Oxford International Resources

6

Science

Student Book

Second Edition

Primary

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Oxford International Resources

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Student Book

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Contents

Contents

How to Use this Book

This Student Book for *Oxford International Primary Science* forms part of your science lessons for this year. Your teacher will introduce the ideas through whole-class activities, then you will explore them in more detail using this book, before all coming back together to discuss what you have learned. Find out more at: www.oxfordprimary.com/international-science

Structure of the book

This book is divided into five units plus an introduction called *Being a Good Scientist* and a picture Glossary:

Each unit covers a different strand of science. You will need a science notebook to write in and to record your investigation results and conclusions.

Being a good scientist

To be a good scientist you need to be curious and ask questions. This section will help you think about how to develop your scientific skills to work like a scientist.

What you will find in each unit

There are three types of lessons:
Wow introduces each unit's scientific ideas and key words. It tells you what you will learn in the unit and lets you discuss what you already know.
Focused lessons cover the scientific knowledge and skills you need to learn this year.
In **What have I learned** you review your understanding and show your teacher what you have learned about the unit.

What you will find in the lessons

Although each lesson is unique, they have common features:

beam light source mirror opaque ray — The words on the Wow pages are included in the picture glossary at the back of the book. You can add your own notes for each word.

Key words: alkali, pH scale, pollution, waste — Gives you the key words for the lesson.

In this lesson you will learn how water is transported and excreted. — Tells you what you will learn in the lesson.


Questions to help you talk to each other and share ideas about the science you are learning and the investigations you do.


Practical and research activities to investigate and report on science topics. Sometimes your teacher will ask you to use different equipment, which is available in school. They may also ask you to carry out a test in a different way, to make sure you are safe.

Stretch zone Challenges you to take your learning further.

Key idea Summarises what you have learned.

Additional features

Think back Reminds you what has been covered before.

Science fact Interesting and amazing science facts.


Highlights the skills needed to be a good scientist.


Important notes about how to stay safe.

Teacher's Guide

There is a Teacher's Guide to help your teacher to work out the resources needed and to offer alternative activities and approaches.

Workbook

At the bottom of each page in this book is a link to a Workbook, where you can record your work and get extra practice to do in your lesson or at home.

Being a Good Scientist

As you know, science is the study of the world around us. You will have found out that to be a good scientist you need to be curious and ask questions. This section will help you think about how to build on your scientific skills to plan and carry out more complicated investigations.

Your work as a scientist this year will allow you to develop further your scientific skills. You will make more detailed predictions and observe patterns in your results. Having detected patterns in data, you will need to decide if these are the result of your investigation or simply happened by chance. You will also need to decide if your results were accurate and valid. You will have to think more deeply about how living and non-living things are classified. You will also be expected to test your own ideas and use scientific evidence.

This diagram shows the steps you can take to plan and carry out investigations like a scientist.

Start here: Asking questions

- Exploring ideas and thinking of questions to investigate.

Making a prediction

- What do I already know that will help me to decide what is likely to happen?

Planning

- Which is the best type of test to carry out?
- What are the variables?
- Which need to be controlled and why?
- How can I find out more before I start?
- Which secondary sources shall I use?
- What equipment do I need?

Making observations

- What observations and measurements should I make?
- How long should I make observations and measurements for?
- When do I repeat measurements?
- What equipment should I use?

Recording findings

- What is the best way to record data?
- Should I present the data in tables, scatter graphs, bar graphs or line graphs?
- Should I use scientific diagrams and labels?
- Is a classification key useful?
- Can I record into a table?
- Would photographs or film be helpful?
- Would a written description work well?

Drawing conclusions

- Does the data show that the research question has been answered?
- Are further tests needed?
- Does the evidence support my ideas?
- Do I trust my results?
- How can I improve the investigation?

Presenting ideas

- Have I used scientific language and illustrations?
- Should I present my ideas by speaking, by writing or by using displays and computer presentations? Would a model help?
- Does my work lead to other questions to study?

Asking questions

You have been encouraged to start your investigation questions with words such as 'which', 'what', 'why', 'how', 'do' and 'does'. This can help to lead you towards planning an investigation or carrying out research that will have a clear answer. The better you are at forming a question, the easier you will find it to plan and carry out investigations. Different types of questions are used in different situations.

Finding out what is happening: verification questions

These questions are designed to help you to collect data to find something out about a situation. You don't need to know anything about it before your investigation. For example:

- What happens when a ray of light hits a mirror?
- Do more batteries make the bulbs in a circuit brighter?

Answers to these questions will help you to build your knowledge, and the questions will lead you towards the type of investigation to carry out.

> Select one of the questions. Talk about what type of investigation you could carry out to answer the question.

Finding out why things happen: theory questions

These questions need you to have some prior knowledge of the subject. The question also means you have to explain WHY something happened. For example:

- Why do shadows change in size when the light source is moved?
- Why do heart rates and breathing rates increase during exercise?

How will we measure if the bulbs change in brightness? Does the way the bulbs are arranged make a difference?

Experimental questions

These questions grow from your prior knowledge of the topic; they need an explanation and they are testable. In other words, other people can test your answer to see if they agree. For example:

- Does adding more volts to a circuit make the bulbs shine brighter?
- Does light travel in a straight line?

> Read the three questions below.
> Decide whether they are verification, theory or experimental questions. Talk about how you would plan to answer the questions.
>
> 1. If an extra bulb is added to a circuit, will the other bulbs be brighter or dimmer?
> 2. How are animals adapted to living in dry countries?
> 3. Why can we not see objects when a room is dark?

The fact that answering a question can lead onto others is why the investigative process is shown as a cycle.

Making a prediction

When answering a research or investigation question you should make a prediction.

This is based on what you already know about a topic. Scientists are usually confident about what will happen in an investigation. They may have done similar investigations before or read about similar work elsewhere.

Use what you know about electricity to help you think about this question.

What would you observe if you added two cells (batteries) to a circuit that already had one cell and three bulbs? Do you think the bulbs would be brighter or dimmer? What did you think about to help you decide?

As a scientist, you draw on your previous experiences to help. You think about when you have created simple circuits. This makes your prediction much better than a guess. It is based on scientific knowledge and evidence.

Scientists may use **models** and **diagrams** to represent objects and systems. These help scientists explain and think about scientific ideas that are not visible or unknown. Scientists can then use their models and diagrams to make predictions or to explain observations.

Remember: a prediction can be shown to be incorrect. An investigation, no matter how often it is repeated, may show that your original prediction cannot be the correct answer.

What would you do if your prediction is shown by your investigation to be incorrect? Use books and the internet to find out some examples of science theories that have now been proved to be incorrect.

Planning

It is vital that scientists plan what they are going to do. They discuss their plan to check it will work. A good scientist will also research the topic to find out as much as they can. They use secondary sources.

A secondary source is any source that gives you information you have not found out for yourself. Examples are written information in books and on the internet, talks from people who did the original work, documentaries, journals, magazines or newspapers.

Use secondary sources when you can but be careful. Some can be trusted more than others. Try to use more than one source of information and check it by doing investigations yourself when you can.

Remember: scientists think carefully about the equipment they will need. They make a list and make sure everything is available before they start an investigation.

Different types of test

Descriptive investigations

This is when you observe something over time and describe what happens. Every time you survey plants or animals you have been doing a descriptive investigation. You do not need to know anything about the topic and you do not need a prediction. You are recording what you see and then making sense of it. You will end up identifying, observing, listing and describing what you see.

Discuss a descriptive test you have carried out. What were you observing?

Comparative investigations

This is when you observe or measure at different times or in different places to compare data to see if there are any changes or differences.

You will be encouraged to set up what are called comparative tests. This is when you design an investigation to compare different things. For example, you could compare the size and shape of shadows with different light sources.

Experimental investigations

This is when you will be designing a fair test. This means you will have to decide on which factor or variable you will alter, which you will measure, and which you will control. The investigation is set up to gather data that supports or does not support a causal relationship. This means we are investigating if changing X causes or makes Y change.

The types of variable are described below:

- **Independent variable** (sometimes called the manipulative variable) – this is what you change on purpose in an investigation.
- **Dependent variable** (sometimes called the response variable) – this is what changes during the investigation because you have altered the independent variable. It is what you measure.
- **Control variables** (sometimes called constants) – these are the variables you keep the same during an investigation.

Study the picture. Discuss and identify the independent, dependent and control variables for this investigation. What causal effect are the students studying? What would your prediction be?

As you have found in your earlier work surveys of habitats also need to be fair. You should survey the same amount of ground so you can do a fair comparison with other areas. If you surveyed a large area in one place and a small area in another place, then it would not be a fair test: you could not fairly compare which has the most plants or insects. When you survey people, for example about what they eat, you should also try to include the same number of people every time.

Science fact

Scientists sometimes give a suggested answer to an investigation. This is called a hypothesis. If other scientists test this and they all agree, it then becomes a theory. In time, a theory that does not change can become a law of science.

Sometimes it is not possible to plan an investigation to answer your questions. If you want to explore forces that are too strong for you to investigate, you cannot carry out a test but you can use secondary sources.

What are secondary sources? List the times you have used them to find out about a topic.

Making observations

Scientists use their observation skills during investigations.

What observations and measurements would the students investigating exercise and pulse rate be carrying out? Write a list.

During the planning stage you will decide which observations and measurements you need to make. This will depend on the type of investigation you are carrying out.

With surveys, this may involve counting different living things and observing what they look like to help with identification.

With experimental investigations, this can involve measuring the time taken for something to happen, the height that something has grown, the temperature of a material, or the number of grams of something.

Scientists also decide on the best place to carry out observations. They think about the equipment they need, the safety measures that need to be followed, and the reason for the investigation. For example, a survey of animals in a habitat is carried out in a particular outdoor location and a chemistry experiment is usually carried out in a laboratory.

Scientists use devices such as computers, data loggers and other devices, such as smartphones and electronic scales, to help them to take accurate measurements.

Science fact

Scientists use standard units to record their results. These units have been agreed throughout the world so all scientists can compare their work. The standard unit for length is the metre or kilometre.

Which standard units would you use to measure: a) temperature, b) distance between villages, c) the amount of flour needed in a recipe?

Good scientists repeat measurements. This is to make sure they have not made any mistakes. They can then calculate a mean average for their readings. The example below shows the results of a light reflection investigation.

Angle of incidence (light reaching the mirror) (degrees)	Angle of reflection (light leaving the mirror) (degrees)			
	Measurement 1	Measurement 2	Measurement 3	Mean (average)
20	19	21	20	
30	32	29	29	
40	40	40	40	

What is the average reading for each angle of reflection? Why is it useful to not just take the first reading? List two reasons why the result may vary every time you do this investigation.

Remember: in some investigations you may use a key to help you to identify living things and objects.

Recording findings

As part of the planning process, scientists think about the best way to record their results. They might decide to use a table or labelled diagrams. They could take photographs or film what is happening. The main thing to think about is:

How can I record results so they help me to see patterns or to sort things into groups?

You will need to use your results to draw conclusions. This is the next part of the investigation process. If you do not record your results carefully, you may not be able to make the most sensible conclusions.

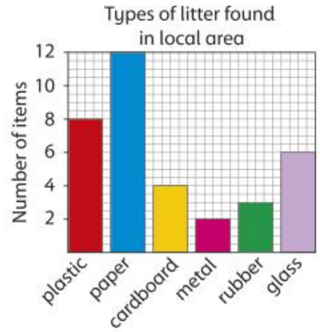
Tables

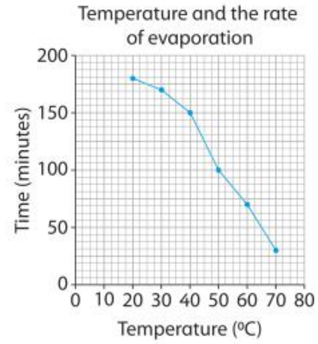
You will often record your results in a table.

Design a table to record the shoe sizes of six people in your class.

Charts/graphs

You have presented your results as bar and line charts or graphs, like the ones below.

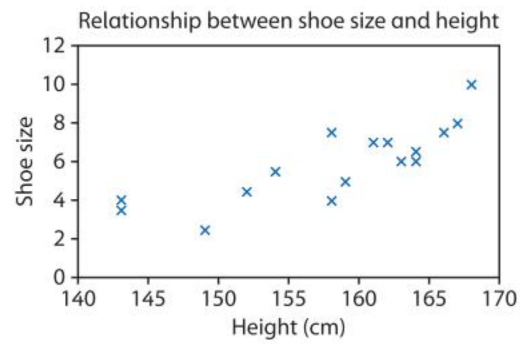




A bar chart is used when there are separate categories or types of things being studied. These are on the horizontal axis as separate bars.

A line graph is used to plot individual points where the values on the horizontal axis and vertical axis are both numbers. The points are then joined together to make a continuous line.

A scatter graph is like a line graph but the points do not show a simple relationship. Instead, they are not joined up but still show a pattern or trend.

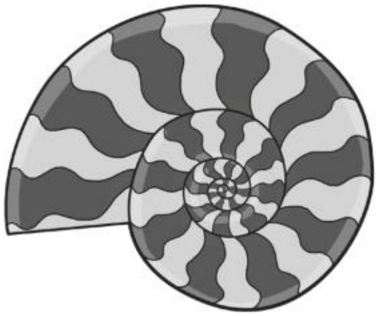


The shoe size of the people is plotted on the y-axis. The heights of the people are plotted on the x-axis.

Why is the scatter graph better here than a bar graph or line graph? Do all of the people of the same height have the same shoe size? Explain your answer.

Drawings, photographs and videos

You have worked with scientific drawings before. Remember they are not like the pictures you paint. Scientific drawings are much simpler.



Scientists also use modern technology to take photographs and video clips of their investigations and results.

Photographs show a lot of detail

This is a very accurate way to record results. This level of detail would not be possible without using a camera.

Filming allows us to see things that may be impossible to see in person. Scientists can observe what happens to shadows during the day and time the details accurately by slowing down a film and piecing it together. This is called time-lapsed filming.

Research on the internet time-lapse films of shadows or the Sun seeming to move across the sky. Choose the best one to share with your class. What does the film show that you could not see with drawings or photos?

Drawing conclusions

The last stage of an investigation is when scientists look at their results carefully. It is at this stage that they make sense of their results. They work out if the results have helped them to answer their investigation question.

The questions they might ask are:

- Can I see any patterns?
- Is there a causal relationship in the data: did one thing cause another thing to happen?
- Are any results unusual? Should I repeat any parts of the investigation?
- Was my prediction correct? Does the evidence support my ideas?
- How much do I trust the results?
- Do secondary sources of information support my ideas?
- Are further tests needed?

Scientists also link their conclusions to bigger scientific ideas. For example, if they are thinking about circuits and voltage, they will link this to their knowledge of electricity and components. They will also think about other factors, such as how many components are in a circuit and how they are arranged. They will even think about wider examples such as the applications of circuits and safety with electricity. They may even consider inventions such as electronic devices, including laptops, smartphones and digital cameras.

After completing an investigation, a good scientist will study their results and think about what went well and what could be improved. This is called evaluation and is an important part of the investigation process.

Presenting ideas

Scientists present their ideas by talking to others informally or at more formal meetings and conferences. They also write reports or make displays. This might be in a poster or computer presentation. They may include models.

Scientists are very careful to use the correct scientific language. This makes their ideas much clearer. They use standard units so their findings make sense across the world.

They also plan their reports and presentations to match the audience. For example, if they are talking to people who are not scientists, they will not include as much detail as they would in a more formal scientific paper.

Tips for presenting ideas

- Plan on paper first.
- Discuss your work with your team and share out the jobs.
- Think about your audience.
- Do not put too much information on a slide, poster or web page.
- Make any text, pictures and models eye-catching and clear.
- Use headings, colour and lists.
- Clearly set out what you did and what you found out.
- Show how your work leads onto further work.
- Use secondary sources of information and give credit to the people whose work you are using.
- Practise your presentation.
- Enjoy sharing ideas.

It is useful to fill out an investigation planning form. This sets out all the stages of your investigation. It helps you to remember everything you need to think about. Your teacher may give you one of these.