



e-Bug

### National Curriculum Link

SCN 3-13b

SCN 3-20b

HWB 3-15a

HWB 3-16a

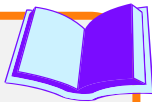
HWB 3-17a

### Estimated Teaching Time

50 minutes

### Key Words

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



### Materials Required

#### Per student

- A copy of [SH 1](#)
- A copy of [SW 1](#)
- A copy of [SW 2](#)

#### For the class

- Some over the counter medicines
- Foods – honey, oranges
- Antibiotics
- e-Bug Antibiotic presentation



## 3.0 Treatment of Infection Antibiotics and Medicine

### Learning Outcomes

#### All students will know:

- Most common infections will get better by themselves through time, bed rest, liquid intake and healthy living.
- If you have antibiotics, finish the course.
- Not to use other peoples or leftover antibiotics.

#### More able students will know:

- Overuse of antibiotics can damage our normal/good bacteria.
- Bacteria are becoming resistant to antibiotics due to overuse.

### Background

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

The body's **immune system** kills microbes if they get past the natural barriers. The main cells in the immune system are the white blood cells (WBC). There are different types of WBC but they have two main functions – to engulf microbes and kill them and to make **antibodies** that stick to the microbes. The antibodies stick to the **antigens** on the surface of the microbes. As each microbe has a different antigen on its surface, only WBC with the correct antibody can stick to them. This is bad for the microbes because when the antibodies of the WBC bind to the antigen on the microbe it can be killed.

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

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

- only use antibiotics prescribed by your doctor
- always finish the course once prescribed
- don't use antibiotics for simple coughs and colds

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





## 3.0 Antibiotics and Medicine

# Lesson Plan

### Advance Preparation (30 min)

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

### Introduction (15 min)

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

### Main Activity (25 min)

1. This activity should be carried out in small groups of 3-5 students
2. Provide students with a copy of [SH 1](#), [SW 1](#) and [SW 2](#).
3. The story in [SH 1](#) can either be read to the students (display on a white board or overhead projector may be beneficial) or students can read the story in their own groups.
4. Students should then complete [SW 1](#) and [SW 2](#).

#### SW 1 Answers

1. Why would Dr Lai find it necessary to carry out the control tests? *Controls are important in any scientific test. By observing how the bacteria grow under normal conditions and how they grow in the presence of antibiotics Dr Lai will be able to recognise the growth pattern when he tests other antibiotics.*
2. What happens to the bacteria in each of the diagrams?
  - a. *The bacteria are growing and multiplying*
  - b. *The antibiotics have killed all bacteria straight away*
  - c. *The antibiotics look as if they are killing all the sensitive bacteria for the first 6 hours but the resistant bacteria continue to multiply in the antibiotic.*
3. What happens to the bacteria in Figure 3? *As 'c' above*
4. Can you explain why this is happening? *The antibiotic is killing all the sensitive bacteria in the culture. But resistant continue to multiply and after 6 hours have increased in number.*





## 3.0 Antibiotics and Medicine

### Lesson Plan

#### Main Activity (25 min)

##### SW 2 Answers

5. Describe what is happening to the bacteria populations in each of the graphs?
  - a. *The antibiotic appears to have stopped the bacteria multiplying so the growth is static for the first 10-12 hours. A continual gradual decline in bacterial numbers is then observed in bacterial numbers. Not all of the bacteria is killed after 24 hours. The antibiotic is described as bacteriostatic.*
  - b. *Following administration of the antibiotic a rapid decrease in bacterial numbers occur.*
  - c. *The bacteria show a rapid decline in the first 11 hours following antibiotic administration. The numbers however start to increase after this time and continue to multiply as normal.*
6. Do you think the bacteria making Harry ill are antibiotic resistant? Explain.  
*Yes, although antibiotic 1 and antibiotic 2 do appear to kill the bacteria, the antibiotic in figure 3 doesn't. It appears to have a killing effect on the bacteria for 11 hours but then the bacteria start to multiply again. This suggests that the bacteria are resistant to antibiotic 3.*
7. Which antibiotic should the doctor prescribe Harry to eliminate the infection and why?  
*The doctor should prescribe antibiotic 2 to Harry. Harry is getting very ill and needs to clear the infection as soon as possible so a fast acting antibiotic is preferable.*
8. What could Harry have done to prevent getting the infection?
  - a. *He should have finished the first course of antibiotics prescribed*
  - b. *He could get the wound regularly washed and dressed*
  - c. *Alternatively, he may have picked up the resistant microbe in the hospital out of no fault of his own*

#### Plenary (15 min)

3. Discuss with the class their opinion on antibiotics under the following heading
  - a. When should they be taken?
  - b. Should we take other people's antibiotics?
  - c. How we are responsible for antibiotic resistance
  - d. What we can do to prevent more bad bacteria becoming antibiotic resistant

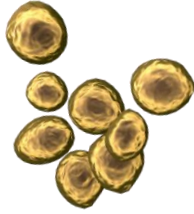
#### Extension Activity

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

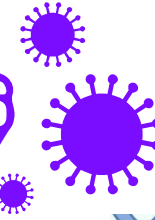




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# ANTIBIOTICS



Harry had to go into hospital to get his appendix removed. After surgery, everything seemed to be going well, Harry appeared to be recovering normally and was sent home. The doctor, Dr Lai, prescribed him a single dose antibiotic for prophylactic reasons (to prevent any infection occurring).



One week later Harry started to feel unwell, he felt tired and nauseous and had pain around his surgical wound. His mother took him to visit their family doctor, Dr Williams, who, after examining Harry, thought that the wound might be infected and prescribed him a second course of antibiotics with a warning to finish the course.

Three days later, Harry did not feel any better. He had a high temperature and his surgical wound was really hurting now. This time Dr Williams sent Harry to hospital for a more thorough examination. After taking some blood tests Dr Lai discovered that Harry had a serious bacterial infection but did not know which bacteria was causing the infection although it appeared to be *Staphylococcus aureus*. He saw that Harry had previously been administered some antibiotics which did not appear to be working and feared that he might have contracted an antibiotic resistant organism or a 'superbug'.

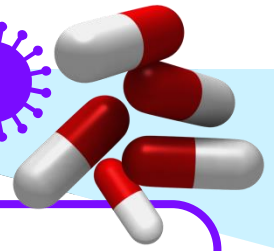


Dr Lai decided that administering more antibiotics to Harry might cause more harm than good. He thought that he needed to test a variety of antibiotics on the pathogenic organism before he administered any to Harry. Dr Lai decided to try out two different tests.



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# ANTIBIOTICS



## Test 1

Dr Lai grew some laboratory grown *Staphylococci* similar to the strains that were infecting Harry in 3 different test tubes. These are known as controls.

- Test tube 1 – The bacteria with growth media alone
- Test tube 2 – The bacteria with antibiotics known to inhibit the growth of that bacteria
- Test tube 3 – Bacteria known to be resistant to the recommended antibiotics

## Results

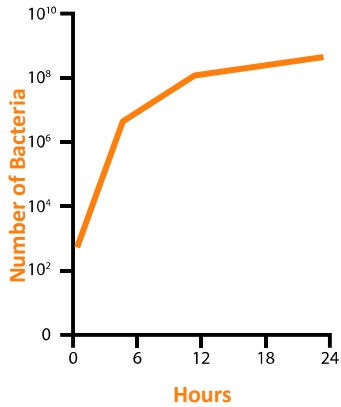


Figure 1. No antibiotic.

The growth of bacteria if NO antibiotics are used.

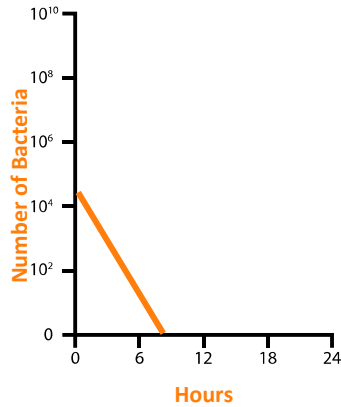


Figure 2. Antibiotics and sensitive bacteria.

The growth of bacteria with active antibiotics.

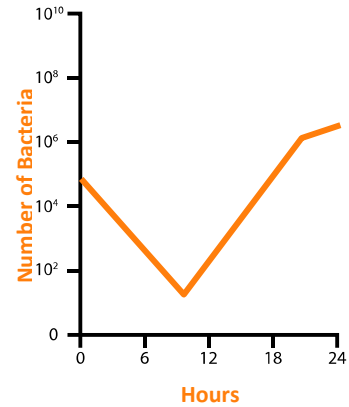


Figure 3. Antibiotics with sensitive and resistant bacteria.

The growth of resistant bacteria in the presence of antibiotics

## Conclusions

1. Why would Dr Lai find it necessary to carry out these control tests?

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2. What happens to the bacteria in each of the diagrams?

a. \_\_\_\_\_

b. \_\_\_\_\_

c. \_\_\_\_\_

3. What happens to the bacteria in figure 3?

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4. Can you explain why this is happening?

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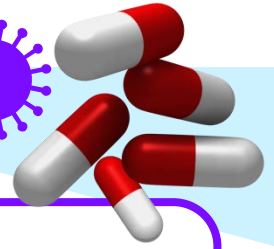
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# ANTIBIOTICS



## Test 2

Dr Chung grew some of the bacteria causing Harry's infection in 3 different test tubes and added a different antibiotic to each of the test-tubes. He grew the cultures for 24 hours taking bacterial counts every six hours. The results are shown below.

## Results

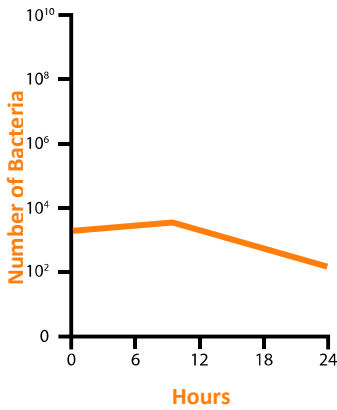


Figure a. Antibiotic 1

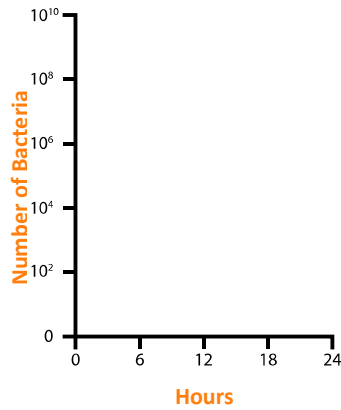


Figure b. Antibiotic 2

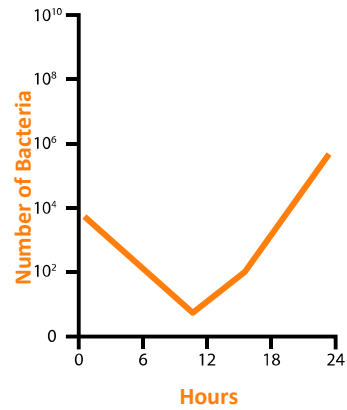


Figure c. Antibiotic 3

1. Describe what is happening to the bacterial populations in each of the graphs above



- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_

## Conclusions

1. Bacteria can be resistant to one or many different antibiotics. Do you think the bacteria making Harry ill are antibiotic resistant? Explain your answer.

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2. Which antibiotic should the doctor prescribe Harry to eliminate the infection and why?

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3. What could Harry have done to prevent getting the infection?

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