SAMPLE TEXTBOOK ANSWERS

Chapter 1 Human biological science

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

Science inquiry

Activity 1.1 Is this how pollen causes hay fever?

1 How could the investigation reported in the article be used to help answer the question 'What is science?'?

Answer: Science is a process of investigation to find answers to questions. In the investigation described, the scientist is trying to find an answer to the question, 'How can grass pollens that are 20 to 30 microns in diameter cause asthma when only particles of 10 microns or less can get into the lungs?'

2 What sorts of things would you need to know if you wished to repeat Professor Murray's observations in order to verify his results?

Answer: The types of grass pollen tested; how the pollen was collected; how pollen diameter was measured; how water was introduced to the pollen.

3 Professor Murray was involved in both observation – looking at pollen grains under a microscope – and experimentation – checking what happened when water was added to the pollen. In testing pollen to see what happens when water is added, what control would be needed if the results were to be valid?

Answer: Testing pollen in dry conditions at the same temperature.

4 Can you think of any practical applications for Professor Murray's discovery?

Answer: The development of a drug/substance that stops the reaction of water on pollen when the pollen comes into contact with the moist membranes of the respiratory tract.

People prone to asthma should avoid exposure to grass pollen in wet, damp or humid weather.

5 The results of research often raise new questions to be answered. Suggest two problems that now need to be solved as a result of Professor Murray's research.

Answer: Problems that could be solved include:

- Is it the fungus OR the pollen that causes allergies following rain?
- Does grass pollen burst open when in contact with nasal secretions?
- Can the reaction of grass pollen when it gets wet in the respiratory tract be prevented?
- Do the particles inside grass pollen actually find their way into the lungs?
- Do the particles inside grass pollen cause an allergic response?

6 Propose a hypothesis based on one of the questions you suggested in answer to Question 5.

Answer: That release of fungal spores following rain causes allergies in susceptible people.

That grass pollen does/does not burst open when in contact with nasal secretions.

That the particles inside grass pollen can/cannot cause an allergic response.

That particles from grass pollen can enter the lungs.

7 The journalist has written an article describing Professor Murray's results for the general public. What additional information should be included in a report intended for other scientists working on the links between pollen grains and asthma?

Answer:

- The hypothesis being tested
- Controlled variables
- Details about the sample
- Method used
- Data from measurements
- Details about how measurements were made

Activity 1.2 *Hairnu*

- State the hypothesis that you are testing.
  Answer: Valid hypotheses could be:
  - that *Hairnu* causes new hair to grow on a bald scalp
  - that *Hairnu* increases the density of hair in areas of the scalp where hair growth is sparse
- What will be your independent variable?
  Answer: Whether *Hairnu* is used or not
- What will be your dependent variable?
  Answer: Quantity or density of new hair growth on the scalp
- What variables will you need to control – that is, keep the same for all trials?
  Answer: Four variables need to be controlled:
  - the same volume of *Hairnu* must be used on all subjects
  - the same concentration of *Hairnu* must be used on all subjects
  - *Hairnu* must be applied to all subjects in the same way
  - hair growth must be measured at the same time interval after application of *Hairnu*.
- How will you provide a control (comparison) so that you will be able to see whether *Hairnu* does what it is claimed to do?
  Answer: Have a group of subjects that do not use *Hairnu* but use a solution that does not contain any *Hairnu*
- How will you measure your results?
  Answer: Count the number of hair follicles in a given area of the scalp before and after use of *Hairnu* or the control solution
- How many people will you need to test to get a reliable result?
  Answer: At least 10 people in each of the experimental and control groups
- Draw a table to show how you would present your data.
  Answer: See page 21 for rules to be observed when drawing up a table
- What results would support your hypothesis? What results would disprove your hypothesis?
  Answer: The hypothesis would be supported if subjects in the experimental group showed much better hair growth than the control group over the period of the experiment.

  The hypothesis would be disproved if there were no difference in hair growth between the two groups.

Review questions

1 a What is science?

Answer: Science is both a process of inquiry and a body of knowledge, gained by systematic observation and testing of ideas.

b Why is human biology a science?

Answer: Human biology is a science because it is a body of knowledge relating to humans that has been built up by discoveries made by successive generations of scientists.

2 a What is a hypothesis?

Answer: A hypothesis is a possible explanation or solution to a problem. Hypotheses are testable.

b Why do scientists make hypotheses?

Answer: A hypothesis is a tentative explanation for observations. By proposing a hypothesis, the scientist can then test it to see whether the explanation is valid. Scientists must design experiments so that the results will either support or disprove their hypotheses.

3 What is a literature review? When would you carry out a literature review?

Answer: A literature review involves reviewing books, scientific journals and the internet to find out what information relating to the subject under investigation has been collected and published by others.

A literature review would be carried out once a scientist decides to investigate a problem. Thus, the scientist can build on past scientific work in the specific field of investigation, and not duplicate work previously done.

4 Explain why an experiment must have a control.

Answer: A control is necessary for the scientist to be able to compare the results with the experiment in which the only difference is the one variable being tested. Without a control, the scientist would be unable to say that the results were due to changes in the experimental variable.

5 a Explain the difference between the validity and the reliability of the results of an experiment.

Answer: An experiment is said to be valid if it tests what it set out to test; while reliability refers to the extent to which an experiment can give the same results each time it is conducted.

b How would you make sure that the results of an investigation are valid?

Answer: The results of an investigation are valid if there is only one variable tested in the experiment. A scientist would have to check for uncontrolled variables, because these would make an investigation invalid.

c How would you make sure that the results of an experiment are reliable?

Answer: The results of an experiment are reliable if repeated tests give the same results each time they are used in the same way. Thus, reliability can be tested by repeating an experiment many times.

6 Using examples, explain the difference between a ratio and a rate.

Answer: A ratio is a numerical statement of how one variable relates to another. For example, if there are 100 rabbits and the ratio of black to white is 3:1, this means that there are 75 black rabbits and 25 white rabbits. A rate is a ratio that is related to time. For example, if a person's heart beats 72 times in one minute, they are said to have a heart rate of 72 beats per minute.

7 Why is repetition important in scientific investigation?

Answer: Repetition is important in scientific investigations because it ensures that the results of an experiment are reliable. It also ensures that, when the results of many trials are averaged, the scientists have minimised the effect of any chance or anomalous results that may influence the overall result.

8 Why are the results of experiments expressed as measurements whenever possible?

Answer: Measurements give a quantitative result that is less likely to be affected by bias, as qualitative observations would be.

9 Why are reports of scientific investigations published?

Answer: Reports are published so that scientists working on similar hypotheses can compare their work with others or build on other scientists' knowledge. Reports also enable other scientists to repeat the investigation and so test the reliability of the results.

10 What is a peer review and what is its purpose?

Answer: A peer review is a process where articles submitted to journals or conferences are reviewed by several experts within the same field of study. The feedback may require the writer to change the way the article is presented. The purpose of this is to decrease the possibility of bias and error being presented to a larger audience, because this may allow misleading information to be made public.

11 Why do scientists use such a lot of technical terms?

Answer: Scientists all over the world use technical terms, or 'scientific terminology', so that precise meanings can be conveyed with little chance of ambiguity or misunderstanding between colleagues and other scientists.

Apply your knowledge

1 Why are you studying human biological science? What do you hope to gain from your study of the course?

Answer: There are probably as many answers to this question as there are students taking the course. The object of the question is to make students think about their motives. Class discussion of some of the answers could be worthwhile.

2 Is history a science? Is music a science? Give reasons for your answers.

Answer: History is not a science, although scientific methods may be used to investigate historical situations. History is subject to interpretation and analysis, but cannot be measured, tested and trialled.

The production of musical sounds can be considered a science because it is based on observation (listening), is tested and trialled, can be measured, and is constantly evolving as new sounds are discovered, and new instruments/systems developed. However, the appreciation of music is not a science, because it is a matter of opinion – different people have different tastes in music.

3 The word 'malaria' comes from two Italian words: *male* meaning 'bad', and *aria* meaning 'air'. The ancient Greeks and Romans believed that malaria was caused by 'bad air' associated with swamps and marshes. We now know that this is not the case.

a Find out how the ancient Greeks and Romans tried to stop the spread of malaria.

Answer: By draining swamps and preventing people from living near swamps or stagnant water.

b Use resources to find out what causes malaria.

Answer: Malaria is caused by a parasite (a protozoan, or single-celled animal) that multiplies in red blood cells. The parasite is introduced into the blood by the bite of a mosquito infected by the parasite.

c What were some of the experiments that were done to determine the cause of malaria?

Answer: Autopsies of victims; microscopic examination of blood from people who did and did not have malaria; observing stomach contents of mosquitoes that had bitten malaria patients; experiments involving bird malaria – transfer of the parasite by mosquitoes from bird to bird.

d Which scientists were instrumental in discovering the cause of malaria? How was their discovery communicated to others?

Answer: Ronald Ross received the Nobel Prize in 1902 for discovering how mosquitoes transferred the parasite from one person to another. Charles Laveran discovered the malarial parasite in 1880. Patrick Manson made important discoveries about the life cycle of the parasite.

4 Many words not only have a meaning that is used in everyday speech and writing, but also have a scientific meaning that may be quite different from normal usage. The following words are examples. Find out the correct meaning of each of these words in human biology.

a Abduction

Answer: To move away from the midline of the body

b System

Answer: A group of organs that work together for a common function

c Absorption

Answer: To be taken up by or movement across a surface – in particular, taking in of nutrients from the alimentary canal

d Origin

Answer: Attachment of a muscle that remains relatively fixed during muscle contraction

e Axis

Answer: Imaginary line about which a joint or structure revolves; also the name of the second cervical vertebra

5 Two students measured the resting pulse rates of the members of a Year 11 class. A list of the resting pulse rates of 20 class members is shown below.

79	87	81	75	69	73	91	82	23	88
76	75	71	84	83	86	79	82	31	72

a Calculate the (arithmetic) mean pulse rate for the class.

Answer: 74.35

b The students identified two pulse rates that they considered to be outliers resulting from errors in counting. Calculate the mean pulse rate when the outliers are excluded. What is the effect of excluding the outliers?

Answer: If outliers are excluded the mean pulse rate for the class is 79.6. Excluding the outliers gives more reliable data because it excludes measurements that are probably incorrect.

c What percentage of the students had a pulse rate between 80 and 89?

Answer: 40%

d The students concluded that the average pulse they calculated was 'the average pulse rate for Year 11 students'. Was this a valid conclusion? Explain the reasons for your answer.

Answer: No, because the sample size should be greater and incorporate many more students to gain reliable and valid data.

6 A baby weighed 3400 g at birth. After three months, the baby's weight was 4600 g. Calculate the percentage increase in the baby's weight over the first three months of its life.

Answer: After three months the baby weighed 1200 g more than the original weight of 3400 g.

Percentage increase is $\frac{1200}{3400} \times 100 = 35.3\%$.