Introduction to Science **Knowledge Organiser**

A science laboratory is used for carrying out practical investigations. This can involve using hazardous chemicals and equipment such as Bunsen burners.

Some practical equipment, such as test tubes, are easily breakable so care must be taken.

Thinking about the students' and teacher's health and safety is very important so that no one gets hurt.

Laboratory Safety Rules

Your teacher will have made the safety rules for the laboratory very clear. Below are some important safety rules, which should always be followed, but there may be others which you need to consider in addition to these.

- Always wear eye protection during a practical.
- Carry out a practical while standing up.
- Do not eat or drink in the laboratory.
- Tie long hair back and tuck loose clothing in during practicals.
- If something is spilled or broken, tell the teacher.
- Ensure that the floor and work space is clear of obstacles.

Hazard Symbols

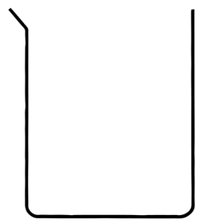
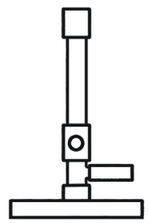
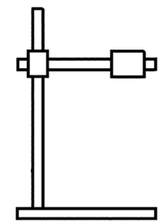
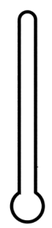
Hazard symbols show people how dangerous a chemical is, and what care should be taken when handling them.

Symbols can be used all over the world and are immediately recognisable, so it does not matter which language is used.

flammable	acute toxicity	corrosive	explosive
			
moderate health hazard	**serious health hazard**	**harmful to the environment**	
			

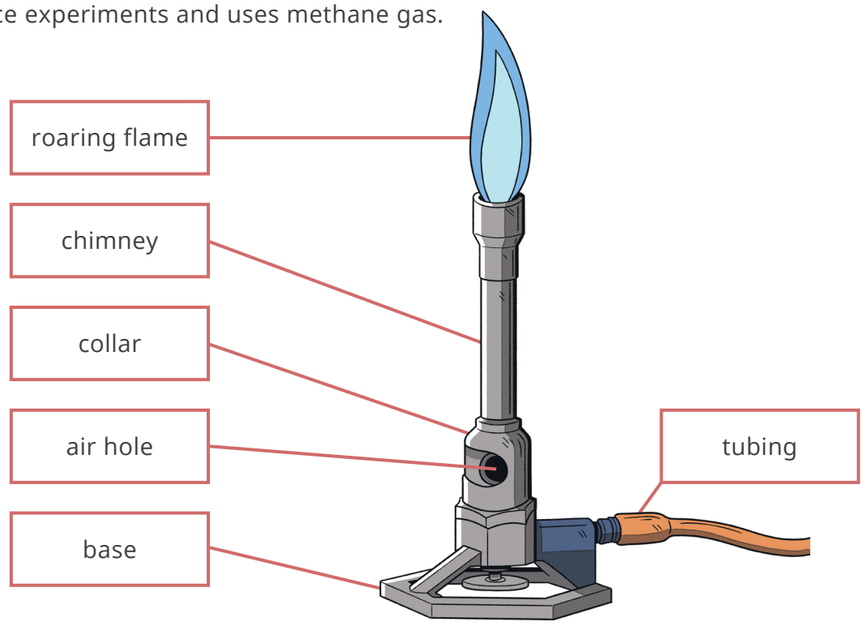
Scientific Equipment

Diagrams are used when drawing practical equipment to make it easier and quicker to draw.

beaker	Bunsen burner	tripod	evaporating basin	clamp stand, boss and clamp	conical flask
					
test tube	**funnel**	**measuring cylinder**	**thermometer**	**heatproof mat**	**gauze**
					xxxxxxxxxxxxxx

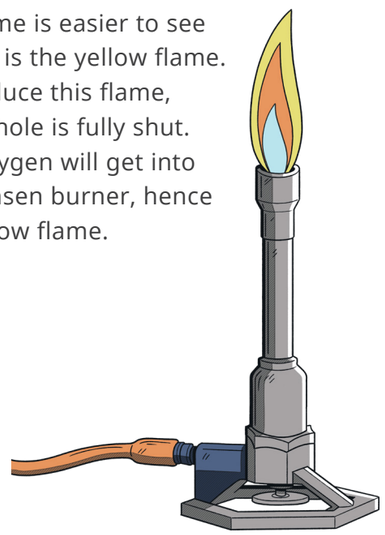
Bunsen Burner

The Bunsen burner is an important piece of scientific equipment. It is used in many science experiments and uses methane gas.



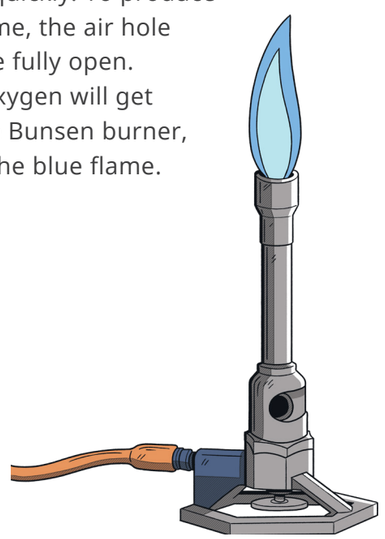
The Safety Flame

The safety flame is used when the Bunsen burner is not in use. The flame is easier to see when it is the yellow flame. To produce this flame, the air hole is fully shut. Less oxygen will get into the Bunsen burner, hence the yellow flame.



The Roaring Flame

The roaring flame is used to heat things quickly. To produce this flame, the air hole must be fully open. More oxygen will get into the Bunsen burner, hence the blue flame.

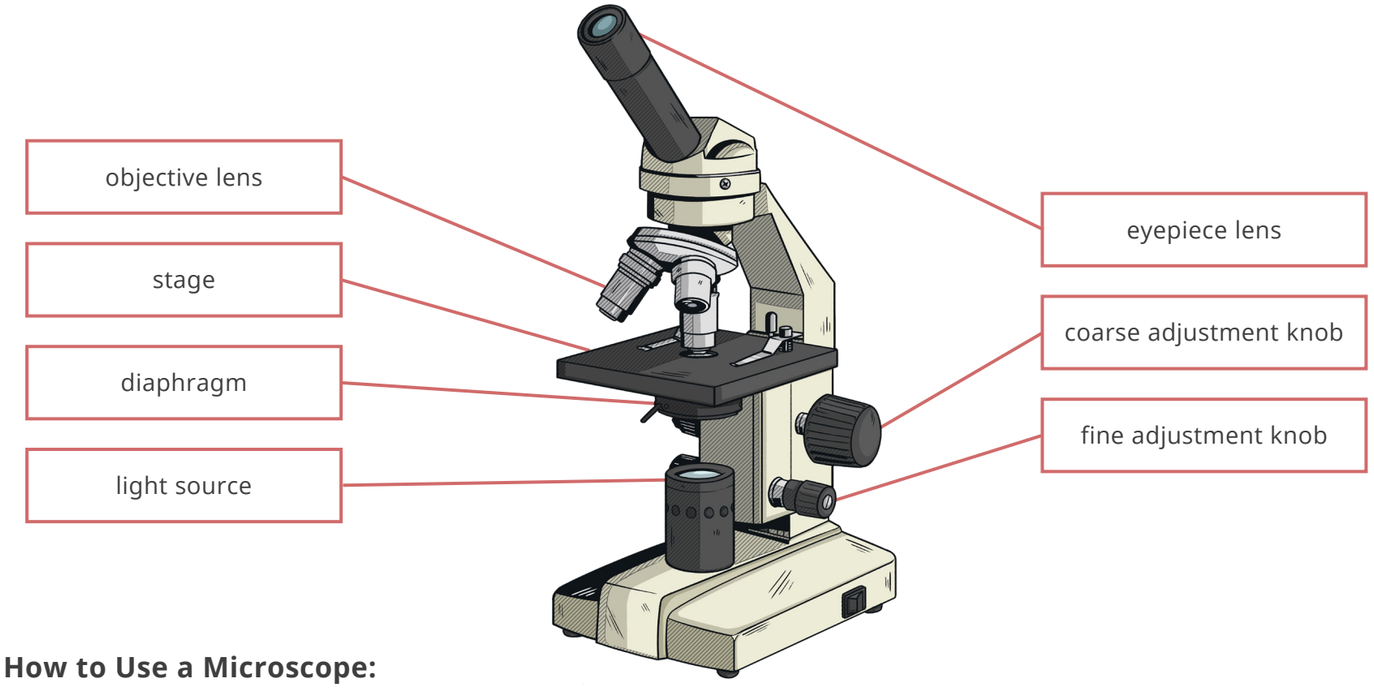


Microscope

Microscopes have been used for years to observe objects that are too small to see with the naked eye.

Over time, the magnification of microscopes has significantly improved due to developments in technology. We now have microscopes that can examine specimens at an atomic level.

We have made many important scientific discoveries thanks to microscopes.



How to Use a Microscope:

1. Plug in the microscope and turn on the light. If your microscope has a mirror, you may need to adjust it so light is directed through the diaphragm.
2. Place your specimen (the object you want to observe) on the stage and secure it with the stage clips.
3. Turn the objective lens to the lowest magnification (usually ×4).
4. Turn the coarse adjustment knob until the objective lens is almost touching the microscope slide. Look from the side of the microscope as you do this, not through the eyepiece, so you do not damage the slide.
5. Looking through the eyepiece, turn the coarse adjustment knob to move the stage away from the objective lens until the image comes into focus.
6. Use the fine adjustment knob to make the image clearer.
7. Turn to a higher power objective lens (×10 or ×40) and refocus the image using the fine adjustment knob.
8. Make a scientific drawing of the specimen or write down any observations.

Investigation Skills

Independent variable: The variable that you change or select the values for.

Dependent variable: The variable that is measured for each change of the independent variable.

Control variable: A variable that may, in addition to the independent variable, affect the outcome of the investigation and therefore must be kept constant.

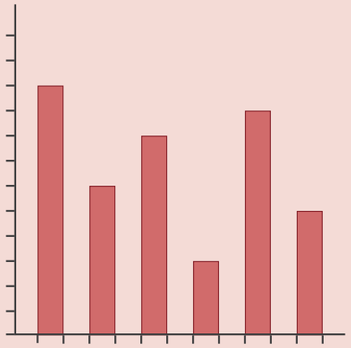
Prediction: What you think will happen and why.

Risk assessment: Identify hazards, the harms they can do and how you will minimise any risks in a practical investigation.

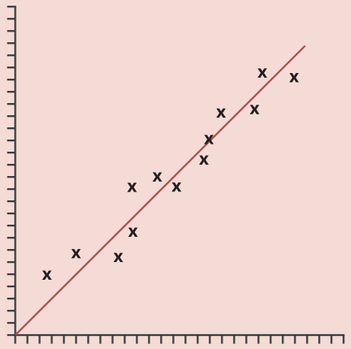
Method: Step-by-step instructions for how to carry out a practical investigation.

Results table: As the practical is carried out, write the results in a table.

Bar chart: used to display data when at least one variable is discrete or categoric.



Scatter graph: used to display data when both the independent and the dependent variables are continuous.



Conclusion: An explanation of what you found out in your investigation.

Evaluation: Where you consider the quality of your method and the data you collected.

The Flame Test

This test is used to find out which metal ion is in a compound. Each metal ion will produce a different coloured flame.

1. Dip a wooden splint into a test tube of a metal chloride solution, e.g. copper chloride.
2. Turn the Bunsen burner to the blue flame and carefully place the end of the splint with the metal chloride solution into the flame.
3. Write down any observations/colours in the results table.
4. Repeat with different metal chloride solutions.

Metal Ion	Flame Test Colour
potassium (K)	purple
calcium (Ca)	red–orange
lithium (Li)	crimson red
sodium (Na)	orange–yellow
copper (Cu)	green

Using a Knowledge Organiser
Guide for Parents and Carers

What is a knowledge organiser?

A knowledge organiser contains all the important information from a particular topic, summarised in just a few pages. It includes key words, important facts, diagrams, methods and skills relating to the topic.

Why is it useful?

A knowledge organiser helps students to organise the content they need to learn. This makes it easier for them to remember the information and access the facts from their memory when they need to answer an exam question.

How can it be used?

The more memories are used, the stronger the memory becomes and the easier it is to access. For students, this means regular practice at retrieving the facts they have learnt and using them in a variety of ways. They could play games with the information, explain the facts to someone, apply the information to a new situation or organise the knowledge organiser into a different format.

How can I help?

The knowledge organiser contains all the facts needed to test someone on the content from a topic. This is great because it means you can help someone revise content even if you haven't studied it yourself!

- You could ask your child some questions on the content, for example the definition of a few key words, or challenge them to draw a diagram from memory. Testing their knowledge with one or two questions a day can make a big difference to how much information they remember. Perhaps it could become part of the after dinner or breakfast routine.
- You could prompt your child to turn some of the information on the knowledge organiser into a different format.
    - A word list could become flashcards.
    - Facts could be transformed into a mind map to show links between ideas.
    - Information could become a song, story or comic strip.
    - A diagram could become a poster, a collage or a model.
- You could ask your child to teach you about something on the knowledge organiser. Having to explain information to someone else, and answer their questions about it, is a great way to reinforce their knowledge and identify areas they need to go back to and revise again.
- You could suggest turning the information into a multiple-choice quiz, either on paper or using a website. This task requires them to process the information to write questions and come up with correct and incorrect answers. You could then use it to test their knowledge or to host a quiz with family or friends, either at home or online.

Using a Knowledge Organiser

Knowledge organisers are useful tools when it comes to learning and recalling information. However, just reading or copying is not the best way to get the most out of them. Learning happens when we have to think about what we are doing, and we can do this by self-testing.

1. Pick a section of the knowledge organiser and read through it.
2. Now turn over your knowledge organiser and write down as much as you can from memory. There are many different ways that you can do this. Look at the suggestions below or come up with your own.
3. Turn the knowledge organiser back over and look for anything that you missed.
4. Flip it back over one more time. Using a different colour pen, see if you can add in any extra information you missed the first time around.

Put the information into a table.

Look	Write	Check	Correct
alkali metals	• Group 1 • react with water to produce hydrogen and a metal hydroxide • reactivity increases as you move down the group	✓ ✓ ✓	• **melting and boiling points decrease as you move down the group** • **soft** • **shiny when cut**

Draw spider diagrams or mind maps.

Write a topic or keyword in the centre of the page. Add everything you know about the topic in subtopics around the centre. Can you connect any ideas? Colour and pictures will make the information more memorable.

Create a set of flashcards.

Write down keywords, questions or equations on one side of a card. On the other, write the definition or answer.

Record yourself on your phone or tablet.

Listen back and check the recording against the knowledge organiser. Can you include more information a second time?

Draw it.

Draw pictures or diagrams to represent each of the ideas in the knowledge organiser. Once you have finished, see if you can use the diagrams to write out the information. Check it against the knowledge organiser, is there anything you need to add?

KS3 Introduction to Science
Unit Overview

About This Unit

This unit aims to give students an introduction to the science laboratory and practical investigation skills.

In this unit students will:

- become familiar with hazard symbols and ways to work safely in a science laboratory;
- learn how to light and safely use a Bunsen burner;
- learn to identify and use laboratory equipment;
- carry out investigations within a biology, a chemistry and a physics context.

A great way to start your students' secondary science experience!

Lessons	Career Links	Spiritual, Moral, Social and Cultural (SMSC) Development
	In the How to Use a Microscope lesson, the development of the microscope and some of the important discoveries it has led to are discussed. This could lead to discussions about careers in which microscopes could be used. In the Marshmallow Investigation and Making a Flare lessons students will discuss everyday applications of chemistry and physics and try to identify which area of science some topics belong to. This could lead to further discussions about the use of science in everyday life and careers related to science subjects.	This unit of work provides several opportunities for students to work together practically in groups, which encourages them to share views and opinions and take instructions from others. Group work opportunities encourage teamwork and respect for others. In practical lessons students follow laboratory rules for the safety of all. There are opportunities to discuss scientific discoveries by scientists in other cultures and the collaborative nature of the scientific community.

Included in this Pack	Learning Objectives	Success Criteria
Introduction to Science: Health and Safety Lesson PowerPoint **Health and Safety Teaching Ideas** **Chemical and Hazards Table** **Hazards Match and Draw** **Hazards in the Home Worksheet** **Problem Solving Worksheet** **Safety Rules Worksheet**	To understand the importance of working safely in a laboratory.	• To identify some important safety rules in a laboratory. • To recall and identify hazard symbols. • To explain how to keep yourself and others safe in a laboratory, especially during practical investigations.

Additional Resources	National Curriculum Links	Working Scientifically
containers of chemicals with hazard symbols, for example: • hydrochloric acid 0.5M • sodium hydroxide 0.5M • nitric acid 0.5M • calcium carbonate • magnesium ribbon mini whiteboards and pens (optional)	Evaluate risks. Use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety.	Evaluate risks. Use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety.

Main Pupil Activities

Hazard Symbols – Students will be introduced to the hazard symbols then use the Hazards **Match and Draw** activity to record their learning.

Hazard Symbols in the Lab – Students could explore the lab, looking for hazard symbols and recording those they find on the **Chemicals and Hazards Table**.

Safety Rules – Discuss the safety rules of the lab with your students. They could then complete the **Safety Rules Worksheet**.

Problem-Solving – Students are presented with scenarios in the **Problem-Solving Worksheet** to which they could suggest possible solutions. This activity reinforces the safety rules as students assess risks in the scenarios and describe how to manage them.

Home Learning – Students could complete the **Hazards in the Home Worksheet**.

Included in this Pack	Learning Objectives	Success Criteria
Finding Your Way Around a Laboratory Lesson PowerPoint **Finding Your Way Around a Laboratory Teaching Ideas** **Equipment List** **Naming Scientific Diagrams Worksheet** **Scientific Diagram Cards** **Scientific Equipment Homework Sheet**	To find your way around the laboratory and recognise some of the equipment used in science lessons.	• To find equipment around the laboratory. • To identify some pieces of scientific equipment. • To draw and label scientific diagrams of different scientific equipment.

Additional Resources	National Curriculum Links	Working Scientifically
laboratory equipment (enough for one of each per group) including: • heatproof mats • Bunsen burners • tripods • gauzes • measuring cylinders • beakers • conical flasks • clamp stands, bosses and clamps • evaporating basins • thermometers • boiling tubes • funnels • mini whiteboards and pens (optional)	Use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety.	Use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety.

Main Pupil Activities

Finding Your Way Around the Lab – Students are given an **Equipment List** and should go around the lab to find the equipment. This is a useful exercise to help students become familiar with where they will collect each piece of equipment from when carrying out practical investigations.

Setting Up an Experiment – Students decide which pieces of equipment they would need to investigate the boiling point of water. Once they have chosen their equipment, they should try to assemble it in the correct way.

Scientific Diagrams – Students could be given a set of **Scientific Diagram Cards** to match the diagrams to the pieces of equipment which they collected at the start of the lesson. Students could then complete the **Naming Scientific Diagrams Worksheet** and draw a scientific diagram of their equipment set-up from the previous task.

Home Learning – Students could be given the **Scientific Equipment Homework Sheet** to complete.

Included in this Pack	Learning Objectives	Success Criteria
Using a Bunsen Burner Lesson PowerPoint **Using a Bunsen Burner Teaching Ideas** **Labelling the Bunsen Burner Worksheet** **Using a Bunsen Burner Worksheet** **Boiling Water Results Table** **Key Word Bingo Templates** **Bunsen Burner Licence Certificates**	To use a Bunsen burner safely.	• To identify the different parts of a Bunsen burner. • To safely use a Bunsen burner to boil water. • To explain when and why the two flames of a Bunsen burner are used.
Additional Resources	**National Curriculum Links**	**Working Scientifically**
each group needs: • Bunsen burner • heatproof mat • beaker • timer • thermometer • tripod • gauze • water	Choose appropriate equipment for a practical. Ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience. Use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety.	Choose appropriate equipment for a practical. Ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience. Use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety.
	Main Pupil Activities	
	Label the Diagram of a Bunsen Burner – Students will watch a demonstration of how to light and use a Bunsen burner. From the demonstration, and with the help of key words, students should then complete the **Labelling the Bunsen Burner Worksheet**. **Using a Bunsen Burner** – Students will practise lighting their Bunsen burners and turning the collar to adjust the flame. They should record differences between the two types of flame on the **Using a Bunsen Burner Worksheet**. **Using a Bunsen Burner to Boil Water** – Students will select and set up the equipment they need to determine the boiling point of water. Students could record the temperature of the water as it is heated in the **Boiling Water Results Table**.	

Included in this Pack	Learning Objectives	Success Criteria
How To Use a Microscope Lesson PowerPoint **How To Use a Microscope Teaching Ideas** **Microscope Observations Worksheet** **Parts of a Light Microscope Worksheet** **Microscope Safety Poster** **Using a Light Microscope Student Instruction Sheet**	To use a microscope to view small objects in more detail.	• To label the parts of a microscope. • To safely use a microscope to magnify objects. • To make scientific drawings of objects under the microscope.

Additional Resources	National Curriculum Links	Working Scientifically
each group needs: • light microscope • prepared slides and other objects to view through the microscope • mini whiteboards and pens (optional)	Observe, interpret and record structures using a light microscope.	Understand that scientific methods and theories develop as earlier explanations are modified to take account of new evidence and ideas.

Main Pupil Activities

Microscopes – Students discuss the uses of microscopes and how the developments in microscopes have led to scientific discoveries.

Parts of the Microscope – Students are introduced to the parts of the light microscope and complete the **Parts of a Light Microscope Worksheet**.

Using a Light Microscope – Students follow the **Using a Light Microscope Student Instruction Sheet** to view prepared slides. They could record their observations on the **Microscope Observations Worksheet**.

Home Learning – Students could be given a choice of research tasks to complete. Either research the history of the microscope or research the differences between light microscopes and electron microscopes.

Included in this Pack	Learning Objectives	Success Criteria	National Curriculum Links
Marshmallow Investigation Lesson PowerPoint **Marshmallow Investigation Teaching Ideas** **Marshmallow Investigation Planning Sheet** **Blank Science Investigation Planning Sheet**	To investigate the effect of marshmallows on the temperature of hot chocolate over time.	• To identify the key variables in an investigation. • To carry out an experiment safely. • To draw a graph representing investigation results.	Comparing the starting with the final conditions of a system and describing increases and decreases in the amounts of energy.

Additional Resources	Working Scientifically
each group needs: • 250ml beaker • spoon • thermometer • timer • instant hot chocolate powder • marshmallows • hot water (a kettle) • mini whiteboards and pens (optional)	Select, plan and carry out the most appropriate types of scientific enquiries to test predictions, including identifying independent, dependent and control variables, where appropriate. Present observations and data using appropriate methods, including tables and graphs. Interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions. Present reasoned explanations, including explaining data in relation to predictions and hypotheses.

Main Pupil Activities

Hot Chocolate and Marshmallows – Students will be presented with the question "Will adding marshmallows to hot chocolate keep it warmer for longer?". Students should discuss their ideas about how this question could be investigated.

Variables – Students will be introduced to independent, dependent and control variables and will identify the variables in this investigation. These could be recorded on the **Marshmallow Investigation Planning Sheet** or, if you prefer, the **Blank Science Investigation Planning sheet**.

Practical - Students will make a prediction, agree on safety precautions required for this investigation and then carry out the investigation, recording their results on the **Marshmallow Investigation Planning Sheet** as they go.

Displaying Your Results – Students will draw a bar chart to represent their investigation results.

Conclusion – Students could discuss their conclusions, based on their investigation results, and decide as a class whether marshmallows do keep hot chocolate warmer for longer.

Included in this Pack	Learning Objectives	Success Criteria
Making a Flare Lesson PowerPoint **Making a Flare Teaching Ideas** **Making a Flare Teacher and Technician Notes** **Making A flare Method Worksheet** **Flame Test Observations Table**	To carry out flame tests and identify the best metal chloride to make a flare.	• To use a Bunsen burner safely during a practical. • To carry out flame tests safely and make observations. • To write a detailed method, including a risk assessment and come to a conclusion based on recorded observations.
Additional Resources	**National Curriculum Links**	**Working Scientifically**
each group needs: • Bunsen burner • heatproof mat • five wooden splints • test tubes containing solutions of: - potassium chloride - calcium chloride - lithium chloride - sodium chloride - copper chloride	Evaluate risks. Use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety. Make and record observations and measurements using a range of methods for different investigations.	Evaluate risks. Use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety. Make and record observations and measurements using a range of methods for different investigations.
	Main Pupil Activities	
	Everyday Uses of Chemistry – Students discuss everyday uses of chemistry such as cooking, fireworks, recycling and others they can think of. Students will learn what a flare is and how they are used and discuss what an effective flare might look like. **Method** – Students will watch a demonstration of a flame test being carried out. After watching the demonstration students will recall the equipment used and write a method for the flame test. This can be done using the **Flame Test Method Worksheet**. **Risk Assessment** – Students should be guided through writing a risk assessment for this practical activity. They could be shown the hazard symbols on containers of metal chlorides and asked what they mean, what harm the chemicals could cause and how they could be used safely. Students should consider the Bunsen burner and glassware used in the investigation too and record their ideas on the **Making a Flare Method Worksheet**. **Making a Flare** – Students will carry out flame tests on five metal chloride solutions and record their observations on either the **Making a Flare Method Worksheet** or the **Flame Test Observations Table**. **Conclusion and Class Results** – Students will use their observations to decide individually and as a class which metal chloride would produce the best flare and explain their reasoning.	

Chemicals and Hazards Table

Complete the table with the name of each chemical and its hazard symbol. You could either draw the hazard symbol or give its meaning.

Chemical	Hazard Symbol

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Chemical	Hazard Symbol

Hazards in the Home

Find five products around the house that have chemical hazard symbols on them. Write down the name of the product, the hazard symbol(s) on the product and explain why the product may have these symbols.

Product	Symbol(s)	Explanation

Did you find any hazard symbols that you did not see in the laboratory?

What do they mean?

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Product	Symbol(s)	Explanation

Did you find any hazard symbols that you did not see in the laboratory? _____

What do they mean? _____

_____

_____

Hazard Symbols **Match and Draw**

Hazard symbols are used to warn us about the potential hazards of a substance.

Draw one line from each symbol to the meaning of that symbol, then draw one line from each meaning to the correct description.

Symbol	Meaning	Description
	flammable	Could cause illness or death if taken into the body.
	moderate health hazard	Catches fire when it comes into contact with oxygen and a heat source.
	corrosive	Could irritate the skin.
	harmful to the environment	Could cause damage to animal and plant life if released into water systems.
	serious health hazard	Could burn the skin and damage the eyes. Avoid breathing in vapours.

Hazard Symbols Match and Draw **Answers**

Symbol	Meaning	Description
	flammable	Could cause illness or death if taken into the body.
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Health and Safety
Teaching Ideas

Learning Objective:
To understand the importance of working safely in a laboratory.

Success Criteria:

- To identify some important safety rules in a laboratory.
- To recall and identify hazard symbols.
- To explain how to keep yourself and others safe in a laboratory, especially during practical investigations.

Context
This lesson is part of the Introduction to Science unit of work, focusing on health and safety in a science classroom.

Resources
containers of chemicals with hazard symbols, e.g. hydrochloric acid 0.5M, sodium hydroxide 0.5M, nitric acid 0.5M, calcium carbonate, magnesium ribbon

mini whiteboards and pens (optional)

Starter

Laboratory Hazards

From the picture on the PowerPoint, students identify hazards in the lab during a practical. Tell the students they can work as a table or in pairs to come up with as many as they can. They then share their ideas with the class. Encourage students to challenge themselves by completing the extension activity and come up with suggestions to prevent these hazards. A quick class discussion around why health and safety are so important will link the next part of the lesson.

Main Activities

Hazard Symbols

What do the following hazard symbols show? This can be done by going through each one on the PowerPoint and students writing their answers on mini whiteboards or using the **Hazard Symbols Match and Draw** worksheet. The answers appear one by one on the following slides or the **Hazard Symbols Match and Draw Answers** can be used for peer- or self-assessment.

Following naming the hazard symbols, students have a go at describing the meaning of each of the hazard symbols. This can be completed on the same **Hazard Symbols Match and Draw** or using mini whiteboards. The answers appear one by one on the following slides or the **Hazard Symbols Match and Draw Answers** can be used for peer- or self-assessment. The match and draw does not include the acute toxicity hazard symbol or the explosive hazard symbol.

Discuss with the class why hazard symbols are so important.

Hazard Symbols in the Lab

Students go around the room and fill in the **Chemicals and Hazards Table**. Bring the class together to discuss their findings. Some may have found more than one hazard symbol on each chemical.

Safety Rules in the Lab

Discuss lab safety rules with the class. Ask the students to look at the pictures and describe the rules. Then ask students to place the rules in order of most important to least. Some students may be able to think of some rules of their own. Ask students to list six of the most important safety rules. To support lower ability students, use the **Safety Rules Worksheet**. The **Safety Rules Answers** can be used to self- or peer-assess.

Problem-Solving

Students read the scenarios and explain, in their own words, what the teacher/student should do. This could be a discussion activity in groups or an independent activity using the **Problem-Solving Worksheet**. Using the answers on the next slide or on the **Problem-Solving Worksheet Answers** students could peer- or self-assess.

Plenary

Hazard Symbols Quiz

Students hold up answers on their mini whiteboards.

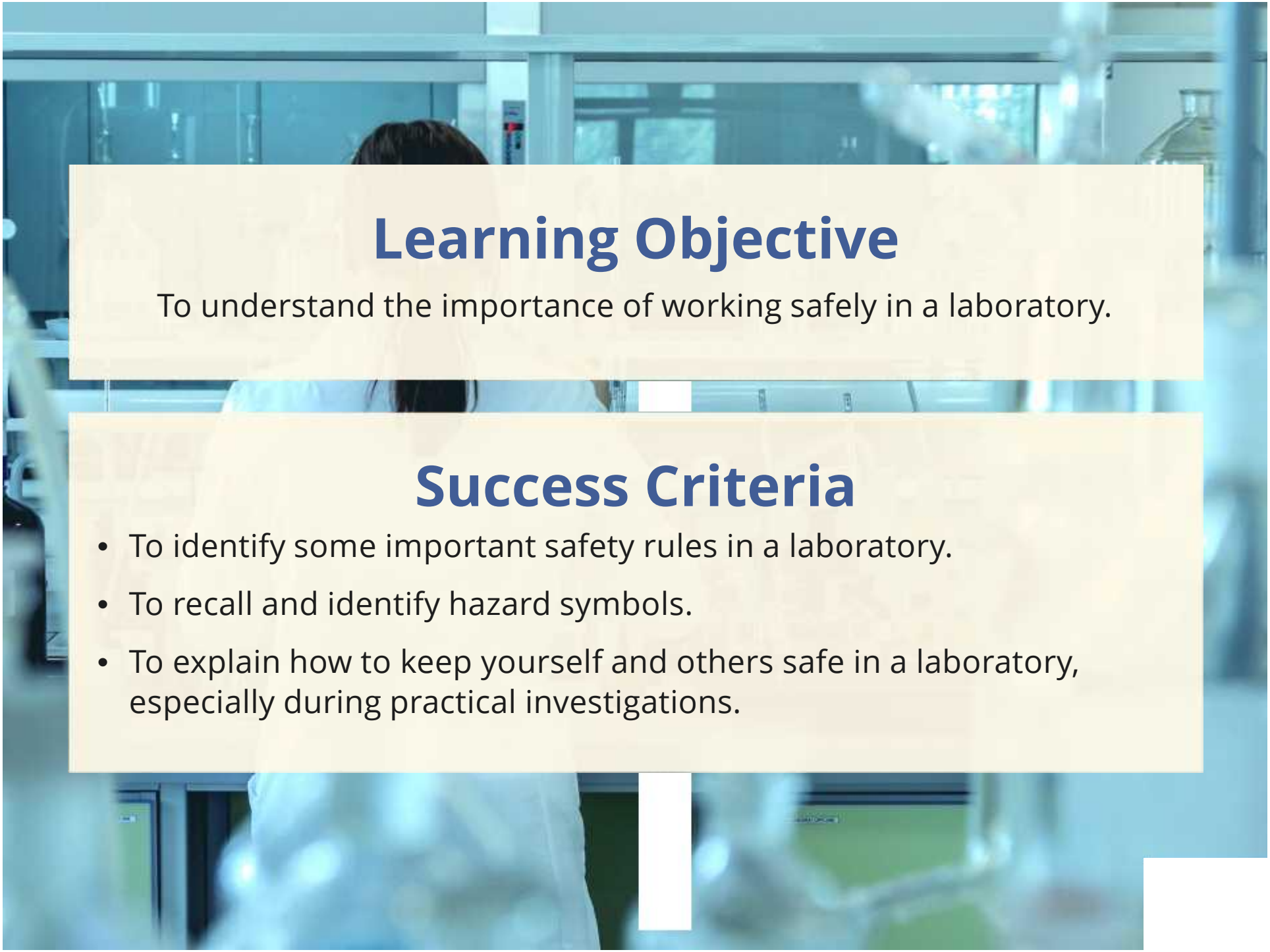
Hazards in the Home

Learning can be extended at home with the Hazards in the Home worksheet. Students must ask a responsible adult to help them find products in the home with hazard symbols on.

Disclaimer

We hope you find the information on our website and resources useful. This resource refers to the use of chemicals. The use of chemicals is potentially hazardous. It is your responsibility to assess whether it is safe to use chemicals in your classroom. You are responsible for ensuring the safe storage, usage, labelling and disposal of chemicals in accordance with COSHH regulations (or equivalent in the country in which you are teaching). We are not responsible for the health and safety of your group or environment and so, insofar as it is possible under the law, we cannot accept liability for any loss suffered by anyone due to the use, storage or disposal of chemicals or any other activity carried out as a result, whether directly or indirectly, of this resource. If you are unsure in any way, we recommend that you take guidance from a suitably qualified professional.

Introduction to Science:
Health and Safety



Learning Objective

To understand the importance of working safely in a laboratory.

Success Criteria

- To identify some important safety rules in a laboratory.
- To recall and identify hazard symbols.
- To explain how to keep yourself and others safe in a laboratory, especially during practical investigations.

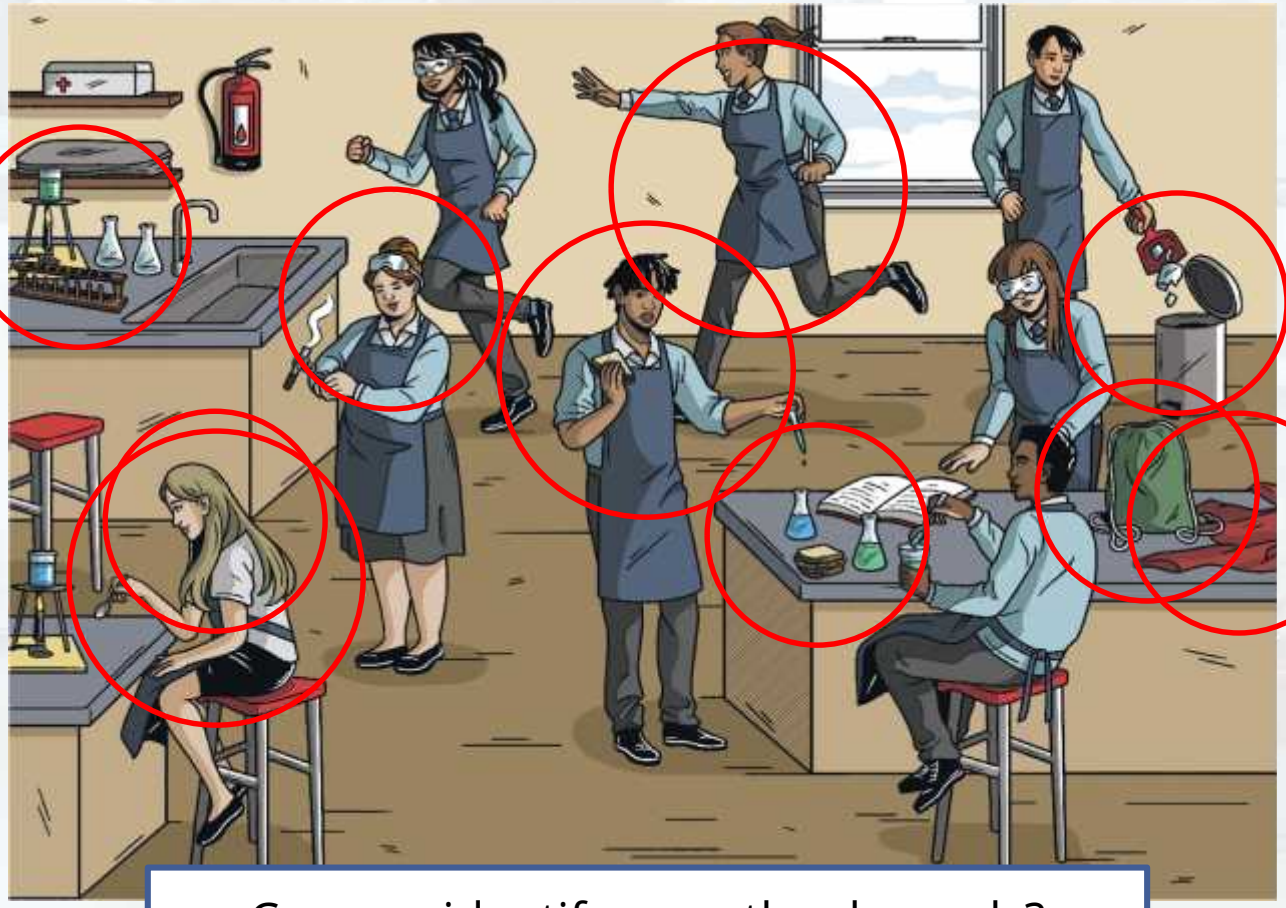
Laboratory Hazards

From the picture below, identify any hazards in the lab.

Extension:
Can you suggest any precautions the students could take to make the lab safer?

Laboratory Hazards

From the picture below, identify any hazards in the lab.



Can you identify any other hazards?

1. running
2. eating
3. sitting down during a practical
4. bags on the desk
5. coats on the desk
6. goggles not covering the eyes
7. unattended practical
8. untied hair
9. putting glass in the bin
10. beakers on the edge of the desk

Why Is Safety So Important?

What do you use a laboratory for and why is safety so important?

Discuss with your table – you have **two** minutes to come up with an answer.

A science laboratory is used for carrying out practical investigations. They can involve using dangerous chemicals and practical equipment such as Bunsen burners.

Some practical equipment, such as test tubes, are easily breakable so care must be taken.

The pupils' and teacher's health and safety are very important so that no one gets hurt.

Hazard Symbols

What do you think the following hazard symbols show?

1

corrosive

2

flammable

3

harmful to the environment

4

serious health hazard

5

moderate health hazard

6

explosive

7

acute toxicity

Hazard Symbols Descriptions

What do you think the following hazard symbols mean?

1

Could burn the skin and damage the eyes. Avoid breathing in vapours.

2

Catches fire when it comes into contact with oxygen and a heat source.

3

Could cause damage to animal and plant life if released into water systems.

4

Could irritate the skin.

5

Could cause illness or death if taken into the body.

Hazard Symbols

Why are hazard symbols so important?

Write down your answers on a mini whiteboard and hold them up.

You have **two** minutes.

They show people how dangerous a chemical is, and what precautions should be taken when handling them.

Extension:

Why use symbols?

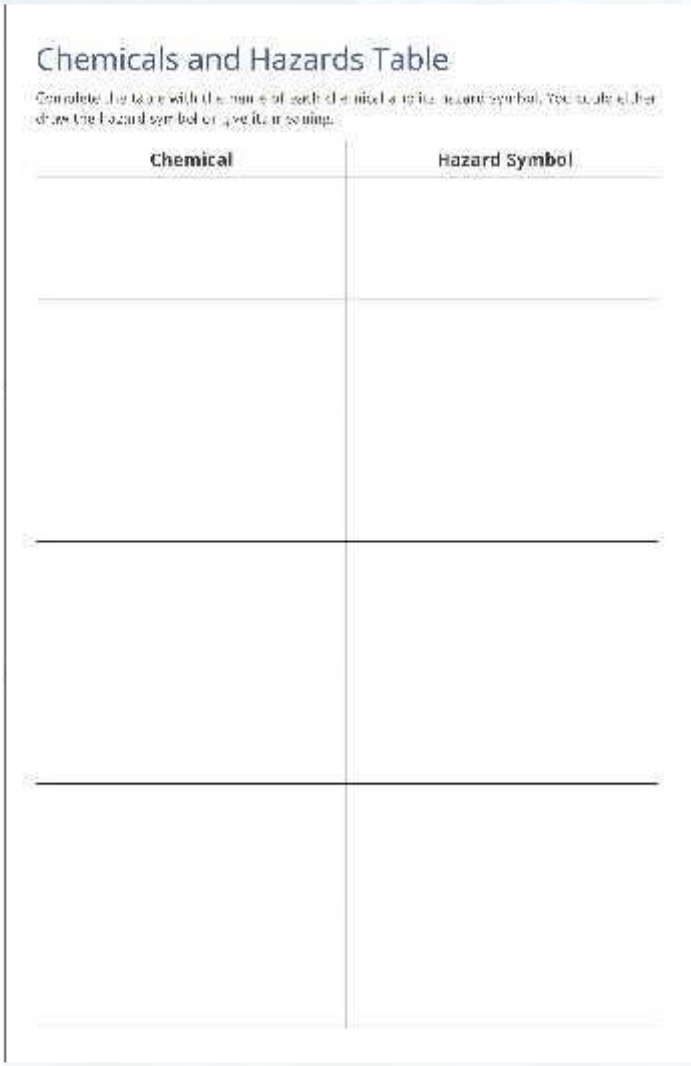
Symbols can be used all over the world and are immediately recognisable, so it doesn't matter which language is used.

Hazard Symbols in the Lab

What hazard symbols can you find around the laboratory?

Complete the table with the name of each chemical and its hazard symbol. You could either draw the hazard symbol or give its meaning.

Extension:
Have you heard of any of these chemicals before? Do you know anything about them?



Chemicals and Hazards Table

Complete the table with the name of each chemical and its hazard symbol. You could either draw the hazard symbol or give its meaning.

Chemical	Hazard Symbol

Safety Rules in the Lab

From the diagrams below, work out what the rules are.

Which rule do you think is the most important in a lab? Put them in order from **most** important to **least** important.

Explain to the person next to you why you have put them in this order.

Extension:
Can you add any of your own rules that are not shown here?

Safety Rules in the Lab

Neatly, list **six** of the most important safety rules in the front of your book.

Problem-Solving

Read the scenarios and explain what the teacher/student should do.

1. You spill a chemical on the desk during a practical. What should you do?

2. You notice a bag in the middle of the floor. What should you do?

3. Your teacher notices a student sitting down at the desk during a practical. What should they do? Why?

4. You feel hungry during a practical. What should you do?

5. You drop a glass beaker on the floor and it breaks. What should you do?

Problem-Solving

Read the scenarios and explain what the teacher/student should do.

1. You spill a chemical on the desk during a practical. What should you do?
   Tell your teacher. Clear it up if they tell you to do so.
2. You notice a bag in the middle of the floor. What should you do?
   Move the bag to either a bag storage area or place under the desk.
3. Your teacher notices a student sitting down at the desk during a practical. What should they do? Why?
   Ask the pupil to stand up and push their chair under the desk. So, if there is a spillage, the pupil can move away more easily.
4. You feel hungry during a practical. What should you do?
   Nothing. Wait until break or lunchtime.
5. You drop a glass beaker on the floor and it breaks. What should you do?
   Tell your teacher. They will brush it up and place it in a glass bin.

Hazards in the Home

Find **five** products around the house that have chemical hazard symbols on them.

Write down the name of the product, the hazard symbol(s) on the product and explain why the product may have these symbols.

A responsible adult must be present!

Did you find any hazard symbols that you did not see in the laboratory?

What do they mean?

Hazard Symbols Quiz

Question 1

What does this hazard symbol mean?

a) corrosive

b) harmful to the environment

c) flammable

Hazard Symbols Quiz

Question 2

What does this hazard symbol mean?

a) corrosive

b) harmful to the environment

c) flammable

Hazard Symbols Quiz

Question 3

What does this hazard symbol mean?

a) corrosive

b) harmful to the environment

c) flammable

Hazard Symbols Quiz

Question 4

What does this hazard symbol mean?

a) flammable

b) moderate health hazard

c) serious health hazard

Hazard Symbols Quiz

Question 5

What does this hazard symbol mean?

a) flammable

b) moderate health hazard

c) serious health hazard

Problem-Solving

1. You spill a chemical on the desk during a practical. What should you do?

2. You notice a bag in the middle of the floor. What should you do?

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Problem-Solving **Answers**

1. You spill a chemical on the desk during a practical. What should you do?

   Tell your teacher. Clear it up if they tell you to do so.

2. You notice a bag in the middle of the floor. What should you do?

   Move the bag to either a bag storage area or place under the desk.

3. Your teacher notices a student sitting down at the desk during a practical. What should they do? Why?

   Ask the pupil to stand up and push their chair under the desk. So, if there is a spillage, the pupil can move away more easily.

4. You feel hungry during a practical. What should you do?

   Nothing – wait until the lesson has finished (break/lunch).

5. You drop a glass beaker on the floor and it breaks. What should you do?

   Tell your teacher. They will brush it up and place it in a glass bin.

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Safety Rules

1. Always wear _____ during a practical.
2. Stand _____ during a practical.
3. Do not _____ or _____ during a practical
4. No _____ around the lab.
5. _____ long hair back.
6. When something gets broken, tell a _____.

Can you think of anything else to add to the list?

7. _____

   _____

8. _____

   _____

9. _____

   _____

10. _____

    _____

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Can you think of anything else to add to the list?

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Can you think of anything else to add to the list?

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5. _____ long hair back.
6. When something gets broken, tell a _____ .

Can you think of anything else to add to the list?

7. _____
8. _____
9. _____
10. _____

Safety Rules **Answers**

1. Always wear **goggles** during a practical.
2. Stand **up** during a practical.
3. Do not **eat** or **drink** during a practical
4. No **running** around the lab.
5. **Tie** long hair back.
6. When something gets broken, tell a **teacher**.

Can you think of anything else to add to the list?
Students will have their own answers. Allow any sensible suggestion.

Safety Rules **Answers**

1. Always wear **goggles** during a practical.
2. Stand **up** during a practical.
3. Do not **eat** or **drink** during a practical
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2. Stand _____ during a practical.
3. Do not _____ or _____ during a practical
4. No _____ around the lab.
5. _____ long hair back.
6. When something gets broken, tell a _____.

Can you think of anything else to add to the list?

7. _____

   _____

8. _____

   _____

9. _____

   _____

10. _____

    _____

Equipment List

- [ ] 1. heatproof mat
- [ ] 2. Bunsen burner
- [ ] 3. tripod
- [ ] 4. gauze
- [ ] 5. measuring cylinder
- [ ] 6. beaker
- [ ] 7. conical flask
- [ ] 8. clamp stand, boss and clamp
- [ ] 9. evaporating basin
- [ ] 10. thermometer
- [ ] 11. boiling tube
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Finding Your Way Around a Laboratory
Teaching Ideas

Learning Objective:
To find your way around the laboratory and recognise some of the equipment used in science lessons.

Success Criteria:

- To find equipment around the laboratory.
- To identify some pieces of scientific equipment.
- To draw and label scientific diagrams of different scientific equipment.

Context
This lesson is part of the Introduction to Science unit of work. Students get to know their way around the laboratory, identify some commonly used scientific equipment and learn how to draw scientific diagrams.

Resources
laboratory equipment, including heatproof mats, Bunsen burners, tripods, gauzes, measuring cylinders, beakers, conical flasks, clamp stands, bosses and clamps, evaporating basins, thermometers, boiling tubes and funnels (enough for one of each per group)

mini whiteboards and pens

Starter

Naming Laboratory Equipment

Students are shown some pictures of equipment that might be used in a scientific experiment. Some of these they may recognise from primary school and some may be new to them. Students are asked to name the pieces of equipment. This could be done in students' books or on mini whiteboards. The answers appear on the following slide one at a time on a click. As an extension, you could ask students to discuss what they think each piece of equipment is used for.

Main Activities

Finding Your Way Around the Lab

Students are given a list of items that they need to find around the laboratory. The **Equipment List** could be laminated for use in multiple lessons. This is a useful exercise to get students used to collecting the equipment that they will need for scientific investigations. This activity works best if students are in groups of three or four and take it in turns to find a piece of equipment on the list and bring it back to their group. This ensures that there are not too many students moving around the classroom at the same time. While the other students in the group are waiting for their turn, they could be thinking about what each piece of equipment could be used for. The equipment list is displayed on the following slide for you to go through each piece of equipment with the class should you wish to do so.

Setting Up an Experiment

Students are asked to set up an experiment that would allow them to find out the boiling point of water, using the equipment that they have collected. A hint appears on the slide on a click to tell students that they need to use six of the pieces of equipment. For any students that are struggling, you could tell them the first three pieces of equipment that are required and ask them to work out which other three they might need. An illustration of the practical set-up is displayed on the following slide. Labels for each piece of equipment appear on a click. You could call on students to tell you the name of each piece of equipment as a recap before showing the labels.

Scientific Diagrams

The slide shows an illustration of a beaker alongside a scientific diagram of a beaker. Students are asked to discuss why a scientific diagram might be useful. An answer appears on the slide on a click. Students are then given a set of **Scientific Diagram Cards** to match to the pieces of equipment on their desk. There is also a **Naming Scientific Diagrams Worksheet** which students can complete as a record of their learning. Following this, you could ask students to draw a scientific diagram of their boiling water practical set-up. They should do this in their book and label the pieces of equipment, using a ruler to draw straight lines. The correct scientific diagram appears on the slide on a click.

Note: There are two scientific diagrams for a Bunsen burner included on the **Scientific Diagram Cards** and **Naming Scientific Diagrams Worksheet**. The more detailed diagram is often used in exam questions so students should be able to recognise it, but it is generally easier for students to simply draw an arrow with the word 'heat' below it for their own diagrams.

Plenary

Scientific Diagrams

Each slide shows a scientific diagram. Students must name the piece of equipment from the diagram. This could be done on mini whiteboards or students could hold up the piece of equipment if they still have these in front of them from earlier in the lesson. The answers appear on each slide on a click.

Home Learning

Uses of Scientific Equipment

Students can complete the **Scientific Equipment Homework Sheet** to recap their learning from the lesson and to record the uses of some pieces of equipment.

Finding Your Way Around a Laboratory

Learning Objective

To find your way around the laboratory and recognise some of the equipment used in science lessons.

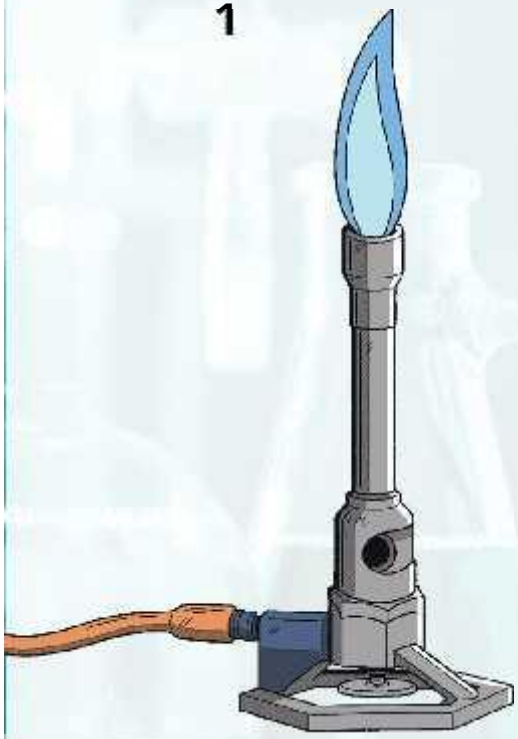
Success Criteria

- **To find equipment around the laboratory.**
- **To identify some pieces of scientific equipment.**
- **To draw and label scientific diagrams of different scientific equipment.**

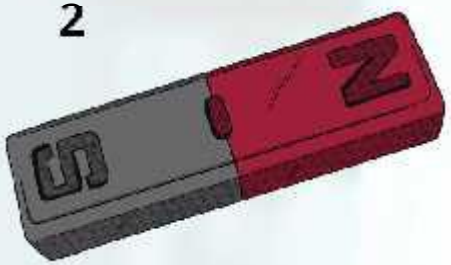
Laboratory Equipment

Can you name any of the pieces of scientific equipment below?

1

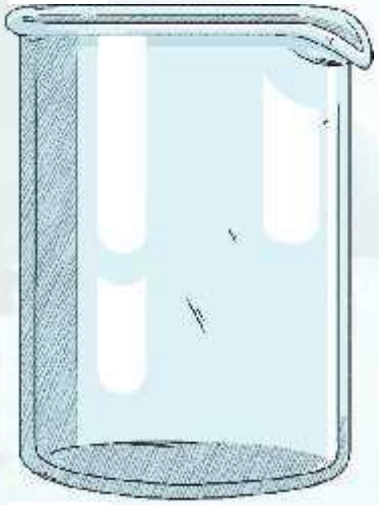


2

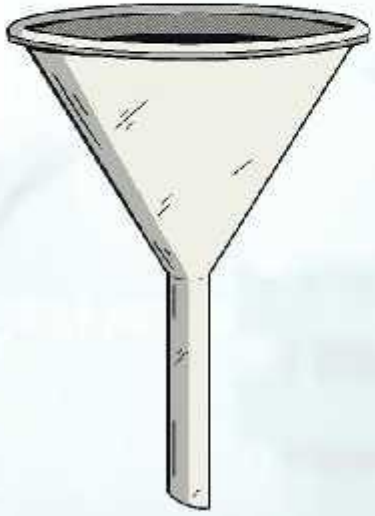


3

4



5

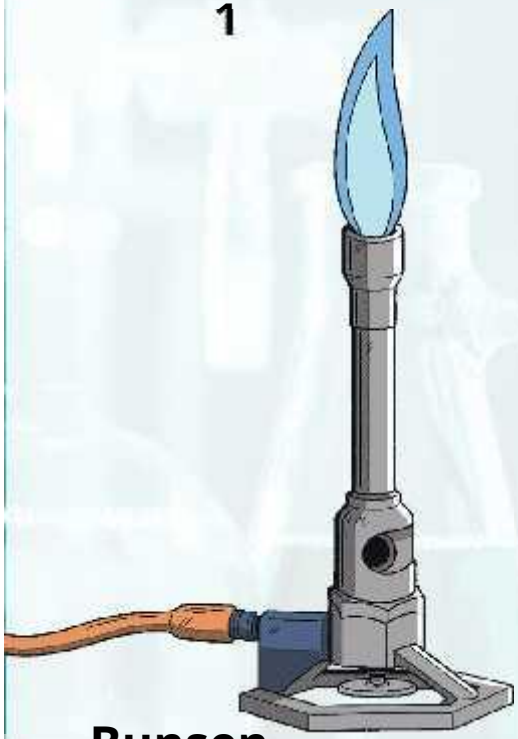


6

Laboratory Equipment

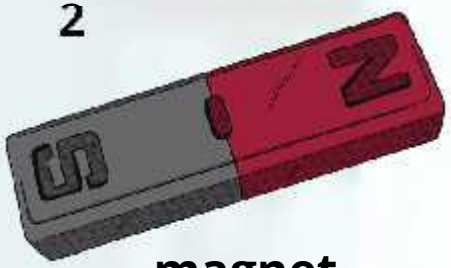
Can you name any of the pieces of scientific equipment below?

1



Bunsen burner

2

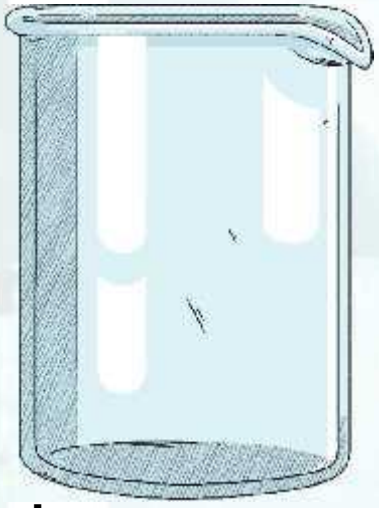


magnet

3

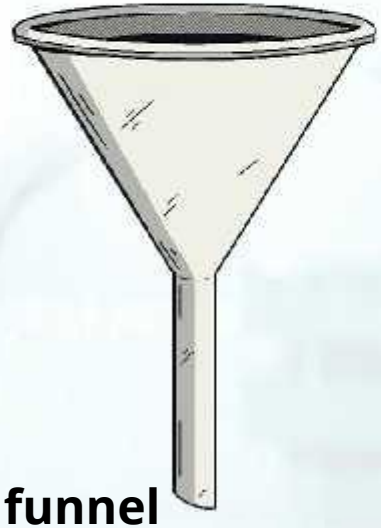
balance

4



beaker

5



funnel

6

thermometer

Finding Your Way Around the Lab

When carrying out a scientific investigation, you need to be able to find all the equipment required.

In front of you is an equipment list. In your groups, take it in turns to go and find one of the pieces of equipment and bring it back to your desk. Tick the items off the list as you find them.

While you are waiting for your turn, see if you can figure out what each piece of equipment might be used for.

Finding Your Way Around the Lab

Equipment List

1. heatproof mat
2. Bunsen burner
3. tripod
4. gauze
5. measuring cylinder
6. beaker
7. conical flask
8. clamp stand, boss and clamp
9. evaporating basin
10. thermometer
11. boiling tube
12. funnel

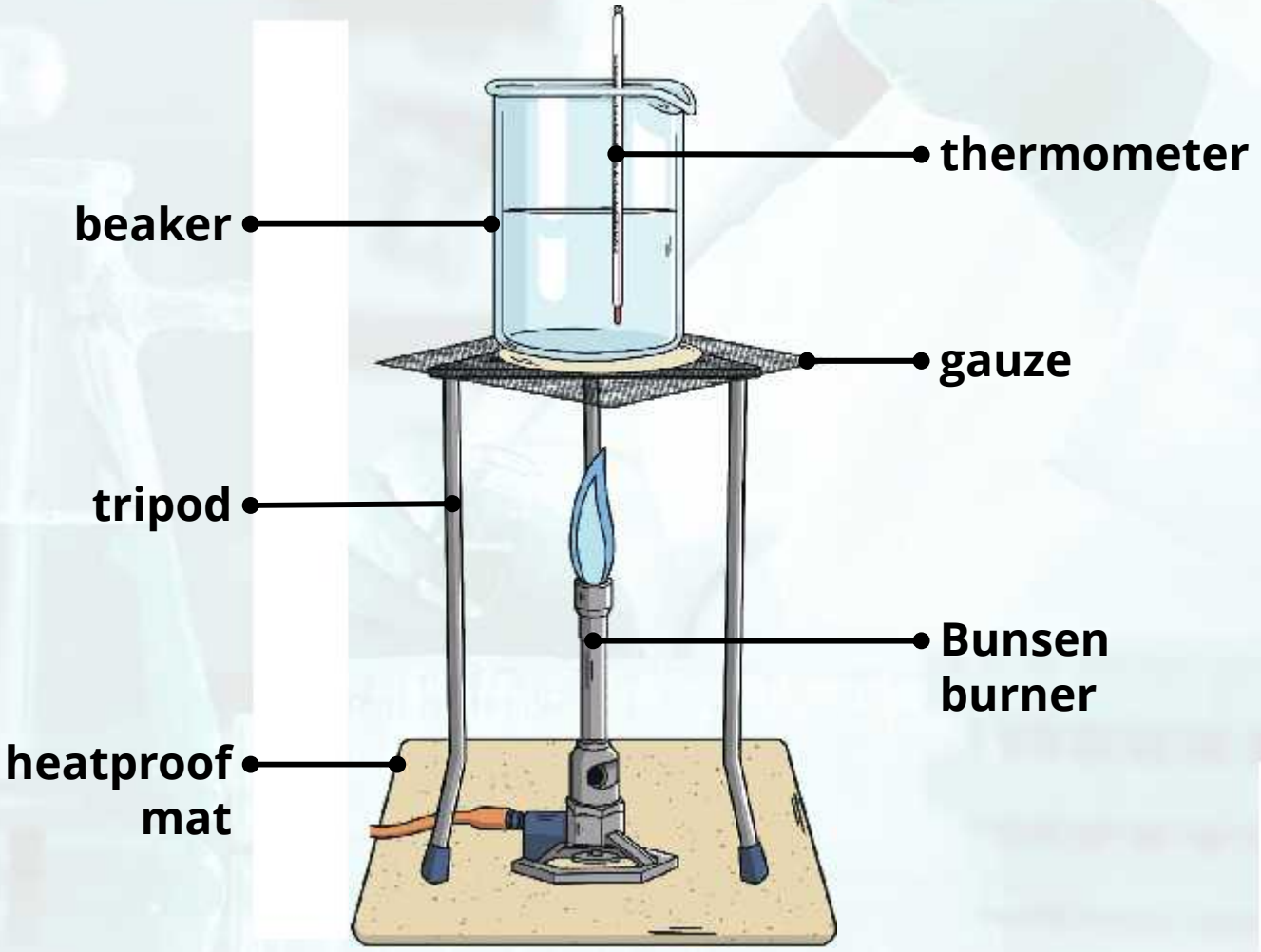
Setting Up an Experiment

Using the equipment that you have collected, set up an experiment that would allow you to find out the boiling point of water.

Hint: You will need to use six pieces of equipment.

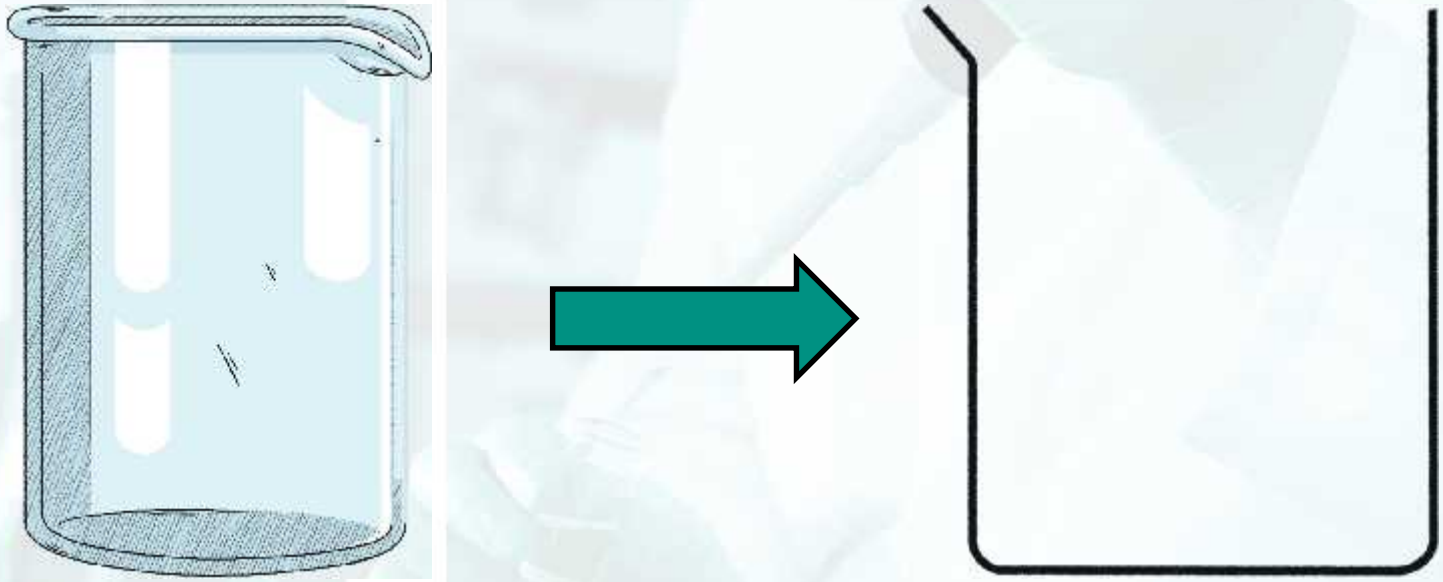
Setting Up an Experiment

Using the equipment that you have collected, set up an experiment that would allow you to find out the boiling point of water.



Scientific Diagrams

Scientific diagrams can be used to represent scientific equipment.

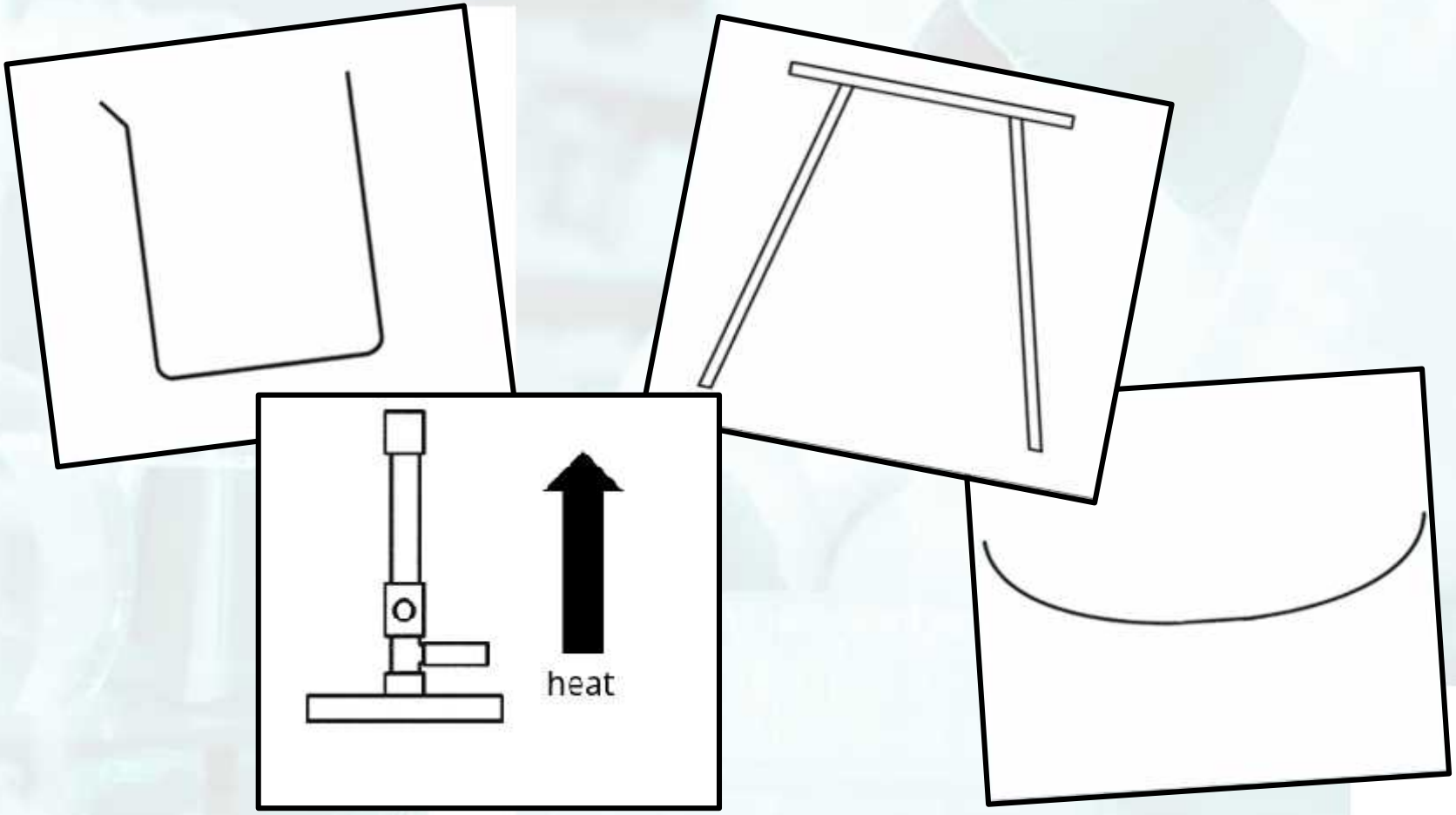


Why do you think a scientific diagram is useful?

To make it simpler to draw and easier to identify each piece of equipment.

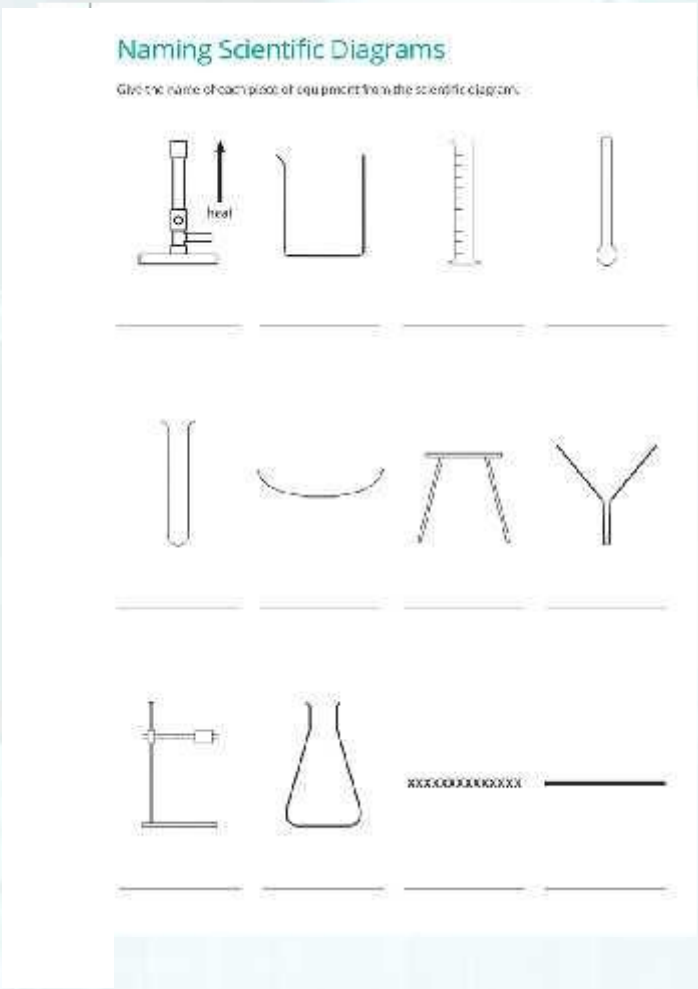
Scientific Diagrams

Match each card with the correct piece of equipment in front of you.



Scientific Diagrams

Complete the worksheet by giving the name of each piece of equipment from the scientific diagram.



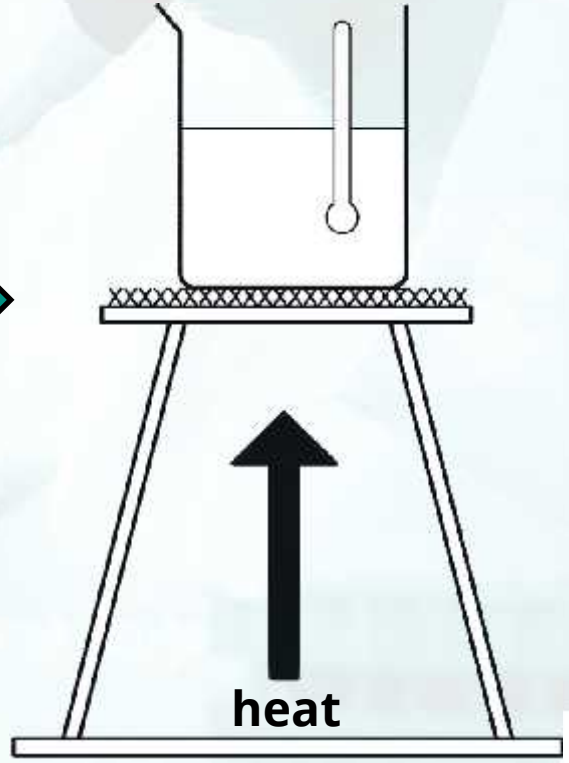
Drawing Scientific Diagrams

There are some rules to remember when drawing scientific diagrams:

- **Use a sharp pencil.**
- **Use a ruler to draw straight lines.**
- **Do not include any shading or colour.**
- **Label each piece of equipment neatly with a straight line.**

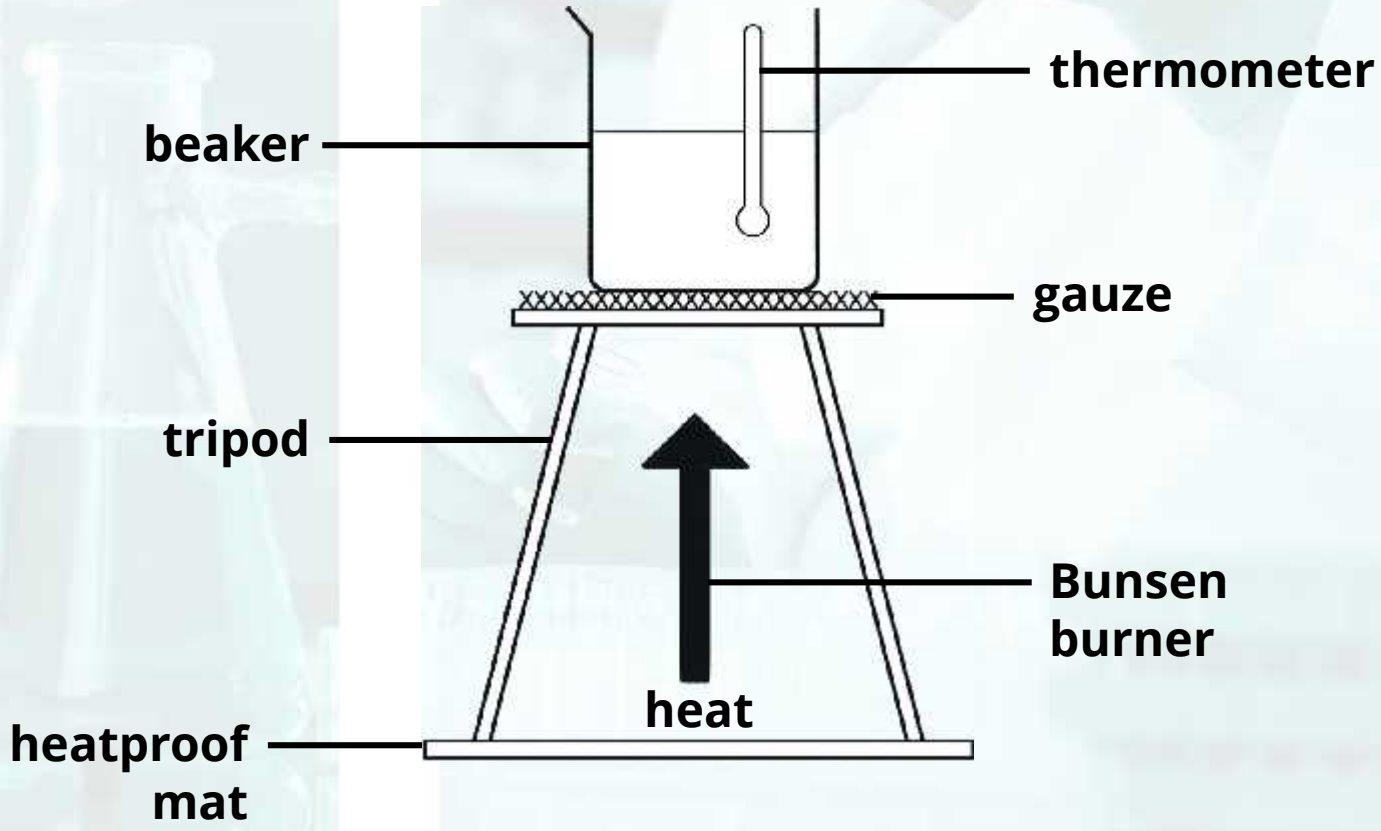
Drawing Scientific Diagrams

Draw a scientific diagram of the experiment that you set up to find the boiling point of water.



Drawing Scientific Diagrams

Draw a scientific diagram of the experiment that you set up to find the boiling point of water.



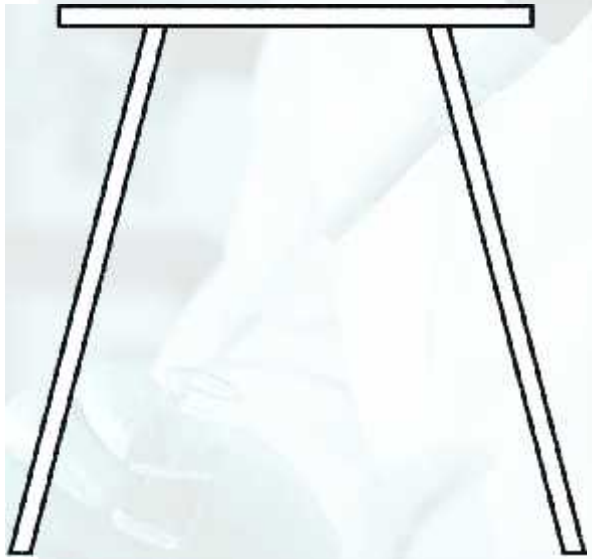
Quick Quiz

Identify the piece of equipment from the scientific drawing.

beaker

Quick Quiz

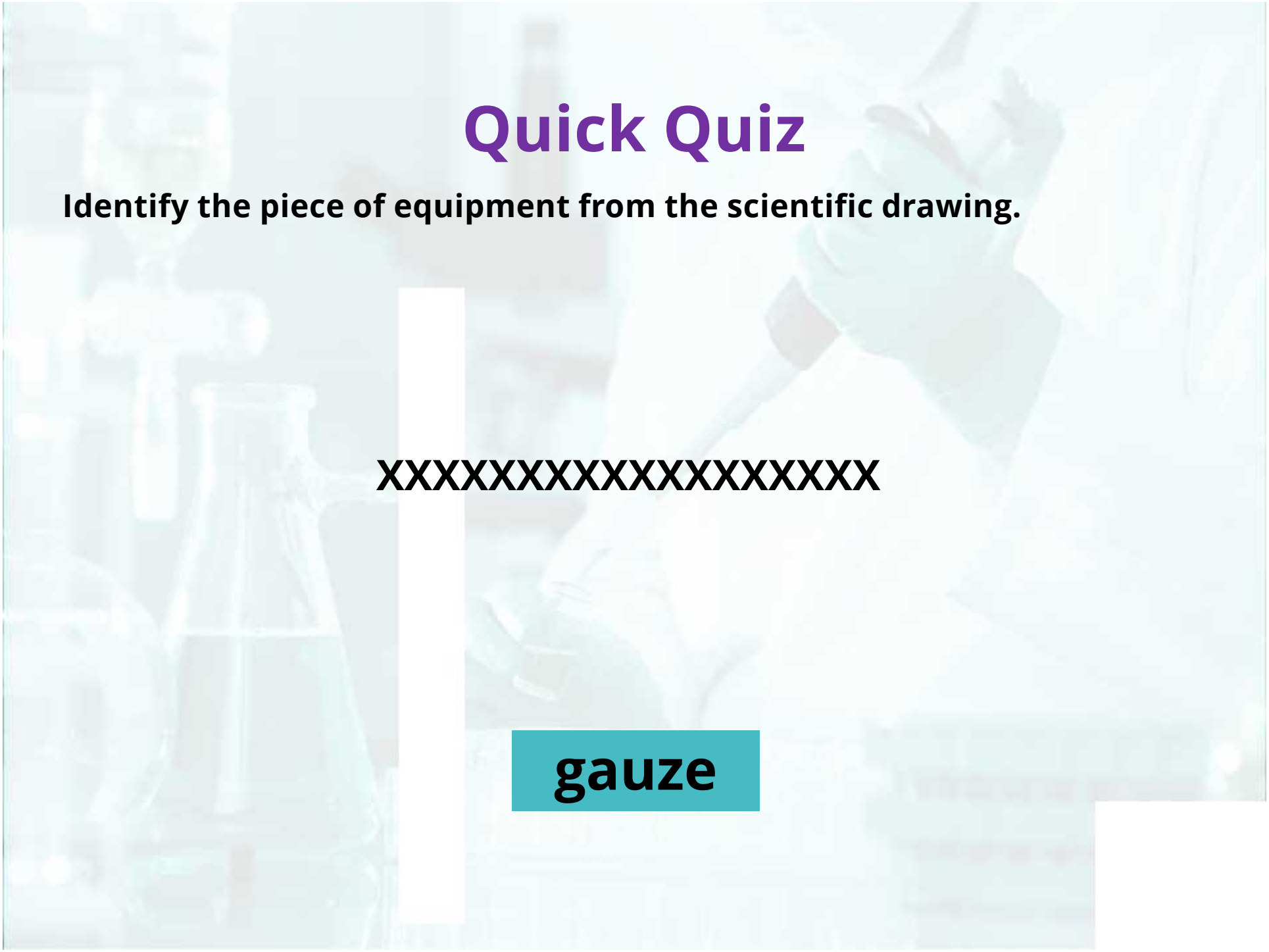
Identify the piece of equipment from the scientific drawing.



tripod

Quick Quiz

Identify the piece of equipment from the scientific drawing.



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gauze

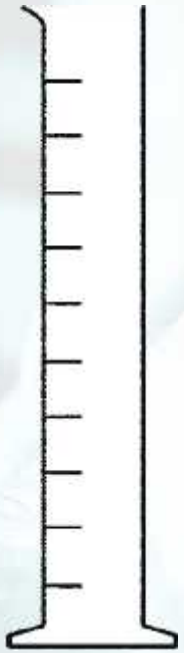
Quick Quiz

Identify the piece of equipment from the scientific drawing.

conical flask

Quick Quiz

Identify the piece of equipment from the scientific drawing.



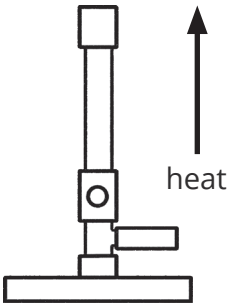
measuring cylinder

Quick Quiz

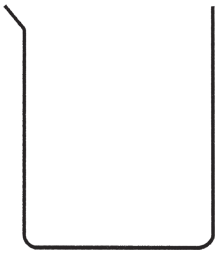
Identify the piece of equipment from the scientific drawing.

funnel

Naming Scientific Diagrams **Answers**



Bunsen burner



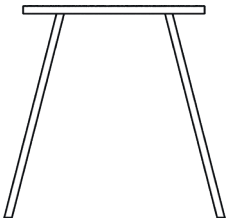
beaker

measuring cylinder

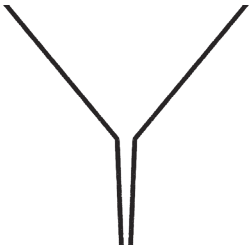
thermometer

boiling tube

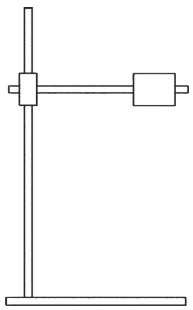
evaporating basin



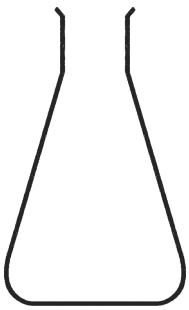
tripod



funnel



clamp stand, boss and clamp



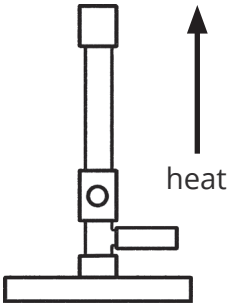
conical flask

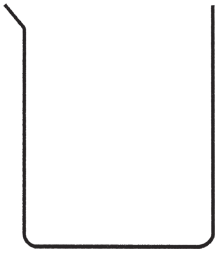
gauze

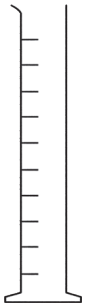
heatproof mat

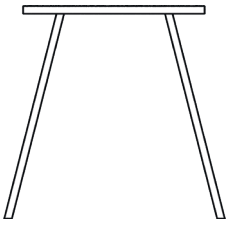
Naming Scientific Diagrams

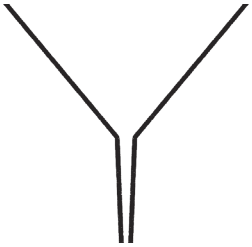
Give the name of each piece of equipment from the scientific diagram.

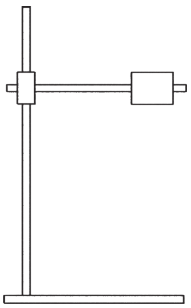


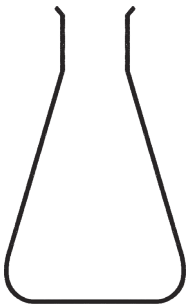












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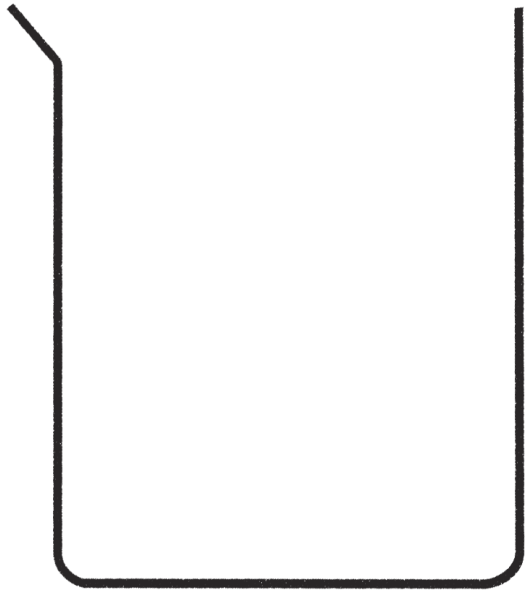
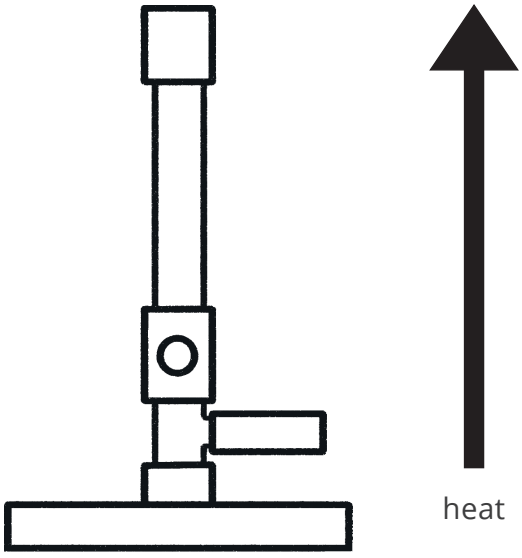
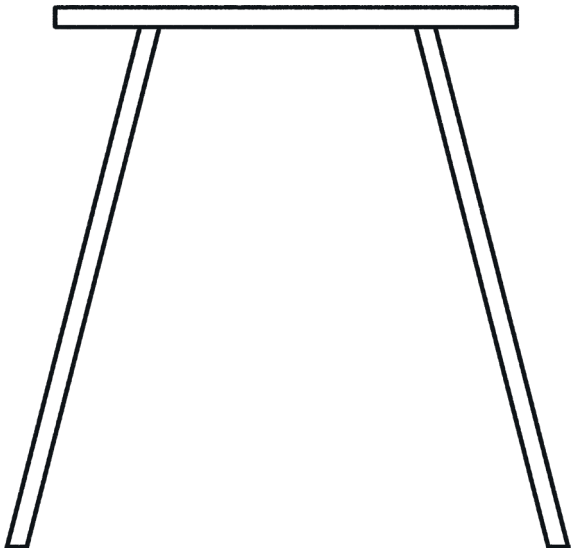
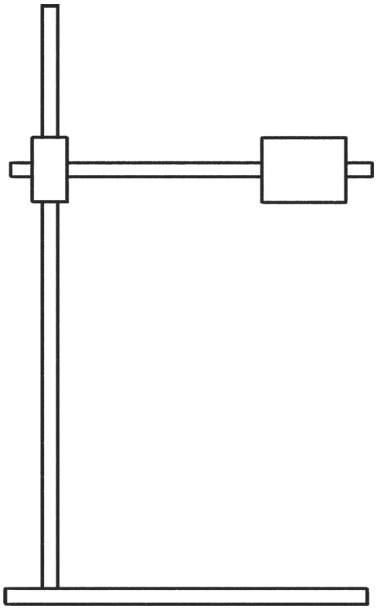
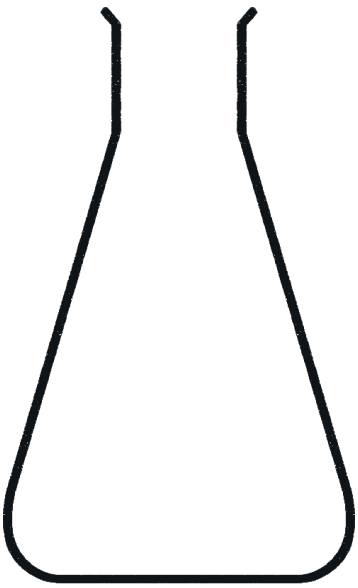
Scientific Diagram **Cards**

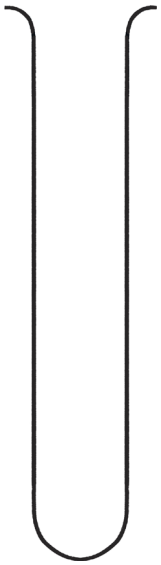
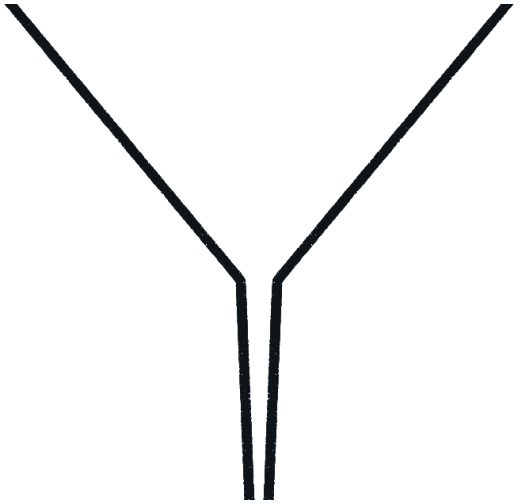
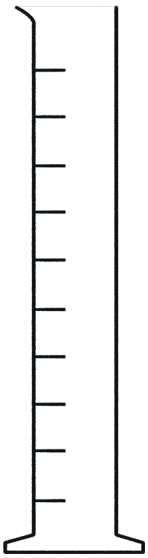






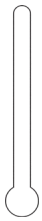




	
	
	XXXXXXXXXXXXXXXXXXXXXXXXXXX

Scientific Equipment

Name six pieces of scientific equipment. For each piece of equipment, draw a scientific diagram and describe what it is used for. An example has been included for you.

Equipment	Scientific Diagram	Use
thermometer		measuring temperature

Boiling Water **Results Table**

Time (seconds)	Temperature (°C)

Boiling Water **Results Table**

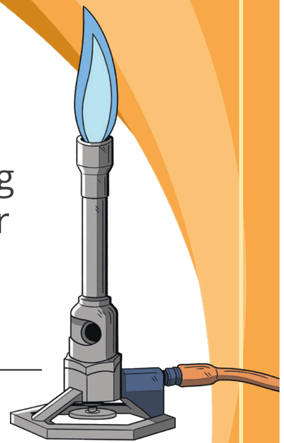
Time (seconds)	Temperature (°C)

Bunsen Burner Licence

____

has completed the Bunsen burner training course and is able to use a Bunsen burner safely in a laboratory. **Well Done!**

Signed ____________________ Dated __________



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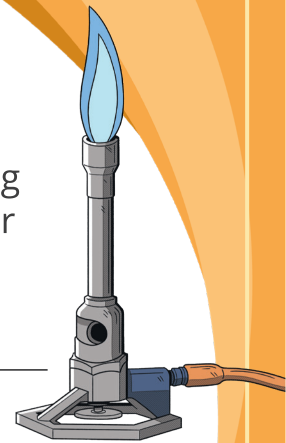

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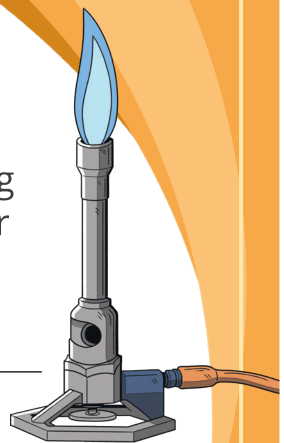

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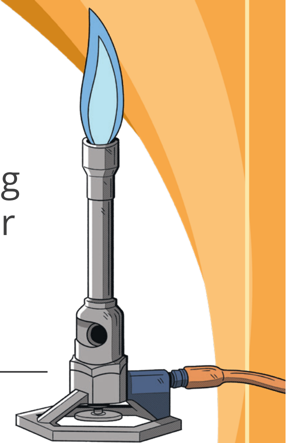


Bunsen Burner **Bingo**

Bunsen Burner **Bingo**

Bunsen Burner **Bingo**

Bunsen Burner **Bingo**

Bunsen Burner **Bingo**

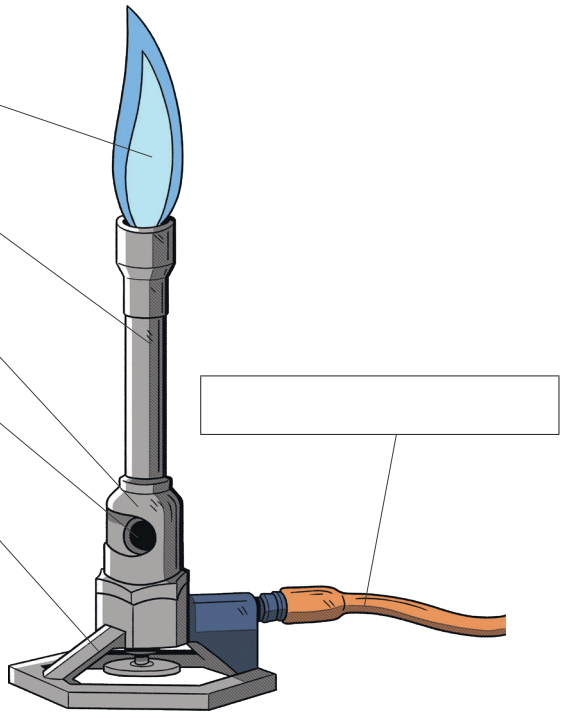
Bunsen Burner **Bingo**

The Bunsen Burner

Label the Bunsen burner using the key words.

Key words

a) collar
b) tubing
c) air hole
d) roaring flame
e) chimney
f) base



What does the air hole do?

What colour is the safety flame?

Why is it called the safety flame?

The Bunsen Burner

Label the Bunsen burner using the key words.

Key words

a) collar
b) tubing
c) air hole
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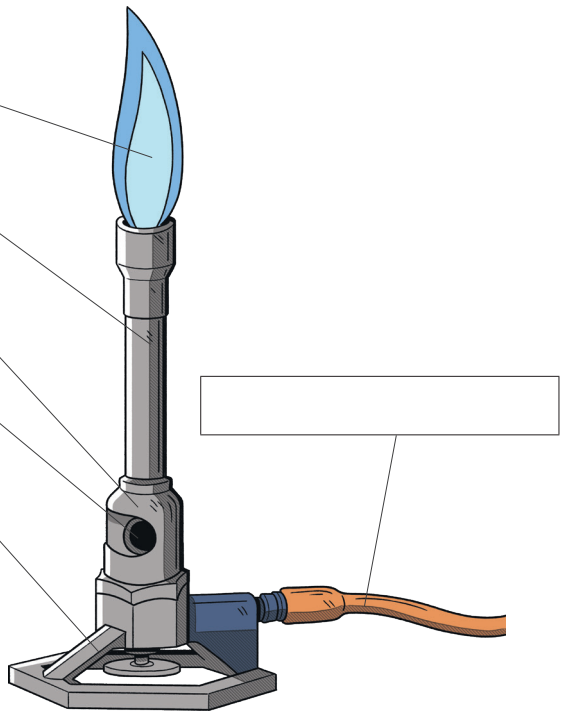


What does the air hole do?

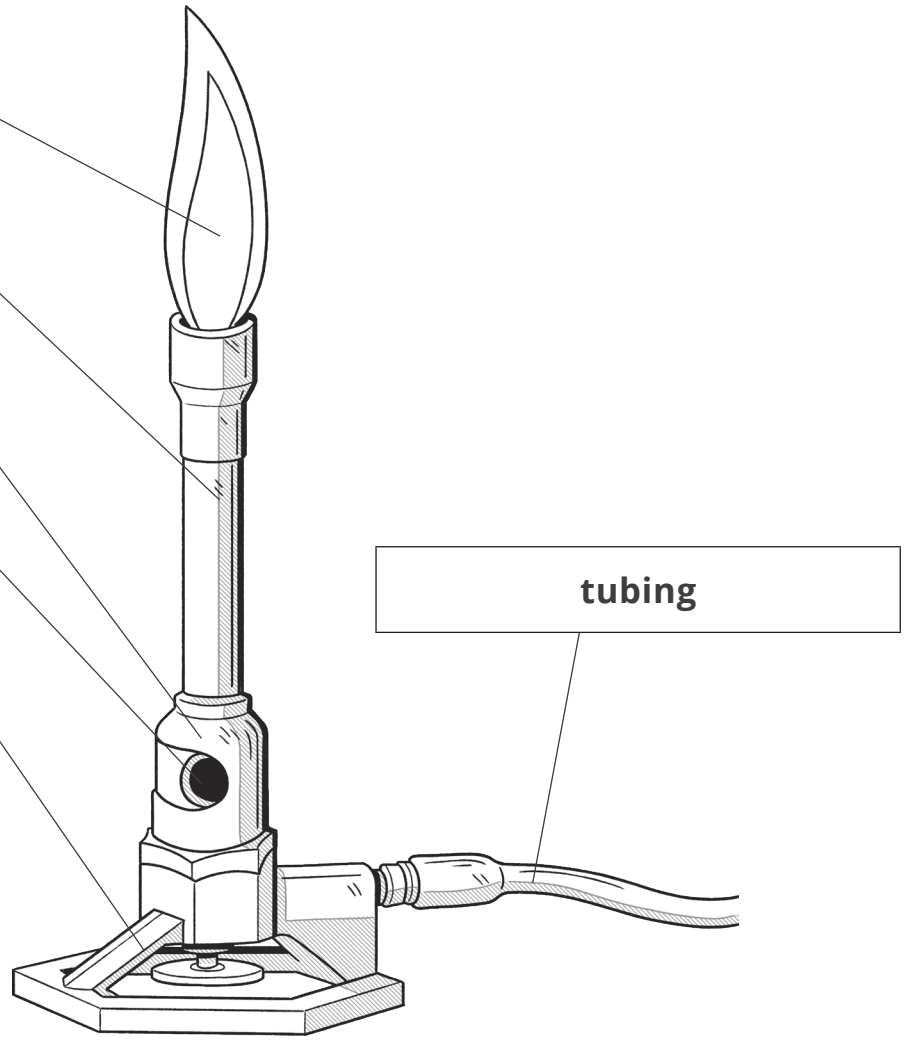
What colour is the safety flame?

Why is it called the safety flame?

The Bunsen Burner **Answers**

Key words

a) collar
b) tubing
c) air hole
d) roaring flame
e) chimney
f) base



What does the air hole do?

When the air hole is open, more oxygen enters the Bunsen burner, making a roaring flame. If the air hole is closed less oxygen will enter the Bunsen burner, making a safety flame.

What colour is the safety flame?

yellow

Why is it called the safety flame?

Because you can see the flame more easily when the Bunsen burner is not in use.

The Bunsen Burner

Label the Bunsen burner using the key words.

Key words

a) collar
b) tubing
c) air hole
d) roaring flame
e) chimney
f) base

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b

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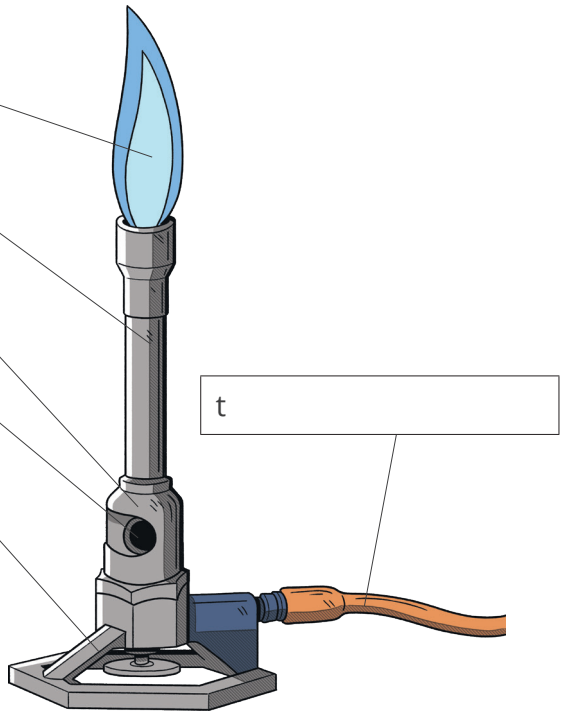

What does the air hole do?

_____

What colour is the safety flame?

_____

Why is it called the safety flame?

_____

The Bunsen Burner

Label the Bunsen burner using the key words.

Key words

a) collar
b) tubing
c) air hole
d) roaring flame
e) chimney
f) base

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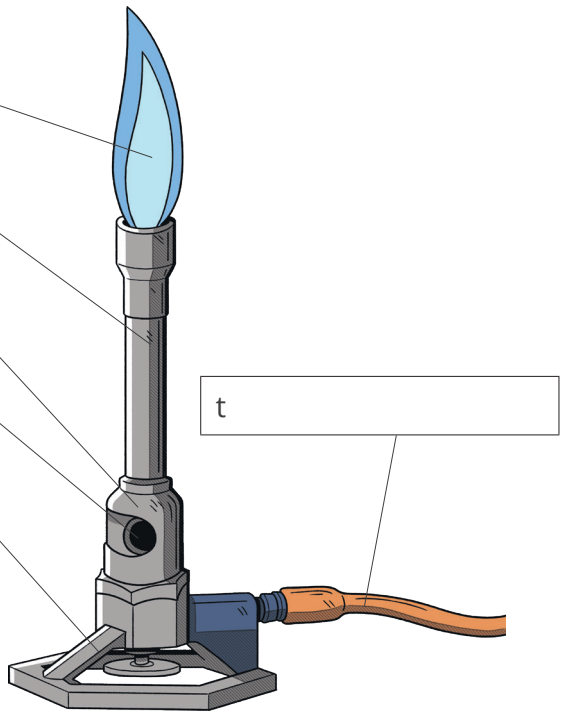


What does the air hole do?

_____

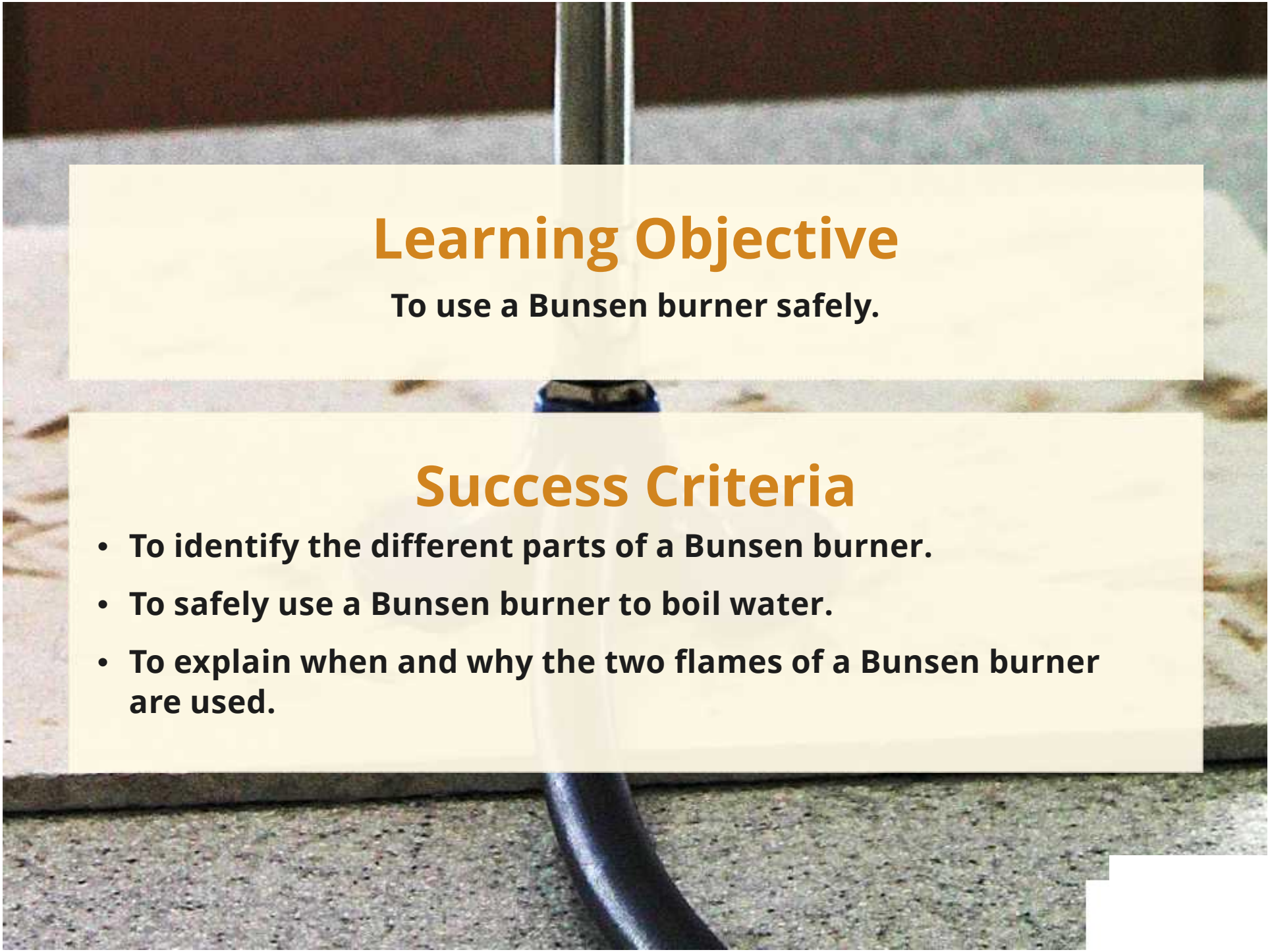
What colour is the safety flame?

_____

Why is it called the safety flame?

_____

Using a Bunsen Burner



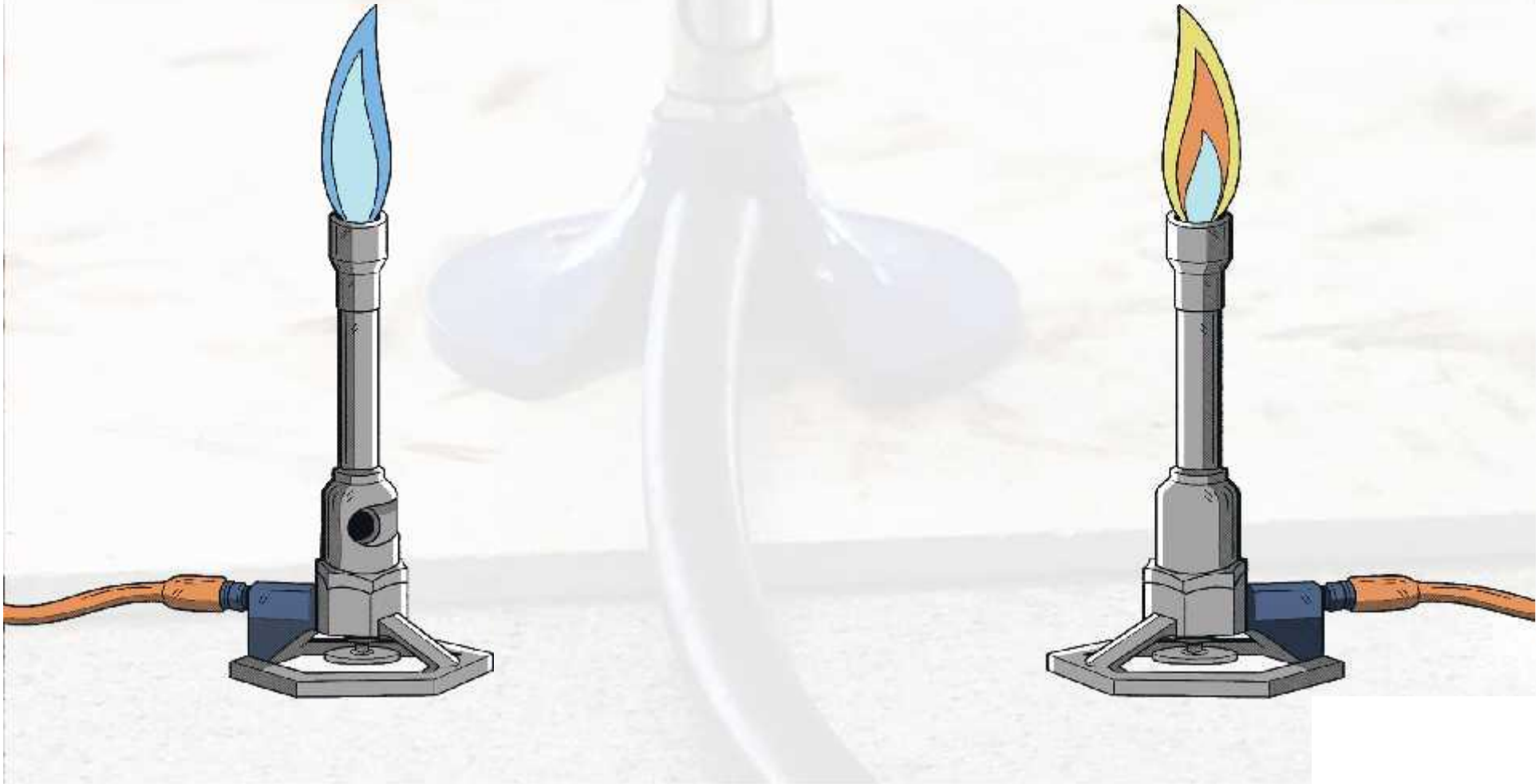
Learning Objective

To use a Bunsen burner safely.

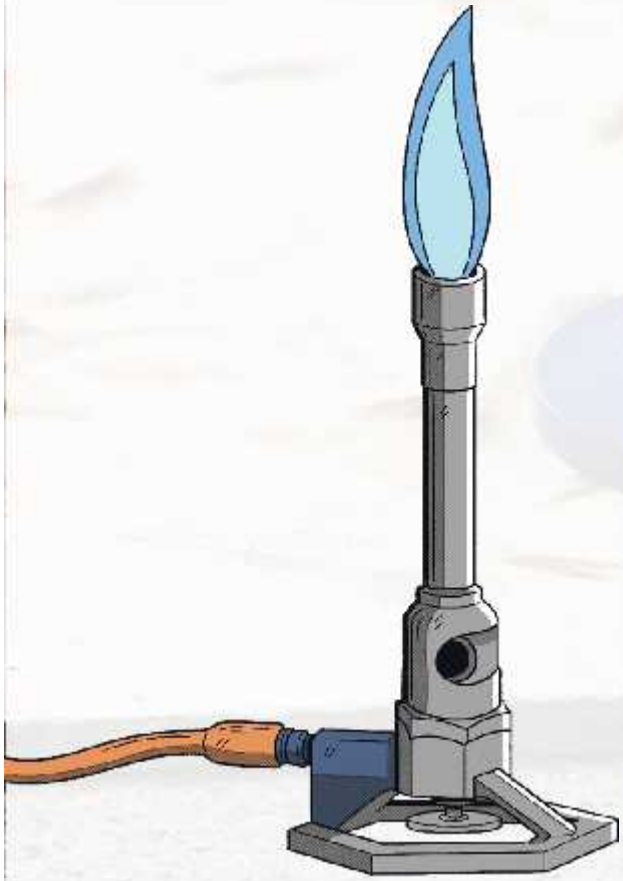
Success Criteria

- **To identify the different parts of a Bunsen burner.**
- **To safely use a Bunsen burner to boil water.**
- **To explain when and why the two flames of a Bunsen burner are used.**

What Are the Differences between the Two Pictures?



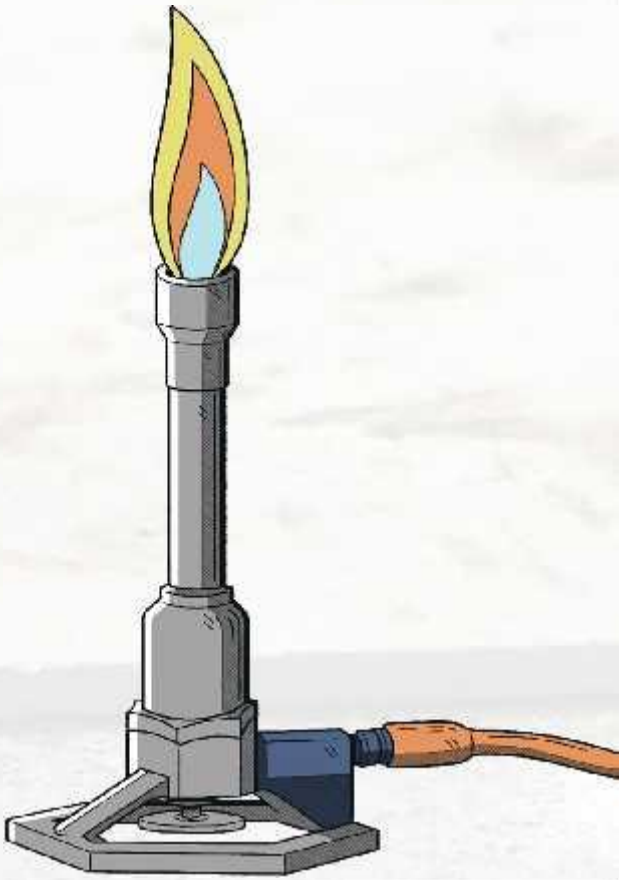
What Are the Differences between the Two Pictures?



One has a blue flame the other has a yellow flame.

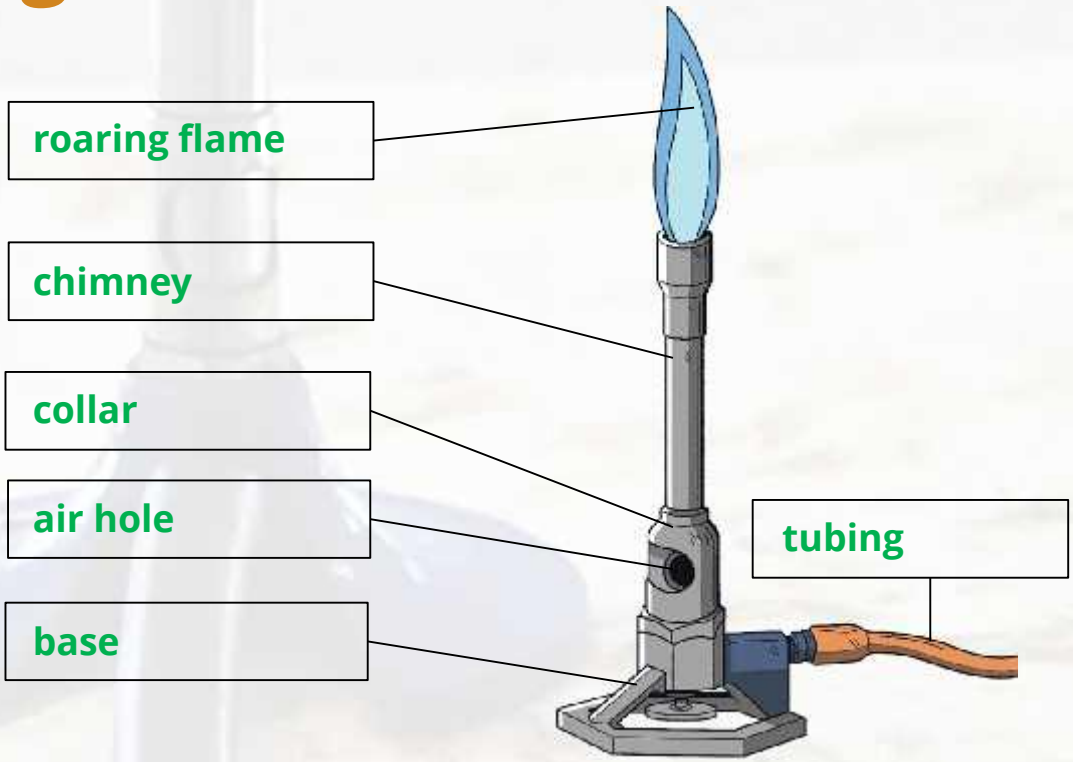
One has an open hole near the bottom and the other does not.

Now carefully watch the demonstration of the correct use of a Bunsen burner.



Label the Diagram of a Bunsen Burner

Key words
- collar
- tubing
- air hole
- roaring flame
- yellow flame
- chimney
- base



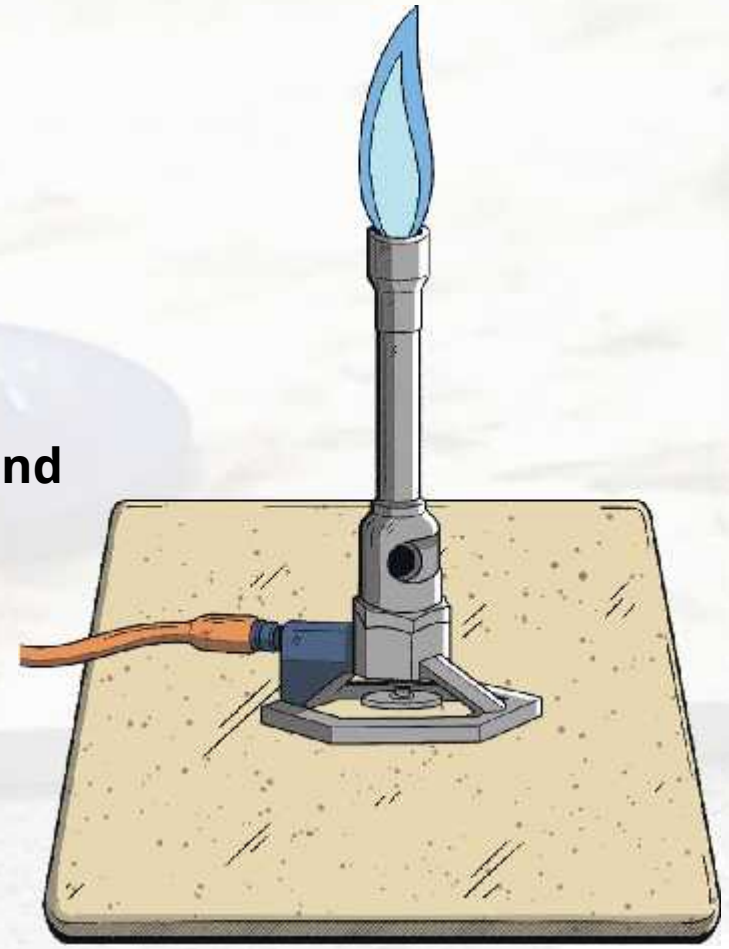
Extension

1. What does the air hole do?
   When the air hole is open more oxygen enters the Bunsen burner, making a roaring flame. If the air hole is closed less oxygen will enter the Bunsen burner, making a safety flame.
2. What colour is the safety flame?
   yellow
3. Why is it called the safety flame?
   Because you can see the flame more easily when the Bunsen burner is not in use.

Using a Bunsen Burner

What safety precautions do we need to put in place when we use a Bunsen burner?

- stand up
- wear eye protection
- tie hair back
- put bags away
- tuck ties in



Soon, you will collect a Bunsen burner and a heatproof mat.

Why do we need a heatproof mat?

To prevent the Bunsen burner from burning the desk.

Using a Bunsen Burner

1. Place the heatproof mat underneath the Bunsen burner.
2. Attach your Bunsen burner to a gas tap. (Do not turn the gas tap on.)
3. Make sure the air hole is closed by turning the collar.
4. When your teacher has checked that your Bunsen burner is set up correctly it may be lit.
5. Very carefully only holding the collar and the tubing, turn the collar to open and close the air hole.
6. Observe the colour and the sound of the flame when the air hole is open, half open and closed. Record your observations.

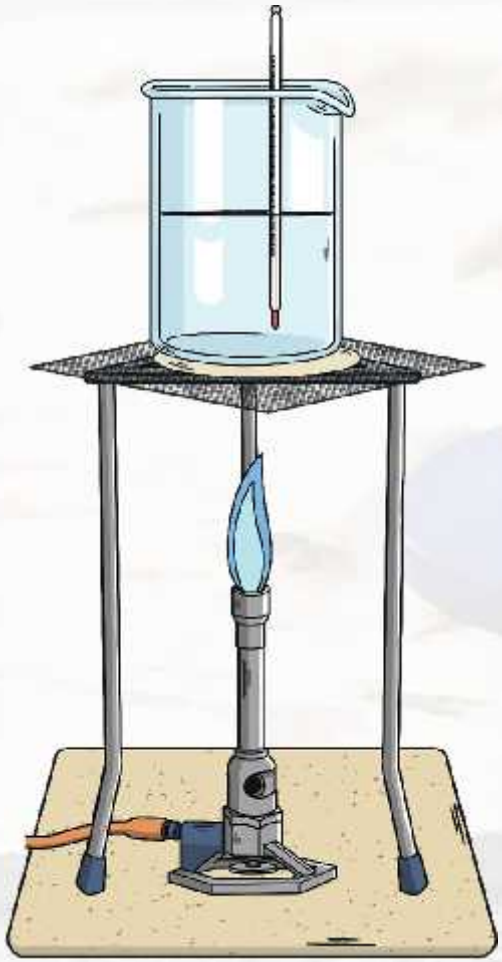
Important!

You must wear eye protection at all times.

Using a Bunsen Burner Observations

	Colour of the Flame	Sound of the Flame	When Is It used?	Amount of Oxygen
Air Hole Open	blue	noisy /roaring	to heat things quickly	lots
Air Hole Half Open	blue	quite noisy	to heat things slowly	a little
Air Hole Fully Closed	yellow	quiet	for safety, when the Bunsen burner is not in use	very little

Using a Bunsen Burner to Boil Water



Set up your equipment as shown.

Equipment list:

- **Bunsen burner**
- **tripod**
- **gauze**
- **heatproof mat**
- **beaker**
- **thermometer**
- **timer**

1. **Measure the starting temperature of the water.**
2. **Light your Bunsen burner and start a timer.**
3. **Record the temperature of the water every 30 seconds.**

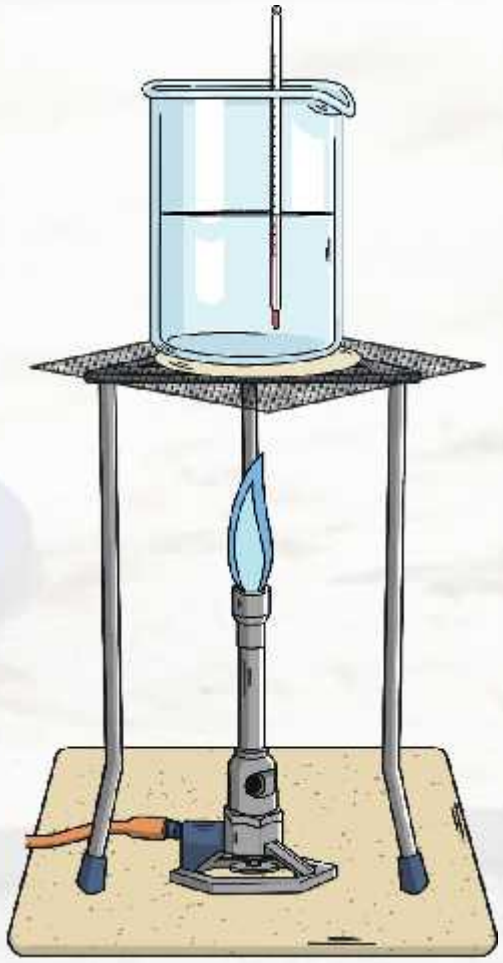
How will you know when the water is boiling?

The water will start to bubble and reach 100°C.

Record your results in a table.

Boiling Water Results Table

Time (seconds)	Temperature (℃)
0	
30	
60	
90	
120	
150	
180	
210	



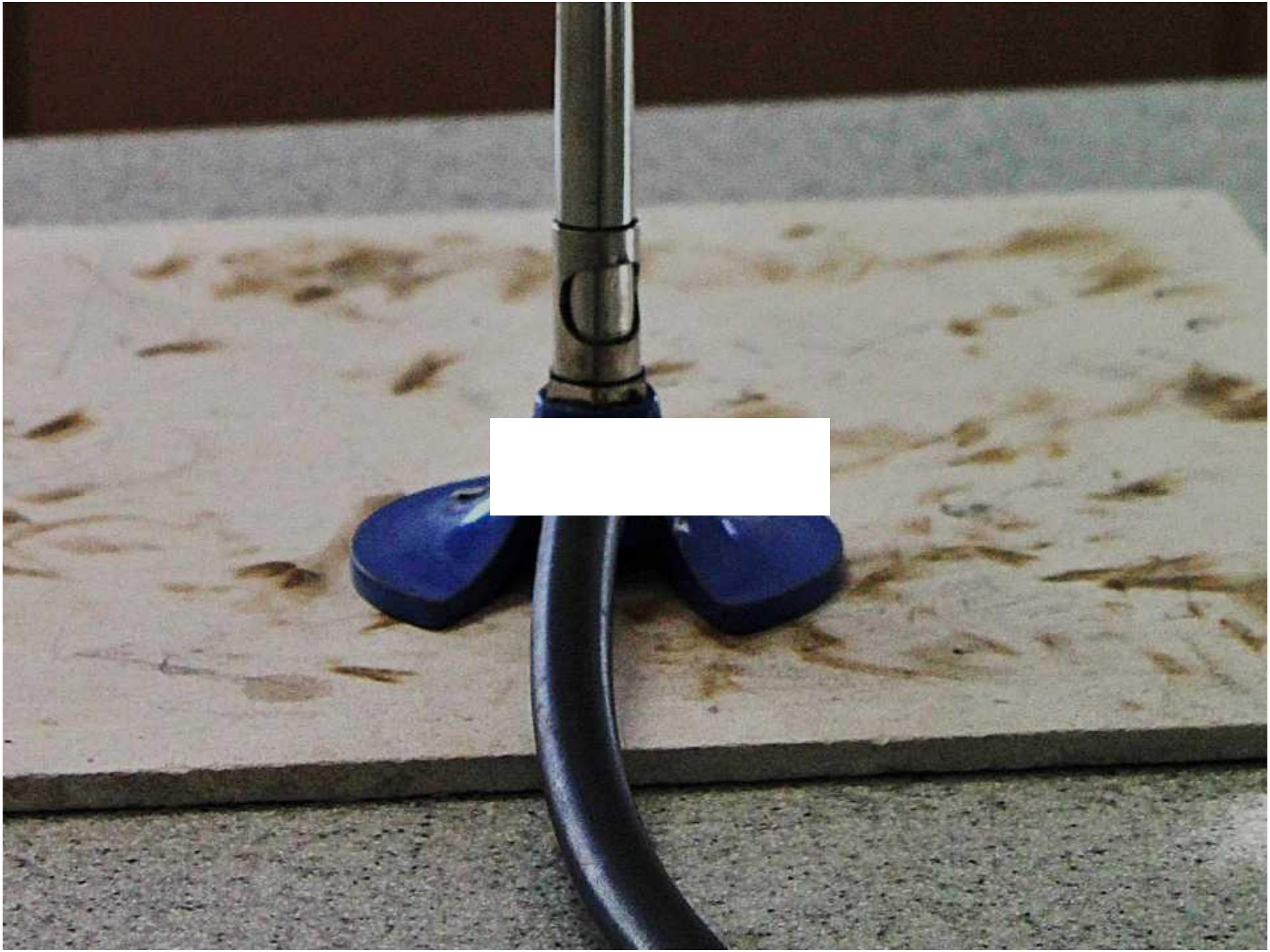
Important!

Turn off your Bunsen burner as soon as the water reaches 100℃.

Key Word Bingo

- Bunsen burner
- flame
- roaring flame
- safety flame
- collar
- base
- oxygen
- air hole
- yellow
- blue
- tubing
- gas tap

Add one word to each box.



Using a Bunsen Burner
Teaching Ideas

Learning Objective:
To use a Bunsen burner safely.

Success Criteria:

- To identify the different parts of a Bunsen burner.
- To safely use a Bunsen burner to boil water.
- To explain when and why the two flames of a Bunsen burner are used.

Context
This lesson is part of the Introduction to Science unit of work for year 7. This lesson follows on from the Health and Safety and Laboratory and Equipment lessons.

Resources (per group)
Bunsen burners, heatproof mat, beaker, timer, thermometer, tripod, gauze, water

Starter

What Are the Differences between the Two Pictures?

Ask students to describe the differences between the two Bunsen burners on the PowerPoint. They can work in pairs or independently. Go through the answers as a class.

Introduce the students to the different parts of the Bunsen burner. Demonstrate how to light the Bunsen burner and how to change the flame between roaring flame and safety flame by turning the collar.

Main Activities

Label the Diagram of a Bunsen Burner

From your demonstration, can the students independently label the diagram of a Bunsen burner? The students can copy the diagram and questions into their books; alternatively, the differentiated **Labelling the Bunsen Burner** worksheets are available to support students.

Go through the answers using the PowerPoint. You may wish for the students to peer-assess each other's work.

Using a Bunsen Burner

Whilst setting up the practical activity, make sure that students are following correct laboratory procedures and rules. Students will light their Bunsen burners, following your instructions and the demonstration you have given them. Students should then observe the colour and sound of the Bunsen burner flame as they adjust the position of the collar to have the air hole open, air hole half open and air hole closed. Pupils can record their observations on the **Using a Bunsen Burner** worksheet.

Using a Bunsen Burner to Boil Water

Students set up a Bunsen burner, tripod, gauze and heatproof mat. Students should half-fill a beaker of water and record the starting temperature. They should then light their Bunsen burner and start a timer. They could record the temperature every 30 seconds in a table of their own design or using the **Boiling Water Results Table** provided in this lesson pack.

Before beginning the practical, discuss with students how they will know when the water has started to boil.

Remind students of the safety precautions necessary when using Bunsen burners and hot liquids. Ensure that time is allowed for equipment to cool before putting the equipment away.

Plenary

Key word Bingo

Using the **Key Word Bingo Template**, or asking students to draw their own grid in their books, the students choose and write down six key words into their bingo grid. Read the words from the PowerPoint slide in a random order or for a more challenging task you could give a description or definition of the word. If students have chosen the word you say or describe they should tick it in their grid and call "Bingo!" when they have ticked all six key words.

At the end of the lesson, provided that the students have acted safely and responsibly with their Bunsen burner, award them with their **Bunsen Burner Licence** certificates.

Disclaimer

We hope you find the information on our website and resources useful. The activities set out in this resource are potentially hazardous. The activities are not suitable for all children and adult supervision may be required for some of the activities. It is your responsibility to assess whether the children in your care are able to safely carry out the activities and whether the children require adult supervision. You are responsible for carrying out proper risk assessments on the activities and for ensuring that activities can be carried out safely. We are not responsible for the health and safety of your group or environment so, insofar as it is possible under the law, we cannot accept liability for any loss suffered by anyone undertaking the activity or activities referred to or described in this resource. It is also your responsibility to ensure that those participating in the activity are fit enough to do so and that you or the organisation you are organising for has the relevant insurance to carry out the physical activity. If you are unsure in any way, we recommend that you take guidance from a suitably qualified professional.

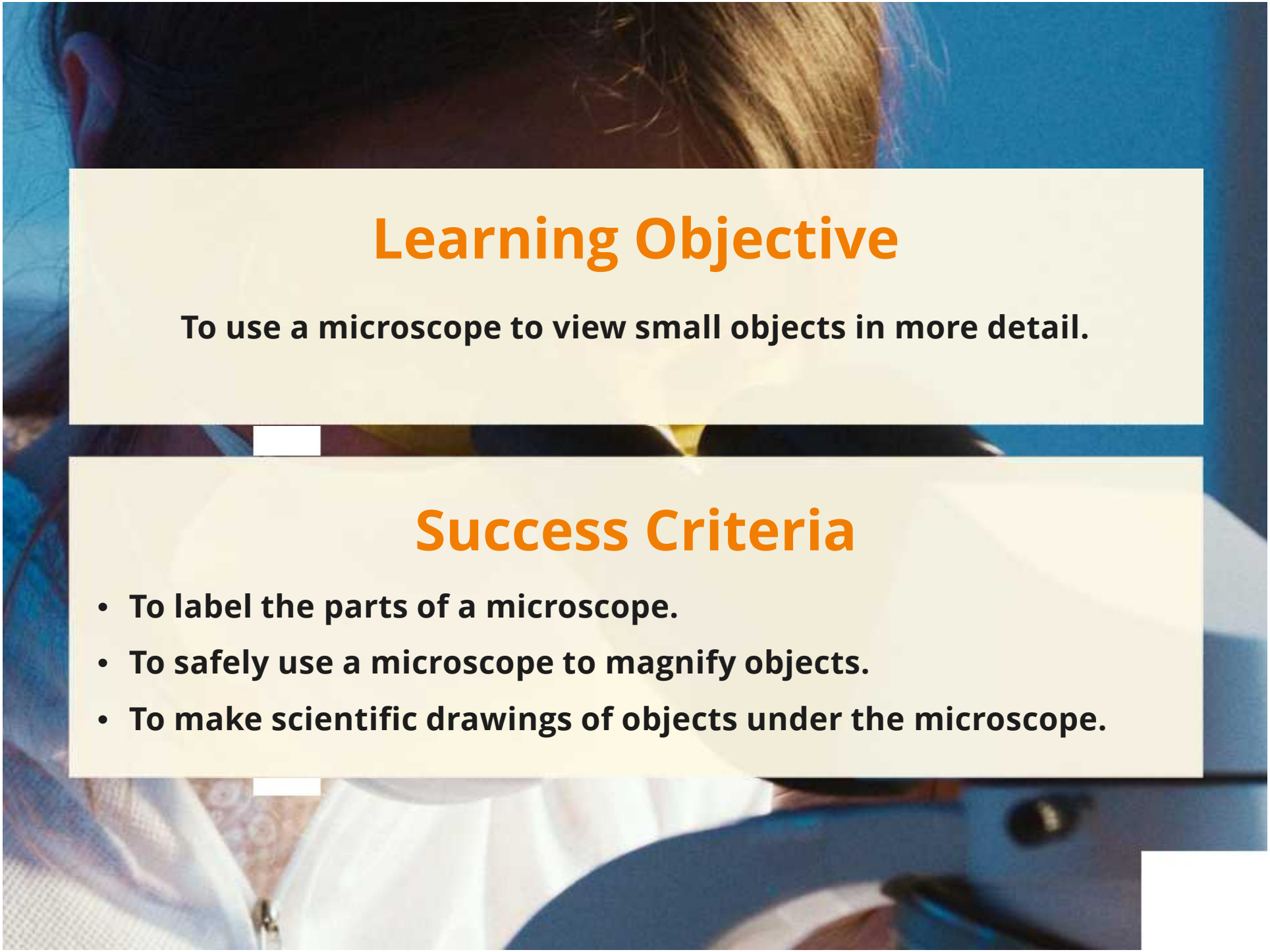
Using a Bunsen Burner **Answers**

	Colour of the Flame	Sound of the Flame	When Is It Used?	Amount of Oxygen
Air Hole Open	blue	noisy/roaring	to heat things quickly	lots
Air Hole Half Open	blue	quite noisy	to heat things slowly	a little
Air Hole Fully Closed	yellow	quiet	for safety, when the Bunsen burner is not in use	very little

Using a Bunsen Burner

	Colour of the Flame	Sound of the Flame	When Is It Used?	Amount of Oxygen
Air Hole Open				
Air Hole Half Open				
Air Hole Fully Closed				

How to Use a Microscope



Learning Objective

To use a microscope to view small objects in more detail.

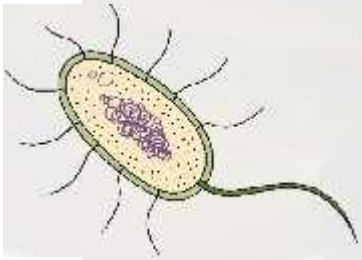
Success Criteria

- **To label the parts of a microscope.**
- **To safely use a microscope to magnify objects.**
- **To make scientific drawings of objects under the microscope.**

Organising Objects

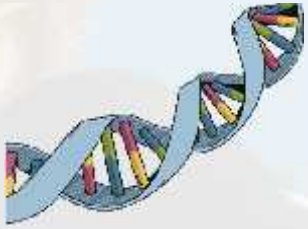
Put the following objects in order of size.

grain of salt



bacteria

paperclip



DNA

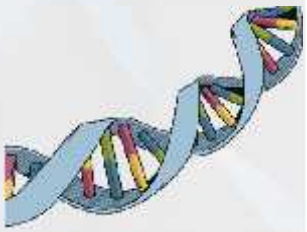
red blood cell

Extension:
Which of these objects can only be seen using a microscope?

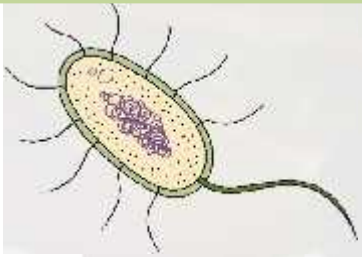
Organising Objects

Put the following objects in order of size.

increasing size



DNA



bacteria

red blood cell

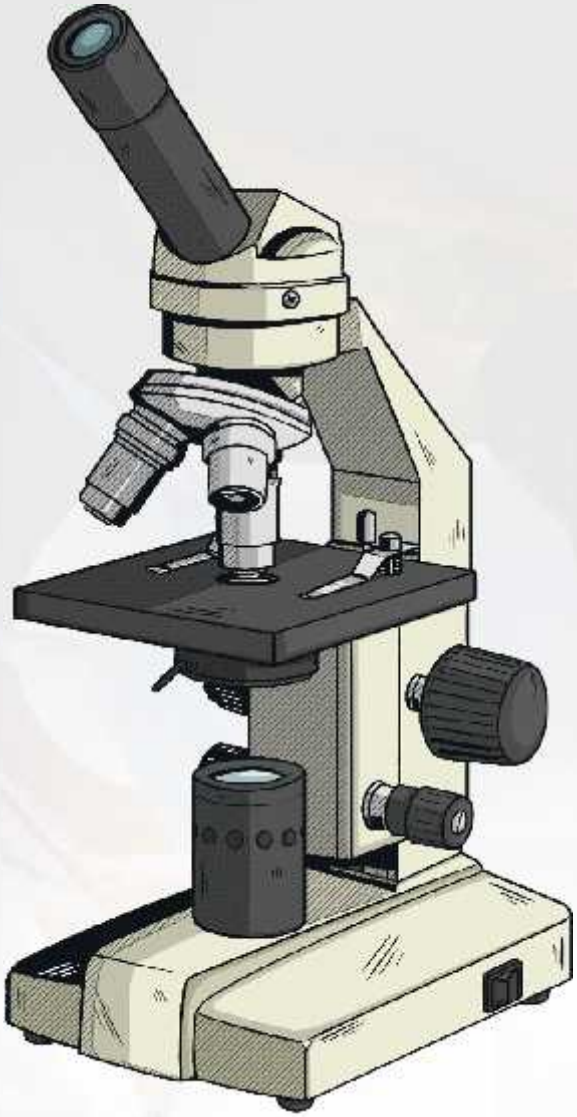
grain of salt

paperclip

Extension:
Which of these objects can only be seen using a microscope?

bacteria, red blood cell and DNA

Microscopes



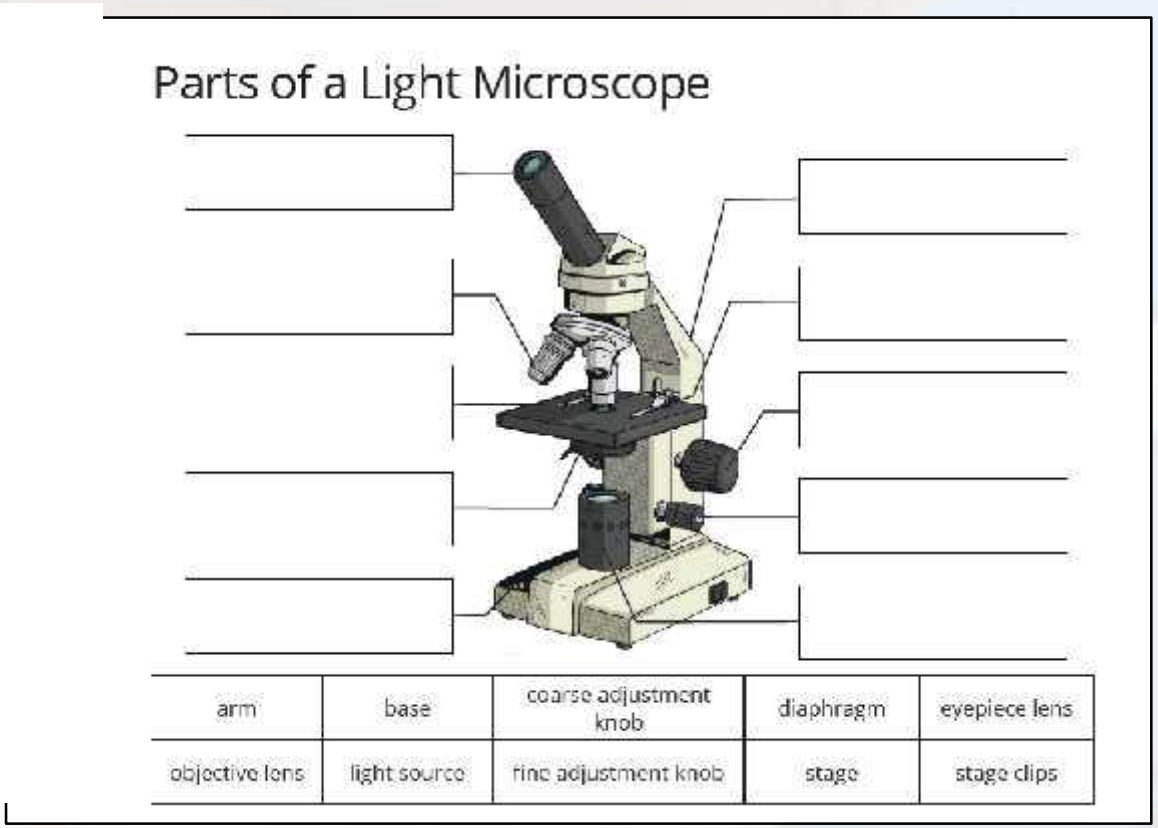
Microscopes have been used for many years to observe objects that are too small to see with the naked eye. The first microscope was invented in the 1500s.

Over time, the magnification and resolution of microscopes has significantly improved due to developments in technology. We now have microscopes that can examine specimens at an atomic level.

Many important scientific discoveries have been made using microscopes.

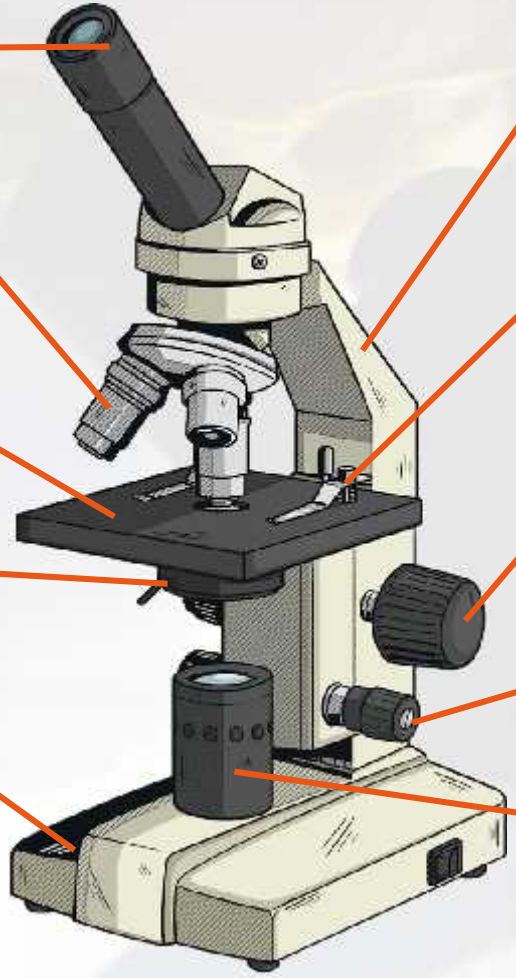
Parts of a Microscope

Can you label any parts of the light microscope?



Parts of a Microscope

Can you label any parts of the light microscope?



- eyepiece lens
- objective lens
- stage
- diaphragm
- base
- arm
- stage clips
- coarse adjustment knob
- fine adjustment knob
- light source

Using a Light Microscope

1. Plug in the microscope and turn on the light. If your microscope has a mirror, you may need to adjust it so light is directed through the diaphragm.
2. Place your specimen (the object you want to observe) on the stage and secure it with the stage clips.
3. Turn the objective lens to the lowest magnification (usually ×4).
4. Turn the coarse adjustment knob until the objective lens is almost touching the microscope slide. Look from the side of the microscope as you do this, not through the eyepiece, so you do not damage the slide.
5. Looking through the eyepiece, turn the coarse adjustment knob to move the stage away from the objective lens until the image comes into focus.
6. Use the fine adjustment knob to make the image clearer.
7. Turn to a higher power objective lens (×10 or ×40) and refocus the image using the fine adjustment knob.
8. Make a scientific drawing of the specimen or write down any observations.

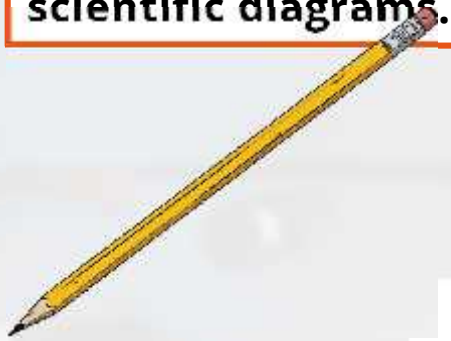
Using a Light Microscope

Have a go at looking at some objects under the microscope. These could be prepared slides provided by your teacher, but you could also try looking at a strand of your hair, the tip of a pencil or any other objects you can find in the classroom.

Object	Diagram/Observation

Remember to start on the lowest magnification!

Use a sharp pencil for drawing scientific diagrams.



Home Learning

Task 1

Research the history of the microscope and how it has developed over time. Add pictures and diagrams.

Task 2

Describe the differences between a light microscope and an electron microscope.

Quick Quiz

1. Which part of the microscope do you look through?

- diaphragm
- eyepiece lens
- objective lens

Quick Quiz

2. Which part of the microscope is used to move the stage up and down?

- coarse adjustment knob
- fine adjustment knob
- stage clips

Quick Quiz

3. What is the name of the object that you observe with a microscope?

sample

species

specimen

Quick Quiz

4. Which part of the microscope can be adjusted to control the amount of light reaching the specimen.

arm

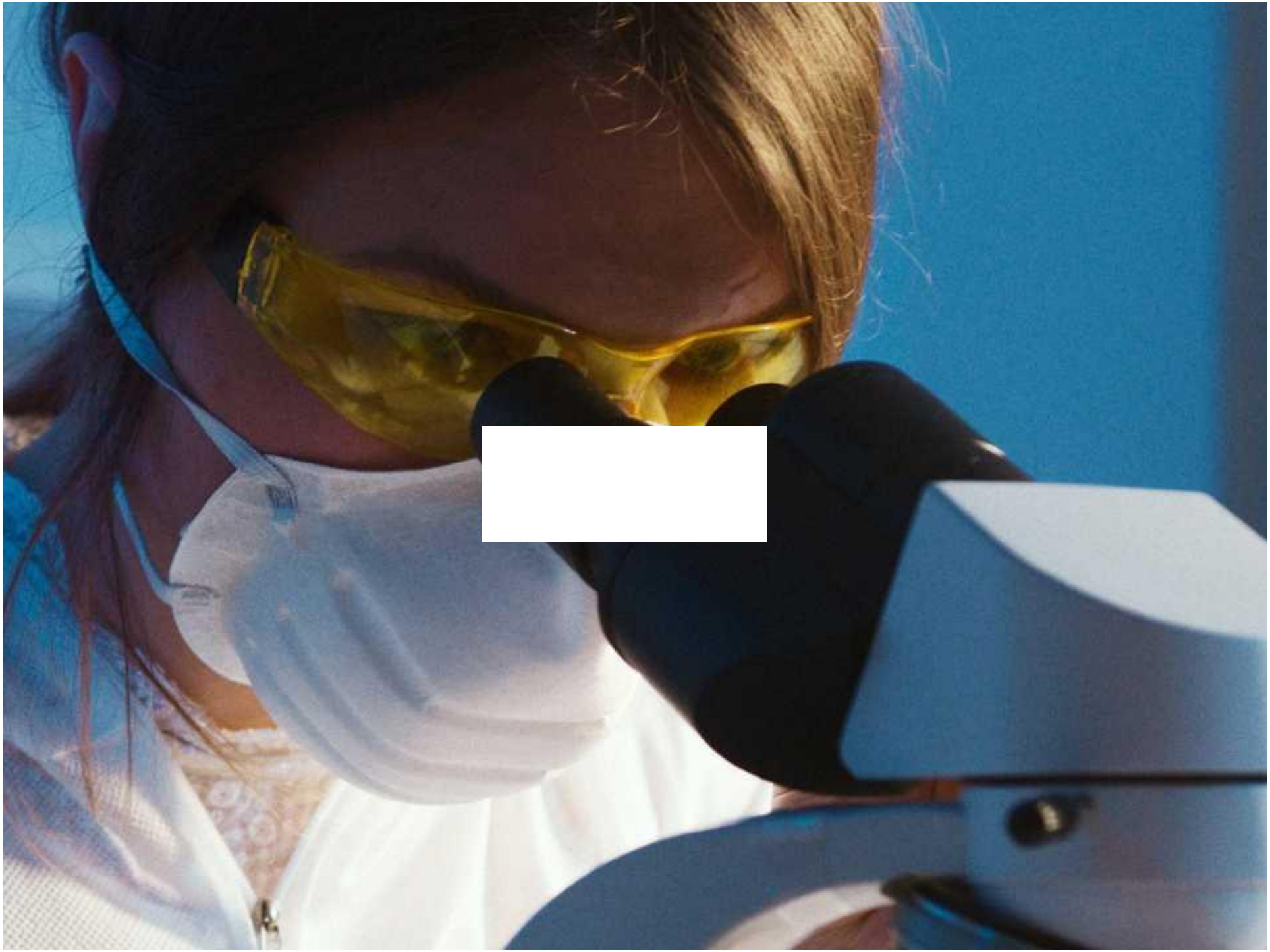
diaphragm

objective lens

Quick Quiz

5. A light microscope has three objective lenses: ×4, ×10 and ×40. Which objective lens should be used first when viewing an object?

- ×4
- ×10
- ×40



How to Use a Microscope

Teaching Ideas

Learning Objective:
To use a microscope to view small objects in more detail.

Success Criteria:

- To label the parts of a microscope.
- To safely use a microscope to magnify objects.
- To make scientific drawings of objects under the microscope.

Context
This lesson is part of the Introduction to Science unit of work. Students learn the parts of a light microscope and use a light microscope to view some objects in more detail.

Resources
light microscopes

prepared slides and other objects to view through the microscope

mini whiteboards and pens

Starter

Organising Objects

Students are asked to put some objects in order of size. Included on the slide are five objects that students should be familiar with, although they may not have learnt about them all in detail. Highlight to students that the illustrations are simply a visual representation of the objects and are not shown to scale. An extension question asks students to link the sizes of the objects to their understanding of what a microscope is used for. The answers appear on the following slide.

Main Activities

Microscopes

The slide gives a brief introduction to microscopes. You could use these points to encourage a discussion between students about what discoveries they think have been made using microscopes. What is the smallest object they can think of?

Parts of a Microscope

The slide shows an illustration of a light microscope and asks students if they can label any of the parts. You may wish to hold up an actual light microscope so students can see what it looks like, or have microscopes out on the desks in front of students for them to look at. If you are having students collect the microscopes themselves, demonstrate the correct way to safely handle it before they do so. On the slide, each label appears one at a time on a click. You could take this opportunity to describe to students what each part of the microscope is used for. Students can then complete the **Parts of a Light Microscope Worksheet**.

Using a Light Microscope

The slide gives instructions for using a light microscope. These are also included on the **Using a Light Microscope Student Instruction Sheet**, which can be given to students as a handout. You may wish to demonstrate these steps to students to ensure that the instructions are clear, before allowing them to use the microscopes themselves. Students can then work in pairs or small groups to observe prepared slides or other objects using their light microscope. They should record their observations on the **Microscope Observations Worksheet**. Following this, bring the class together to discuss anything they found interesting and any difficulties they had when viewing their specimens.

Plenary

Quick Quiz

Five multiple choice questions appear on the slides. Students could write their answers on mini whiteboards or in the back of their books.

Home Learning

Research Task

Students select one of the tasks to complete at home. Task 1 asks them to research the history of the microscope and how it has developed over time. Task 2 asks them to describe the differences between a light microscope and an electron microscope.

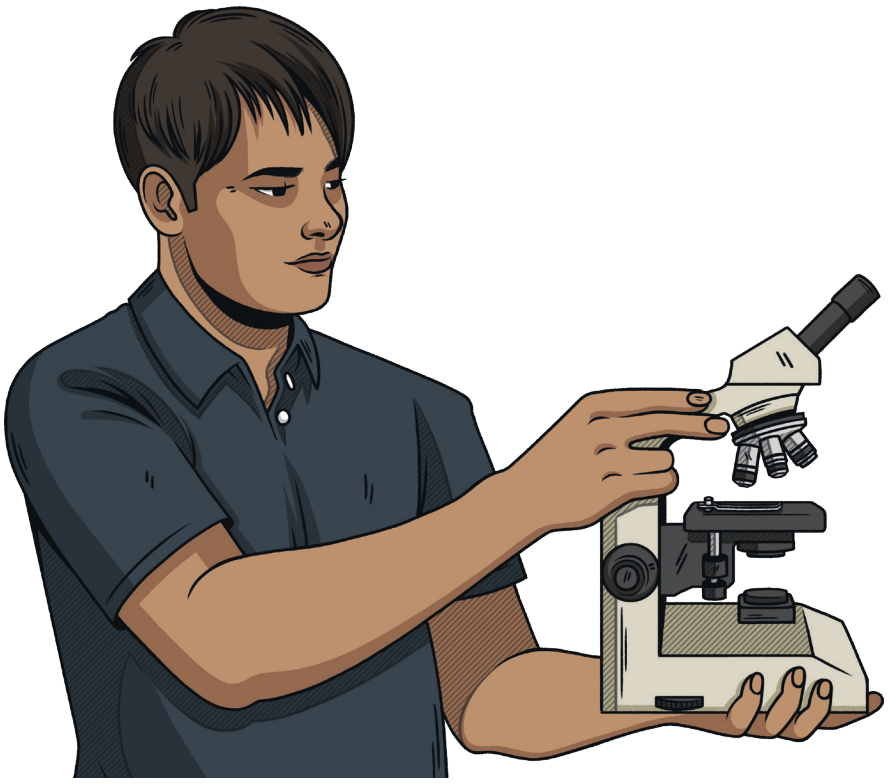
Microscope Observations

Look at some objects under the microscope and draw a diagram or write down what you observe.

Object	Diagram/Observation

Taking Care of a Microscope

When using a microscope, it must be cared for in the correct way.



Collecting Your Microscope

Always carry the microscope with **two** hands. Hold the arm of the microscope with one hand and the base of the microscope with the other. **Do not** touch the light as it may be hot.

Using Your Microscope

Place your prepared slide on the stage carefully and put the clips over the ends to hold the slide in place.

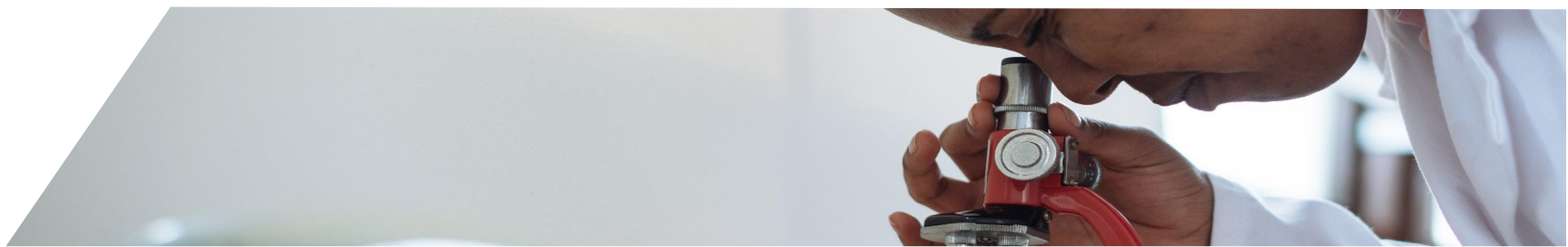
Turn the objective lens to the **lowest** magnification. Turn the coarse adjustment knob until the objective lens is **almost** touching the microscope slide. Look from the side of the microscope as you do this, **not** through the eyepiece.

Looking through the eyepiece, turn the coarse adjustment knob to move the stage **away** from the objective lens until the image comes into focus. This is to make sure that the objective lens and slide **do not** come into contact, or it may cause the lens or slide to crack.

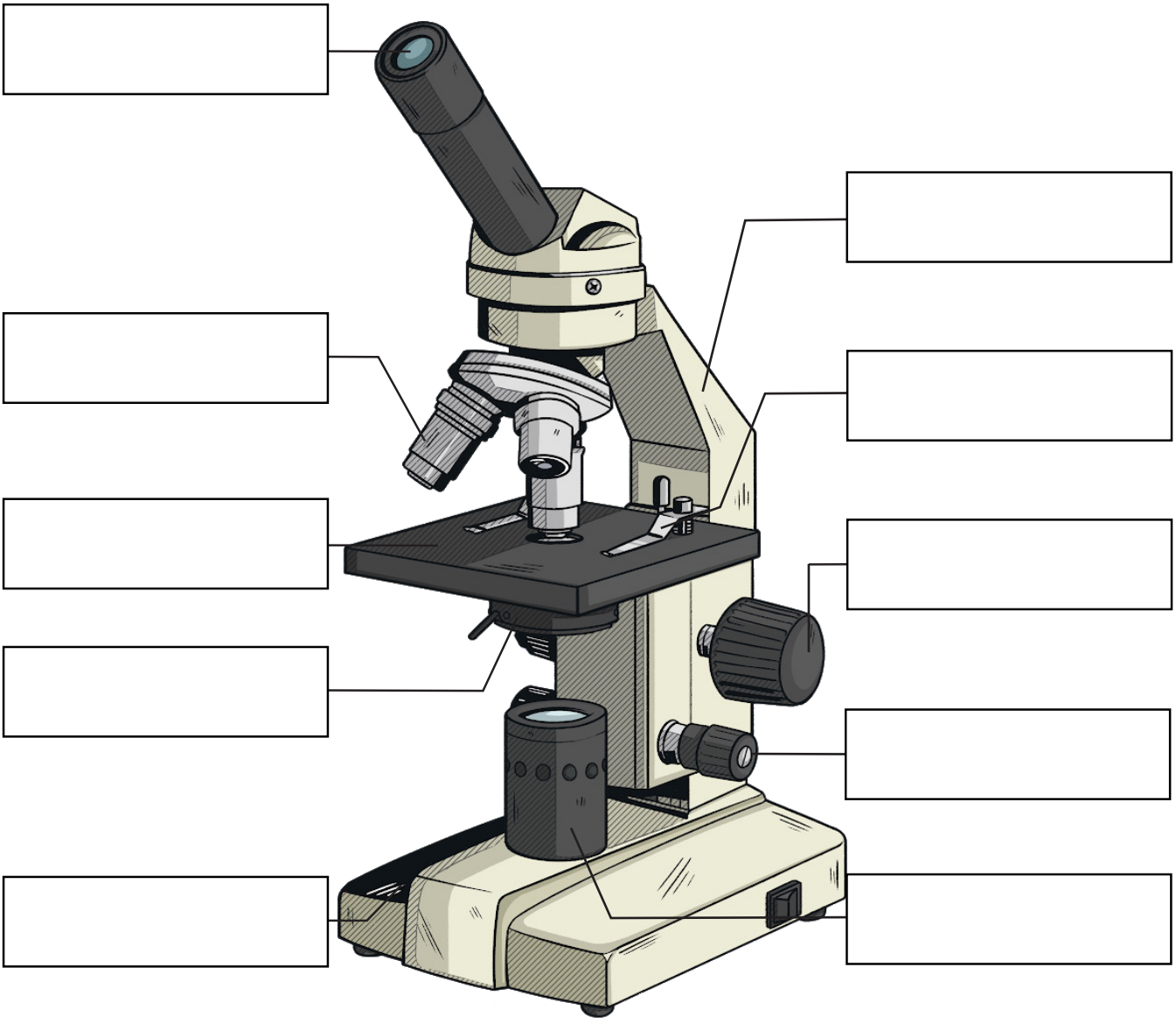
Turn to a higher power objective lens and refocus the image using the fine adjustment knob. Repeat until you are using the highest magnification.

Putting Your Microscope Away

When you have finished with your microscope **remove the slide** with the specimen on. Wrap the cord carefully around the arm, and if the microscope has a cover, put it on.

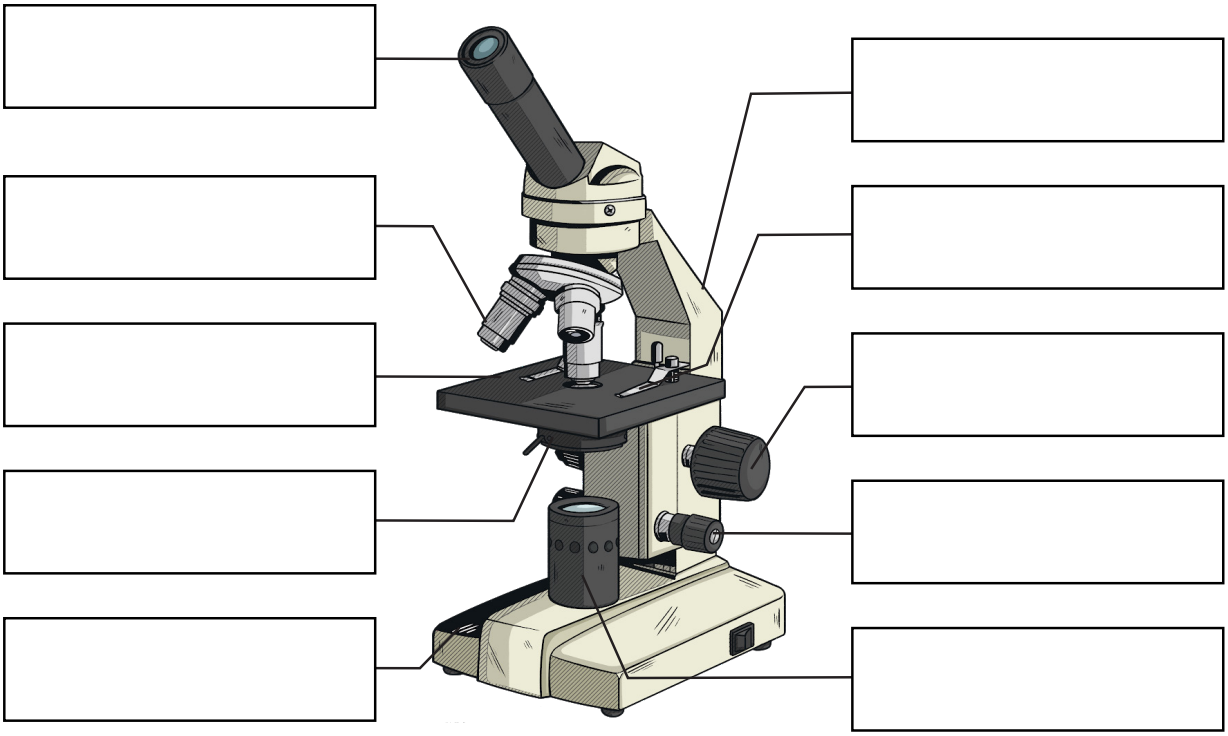


Parts of a Light Microscope



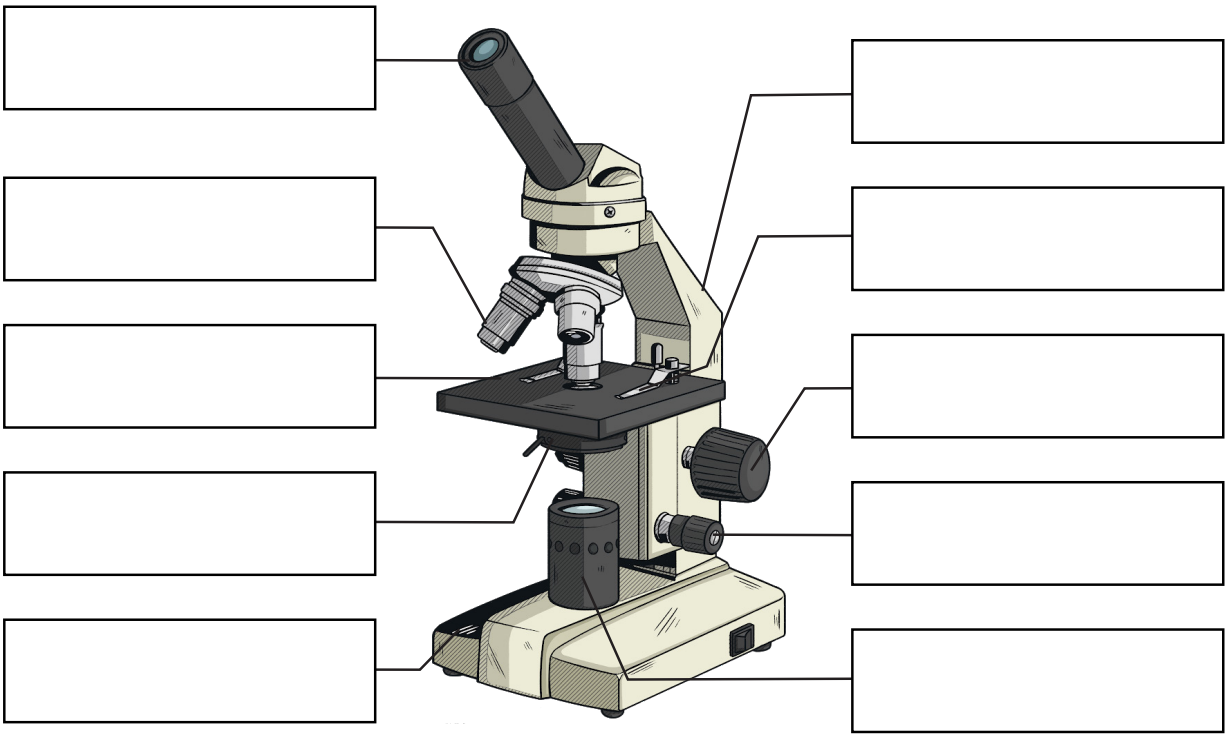
arm	base	coarse adjustment knob	diaphragm	eyepiece lens
objective lens	light source	fine adjustment knob	stage	stage clips

Parts of a Light Microscope



arm	base	coarse adjustment knob	diaphragm	eyepiece lens
objective lens	light source	fine adjustment knob	stage	stage clips

Parts of a Light Microscope



arm	base	coarse adjustment knob	diaphragm	eyepiece lens
objective lens	light source	fine adjustment knob	stage	stage clips

How to Use a Light Microscope

1. Plug in the microscope and turn on the light. If your microscope has a mirror, you may need to adjust it so light is directed through the diaphragm.

2. Place your specimen (the object you want to observe) on the stage and secure it with the stage clips.

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5. Looking through the eyepiece, turn the coarse adjustment knob to move the stage away from the objective lens until the image comes into focus.

6. Use the fine adjustment knob to make the image clearer.

7. Turn to a higher power objective lens (×10 or ×40) and refocus the image using the fine adjustment knob.

8. Make a scientific drawing of the specimen or write down any observations.

Remember:

- Always carry a microscope with **two** hands. Hold the arm of the microscope with one hand and the base of the microscope with the other.
- Do **not** let the objective lens touch the slide – it could damage it.
- Take care not to touch the light – it can get very hot.
- Look through the eyepiece lens with one eye.
- The image you see is flipped vertically and horizontally, so bear this in mind when trying to reposition the slide while looking through the eyepiece lens.

Science Investigation **Planning Sheet**

Aim (what you are trying to find out):

Independent Variable (the variable that you change or select the values for):

Dependent Variable (the variable that is measured for each change of the independent variable):

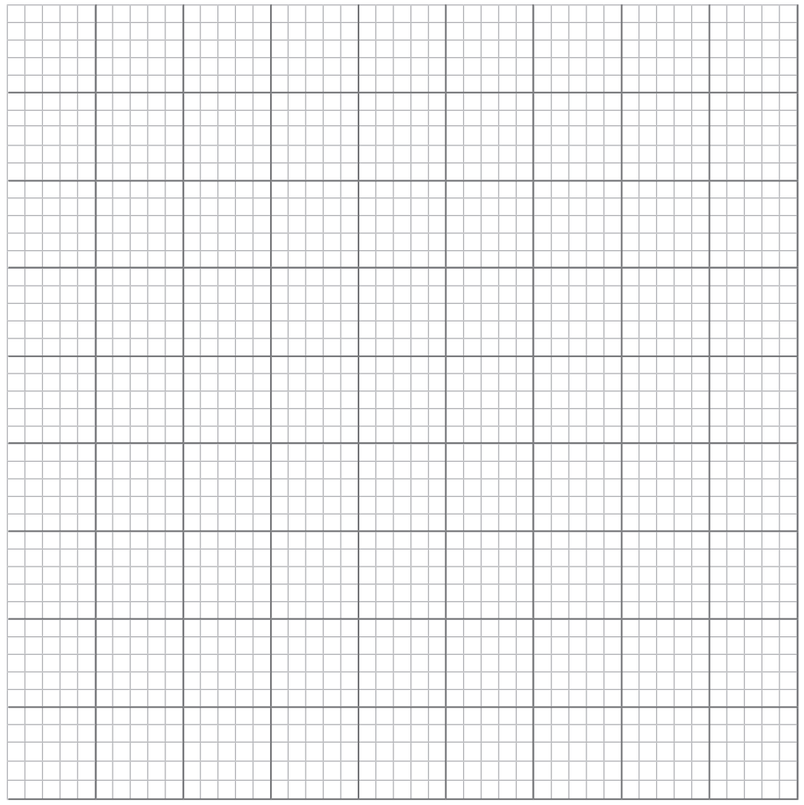
Control Variables (variables that could affect the outcome of the experiment and need to be kept constant):

Hazard	Risk	Prevention

Method
This should include the equipment you are going to use, a step-by-step guide for carrying out the experiment and how you will make sure your results are valid.

Results Table
Draw a table to record your results in the space below.

Displaying Your Results
Draw a graph of your results in the space below.



Conclusion
Explain what you found out in your investigation, including some data to support your explanation.

Evaluation
Consider the quality of your method and how successful you were at collecting valid results.

Science Investigation **Planning Sheet**

Aim (what you are trying to find out):

Variables

I**ndependent Variable** (the variable that you change or select the values for):

Dependent Variable (the variable that is measured for each change of the independent variable):

Control Variables (variables that could affect the outcome of the experiment and need to be kept constant):

Risk Assessment

Hazard	Risk	Prevention

Method

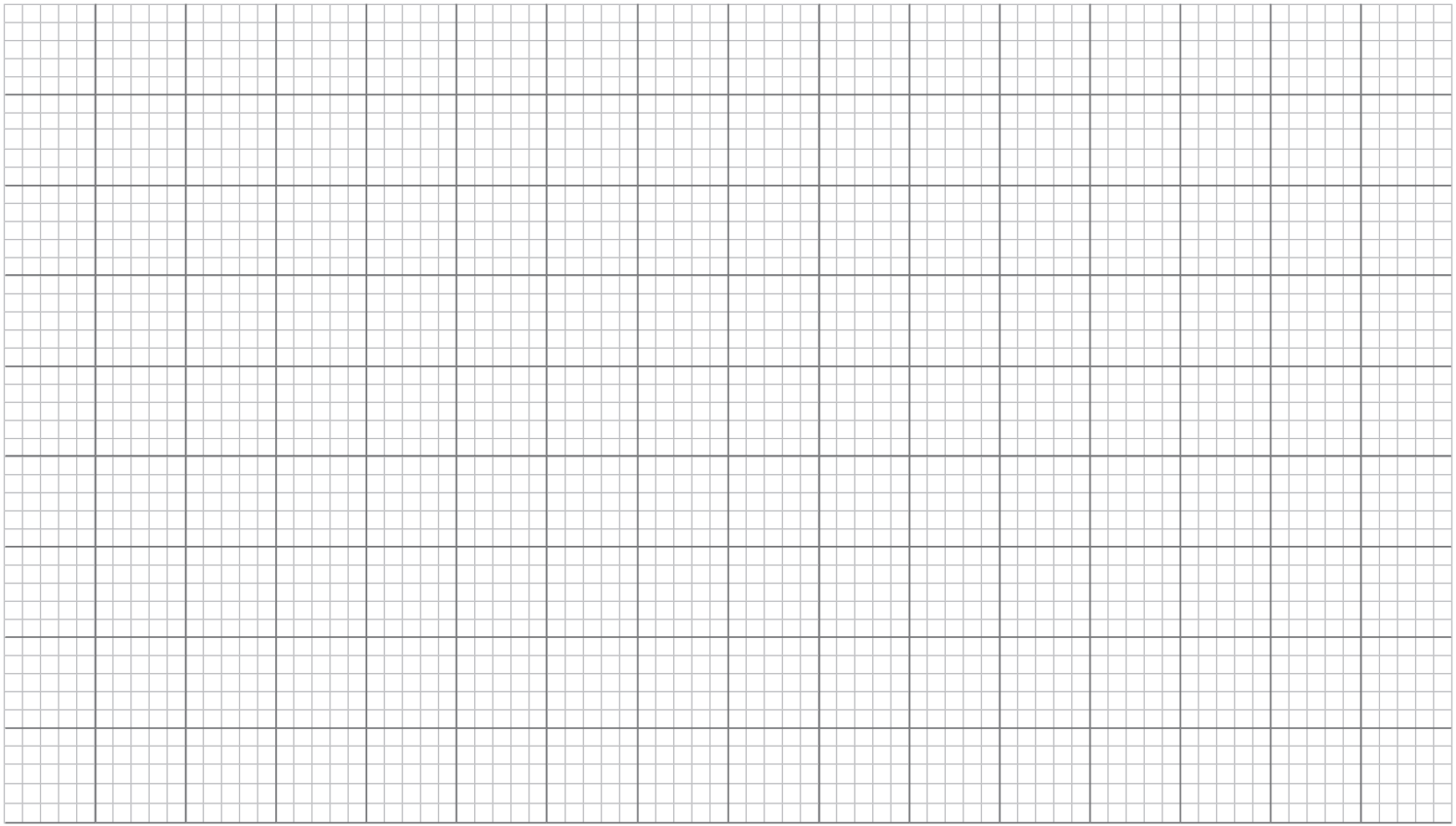
This should include the equipment you are going to use, a step-by-step guide for carrying out the experiment and how you will make sure your results are valid.

Results Table

Draw a table to record your results in the space below.

Displaying Your Results

Draw a graph of your results in the space below.



Conclusion

Explain what you found out in your investigation, including some data to support your explanation.

Evaluation

Consider the quality of your method and how successful you were at collecting valid results.

Marshmallow Investigation **Planning Sheet**

Aim

To investigate the effect of marshmallows on the temperature of hot chocolate over time.

Independent Variable

The **independent variable** is the variable that you change or select the values for.

What is the independent variable in your investigation?

_____

Dependent Variable

The **dependent variable** is the variable that is measured for each change of the independent variable.

What is the dependent variable in your investigation?

_____

Control Variables

A **control variable** is one that may, in addition to the **independent variable**, affect the outcome of the investigation and therefore must be kept constant.

What variables will you need to control in your investigation?

_____

_____

_____

Prediction

What effect, if any, do you think the marshmallows will have on the temperature of the hot chocolate over time?

Why do you think this will happen?

Method

1. Collect a small cup/250ml beaker.
2. Add 1 spoonful of hot chocolate powder.
3. Add 150ml of boiled water.
4. Add the marshmallows, place the thermometer in the beaker and start the timer.
5. Wait for 1 minute (to allow the marshmallows to melt), then measure the temperature.
6. Measure the temperature after 5 minutes.
7. Repeat the above steps, but without the marshmallows

Marshmallow Investigation **Planning Sheet**

Safety

What safety precautions do you need to take during your investigation?

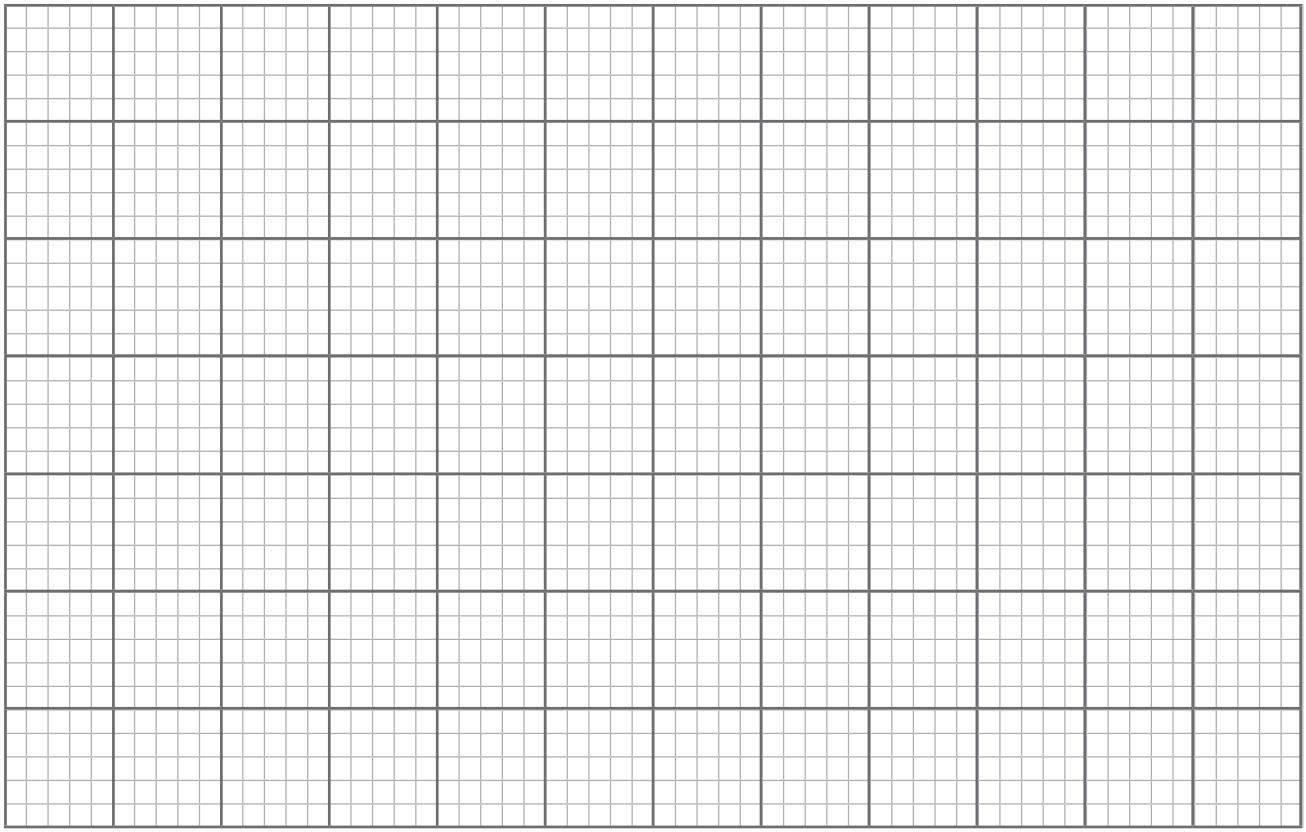
Results Table

Record your results in the table.

	Temperature after 1 Minute (ºC)	**Temperature after 5 Minutes (ºC)**	**Decrease in Temperature (ºC)**
With Marshmallows			
Without Marshmallows			

Displaying Your Results

Draw a graph in the space below.



Marshmallow Investigation **Planning Sheet**

Conclusion

A **conclusion** is an explanation of what you found out in your investigation.

What was the effect of adding marshmallows on the temperature of the hot chocolate over time?

How do you know this?

(Use the data you collected to support the pattern you have identified.)

Why does this happen?

(Give the science behind your results.)

Marshmallow Investigation **Planning Sheet**

Marshmallow Investigation **Planning Sheet**

Aim

To investigate the effect of marshmallows on the temperature of hot chocolate over time.

Independent Variable

The **independent variable** is the variable that you change or select the values for.

What is the independent variable in your investigation?

_____

Dependent Variable

The **dependent variable** is the variable that is measured for each change of the independent variable.

What is the dependent variable in your investigation?

_____

Control Variables

A **control variable** is one that may, in addition to the **independent variable**, affect the outcome of the investigation and therefore must be kept constant.

What variables will you need to control in your investigation?

_____

_____

_____

Prediction

What effect, if any, do you think the marshmallows will have on the temperature of the hot chocolate over time?

_____

_____

Why do you think this will happen?

_____

_____

Method

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5. Wait for 1 minute (to allow the marshmallows to melt), then measure the temperature.
6. Measure the temperature after 5 minutes.
7. Repeat the above steps, but without the marshmallows

Safety

What safety precautions do you need to take during your investigation?

_____

_____

_____

_____

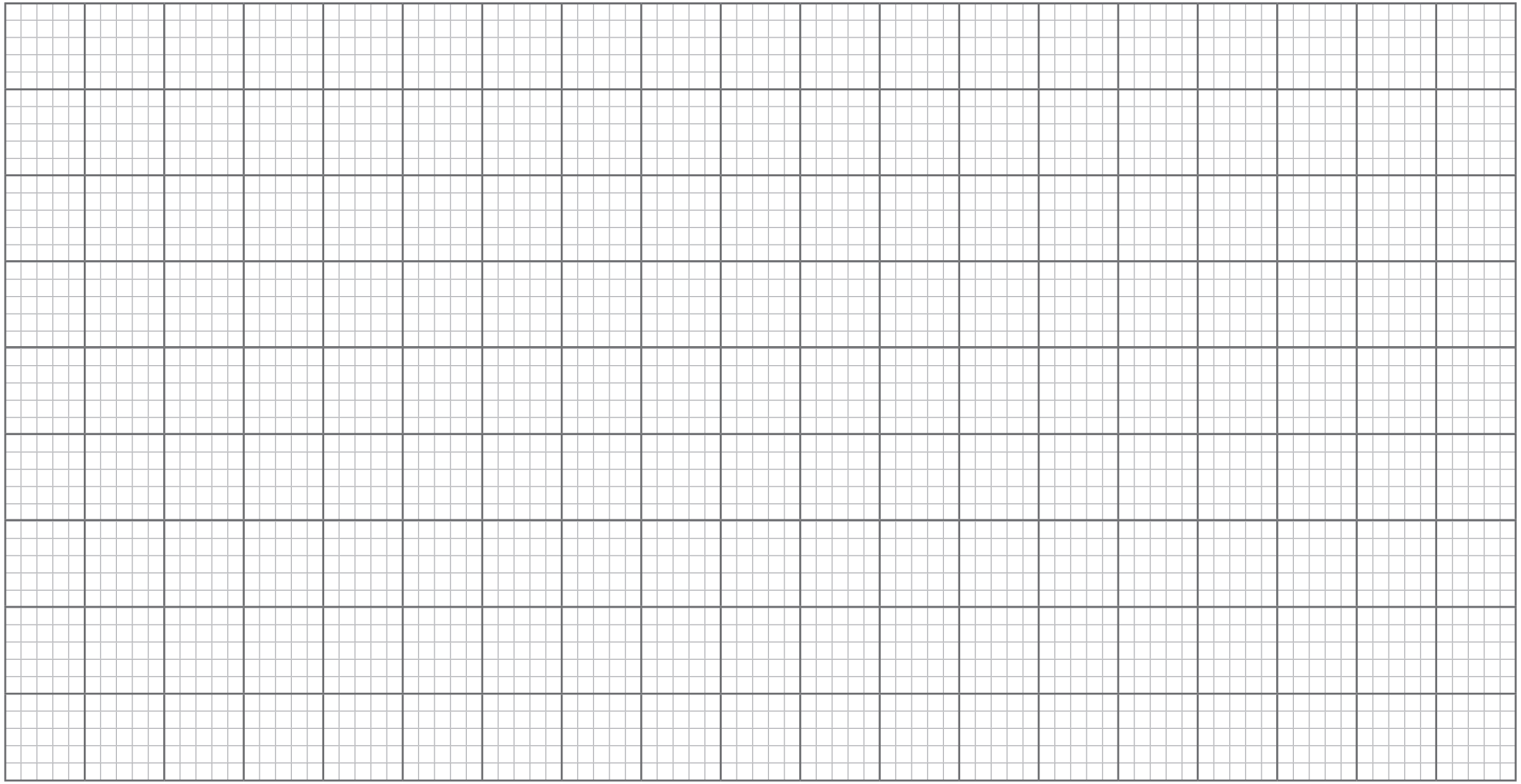
Results Table

Record your results in the table.

	Temperature after 1 Minute (ºC)	**Temperature after 5 Minutes (ºC)**	**Decrease in Temperature (ºC)**
With Marshmallows			
Without Marshmallows			

Displaying Your Results

Draw a graph in the space below.



Conclusion

A **conclusion** is an explanation of what you found out in your investigation.

What was the effect of adding marshmallows on the temperature of the hot chocolate over time?

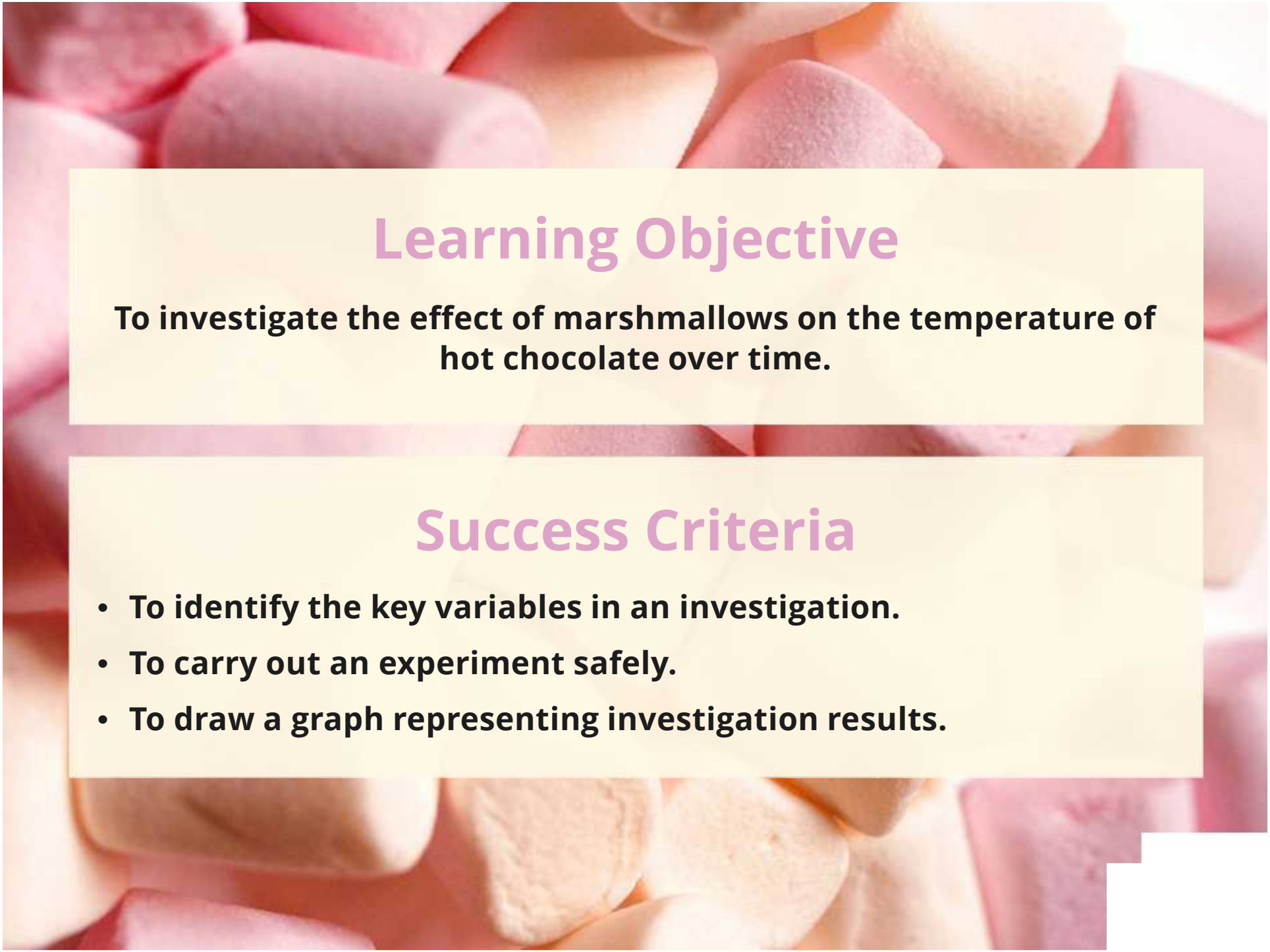
How do you know this?

(Use the data you collected to support the pattern you have identified.)

Why does this happen?

(Give the science behind your results.)

Marshmallow Investigation



Learning Objective

To investigate the effect of marshmallows on the temperature of hot chocolate over time.

Success Criteria

- **To identify the key variables in an investigation.**
- **To carry out an experiment safely.**
- **To draw a graph representing investigation results.**

What is Physics?

Today we are going to investigate an area of physics.

Which topics below are physics topics? (Hint: there are six.)

electricity

chemical reactions

forces

cells

static

energy

ecology

health

space

diseases

evolution

acids and alkalis

waves

Physics Investigation

Our investigation today is related to energy.

Most objects have energy stores.

The larger an object's energy store, the higher its temperature.

What piece of equipment would you use to measure the temperature of a liquid?

a thermometer

What are the units of temperature?

^{o}C

Hot Chocolate

What will happen to this cup of hot chocolate over time?

It will cool down.

Why does the hot chocolate cool down?

Energy is transferred from the hot chocolate to the surroundings.

As the energy store of the hot chocolate decreases it will become cooler.

Eventually the hot chocolate will be the same temperature as the surroundings.

Marshmallows

Does adding marshmallows keep hot chocolate warmer for longer?

How could you investigate this question?

- **What equipment would you need?**
- **What would your method be?**
- **How would you ensure a fair test?**

Variables

A variable is something which can change in an investigation.

The independent variable is the variable that you change or select the values for.

What is the independent variable in your investigation?

with or without marshmallows

Variables

A variable is something which can change in an investigation.

The dependent variable is the variable that is measured for each change of the independent variable.

What is the dependent variable in your investigation?

the temperature change of the hot chocolate

Variables

A variable is something which can change in an investigation.

A control variable is one that may, in addition to the independent variable, affect the outcome of the investigation and therefore must be kept constant.

When planning the investigation, you need to identify the other variables that might affect the dependent variable and plan how to control them.

Read the m slide and identif les.

Method

1. Collect a small cup/250ml beaker.
2. Add 1 spoonful of hot chocolate powder.
3. Add 150ml of boiled water.
4. Add the marshmallows, place the thermometer into the beaker and start the timer.
5. Wait for 1 minute (to allow the marshmallows to melt), then measure the temperature.
6. Measure the temperature again after 5 minutes.
7. Repeat the above steps without the marshmallows.

Identify the control variables in the method above.
(Hint: There are four.)

size of beaker, amount of hot chocolate, volume of water, time when temperature is measured

Why is it important to control each of these variables?

Prediction

What effect, if any, do you think the marshmallows will have on the temperature of the hot chocolate over time?

Why do you think this will happen?

Safety

What safety precautions do you need to take during your investigation?

Wear eye protection.

Do not eat or drink in the laboratory

Carry out the practical while standing up.

Do not place hot liquids at the edge of the bench.

Remember: tell the teacher immediately if a spill, breakage or injury occurs.

Results Table

Follow the instructions for the investigation and record your results in a table.

	Temperature after 1 Minute (ºC)	Temperature after 5 Minutes (ºC)	Decrease in Temperature (ºC)
With Marshmallows			
Without Marshmallows			

Remember: tell the teacher immediately if a spill, breakage or injury occurs.

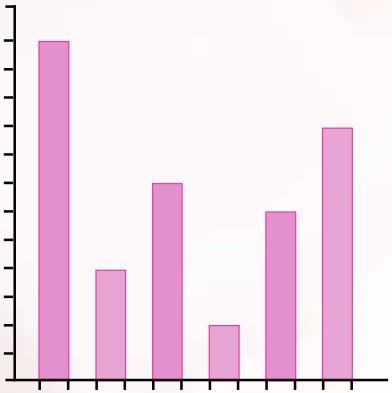
Example Results

	Temperature after 1 Minute (ºC)	Temperature after 5 Minutes (ºC)	Decrease in Temperature (ºC)
With Marshmallows	81	75	6
Without Marshmallows	83	73	10

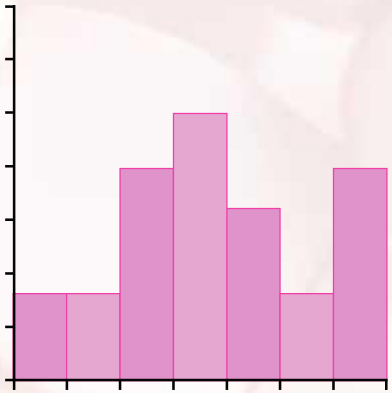
Displaying Your Results

There are different types of graph.

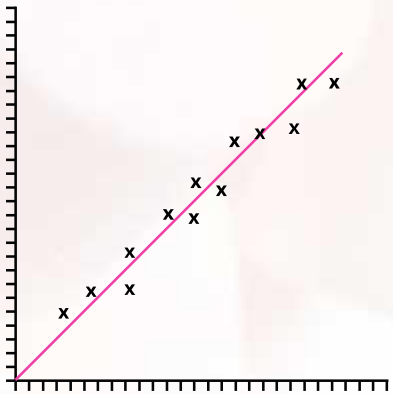
Which one should we use to display our results?



When one of our variables is discrete or categoric (not measured on a continuous scale), we draw a bar chart.



When continuous data (which can have any numerical value) is grouped into categories, we draw a histogram.



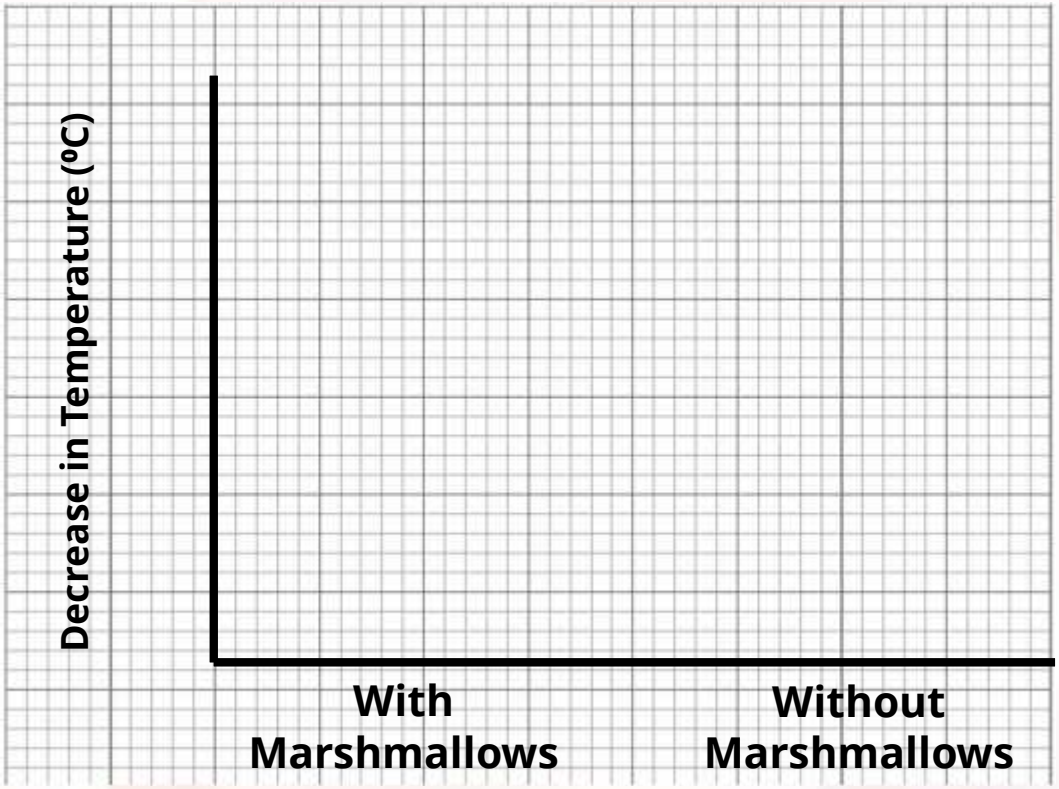
When both variables are continuous (can have any numerical value), we draw a scatter graph.

Drawing a Bar Chart

Draw an x-axis and a y-axis for your graph.

The independent variable is labelled on the x-axis.

The dependent variable is labelled on the y-axis.



	Temperature after 1 Minute (ºC)	Temperature after 5 Minutes (ºC)	Decrease in Temperature (ºC)
With Marshmallows	81	75	6
Without Marshmallows	83	73	10

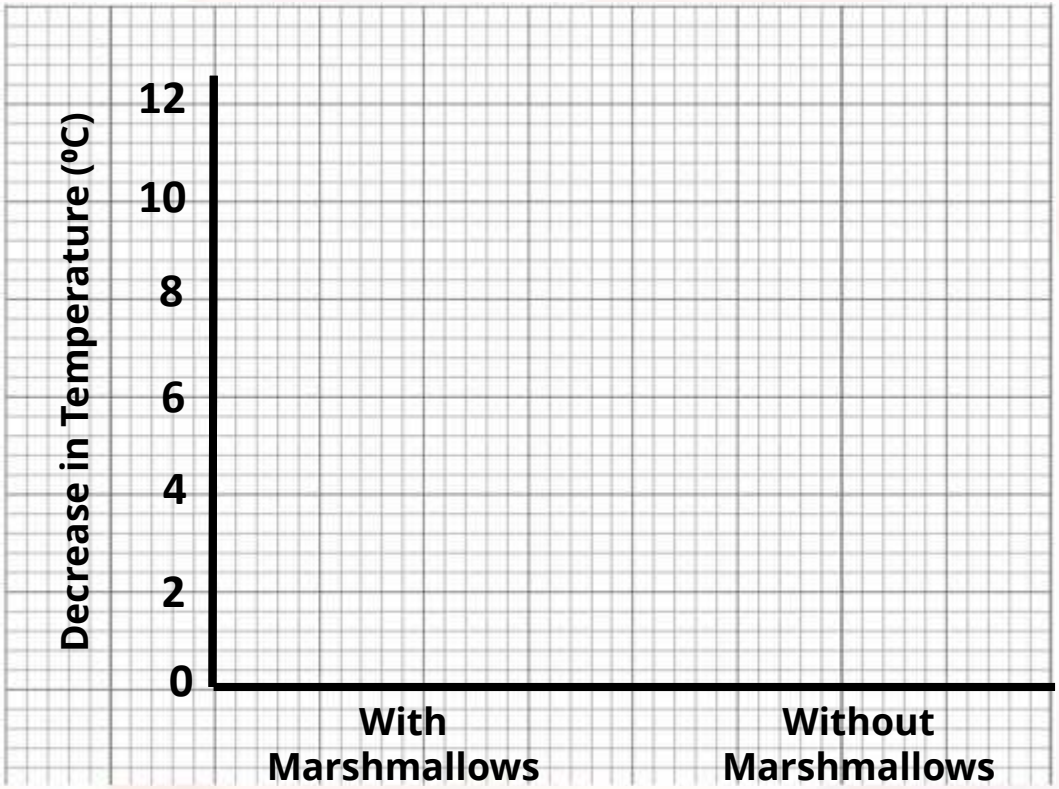
Drawing a Bar Chart

Add a suitable scale to the y-axis.

You must be able to display all of your data on your graph.

In the example results below the largest decrease in temperature is 10.

The y-axis must show this.

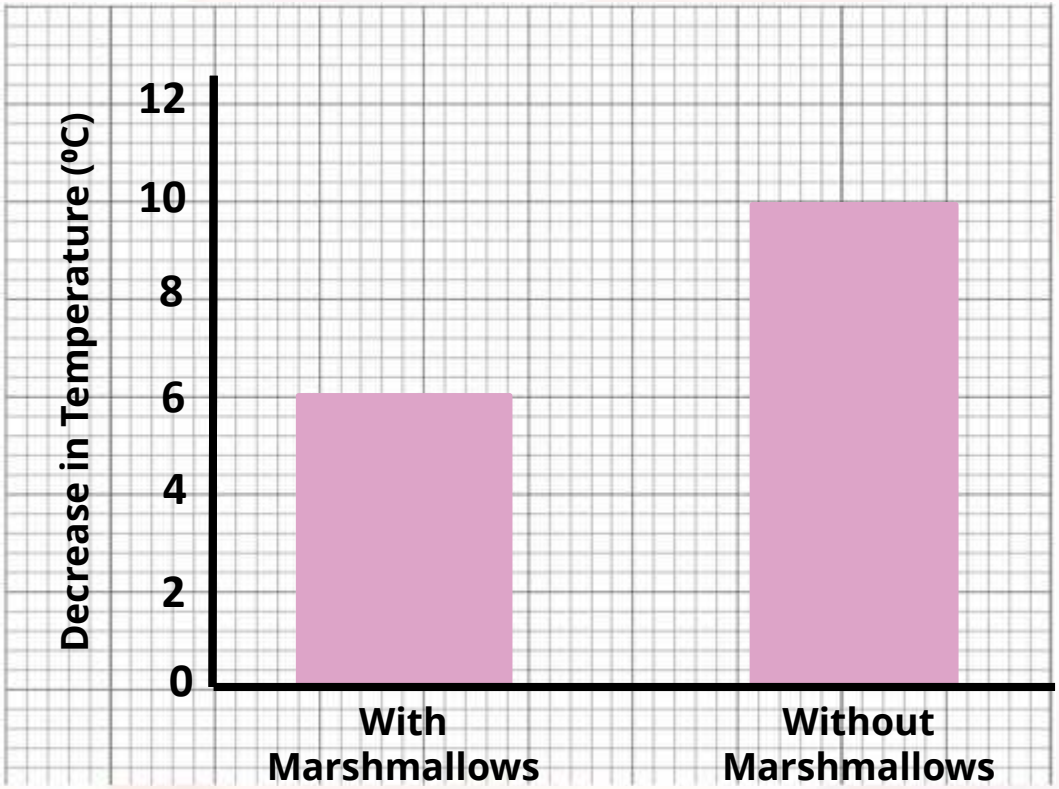


	Temperature after 1 Minute (ºC)	Temperature after 5 Minutes (ºC)	Decrease in Temperature (ºC)
With Marshmallows	81	75	6
Without Marshmallows	83	73	10

Drawing a Bar Chart

Add a bar to show the decrease in temperature of the hot chocolate with and without marshmallows.

There should be a gap between the bars.



	Temperature after 1 Minute (ºC)	Temperature after 5 Minutes (ºC)	Decrease in Temperature (ºC)
With Marshmallows	81	75	6
Without Marshmallows	83	73	10

Conclusion

A conclusion is an explanation of what you found out in your investigation.

What was the effect of adding marshmallows on the temperature of the hot chocolate over time?

The temperature of the hot chocolate with marshmallows decreased less over time compared to the temperature of the hot chocolate without marshmallows. The hot chocolate with marshmallows stayed warmer for longer.

How do you know this? (Use the data you collected to support the pattern you have identified.)

After five minutes the temperature of the hot chocolate with marshmallows had decreased by 6ºC whereas the temperature of the hot chocolate without marshmallows had decreased by 10ºC.

Why does this happen?

When the marshmallows melted on the surface of the hot chocolate they created an insulating layer which reduced the transfer of energy

Class Conclusion

Does adding marshmallows keep hot chocolate warmer for longer?

Yes or **No**

Did every group reach the same conclusion?

Plenary

The independent variable in our investigation was....

with or without marshmallows

Plenary

The dependent variable in our investigation was….

the change in temperature over time

Plenary

The control variables in our investigation were....

the size of the beaker
the amount of hot chocolate
the volume of water
the time after which we measured the temperature

Plenary

Which variable goes on the x-axis of a graph?

the independent variable

Plenary

Which type of graph should we use to display discrete or categoric variables?

a bar chart

Marshmallow Investigation
Teaching Ideas

Learning Objective:
To investigate the effect of marshmallows on the temperature of hot chocolate over time.

Success Criteria:

- To identify the key variables in an investigation.
- To carry out an experiment safely.
- To draw a graph representing investigation results.

Context
This lesson is part of the Introduction to Science unit of work for year 7. This lesson introduces students to investigative skills, including identifying variables, recording measurements, representing data in a graph and drawing conclusions from data. These skills are developed while investigating the effect of marshmallows of the rate of cooling of hot chocolate.

Although the focus of this lesson is investigative skills the context involves some discussion relating to energy. This can be a challenging topic for key stage three students due to its abstract nature. You may find our **Teaching Guide: Energy** helpful.

Resources
per group:
250ml beaker, spoon, thermometer, timer, instant hot chocolate powder, marshmallows, hot water (a kettle), mini whiteboards and pens (optional)

Starter

Physics Investigation
From the twelve topics listed on the PowerPoint, can students identify the six physics topics? Students could discuss their ideas in pairs or write their ideas into their books or onto mini whiteboards.

Explain to students that the investigation they will carry out in this lesson relates to energy and that hot objects have a large energy store and that the average kinetic energy of the particles in a substance is known as temperature. Ask students to identify a piece of equipment which can be used to measure temperature.

Main Activities

Hot Chocolate
Ask students "What will happen to a cup of hot chocolate over time?" and ask them to explain their ideas.

Explain that hot objects like hot chocolate transfer energy to their surroundings. As the energy store of the hot chocolate decreases, its temperature will also decrease.

Marshmallows
Give students 2-3 minutes to discuss how they could investigate this question. Prompts are provided on the PowerPoint. Students could share their ideas with the rest of the class.

Variables
Use the PowerPoint to introduce students to each type of variable in turn and identify the variables in this investigation. The Marshmallow Investigation Planning Sheets includes space for students to record the variables, a prediction, results, graph and conclusions for this investigation. A Blank Science Investigation Planning Sheet has also been included in this pack should you wish to focus on an alternative investigative skill.

Method
Ask the students to read through the method on the PowerPoint and identify the control variables. They can do this activity in pairs or small groups. They should write their answers on mini whiteboards and then discuss as a class. Have any students identified control variables that are not included in the method? Once the class has agreed on a set of control variables, they can add these to their planning sheets.

Extension
Can students explain why each variable they have identified needs to be kept the same?

Prediction
Students should record their prediction with a reason, on their planning sheets.

Safety

Students should discuss and decide upon safety instructions for this investigation. They should then record these on their planning sheets.

Practical

Students then carry out the practical, safely, wearing eye protection and while standing up. They should complete the results table as they go. There is an example set of data included in the **PowerPoint**.

Displaying Your Results

The **PowerPoint** takes students step by step through drawing a bar chart to display their results.

Conclusion

Students should consider their results and form a conclusion based upon them. You could ask the class to compare their results and conclusions. Did all groups come to the same conclusion? If not, why might this be the case?

Plenary

Use mini whiteboards to review students' knowledge of the key variables and graph drawing skills from this investigation.

Flame Tests Observations

Metal Chloride	Observations	Order (Brightest to Least Bright)
potassium chloride		
calcium chloride		
lithium chloride		
sodium chloride		
copper chloride		

Flame Tests Observations

Metal Chloride	Observations	Order (Brightest to Least Bright)
potassium chloride		
calcium chloride		
lithium chloride		
sodium chloride		
copper chloride		

Making a Flare Method **Answers**

Your task is to work out which metal chloride is the best for use in a flare.

Equipment List

Bunsen burner

heatproof mat

wooden splint

metal chlorides

Method

Students' methods will vary. If self- or peer-assessing their methods, students should check that the method is clear and could be followed easily and safely.

Example:

1. **Dip a wooden splint into a test tube of a metal chloride solution, e.g. copper chloride.**
2. **Turn the Bunsen burner to the blue flame and carefully place the end of the splint with the metal chloride solution into the flame.**
3. **Write down any observations/colours in the results table.**
4. **Repeat with different metal chloride solutions.**

Risk Assessment

Hazard	Harm it Can Do	How You Will Minimise the Risk
metal chloride solutions	It could cause irritation to the eyes or skin. It could be harmful to the environment.	Wear eye protection. Use a low concentration. Avoid contact with skin.
Bunsen burner	It could cause burns.	Turn the Bunsen burner to the safety flame when not being used. Tie hair back.
glassware	If broken, it could cause cuts.	Tell the teacher if something is broken.

This is not an exhaustive list of hazards, risks and precautions to minimise them. You and your students may wish to add to the suggestions given above.

Observations

Metal Chloride	Observations	Order (Brightest to Least Bright)
potassium chloride	**purple**	**Answers will vary.**
calcium chloride	**red-orange**	**Answers will vary.**
lithium chloride	**crimson red**	**Answers will vary.**
sodium chloride	**orange-yellow**	**Answers will vary.**
copper chloride	**green**	**Answers will vary.**

My Conclusion

Which metal chloride would you use in a flare and why?

Answers will vary.

Class Conclusion

Answers will vary.

Making a Flare **Method**

Your task is to work out which metal chloride is the best for use in a flare.

Equipment List

B_____ **b**_____

h_____ **m**_____

w_____ **s**_____

m_____ **c**_____

Method

Step 1_____

Step 2 _____

Step 3 _____

Step 4 _____

Step 5 _____

Risk Assessment

Hazard	Harm it Can Do	How You Will Minimise the Risk
metal chloride solutions	It could cause irritation to the e_____ or s_____. It could be harmful to the e_____ .	Wear eye p_____. Use a l_____ concentration. Avoid contact with s_____.
Bunsen burner	It could cause b_____ .	Turn the Bunsen burner to the s_____ f_____ when not being used. Tie h_____ back.
glassware	If broken, it could cause c_____.	Tell the t_____ if something is broken.

Observations

Metal Chloride	Observations	Order (Brightest to Least Bright)
potassium chloride		
calcium chloride		
lithium chloride		
sodium chloride		
copper chloride		

My Conclusion

The metal chloride I would use to make a flare is _____

because _____

_____

Class Conclusion

As a class, the most popular metal chloride to use in a flare would be _____

Making a Flare **Method**

Your task is to work out which metal chloride is the best for use in a flare.

Equipment List

_____

_____

_____

_____

Method

_____

_____

_____

_____

_____

_____

_____

_____

Risk Assessment

Hazard	Harm it Can Do	How You Will Minimise the Risk

Observations

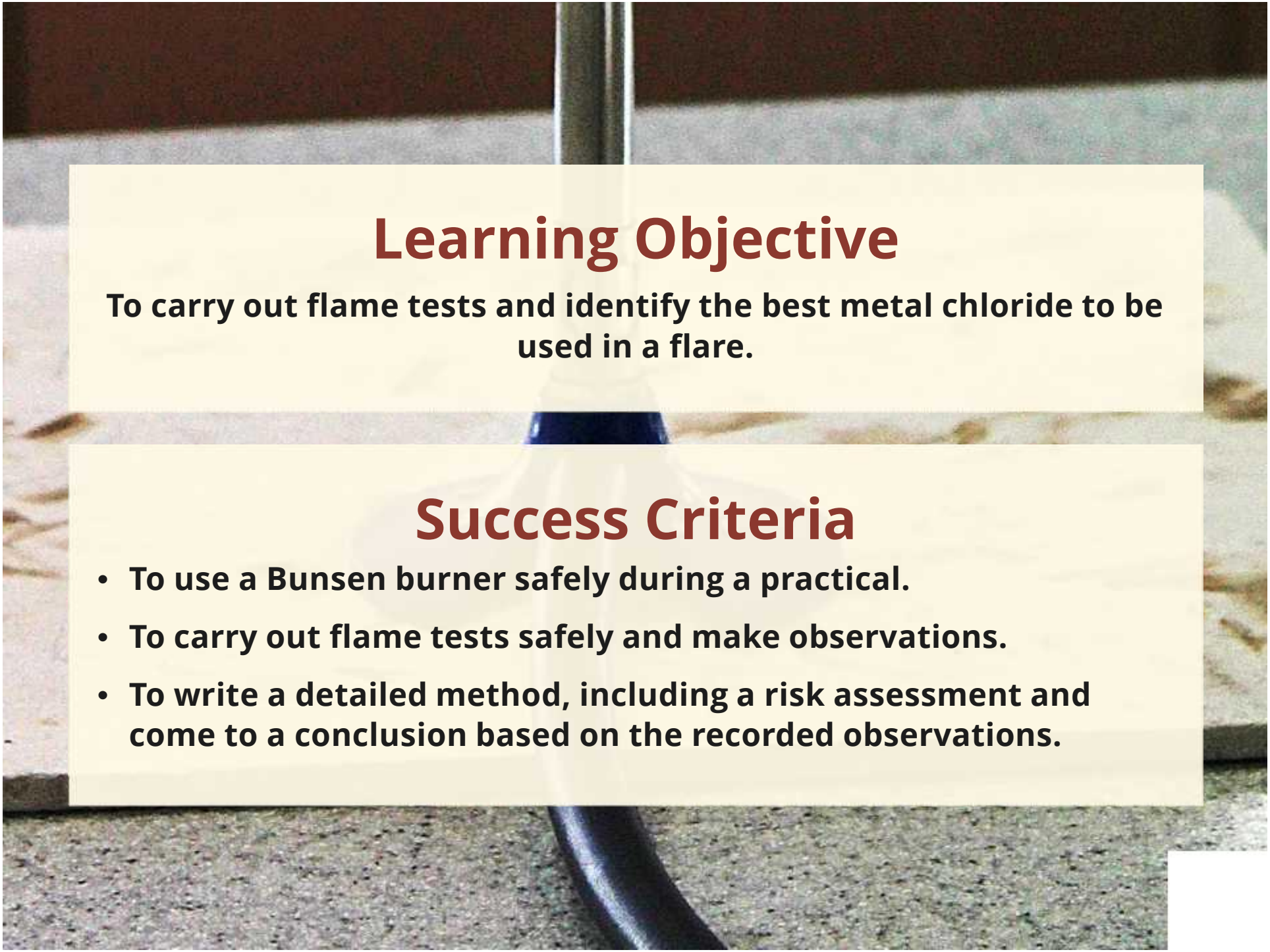
Metal Chloride	Observations	Order (Brightest to Least Bright)
potassium chloride		
calcium chloride		
lithium chloride		
sodium chloride		
copper chloride		

My Conclusion

Which metal chloride would you use in a flare and why?

Class Conclusion

Making a Flare



Learning Objective

To carry out flame tests and identify the best metal chloride to be used in a flare.

Success Criteria

- **To use a Bunsen burner safely during a practical.**
- **To carry out flame tests safely and make observations.**
- **To write a detailed method, including a risk assessment and come to a conclusion based on the recorded observations.**

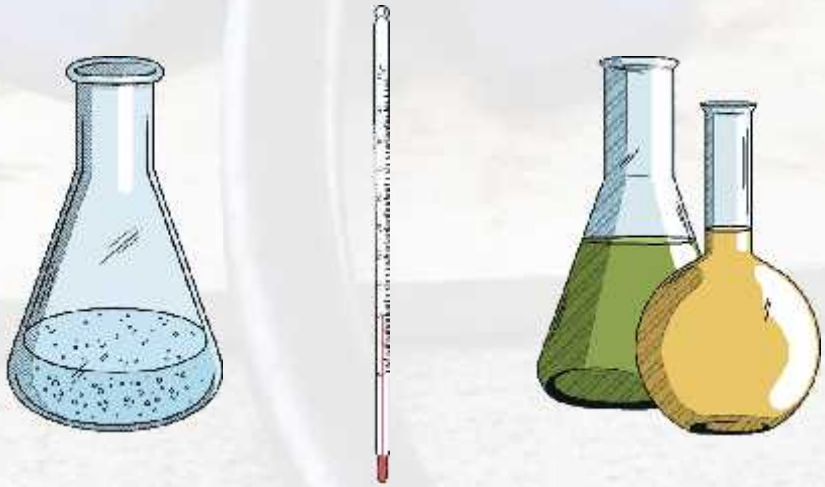
Chemical Reactions

How can you tell if a chemical reaction has taken place?

Fizzing/bubbles – a gas is produced.

A change in temperature (up or down).

A change in colour.



Everyday Uses of Chemistry

Chemistry is used in every day life, there are many examples including: cooking, fireworks and recycling. Can you give any more examples?

One of the uses of chemistry is in a flare.

What is a flare?

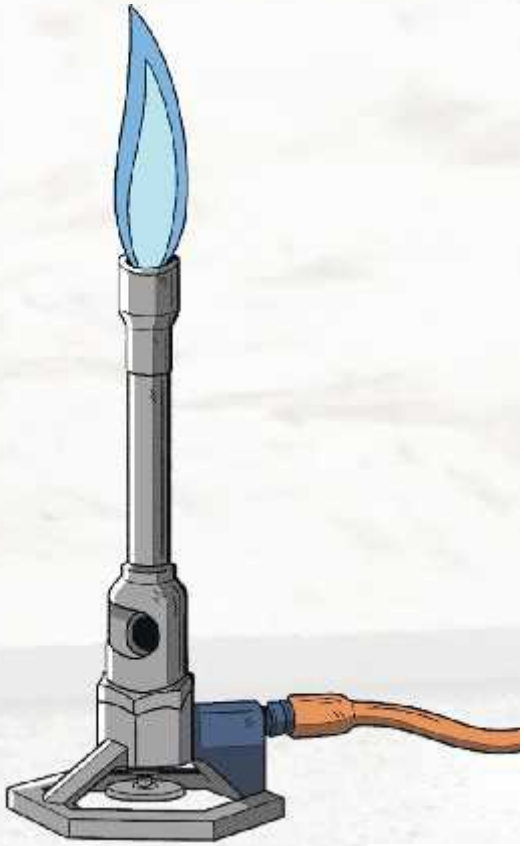
A flare is something used by people who are lost,
stranded or generally in trouble, for signalling to rescue services.

What properties do you want a flare to have?
bright and colourful

Demonstration: How to Carry Out a Flame Test

Your task is to work out which metal chloride is the best for use in a flare.

1. **Dip a wooden splint into a test tube of a metal chloride solution, e.g. copper chloride.**
2. **Turn the Bunsen burner to the blue flame and carefully place the end of the splint with the metal chloride solution into the flame.**
3. **Write down any observations/colours in the results table.**
4. **Repeat with different metal chloride solutions.**



Making a Flare Method

From the demonstration, make a list of the equipment you will need to carry out the flame tests and decide which metal chloride would make the best flare.

Equipment List

- Bunsen burner
- heatproof mat
- wooden splints
- metal chloride samples

Write a clear and detailed step-by-step method for how to carry out a flame test.

Peer-Assess Method

Write down what they have done well.

Suggest improvements they can make.

Things to look for:

1. **Have they written the method step by step?**
2. **Could you follow their method?**
3. **Is it detailed?**

Self-Assess Method

Did you remember all of the steps? Is your method clear and easy to follow?

1. **Dip a wooden splint into a test tube of a metal chloride solution, e.g. copper chloride.**
2. **Turn the Bunsen burner to the blue flame and carefully place the end of the splint with the metal chloride solution into the flame.**
3. **Write down any observations/colours in the results table.**
4. **Repeat with different metal chloride solutions.**

Risk Assessment

What do these hazard symbols mean?

health hazard

harmful to the environment

Containers of some concentrated metal chloride solutions would show these symbols.

What harm could chemicals with these symbols cause?

Chemicals with these symbols could cause irritation to the eyes or skin and could kill or harm living things in the environment.

What precautions should we take to make sure that no harm is caused when using these chemicals?

wear eye protection, use only a small amount of the solution, use a low concentration (dilute the solutions)

Risk Assessment

Before we carry out a practical we must assess the risks and think about how we will minimise them.

This is called a risk assessment.

Hazard	Harm it Can Do	How You Will Minimise the Risk
metal chloride solutions	It could cause irritation to the eyes or skin. It could be harmful to the environment.	Wear eye protection. Use a low concentration. Avoid contact with skin.

Risk Assessment

What other hazards could there be when carrying out flame tests?

e.g. Bunsen burner, broken glassware

What harm could these hazards cause?

Bunsen burners could cause burns.
Broken glassware could cause cuts.

How could we minimise these risks?

Use the safety flame when not using the Bunsen burner.
Tie hair back.
Tell the teacher if glassware is broken.

Important: Always tell the teacher straight away about cuts, burns or spills.

Risk Assessment

Complete the risk assessment.

Hazard	Harm it Can Do	How You Will Minimise the Risk
metal chloride solutions	It could cause irritation to the eyes or skin. It could be harmful to the environment.	Wear eye protection. Use a low concentration. Avoid contact with skin.
Bunsen burner	It could cause burns.	Turn the Bunsen burner to the safety flame when not being used. Tie hair back.
glassware	If broken, it could cause cuts.	Tell the teacher if something is broken.

Making a Flare

Carry out the flame tests and record your observations.

1. **Dip a wooden splint into a test tube of a metal chloride solution, e.g. copper chloride.**
2. **Turn the Bunsen burner to the blue flame and carefully place the end of the splint with the metal chloride solution into the flame.**
3. **Write down any observations/colours in the results table.**
4. **Repeat with different metal chloride solutions.**

Important: Wear eye protection.

Tell the teacher straight away about cuts, burns or spills.

Flame Tests Observations

Metal Chloride	Observations	Order (Brightest to Least Bright)
potassium chloride		
calcium chloride		
lithium chloride		
sodium chloride		
copper chloride		

Important: Wear eye protection.

Tell the teacher straight away about cuts, burns or spills.

Conclusion

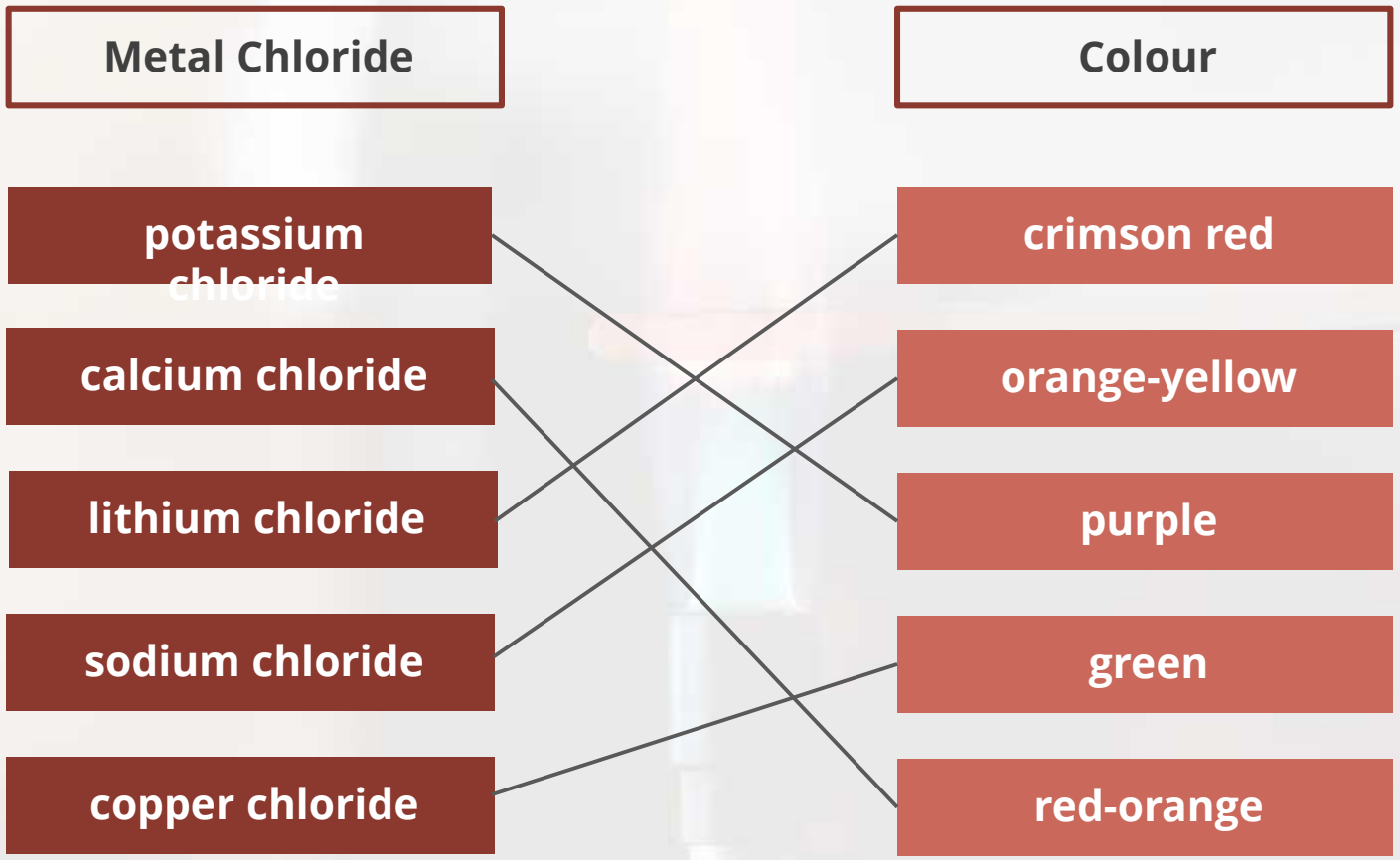
Class Results Tally Chart

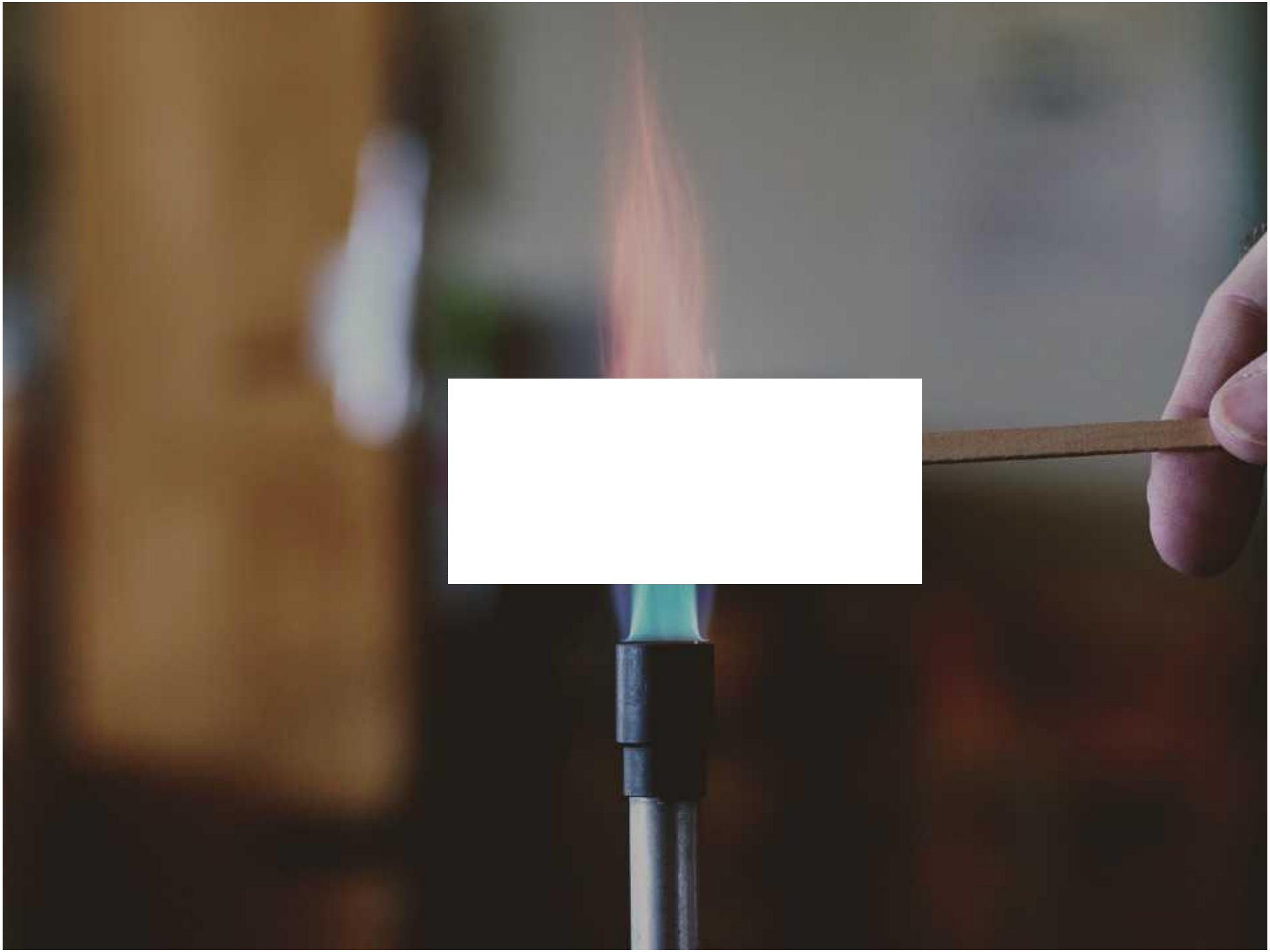
Vote for your choice of metal chloride. Create a tally in the chart below.

Metal Chloride	Number of students who think this is the best for a flare.
potassium chloride	
calcium chloride	
lithium chloride	
sodium chloride	
copper chloride	

Which metal chloride does the class prefer? Why?

Plenary


Metal Chloride
Colour
potassium chloride
calcium chloride
lithium chloride
sodium chloride
copper chloride
crimson red
orange-yellow
purple
green
red-orange



Making a Flare
Teacher and Technician Notes

In the Making a Flare lesson within the Introduction to Science unit of work for year 7, students will carry out flame tests to identify the metal chloride which would make the best flare.

Safety Information

Some concentrated metal chloride solutions are irritants and harmful to the environment. For this reason, we suggest that you use metal chloride solutions with a concentration of 0.5 mol dm^{-3}. At this concentration, the metal chlorides we have suggested pose a low risk.

As with any practical activity you should remind students of the laboratory safety rules and ensure that students wear eye protection throughout this practical.

Equipment per Group

Bunsen burner

heatproof mat

wooden splints

test tube rack

test tubes containing small amounts of:

- 0.5 mol dm^{-3} calcium chloride solution
- 0.5 mol dm^{-3} copper chloride solution
- 0.5 mol dm^{-3} lithium chloride solution
- 0.5 mol dm^{-3} potassium chloride solution
- 0.5 mol dm^{-3} sodium chloride solution

Notes

Other metal salt solutions could be used if the above are not available but you should always check the suitability of the chemicals you plan to use.

The risk assessment example answers included within this lesson is not an exhaustive list of hazards, risks and precautions to minimise them. You and your students may wish to add to the suggestions provided in the PowerPoint and Answer Sheet for this lesson.

Disclaimer

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Making a Flare
Teaching Ideas

Learning Objective:
To carry out flame tests and identify the best metal chloride to make a flare.

Success Criteria:

- To use a Bunsen burner safely during a practical.
- To carry out flame tests safely and make observations.
- To write a detailed method, including a risk assessment and come to a conclusion based on recorded observations.

Context
This lesson is part of the Introduction to Science unit of work for year 7 students. The lesson focuses on chemistry and using Bunsen burners to carry out flame tests. Students need to know how to use a Bunsen burner safely, so it is recommended that this lesson takes place after the **Using a Bunsen Burner** lesson in this unit of work.

Resources per group:
Bunsen burner, heatproof mat, five wooden splints, test tubes containing solutions of:

- potassium chloride
- calcium chloride
- lithium chloride
- sodium chloride
- copper chloride

eye protection

mini whiteboards (optional)

Starter

Chemical Reactions
How can you tell if a chemical reaction has occurred? Ask your students to write their answers on mini whiteboards or in their books. They can work in groups or independently. Ask them what they would see; what they would hear, what they would smell.

Main Activities

Everyday Uses of Chemistry
In groups, students discuss the uses of chemistry. Do they come up with examples that are related to biology or physics – can they explain the difference? Introduce them to flares and when/why they are used.

Demonstration: How to Carry Out a Flame Test
Demonstrate how to carry out a flame test. Remind students to pay close attention as they will be writing a plan including a method in their next activity of the lesson.

Method
After watching the demonstration of how to carry out a flame test, students identify the equipment needed for their investigation and write a method using the **Making a Flare Method Worksheet**. A support version of this worksheet is available if appropriate for your students. The students could peer- or self-assess their methods using the prompts in the PowerPoint.

Risk Assessment
Students should be guided through identifying the hazards, the harm they can do and the precautions which should be taken in this practical activity. A recap of hazard symbols and a discussion of how to use equipment safely should take place. The lesson PowerPoint includes prompts to assist students in completing the risk assessment on the **Making a Flare Method Worksheet**.

Making a Flare
Students carry out the practical in groups. Ensuring that all students are listening, make them aware of the health and safety rules. Students can record their observations on the **Making a Flare Method Worksheet**, or alternatively, a separate **Flame Tests Observations Table** is provided.

Conclusion and Class Results

Ask each student to choose a metal chloride for a flare, giving a reason. As a class, students vote for their choice of metal chloride to be used in the flare. The class comes to a joint conclusion as to which metal chloride is the best for a flare.

Plenary

Everyday Uses of Chemistry

Complete the match-up activity on the PowerPoint matching metal chlorides to their flame test colours. Students could complete this activity on mini whiteboards or in their books.

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