resistant to that antibiotic, or the infection may not be cured and might come back.
6. Why is sneezing and coughing without covering our mouths a bad thing to do?

Coughs and sneezes are ways that our body gets rid of any harmful microbes from our airways, and is one of the most common way for microbes to spread.

By catching our coughs and sneezes into tissues we are stopping the microbes from spreading to others.

7. Why should we wash our hands before and after making food and touching raw meat?

Microbes can spread from the person making the food, or from the food itself to other people.

The person that is making the food can also catch harmful microbes from uncooked meat or vegetables if they do not wash their hands afterwards. Separate chopping boards should be used when preparing meat and vegetables.

8. We already know that washing our hands is important. But why is it most important to wash our hands before and after visiting the hospital?

People in hospital are more likely to get infections. If we don’t wash our hands when we visit patients we may spread harmful microbes to patients making them sicker.

If we don’t wash our hands when we leave the ward or hospital we may catch an infection from the hospital.

9. Why do we have to be careful when we touch raw meat?

Raw meat may contain dangerous bacteria like Campylobacter or Salmonella. These food poisoning microbes like Salmonella can make us very ill so it’s important we wash our hands after touching raw meat. Never chop other food on the same board (especially salad). Use a red board for raw meat to help remind you.
4.2 Treatment of Infection
Antibiotic resistance

Lesson Plan

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 normal bacteria back in the pile

Information: If you think you need antibiotics ask your doctor. They can advise on if an antibiotic is needed and the dose.

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 normal 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 normal bacteria back in the pile

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

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10. Why should we take left over antibiotics to a pharmacy for disposal?
Nobody should have any left-over antibiotics if we take them as the doctor has told us to, but occasionally we are given too many or the side effects can be particularly bad that the doctor may advise us to stop taking them. If so you should return any unused antibiotics to the pharmacy so they can dispose of them safely.

11. Why is buying antibiotics on holiday for future use a bad idea?
There are many different types of antibiotics that work on different bacteria. If you buy them without a doctor or nurses advice you run the risk of taking the wrong antibiotic that won’t work and will also increase antibiotic resistance.

12. Why shouldn’t we share antibiotics in this context?
The mother is very ill and needs to make sure she takes all of the antibiotics she’s been prescribed. If the mother doesn’t take all of her antibiotics she runs the risk of her infection not getting better, also the antibiotic prescribed is for a specific chest infection and may not work on a cough.

13. Why is it important to remember to take our antibiotics as the doctor tells us to?
If you do not take them all or forget to take a few, some bacteria may not be killed and they may become resistant to that antibiotic, or the infection may not be cured or will come back.
14. Why should we try and avoid taking antibiotics for acne?
Treatment for acne needs to be taken for at least 3 months. During this time our gut microbes will change or could develop resistance. There are many other options for treating acne that don’t involve antibiotics, so only take them as a last resort.

15. Why is it important to rest, drink plenty of fluids and take paracetamol when we have a runny nose and a cold?
Being hydrated and getting plenty of rest gives your body a chance to recover and use its energy to fight the infection. Paracetamol helps the pain and brings down a temperature so you can feel so much better.

16. Why should we wash our hands once we are already ill?
Washing our hands is a really good way of stopping our infections from spreading to others. By washing our hands we’re reducing the chances of our friends and family members catching our infection.

17. Why should we encourage others to use a tissue?
Catching sneezes and coughs in tissues is one of the best ways of stopping the cough/cold spreading to others. If we can get our friends and family to use a tissue when they cough or sneeze it will decrease the chance of us getting ill from their germs.

18. Why is it a good idea to encourage our friends to wash their hands before and after making food?
If your friend has been handling raw meat they run the risk of catching harmful infections from the uncooked meat. These microbes could be spread from your friend to you and you could both become ill. Unwashed vegetables, such as potatoes, can also contain harmful microbes.
# 4.2 Treatment of Infection

## Antibiotic resistance

### Teacher Answer Sheet

## Student Activity 1

<table>
<thead>
<tr>
<th>Antibiotics can</th>
<th>Antibiotics can’t</th>
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</thead>
</table>
| **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 more quickly**  
*Pneumonia is often caused by a serious bacterial infection and is therefore treated with antibiotics* | **5. Kill viruses**  
*Viruses are not affected by antibiotics* |
| **8. Kills many of our good bacteria in the body**  
*Antibiotics not only kill the bad bacteria that make you unwell, antibiotics also kill the good 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 quicker**  
*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* |
| **11. Help ear ache get better more quickly**  
*Most ear infections are caused by viruses and are therefore not helped by antibiotics* | **10. Help sore throats get better more quickly**  
*Most sore throats 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* | **14. Encourage our good bacteria to become resistant to antibiotics**  
*The bacteria in our bodies can become resistant to antibiotics through natural selection.* |
4.2 Treatment of Infection
Antibiotic resistance

Teacher Answer Sheet

Can you work out these anagrams of bacterial infections?

1. pnoinmeua
   \( P\ n\ e\ u\ m\ o\ n\ i\ a \)

2. ginnemitis
   \( M\ e\ n\ i\ n\ g\ i\ t\ i\ s \)

3. butlerosisuc
   \( T\ u\ b\ e\ r\ c\ u\ l\ o\ s\ i\ s \)

4. malleasnlol
   \( S\ a\ l\ m\ o\ n\ e\ l\ l\ a \)
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Resistant Bacteria
Resistant bacteria can no longer be killed by antibiotics and this is called antibiotic resistance.
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<tr>
<td>You’re not feeling well, so a friend offers you some of their left over antibiotics which you take.</td>
<td>You’ve come down with a sore throat so you try and get antibiotics from your doctor.</td>
<td>You have a cold and have been sneezing a lot. Every time you sneeze you use a tissue to catch it and then you throw it in the bin to stop other people catching your cold.</td>
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</tr>
<tr>
<td><strong>Pick up 1 resistant bacteria</strong>&lt;br&gt;<strong>Pass on 2 normal bacteria</strong></td>
<td><strong>Pick up 1 resistant bacteria</strong>&lt;br&gt;<strong>Put 2 normal bacteria back in the pile</strong></td>
<td><strong>Pick up 1 normal bacteria</strong></td>
<td></td>
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<tr>
<td>Information: You must not use anyone’s leftover antibiotics as this can increase antibiotic resistance.</td>
<td>Information: Most common infections will get better by themselves through time, bed rest, fluids and healthy living.</td>
<td>Information: The best way to stop colds and flu spreading to others is by catching your cough and sneezes in a tissue.</td>
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<td>You’ve got a head ache, so you take some antibiotics that you find at home to try and relieve the pain.</td>
<td>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.</td>
<td>By mistake you sneeze in the classroom without covering your mouth.</td>
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<td>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.</td>
<td>You visit a friend in hospital but you forget to wash your hands when you leave.</td>
<td>You’re cooking lunch for yourself and handle raw chicken. You wash your hands thoroughly afterwards.</td>
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<td><strong>Pass on 1 normal bacteria</strong>&lt;br&gt;<strong>Pass on 1 resistant bacteria</strong></td>
<td><strong>Pick up 1 resistant bacteria</strong>&lt;br&gt;<strong>Put 2 normal bacteria back in the pile</strong></td>
<td><strong>Put 1 resistant bacteria back in the pile</strong>&lt;br&gt;<strong>Take 1 normal bacteria from the person to your left</strong></td>
</tr>
<tr>
<td>Information: You should always remember to wash your hands to stop harmful bacteria spreading, especially after touching raw meat.</td>
<td>Information: Always remember to wash your hands to prevent the spread of infection, especially in hospitals where there are dangerous microbes.</td>
<td>Information: You should always remember to wash your hands, especially before and after making food.</td>
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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.

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

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Put 2 normal bacteria back in the pile

Information: If you think you need antibiotics ask your doctor. They can advise on if an antibiotic is needed and the dose.

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

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Put 1 normal 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 normal 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 normal 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 normal 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 normal 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
Your friend has a cold and is sneezing a lot. You offer your friend a tissue so they can catch their sneezes.

Put 1 resistant bacteria back in the pile

Information: The best way to stop colds spreading to others is by catching your sneeze or cough in a tissue.

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.
Can you work out these anagrams of bacterial infections?

5. pnoinmeua

6. ginnemitis

7. butlerosisuc

8. malleasnl