

GCSE / IGCSE Biology – Infection and Response

GCSE / IGCSE (Edexcel / Cambridge style) · Total marks: 39 · Answers on the last page

This worksheet covers pathogens and disease, the body's defences and immune response, vaccination, and drug development including antibiotics. No calculator is needed.

Section A – Pathogens and Disease (Skills)

1. Define "pathogen" and name the four types of pathogen studied in this topic, giving one example disease caused by each. [5]
2. Describe two ways in which a disease-causing microorganism can be spread from one person to another. [2]
3. Explain how the skin acts as a barrier to prevent the entry of pathogens into the body. [2]

Section B – Immune Response and Vaccination (Exam-style)

4. Describe how white blood cells defend the body against pathogens, referring to phagocytosis and antibody production. [4]
5. Explain how vaccination can protect an individual from a serious disease, referring to memory cells in your answer. [4]
6. A country introduces a vaccination programme against a viral disease. After several years, 92% of the population is vaccinated. Explain how this can protect even the unvaccinated 8% of the population. [3]
7. Explain why antibiotics are not effective against viral infections such as the common cold. [2]

Section C – Drug Development and Extended / Challenge

8. Describe the main stages involved in the preclinical and clinical testing of a new medicinal drug, before it can be prescribed by doctors. [4]
9. Explain why it is important to use a placebo and carry out a "double-blind" trial when testing a new drug. [3]
10. Bacteria can become resistant to antibiotics through natural selection. Explain how a population of bacteria in a patient could become resistant to a particular antibiotic over time. [4]
11. Explain why it is important that doctors do not over-prescribe antibiotics, and that patients complete the full course of antibiotics prescribed. [3]
12. Monoclonal antibodies are produced to be specific to one particular type of antigen. Suggest one use of monoclonal antibodies in medicine and briefly explain how they work in this use. [3]

Answers

Check your working against these. If an answer does not match, try the question again before looking for the method.

1. A pathogen is a microorganism that causes infectious disease. Bacteria – e.g. Salmonella (food poisoning). Viruses – e.g. measles. Fungi – e.g. rose black spot (or athlete's foot). Protists – e.g. malaria (caused by Plasmodium).
2. Any two of: direct contact (touching); through the air (droplet infection, e.g. coughing or sneezing); through contaminated water; via a vector (e.g. a mosquito); via bodily fluids.
3. The skin covers the body and provides a physical barrier that pathogens generally cannot penetrate; it also secretes antimicrobial substances (e.g. in sebum) that can inhibit the growth of microorganisms, and if it is cut, blood clots rapidly to seal the wound and prevent pathogens entering.
4. Some white blood cells (phagocytes) engulf and digest pathogens by phagocytosis. Other white blood cells (lymphocytes) produce antibodies that are specific to a particular antigen on the surface of a pathogen; the antibodies bind to these antigens, which helps to destroy the pathogen (e.g. by clumping pathogens together). Lymphocytes may also produce antitoxins that neutralise toxins produced by pathogens.
5. A vaccine contains a small, safe (dead or inactive) form of a pathogen or its antigens. This stimulates white blood cells to produce antibodies specific to that pathogen, and the body also produces memory cells. If the person later encounters the live pathogen, the memory cells recognise the antigen and allow a much faster, stronger secondary immune response, destroying the pathogen before the person becomes ill.
6. With such a high proportion of the population immune, the pathogen finds it much harder to spread between people (herd immunity), reducing the chance that an unvaccinated person comes into contact with someone carrying the disease. This protects the unvaccinated minority indirectly, even though they are not immune themselves.
7. Antibiotics kill bacteria or inhibit their growth (e.g. by disrupting cell wall production), but viruses reproduce inside host cells using the host's own cellular machinery, so they do not have the structures/processes that antibiotics target. Antibiotics therefore have no effect on viruses.
8. Preclinical testing: the drug is tested on cells, tissues and live animals in the laboratory to check for toxicity, efficacy and the best dosage. Clinical testing: the drug is tested on healthy human volunteers at low doses to check for toxicity and side effects, then on patients in clinical trials to find the optimum dose; double-blind trials are often used, in which some patients receive a placebo and neither doctors nor patients know who received the drug until the trial is complete.
9. A placebo (containing no active drug) allows scientists to compare the effect of the real drug against a control, ruling out the placebo effect (patients feeling better simply because they believe they are being treated). In a double-blind trial, neither the patient nor the doctor knows who has the real drug or the placebo until the results are collected, which prevents bias affecting how patients report symptoms or how doctors interpret the results.
10. Within a large bacterial population, random mutation means a small number of bacteria may already carry (or develop) a gene giving resistance to the antibiotic. When the antibiotic is used, non-resistant bacteria are killed, but resistant bacteria survive and reproduce, passing the resistance gene(s) to their offspring. Over many generations, the proportion of resistant bacteria in the population increases, until eventually the whole population may become resistant.

11. Overprescribing antibiotics (e.g. for viral illnesses, on which they have no effect) increases the rate at which bacteria are exposed to them, speeding up the development of resistant strains by natural selection. Completing the full course ensures nearly all of the bacteria, including less-susceptible ones, are killed, rather than stopping early and leaving surviving (potentially more resistant) bacteria to multiply and spread resistance.
12. Example: pregnancy testing. Monoclonal antibodies specific to the hormone hCG (present in the urine of pregnant women) are bound to a coloured dye on the test strip; if hCG is present in a urine sample, it binds to these antibodies, producing a colour change in the test window that indicates a positive result. (Other valid uses: diagnosing disease, or targeting drugs directly to specific cells such as cancer cells.)

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