Introduction

These Answers have been suggested by the authors, they are not intended to be either comprehensive or exclusive. In some cases no answer is suggested because it relies on research or an individual response from students.

The Laboratory Notes are suggested, particularly for use by Teachers and Laboratory technicians, and again are advisory and not intended to be either comprehensive or exclusive.

Chapter 2.1 Answers

1. An infectious disease can be transmitted from one organism to another either directly or by a vector. A non-infectious disease is unable to be transmitted.
2. A pathogen is a disease-causing microbe. A parasite is an organism that lives inside or on a host and may or may not cause disease.
3. 'Ring worm' refers to the appearance of the condition caused by infection by a fungal species.
4. Three characteristics are:
   - entering the host by having adaptations to avoid the protective barriers
   - able to reproduce inside the host
   - able to evade the host's immune system
5. Regarding spores:
   a) reproduction, dispersal and ability to survive harsh conditions
   b) reproduction e.g.1 fungi which enables it to spread very easily and rapidly and/or survive harsh conditions e.g.2 bacteria which enables bacteria to survive harsh conditions and germinate in favourable ones
6. Regarding toxins:
   a) A toxin is a poisonous substance secreted by a range of pathogens and other organisms.
   b) Botulinum neurotoxin is highly toxic and can lead to paralysis and death produced by a bacterium (*Clostridium botulinum*)
7. These are our natural microflora. They live in and on us in a mutually beneficial relationship, generally not causing harm as they have evolved with humans over time.
8. Your table should look something like this:

Pathogen	Example of disease	Adaptation
Bacteria	food poisoning	heat resistant and can survive high salt e.g. in them
Fungi	toenail infection	easily spread from nails to colonise new areas
Protozoa	malaria	spread through vector or; mosquito
Virus (HIV)	AIDS	evades host's immune system and then disables it
Parasitic worm	nausea, fatigue	Well-developed reproductive system, hermaphroditic
Prion	Mad Cow disease (BSE)	Ability to stimulate the host to replicate infective agent

9. Not generally. They do not display characteristics associated with life e.g. responding to stimuli, using energy etc. They can only reproduce using the host's metabolism and processes.
10. Your table should look something like this:

Disease	Bacterium	Fungus	Virus	Protist	Worm	Prion
Common cold			T			
Diarrhoea	T		T	T		
Malaria				T		
Sinusitis	T (rare)	T (rare)	T			
Tapeworm infections					T	
Pneumonia	T	T	T			
Mad cow disease						T
Genital herpes			T			

11. With reference to the data table:
    a) Africa, Sudan, Southeast Asia
    b) low income, poor health facilities, ability to identify isolate and treat infected individuals, poor education, low vaccination rates, poor sanitation
    c) most people in low income countries die from infectious disease due to the reasons listed above. Lifestyle diseases are more common in high income countries, e.g. dietary and degenerative diseases.

SIS 2.1 Laboratory Notes

Prepared slides can be purchased from a number of Suppliers including:

- Southern Biological <www.southernbiological.com>
- Omega Scientific Pty Ltd <www.omegascientific.com.au>
- Livingstone School Science <www.livingstone.com.au>
- Haines Educational <www.haines.com.au>

Chapter 2.2 Answers

1. You may have used different examples:

Method	Examples of pathogens
Droplets (cough or sneeze)	Flu virus, cold virus
Direct contact	Fungal infection, herpes virus
Faeces	Cholera bacteria, hepatitis A
Contaminated food	Salmonella bacteria, E.coli bacteria

2. Touching, droplet infection, sexual practices, drug use, bites from infected species e.g. dogs, mosquitoes
3. Methods of transmission include:
    - exchanging needles for drug use
    - unprotected sex
    - breast milk
4. Regarding the tapeworm:
    a) Energy is not needed here as it uses food from the host. Energy is used in reproduction.
    b) This saves energy, it can use the movement of the host's digestive system for this.
    c) If it is the only tapeworm in the gut it can still self-fertilise and reproduce.
5. Salmonella bacteria are very commonly found in poultry. Unless good hygiene practices and thorough cooking occurs they can easily be transmitted to humans and cause disease.
6. In freshwater streams, creeks and lakes that may have undergone pollution by human waste.
7. Regarding cat bites:
    - The cat bite penetrates the protective barrier of the skin and into the underlying tissue.
    - Cats have high levels of pathogenic bacteria in their saliva which can be transmitted by biting.
8. A lot of these insects that are vectors of disease live in tropical areas. With global warming, new zones with higher temperatures enable the vectors to spread. This can increase the spread of disease.

9. With regards to malaria:
    a) The *Plasmodium* reproduces inside the mosquito and the mosquito spreads the disease to humans when they bite them to feed on human blood.
    b) Destroying red blood cells and interfering with liver function due to an increase in the inflammatory response.
    c) The asexual phase can occur in the human liver. The sexual phase which involves fusion of male and female gametes occurs in the mosquito.
    d) Some methods include spraying insecticides to kill the mosquitoes and reducing the amount of stagnant freshwater which is ideal for their breeding.There are many examples to mention here, you need to focus on the cyst as a protective phase able to resist harsh conditions enabling the protist to survive, reproduce and disperse.

SIS 2.2 Laboratory Notes

Preparation for this investigation is quite straightforward. The measuring cups are basic plastic medicine measuring cups, or alternatively, cheap plastic 'shot glasses' could be used.

- Label the cups A, B, C, etc. one for each student. An even number is needed. If necessary, the teacher can be included.
- Put sufficient tap water (allow 10 mL for each student) in a beaker and adjust the pH to 4 with 0.1 M Hydrochloric acid. The excess can be washed down the sink once the preparation is complete.
- Aliquot 5mL of the pH adjusted water into all but one (selected at random) of the measuring cups.
- Add 5mL of 0.5M Sodium Hydroxide to the randomly selected cup. (and note for the teacher which one it is, as this is the 'original infected student')
- 3mL plastic transfer pipettes are standard school laboratory equipment and available from commonly used suppliers.
- To prepare Phenol red indicator, dissolve 1g Phenol red (free acid) powder in 29 mL of 0.1M sodium hydroxide solution. Dilute to 1L with distilled or deionised water. The final colour should be bright red. If not, add a drop of 0.1M sodium hydroxide solution.

At each 'contact' the student draws up 3mL of their solution (there is a 3mL mark visible on the neck of the pipette) and exchanges it with their randomly selected contact. All students in the class should complete the first 'contact' before beginning the next one.

Once this has been done three times, add 1 drop of phenol red indicator to each measuring cup. The liquid in the cups will turn either yellow or pink (pink being infected).

By reviewing the contacts in the table it is possible to work out which cup was the ' initially infected ' one. Work backwards. For example, if cup K is yellow at the end, then none of the people they came into contact with was 'infected'. If D is pink and therefore 'infected' check who they have come into contact with.

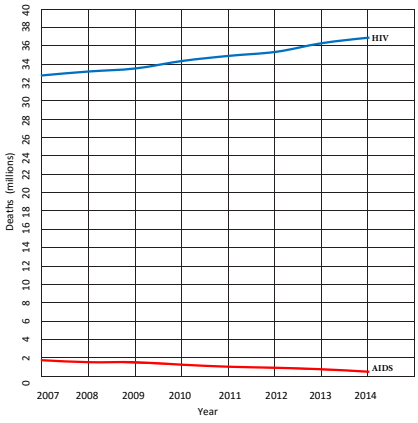
By process of elimination, it should be possible to work back to one possibility (sometimes not, depending on how the students interact, but it will be possible to narrow it down)

Chapter 2.3 Answers

1. Possibilities include:
   - increased virulence of the pathogen e.g. genetic changes to antigen
   - transmission to a new group of individuals not previously exposed
   - transmission from an animal of a new strain of pathogen
2. Suggestions are:

Disease	Pathogen	Factors influencing spread
Influenza	Flu virus	Level of immunity in population
Cholera	Bacterium	Poor sanitation in a refugee camp
AIDS	HIV	Understanding of how the virus spreads
Colds	Virus	Poor herd immunity
Malaria	Plasmodium	Vector; mosquito

3. With reference to *Figure 232*:
   a) Something like this:



   b) Two factors are:
   - either the number of HIV infections globally are rising or more cases are detected
   - although there are more infections, treatments are reducing the fatality rate

   c) Two factors are:
   - it spreads so rapidly
   - low virulence so it can survive in a host for a long period of time

   d) Two factors are:
   - education of causes and methods of transmission of the virus
   - medication/drugs are having an impact on survival

4. Suggestions are:
   a) where an antibiotic that was once effective against specific bacteria now has reduced effectiveness
   b) there are some 'superbugs' that are resistant to all known antibiotics. Antibiotics are necessary to destroy bacterial infections and without them the whole human race is very susceptible to fatal disease caused by bacteria.
5. Virulence of a pathogen refers to its disease-causing features. A mutation changes the DNA which may change the virulence. It may be that humans have no immunity to a new strain and it may therefore cause higher levels of disease.
6. Herd immunity is where the population has a certain level of immunity due to the fact that most or many individuals within the population are immune, therefore the disease is less likely to spread. This term only applies to contagious diseases as these are the only ones that can spread from one individual to another.

7. Re: *Staphylococcus aureus*:
   a) e.g. the person may be on chemotherapy for cancer treatment. Those with wounds that are not healing e.g. old and/or frail people
   b) There is a lot of antibiotic use in hospitals but strains such as 'golden staph' have built up resistance to antibiotics and therefore they multiply and cause disease.
8. There is a better understanding of the cause of diseases and how they are spread. There are better treatments e.g. antibiotics, anti-viral medications and there is much better sanitation in most parts of the world.
9. Suggested answers are:
   a) 'Hit and Run'. e.g. Cold virus; infects victims, multiplies rapidly, it spreads quickly to others to keep reproducing and then the infection is defeated.
   b) 'Hit and Stay'. e.g. HIV; causes the disease of AIDS. Avoids or disables the immune system often lying dormant inside cells. This is an advantage; fairly low virulence, the victim may spread the virus without even knowing that they are infected over a long period of time.
10. Many to choose from, no answer suggested.

Chapter 2.4 Answers

1. Four examples include:
   - destroying or reducing the number of vectors
   - quarantine
   - killing the pathogen e.g. using an antibiotic or antiseptic
   - the body's own immune responses
2. Measures include:
   a) spraying with insecticide and or reducing stagnant water to reduce breeding grounds
   b) using insect repellent, use of netting and screens, avoiding areas of mosquito infestation
3. Use of malathion to kill mosquitoes and hence reduce the spread of malaria.
4. Antiseptics kill microbes on the outside of the body e.g. ***Dettol***, whereas disinfectants kill microbes on floors and surfaces e.g. bleach
5. Methods include:
   - white blood cell may engulf and destroy microbe
   - white blood cell produces a protein antibody that may bind to and destroy the antigen
6. Reasons include: poor sanitation, overcrowding leading to easy spread of disease, poor early detection and treatment and lack of medical facilities.
7. Vectors are necessary for some pathogens to spread otherwise they cannot be transferred between individuals. Spraying flies to reduce spread of pathogens which cause diarrhoea.
8. Possible reasons include:
   - antibiotics work in specific ways and some bacteria may already have adaptations that confer resistance
   - the bacteria may have evolved and developed a resistant strain
9. Ethical considerations include:
   - reducing civil liberties e.g. by holding people in quarantine or isolation.
   - this often further marginalises poorer groups who are frequently more susceptible to disease and infection
10. No answer required.

App

Chapter 2.5 Answers

1. Examples include:
   - respiratory surfaces: rhinovirus-colds and respiratory infections
   - digestive system: *Salmonella* - food poisoning, diarrhoea
   - reproductive organs: HIV-causing AIDS
2. Pathogenicity is the ability of a pathogen to cause disease, whereas virulence is the degree to which the pathogen causes disease. High virulence means that the pathogen brings about a high level of disease.
3. Suggestions include:

Adaptation	**Description of how the adaptation works**	**Example**
Using a vector	Enables transmission from one host to another	Plasmodium
Adhesion proteins	Attachment to host cells to avoid being flushed out of host	Bacteria
Secretes enzymes	Neutralises stomach acid	*Helicobacter pylori*
Production of toxins	Reduce the ability to clear infection	Bacteria: *B. Pertussis*
Hiding inside host cells	Avoid or disable the immune system	HIV

4. Advantages include:
   - reproductive: light, easily dispersed, some will end up in favourable environments and grow quickly
   - survival: some are resistant to harsh conditions and germinate when conditions are more favourable.
5. Comparing two pathogens:
   - high virulence: Ebola virus-evades immune system and will destroy human tissue rapidly
   - low virulence: HIV-hides inside white blood cells and may remain dormant
6. If the virus kills its host too quickly, this may impair its ability to spread and multiply.
7. Methods include:
   - Spraying: will have an immediate effect in destroying some of the fungus and enable some plants to recover but spores may survive and the disease may return.
   - Sanitising boots/tools: can assist in reducing spread into new areas and when used with spraying will produce some good outcomes.
8. Arguments include:
   - Host: enables host to expel some of the pathogen and assist the immune system.
   - Pathogen: helps spread and infect other hosts via contaminated water or food
9. By hiding inside a host cell, the pathogen reduces its chance of being attacked by the host's immune system e.g. white blood cells.
10. No answer given.

Chapter 2.6 Answers

1. The four key entry points are:
   - respiratory surfaces e.g. lungs
   - wounds or breaks in the skin surface
   - digestive system e.g. mouth
   - reproductive organs e.g. urethra
2. Suggestions are:

Feature	Mode of action in providing protection
Earwax	Antimicrobial chemicals
Blood clotting agents	Forming a scab on the surface of the skin to seal a wound
Blinking	Moving pathogens across to the corner of the eye
Tears	Antimicrobial substances e.g. lysozyme
Cilia lining the respiratory tract	Rhythmic action of hair-like structures to move mucus to the mouth

3. Barriers include:
   - oil glands make the skin quite waterproof
   - consists of outer layer of dead, keratinised cells
   - secretes antimicrobial chemicals
4. An irritant such as a pathogen acts as a stimulus to bring about a reflex response cough/sneeze which acts to expel the pathogen from the body. It is called a reflex as it is an involuntary response.
5. In the case of a cough or sneeze:
   - the stimulus is viral particles
   - the effect is the diaphragm and intercostal muscles
   - the response is a sneezing or coughing action
6. Suggestions are: tears from the eyes and secretions from the skin which break down bacterial cell walls.
7. Suggestions are:
   - mucus is a thick secretion lining the respiratory surfaces that traps microbes and these are then swept towards the mouth by cilia to be expelled from the body or swallowed.
   - areas include the upper respiratory tract and reproductive organs e.g. vagina.
8. Cellular responses by respiratory and nasal passages to release more mucus to trap the virus before it can enter the bloodstream.
9. The skin is an effective first line of defence; burns victims have suffered damage to this layer allowing pathogens to enter into underlying tissues and the bloodstream causing infection.
10. Earwax is a normal, essential barrier containing antimicrobial chemicals necessary to prevent pathogen entry into the inner ear. People may cause damage or a wound to the ear, allowing pathogen entry if they use something like a cotton bud to clean their ears.
11. Pathogenic microbes cause disease whereas our microflora generally does not. Humans have evolved together with our normal microflora and therefore live in what is termed a symbiotic or mutualistic relationship benefiting both organisms.
12. 'Self' refers to our own tissue and cell marker proteins. 'Non-self' refers to foreign tissue and markers not made by our tissues. Our white blood cells (lymphocytes) have special adaptations and markers that allow them to recognise the difference between 'self' and 'non-self'.
13. No suggested answers given.

SIS 2.6 Laboratory Notes

Refer to Science Inquiry Skills 1.7 Laboratory Notes - the Science Inquiry Skills activity here is the same process but in a different context.

Chapter 2.7 Answers

1. The innate immune system is:
   a) Non-specific because it has no recognition of a specific antigen and attacks 'non-self' in general. It also has no memory of a specific antigen.
   b) Rapid because it has a vast array of white blood cells ready for immediate action.
2. Suggestions are:
   a) Macrophages and neutrophils carry out phagocytosis and destroy pathogens. Cells release chemicals that bring about other responses.
   b) Cytokines signal other cells to respond to the pathogen. Complements will punch holes in membranes of pathogens and assist in phagocytosis.
   c) The inflammatory response will increase permeability of vessels and allow more macrophages and neutrophils to enter body tissues. Clotting agents act to seal area and other chemicals will attract more white blood cells.
3. Their role is to have a cascade effect increasing the innate response; more cells will lead to more chemical action to destroy pathogens. Some chemicals bind to pathogens to alert macrophages e.g. cytokines are one such class of chemicals.
4. This makes the pathogen is more able to be recognised by such phagocytic cells as macrophages and neutrophils.
5. Mast cells are important as they release histamine. Histamine increases permeability of capillaries allowing white blood cells and chemicals to move to the site of infection.
6. Regarding pus:
   a) Pus consists of dead pathogens, cellular debris and macrophages and neutrophils near the site of an infection.
   b) Pus is the end result of the death of pathogens and therefore is important in fighting and getting rid of the infection.
7. Similarities are that both have barriers to restrict entry of pathogens and both have an innate system with antimicrobial chemicals and cells that bind and recognise pathogens. However plants have no adaptive immune system with lymphocytes circulating in their sap.
8. Non-self recognition by binding is an important part as this binding, e.g. by macrophages, stimulates them to release chemicals like cytokines which in turn stimulate a range of effects to boost the response.
9. Physical barriers include leaf cuticles and wax which are waterproof and restrict access of airborne pathogens. Bark as it is an impervious hard outer layer. Chemicals like phenols and alkaloids are also produced and these have antimicrobial effects.
10. It provides a level of protection for the fungus against bacterial attack. It is innate as it is a general form of response against a range of bacteria.
11. Explanations are:
    - Redness; increased blood flow to the region.
    - Increase in temperature; increased blood flow and increase cellular activity.
    - Swelling; increased permeability of capillaries leaks more fluid into the tissue spaces.
12. No answer given.

Chapter 2.8 Answers

1. The main difference is that the adaptive response is specific in that the cells target only one type of antigen and are able to remember the antigens to which they have been exposed previously.
2. B cells release a specific protein antibody that can bind to the specific antigen that is associated with the pathogen. T cells have a few different types but generally this is direct cell action, releasing chemicals that punch holes in the infected cells.
3. This complex displays antigens on the surface of cells and this display enables other cells of the immune system to bind to them and thus become activated.Regarding T lymphocytes:
   a) T helper is a specific cell and it increases in number producing clones of the required type. They develop into killer cells and stimulate B cells.
   b) The specific T-cell for the particular antigen needs to bind to the antigen (often displayed by MHC) before it is activated.
4. Suggestions are:

First line of defence	Second line of defence	Third line of defence
earwax	macrophages	antibodies
skin	cytokines	B cells
lysozyme	neutrophils	MHC
	inflammation	cytotoxic T cells

5. Regarding immunity:
   a) When infected or exposed to the pathogen the person will not become sick or diseased as they mount a very effective response to quickly destroy the pathogen.
   b) Differences are:
   - active immunity stimulates B and T lymphocytes either naturally or artificially.
   - passive immunity is an injection of antibodies and the lymphocytes are not activated.
6. Regarding vaccination:
   a) Vaccination can stimulate B and T lymphocytes producing memory cells that are stored in the spleen and lymph nodes. When infected this enables a quick secondary response.
   b) Memory cells may die off over long periods and the 'booster' injection stimulates more of them to be produced and stored in case of an infection.
7. With reference to the graph:
   a) The primary response is slower and produces less antibody than the secondary response.
   b) In the secondary response it is quicker and larger, therefore the pathogen is generally destroyed before an infection can take hold.
   c) Memory B and T cells are stored in the spleen and lymph nodes, usually many of them specific to the particular antigen. When activated they mobilise plasma cells which produce antibodies and T killer cells quickly to destroy the pathogen.
8. The correct order is: e, c, g, f, a, d, b, h
9. Referring to the diagram:
   a) Antibodies binding to surface antigens on pathogens causing several pathogens to clump together.
   b) Bacteria may now be inactive as they are clumped and in addition it now provides a bigger target for macrophages to engulf and destroy them.
10. It is a united effort of both the second and third line of defence working together. The innate response is the quick acting but non-specific action that acts as a first response and then immediately signals the adaptive response for assistance. This signalling can occur by chemicals such as cytokines. Macrophages display antigen fragments for T helper cells to alert them. This mobilises the entire adaptive response of killer T cells and antibodies. As seen above in question 10 antibody action is working to make it easier for macrophages to carry out phagocytosis.

11. The primate's immune system is stimulated to fight off the infective agent. Antibodies would be produced and these are then passed on to the baby during suckling to help fight infection.
12. Regarding snake bites:
    a) This would be too slow. By the time the lymphocytes are stimulated and B and T cell action begins, the venom would have spread and brought about its effects which can include death.
    b) Using passive immunity; i.e. an injection of anti-venom which is a preparation of ready made antibodies to combine with the antigen (venom) and de-activate it.
    c) Regarding examples of active and passive immunity:

	Passive immunity	**Active immunity**
Natural	breast milk antibodies	exposure to pathogen
Artificial	injection of anti-venom	typhoid vaccination

13. To obtain memory to the pathogen, an accumulation of B and T memory cells stored in the secondary lymph organs is required. This does not occur with passive immunity.
14. This requires an individual response and no answer is required.

TOPIC 2 Test Yourself

Allocate 60 minutes to complete this test. Answer all of the questions in the spaces provided. The number of marks for each question is shown in brackets. Answers are suggested for all questions at the end of the test. Note that they are not intended to be the only possible answer. Read these carefully after the test and use them as part of an assessment for learning activity.

1. Diseases can be placed into different categories.

   a) State the difference between infectious and non-infectious disease.

(2 marks)

   b) Complete the following table by placing the diseases listed below in the correct category.

   Diseases: *tuberculosis, food poisoning, heart disease, AIDS, cancer, diabetes*

Infectious disease	**Non-infectious disease**

(6 marks)

2. Diseases can be spread in a range of ways. Droplet infection is one of these mechanisms.

   a) Explain what droplet infection is, how it enables the spread of the pathogen and give an example to illustrate your answer.

(4 marks)

   b) Name one other way in which a pathogen can be transmitted, giving an example to illustrate your answer.

(2 marks)

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3. An epidemic can occur when a particular pathogen spreads disease in a short space of time. Epidemics can be caused by a number of factors. Using a relatively recent epidemic, from the last decade or so:

   a) Select the most likely factor that caused the epidemic to occur, explaining the reasons for your choice.

(4 marks)

   b) Predict the most likely method/s that you believe are being used or should be used to contain such outbreaks.

(4 marks)

4. The virus which gives rise to AIDS consists of ribonucleic acid covered with a protein coat. One of the adaptations of the virus which assists in its survival and spread is its ability to change its protein coat. Explain how this ability can aid in its survival and spead.

(4 marks)

Human Endeavour Question

5. Below is a heading that appeared in The Advertiser in April 2016.

'SA Health blames raw bean sprouts for surge in salmonella cases.'

This was prompted by 108 reported cases of salmonella poisoning in a relatively short period of time. It was suspected that eating raw bean sprouts (pic) may have been cause of the poisoning. Salmonella infection symptoms include such things as fever, diarrhoea, nausea and vomiting.

a) State a likely reason as to why infection with salmonella bacteria may give rise to the symptoms listed.

(2 marks)

b) One of the recommended measures that could be used by people eating bean sprouts was to cook them before consumption. Explain why this is likely to be an effective measure.

(2 marks)

c) Choose one of the following to answer related to Science as a Human Endeavour.

- Explain, using specific examples, the role of communication between a range of departments, industries, groups and individuals that would be essential in any scientific investigation aimed at verifying the source of contamination and ensuring that the spread of disease was stopped.

OR

- Propose the most likely strategies that would have been implemented by scientists and health authorities to stop the spread of disease. Evaluate the likely effectiveness of your suggestions, taking into account and limitations in knowledge and unknown factors.

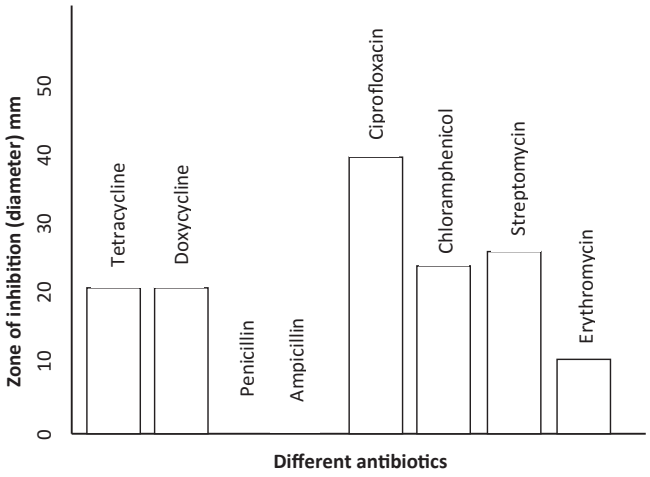
(10 marks)

App

Inquiry Skills Question

6. *Refer to the information and graph below* of an investigation into the effectiveness of eight different antibiotics on the growth of one bacterial species. The antibiotics are soaked into filter paper which is placed on an agar plate coated with the bacteria. To measure the effectiveness of the antibiotics in inhibiting bacterial growth a measurement is taken of the 'zone of inhibition'. The greater the zone, the more effective the antibiotic is in reducing bacterial growth.

a)



b) Write the aim of the investigation.

(2 marks)

c) Explain a possible reason why different antibiotics are not equally effective at inhibiting the growth of the bacteria.

(4 marks)

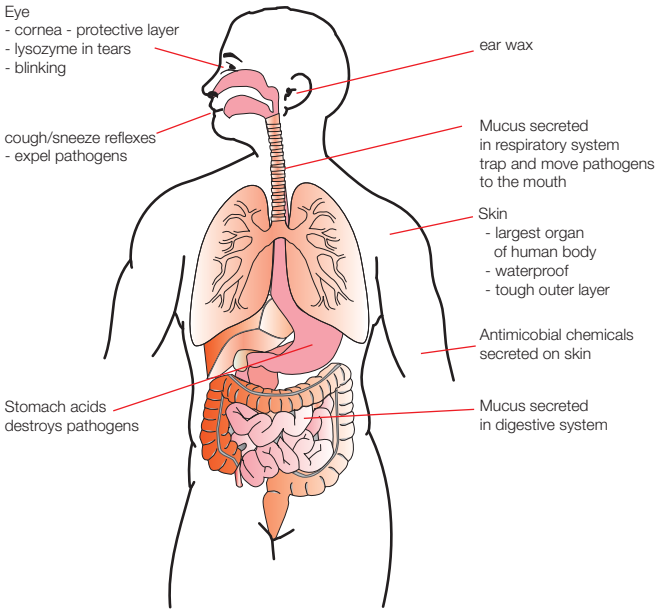
d) State which antibiotic you would use on a person who was infected with this particular strain of bacteria and give your reasons.

(4 marks)

e) Explain the difference between antibiotics and antiseptics, describing where each is most effective in reducing the negative impact of pathogens.

(4 marks)

7. Explain why the ability to change its outside protein makes it difficult to develop a vaccine against the HIV virus. Refer to the diagram below to assist you in answering the questions that follow.



a) This diagram illustrates examples of non-specific or innate defence mechanisms. Explain the difference between non-specific and specific defence mechanisms.

(4 marks)

b) There are both physical and chemical mechanisms that provide non-specific protection against invading pathogens. Give an example of each and describe how each example helps protect humans from attack by pathogens.

- Physical

(4 marks)

- Chemical

(4 marks)

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8. An experiment was conducted to observe responses of an organism to infection by a pathogen. For each of the observations below explain the likely biological processes responsible.

   a) An increase in red colour and temperature of the skin.

(4 marks)

   b) An increase in the number of white blood cells in the area.

(4 marks)

9. Name the cell types that carry out particular roles in the specific defence system.

   a) Cells that produce antibodies.

(2 marks)

   b) Cells that can destroy human cells infected with virus particles.

(2 marks)

   c) Cells that can provide memory to a specific pathogen and boost the secondary response.

(2 marks)

10. When a woman is pregnant, antibodies for some specific diseases may move across the placenta and enter the bloodstream of the foetus.

    a) State the name of this type of immunity

(2 marks)

    b) Give reasons that this immunity does not last for very long.

(4 marks)

    c) In individuals who are allergic to certain substances, for eg pollen, it is often noticed that this allergy gets worse as the person is exposed on many occasions to the pollen. The allergic response is caused by the immune system. Put forward an argument to explain this observation.

(4 marks)

Assessment Key

Assessment Design Criteria	Questions where this could be assessed
IAE1	4.c
IAE2	3.b
IAE3	5.a
IAE4	
KA1	1.a,b; 2.a,b; 4.a,b,d; 7.a,b; 9.a,b,c; 10.a,b.
KA2	3.a; 5.b; 6; 8.a,b; 10.c.
KA3	4.c,d; 5.c.
KA4	4.c,d (and most other 4 mark questions)

App

Topic 2 Test Yourself - Suggested answers

These answers for each part of each question provided here are suggestions. They are not intended to be the only answer. Read and use them carefully to self-assess your performance in the test. Consider asking someone in your class to peer-assess them as well, then discuss. Make notes of errors for future reference and seek the assistance of your teacher as required.

1. Regarding the categories of diseases:

   a) Infectious visas are caused by microbes or pathogen is. Non-infectious diseases are caused by other factors.

   b) Classifications are as follows

Infectious disease	Non-infectious disease
Tuberculosis	Heart disease
Food poisoning	Cancer
AIDS	Diabetes

2. Regarding the spread of diseases:

   a) Droplet infection is when a pathogen is transmitted from one person to by droplets of moisture from the upper respiratory tract. The pathogens are present in large numbers, trapped inside the bubbles or droplets of moisture which are expelled by a cough or sneeze. Colds can be spread in this manner.

   b) Several possibilities including direct contact (sexually-transmitted HIV), faeces, contaminated food (salmonella).

3. Regarding epidemics:

   a) For example Ebola; caused by the Ebola virus. May have been caused when hunters of infected animals consumed meat products. No prior exposure, very virulent strain therefore no immunity built up. Other diseases include SARS, Zika etc.

   b) One very important method is education; to better inform communities of the risks and how to better protect themselves. Another important method is better hygiene and medical practices to treat and isolate diseases and contain the outbreaks.

4. Humans develop their ability to fight off specific pathogen is by recognising specific antigens on the exterior of the pathogen. If this antigen changes, the human does not recognise it as the same pathogen, they need to build up protection or immunity over again. This lapse allows the virus to evade the immune system, survive and spread.

5. Regarding the report about salmonella;

   a) bacteria increase rapidly in number producing toxic waste products.

   b) raising the temperature, such as with cooking will kill most of the bacteria preventing them from multiplying.

   c) Suggestions include:

   - Identifying infected people-communication, hospitals, clinics, emergency departments, informing Health Authority so that an investigation can be launched
   - information pulled and collated to establish the sources of infection
   - identifying and testing for pathogen is
   - communicate to media to inform public of the dangers and precautions
   - work with growers, providers, carriers of contaminated sprouts to rectify the problem.

OR

   - identify the source of infection after an investigation
   - inform people via media to avoid possible sources of contamination
   - remove products from shelves
   - work with growers and suppliers to destroy infected products
   - educate people about changes in practices
   - despite all these measures there is no guaranteed success as there are many links, different possibilities for errors and unknown factors

6. With reference to the data:
   a) To investigate a range of antibiotics and compare their effectiveness in destroying the specific bacteria.
   b) Antibiotics work in a range of ways including stopping cell wall production or interfering with protein synthesis. Some bacterial strains may be resistant to particular antibiotics as they have evolved changed genetic make up which enables them to overcome the effects of this antibiotic.
   c) Ciprofloxacin; it has the greatest zone of inhibition implying that it inhibits or destroys the bacteria more than any of the other antibiotics tested.
   d) Antibiotics operate inside the body, chemicals that destroy bacteria internally. Antiseptics kill microbes on the exterior of the body e.g. hydrogen peroxide, iodine
7. With reference to the diagram:
   a) Non-specific defence mechanisms are mechanisms that are more general in their mode of action, they are usually barriers or traps and are effective against a range of pathogens. Specific defence mechanisms target specific pathogen is e.g. lymphocytes producing a specific antibody.
   b) Defence mechanisms include:
   - Physical; coughing and sneezing. Irritation by pathogen is in the upper respiratory tract initiates the physical actions of coughing/sneezing which act to push or expel pathogen is from the body.
   - Chemical; stomach acid. Asses in the stomach have a low pH which simply destroys many bacteria and thus reduces their numbers either totally or significantly and thereby reduces the chance of disease.
8. Regarding likely biological processes:
   a) This is most likely related to the inflammatory response which is designed as a non-specific response to destroy pathogens. The red colour and temperature both linked to increased blood flow to an area carrying white blood cells and chemicals associated with destroying the pathogen.
   b) When chemicals within the body are secreted in response to the pathogen e.g. complimented, one of the effects is that white blood cells are attracted to the area. White blood cells could be macrophages that engulf and destroy pathogens like bacteria.
9. The cells are:
   a) B lymphocytes --plasma cells
   b) natural killer cells
   c) B and T lymphocyte memory cells
10. Regarding pregnancy:
   a) Passive immunity
   b) Antibodies are protein molecules produced by plasma cells. They work by combining with and inactivating antigens but last only for a relatively short period. The B cells and T cells involved in active immunity have not been stimulated so there is no memory to the disease.
   c) The pollen is seen as quote non-self quote or foreign and brings about an immune response against the pollen antigens. This also stimulates B and T memory cells which build up in the live system over time and then on subsequent exposures, the response is greater and last longer.

Science Inquiry Skills (SIS)

The following information has been prepared to assist students and teachers with the teaching and learning of SACE Science Inquiry Skills, as required.

1. Designing investigations and experiments

The problem can be deconstructed to determine the most appropriate method for investigation. An investigation has a well-defined purpose but is unlike an experiment in that it is not designed to test a hypothesis.

An example of an investigation is:

The purpose of the investigation is to investigate the effect of increasing the salt concentration on the growth of wheat seedlings.

An experiment is designed to test a hypothesis.

A hypothesis is an informed guess about the way a process works, which allows a prediction about what will happen in different situations.

Some important points about the hypothesis:

- A hypothesis or 'investigable question' is an idea which an experiment is designed to test
- A hypothesis relates the 'independent' variable to the 'dependant' variable.
- Data can be used to support, modify or reject the hypothesis.
- Data from an experiment can not be used to prove that a hypothesis is absolutely correct.

An example of a hypothesis is:

'If the salt concentration is increased, the growth rate of wheat seedlings will be decreased'.

In this case the 'independent' variable is the salt concentration.

The 'dependent' variable is the growth rate of wheat seedlings.

---

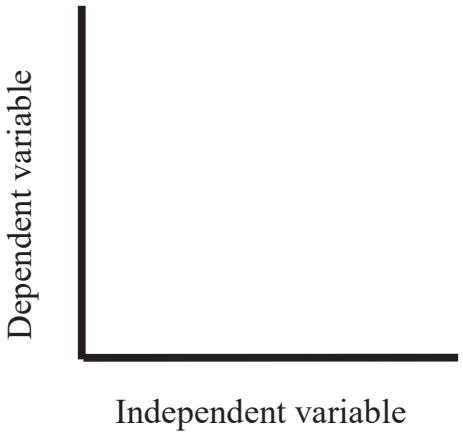
2. Variables

The **independent variable** is a quantity that is deliberately changed by the experimenter. It is usually plotted on the X axis when it is graphed. Sometimes it is necessary to plot time on the X axis and use different lines to represent the independent variable. An experiment must have only one independent variable – this ensures that it is a 'fair test' and that any changes in the dependent variable can be attributed to the independent variable.

The **dependent variable** is the quantity that varies or changes as a result of changes in the independent variable. It is plotted on the Y axis when being graphed. See adjacent Figure for axes.

A controlled experiment is designed to test the effect of varying one quantity (independent variable) on another quantity (dependent variable).

All other factors that might affect the outcome of the experiment must be held constant during the experiment. These are called **controlled variables** or **constants**.



Some factors or variables are not able to be easily controlled and should be identified.

For example, *'If the salt concentration is increased, the growth rate of wheat seedlings will be decreased'.*

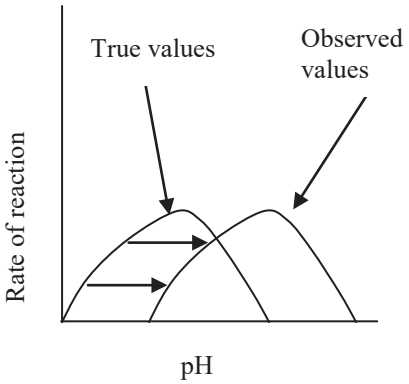
In this case the **independent** variable is the salt concentration, the **dependent** variable is the growth rate of wheat seedlings and the **controlled variables or constants** would include the: temperature, available nutrients for growth, frequency of watering, type of wheat seeds etc.

3. Errors in measurements

Measurements made in experiments are subject to uncertainty which represents the size of the error made in determining the results. The error is the difference between an observed (or calculated) value and the true value. It is important to reduce errors by improving the experimental techniques and repeating measurements to help identify the sources of errors. There are two types of errors:

Systematic errors

- These are errors that cause results to differ from the true values with reproducible discrepancies. These errors could be caused by: e.g. faulty calibration, faulty instruments, bias by the experimenter. They may be identified by repeating an experiment. A well designed experiment will minimise these errors.
- These errors exist throughout the experiment and will not be reduced by a statistical averaging process.
- If data is plotted on axes and a line-of-best-fit is drawn (*see graph*) and the measured values differ consistently from the true values, this type of uncertainty is caused by a systematic error.



Random errors

- These are seen as fluctuations in observations and differ from experiment to experiment. They could be caused by: environmental factors, poor techniques or instruments. Taking a statistical average can reduce the effect of random errors.
- Increasing the sample size in an experiment can reduce the effect of random errors and increase the reliability of the data. Reliability is increased when the effects of random errors are minimised. An experiment is reliable if repeated trials give the same results.
- When data is plotted on axes and a line-of-best-fit is drawn, points show scatter around the line. Random error gives rise to this scatter of points seen in the data.

---

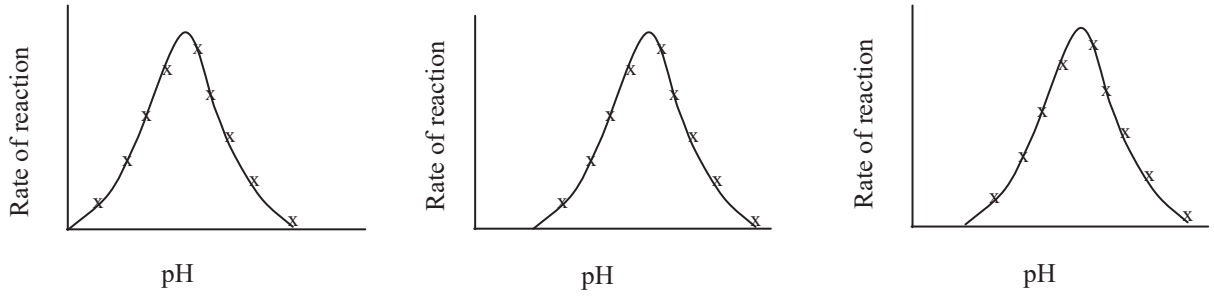
4. Sample size and repeating an experiment

Sample size

It is usually important to increase the number of samples in an experiment. When you increase the sample size there is less of a chance that individual variation and **random errors** will distort the data and will therefore be more reliable. In an experiment to investigate the effect of pH on the rate of an enzyme reaction, you might decide to have three trials or samples for each pH value. This is said to be increasing the sample size. When you have a number of samples an average can be calculated and this will reduce the effect of the random errors.

Repeating the experiment

To repeat the experiment implies that the whole experiment is repeated on a separate occasion with fresh solutions and, if possible, new apparatus. This helps to identify **systematic errors.** If the same data is obtained when the experiment is repeated, it improves the validity of the results. Data is valid if it is reasonable and measures what it is supposed to be measuring. In the pH experiment, you might get the results as shown below when you do the experiment three times. From the left A, B and C.



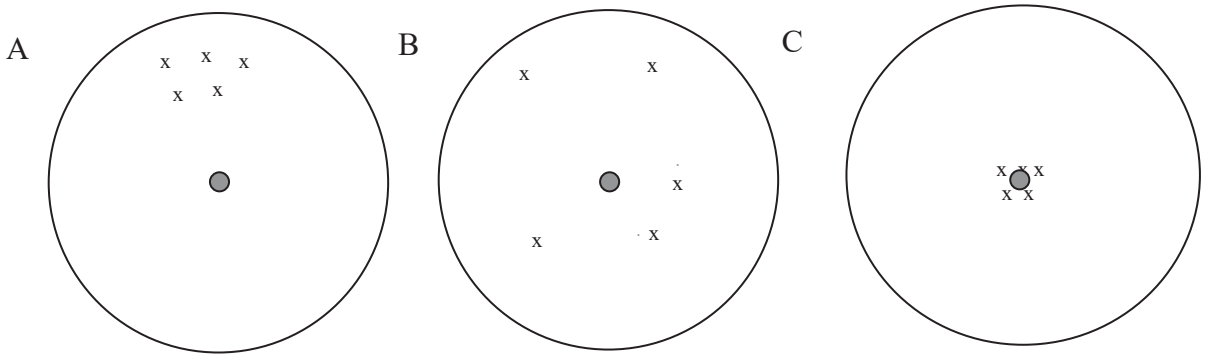
It would appear that in experiment A there was a systematic error that caused a difference in the observed value for optimum pH that was lower than in experiments B and C. Conducting the experiment three times has helped identify that it was likely there was a systematic error in experiment A.

5. Accuracy and Precision

The **accuracy** of an experiment is a measure of how close the result of the experiment is to the real value. **Systematic errors** need to be minimised if the result is to be accurate. As indicated previously the best way to identify these errors is to repeat an experiment. The **precision** of an experiment is a measure of how well the result has been determined- irrespective of close it is to the true value. Data from an experiment that is reproducible is precise. Measurements are more precise when there is less scatter in the results.

Random errors need to be minimised if the data is to be precise. High scatter = low precision. In an experiment you must consider both precision and accuracy. Data that is both accurate and precise is close to the real value and with small uncertainty.

The illustration below provides a useful analogy to show the difference between precision and accuracy. The outer circle represents a target and the archer is aiming at the centre point.



The x's show the position of the arrows fired (shots) from an archer's bow.

A The shot pattern could be described as precise but not accurate. The shots were all in close proximity to one another, very little scatter and quite precise, but not accurate.

B The shot pattern here is neither precise nor is it accurate. If statistical averaging was done this would reduce the effects of the scatter and the average shot would be somewhere near the centre of the target.

C The shot pattern is both accurate and precise- just what the archer is looking for!

---

6. Resolution and Reproducibility

Resolution is a property of the measuring instrument. It is determined by the number of digits able to be read from the measuring instrument. When data is recorded, the number of significant figures that is justifiable is determined by the resolution of the instrument and also whether the measurement is able to be **reproduced**.

An example is given below to illustrate this point.

Aim of the investigation:

To measure the effect of changing the pH on the rate of digestion of egg white by the enzyme pepsin.

In choosing an instrument to measure the mass of the egg white before and after digestion, you would choose an electronic balance with a relatively high resolution e.g. 0.001g, rather than a triple beam balance with a lower resolution of 0.1g.

The general rule is that the average of data cannot be given to any more significant figures than was justified in the measurement of the data.

For example, if the following measurements were made:

0.251g, 0.256g, 0.257g

The balance is capable of measuring the mass to 1/1000 g.

the calculated average would be 0.25466666g

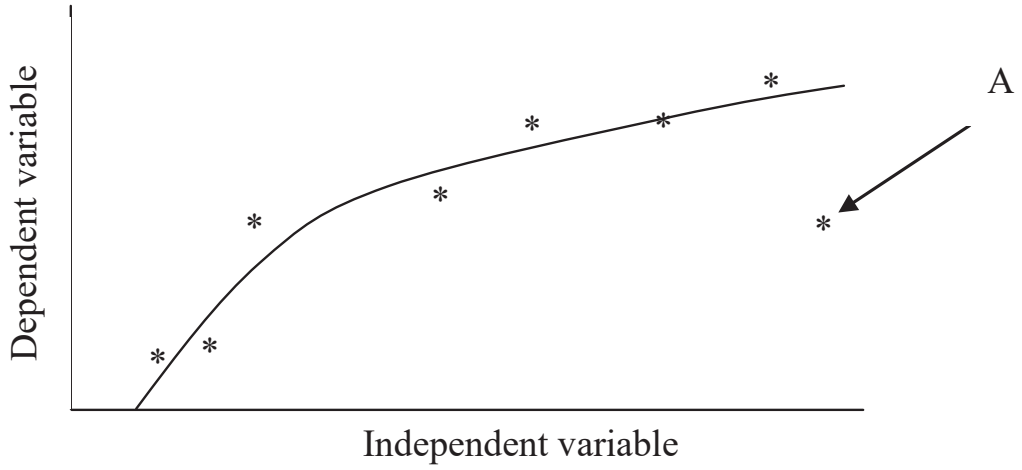
BUT this level of precision is not justified and could not be reproduced.

A more appropriate average is 0.255g

7. Data and presentation

Displaying data in graphical form

Title: Usually stated as: "The effect of the '*independent variable*' on the '*dependent variable*'



Important things to be represented appropriately are:

- Include a title e.g. as shown
- Ensure that the independent and dependent variables are on the correct axes
- Use an appropriate scale, use even graduations and a scale that will spread out across the graph
- Accurately plot the points on the graph with a sharp pencil
- Join the points in a curve-of-best-fit, as shown in the example above.

In the example above the point labelled 'A' seems inconsistent with the rest of the data. It is most likely that this was caused by a random error and therefore has been ignored in the plotting of the graph.

Ensure that appropriate SI units are used. Contruct tables with appropriate headings for columns and rows.

---

8. Analysis and evaluation

Experiments are designed so that the data generated will either support OR negate the hypothesis.

Careful observation is necessary in an investigation or experiment so that data is recorded accurately. You must be able to describe a pattern observed in the results obtained.

Data can be processed and analysed to reveal whether or not it supports the hypothesis.

A **conclusion** should be based on the results of the experiment and should clearly state whether the data supports or negates the hypothesis. An experiment never proves a hypothesis. Inferences may be made when interpreting data and are based on observations and background knowledge. Select and use evidence to justify your conlcusions.

Evaluation

You must be able to conduct a critical evaluation of the experiment or investigation.

This evaluation may include:

- Identification of possible sources of error-systematic or random.
- Ways to improve the procedures of the experiment.
- A comment on the sample size; was it adequate?
- A comment on the value of repeating the experiment.
- What worked well in the experiment?
- Perhaps a new or modified hypothesis needs to be constructed.
- Discuss the limitations to the conlcusions reached.

Master summary sheet of the SIS Criteria and Skills

A.D.C.	Science Inquiry Skills	Teacher comment (Re: Performance Standards)
IAE1	DESIGN APPROPRIATE INVESTIGATIONS Deconstruction Design Investigation • Hypothesis construct • Inquiry question Variables • Dependent/independent • Constants • Variables unable to be controlled Materials Procedure Data Collection – type, amount, level of precision Ethical/safety considerations	
IAE2	CONDUCT OF INVESTIGATIONS Selection and safe use of equipment Data collection – primary and secondary Conducting the practical • Individual • Collaborative	
IAE2	DATA PRESENTATION Appropriate graphs and/or tables • Conventional use of labels and titles • Graphs linear/non-linear – line of best fit • Conventional use of SI units/symbols • Appropriate use of significant figures	
IAE3	DATA ANALYSIS Identify and discuss trends Pattern of results Select and use evidence to make and justify conclusions	
IAE4	EVALUATION OF PROCEDURES/OUTCOMES Identify sources of uncertainty • Random/systematic errors • Control of variables • Impact of variables on results Evaluate experimental design • Sample size • Replication • How effectively it enabled a test of hypothesis Evaluate data collection • Accuracy • Precision • Validity • Reliability • Limitations of conclusions	
KA4	PRESENTATION AND COMMUNICATION Appropriate representations • Ratios, diagrams, images, equations Effective communication • Appropriate language • Use of correct conventions and terminology • Variety of forms e.g written, oral, multi-media etc.	

Guidelines for writing a practical report

Your report, if written, needs to be a maximum of 1,000 words; ***not included*** in this limitation are the following: Materials, Method, identification and management of safety, ethical concerns and Results.

If your report is in another format e.g. oral, around a 6 minute presentation is seen as the equivalent.

In designing and conducting your investigation, and in the write up of your report you will be developing your Science Inquiry Skills (SIS) that are outlined in the SACE Stage 1 Subject Outline.

You should refer to the following to assist you in the conduct of the experiment and writing the report:

1. These guidelines
2. SACE Science Inquiry Skills (SIS) SACE Stage 1 Subject Outline.
3. Master summary sheet of the SIS criteria – see page ----- of this book.
4. SACE Stage 1 Performance Standards – SACE Stage 1 Subject Outline (SACE page……)

Your practical report should usually include the following:

Introduction

- A brief explanation of the relevant biological concepts
- A brief description of the process used to deconstruct the problem to determine the best method for the investigation
- A statement of the hypothesis or investigable question
- Identify the variables – independent, dependent, and the constants

Materials and Methods

(including the identification and management of ethical and safety concerns)

- Include the steps in the procedure
- Identify the type, amount and the level of precision of the data to be collected.

Results

- Appropriate graphs and /or tables with the accepted conventions – e.g. units, headings etc.

Analysis of results

- Pattern of results – identify the trends
- Link results to the relevant concepts

Evaluation

- Identify sources of uncertainty- random and systematic errors
- How well were the variables controlled? – which were difficult to control?
- Describe the impact of the above on the results
- Evaluate the experimental design - adequacy of the sample size, replication, how effectively the design enabled a test of the hypothesis
- Evaluate the data collection – accuracy, precision, validity and reliability

Conclusion

- Select and use evidence to make and justify conclusions
- Discuss the limitations of the conclusions made

Science as a Human Endeavour (SHE)

The Science as a Human Endeavour strand highlights science as a way of knowing and doing, and explores the use and influence of science in society.

By exploring science as a human endeavour, students develop and apply their understanding of the complex ways in which science interacts with society, and investigate the dynamic nature of biological science.

Students understand that the development of science concepts, models, and theories is a dynamic process that involves analysis of evidence and sometimes produces ambiguity and uncertainty.

Students explore how scientific progress and discoveries are influenced and shaped by a wide range of social, economic, ethical, and cultural factors. They investigate ways in which the application of science may provide great benefits to individuals, the community, and the environment, but may also pose risks and have unexpected outcomes.

Science as a Human Endeavour in the study of Biology encompasses the following aspects:

1. Communication and Collaboration

- Science is a global enterprise that relies on clear communication, international conventions, and review and verification of results.
- International collaboration is often required in scientific investigation.

2. Development

- Development of complex scientific models and/or theories often requires a wide range of evidence from many sources and across disciplines.
- New technologies improve the efficiency of scientific procedures, data collection and analysis. This can reveal new evidence that may modify or replace models, theories, and processes.

3. Influence

- Advances in scientific understanding in one field can influence and be influenced by other areas of science, technology, engineering, and mathematics.
- The acceptance and use of scientific knowledge can be influenced by social, economic, cultural, and ethical considerations.

4. Application and Limitation

- Scientific knowledge, understanding, and inquiry can enable scientists to develop solutions, make discoveries, design action for sustainability, evaluate economic, social, and environmental impacts, offer valid explanations, and make reliable predictions.
- The use of scientific knowledge may have beneficial or unexpected consequences; this requires monitoring, assessment, evaluation of risk, and provides opportunities for innovation.
- Science informs public debate and is in turn influenced by public debate; at times, there may be complex, unanticipated variables or insufficient data that may limit possible conclusions.

(Note: This information is an adapted version of a document on the SACE website and is used with permission)

Performance Standards for SACE Stage 1 Biology

	Investigation, Analysis and Evaluation	Knowledge and Application
A	Designs a logical, coherent, and detailed biological investigation. Obtains, records, and represents data, using appropriate conventions and formats accurately and highly effectively. Systematically analyses and interprets data and evidence to formulate logical conclusions with detailed justification. Critically and logically evaluates procedures and their effects on data.	Demonstrates deep and broad knowledge and understanding of a range of biological concepts. Develops and applies biological concepts highly effectively in new and familiar contexts. Critically explores and understands in depth the interaction between science and society. Communicates knowledge and understanding of biology coherently, with highly effective use of appropriate terms, conventions, and representations.
B	Designs a well-considered and clear biological investigation. Obtains, records, and displays findings of investigations, using appropriate conventions and formats mostly accurately and effectively. Logically analyses and interprets data and evidence to formulate suitable conclusions with reasonable justification. Logically evaluates procedures and their effects on data.	Demonstrates some depth and breadth of knowledge and understanding of a range of biological concepts. Develops and applies biological concepts mostly effectively in new and familiar contexts. Logically explores and understands in some depth the interaction between science and society. Communicates knowledge and understanding of biology mostly coherently, with effective use of appropriate terms, conventions, and representations.
C	Designs a considered and generally clear biological investigation. Obtains, records, and displays findings of investigations, using generally appropriate conventions and formats with some errors but generally accurately and effectively. Undertakes some analysis and interpretation of data and evidence to formulate generally appropriate conclusions with some justification. Evaluates procedures and some of their effects on data.	Demonstrates knowledge and understanding of a general range of biological concepts. Develops and applies biological concepts generally effectively in new or familiar contexts. Explores and understands aspects of the interaction between science and society. Communicates knowledge and understanding of biology generally effectively, using some appropriate terms, conventions, and representations.
D	Prepares the outline of a biological investigation. Obtains, records, and displays findings of investigations, using conventions and formats inconsistently, with occasional accuracy and effectiveness. Describes data and undertakes some basic interpretation to formulate a basic conclusion. Attempts to evaluate procedures or suggest an effect on data.	Demonstrates some basic knowledge and partial understanding of biological concepts. Develops and applies some biological concepts in familiar contexts. Partially explores and recognises aspects of the interaction between science and society. Communicates basic biological information, using some appropriate terms, conventions, and/or representations.
E	Identifies a simple procedure for a biological investigation. Attempts to record and display some descriptive results of an investigation, with limited accuracy or effectiveness. Attempts to describe results and/or interpret data to formulate a basic conclusion. Acknowledges that procedures affect data.	Demonstrates limited recognition and awareness of biological concepts. Attempts to develop and apply biological concepts in familiar contexts. Attempts to explore and identify an aspect of the interaction between science and society. Attempts to communicate information about biology.

Evaluating Online Sources: Checklist for Students

Using the following checklist will help you determine whether or not an on-line source is suitable.

Name of student .....

Assignment ..... Due Date .....

(This page may be freely copied for use by purchasing schools).

What is the URL?	Comments	Yes/No
Is it a personal page or site? Look for names in the URL, or words such as 'users' or 'members'	If it is a personal page, remember to do further investigation on the author. Personal pages may be opinion pieces, not necessarily based on reliable evidence.	
What kind of website is it? .com .net .gov .org .edu .au other _____	Is the type of website appropriate for your research? This may help you determine if the site is for profit, educational, commercial etc. Which type is most suitable for your research?	
Authority and Currency		
Who is the author? Is it an individual or an organisation/ association?	Is there enough information about the author or the organisation? If not, you may need to do some extra research about them. Just an email address is not usually sufficient to determine reliability.	
What are the author's credentials?	Remember, anyone can post to the Internet without necessarily having a reliable background in the subject. Not being able to find this information on the website may lead you to question its reliability.	
Which other sites discuss the author/organisation?	Often you can find out about someone's background or organisation's information from doing a quick web search.	
Which other sites use the website? Use link:URL in a search engine to discover what other pages link to it.	Some websites are not linked by/to any other websites. Others are linked to sites which are obviously personal or commercial. This may lead you to question the reliability of the page you are evaluating.	
Is it current? Yes/No Date: _____	If you cannot find the date, you need to be suspicious of when the information was put on the website. This may also lead you to question whether the website is still being maintained.	
Accuracy		
Is the information accurate? Reference List/Bibliography/Other	Most academic or scholarly work that you will use for your research will include some kind of referencing of other sources. This is to provide reliable evidence of their claims. If referencing is not evident, or if the references are out-of-date or not reliable, you may need to question your source.	
Are there links to other sources on the same topic?		
Objectivity		
Is the information balanced? Are all sides of an issue presented?	Often, pages give links to other sites that have similar views to their own. However, a webpage that is trying to present an un-biased opinion will often also give links to sites that offer differing views. If there is no objectivity, it may lead you to question the evidence the author is presenting.	
If there are links to other sources, do they illustrate other opinions?		
Evaluation		
Based on the above analysis:		
What is the purpose of the web-site?	You need to consider the purpose of a website and whether it is appropriate for how you are using it.	
Should I use it as part of my research or investigation?	Remember, using sources that are not reliable or overly biased will have a negative effect on your work. If you are still unsure about your source after completing this checklist, it may be safer not to use it.	

(Note: This checklist is a condensed version of a document on the SACE website and is used with permission)

Guidelines for Referencing

The main advice is that the style should remain consistent throughout a piece of work.

Referencing style

Referencing style can require three types of acknowledgment:

1. In-text acknowledgement

a) When quoting another's words, indentation of text or use of quotation marks (for a phrase, line or two) as well as brief reference to author, date and page number

b) To identify another's ideas, words, art work, diagrams, images or tables, provide a brief reference (author, date, page number/s) immediately following the text.

2. Footnotes and endnotes

Footnotes and endnotes are easy to use and do not break the flow of text. They are used in literature, history and the arts, where source materials may have lengthy reference information. Generally, footnotes are used for a small number of citations and endnotes for large numbers or lengthy endnotes.

Consecutive superscript numbers are placed in the text and corresponding footnotes are located at the bottom of the same page as the text to which they refer. End notes are placed at the end of a chapter or the end of the complete piece of work.

When referencing a source for the first time the footnote or endnote should be a full citation, including:

a) Author's first name, then surname, title of article, book etc.(in italics), editors where applicable, publisher name and location, and year published.

b) Exact page numbers should be given if the reference is a direct quotation, a paraphrase, an idea, an image, chart, graphic or visual support, direct from the source.

For subsequent references, include:

- author's surname
- exact page numbers

3. Reference list and/or Bibliography

Place at the end of your work. It should contain full source details. Use the detailed guidelines in Part D to assist in creating the list.

Order of elements of a citation (i.e. a reference to a source)

a) Author and date (The *Harvard* or *Author-date* style of referencing).

b) The details of the citation should be organised showing only what is appropriate for your source type.

c) When organising your citation, look for the basic elements first and then use them in order.

(Note: These Guidelines are a condensed version of a document on the SACE website and are used with permission)

Helpful Online RESOURCES for the full SACE Guidelines

Use this QR code to jump to the SACE website for more detailed information:

<https://www.sace.sa.edu.au/documents/652891/722147/Student+Guide+to+Referencing.pdf/50c39188-4415-42e5-a7e6-fa326ec9aaff>

App