Chapter 1: Science toolkit

1.1 Science laboratories contain hazards

Student book answers (pages 2–3)

Check your learning 1.1

Remember and understand

1 What is the purpose of:

a a lab coat?

A lab coat protects your body and clothing in the laboratory.

b safety glasses?

Safety glasses protect your eyes in the laboratory.

c gloves?

Gloves protect your hands in the laboratory.

d close-toed shoes?

Close-toed shoes protect your feet and toes in the laboratory.

2 Why would you be unlikely to find a substance with the skull and crossbones hazard symbol in a school science laboratory?

The skull and crossbones symbol represents toxic substances that can cause death if touched, inhaled or swallowed. Such substances are banned from school laboratories.

3 What precautions might you take when using a substance labelled with the exclamation mark hazard symbol?

The exclamation mark symbol represents substances that can cause irritation. Use gloves, lab coats and safety glasses, handle with care and wipe up any spills immediately.

4 What is an acid neutralising trap used for?

An acid trap within a drain allows acids to be neutralised.

Apply and analyse

5 Some acids are considered corrosive. Research the word ‘corrosive’ and write its definition. What precautions should you take when handling acids?

Student answers will vary. Typically, corrosive means to eat away and eventually cause destruction. Precautions include wearing a buttoned-up lab coat, tying long hair back, wearing safety glasses and gloves. Acids should be handled with care and all spills wiped up immediately.

6 Why should you never randomly mix chemicals together in a science laboratory?

Although mostly safe to use, some school chemicals may cause a harmful reaction when mixed. So, you should never randomly mix chemicals together in a science laboratory.

7 Some people are allergic to the latex found in gloves. How could you tell if someone is allergic to a substance and what alternative safety precautions might be taken?

If someone is allergic to a substance, their body will emit an allergic reaction. This can range from redness, itching and lesions to severe anaphylaxis, which can be life threatening. Synthetic rubber gloves are a good alternative if someone has a latex allergy.

1.2 Dissection is an important science skill

Student book answers (pages 4–5)

Check your learning 1.2

Remember and understand

1 How is dissection different to just cutting something up?

Dissection involves disassembling and studying the internal structure of an organism. It involves care and precision as opposed to the ‘chaos’ of simply cutting something up.

2 Why is dissection a useful tool for scientists?

Dissection is a useful tool for scientists because it allows them to analyse and identify tissues, structures and the overall anatomy of an organism.

3 List three important safety rules that you must follow during a dissection.

Three safety rules of dissections are:

• Your lab coat and gloves should be on before you start your dissection and they shouldn’t come off until the dissection is completely finished – this includes disposal and cleaning!

• Dissection instruments and workspaces should be cleaned while you are still wearing your safety gear.

• The last things you should do are to: remove your gloves and throw them in the bin; wash your hands thoroughly; and take off your lab coat and hang it up.

4 Why might gloves *not* be essential for all dissections?

Gloves may not be essential for all dissections because some specimens may be by-products of the meat industry and, therefore, items humans eat, such as liver, kidney or brain. Gloves are generally not worn at home in the kitchen to prepare meat for cooking. Hand washing afterwards is generally enough.

5 Name three tools that are used as part of a dissection. Include a sketch of each tool.

Any three of the following, with an appropriate sketch: probes, forceps, scalpels or scissors.

6 Why is it important to leave lab coats and gloves on until *after* the clean-up?

Lab coats and gloves are needed to protect clothing and skin during the clean-up.

Apply and analyse

7 Without dissection, do you think our knowledge of human anatomy would be more or less advanced? Explain.

Without dissection, our knowledge of human anatomy would be much less advanced because dissections have enabled scientists to see inside the human body and to understand how we function.

8 Draw your own ‘surgical tool of the past’. Write a description of this tool and give it a name.

Student answers will vary.

1.3 Scientists design their own experiments

Student book answers (page 8)

Check your learning 1.3

Remember and understand

1 What are the three types of variables in an experiment?

Dependent, independent and controlled variables

2 Why is it important for an experiment to be reproducible?

It is important for an experiment to be reproducible because this shows that the experiment was valid and correct. If a number of different people get the same results, it shows the results weren’t just a fluke. It is also important for an experiment to be reproducible because this is a major part of the ‘scientific method’.

3 How do you change a ‘what if’ question into a hypothesis? Use one of the ‘what if’ questions you did not test as an example.

A hypothesis should start with ‘if’ and refer first to a change in the independent variable, ‘then’ predict the change in the dependent variable. Student examples will vary. As an example, ‘What if the balloon was blown up more?’ may become ‘If the balloon was blown up more, then the balloon will travel further along the string’.

4 Were there any variables that you could not control in your balloon rocket experiment?

Student answers will vary.

Apply and analyse

5 Most experimental methods are checked by other scientists. Can you suggest a reason for this?

Student answers will vary. Typically, most experimental methods are checked by another scientist to ensure the method is valid and does not contain mistakes or errors.

1.4 Scientists keep a logbook and write formal reports

Student book answers (pages 10–11)

Check your learning 1.4

Remember and understand

1 What is the purpose of a laboratory logbook?

The purpose of a laboratory logbook is to record the details of the work done in the laboratory. It contains information that the scientist may otherwise forget and provides evidence of the planning, changes and results of an experiment.

2 Why should an electronic logbook be backed up regularly?

An electronic logbook should be backed up regularly in case the original becomes damaged or in case information is lost.

3 A student made a mistake and ripped the page out of their logbook. Why would this be the wrong thing to do?

Pages should not be ripped out because a logbook is not a formal report and what may appear as a mistake may be useful later on.

4 Why is it important to make sure the writing in your logbook is legible?

Other members of your group or your teacher may need to read your logbook entries, so it is important to make them legible.

5 How is a logbook different to a formal science report?

A logbook differs from a formal science report in that it contains ideas, planning notes, sketches, changes and even mistakes made during the experiment. A formal report will be written using some of the information contained in the logbook, but not all of it.

6 Suggest one reason why it is important to include the date of the experiment in the logbook.

Student answers will vary. Typically, the date may be useful for validation purposes or proof that a student was at school and in class on that date.

7 Why should you reflect on each experiment before starting the next experiment?

Reflection allows a chance to understand why you got the results you did or to consider ways to improve your next experiment.

1.5 Tables and graphs are used to present scientific data

Student book answers (pages 12–13)

Check your learning 1.5

Remember and understand

1 What features should all graphs have in common?

All graphs should have the following features in common:

• a descriptive title of what the graph shows

• a grid that is used to plot the points or data

• the independent variable on the horizontal axis

• the dependent variable on the vertical axis.

2 What does ‘extrapolate results’ mean?

The term ‘extrapolate’ means to continue the shape of the graph to determine what would happen if you continued the experiment.

3 Describe the relationship between the independent variable and dependent variable in the following graph.

The height of both plants (dependent variable) generally increased with time (independent variable) from Day 2 onward. The height of the Dirt Plant had a linear relationship with time. The Jellies Plant exhibited ‘growth spurts’.

4 Extrapolate the following graph to determine what would happen if the water were heated for 8 minutes.

If the water were heated for 8 minutes, the temperature would approach 100°C.

Apply and analyse

5 Explain why graphs are often used in scientific reports.

Graphs are often used in scientific reports because they make it easier to analyse the data. Graphs show what happened. Patterns in the data can be seen, and this enables predictions about what may happen if you continued the experiment.

Review 1

Student book answers (pages 14–15)

Remember and understand

1 When are the following symbols or objects used?

a corrosive – used for a substance that is destructive to living tissue and to metals

b oxidising – used for a substance that provides oxygen to make other substances burn more fiercely

c toxic – used for a substance that can cause death if touched, inhaled or swallowed

d probe – used to look at and explore a specimen and to probe openings

2 How should you dispose of hazardous waste from dissections?

Hazardous waste from dissections should be wrapped in newspaper.

3 Define the following words:

a dissection

Cutting something apart and observing it in order to study it

b anatomy

The internal structure of an organism

c dependent variable

The variable that shows the effects of a change during an experiment

d hypothesis

Description of the expected relationship between the independent variable and the dependent variable

4 Describe the information that should be included in an experimental logbook.

A logbook should contain the aim, hypothesis, method, measurements, calculations, ideas, explanations, diagrams, sketches, graphs, mistakes, conclusion and reflections.

5 Why is it important to include any changes you make to an experimental method in your logbook?

Recording changes to the method is important when it comes to understanding and explaining your results fully.

6 How do you determine the average of a set of results?

To obtain an average of a set of results, add up the results and divide the total by the number of results.

7 What are the four common features that should be present on all graphs?

All graphs should have these features in common:

• a descriptive title of what the graph shows

• a grid that is used to plot the points or data

• the independent variable on the horizontal axis

• the dependent variable on the vertical axis.

8 What is the difference between the independent variable and the dependent variable?

The independent variable is the one that is deliberately changed during an experiment and the dependent variable is the one that is measured.

9 How should you safely dispose of:

a newspaper used for dissections?

Newspaper used for dissections is placed in the rubbish bin.

b vegetable oil?

Vegetable oil is collected in a bottle and placed in the rubbish bin.

c weak acid?

A weak acid can be poured down the drain.

d strong acid?

A strong acid is neutralised with an alkali and poured down the drain.

Apply and analyse

10 What dissection tools do you have in the science laboratory?

Scissors, probe, forceps and scalpel

11 How can you make sure an experiment is a fair test?

To ensure an experiment is a fair test, all the variables should be controlled and the experiment should be repeatable by other students.

12 Why should you wash science equipment thoroughly before putting it back?

Science equipment should be washed before putting it back in storage to avoid it becoming a health hazard and to avoid contamination when it is next used.

13 What might happen if you put play dough down the sink?

Play dough could form a blockage if put down the sink.

14 What is the difference between a logbook and a formal written report? When should a formal written report be used?

A logbook differs from a formal science report in that it contains ideas, planning notes, sketches, changes and even mistakes made during the experiment. A formal report will be written using some of the information contained in the logbook, but not all of it. A formal written report should be used as a means of communicating to other scientists.

Evaluate and create

15 Draw a graph from the data below that show how much Enza has grown in her first 8 years. Extrapolate the results to determine how tall Enza will be when she is 10 years old.



At age 10, Enza would be approximately 125–130 cm tall.

16 Answer the following questions about the graph on the next page.

a What label should be on the *x*-axis?

Year

b What label should be on the *y*-axis?

Number of deaths

c Which year was the number of road deaths at the highest level?

Around 1971

d How many road deaths were there in 1965?

Around 580

e Describe the trend in:

i 1945–1965

Over this period, there was an overall increase in the number of deaths.

ii 1975–1985

Over this period, there was an initial decrease followed by an overall increase in the number of deaths up until 1985.

iii 1990–2010.

Over this period, there was an overall decrease in the number of deaths.

f What could have caused the trend from 1985 to the current day?

Student answers will vary. Typically, the compulsory wearing of seatbelts in the backseat, safer cars with airbags, better road safety campaigns, better speed detection devices and speeding blitzes by the police will have contributed to lowering the number of deaths.

17 One of the first scientists to record their dissections was Leonardo da Vinci. Create a picture scrapbook of copies of some of Leonardo da Vinci’s best work on the study of the human body.

Student answers will vary.

18 Scientists present formally written reports in scientific journals. Many of these reports must be examined by other scientists before they will be accepted for printing. Suggest a reason for this.

It is important for a report to be examined by other scientists to ensure it is reproducible, valid and correct. (The case of ‘cold fusion’ is a famous one from history).

Ethical understanding

19 Dissections and research involving animals have contributed significantly to our understanding of the human body. In fact, it would probably be fair to say that we couldn’t have come this far without them. Critically evaluate the positives and negatives involved in using animals for medical research purposes. Discuss your points with a partner and share your thoughts with the class. Do you think animals should continue to be used for medical research?

Student answers will vary.

Positives: animals behave and respond in a similar way to humans, so humans don’t have to feel the effects of the testing; can assist scientists to find cures

Negatives: animals behave and respond in a similar way and are therefore affected by the testing; only provides an indication of the effects and effectiveness of a drug because humans don’t always respond in the same way as each other