



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

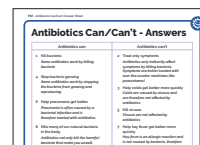
Extension Activity: Antibiotic Resistance Debate Kit

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

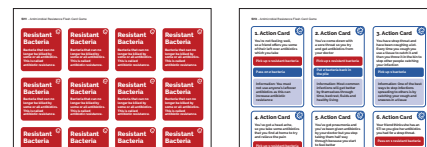
Advance Preparation

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



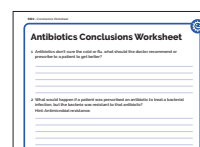
TS1 Antibiotics Can/Can't Answers



SH1-4 AMR Flash Card Game



SW1 Antibiotics Can/Can't Game



SW2 Conclusions worksheet



SW3 Differentiated Conclusions

Lesson Plan

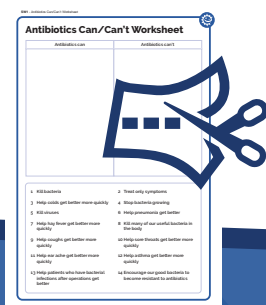


☰ Introduction

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.

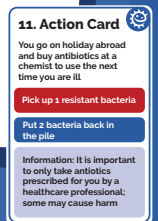
Main Activity: Antibiotics Can/Can't Game

- 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](https://debate.imascientist.org.uk/antibioticresistance-resources)

Discussion

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

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

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



Resistant Bacteria

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

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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 antibiotics 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.*

