Hot times

Part 4 Heat and fire

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Version date	3 December 2004

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Contents – Part 4

Lesson 16 – The fire triangle

Have a look at a really simple way of making heat. Rub the palms of your hands together hard. What do you feel? Whenever two surfaces rub together, heat is produced.

The Aboriginal people of Australia made fires by rubbing two surfaces together. One stick was twisted between the fingers. The end of this stick was placed in a small hole in a second piece of wood together with some powdered wood. The place where the two pieces of wood touched got hot because of friction. When enough heat was produced by the rubbing, the powdered wood caught alight and smouldered. The powdered wood was used to light dried grass and so the fire was started.

Development of the technology of making fire by friction made life easier for Aboriginal people. This development involved working scientifically – making observations, experimenting and understanding cause and effect.

You could try this friction method of starting a fire. (You might find it is not as easy as it looks!) Do so responsibly – when you have finished cover the fire material with water.

Activity: What is needed for a fire?

Think about the aboriginal method of starting a fire. Two things that are needed for a fire were mentioned. Can you write down what they are?

_____

_____

The two things were wood and heat.

Can you think of a third thing that is needed?

_____

A fire also needs oxygen.

Three things are needed for a fire to burn:

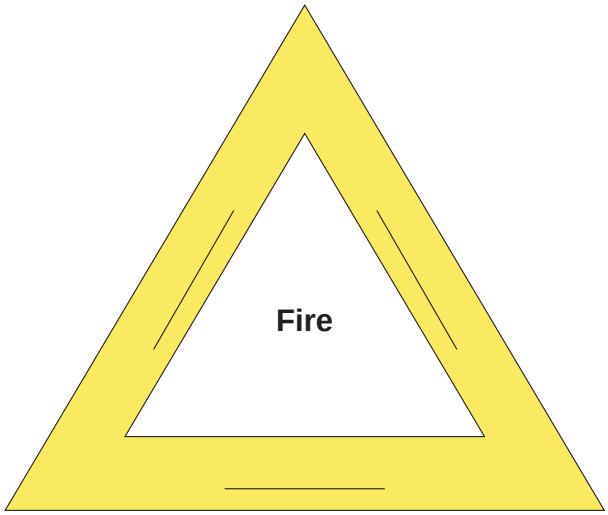
- a fuel, that is something to burn
- heat
- oxygen that usually comes from the air.

What is the fire triangle?

The ‘fire triangle’ is an easy way to remember that three things are necessary for a fire to burn.

Activity: The fire triangle

Fill in the three sides of the fire triangle with the names of the things that are needed to make a fire burn.



Check your response by going to the suggested answers section.

Take away any one of the components on the fire triangle and you have no fire!

Fuels

In our homes, there are many materials which can catch on fire. Some of these are meant to, but many of them are not.

Use your dictionary to look up the meaning of flammable. Write the meaning on the lines below.

_____

_____

Flammable means burns readily.

Flammable materials

Some flammable materials are used as fuels. Fuels are used to heat and sometimes light your home; to cook your food; for transport.

Activity: Flammable materials

Here is a list of materials. Which of the materials are often used as fuels?

Write the names of the materials under the correct heading.

wood	paint	cotton
natural gas	kerosene	wool
nylon	petrol	candle wax

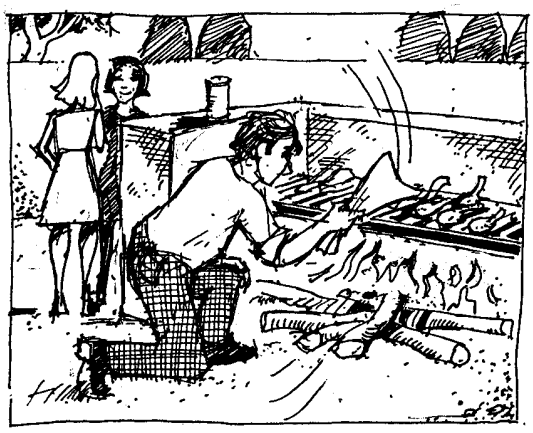
Commonly used fuels	Materials not meant to burn

Check your response by going to the suggested answers section.

Oxygen

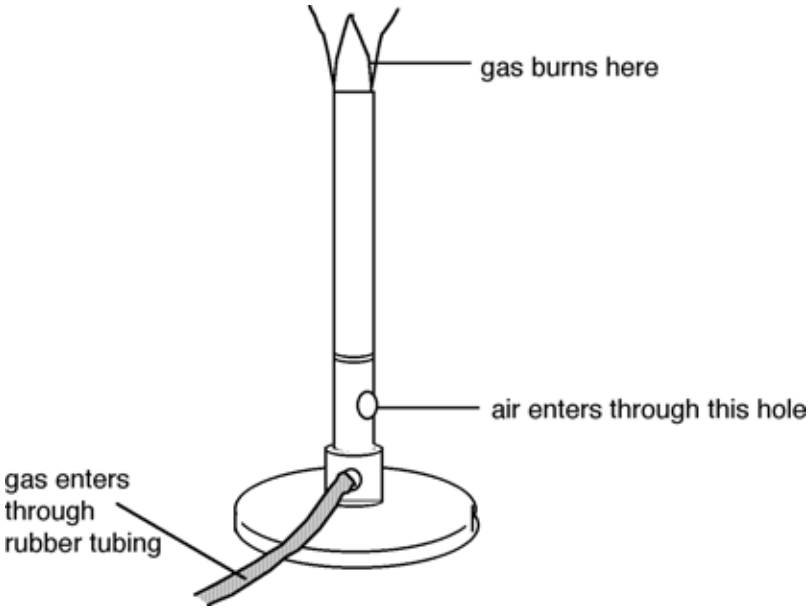
A supply of oxygen is needed for a fire to start and to continue burning. If fires don't have enough oxygen, they may go out. If something is burnt in oxygen alone, it burns more quickly than in air.

Have you ever gently fanned a fire to get it started? By gently blowing air over the fire you provide more oxygen for the fire to use.



The Bunsen burner

In school laboratories, heat for experiments is usually supplied by a Bunsen burner.



The parts of a Bunsen burner

Gas enters the burner through the rubber tubing. Air enters through the hole near the base of the burner. The air and gas mix in the tube and the mixture is set alight at the top of the tube.

Jane's initial observations

When Jane was doing an experiment, she noticed that her Bunsen burner could give two different flames. You can see the two flames the following photographs.

The yellow flame of a Bunsen burner

The yellow, flickering flame above is produced when the air hole of the Bunsen burner is closed. Very little oxygen is mixed with the gas when the air hole is closed.

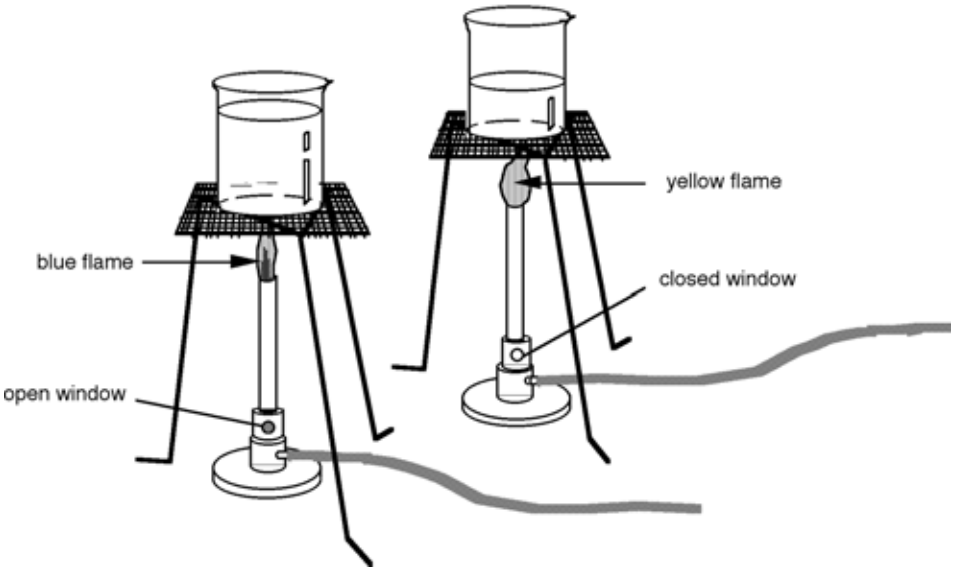
The blue flame of a Bunsen burner

The steady blue flame is produced when the air hole of the Bunsen burner is open. Plenty of oxygen enters the air hole and is well mixed with the gas before the gas and air mixture leaves the burner and starts to burn.

Jane's tests

Jane decided to so some tests to find out what was different about the two flames. She set up some equipment to find out which flame was faster at making water boil.

Jane noticed that Sharon, on the bench next to her, was doing the same thing. Here is a drawing showing Sharon's experiment.



Sharon's experiment

Jane did not think that Sharon's experiment was a fair test. Look closely at the beakers. Do you agree the test isn't fair? What would you change to make the test fair?

_____

_____

Did you notice that the amounts of water in the beakers were different? They should be the same for the test to be fair.

Jane's final observations

Jane made her experiment fair by putting 50 mL of water in each beaker. These are the results.

- Time for the yellow flame to boil 50 mL of water = 12 minutes
- Time for the blue flame to boil 50 mL of water = 4 minutes

Activity: Bunsen flames

Answer the following questions based on Jane's experimental results.

1 Which flame was faster at making the water boil?

_____

2 Which flame do you think is hotter?

_____

The blue flame was faster at making the water boil. The blue flame is hotter.

3 Compare the two flames by finishing this sentence:

The yellow flame is different from the blue flame because the yellow flame is_____ .

The yellow flame is different from the blue flame because the yellow flame is cooler than the blue flame.

Jane noticed another difference between the two flames. The beaker she heated with the yellow flame was covered in black soot. The presence of soot indicates that there was not enough oxygen to burn the fuel completely. Cars which are not tuned properly often have soot around the exhaust pipe.

4 Write another sentence comparing the amount of soot produced by the two flames.

The yellow flame is different from the blue flame because the yellow flame _____ .

The yellow flame is different from the blue flame because the yellow flame leaves soot on the container it is used to heat.

Go to the exercises section and complete the Exercise 4.1: Fire safety equipment in school science rooms.

What did you achieve?

Tick what you can do.

- ❒ describe technology used by Australian Aboriginal people to start fires
- ❒ identify the three things needed to make a fire burn
- ❒ explain how a Bunsen burner can produce a blue flame or a yellow flame.

Lesson 17 – Testing substances

How can you find out what substances are produced when a material burns? You can use the properties of substances to identify them.

Things that you can observe about a substance are called the properties of the substance. Some examples of properties are the state of the substance, how it tastes and smells, and its colour. Other properties are whether the substance burns and how it changes when it is mixed with other substances.

Do you remember what group of scientists investigate substances?

Write the name of the group of scientists that investigate substances.

_____

Chemists investigate substances. Chemistry is the investigation of substances.

Chemists often need to identify an unknown substance (find out what a substance is). To do this, they find out the properties of the unknown substance. Then they compare its properties to those of known substances. If two substances have identical properties, they are almost certainly the same substance.

Activity: Preparing limewater

Getting organised

You will need some **limewater** for this lesson and it must be prepared before you start the lesson. Here is how you can prepare it.

1 Get an old glass jar which has a screw-on lid. Make sure the lid fits tightly.

2 Get the packet marked calcium hydroxide from your minikit. Read the safety instructions on the packet. Explain to your supervisor how you will use the chemical safely.

3 Put on your safety goggles.

4 Empty the contents of the packet into the jar. Half-fill the jar with water. Screw the lid on and shake the mixture. Unscrew the lid and fill the jar with water. Screw the lid on again so it is airtight.

5 Use a texta to label the jar as limewater. Put it somewhere safe. Where will you store it?

_____

6 Don't shake the jar again. You want the liquid, not the solid on the bottom.

After you have used some of the limewater you can top up the water in the jar, as long as some white powder is left on the bottom of the jar. It is important that you screw the lid on again so that it is airtight.

Make sure the white powder has settled before you use the limewater again.

Activity: Investigating properties of carbon dioxide

Use carbon dioxide as an example. Carbon dioxide is a colourless, odourless gas produced when substances containing carbon burn in the presence of oxygen. If you are going to investigate carbon dioxide, you will need to make some.

You will need:

- 2 test tubes
- safety goggles
- spirit burner or a lighted match
- some vinegar
- some baking soda from your kitchen
- jar of limewater that you made earlier
- empty glass jar with a lid
- matches
- drinking straw
- a clean spoon.

Are you wearing your safety goggles?

Why do you think you need goggles to perform this experiment?

_____

_____

Perhaps the vinegar will splash, so the goggles will protect your eyes.

What you should do:

1 Put about 1 teaspoon of baking soda in the bottom of the empty jar.

2 *Slowly* pour in some vinegar. Don't let the mixture fizz out of the jar.

In the next step do not screw the lid on.

The jar could explode.

3 Wait until the fizzing dies down a bit and then rest the lid loosely over the top of the jar. The fizzing is the sound of carbon dioxide being produced.

Observing the properties of carbon dioxide

Now that you have made some carbon dioxide it is time to test it.

Activity: Observing the properties of carbon dioxide

1 Appearance

Your jar contains the gas carbon dioxide above the vinegar and baking soda mixture. Describe the appearance of the carbon dioxide. To do this, write down its colour and state. (State means whether it is a solid, liquid or gas.)

_____

Carbon dioxide is a colourless gas.

For this next part of the activity you need to have your supervisor present.

2 Effect on a flame

Light your spirit burner and pour some of the carbon dioxide onto the flame. That might seem a strange idea, but you can pour a gas even if you can't see it. Be careful that you don't pour out any of the liquid in your jar. Pour as though you were emptying out the top two-thirds of a full jar.

What effect does the carbon dioxide have on the flame?

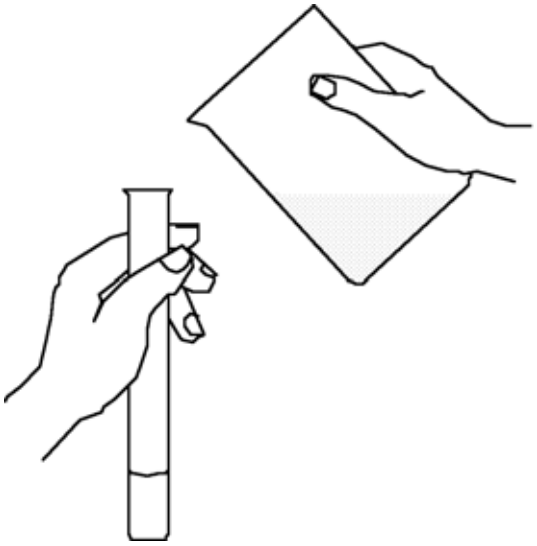
_____

Carbon dioxide puts out, or extinguishes, the flame.

3 Effect on limewater

The other jar you set up to make limewater should have some white powder on the bottom and a clear liquid on top. The clear liquid is limewater. Pour some of the clear limewater out of this jar very carefully so that none of the white powder comes with it.

Pour out enough clear limewater so that there is 1 or 2 cm in the bottom of a test tube. Now pour some carbon dioxide gas from the jar where you made carbon dioxide into the test tube. The diagram below shows you how.



Pouring carbon dioxide from a jar into a test tube containing limewater

Observe the surface of the limewater carefully. Write down what you observe.

_____

The surface turns white or cloudy.

Summary of the properties of carbon dioxide

The sentence below summarises what you have found out about the properties of carbon dioxide.

Activity: Properties of carbon dioxide

Fill in the spaces in this sentence.

Carbon dioxide is a _____ gas which _____

flames and makes limewater turn _____ .

Carbon dioxide is a colourless gas which extinguishes flames and makes limewater turn cloudy.

Now you have recognised some of the properties of carbon dioxide use that information to develop a test for carbon dioxide.

Testing for carbon dioxide

How can you test a gas to find out if it is carbon dioxide? That's easy! Carbon dioxide is the only colourless gas which turns limewater cloudy. So if you want to find out if carbon dioxide is present, you can test the gas with limewater.

Have you been told that the air you breathe out contains a lot of carbon dioxide? Test your breath and find out if that is true.

Activity: Testing for carbon dioxide

Pour about 3 or 4 cm of limewater into a test tube. Get a straw and start gently blowing bubbles into the limewater. Stop after every breath and observe what is happening to the limewater.

Do you think your breath contains carbon dioxide? Why do you think that?

_____

_____

Your breath contains carbon dioxide because your breath turns limewater cloudy.

Testing for water

Water is a colourless liquid. How can you test a liquid to find out if it is water? One test that chemists use involves a substance called cobalt chloride. Paper can be coated with cobalt chloride to make cobalt chloride paper. Cobalt chloride paper turns from blue to pink in the presence of water.

Imagine that you have a strip of blue cobalt chloride paper. You put a drop of water onto it. What would you expect to see?

_____

_____

The paper would change colour from blue to pink wherever it was wet with water.

Imagine the water soaks right through the cobalt chloride paper. Now it is all coloured pink. You warm the paper by putting it in an oven on the lowest setting or by blowing some warm air onto it from a hair drier.

What would you expect to see?

_____

_____

The wet paper would dry. As it does, it would change colour from pink to blue.

Water is the only colourless liquid which turns cobalt chloride paper from blue to pink. Some liquids which contain water will also cause the same colour change. (For example, methylated spirits often contains some water so it can turn blue cobalt chloride paper pink.) You can turn the paper from pink to blue many times as long as you don't wash the cobalt chloride off the paper.

Go to the exercises section and complete the Exercise 4.2: Describing chemicals

Fuels

Most fuels are hydrocarbons – chemicals made up of carbon and hydrogen.

When a fuel burns with oxygen the carbon from the hydrocarbon fuel combines with oxygen to produce carbon dioxide. This can be represented as a summary called a chemical equation. The → means gives or produces.

carbon + oxygen → carbon dioxide

The hydrogen from the hydrocarbon fuel combines with oxygen to produce water:

hydrogen + oxygen → water

A summary of the burning of a hydrocarbon in oxygen (or air) is:

hydrocarbon + oxygen → water + carbon dioxide

Heat energy released by the burning fuel produces a mixture of hot gases (mostly water and carbon dioxide) called a **flame** or flames.

If there is not enough oxygen for the fuel to completely burn the hydrocarbon may produce poisonous carbon monoxide gas or carbon particles called soot.

What did you achieve?

Tick what you can do.

- ❒ follow the planned procedure when performing an investigation
- ❒ describe a test for carbon dioxide
- ❒ describe a test for water.

Lesson 18 – The burning candle

In this lesson you identify the substances produced by a burning candle.

Activity: Fire triangle revision

First, a memory check before you begin your investigation.

1 Write down the three things that are needed for a fire to start:

_____

_____

2 When you light a candle, can you:

a name the fuel?

_____

b say where the heat comes from to start the fuel burning?

_____

c say where the oxygen for the fire comes from?

_____

Check your response by going to the suggested answers section.

For this next activity your supervisor must be present.

Activity: Testing products of a burning candle

You will need:

- an eyedropper
- a clock glass or saucer
- safety goggles
- a beaker
- a test tube holder
- a candle holder (not your best silver one) or an old saucer
- a candle
- some matches
- limewater.

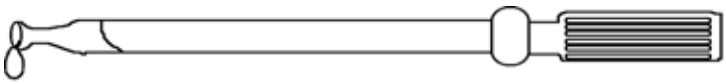
Make sure you are wearing your safety goggles.

What you should do:

1 Put the candle in the candle holder. If you are going to put the candle on a saucer, use dripping wax from the lighted candle to attach the base of the candle to the saucer.

2 Get some limewater in your eyedropper by squeezing the rubber bulb and then putting the tip of the eyedropper into the limewater and letting go of the rubber bulb.

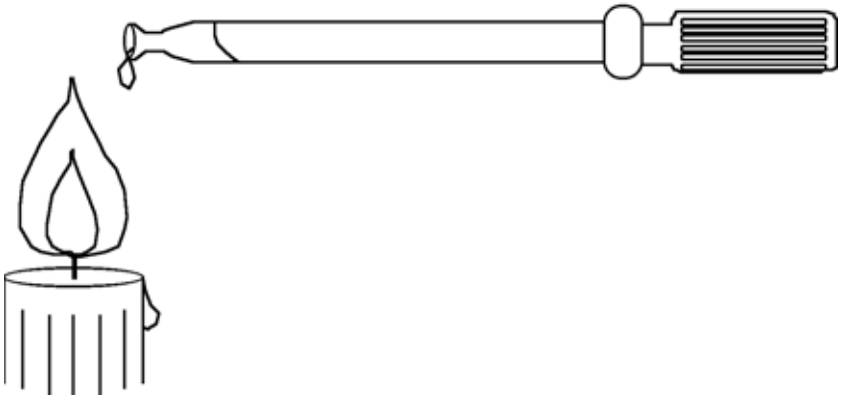
Hold the eyedropper in the air away from the candle flame. Press the end of the eyedropper so that a drop of limewater is exposed to the air. (See the diagram below.)



Watch the drop. How long does it take to look cloudy? (If it has not turned cloudy after 2 minutes, write more than 2 minutes on the line below and go on with the experiment.)

_____

3 Squeeze out the limewater into an empty beaker and wash out the eyedropper with water. Then get a fresh drop of limewater and hold it near the flame of the candle.



How long does it take to look cloudy?

_____

4 Now get your clock glass and hold it by its edge horizontally about 10 cm above the burning candle. Keep it there for a few seconds and then look at what is formed on the glass.

Do you see some small drops of liquid? If you do not, wait until the clock glass is cool and try again.

What do you think the substance is? Why?

_____

Did you notice that the liquid is colourless? Perhaps it is water.

A drop of the liquid put onto some blue cobalt chloride paper turns the paper pink.

Does this help you to identify the liquid substance? Why?

_____

Yes. Water turns blue cobalt chloride paper pink so the colourless liquid is water or contains water.

5 Now, use a test tube holder to hold the clock glass. Wave it through the candle flame for 30 seconds (no longer!). What do you see on the clock glass?

_____

You should see soot (carbon) formed on the outside of the clock glass.

Go to the exercises section and complete the Exercise 4.3: Observations on a burning candle.

What did you achieve?

Tick what you can do.

- ❒ test a burning candle for carbon dioxide and water
- ❒ distinguish between qualitative and quantitative observations.

Lesson 19 – Bushfires

Bushfires are a relatively common event in Australia. They have shaped the landscape.

Fire and the Aboriginal people

Fire has been of great importance to the Aboriginal people. It was used for warmth, for cooking food and for protection from spirits. Fires were lit at night by some Aboriginal people to keep away the spirits of the dead. Some Aboriginal people would not walk alone in the dark bush without a fire stick.

Fire has been used by the Aboriginal people in managing the land.
An explorer in 1889 wrote:

> The natives were about burning, burning, ever burning...
> *Ernest Giles, 1889*

Why did the Aboriginal people burn off so often?

It seems there were several reasons. Fire was a help in the hunt for food. The Aboriginal people used fire to drive out kangaroos and other animals from bushy areas.

A second use for fire was for encouraging new plant growth.
Fire destroyed a lot of grasses which had hard, dry leaves and which were not good for animals to eat. After these plants were burnt, new plants with soft leaves would grow. Kangaroos would then move into the area to eat these soft leaved grasses.

The burning also produced ash. Ash is a good fertiliser for the soil.
So, by burning bushland, the Aboriginal people produced good grasslands. When white settlers moved inland they often did not realise that Aboriginal people using burning had created the rich grasslands which the new settlers admired so much.

Activity: Fire and the Aboriginal people

Answer these questions using the information about fire and Aboriginal people.

1 Write down three reasons why fire was important in the everyday lives of Aboriginal people.

_____

_____

_____

2 Write down three benefits that Aboriginal people obtained from burning bushland.

_____

_____

_____

Check your response by going to the suggested answers section.

Today bushfires are often treated as disasters needing management.

‘Modern’ methods of managing bushfires

Australia, has some of the worst bushfires in the world. Now scientists believe that the Aborigines’ way of dealing with fire has a lot to teach us. Think about the fire triangle. Three things are needed for a fire to start. If you remove one of the three things, a fire is not likely to start at all.

Activity: ‘Modern’ methods of managing bushfires

Which do you think is the easiest thing on the fire triangle to remove to prevent bushfires starting?

_____

It would be easiest to remove the fuel for the fire.

Scientists believe that the fuel for a bushfire can be reduced by lighting small fires when the weather is cool. Then, when it is hot and dry there will not be enough fuel available to start large bushfires. Scientists from all over the world have come to Australia to see how the method works. Australian bushfires are amongst the most dangerous in the world.

How are modern methods of fire control similar to those of the Aboriginal people?

Modern methods of fire control are similar to those used by the Aboriginal people because they both _____

_____

They both reduce the amount of fuel available by lighting many small fires.

Activity: Mastery test on understanding fires

Lesley tested two methods of putting out a fire. First she made two identical fires. Then she timed how long it took to get the water and the carbon dioxide and how long it took to put the fire out. Her results were:

Method of putting out the fire	Time to get to the fire	Time to put out the fire
water	25 seconds	5 seconds
carbon dioxide	12 seconds	11 seconds

1 What did Lesley do to make sure that she carried out a fair test?

_____

2 How does water make the fire triangle collapse?

_____

3 How does carbon dioxide make the fire triangle collapse?

_____

4 Which was the faster method for putting out the fire?

_____

5 What is the total time taken for each method of putting out the fire?

a water _____

b carbon dioxide _____

6 Can you suggest a reason for the time it took to collect the water?

_____

Check your response by going to the suggested answers section.

Go to the exercises section and complete Exercise 4.4: Applying the fire triangle.

What did you achieve?

Tick what you can do.

- ❒ relate Aboriginal peoples' use of fire to their environment
- ❒ compare 'modern' and Aboriginal methods of using fire
- ❒ apply the fire triangle to extinguish fires.

Lesson 20 – Fire-extinguishers

A fire-extinguisher is a device for putting out fires. The chemical that comes out of the fire extinguisher is called the extinguisher. In science laboratories there is often a bucket of sand. Sand is a good extinguisher for small fires of burning liquid or burning metal.

Before you can talk about ways of putting out a fire, you need to look at some of the different types of fires.

Classes of fire

There are many different ways to classify or group fires. The method used in the following table classifies a fire by the fuel that is burning.

Class of fire	Fuel	Examples
A	materials found in the home	curtains, wood
B	flammable liquids	petrol, methylated spirits
C	electrical equipment	fire in a toaster, fire in an electric heater
D	metals which burn	lithium, magnesium

Activity: Which class of fire

If these fuels or objects were burning, which class of fire would be the result?

Identify the class of fires where the fuel listed below is burning.

1 cooking oil _____

2 record player _____

3 kerosene _____

4 chair _____

5 sodium metal _____

Check your response by going to the suggested answers section.

Different classes of fire are best controlled using different types of extinguishers.

Types of extinguishers

Here are some of the chemicals used as extinguishers in putting out fires.

Extinguisher	How it works	Advantage	Disadvantage
water	removes heat	cheap	dangerous near electricity
sand	cuts off air	cheap	heavy to carry
carbon dioxide	cuts off air	no mess	blows away outside
foam	cuts off air	doesn't blow away easily	messy
dry chemical powder	cuts off air	fast acting	none

Activity: Types of extinguishers

Use the information about types of extinguishers to answer these questions.

1 Which extinguishers work by cutting off air from the fire?

_____

2 Why would you prefer to use a carbon dioxide extinguisher inside rather than outside?

_____

3 Why would you prefer to use a foam extinguisher outside rather than inside?

_____

4 Look at the top row in the table. It gives you information about how water can be an extinguisher. Here is a paragraph that converts information from the row into sentences.

> Water can extinguish a fire because it removes heat. It is cheap to use but can be dangerous near electricity.

Choose three other extinguishers from the table. Convert the information into sentences.

- _____
  _____
  _____
- _____
  _____
  _____
- _____
  _____
  _____

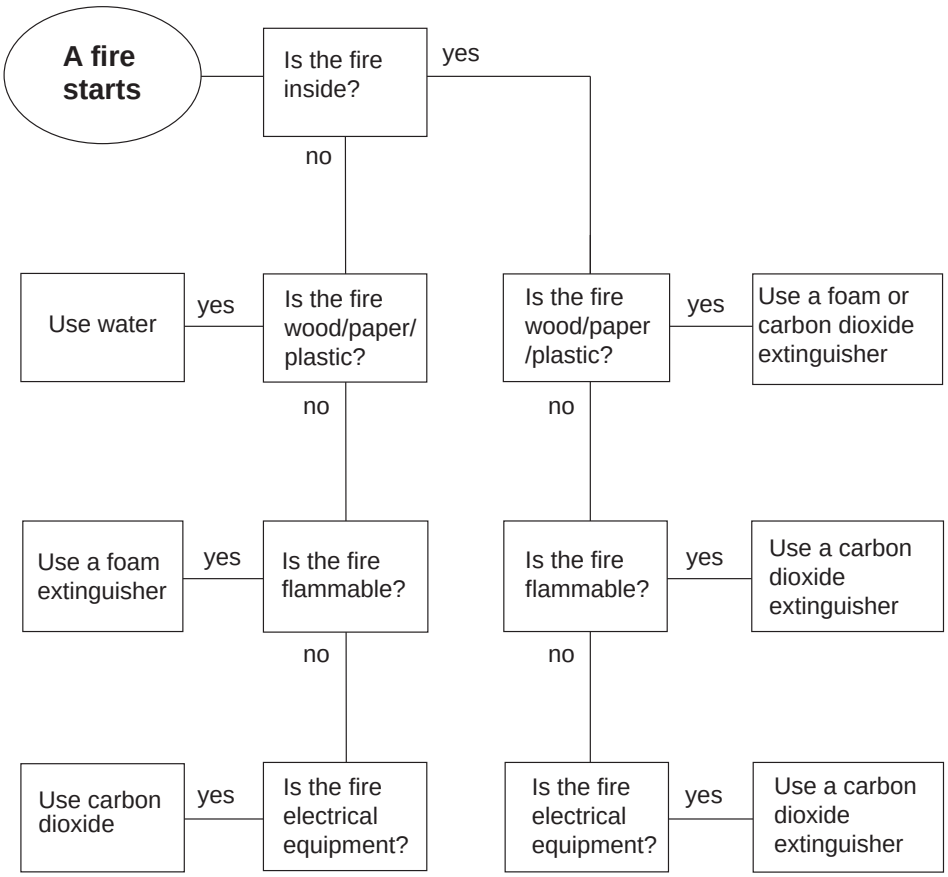
Check your response by going to the suggested answers section.

Deciding which type of extinguisher to use is important.

How can you choose the right sort of fire-extinguisher? The flow chart can help.

Activity: Using a flow chart

See if you can follow this flow chart. It helps you decide on the appropriate fire extinguisher.



Follow through the steps in this example.

Example: Suppose the TV set in your lounge room is burning. Which would be the best type of extinguisher for Sue to use to put out the fire.

Solution

1 Start by finding out what class of fire you have to put out. A TV is a piece of electrical equipment often connected to electricity.

2 Now go to the top left of the key. Follow the line from 'A fire starts' to the first box and answer the question in the box.

Is the fire inside? _____

3 The answer is yes, so follow the 'yes' line across to the right and then down to the next box and answer that question.

Is the fire wood, paper or plastic? _____

4 The answer is no, so follow the 'no' line down to the next box and answer that question.

Is the fire flammable liquid? _____

5 The answer is no. which box do you go to now – the one on the right or the one underneath?

The 'no' line leads us to the box underneath which asks:

Is the fire electrical equipment.

6 This time the answer is yes, so you move along the 'yes' line to the box on the right. That box contains the name of a type of fire extinguisher.

Write down the name of the fire extinguisher.

_____

The fire extinguisher you should use is a carbon dioxide extinguisher.

1 Use the flowchart to find out the type of extinguisher you should used to put out a fire in a pile of newspaper inside your laundry.

_____

You would use either foam or a carbon dioxide extinguisher.

2 Would your answer be the same if the pile of newspaper were outside?

_____

No – this time you would use water to put out the fire.

Portable fire-extinguishers can be carried to a fire by the average person. you can see them in public buildings, schools, shops, etc. and may even have one or more at home. They are colour coded and labelled with their contents.

No extinguisher is suitable for *all* fires. Firefighters choose an appropriate extinguisher for:

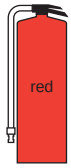
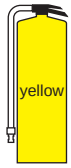
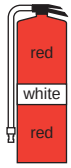
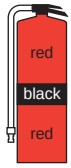
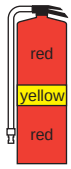
- ordinary combustibles eg, wood, paper, plastics
- flammable liquids eg, petrol, methylated spirits
- flammable gases eg, LPG (liquefied petroleum gas), CNG (compressed natural gas)
- energised electrical equipment (electrical equipment connected to electricity)
- cooking oils/fats.

Activity: Types of fire-extinguishers in the community

Locate three portable fire-extinguishers in your community. Record the location, colour and labelling of the fire-extinguishers in the table below.

Location	**Colour**	**Labelling**

Check your response by going to the information in the Portable fire extinguisher chart below.

Indicator ⇨		A	B	C	(E)	F
Type of fire ⇨		Ordinary combustibles (wood, paper, plastics,etc.)	Flammable and combustible liquids	Flammable gases	Fire involving energised electrical equipment	Fire involving cooking oils and fats
Identifying colours ⇩	Type of extinguisher ⇩	Extinguisher suitability ⇩				
	Water	✓	✗	✗	✗	✗
	Wet chemical	✓	✗	✗	✗	✓
	Alcohol resistant foam	✓	✓	✗	✗	✗
	AFFF type foam	✓	✓	✗	✗	✗
	AB(E) dry chemical powder	✓	✓	✓	✓	✗
	B(E) dry chemical powder		✓	✓	✓	✓
	☆ Carbon dioxide (CO_2)	✓	✓	✗	✓	✓
	☆ Vaporising liquid # (fumes may be danderous in confined spaces)	✓	✓	✓	✓	✗

☆ Carbon dioxide and vaporising liquid extinquishers are not suitable for deep seated smouldering A class fires.
Fumes may be dangerous in confined places, eg lifts

Portable fire extinguisher chart

Go to the exercises section and complete the Exercise 4.5: Australian bushfires

What did you achieve?

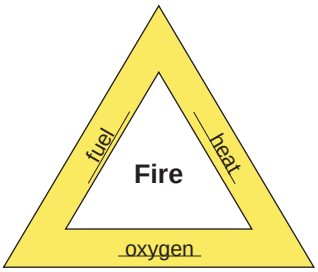
Tick what you can do.

- ❒ acknowledge that different types of fire require different types of fire extinguisher
- ❒ identify the different types of fire-extinguisher in your community
- ❒ appreciate the importance of knowing the type and frequency of bushfires where you live.

Suggested answers – Part 4

Check your responses against these suggested answers.

Activity: The fire triangle



Activity: Flammable materials

Commonly used fuels	Materials not meant to burn
wood	paint
natural gas	cotton
kerosene	wool
petrol	nylon
candle wax	

Activity: Fire triangle revision

1 The three things that are needed are a fuel, oxygen and heat.

2 a The fuel is the wax that the candle is made from.

b The heat comes from the burning match that you use to light the candle.

c The oxygen comes from the air.

Activity: Fire and the Aboriginal people

1
- for warmth
- for cooking food
- for protection from spirits.

2
- to help in the hunt for food
- to bring on new plant growth

- to produce ash which is a good fertiliser to help produce good grasslands.

Activity: Mastery test on understanding fires

1 Lesley made two identical fires. She also measured the time it took to put the fire out separately from the time to get the extinguisher.

2 Water removes heat from the fuel.

3 Carbon dioxide prevents oxygen reaching the fuel.

4 Water

5 a 30 seconds

b 23 seconds

6 She probably had to find a bucket and then fill it.

Activity: Which class of fire?

1	cooking oil	class B
2	record player	class C
3	kerosene	class B
4	chair	class A
5	sodium metal	class D

Activity: Types of extinguishers

1 Sand, carbon dioxide, foam and dry chemical powder all work by cutting off the air to the fire.

2 A carbon dioxide extinguisher is preferred inside because outside, the gas might blow away and not put out the fire.

3 A foam extinguisher is usually used outside because it would make a mess inside.

4 Here are some examples of paragraphs about the different extinguishers.

- Sand can put out a fire as it cuts off the air. It is cheap but is heavy to carry
- A carbon dioxide extinguisher cuts off air from a fire to extinguish it. It does not make a mess because carbon dioxide is a gas but this can be a disadvantage because the gas blows away outside.
- Foam prevents air from getting to a fire and therefore extinguishes it. It does not blow away easily outside but makes a mess.
- Dry chemical powder extinguishes a fire by stopping air reaching the fire. It works very quickly and is easy to clean up.

Exercises – Part 4

Exercises 4.1 to 4.5

Name _____

Teacher _____

Exercise 4.1: Fire safety equipment in school science rooms

Each school science room must contain:

- an approved fire blanket placed in a prominent position, visible and accessible to students and staff. It is used for smothering small fires in containers and burning clothes or hair.
- a carbon dioxide (CO_2) portable fire-extinguisher (red with a black band)

Metal fire buckets in preparation rooms contain dry sand. Sand stops the spread of fire by absorbing burning liquid. Sand can also be used to smother small fires of burning metal.

The *PASS* method for using fire-extinguisher is recommended.

*P*ull the pin

*A*im low at the base of the fire

*S*queeze the handle

*S*weep from side to side at the base of the fire.

In a school the fire-extinguisher should only be used by the teacher, and only on small and containable fires or to help people escape the fire. If there is any doubt whether the fire can be put out it is safer to leave the area and raise the alarm.

There are good scientific reasons behind this information.
Think scientifically before answering each question.

1 If a person's clothing or hair is on fire they must be stopped from running around. Why would running around increase the fire?

_____

_____

_____

2 How does a fire blanket stop clothes or hair burning?

_____

_____

_____

3 Sand must NEVER be put on a hair or clothing fire. How would the sand affect treatment of the person's burns.

_____

_____

_____

4 Why is a fire-extinguisher aimed at the base of the flames rather than middle or the top?

_____

_____

_____

Exercise 4.2: Describing chemicals

Congratulations, you have just handled seven different chemicals.

The table below gives details about these seven chemicals. Full details are given for calcium carbonate, the white solid formed when carbon dioxide dissolves in limewater.

The middle column shows you the shorthand way chemists have of writing chemical formulas – you probably already know H_2O for water. There is no need to learn the formulas. In the fourth column put solid, liquid or gas.

Note: (aq) stands for aqueous solution meaning solution in water.

common name	**chemical name**	**chemical formula**	**state of matter**	**colourless or white**
lime	calcium hydroxide	$Ca(OH)_2$		
water	dihydrogen oxide	H_2O		
limewater	solution of calcium hydroxide in water	$Ca(OH)_{2\,(aq)}$	liquid solution	
baking soda	sodium hydrogen carbonate	$NaHCO_3$		
vinegar	solution of acetic acid in water	$CH_3COOH_{\,(aq)}$	liquid solution	
carbon dioxide	carbon dioxide	CO_2		
chalk	calcium carbonate	$CaCO_3$	solid	white

Exercise 4.3: Observations on a burning candle

Quantitative observations answer the question 'how much?' by giving quantities. Other observations are called qualitative.

Complete quantitative and qualitative observations for your burning candle by filling in the missing spaces. You will probably need to relight your candle to answer some of the observations.

The candle I used was _____ in shape, _____ centimetres across and _____ centimetres high. The wick is made of _____ strands twisted together.

When it is burning most of the wick is black except for the top _____ centimetres which glows red. The wick is straight until _____ centimetres from its top.

The flame is about _____ centimetres high and about _____ centimetres at its widest. The flame begins about _____ centimetres above the top of the candle where there is a pool of _____ colourless liquid. The bottom of the flame is a _____ colour, while the rest of the flame is mostly _____ in colour. Around the wick is a dark flame region about _____ cm high and _____ cm wide.

A finger feels uncomfortable after 10 seconds when held _____ cm above the flame. The same finger feels uncomfortable after 10 seconds when held _____ cm to the side of the flame.

Use a pencil to draw a circle around each quantitative observation.

Exercise 4.4: Applying the fire triangle

You can extinguish a fire by removing one or more of the things a fire needs to burn.

If you can make the fire triangle collapse by taking away one of its sides, the fire will go out. Here are some common ways of extinguishing fires.

Work out which side of the fire triangle has been removed in each example:

1 Imagine your little sister is standing in front of an electric radiator and her dress catches on fire. You grab her and roll her on the ground to put out the fire. Well done! How did you make the fire triangle collapse?

_____

_____

2 Imagine your brother is watering the garden when he sees that the garden shed has caught on fire. He turns the hose on the shed and puts out the fire. How did he make the fire triangle collapse?

_____

_____

3 When you pour carbon dioxide on a flame the flame goes out. How did this make the fire triangle collapse?

_____

_____

4 You are hiking in the bush and use a fire to cook lunch. Before you leave you make sure the fire is out by covering it with sand and dirt. How did you make the fire triangle collapse?

_____

_____

5 When homes are threatened firefighters often use back-burning. This means they start a small fire between the bush and the houses. How are firefighters trying to collapse the fire triangle?

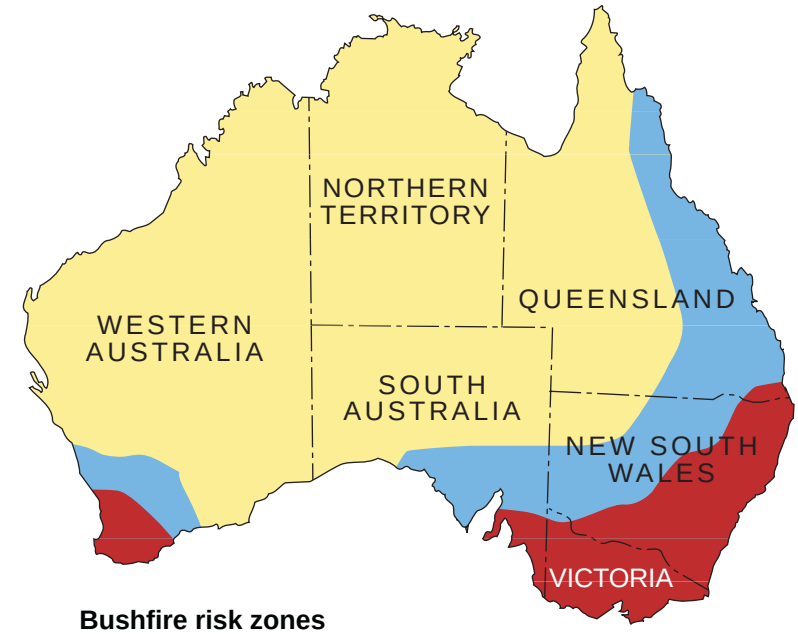
_____

_____

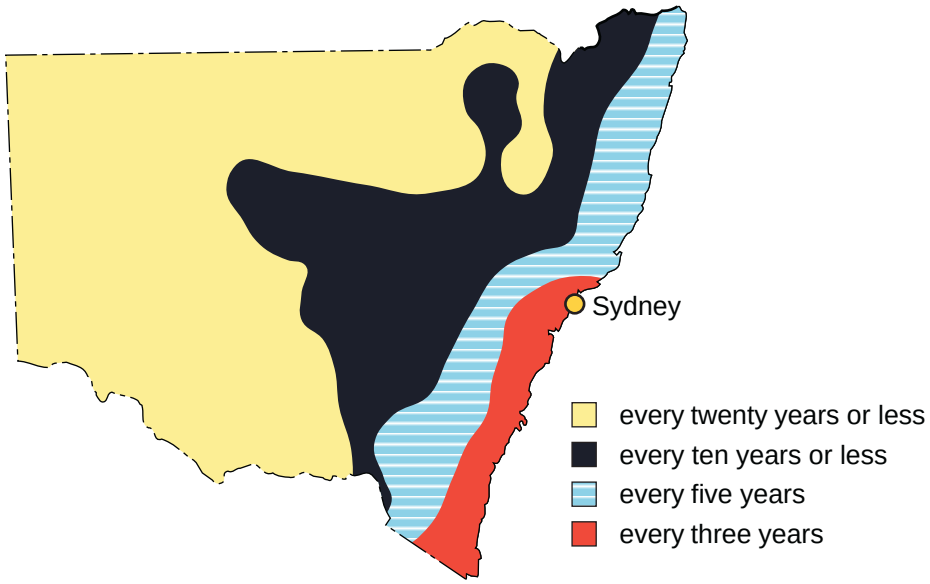
Exercise 4.5: Australian bushfires

Use crosses to show where you live or have lived on these maps of Australia and New South Wales.

Select one of the locations in NSW where you have lived or know about. Now use the information in both maps to describe bushfire conditions at this NSW location. Be careful in your answer. The two maps show different things.



Bushfire risk zones



Bushfire frequencies in NSW

Bushfire conditions at _____location:

_____

_____

_____

_____

_____

_____

_____

_____