

SUGGESTED TEXTBOOK ANSWERS

Chapter 10 Protection against invaders

The following are suggested answers only. Other answers to the same questions may also be correct.

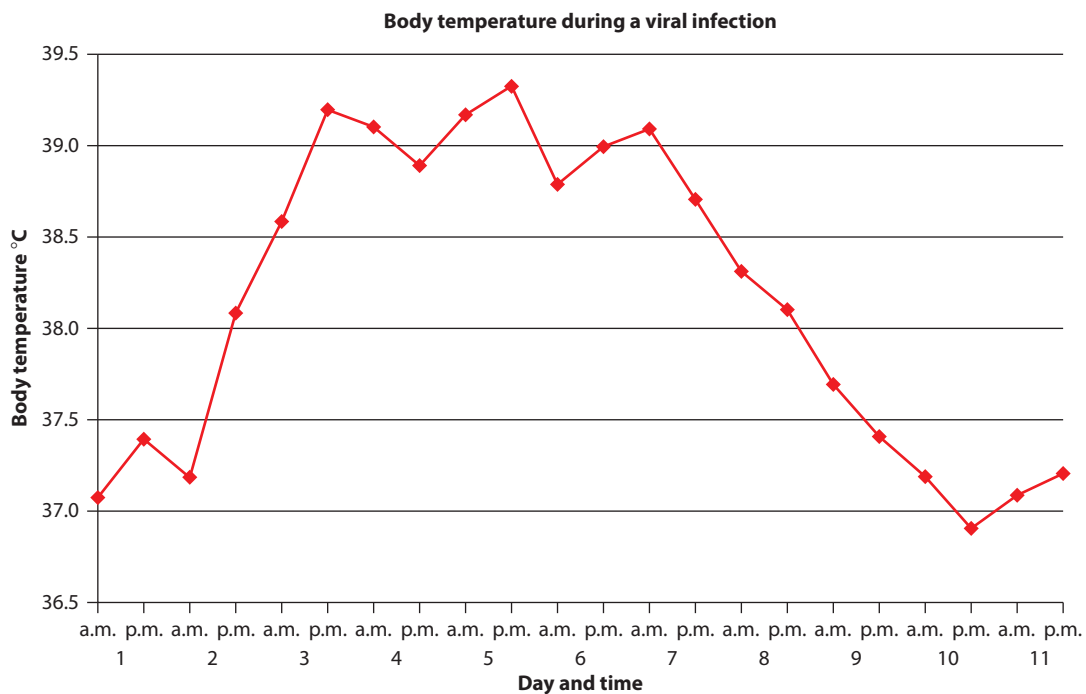
Science inquiry

Activity 10.1 Fever

What to do

- Plot these data on a graph. Make sure your graph conforms to all the conventions for drawing scientific graphs (see Chapter 1, page 13).

Answer:



- Describe in words what happened to the patient’s temperature over the 11-day period covered by the data.

Answer: Temperature was normal on day 1; began to rise in the afternoon of day 2; remained abnormally high for days 3 to 7; declined on day 8; and was back to normal on day 9.

- Calculate the patient’s average temperature from 8.00 a.m. on day 3 to 8.00 p.m. on day 8.

Answer: 38.8°C

- 4 During a fever, the body's 'thermostat' is set to a higher level. Explain how your graph illustrates this characteristic of a fever.

Answer: Once the fever set in at the end of day 2, body temperature remained fairly constantly around 39°C, until it went down on day 10.

Activity 10.2 Reye's syndrome

Use the Internet to research Reye's syndrome. See if you can find out:

- 1 the signs and symptoms

Answer: Signs and symptoms of Reye's syndrome include:

- recent upper respiratory infection or chickenpox
- nausea and vomiting
- aggressive or irritable behaviour
- lethargy
- confusion
- rash on palms of hands and feet
- loss of consciousness or coma may develop
- seizures
- unusual placement of arms and legs (decerebrate posture), where the arms are extended straight and turned toward the body, the legs are held straight, and the toes are pointed downward.

Sources: <http://www.nlm.nih.gov/medlineplus/ency/article/001565.htm> and <http://www.myvmc.com/diseases/reyes-syndrome>; plus others

- 2 the long-term consequences

Answer: How well a person recovers depends on the severity of any coma, as well as other factors. The average death rate for patients with Reye's syndrome is a little over 30%. However, the outcome for those who survive an acute episode is good. Possible complications are permanent brain damage and coma.

- 3 how often Reye's syndrome occurs in Australia

Answer: Reye's syndrome is rare, occurring almost exclusively in children aged under 18 years. There are estimated to be 0.03–1 cases per 100 000 people aged less than 18 years.

Most cases occur between 5 and 14 years of age, with males and females affected at the same frequency. The incidence of Reye's syndrome has decreased dramatically in recent years, possibly due in part to the decreased use of aspirin in children.

Source: www.virtualendocrinecentre.com/diseases.asp?did=460

- 4 the causes

Answer: The cause of Reye's syndrome is unknown, but it typically follows a viral illness such as an upper respiratory tract infection, chickenpox, influenza or gastroenteritis, and is associated with aspirin use during the illness. Any young child who has recently suffered a previous viral infection, such as the flu or chickenpox, should be monitored closely.

5 how to prevent it

Answer: Never give a child aspirin unless specifically told to do so by a doctor.

When a child must take aspirin, care must be taken to reduce the child's risk of catching a viral illness such as the flu and chickenpox. Aspirin should be avoided for several weeks after receiving a varicella (chickenpox) vaccine.

6 expert opinions on whether Reye's syndrome is associated with aspirin use, or is a distinct disorder.

Answer: There seems to be general acceptance that Reye's is a distinct disorder, but opinion is divided on its link with aspirin.

Activity 10.3 Skin bacteria

Propose a hypothesis and then design your experiment.

Answer: See *Human Perspectives ATAR Units 1 and 2*, page 17, for the characteristics of a good hypothesis. Responses will vary depending on what the students decide to test. Any of the suggested comparisons could be turned into a hypothesis.

One hypothesis could be: 'hand washing removes bacteria from fingers'.

The answers that follow are based on this hypothesis.

1 What will be your independent variable – what variable are you investigating?

Answer: Washing hands

2 What will be your dependent variable – what variable will change because of the changes you make to the independent variable?

Answer: Number of bacterial colonies growing on the culture plate

3 What variables will you need to control – what variables will have to be the same for all trials?

Answer: Same hands touching the plate; same agar; same temperature of environment for incubation; same soap/ antiseptic used for each trial; hands washed for same length of time; hands equally dirty each time; same temperature of water for washing; all plates incubated for same length of time; fingers pressed onto agar with same pressure and for same length of time for each trial.

Review questions

1 What is a communicable disease? Give five examples of such diseases.

Answer: A communicable disease is one that can be passed from one person to another – caused by foreign organisms invading the body. Examples include influenza, AIDS, hepatitis, chickenpox and rubella (refer to Table 10.1 on page 131 for more).

2 Explain the difference between:

a pathogen and a vector

Answer: Pathogens are disease-causing organisms such as certain bacteria and viruses, whereas vectors are intermediate hosts of the pathogen, such as mosquitoes or fleas, which spread the pathogen from person to person.

b RNA viruses and DNA viruses

Answer: RNA viruses contain only ribonucleic acid (RNA); whereas DNA viruses contain only deoxyribonucleic acid (DNA).

c bacteria and bacteriophages.

Answer: Bacteria are very small single-celled organisms. They can be seen only with a microscope and some are pathogens.

Bacteriophages are viruses that multiply in bacterial cells, causing the death of the bacterium.

3 a Bacteria were first seen in 1683 but viruses were not seen until 1938. Why?

Answer: Viruses are much smaller than bacteria and can only be seen using an electron microscope. The first electron microscope was invented in 1931, but viruses were not identified until 1938.

b List four differences between bacteria and viruses.

Answer: Differences between viruses and bacteria include the following:

- Bacteria are living things; viruses are difficult to classify and there is debate about whether they should be seen as living or non-living because they do not have all the characteristics of a living organism.
- Bacteria are large enough to be seen with a light microscope; viruses are much smaller and can only be seen with an electron microscope.
- Bacteria have cell walls; viruses do not.
- Bacteria can live independently; viruses need host cells to survive and reproduce.
- Bacteria contain both RNA and DNA; viruses have only DNA or RNA, not both.
- Viruses have a protein coat and lipoprotein envelope; bacteria have a cell wall and cell membrane.

4 List the external defences that prevent the entry of pathogenic organisms into the body.

Answer: The body's external defences include:

- cerumen, which inhibits bacterial growth in the outer ear
- the skin that forms an impervious barrier on the outside of the body
- tears, which contain the enzyme lysozyme. They cleanse the eyes and inhibit bacterial growth
- mucous membranes that line body cavities that open to the exterior
- mucus which is produced in the trachea and bronchi to trap micro-organisms
- acid in the stomach kills many micro-organisms
- acidic secretions in the vagina inhibit growth of pathogens
- mucus secreted at the anus traps micro-organisms
- urine which flushes the urethra
- the mouth cavity with a mucous membrane that is cleansed by saliva
- hairs and mucus in the nasal cavity trap micro-organisms.

5 a How do protective reflexes help to defend the body from infection by pathogenic organisms?

Answer: Protective reflexes are automatic, involuntary responses to a stimulus and are able to defend the body from infection by removing the pathogenic organism before it has a chance to cause an infection.

- b** List four reflexes that help to protect against infection.

Answer: Four reflexes that help to protect against infection include the following:

- **Sneezing:** When the walls of the nasal cavity are stimulated by such things as noxious fumes or dust particles, the forceful expulsion of the air from the lungs carries mucus, foreign particles and irritating gases out through nose
- **Coughing:** Irritation to the bronchi and bronchioles results in the forceful expulsion of air from the lungs, which carries with it any mucus and foreign matter up to the throat and mouth.
- **Vomiting:** Contraction of the muscles of the abdomen and diaphragm as a result of the presence of bacterial toxins, stretching of the stomach, or psychological factors, results in the expulsion of the stomach contents.
- **Diarrhoea:** Contraction of the muscles of the walls of the small and large intestine as a result of irritation by bacteria, viruses or protozoans results in the removal of the irritant so quickly that water has little time to be absorbed.

- 6 a** What is a phagocyte?

Answer: Phagocytes are cells that are able to engulf and digest micro-organisms and cell debris. They are important in internal defence against disease because they can remove pathogenic micro-organisms.

- b** Describe the process of phagocytosis.

Answer: During phagocytosis projections from a phagocytic cell surround the micro-organism and take it into the cell where it is destroyed by enzymes. Most bacteria ingested in this way are killed within 10 to 30 minutes.

- c** Explain the importance of phagocytes in defence against disease.

Answer: Phagocytes ingest debris and micro-organisms before they have a chance to cause symptoms of disease.

- 7 a** What are the four signs of inflammation?

Answer: Inflammation is characterised by:

- redness
- swelling
- heat
- pain.

- b** How does the inflammatory response cause the four signs?

Answer: Histamine increases blood flow through the area and causes the walls of the blood capillaries to become more permeable, so that fluid is filtered from the blood. It is the increased blood flow that causes the heat and the redness. The escape of fluid from the blood into the tissues causes the swelling. The abnormal conditions in the tissue stimulate pain receptors so that the person feels pain in the inflamed area.

- 8** In the inflammatory response, describe the role of:

- a** mast cells

Answer: Mast cells stimulate and coordinate inflammation by releasing histamine, heparin and other substances into the tissues.

b histamine

Answer: Histamine increases blood flow through the area and causes the walls of the blood capillaries to become more permeable, so that fluid is filtered from the blood.

c heparin

Answer: Heparin is released from the mast cells to prevent clotting in the immediate area of the injury.

d phagocytes.

Answer: Phagocytes such as macrophages and leucocytes are attracted by the chemicals released from the mast cells. They consume micro-organisms and cell debris at the site of the infection.

9 How is fever during the course of an infection thought to be beneficial?

Answer: The beneficial effects of fever result from the elevated body temperature that inhibits the growth of some bacteria and viruses. In addition, heat increases the rate of chemical reactions, which may assist body cells to repair themselves more quickly during an infection.

10 List behavioural practices that can be adopted to help reduce the spread of disease.

Answer: Personal habits that will help reduce the spread of disease include the following:

- Washing hands with soap and water after going to the toilet or following any activity where micro-organisms may have made contact with the skin (for example, gardening); washing hands before preparing and eating food.
- Covering your mouth when you cough or sneeze so that you reduce the spread of micro-organism, and possibly infection, to others.
- Wearing gloves when cleaning up blood or other body fluids. If there is a risk of splashing, safety glasses should be worn.
- Wiping surfaces with disinfectant if they have been contaminated with blood or other body fluids, or if they are just plain dirty.
- Using tongs, pliers or tweezers or wearing heavy gloves when picking up discarded syringes or condoms. Using a puncture-proof container, such as a tin with a lid, to dispose of syringes and needles.
- Never sharing personal articles such as toothbrushes, razors, towels or syringes.

11 What are mechanical barriers and how do they reduce the spread of infectious diseases?

Answer: Mechanical barriers provide an obstacle that prevents pathogens from entering the body and possibly causing disease. Examples of mechanical barriers are surgical masks, sterile gloves, protective clothing and safety glasses.

Apply your knowledge

1 Leprosy (Hansen's disease) is endemic to the Northern Territory of Australia, where it is found mainly among Australian Aboriginal people. It is not very contagious but it is found in unhygienic, overcrowded conditions. What could be done to reduce the incidence of leprosy in Australia?

Answer: The incidence of leprosy could be reduced by:

- improving housing and other living conditions
- the provision of clean water

- effective waste disposal
- education about hygiene
- encouragement of the personal hygiene practices listed on page 138.

2 An economist claimed that, economically, the virus causing the common cold was the most important of the viruses that cause disease in humans. What do you think would be the economic importance of the cold virus?

Answer: Colds cause many people to take time off work, so this decreases the overall productivity of the workforce. The cold virus is also very contagious, so many people working in a particular area are likely to be affected by it. Production and sale of medicines for relieving the symptoms of colds is a huge industry.

3 The Russian composer Tchaikovsky died of cholera during an epidemic in Moscow in 1893. It is believed that Tchaikovsky drank unboiled water during the epidemic, some think in a deliberate attempt to commit suicide. Why would drinking unboiled water increase the risk of cholera infection?

Answer: Cholera is transmitted by the ingestion of water contaminated with faeces or through ingesting fruit and vegetables watered with, or washed with, contaminated water. Bacteria, such as those that causes cholera, can live in moist surroundings at a variety of temperatures, but cannot survive temperatures of 100°C – that is, the temperature at which water boils. Thus, there is more chance of getting infected by the disease with unboiled water.

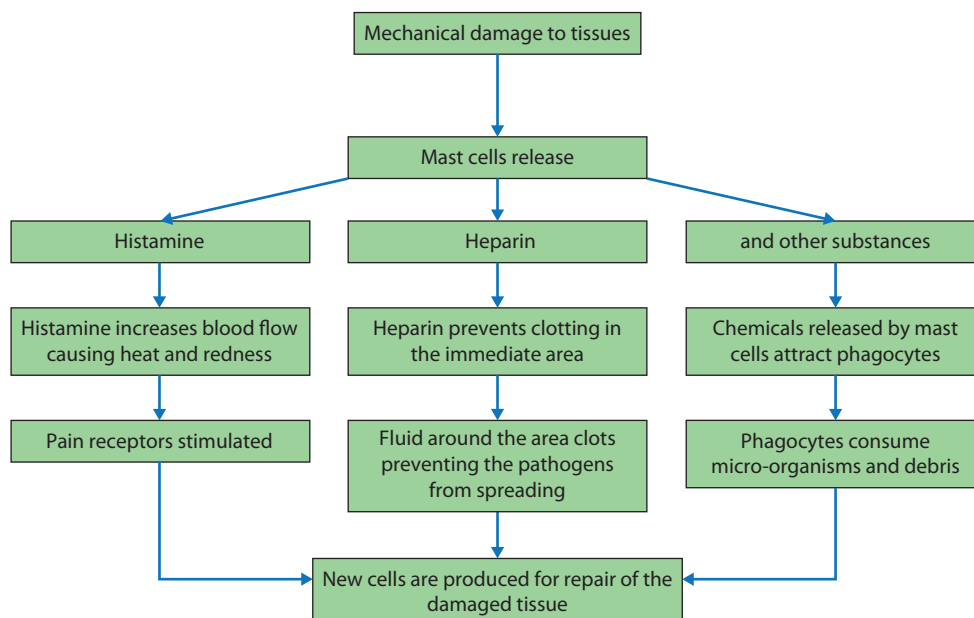
4 Hepatitis B is a disease that is causing concern in Australia. Why are medical authorities so concerned about the disease? What precautions can you take to avoid the disease?

Answer: Hepatitis B is extremely contagious and virulent, and can be transmitted via body fluids such as blood, breast milk, vaginal secretions and semen. Its incidence is increasing, and is associated with a rise in promiscuity, unprotected sexual intercourse and IV drug administration.

It can be avoided through basic hygiene practices, using clean or sterilised needles and tattooing implements, having protected sex using condoms, having few sexual partners and knowing their history, or abstaining from sex unless a partner is known to be free of the disease.

5 Draw a flow chart showing the events that occur in an inflammatory response.

Answer:



Or:

Mechanical damage to tissues → mast cells release histamine and heparin → histamine increases blood flow and capillaries become more permeable → heparin prevents clotting in the immediate area → fluid around the area clots to prevent pathogens spreading → phagocytes attracted to the area → pain receptors stimulated → phagocytes consume debris and microbes → phagocytes die producing pus → new cells produced for repair.

- 6 Explain why someone with an infected toe may develop a lump in the groin.

Answer: Bacteria and cell debris from the infected toe enter the lymph system. There are large numbers of lymph nodes in the groin and those nodes filter and destroy bacteria and other debris in the lymph coming from the toe. Micro-organisms are attacked by macrophages and there is an increased production of lymphocytes to assist with the destruction. The increased activity causes the groin lymph nodes to become swollen and painful.

- 7 Outbreaks of virulent forms of influenza, and other diseases such as SARS and Ebola, create major problems for health agencies around the world that are seeking ways to control their spread. What action could these agencies take to protect the citizens of their countries?

Answer: Spread of viral diseases could be minimised through:

- education about basic hygiene and awareness of signs and symptoms so that people can be treated early, and not spread the disease
- vaccination, where available, of as many people as possible, especially children, elderly and susceptible people
- limiting the movement of people into and out of affected regions
- encouraging use of/making available face masks, gloves and other forms of protective clothing
- controlling vectors of the micro-organism where relevant.

- 8 During a fever, people often have severe chills and can shiver uncontrollably even though their temperature is above normal. Explain how this is thought to come about.

Answer: During a fever the body's thermostat seems to be set at a higher temperature. The person feels cold and may shiver because the body temperature is lower than the body's set point for temperature. The shivering and vasoconstriction in the skin rapidly drive the body temperature up to the new elevated set point.

- 9 It has been possible to keep Australia relatively free of infectious diseases such as typhoid, cholera and yellow fever. Why has AIDS, however, been able to become so widespread in Australia?

Answer: There is no vaccine or cure for AIDS. Therefore, if people are exposed they suffer the disease and never get rid of the virus that causes it. They are therefore carriers of the disease for the rest of their lives. Many people don't know that they have AIDS until after they have spread it to others. There are many phases of AIDS infection where the infected person shows no symptoms at all. It is therefore difficult to screen people for AIDS before they enter Australia.

AIDS spreads due to behaviour such as sexual intercourse with many partners, taking IV drugs, using infected needles, and engaging in sexual behaviour when overseas where the disease, in some countries, is far more prevalent. Travellers may bring the infection back to Australia and contribute to its spread.