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**Year 10 – Teacher Booklet A (Triple)**

Key Stage 4 Science:

**Infection & Response**

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**Ensure that your booklet is returned to your class book box at the end of the lesson.**

**Lesson Breakdown**

Lesson 1: 4.3.1.1 Communicable diseases

Lesson 2: 4.3.1.2 – 4.3.1.4 Viral diseases, bacterial diseases, fungal diseases

Lesson 3: 4.3.1.2 – 4.3.1.4 Viral diseases, bacterial diseases, fungal diseases

Lesson 4: 4.3.1.5 Protist diseases (including malaria)

**Lesson 5 (HT only): 4.3.3.1** **Detecting and identification of plant diseases**

**Lesson 6: 4.3.3.1 Plant defence responses**

Lesson 7: 4.3.1.6 Human defence systems (barriers and symptoms)

Lesson 8: 4.3.1.6 Human defence systems (white blood cells)

Lesson 9: 4.3.1.7 Vaccination

Lesson 10: 4.3.1.8 Antibiotics and painkillers

Lesson 11: 4.3.1.9 Discovery and development of drugs

Lesson 12: 4.3.1.9 Discovery and development of drugs (placebo effects,

double blind trials etc).

**Lesson 13 (HT only): 4.3.2.1 Producing monoclonal antibodies**

**Lesson 14 (HT only): 4.3.2.1 Uses of monoclonal antibodies**

**Keystone words**

Microorganism

Communicable

Pathogen

Vector

Response

Infection

Resistance

Immune

**Lesson 1: Teacher notes**

**AQA Content**

**Students should be able to** explain how diseases caused by viruses, bacteria, protists, and fungi are spread in animals and plants.

**Students should be able to** explain how the spread of diseases can be reduced or prevented.

Pathogens are microorganisms that cause infectious disease. Pathogens may be viruses, bacteria, protists, or fungi. They may infect plants or animals and can be spread by direct contact, by water or by air. Bacteria and viruses may reproduce rapidly inside the body. Bacteria may produce poisons (toxins) that damage tissues and make us feel ill. Viruses live and reproduce inside cells, causing cell damage.

**Chunking**

1. Defining communicable and non-communicable diseases
2. How communicable diseases are transmitted (airborne, water borne, and direct contact via micro-organisms)
3. The four types of pathogens (virus, bacteria, protist, and fungi)
4. How bacteria and viruses affect the body

**Key direct and explicit teacher explanations:**

1. The image shows a man sneezing because he has influenza (the flu). When he sneezes water droplets are sprayed into the air. If another person breathes the water droplets in, they can catch influenza too. Scientists call diseases that you can catch from other living things **communicable diseases**.

Scientists call diseases that cannot be passed from one living thing to another are called **non-communicable diseases**.

**USE EXAMPLES AND NON-EXAMPLES TO ILLUSTRATE THE DIFFERENCE.**

1. **Communicable diseases** can move from one living thing to another; they are also called **infectious diseases**. For example, the man sneezed, and water droplets were sprayed into the air. Anybody who breathed in the droplets could catch influenza. Scientists call the movement of disease between organisms, **transmission**. Disease can be **transmitted** in several ways: in **airborne droplets** (e.g., influenza or Sars - cov-2), **waterborne** (e.g., cholera) or transmitted by **direct contact** (e.g., HIV).

**USE EXAMPLES AND NON-EXAMPLES TO ILLUSTRATE MODES OF TRANSISSION.**

1. **Communicable diseases** can be **transmitted**, or passed, from one organism to another. Diseases are caused by **pathogens**. **Pathogens** are microorganisms that harm other living things. There are four types:

* Viruses
* Bacteria
* Fungi
* Protists

Each **communicable disease** is caused by a different **pathogen** and is transmitted in a specific way.

**USE EXAMPLES AND NON-EXAMPLES TO ILLUSTRATE TYPE OF PATHOGEN AND MODE OF TRANSMISSION.**

1. Bacteria and viruses are two types of **pathogens**. They make us feel ill because they **reproduce** rapidly inside our bodies. Bacterial pathogens are prokaryotic cells that can produce **toxins** which attack our tissues. Once inside our tissues they reproduce by **binary fission**. Viruses live and **reproduce** inside living cells (not by **binary fission**) and damage the cells by causing it to burst. Viruses are about 100 times smaller than a bacterial cell.

**Examples: A range of examples and non-examples are given to enable interpolation and limit extrapolation:**

**Communicable diseases affect plants and animals.**

**Communicable disease transmission can be airborne, waterborne or via direct contact.**

**Communicable diseases are caused by viruses, bacteria,** **fungi, and protists (pathogens).**

Influenza – airborne virus

SARS-CoV-2 – airborne virus

Measles – airborne virus

Hepatitis A – waterborne virus

HIV – direct contact / virus

**TMV – direct contact virus in plants**

Typhoid – waterborne bacteria

Cholera – waterborne bacteria

Salmonella – airborne / direct contact bacteria

Gonorrhoea – direct contact / bacteria

**Rose black spot – airborne / fungus that affects plants**

Malaria – direct contact / protist

**Non-examples: The non-examples are usually caused by lifestyle factors.**

Coronary heart disease (see Organisation)

Cancers (see Organisation)

Diabetes

Arthritis

Chronic respiratory disease

**Teacher notes (e.g. key questions, examples, non-examples, explanations)**

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**Teacher notes (e.g. key questions, examples, non-examples, explanations)**

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**Lesson 1: Communicable Disease**

**Objective: By the end of this lesson, you will be able to define ‘communicable disease’ and explain how they are transmitted.**

**Skills Drill / Retrieval**

|  |  |  |
| --- | --- | --- |
| Answer | | PA / SA |
| 1 |  |  |
| 2 |  |  |
| 3 |  |  |
| 4 |  |  |
| 5 |  |  |

**Connect**

In the Organisation topic you studied examples of non-communicable diseases (CHD and cancer).

1. **Which organ is affected by CHD?**

Coronary Heart Disease affects the heart

1. **What causes CHD?**

In coronary heart disease layers of fatty material build up inside the coronary arteries, narrowing them. This reduces the flow of blood through the coronary arteries, resulting in a lack of oxygen for the heart muscle.

1. **In what three ways can CHD be treated?**
2. Stents are used to keep the coronary arteries open.
3. Statins are widely used to reduce blood cholesterol levels which slows down the rate of fatty material deposit.
4. Lifestyle changes.
5. **Classify each disease as communicable, non-communicable or both using the Venn diagram.**

Asthma Diabetes Arthritis

Influenza Measles SARS-Cov-2 HIV TMV Cholera Malaria Rose black spot

**2. There were almost 24 million cases of SARS-CoV-2 (Covid) during the pandemic in the 2020’s. These resulted in over 200,000 deaths and caused global disruption.**

1. **Was SARS-CoV-2 transmitted through airborne droplets, water supply or by direct contact?**

Airborne droplets

1. **List three measures that the government took to reduce the rate of transmission.**

Face masks when in public places

Distancing

Hand sanitiser etc

1. **Pick one measure that the government took and explain how it prevented or reduced transmission of SARS-CoV-2.**

Dependent on the student’s response.

E.g., face masks reduced airborne transmission by up to 40% by reducing aerosol dispersion of droplets.

**Influenza Measles Asthma SARS-CoV-2 Diabetes HIV Tobacco mosaic virus Cholera Rose black spot Arthritis Malaria**

**Both**

**Non-communicable**

**Communicable**

**3. JOHN SNOW'S THEORY OF HOW CHOLERA SPREAD**

A person sitting in a chair

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14. He eventually convinced local officials to remove the handle of the pump, although by that time the

15. worst of the epidemic had actually passed. It was later established that a leaking sewer ran near the

16. well from which the water was drawn.

17. Unfortunately, Snow failed to convince many in the medical establishment of his theory, including

18. William Farr, who was responsible for medical statistics at the General Register Office. Farr took part

19. in the General Board of Health's 1854 Committee for Scientific Enquiries on the cholera outbreak but

20. although they accepted Snow's data, they dismissed his theory that the mode of transmission for

21. cholera was waterborne.

22. Farr was finally converted to Snow's theory in the wake of the final London cholera epidemic of

23. 1866.  He produced a monograph which showed that mortality was extremely high for people who 24. drew their water from the Old Ford Reservoir in East London. Farr's work was then considered

25. conclusive.

1. **Is Cholera transmitted through the airborne droplets, through water or by direct contact?**

Cholera is waterborne.

1. **What evidence did John Snow have to show how Cholera was transmitted?**

John Snow collected statistical evidence from Broad Street in London. He recorded the location of deaths and showed that the majority were clustered around a public water pump. This suggested that Cholera is waterborne.

1. **How could the transmission of Cholera be controlled if John Snow was correct?**

Examples might include:

* Sterilise water using heat (there are other methods but they probably would not have been known to John Snow).
* Avoid the water pumps in areas where deaths occurred.
* Drink beer / wine instead of water (historians theorise that this was common in the middle ages).

1. In 1848–49 there was a second outbreak of cholera, and this was
2. followed by a further outbreak in 1853–54. Towards the end of the
3. second outbreak, John Snow, a London-based physician, published
4. a paper, On the Mode of Communication of Cholera (1849), in
5. which he proposed that cholera was not transmitted by bad air but
6. by a water-borne infection. However, little attention was paid to the
7. paper.
8. Following the third cholera outbreak in 1854, Snow published an
9. update to his theory, with statistical evidence that he had collected
10. from an area of London around Broad Street, Soho. By recording
11. the location of deaths related to cholera in the area, Snow was able
12. to show that the majority were clustered around one particular
13. public water pump in Broad Street.

**4. Pathogens**

**a. Name four types of pathogen.**

Bacteria, viruses, fungi and protists.

**b. Name one example of a communicable disease caused by each type of pathogen.**

Bacteria – typhoid, cholera, salmonella, gonorrhoea etc

Virus – Influenza, SARS-Cov-2

Fungi – Rose black spot, athletes foot

Protists – Malaria

Allow correct alternatives.

**c. Compare bacterial and viral pathogens and how they make us feel ill.**

Bacteria and viruses are both pathogens; they are microorganisms that do harm.

Bacteria reproduce by binary fission, mainly within our tissues.

Viruses reproduce inside living cells and cause cells to burst.

Bacteria also release toxins that cause some symptoms.

Viruses are about 100 times smaller than bacterial cells.

**d. Scientists have been tracking an outbreak of a new form of Ebola. It is has a high transmission rate and is thought to be spread by direct contact with blood and other body fluids. It is also thought to be waterborne because it is more stable that wild-type Ebola.**

**The prime minister has asked you to advise him on how to control the outbreak.**

* **List the measures that you would advise the prime minister to take.**
* **Explain why each measure would reduce the rate of transmission.**

Expect answers such as:

Waterborne:

1. Sterilise water that might be contaminated using heat to reduce exposure
2. Avoid water sources that might be contaminated to reduce exposure
3. Drink other fluids to reduce exposure

Direct contact:

1. Avoid being near animals that might have the disease. This reduces the risk of direct contact
2. Don’t eat meat from contaminated animals. This reduces exposure to their blood and other bodily fluids.
3. Use basic hygiene measures to remove pathogen if exposed to it.

Students might give alternative responses. Credit those that make sense.

**Lesson 2: Teacher notes**

**AQA Content**

Measles is a viral disease showing symptoms of fever and a red skin rash. Measles is a serious illness that can be fatal if complications arise. For this reason, most young children are vaccinated against measles. The measles virus is spread by inhalation of droplets from sneezes and coughs.

HIV initially causes a flu-like illness. Unless successfully controlled with antiretroviral drugs the virus attacks the body’s immune cells. Late-stage HIV infection, or AIDS, occurs when the body's immune system becomes so severely damaged it can no longer deal with other infections or cancers. HIV is spread by sexual contact or exchange of body fluids such as blood which occurs when drug users share needles.

Tobacco mosaic virus (TMV) is a widespread plant pathogen affecting many species of plants including tomatoes. It gives a distinctive ‘mosaic’ pattern of discolouration on the leaves which affects the growth of the plant due to lack of photosynthesis.

**Students should be able to** explain how diseases caused by viruses, bacteria, protists and fungi are spread in animals and plants. **Students should be able to** explain how the spread of diseases can be reduced or prevented.

**Chunking**

1. Structure and mode of action of viruses.
2. Measles: Symptoms and mode of transmission.
3. HIV: Mode of action and mode of transmission.
4. TMV: Symptoms and why TMV stunts the growth of plants. ￼

**Key direct and explicit teacher explanations:**

1. **Viruses** are **pathogens** that reproduce inside cells. The structure of viruses is diverse, however, they all have the following things in common:
2. A **protein capsule** around the outside
3. **Genetic material** (either DNA or RNA) inside the virus.

**Viruses** reproduce inside cells; they are not cells themselves. They do this by inserting their **genetic material** into a cell. This forces the cell to make lots of copies of the virus. Eventually the cell bursts because so many **virus** particles have been made.

**MICROGRAPHS SHOW THE DIVERSITY OF STRUCTURE BEFORE DISCUSSING THE GENERIC STRUCTURE AND MODE OF ACTION.**

1. Measles is a disease caused by **a virus**. It is a **communicable disease** that is **transmitted** through the air by droplets from sneezes and coughs. The common **symptoms** are fever and a red rash. However, it can cause complications that are fatal. We **vaccinate** children against measles because of this.
2. HIV is a viral **pathogen** that is transmitted through **direct contact** with blood (e.g. when drug users share needles), sexual contact or other bodily fluids. It initially causes **flu-like symptoms**. Doctors attempt to control it using **antiretroviral** drugs. If this is unsuccessful, the virus attacks the **immune systems**. During late-stage HIV the person develops AIDS. When this happens the **immune system** is too weak to fight other diseases such as infections or cancers. These diseases can eventually kill the person.
3. Tobacco mosaic virus is a **plant pathogen** that attacks many plants including tomatoes. It causes the leaves of plants to develop leaves with a ‘mosaic’ pattern. This can result in stunted growth. This is because, the discoloured parts of the leaves do not contain **chlorophyll**. The amount of light absorbed by the leaves is reduced so the **rate of photosynthesis** is much lower.

**Examples and non-examples: A range of examples and non-examples are given to enable interpolation and limit**

**extrapolation:**

Examples of viruses: They show a range of morphology. However, they all have a protein coat and contain genetic material).

Some viruses have a lipid envelope derived from the host cells (e.g., HIV). This makes it harder for the immune system to recognise.

Ebola: RNA Smallpox: DNA Tobacco rattle virus: RNA SARS-CoV-2: RNA

**Teacher notes (e.g. key questions, examples, non-examples, explanations)**

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**Lesson 2: Viral Diseases**

**Skills Drill / Retrieval**

**Objective: By the end of this lesson, you will be able to describe how communicable diseases caused by viruses affect the host and how their transmission can be reduced.**

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| --- | --- | --- |
| Answer | | PA / SA |
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**Connect**

1. **Viruses reproduce inside cells. Describe the reproductive cycle of a virus.**

The virus identifies a host cell

The virus injects its genetic material into the host cell

The genetic material uses the cells organelles to make more copies of the virus

The cell eventually bursts

Viruses are dispersed into the environment where they can infect other cells.

1. **HIV**
2. How is HIV transmitted?

Sexual contact

Exchange of bodily fluids

1. Which part of the body does HIV attack?

The immune system

1. How is HIV different to AIDS?

HIV is a virus

AIDS is a condition caused by the HIV virus compromising the immune system.

**Graphical user interface, text, application, email

Description automatically generated**

Any **two** from: Avoid sexual contact; use a condom; do not share needles; use antiretroviral drugs; screen blood used for transfusions; regular tests to see if you have HIV

Ignore: handwashing; social distancing; protection unqualified; contraception unqualified; use medication unqualified

If no other marks are given award **1 mark** for do not exchange bodily fluids.

X

1. **Measles**
2. How is measles transmitted?

Air borne droplets from sneezes and coughs.

1. Name two symptoms of measles.

Fever and red rash.

**Graphical user interface, email

Description automatically generated**

4.5

2030 – 91 = 1939

1939/2030 x 100 = 4.5%

Any **one** from: Not everyone would go to the doctor; sample will not always be sent for analysis; some cases not tested / diagnosed / confirmed.

Allow: Not all cases recorded; only medically confirmed cases recorded; idea of doctor making judgement error or misdiagnosis. Ignore some cases unknown.

1. **Tobacco Mosaic Virus**

**Graphical user interface, text, email

Description automatically generated**

64

16 micrometres = 1.6 x 10-5m **OR** 2.5 x 10-7m = 0.25 micrometres

1.6 x 10-5m / 2.5 x 10-7m **OR** 16 / 0.25

= 64

Electron microscope. Ignore microscope unqualified. Ignore scanning tunnelling. Do **not** accept light microscope.

**A picture containing text

Description automatically generated**

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Accept any sensible measure. These might include:

Media campaign to raise awareness with general public

Workplace training for those likely to be exposed

Widespread use of personal protection equipment in relevant workplaces

Needle banks supplying clean needles

Widespread availability of condoms

Increase funding to research institutes to develop an understanding of the virus and potential cures

Attempts to produce a vaccination / medicines

Icon

Description automatically generated

Activity 5.

1. The first case of HIV occurred in 1959 in a Congolese man. The AIDS epidemic
2. officially started in 1981. Between 1959 there were numerous cases of HIV
3. detected but they occurred in isolated clusters.
4. Very little was known about the disease and how it was transmitted at the start of
5. the epidemic. However, it was known that the AIDS was common in addicts that
6. injected drugs and sex workers.
7. Use this information to suggest measures that the government should have taken
8. to control or reduce transmission of the disease.

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**Lesson 3: Teacher notes**

**AQA Content**

Salmonella food poisoning is spread by bacteria ingested in food, or on food prepared in unhygienic conditions. In the UK, poultry are vaccinated against salmonella to control the spread. Fever, abdominal cramps, vomiting, and diarrhoea are caused by the bacteria and the toxins they secrete.

Gonorrhoea is a sexually transmitted disease (STD) with symptoms of a thick yellow or green discharge from the vagina or penis and pain on urinating. It is caused by a bacterium and was easily treated with the antibiotic penicillin until many resistant strains appeared. Gonorrhoea is spread by sexual contact. The spread can be controlled by treatment with antibiotics or the use of a barrier method of contraception such as a condom.

Rose black spot is a fungal disease where purple or black spots develop on leaves, which often turn yellow and drop early. It affects the growth of the plant as photosynthesis is reduced. It is spread in the environment by water or wind. Rose black spot can be treated by using fungicides and/or removing and destroying the affected leaves.

**Students should be able to** explain how diseases caused by viruses, bacteria, protists, and fungi are spread in animals and plants.

**Students should be able to** explain how the spread of diseases can be reduced or prevented.

**Chunking**

1. Review of bacterial infection
2. Salmonella as a bacterial infection
3. Gonorrhoea as a bacterial infection
4. Rose Black Spot as a fungal infection in plants
5. Why plants with rose black spot have stunted growth

**Key direct and explicit teacher explanations:**

1. Bacterial pathogens are prokaryotic cells that can produce **toxins** which attack our tissues. Once inside our tissues they reproduce by **binary fission**.
2. Salmonella food poisoning is spread by bacteria ingested in food, or on food prepared in **unhygienic** conditions. In the UK, poultry are **vaccinated** against salmonella to control the spread. Fever, abdominal cramps, vomiting and diarrhoea are caused by the bacteria and the **toxins** they secrete.
3. Gonorrhoea is a sexually transmitted disease (STD) with symptoms of a thick yellow or green discharge from the vagina or penis and pain on urinating. It is caused by a bacterium and was easily treated with the **antibiotic** penicillin until many resistant strains appeared. Gonorrhoea is spread by sexual contact. The spread can be controlled by treatment with **antibiotics** or the use of a **barrier method of contraception** such as a condom.
4. Rose black spot is a fungal infection that affects rose leaves. Purple or black spots develop on leaves, which often turn yellow and **drop early**. It is spread in the environment by **spores** that are **airborne** or **water borne:** It can also be spread by **direct contact**. Rose black spot can be treated by using fungicides and/or removing and destroying the affected leaves. The **spores** can remain **dormant** over the winter so it is important to remove infected leaves.
5. Rose black spot can cause plants to have **stunted** growth. This is because the plant absorbs less light that can be used for **photosynthesis**. The plant absorbs less light because its leaves contain less **chlorophyll.** Less **glucose** is produced because the **rate of photosynthesis** is lower. So, less **glucose** is available to make **amino acids** and **cellulose** which are used for growth. Also, less energy is released because less **glucose** is available for **respiration**.

**Examples: A range of examples and non-examples are given to enable interpolation and limit extrapolation:**

**Examples:**

Fungal infections require warm and damp conditions. For example:

Athletes foot; nail bed infections; oral thrush; ringworm; rose black spot; powdery mildew.

Examples of bacterial infections: Tuberculosis; Anthrax; Tetanus; Pneumonia; Cholera; MRSA

Examples should focus on prokaryotic structure as this differentiates them from viruses and fungi.

**Non-examples:** Choose alternative pathogen groups for structural comparisons.

**Teacher notes (e.g. key questions, examples, non-examples, explanations)**

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**Lesson 3: Bacterial and Fungal Diseases**

**Objective: By the end of this lesson, you will be able to describe how communicable diseases caused by bacteria and fungi affect the host and how their transmission might be reduced.**

**Skills Drill / Retrieval**

|  |  |  |
| --- | --- | --- |
| Answer | | PA / SA |
| 1 |  |  |
| 2 |  |  |
| 3 |  |  |
| 4 |  |  |
| 5 |  |  |

**Connect**

Viruses are one of the types of pathogens that can cause communicable diseases.

Compare the structure of a virus to the structure of a bacterial cell.

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Viruses are composed of genetic material within a protein capsule. Some viruses have additional components (e.g HIV has a membrane). The genetic material is not found in a membrane bound nucleus.

Bacterial cells also have DNA ‘naked’ in the cytosol. They can have additional circular pieces of DNA called plasmids.

Bacterial cells have a complex cell wall whereas viruses have a relatively simple capsule.

Bacterial cells have a cell membrane. Some viruses also have a membrane.

The cytoplasm of the bacterial cell is relatively complex and includes other organelles / sub-cellular structures not found in viruses. E.g., ribosomes.

Fungicidal sprays / anti-fungal sprays

Removal of infected leaves and burn them. Remove and burn infected plants etc.

Rose black spot.

Discoloured leaves with black / dark purple spots.

Tobacco mosaic virus / TMV / ToMV

Mosaic pattern of discolouration.

**Graphical user interface

Description automatically generated**

The leaves on the rose bush have black and purple spots.

The leaves on the tomato plant and mottled with green and yellow areas.

Text

Description automatically generated with medium confidence

Graphical user interface, website

Description automatically generated with medium confidence

**Short term:**

Advise that eggs and chicken should be cooked thoroughly

Hands should be washed after handling eggs and chicken

**Long term:**

Introduce safety standard for eggs and chicken (e.g. the red lion mark on eggs)

Quality control eggs and chicken before selling for consumption

Other answers are possible.

1. On December 3, 1988, Edwina Currie, a British politician, stood in front of reporters and
2. television cameras on a mild December morning and delivered a death sentence to the egg
3. industry. “Most of the egg production in this country, sadly, is now affected with salmonella,”
4. she announced in an official statement to the waiting journalists and TV crew. Elaboration
5. would have clarified that only the flocks had been “mostly” infected, not necessarily
6. their eggs—and the fact that, once properly cooked, all eggs were perfectly safe to eat.

*Extract from: https://www.myrecipes.com/extracrispy/how-one-politician-nearly-broke-the-british-egg-industry*

**Salmonella bacteria cause food poisoning.**

**Suggest ways that the incidences of food poisoning caused by Salmonella could be reduced**

1. **In the short term**
2. **In the long term**

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Roses that become infected by rose black spot usually have stunted growth.

Tomato plants also have stunted growth if they become infected with tobacco mosaic virus.

Explain why both of these communicable diseases cause stunted growth.

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Infected parts produce less chlorophyll

The rate of photosynthesis is lower

So, less energy is available for growth

Because less glucose is available for respiration

**And / or**

Less glucose is available for making amino acids / proteins / cellulose

**Lesson 4: Teacher notes**

**AQA Content**

The pathogens that cause malaria are protists. The malarial protist has a life cycle that includes the mosquito. Malaria causes recurrent episodes of fever and can be fatal. The spread of malaria is controlled by preventing the vectors, mosquitos, from breeding and by using mosquito nets to avoid being bitten.

**Students should be able to** explain how diseases caused by viruses, bacteria, protists, and fungi are spread in animals and plants.

**Students should be able to** explain how the spread of diseases can be reduced or prevented.

**Chunking**

* **What is malaria and where is it found?**
* **What are protists?**
* **Mosquitos as a vector**
* **Controlling the spread of malaria**

**Key direct and explicit teacher explanations:**

1. **Malaria** is a disease that affects very large numbers of people every year. More than 800,000 African children under the age of 5 die from malaria every year. It also contributes to malnutrition which is indirectly linked to the death of over half of children under the age of five across the globe. Malaria can also cause anaemia in women, especially pregnant women, resulting in babies having a low birth weight.

**Malaria** is caused by a **protist**. **Mosquitoes** carry the **protist** (the **mosquito is a vector**); the **protist** is injected into humans when they get bitten by an infected **mosquito**. The **symptoms** include, chills, sweats, headaches and diarrhoea.

1. **Protists** are simple organisms that have some features in common with **eukaryotes and fungi**. Some protists are similar to plant cells and others are similar to animal cells. For example, they have a nucleus and mitochondria just like eukaryotic cells.

The protist, **plasmodium**, causes malaria in humans.

1. **This content is covered because it enables students to rationalise the control methods.**

**Mosquitos** are the **vector** for **malaria**; this means that they carry the **pathogen** from one place to another. This means that if we can understand the mosquito’s **life cycle**, we can control the **population of mosquitos**; if there are less mosquitos, malaria will be **transmitted** less.

Mosquitos lay eggs. When the **eggs** hatch, **larvae** emerge. **Larvae** need to live in water.

The larvae develop into **pupae; pupae** also live in water.

Eventually the **pupae**, develop into adult mosquitos that can fly; the adult mosquitos are the **vector** and carry the **protist** to other humans.

1. **Control measures** focus on either **interrupting the mosquitos life cycle** or preventing adult mosquitos from **biting people**; the disease is transmitted by mosquito bites.

Control measures are therefore:

1. Preventing the mosquitoes from biting humans (e.g. using mosquito nets)
2. Preventing the mosquito from breeding by reducing the amount of water in the environment
3. Preventing the mosquito from breeding by sterilising male mosquitos.

There have also been attempts to produce a vaccine for malaria. So far, the attempts have not been successful.

**Teacher notes (e.g. key questions, examples, non-examples, explanations)**

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**Lesson 4: Protist Diseases**

**Objective: By the end of this lesson, you will be able to describe how communicable diseases caused by a protist affect the host and how their transmission might be reduced.**

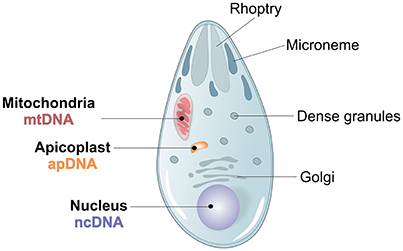
**Skills Drill / Retrieval**

|  |  |  |
| --- | --- | --- |
| Answer | | PA / SA |
| 1 |  |  |
| 2 |  |  |
| 3 |  |  |
| 4 |  |  |
| 5 |  |  |

**Connect**

An image of a protist is shown on the left. Compare its structure to the structure of a prokaryotic cell.

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Both have a cell membrane.

Protists have a nucleus whilst prokaryotes do not; the DNA is found in the cytoplasm.

Protists have mitochondria whereas prokaryotes do not.

Protists have additional sub-cellular structures such as a rhoptry, microneme and apicoplast.

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Sterile male mosquitoes compete for mates with the other male mosquitoes. This reduces the birth rate and so reduces the population size over time.

Mosquitoes are the vector for malaria. Their lifecycle requires access to pools of water. If these are removed, the mosquito’s lifecycle is interrupted so their population would decrease in size. The rate of transmission would decrease because the vector population has decreased in size.

Effective vaccines would ensure that the body can protect itself if it becomes infected (details have not been taught yet).

Mosquitoes are the vector for malaria. Insect repellents repel the mosquitoes, so humans are bitten less often.

Mosquitoes infect humans by biting; this transfers the protist into them. The mosquito net protects people from being bitten.

Mosquitoes can be turned into carriers when they bite an infected person. This is prevented by mosquito nets.

Mosquitoes are the vector for the protist that causes malaria.

Insecticides kill the vector and so reduce the rate of infection in animal species.

Icon

Description automatically generated with medium confidence

Icon

Description automatically generated with medium confidence

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Description automatically generated with medium confidence

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Description automatically generated with medium confidence

Icon

Description automatically generated with medium confidence

Logo

Description automatically generated

Explain why the following methods can be used to control the spread of malaria:

1. **I DO** - Insecticides

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1. **WE DO / YOU DO** - Mosquito nets

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1. **WE DO / YOU DO** - Insect repellents

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1. **WE DO / YOU DO** - Vaccination

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1. **WE DO / YOU DO** - Draining paddy fields that are used to grow rice

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1. **WE DO / YOU DO** - Releasing sterilised male mosquitos into habitats

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**Future:**

Vaccination programmes so the protist can not survive in the human hosts.

Releasing sterile male mosquitoes so the mosquito population decreases in size.

Draining rice paddy fields and encouraging alternative forms of agriculture. This reduces the size of the habitat available to the mosquito population.

**Quick:**

Mosquito nets could be given to the local human population. This will reduce the incidences of people being bitten by mosquitoes (the vector for malaria).

Insecticides and insect repellents decrease the frequency of humans being bitten.

1. Bill Gates is one of the richest men in the world. He has invested $200,000,000 into
2. eradicating malaria via the Bill Gates Foundation. A key part of their strategy is to
3. use complex surveillance techniques and data management to identify when and
4. where outbreaks are likely. They then support communities in addressing the
5. malaria outbreak.

**List two methods that could be implemented quickly to respond to an outbreak.**

**Explain how they can help minimise cases of malaria.**

Method 1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Explanation:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Method 2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**List two methods that could be used to reduce the risk of future outbreaks.**

**Explain how each method reduces the risk of future outbreaks.**

Method 1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Explanation:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Method 2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Explanation:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Lesson 5: Teacher notes**

**AQA Content**

(HT only) Plant diseases can be detected by: • stunted growth • spots on leaves • areas of decay (rot) • growths • malformed stems or leaves • discolouration • The presence of pests.

(HT only) Identification can be made by: • reference to a gardening manual or website • taking infected plants to a laboratory to identify the pathogen • using testing kits that contain monoclonal antibodies.

Plants can be infected by a range of viral, bacterial and fungal pathogens as well as by insects.

Knowledge of plant diseases is restricted to tobacco mosaic virus as a viral disease, black spot as a fungal disease and aphids as insects.

Plants can be damaged by a range of ion deficiency conditions:

• stunted growth caused by nitrate deficiency • chlorosis caused by magnesium deficiency.

Knowledge of ions is limited to nitrate ions needed for protein synthesis and therefore growth, and magnesium ions needed to make chlorophyll.

**Key direct and explicit teacher explanations:**

1. All organisms, including plants, can get diseases. Some of these diseases are non-communicable and some are communicable. Humans get symptoms when they get a disease. Similarly, plants get symptoms. You have come across some of these symptoms in the lessons on pathogens.

If plants get a disease, they might get some of the following symptoms:

* Stunted growth
* Spots on leaves
* Areas of decay or rot
* Growths
* Malformed stems and leaves
* Discolouration
* Pests might be present

1. Plant disease can be identified from the symptoms. Depending on the disease, you might be able to identify the disease using a gardening manual or website. This is the quickest and cheapest method. Sometimes, it is more difficult to identify a disease. If this is the case, a sample might be sent to a laboratory for identification. This takes longer and is more expensive. Finally, testing kits can be used to identify diseases. These often contain monoclonal antibodies; these contain antibodies for the specific pathogen.
2. Communicable diseases in plants are often caused by pathogens. They can also have non-communicable diseases; for example, those caused by mineral deficiencies.

Nitrate deficiency can cause stunted growth. This is because plants use nitrate to make amino acids (they react it with glucose). Amino acids are used for growth. So, if the plant doesn’t get enough nitrate, it can not make enough protein to grow quickly; it’s growth will be stunted.

Chlorophyll contains a magnesium ion; if the plant has a chlorophyll deficiency it won’t contain much chlorophyll. If the plant has a magnesium deficiency it can not make enough chlorophyll; it will have yellow patches. This is called chlorosis. This can also cause stunted growth because the plant won’t be able to perform photosynthesis efficiently.

**Chunking**

1. Symptoms of plant disease.
2. Identifying plant diseases.
3. Symptoms caused by mineral deficiency.

**Lesson 5: Detection and identification of plant diseases**

**Teacher notes (e.g. key questions, examples, non-examples, explanations)**

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**Objective: By the end of this lesson, you will be able to describe symptoms of disease in plants, how to identify the disease and the cause of some symptoms.**

**Skills Drill / Retrieval**

|  |  |  |
| --- | --- | --- |
| Answer | | PA / SA |
| 1 |  |  |
| 2 |  |  |
| 3 |  |  |
| 4 |  |  |
| 5 |  |  |

**Connect**

Tobacco mosaic virus infects over 150 species of plants. It causes the leaves to have a distinctive mosaic pattern; this happens because the virus infects chloroplasts, so they don’t contain much chlorophyll. This reduces the plant’s ability to do photosynthesis. This can reduce the plants growth because it makes less glucose by photosynthesis. This means that there is less glucose available for respiration and to make larger molecules required for growth like proteins and cellulose.

1. List two symptoms that plants might have if they are infected with tobacco mosaic virus.

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Mottled leaves

Stunted growth

1. Explain why the plant gets one of these symptoms when it has a tobacco mosaic virus infection.

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Mottled leaves – the virus infects chloroplasts. This causes them to contain less chlorophyll.

Stunted growth – the plant contains less chlorophyll so the rate of photosynthesis is lower. This is because less light can be absorbed.

Less glucose is made.

Less energy is transferred from glucose by respiration.

Less amino acids / proteins / enzymes / cellulose is made that can be used for growth.

**Task B**

The roots of the gorse plant have bacteria that turn nitrogen gas into nitrate ions.

Explain why nitrate ions are needed by the gorse plant.

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**Task A**

Diagram

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**I Do**

A scientist noticed that in one area gorse plants can have yellow leaves and stunted growth.

One reason for yellow leaves and stunted growth is a deficiency of nitrate ions in the soil.

Explain **two** other possible reasons for the yellow leaves and stunted growth.

Do **not** refer to nitrate ions in your answer.

Reason 1

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Explanation

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Reason 2

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**Lesson 6: Teacher notes**

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**We Do / You Do**

Plants infected with aphids may show symptoms of magnesium deficiency.

Magnesium deficiency symptoms include:

•   yellow leaves

•   stunted growth.

Explain how a deficiency of magnesium could cause these symptoms.

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**AQA Content**

Students should be able to describe physical and chemical plant defence responses.

Physical defence responses to resist invasion of microorganisms. • Cellulose cell walls. • Tough waxy cuticle on leaves. • Layers of dead cells around stems (bark on trees) which fall off.

Chemical plant defence responses. • Antibacterial chemicals. • Poisons to deter herbivores.

Mechanical adaptations. • Thorns and hairs deter animals. • Leaves which droop or curl when touched. • Mimicry to trick animals.

**Key direct and explicit teacher explanations:**

1. All living things have adaptations. Adaptations are characteristics that help the organism to survive. For example, tigers are camouflaged. This helps them to remain hidden when hunting for prey.

Plants have adaptations also. These are often defence responses; they help to protect them from harm.

**Examples of defence responses to cover:**

Cellulose cell walls; antibacterial chemicals; thorns and hairs to deter animals; tough waxy cuticle on leaves; poisons to deter herbivores; leaves which drop or curl when touched; layers of dead cells around stems (bark on trees) which fall off; mimicry to trick animals.

**Non-examples:** Choose non-defence adaptations.

1. Physical defence responses act as a barrier. For example, the bark on a tree.

Chemical defence responses require the plant to make a chemical that kills or harms other living things.

Mechanical adaptations deter other organisms which, for example, might eat them. They can also cause sudden movements.

**Use Engelmann structures to cover the full range and classify with reasoning.**

**Chunking**

1. Examples of adaptations.
2. Classification of adaptations.

**Lesson 6: Plant defences**

**Teacher notes (e.g. key questions, examples, non-examples, explanations)**

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**Objective: By the end of this lesson, you will be able to describe how plants defend themselves using physical, chemical and mechanical defences.**

**Skills Drill / Retrieval**

|  |  |  |
| --- | --- | --- |
| Answer | | PA / SA |
| 1 |  |  |
| 2 |  |  |
| 3 |  |  |
| 4 |  |  |
| 5 |  |  |

**Connect**

A plant has yellow leaves and stunted growth.

1. Explain how a magnesium deficiency could cause these symptoms.

Magnesium is contained in chlorophyll. If there is a deficiency, the chloroplasts contain less chlorophyll so leaves look yellow.

Less light is absorbed. So, the rate of photosynthesis is lower. Less glucose is made so the less energy is transferred by respiration. Less cellulose / proteins / enzymes / aa’s are available for growth.

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1. Explain why a nitrate deficiency could cause one of these symptoms.

Nitrate is used to make amino acids from glucose.

If less amino acids are made, less protein / enzymes are made. These are used for growth, so growth is slower.

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1. Explain why tobacco mosaic virus might cause these symptoms.

TMV infects chloroplasts. They will contain less chlorophyll so the leaves appear yellow.

Less light is absorbed. So, the rate of photosynthesis is lower. Less glucose is made so the less energy is transferred by respiration. Less cellulose / proteins / enzymes / aa’s are available for growth.

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1. List three ways of confirming the cause of the symptoms.

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Consult a gardening manual or website.

Identification in a laboratory

Use testing kits containing monoclonal antibodies.

Mechanical defence response

Stinging hairs / can sting

(so) this harms herbivores / stops animals eating them

(so) less of the plant is removed / damaged

Plants have adaptations to help defend themselves and to help them survive.

**Figure 1** shows a nettle plant.

**Figure 1**

A picture containing diagram

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(a)     Explain how the nettle is adapted for defence and protection.

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**Task A**

(a)  mechanical

*allow physical*

*allow structural*

**1**

(b)  any **one** from:

•   to deter herbivores

*ignore to injure animals, unqualified*

*allow to deter animals eating it*

*do****not****accept to deter predators*

•   to prevent animals damaging it

**1**

(c)  chemical

**1**

Many plants have evolved defence mechanisms.

**Figure 1** shows part of a gorse plant and part of a deadly nightshade plant.

**Figure 1**

A picture containing plant, vegetable

Description automatically generated

(a)  The gorse plant has evolved to have sharp thorns.

What type of defence response are thorns?

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**(1)**

(b)  How do thorns defend the gorse plant?

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**(1)**

(c)  The deadly nightshade plant has poisonous berries.

What type of defence response are poisonous berries?

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**(1)**

**I Do**

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Explain how plants defend themselves against microorganisms.

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**We Do / You Do**

Explain how plants defend themselves against organisms that might harm them.

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**Two physical and two chemical defence examples should be identified as a minimum.**

**Each defence response should be accompanied by an explanation (see I DO).**

**Lesson 7: Teacher notes**

**Key direct and explicit teacher explanations:**

1. The body is constantly being attacked by **pathogens**. The body has two ways of defending itself:
2. **Non-specific defences** prevent pathogens from entering our tissues
3. **Specific defences** that are used if pathogens enter our bodies. These are extremely complex.

**Non-specific defences** can be found in the nose, skin, trachea and bronchi and stomach.

1. The skin is the largest organ in the human body. It has many roles. One important role is that it acts as a **physical barrier** to pathogens. If the skin is damaged it begins to repair itself quickly. This process often started with forming a scab over the damaged area. The skin is a physical barrier.
2. **Airborne pathogens** often enter the body through the nose or mouth. The body has several ways to trap these **pathogens** and kill them:
3. The nose produces **mucus** that traps the **pathogens** because it is sticky. When you blow your nose, you remove the trapped **pathogens**.
4. If the **pathogens** don’t get trapped by **mucus** in the nose, they can get trapped by **mucus** produced by **goblet cells** produced in the **trachea and bronchi**. The **trachea and bronchi** also contain **ciliated epithelial cells**. The **cilia** look like small hairs. Their function is to waft mucus to the top of the throat; it is then swallowed or spat out.

The mucus is a **physical barrier**.

1. The stomach produces **hydrochloric acid** which is then **churned** with food. This **hydrochloric acid** is strong enough to kill **pathogens**. This is a **chemical barrier**.

**Examples: A range of examples and non-examples are given to enable interpolation and limit extrapolation:**

**Examples:** Non-specific responses -Skin (physical barrier), stomach acid (chemical barrier), mucus and cilia (physical barrier)

**Non-examples:** White blood cells (specific response)

**Chunking**

1. Preventing pathogens from entering out tissues.
2. The skin as a barrier.
3. Protection against airborne pathogens.
4. Protection against pathogens in food.

**AQA Content**

**Students should be able to** describe the non-specific defence systems of the human body against pathogens, including the: • skin • nose • trachea and bronchi • stomach.

**Teacher notes (e.g. key questions, examples, non-examples, explanations)**

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