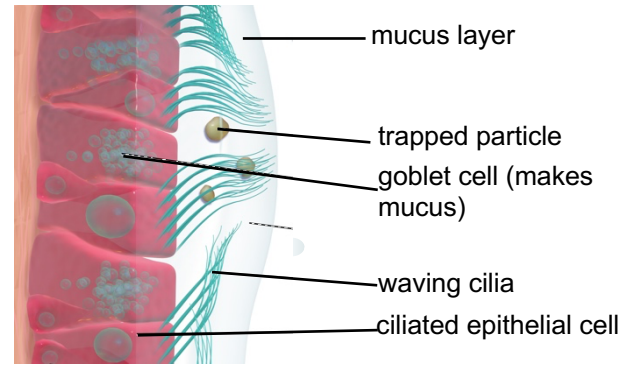


Barriers to infection

The body tries to stop **pathogens** (disease-causing microorganisms) getting into tissues. Skin acts as a barrier, and cuts are quickly healed by **platelets** and other substances in the blood.

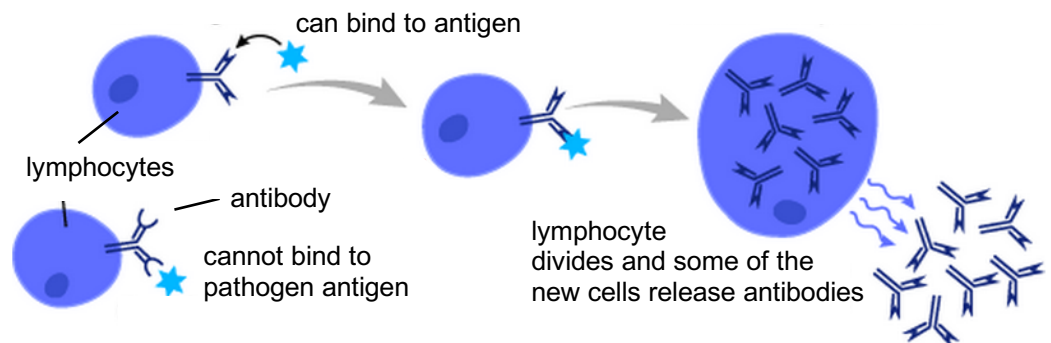


The tubes in the gas exchange system produce about 2 litres of sticky mucus each day. This traps small particles, which ciliated epithelial cells sweep up to the throat to be swallowed. Mucus also contains **lysozyme** (an enzyme that attacks the cell walls of some bacteria).

Lymphocytes and antibodies

Cells have **antigens** (proteins and other molecules) on their surfaces. In body tissues, white blood cells use antigens to work out if a cell belongs to the body or not. Foreign cells must be destroyed.

Lymphocytes are white blood cells that have **antibodies** on their surfaces. If the shape of an antibody matches that of a foreign antigen, they lock together. This



activates the lymphocyte, which divides to form many identical cells. Some of these release large quantities of their specific antibody. The foreign cell (or virus) becomes coated in these antibodies, which inactivate it and mark it out for **phagocytes** to surround and ingest.

This process can take days, and so pathogens make people ill before they get better. However, the process forms **memory lymphocytes**, which make the person **immune** (unable to get the disease). If the pathogen invades again, the body is prepared; memory lymphocytes quickly release antibodies in a **secondary response**, which soon destroy the pathogen and the person does not become ill.

Immunity lasts for different lengths of time. Scientists do not yet know how long immunity to COVID-19 lasts or if everyone who gets the disease becomes immune.

Find out

- I. 1. Scientists are developing tests to find out if someone has had COVID-19.
 - a. Names the two types of antibody these tests look for. _____

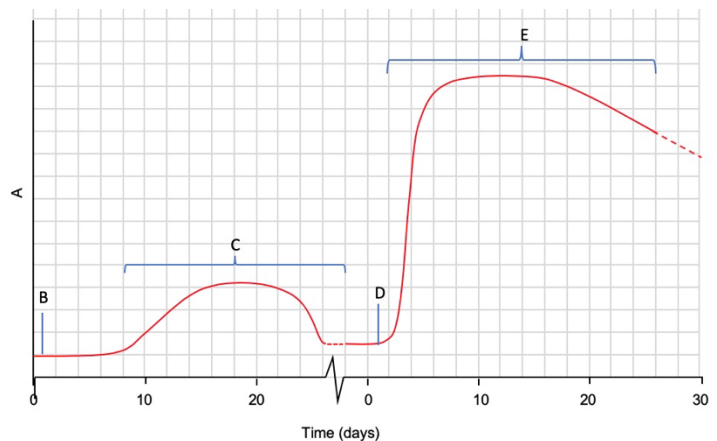
- b. During an infection, which antibody is first to be made? _____
2. White blood cells attack pathogens in tissues. The body tries to stop pathogens reaching tissues, using physical barriers and chemical defences (reactions with substances in pathogens). Complete the table to show some examples. You may need to do research.

Physical barrier	Chemical defence
	lactoferrin (e.g. in earwax)

Test yourself

3. Describe what an antigen is. _____
4. Explain why most of the body's lymphocytes are not activated by a particular pathogen.
5. The graph shows the body's 'immune response'. Add the letters to the labels below.

- ___ primary response
- ___ secondary response
- ___ antibody concentration
- ___ first infection
- ___ second infection



6. Identify two differences in the immune response each time the pathogen enters the tissues. _____

Check-up

- I. Check your answers.
- II. Some people have suggested that people who test positive for coronavirus antibodies should get an 'Immunity Passport' allowing them to move around freely. Prepare arguments for and against this idea, to use in a debate.



Answers

Note to home educators

The worksheet is designed to support understanding of the body's defences to infection (using physical barriers, chemical defences and white blood cells). You may wish to share these objectives with students:

- Explain how specialised cells keep the lungs clean (mucus production and ciliated epithelial cells).
- Describe how the physical barriers and chemical defences of the human body provide protection from pathogens. (GCSE)
- Explain the role of the immune system in defence against disease (including pathogen antigens, lymphocytes, antibodies and memory lymphocytes). (GCSE)

To access this sheet, students will need a knowledge of cells, microorganisms and molecules.

It is suggested that students complete the worksheet independently, making use of the internet to complete questions 1 and 2. Questions 3 - 6 should be completed without help from additional sources.

Some questions will be accessible by students in Years 8 and 9 but most of this sheet is drawn from GCSE 9-1 Science specifications (Combined Science).

- I. 1. a. IgG, IgM (or Immunoglobulin G, Immunoglobulin M)
b. IgM
2.

Physical barrier	Chemical defence
skin	stomach acid
mucus	lysozyme (e.g. in mucus, tears)
ciliated epithelial cells	lactoferrin (e.g. in earwax)

- Note that these are the expected answers; there are other correct answers. The distinction is that chemical defences involve a *substance* that reacts with/attacks part of a pathogen and destroys it (before it can enter the body's tissues). There are also a range of mechanical defences (such as vomiting). Accept these as 'physical barriers'.
3. A molecule that sticks out of the surface of a cell (or virus).
4. Only some of the lymphocytes have the correct shape of antibody that fits/locks onto the antigen on the pathogen.
5. From top to bottom: C, E, A, B, D
6. Compared to the primary response, the secondary response is faster and produces more antibodies.

II. Points in favour could include:

- allow people who are not at risk of having/spreading the disease to return to work/school
- help re-start the economy
- allow families to see one another again

Points against could include:

- tests only show antibodies and may not show immunity/tests may not be accurate
- people will fake the documents (allowing people to spread the virus again)
- it encourages people to ignore health advice (e.g. don't touch eyes, nose, mouth)
- it encourages people to risk stopping their isolation, even if they don't have a passport