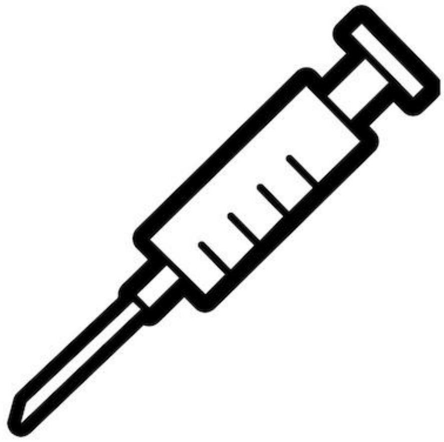
Maintaining health



Name ________________________________

Class ________________________________

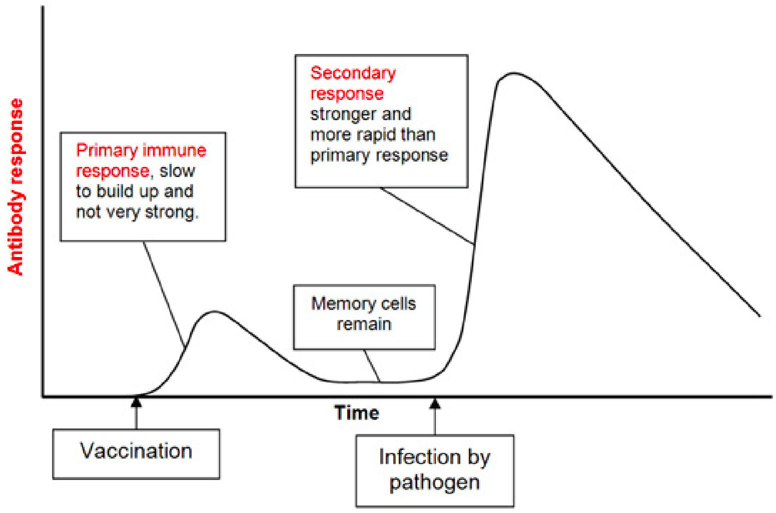
Teacher ________________________________

L1 Vaccination

Vaccination is a way to protect people from getting sick. It involves introducing a small, safe amount of dead or inactive pathogens into the body. These pathogens can't cause disease, but they do stimulate the immune system to protect against future infections.

How Does Vaccination Work?

1. **Introduction of Pathogen**: A vaccine contains a tiny amount of a dead or inactive pathogen, such as a virus or bacteria. These pathogens have special markers on their surface called antigens.
2. **Antigen Recognition**: The antigens on the pathogen are recognized by the white blood cells as foreign invaders.
3. **Immune Response**: When the vaccine is introduced into the body, the white blood cells (a crucial part of the immune system) recognize the antigens on the pathogen.
4. **Antibody Production**: Antibodies are proteins made by white blood cells to fight off harmful pathogens by recognizing and binding to the antigens on the pathogen. Once they attach, antibodies can neutralize the pathogen and signal other immune cells to destroy them.
5. **Memory Cells**: After fighting off the pathogen, some of the white blood cells become memory cells. These cells "remember" the pathogen and how to fight it.



Long-term Protection

If the same type of pathogen enters the body again in the future, the memory cells recognize it immediately. They quickly produce the right antibodies to destroy the pathogen before it can cause illness. This rapid response prevents the person from getting sick.

Preventing Illness in Individuals

When you get vaccinated, you gain protection against specific diseases without having to get sick first. This is important because some diseases can be very dangerous or even deadly. Vaccines provide a safe way to build immunity.

Reducing the Spread of Pathogens

Vaccinating a large proportion of the population is crucial for controlling the spread of diseases. Here's how:

1. **Herd Immunity**: When many people in a community are vaccinated, it's harder for the disease to spread. This is because there are fewer people for the pathogen to infect. This concept is called herd immunity.

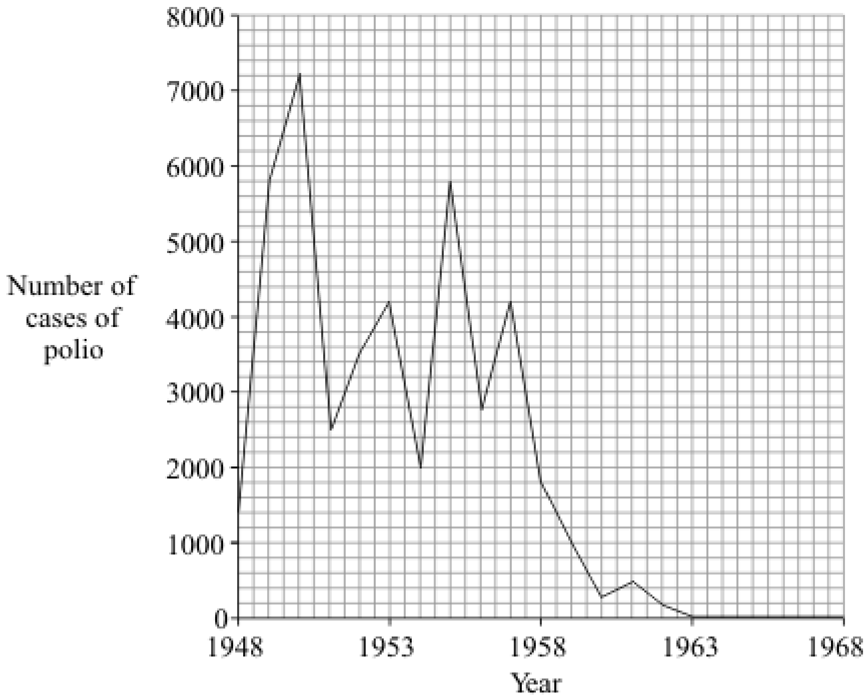
2. **Protection for All**: Herd immunity is especially important for people who can't get vaccinated, such as newborns or individuals with certain medical conditions. When the spread of the disease is reduced, these vulnerable people are also protected.

Independent practice. Answer in full sentences in your book.

1. What does a vaccine contain?
2. What is on the surface of a pathogen, and what are they recognised by.
3. How do antibodies work?
4. Describe the difference between the primary response and the secondary response.
5. Why is herd immunity important?
6. A vaccine against E. coli is being trialled. Suggest what this vaccine contains to cause immunity to E. coli.
7. Gonorrhoea is a bacterial disease. A new vaccine is being developed against gonorrhoea. Describe how a vaccine would work to prevent gonorrhoea.
8. A new vaccine has been developed to protect people against salmonella food poisoning. Explain how the vaccine prevents people becoming ill with salmonella food poisoning.

9. Polio is a disease caused by a virus. In the UK, children are given polio vaccine to protect them against the disease.

The graph shows the number of cases of polio in the UK between 1948 and 1968.



(a) In which year was the number of cases of polio highest?

(b) Polio vaccination was first used in the UK in 1955.

How many years did it take for the number of cases of polio to fall to zero?

(c) There have been no cases of polio in the UK for many years. But children are still vaccinated against the disease.

Suggest **one** reason for this.

L2 Antibiotics and painkillers

When we get sick, doctors often prescribe medicines to help us get better. Two main types of medicines are antibiotics and painkillers. Each type works differently and is used for specific purposes.

Antibiotics: The Bacteria Fighters

Antibiotics are special medicines designed to treat bacterial infections. One of the most famous antibiotics is penicillin. These medicines work by killing bacteria or stopping their growth. The method by which the antibiotics damage bacterial cells can vary, for example some work by damaging the cell wall. It’s important to remember that different antibiotics are used to treat different kinds of bacteria. For example, the antibiotic that treats a throat infection might not work for an ear infection. This is why doctors need to know exactly which bacteria is causing the illness to prescribe the correct antibiotic.

Since the discovery of antibiotics, they have saved countless lives. Diseases that used to be deadly, like tuberculosis and pneumonia, are now treatable. However, there's a significant challenge we face with antibiotics: antibiotic resistance. This happens when bacteria change in a way that makes antibiotics no longer effective. When this occurs, the antibiotics can’t kill the bacteria, and the infections become harder to treat. This is why it's crucial to use antibiotics only when necessary and to follow the doctor's instructions carefully when taking them.

Antibiotics vs. Viruses: Different Enemies

It’s important to know that antibiotics do not work against viruses. Viruses are very different from bacteria. While bacteria are single-celled organisms that can live and multiply on their own, viruses are much smaller and need to invade living cells to reproduce. Because of this, antibiotics, which target bacteria, are useless against viral infections like the flu or the common cold.

Painkillers and Symptom Relief

When you're sick, you might also be given painkillers or other medicines to help you feel better. These medicines don’t kill the pathogens (the bacteria or viruses causing the illness) but can relieve symptoms like pain, fever, or headaches. For example, paracetamol or ibuprofen can help reduce a fever or ease pain, making you more comfortable while your body fights off the infection.

The Challenge of Treating Viruses

Treating viral infections is much harder than treating bacterial ones. This is because viruses use the body’s own cells to reproduce, so it’s difficult to create a drug that targets the virus without harming the body’s own tissues. Scientists are working hard to develop antiviral drugs, but it's a challenging task. Vaccines are one effective way to prevent viral infections, like the flu vaccine or the measles vaccine, by helping your immune system recognize and fight the viruses.

Independent practice

1. State which type of pathogen can be killed by antibiotics.
2. What is one of the main types of antibiotics.
3. What is antibiotic resistance?
4. Why should a person not stop taking antibiotics as soon as they feel better.
5. Explain why antibiotics can not treat viruses.
6. What is a painkiller?
7. Why should a person with measles take painkillers and not antibiotics.
8. Why is it hard to develop antiviral drugs.
9. Antibiotics that disrupt the bacterial cell membrane often cause more side effects in humans compared with antibiotics that disrupt bacterial cell walls. Suggest why.
10. Some antibiotics prevent ribosomes functioning. Suggest how this damages the bacterium.

L3 Antibiotic resistance

How Does Antibiotic Resistance Develop?

1. **Natural Variation**: In any group of bacteria, there are slight variations due to random mutations in their DNA. Some of these mutations may give a bacterium a slight advantage, such as the ability to survive an antibiotic that would kill other bacteria.
2. **Survival of the Fittest/Natural selection**: When an antibiotic is used, it kills the susceptible bacteria, leaving behind those with resistance traits. These resistant bacteria then have more resources and space to grow and reproduce. This means there are then more resistant bacteria.

Factors Contributing to Antibiotic Resistance

- **Overuse of Antibiotics**: Using antibiotics when they aren't necessary, such as for viral infections like the common cold, can promote resistance. Antibiotics should only be used to treat bacterial infections, and many mild bacterial infections get better on their own without using antibiotics.
- **Misuse of Antibiotics**: Not completing a prescribed antibiotic course can leave some bacteria alive, which can then develop resistance. It's crucial to take the full course as directed by a doctor.
- **Agricultural Use**: Antibiotics are often used in livestock to prevent disease and promote growth. This widespread use can contribute to the development of resistant bacteria, which can spread to humans through the food chain.

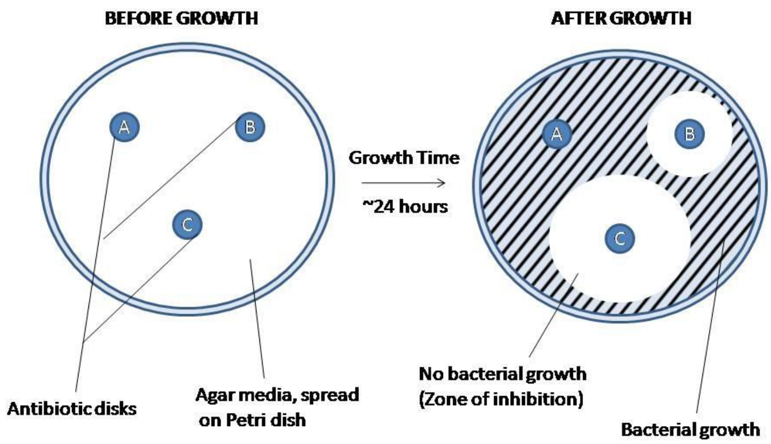
Consequences of Antibiotic Resistance

Antibiotic resistance makes infections harder to treat, leading to longer illnesses, more hospital visits, and a higher risk of death. It also increases medical costs as doctors must use more expensive or less readily available treatments.

What Can We Do to Prevent Antibiotic Resistance?

1. **Use Antibiotics Wisely**: Only take antibiotics when prescribed by a healthcare professional. Do not demand antibiotics if your doctor says they are unnecessary.
2. **Complete the Course**: Always finish the entire course of antibiotics as prescribed, even if you start feeling better before the medicine is gone.
3. **Practice Good Hygiene**: Wash your hands regularly, prepare food safely, and keep vaccinations up to date to prevent infections that might require antibiotics.
4. **Support Research and Policies**: Advocate for and support policies that reduce antibiotic misuse and promote the development of new antibiotics and alternative treatments.

Investigating how effective antibiotics are.



Bacteria can be grown on agar plates. If disks are soaked in antibiotics and then placed on the plate you can determine how effective the antibiotic.

The area of no growth called zone of inhibition is where the antibiotic killed the bacteria. The bigger the zone the more effective.

If there is no zone of inhibition the bacteria is resistant to the antibiotic.

Independent practice

1. What type of pathogen are treated by antibiotics.
2. Why is there natural variation in a population of bacteria.
3. Why might some bacteria be resistant to the antibiotics.
4. What can the resistant bacteria do that the susceptible ones cannot?
5. Compare overuse of antibiotics with misuse of antibiotics.
6. Many strains of bacteria have developed resistance to antibiotics. The table shows the number of people infected with a resistant strain of one species of bacterium in the UK.

Year	2004	2005	2006	2007	2008
Number of people infected with the resistant strain	3499	3553	3767	3809	4131

(a) Calculate the percentage increase in the number of people infected with the resistant strain between 2004 and 2008. Show clearly how you work out your answer.

(b) Explain, in terms of natural selection, why the number of people infected with the resistant strain of the bacterium is increasing.

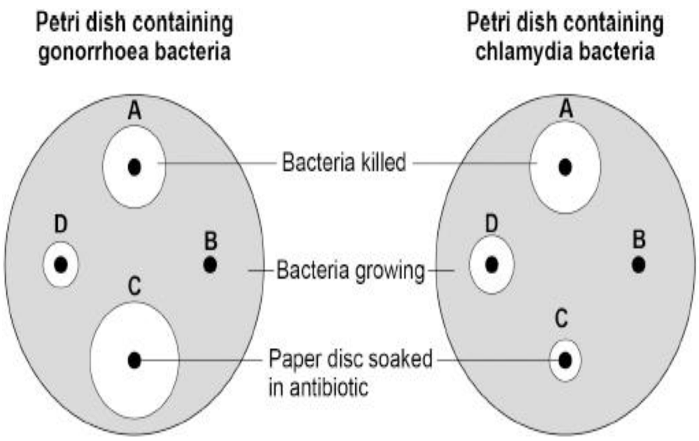
7. Drug manufacturers are spending less on research into new antibiotics. One reason why is because new antibiotics are rarely prescribed. Some people think that governments should pay drug manufacturers to develop new antibiotics. Suggest why.
8. What is the zone of inhibition?
9. A scientist investigated which antibiotics were most effective at treating gonorrhoea and chlamydia.

This is the method used.

1. Grow gonorrhoea bacteria in a Petri dish.
2. Prepare four different antibiotic solutions, **A**, **B**, **C** and **D**, of the same concentration.
3. Cut four filter paper discs to the same size.
4. Soak each paper disc in a different antibiotic solution.
5. Put the four paper discs into the Petri dish.
6. Repeat steps 3 to 5 using a Petri dish with chlamydia bacteria growing in it.
7. Keep both Petri dishes at 25 °C for 3 days.

(a) Give **two** control variables used in this investigation.

The figure below shows the results. A clear area around a paper disc is where the antibiotic has killed the bacteria.



(b) Which antibiotic did **not** kill either type of bacterium?

(c) Which antibiotic would be the most effective to treat a person with a **gonorrhoea** infection?

(d) Which antibiotic would be the most effective to treat a person who had both gonorrhoea **and** chlamydia infections?

L4 Discovery and development of drugs

Traditional Sources of Drugs

Historically, many drugs were extracted from plants and microorganisms. These natural sources have provided us with some of the most important medicines:

- **Digitalis**: This heart drug comes from the foxglove plant. It helps strengthen the heart muscle and regulate heartbeats.
- **Aspirin**: This common painkiller originates from the willow tree. It is used to relieve pain, reduce fever, and lower inflammation.
- **Penicillin**: Discovered by Alexander Fleming from the Penicillium mould, penicillin was the first antibiotic and revolutionized the treatment of bacterial infections.

Modern Drug Synthesis

Today, most new drugs are created by chemists in the pharmaceutical industry. These scientists design and synthesize new compounds, often using chemicals originally extracted from plants as a starting point. This approach allows for the development of more targeted and effective medications.

Testing and Trials

Before any new drug can be used in medicine, it must undergo rigorous testing to ensure it is safe and works as intended. This testing is divided into two main phases: preclinical and clinical testing.

1. **Preclinical Testing**
   - **Laboratory Research**: Scientists test the drug in a laboratory using cells and tissues to see how it interacts with biological systems.
   - **Animal Testing**: The drug is then tested on live animals to study its effects on a whole organism and to check for any harmful side effects (toxicity).
2. **Clinical Testing**
   - **Phase 1**: The drug is given to a small group of healthy volunteers at very low doses to ensure it is safe and to observe how it behaves in the human body.
   - **Phase 2**: If the drug is safe, it is then given to a larger group of patients who have the condition the drug is meant to treat. This phase tests the drug's efficacy (how well it works) and helps determine the right dosage.
   - **Phase 3**: The drug is given to an even larger group of patients to confirm its effectiveness, monitor side effects, and compare it to existing treatments. This phase often includes double-blind trials, where neither the patients nor the doctors know who is receiving the drug and who is receiving a placebo (a substance with no therapeutic effect). This helps eliminate bias and ensures the results are reliable.

The Thalidomide Problem

In the late 1950s and early 1960s, a drug called thalidomide was prescribed to pregnant women to help with morning sickness. However, it was later discovered that thalidomide caused severe birth defects, affecting thousands of babies worldwide. This tragedy highlighted the importance of thorough drug testing. As a result, drug regulations were tightened, and the processes for testing new medicines were significantly improved to ensure such an incident would not happen again.

Independent practice – Answer in full sentences in your book.

1. What is the pharmaceutical industry?
2. Why are drugs tested on animals?
3. What is the difference between a blind trial and a double-blind trial.
4. Compare the three stages in clinical testing.
5. What does dosage mean?
6. Explain why after Thalidomide drug testing became more controlled.
7. Paracetamol and ibuprofen are two medicines used to reduce a high body temperature.

   Doctors investigated which medicine was more effective at reducing high body temperature in 200 children who were ill.

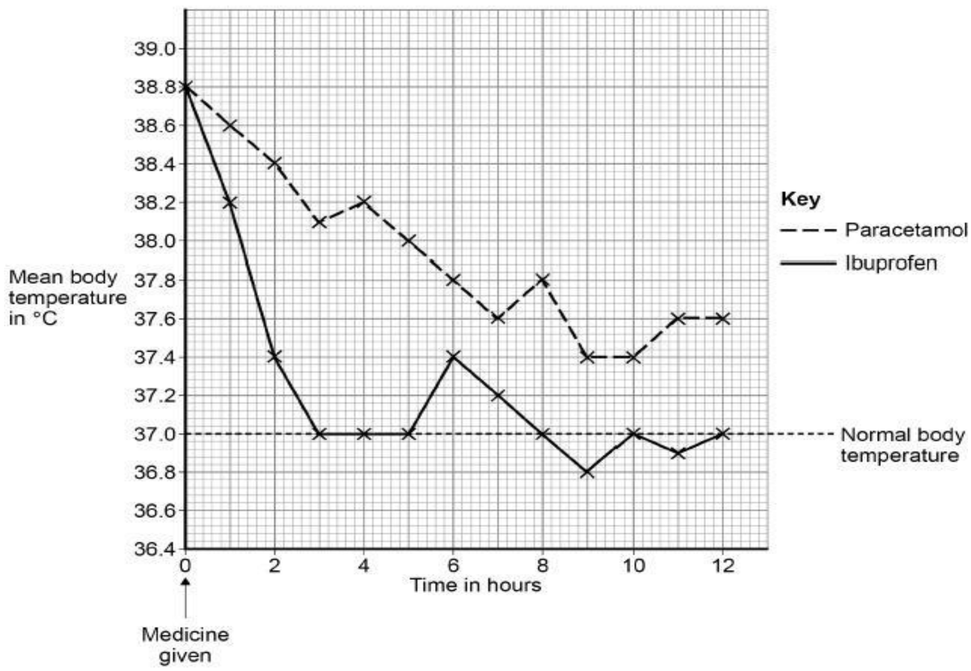
   The children were put into two groups, which were matched for:
   - age
   - gender
   - body mass.

   Each group had 100 children.

   This is the method used.
   1. Measure the body temperature of each child before any medicine is given.
   2. Give children in Group 1 paracetamol.
   3. Give children in Group 2 ibuprofen.
   4. Measure the body temperature of each child every hour after the medicine is given.

   (a) Give **two** control variables in this investigation.

   (b) None of the children was given a placebo. Suggest **one** reason why.



   (c) What was the mean body temperature after 6 hours for the children given ibuprofen?

   (d) The doctors concluded that children with a high body temperature should be given ibuprofen and not paracetamol. Give **two** reasons for the doctors' conclusion.