## INTRODUCTION

Every single person in our community is connected in one way or another with fire. Fire may be disastrous in that it destroys our belongings and interrupts our way of life or fires may be beneficial by providing us with an energy source which we can use to prepare meals, keep us warm, transport us and our goods and maintain our standard of living. Developing a better understanding of the nature and behaviour of fire will enable us to maximise the benefits and minimise the disastrous affects of fire.

■ It is within this context that FireScience provides learning experiences through which students can acquire scientific knowledge, skills and attitudes within a conceptual framework to facilitate the application of their understanding to everyday life.

FireScience aims towards developing a fire sensible population that will be well informed about fire behaviour, management and safety. ■ This student based activity book relates many of the scientific concepts of fire behaviour and management to the Syllabus Core Content Areas of the NSW Science Syllabus in order to promote fire consciousness into the teaching of science. Science provides a medium in which many of the fire safety concepts introduced in primary school can be continued into the later years at school.

**Teachers - Please note:**

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- Survival of native animals

# air
## & Gases

## SYLLABUS CORE CONTENT COVERED BY THESE EXERCISES INCLUDE:

**4.22.1 (b) Categorise elements as metals and non-metals according to their common characteristics.**

**4.22.2 (a) Distinguish between elements and compounds.**

**(b) Recognise that a new compound is formed by rearranging particles rather than creating matter.**

**(c) Identify when a chemical reaction has taken place.**

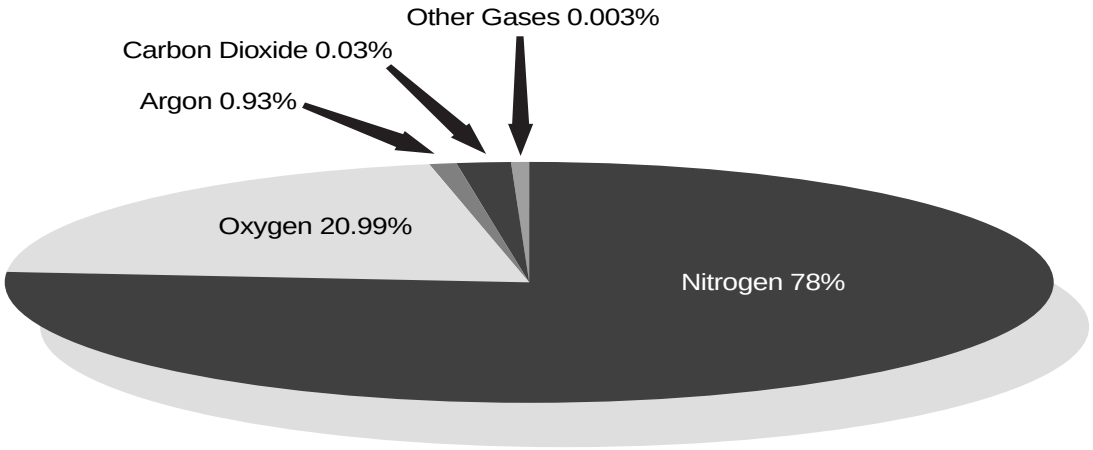
**4.26.1**

**(b) Identify gases that comprise the greater percentage of the air.**

**(c) Describe the history and application of the idea of air pressure.**

## AIR IS A MIXTURE

The following pie graph shows the gases, which are present in air.




**Use the information in the graph to answer the question below.**

- From this information, which is the most abundant gas? .....
- Which is the gas that supports burning? .....
- Which is the gas that is sometimes used in fire extinguishers? .....
- What fraction of the air is oxygen? .....

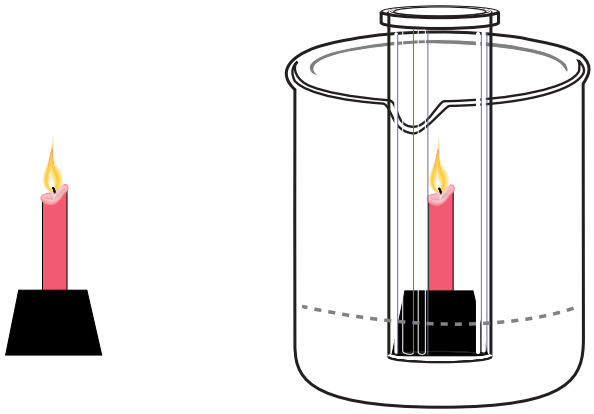
**Experiment** **HOW MUCH OF THE AIR IS OXYGEN?**

**AIM**

**How much oxygen is used up when something burns?**

**METHOD**

- Set up a lighted candle in a rubber stopper and place the stopper into the beaker of water as shown in the following diagram.



- Place a gas jar over the lighted candle so that the gas jar is in the water.
- Measure the distance that the water goes up the gas jar.

**RESULT**

**Describe what happened to the candle and the water:**

.....

.....

**Illustrate your answer with a neat well-labelled diagram:**

## CONCLUSION

- When something burns it uses oxygen. This oxygen is taken from the .....

.

Oxygen takes up about 1/5 of the air. When the oxygen is used up in the gas jar it is replaced by the water.

Measure the distance between the water and the top of the gas jar

X= .....

Measure the distance that the water goes up the gas jar

Y= .....

Calculate the fraction of the air that is oxygen

X/Y = .....

Account for any differences between your result and the theoretical result for the % of oxygen in the air.

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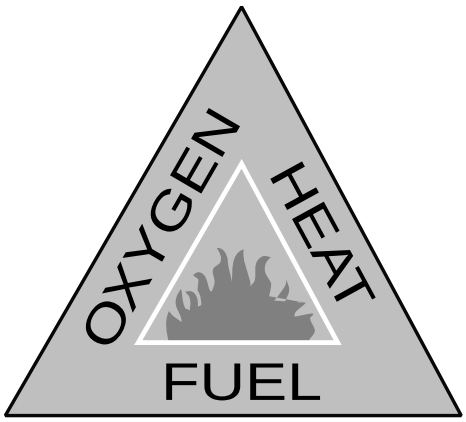
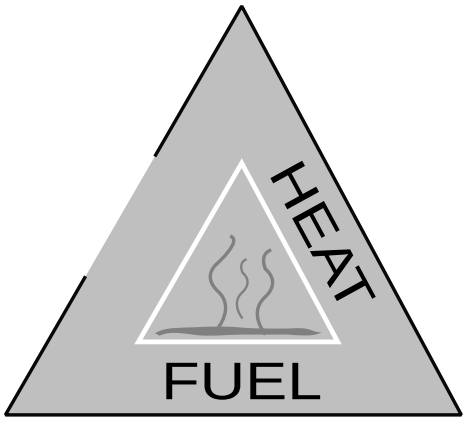



In order to have fire the three elements in the fire triangle must be present.



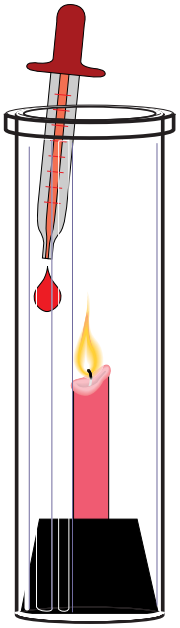

If one or more of these elements is removed or not present a fire will not burn.

# CARBON DIOXIDE AND FIRE

**Aim**

**Is carbon dioxide capable of extinguishing fire?**



**Requirements:**

- vinegar
- bicarbonate of soda
- gas jar
- stopper and candle
- large dropper

**Method:**

- Place the candle into the stopper.
- Carefully slide the stopper/candle into the gas jar.
- Light the candle.
- Sprinkle the bicarbonate of soda around the stopper.
- Add some vinegar to the bicarbonate of soda.

**Result**

what I saw: .....

.....

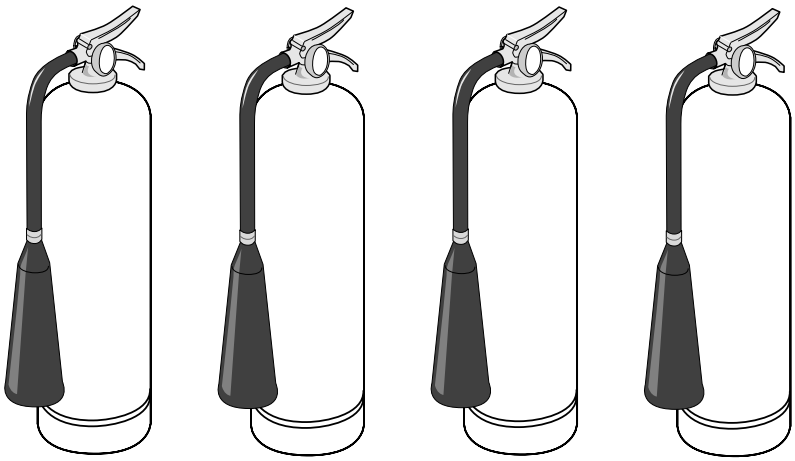
what I heard: .....

.....

**Conclusion.**

The gas made in this experiment is called carbon dioxide. It can be distinguished from many other gases because it extinguishes a flame. The shorthand way of writing carbon dioxide is ..... The laboratory should have a carbon dioxide extinguisher located near the exit to the room. Locate this extinguisher and colour in one of the following diagrams of extinguishers.

**WHAT SORT OF FIRE EXTINGUISHER IS THAT?**



Read the following descriptions of some different types of fire extinguishers.

**Colour and label the above diagrams accordingly.**

| TYPE | COLOUR | USE |
|---|---|---|
| WATER | ALL RED | ..... |
| FOAM | ALL BLUE | ..... |
| CO2 | RED WITH A BLACK BAND | ..... |
| DRY CHEMICAL | RED WITH A WHITE BAND | ..... |
| WET CHEMICAL | BROWN | ..... |

**(check these colors with your local authority as they may change)**

**The following table lists the different uses of each type of extinguisher:**

.....

.....

.....

.....

.....

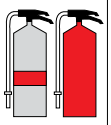
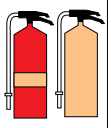
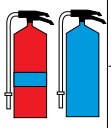
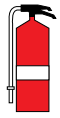
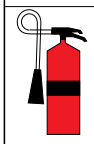
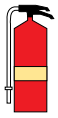
.....

.....

.....

.....

| CLASS OF FIRE | | A | B | C | (E) | F |
|---|---|---|---|---|---|---|
| TYPE OF FIRE | | Ordinary combustibles (wood, paper, plastics etc.) | Flammable and combustible liquids | Flammable gases | Fire involving energized electrical equipment | Fire involving cooking oils and fats |
| INDICATING COLOUR | TYPE OF EXTINGUISHER | EXTINGUISHER SUITABILITY | | | | |
|  | WATER | YES Most suitable | NO | NO | NO | NO |
|  | WET CHEMICAL | YES | NO | NO | NO | YES Most suitable |
|  | ALCOHOL RESISTANT FOAM | YES | YES Most suitable for alcohol fires | NO | NO | NO |
| | AFFF TYPE FOAM | YES | YES Most suitable except for alcohol fires | NO | NO | NO |
|  | AB(E) DRY CHEMICAL POWDER | YES | YES | YES | YES | NO |
| | B(E) DRY CHEMICAL POWDER | NO | YES | YES | YES | YES |
|  | CARBON DIOXIDE ($C0_2$) | YES | YES | NO | YES | YES |
|  | VAPOURIZING LIQUID (fumes may be dangerous in confined spaces) | YES | YES | NO | YES | NO |

**Choose the best type of extinguisher that might be used in each of the following situations:**

- A TV set catches on fire .....
- A pile of old papers is burning in the corner of a room .....
- Some petrol is on the roadway following an accident .....
- The oil in the fish and chip shop has ignited .....

**Now answer these questions:**

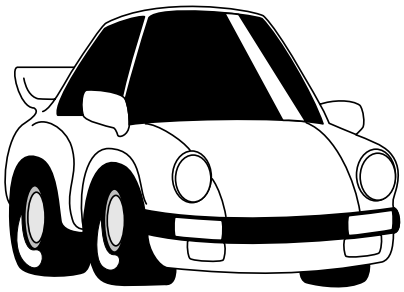
1. Which type of fire extinguisher is found in the laboratory? .....

2. List some other things in the laboratory, which could be used to extinguish a fire?

.....

.....

## HOW MAGNESIUM BURNS



Many modern cars have mag wheels to not only make them look good but to also reduce weight and provide better cooling for the brakes. Motors may have magnesium bits as well because of its lightness.
BUT! LOOK OUT IF THEY BURN.

### THE MAGNESIUM / OXYGEN SNATCH AND GRAB

Magnesium is a metallic element, its chemical symbol is .....

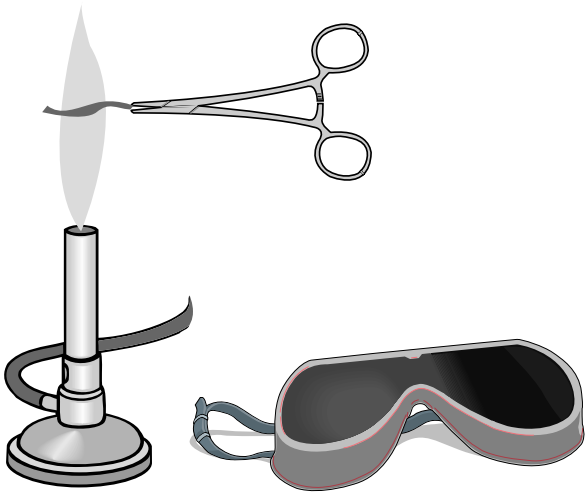
Oxygen is a non-metallic element, its chemical symbol is .....

### AIM

Can magnesium combine with oxygen to form a new substance?

### METHOD

Hold the magnesium ribbon with metal tongs and place the magnesium into the Bunsen flame.
DO NOT STARE AT THE FLAMING MAGNESIUM - look at it out of the corner of your eye.
Make sure you have a heat proof mat and wear safety goggles.



### RESULT

Describe the flame and how the magnesium burnt .....

.....

What was left after the magnesium burnt? .....

.....

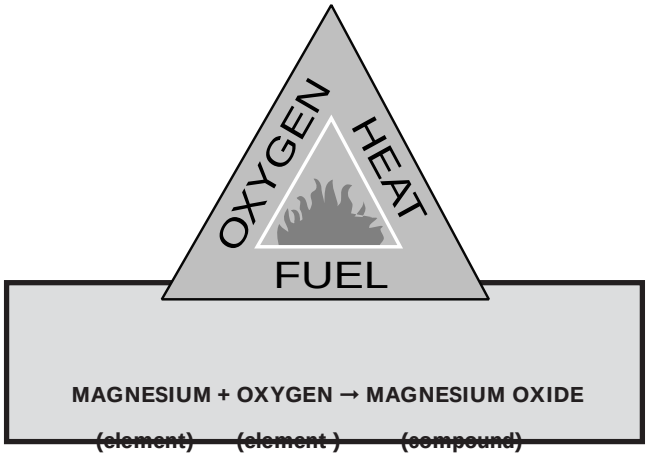
What was the main energy type produced in this reaction? .....

.....

**CONCLUSION**

When things burn they combine with oxygen in the air. Oxygen is part of the FIRE TRIANGLE .




**Do you think that burning magnesium would be easy to put out?**

..... currently available extinguishers are very suitable for putting out this type of fire. Rural fire fighters would probably respond to this type of fire by covering with soil and containing the fire.

Suggest a reason why this method of extinguishment could be successful. .....

.....

Do you think that all of the ash, smoke, and dust formed in this reaction would be heavier or lighter than the original strip of magnesium metal? ..... How come? .....

.....

**FACT OR FICTION ? In the olden days before many rural communities had electricity, travelling picture shows travelled around the bush. They used sticks of magnesium to provide the light for the projectors. This used to work OK but there was the added danger of ..... !FIRE!!!**

See if you can find out some more about this.

## WATER AND HYDROGEN

Our society today loves to live in, around, above and below water. We use it to drink, to clean, to cool, to wash, to get rid of wastes and to play with. In fact our life would be pretty dull without water. Some people even think that we might be able to use water as an energy source. What do you think?

The chemical formula for water is ..... This means that in one m..... of water there are two a .....of h..... and one a.....of o.....

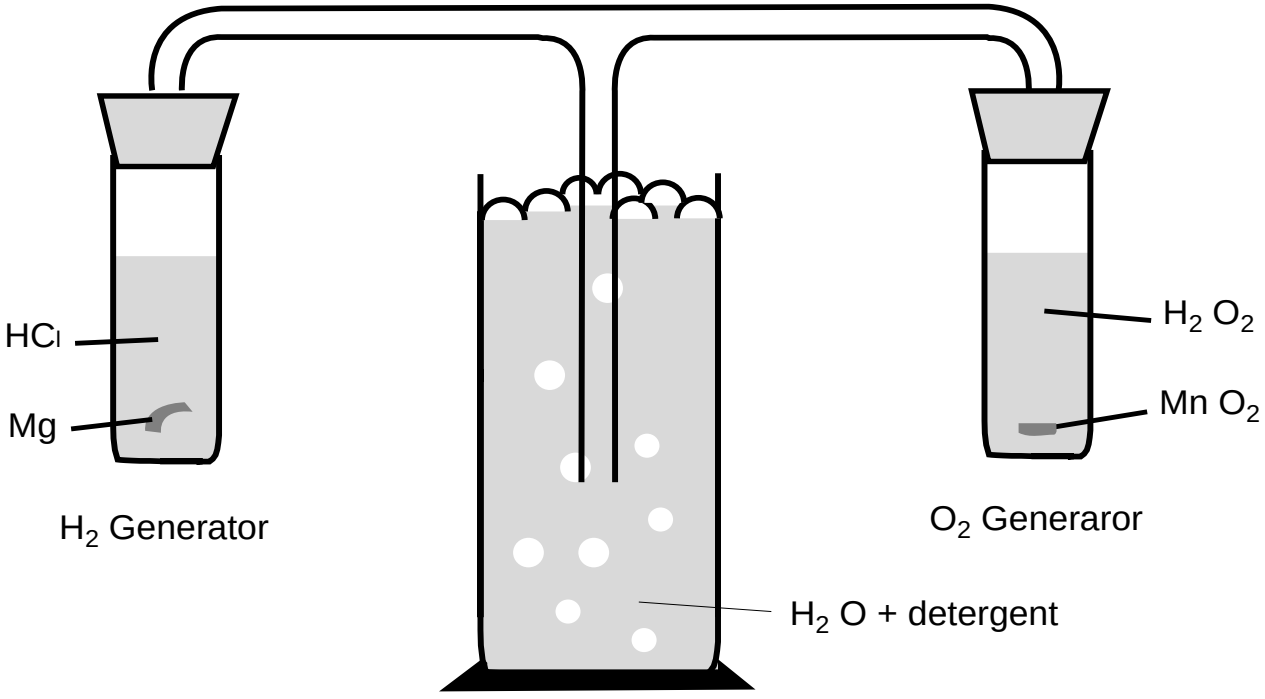
**Water can be made by burning hydrogen with oxygen. When this happens there is a very loud explosion.**

**The percentage of oxygen in air is 21%. Hydrogen "POPS" when ignited in air.**

**When hydrogen is ignited in pure oxygen... WELL!!!!!**

**ASK YOUR TEACHER TO DO THIS AS A DEMONSTRATION**

**DO NOT DO IT YOURSELF.**



When the bubbles containing the mixture of hydrogen and oxygen are ignited it gives off a fair bit of energy doesn't it. If we could utilize this energy change we could possibly power our vehicles using hydrogen.

**HYDROGEN + OXYGEN → WATER**

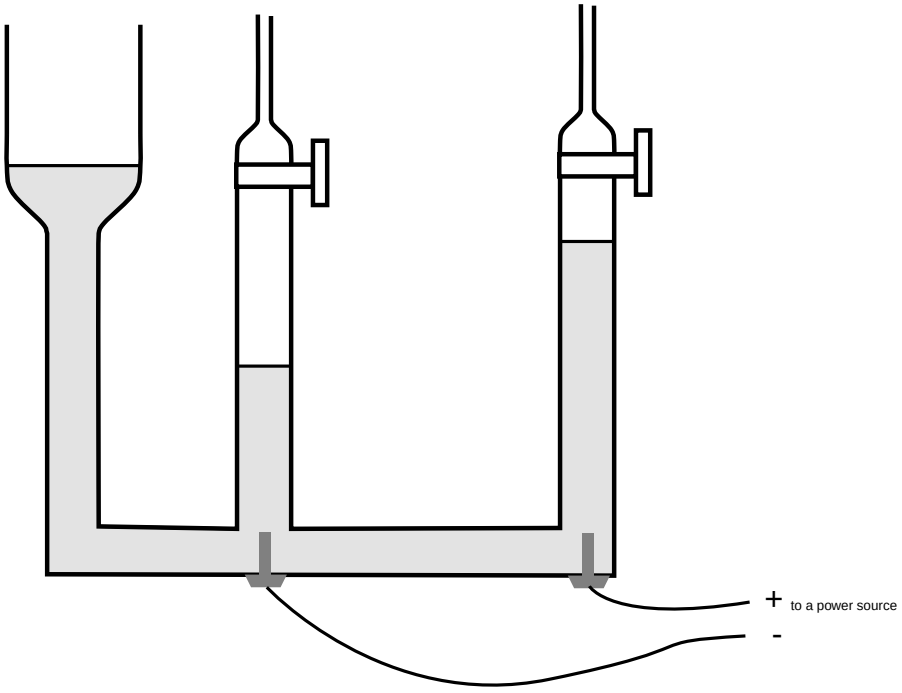
**(element) (element) (compound)**

BUT... from where can we easily get the hydrogen and oxygen to make all this happen?

Observe the teacher demonstration showing how electricity can be used to change water into hydrogen and oxygen .

Which tube do you think contains the hydrogen and which tube do you think contains the oxygen?

Label these gases on the diagram.




**WATER HYDROGEN + OXYGEN**

SO!!!! We can start with water to make hydrogen and oxygen and use these as fuels and end up with water again.

**SOURCE OF WATER = THE OCEAN**

**SOURCE OF ELECTRICITY = SOLAR**

**POLLUTION = ZERO (or does it)**

Form small groups and discuss this and /or research this form of energy usage.

Share your findings and ideas with the rest of the class. Write your findings here. .....

.....

.....

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.....

.....

.....

.....

.....

.....

**Did you know?**

**ROCKETS TAKE THEIR OWN OXYGEN SUPPLY WITH THEM.**

**The fuels they burn, burn with pure oxygen.**

**This really gives them some get up and go.**

Cars do not function as well at higher altitudes. Why would this be so? .....

.....

.....

.....

.....

.....

.....

.....

.....

.....

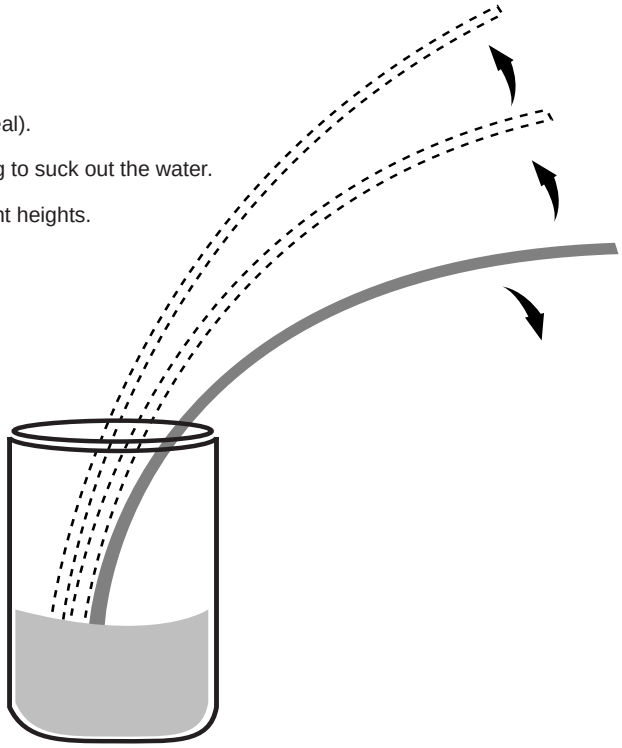
## THE BIGGEST STRAW IN THE WORLD

**AIM**

**What is the furthest distance that water can be sucked up a straw?**

**METHOD**

- obtain a clean long straw
  (a long length of rubber tubing would be ideal).
- container of water from which you are going to suck out the water.
- Suck the water into the "straw" from different heights.
  Record all observations.



**RESULT**

**CONCLUSION**

The highest distance that I could suck up the water was .....

**In theory we should be able to raise the water by sucking to a height of 10 metres.**

This theoretical value is nearly impossible to achieve however.

Suggest some reasons as to why you think this might be the case. .....

.....

Firefighting pumps should always be placed as close to the water source as possible. Seven metres is probably a practical distance to which water can be raised.

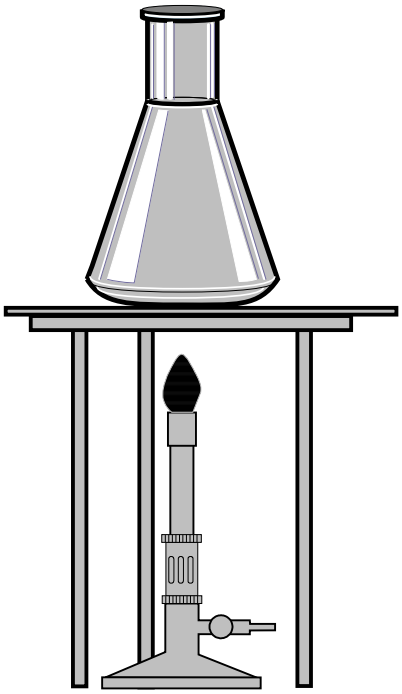
# AIR HAS WEIGHT AND CAN EXERT PRESSURE

**AIM**

**Can a balloon be made to inflate itself inside of a flask?**

**METHOD**

1. Heat water in flask until it is boiling.
2. Remove from heat and carefully place a balloon over the top of the flask. DON'T BURN YOURSELF.
3. Allow the flask to cool.



**RESULT**

Draw and describe what happened to the balloon.

.....

.....

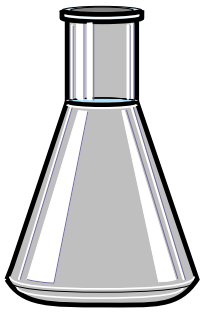
.....

.....

.....

.....

.....



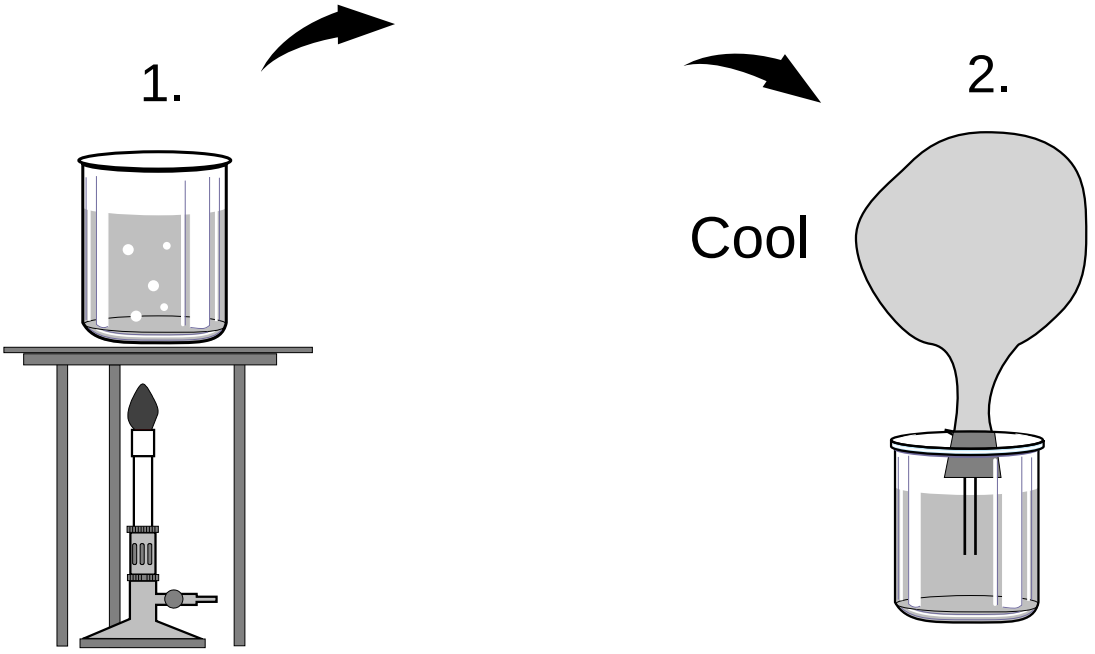
 

.....

**CONCLUSION**

Heating the water causes it to ..... and change to ..... The steam fills the flask. When the balloon is placed over the neck of the flask it prevents outside air getting back in. As the steam cools it ..... to form water, leaving an empty space or ..... inside of the flask. Air tries to get in, so it pushes against the balloon and causes it to inflate inside of the flask.

TEACHER DEMONSTRATIONS




| | Demonstration 1 | Demonstration 2 |
|---|---|---|
| Observations ..... | ..... | ..... |
| ..... | ..... | ..... |
| Explanation ..... | ..... | ..... |
| ..... | ..... | ..... |

**THIS ACTUALLY HAPPENED**

**The contents of a feed silo on a large dairy farm caught on fire. The farmer was instructed to seal up the silo so as to starve it of oxygen and therefore extinguish the fire. The available oxygen was used up by the smouldering feed and this resulted in the formation of a partial vacuum in the silo. Air pressure caused the sides of the silo to crumple thereby breaking the seal. Fresh air rushed in and fed the fire. A type of 'back draft' resulted. The fine particles of feed in the silo exploded and the top of the silo was blown 50 metres away from the rest of the silo.**

matter

## SYLLABUS CORE CONTENT INCLUDED IN THESE EXERCISES ARE:

4.14 (a) Define all matter as being made up of particles that are continuously moving and interacting

(b) Describe expansion and contraction of materials in terms of simple particle motion

4.12 (a) Apply the term solid, liquid and gas to a range of everyday substances

(b) Identify when a physical change occurs by observing evaporation, condensation, boiling, melting and freezing

4.22.2 (a) Distinguish between elements and compounds

4.26.2 (a) Recognise the importance of water.....

## THE BIG FREEZE

Your teacher will have a carbon dioxide fire extinguisher at the front of the laboratory. When the extinguisher is shaken do you hear things that : **-grind together or lap about or woof around**

In a textbook read about the properties of solids, liquids and gases.

Do you think that the carbon dioxide in the extinguisher is a

solid? or liquid? or gas?

• ..... Why? .....

.....

When the carbon dioxide is released from the extinguisher it "WOOFS" out as a gas. If the extinguisher is discharged for a while you will notice ice around the end of the outlet.

**CO2 MAKES A LOUD ROARING NOISE AND IS**

**INTENSELY COLD WHEN DISCHARGED**

List some precautions that should be used when a $CO_2$ extinguisher is discharged:

.....

.....

**HEAT ENERGY IS NEEDED TO CHANGE AN OBJECT'S STATE FROM A SOLID TO A LIQUID TO A GAS. HEAT ENERGY MAY COME FROM THE AIR, OR OTHER OBJECTS. HEAT ENERGY IS TAKEN IN AND CAN MAKE THE SURROUNDS FEEL COLD. AS MATTER CHANGES BACK TOWARDS SOLID, HEAT ENERGY IS GIVEN OUT.**

In the following boxes draw how you think the particles inside of the $CO_2$ extinguisher may be organised and how the particles would be organised as they leave the extinguisher.

| **Inside the extinguisher** | **Outside the extinguisher** |
|---|---|
| | |

**$CO_2$ is contained at a high pressure in its cylinder.**

**When the cylinder is discharged the pressure is released and the $CO_2$ vaporises.**

## THE PRESSURE IS OFF

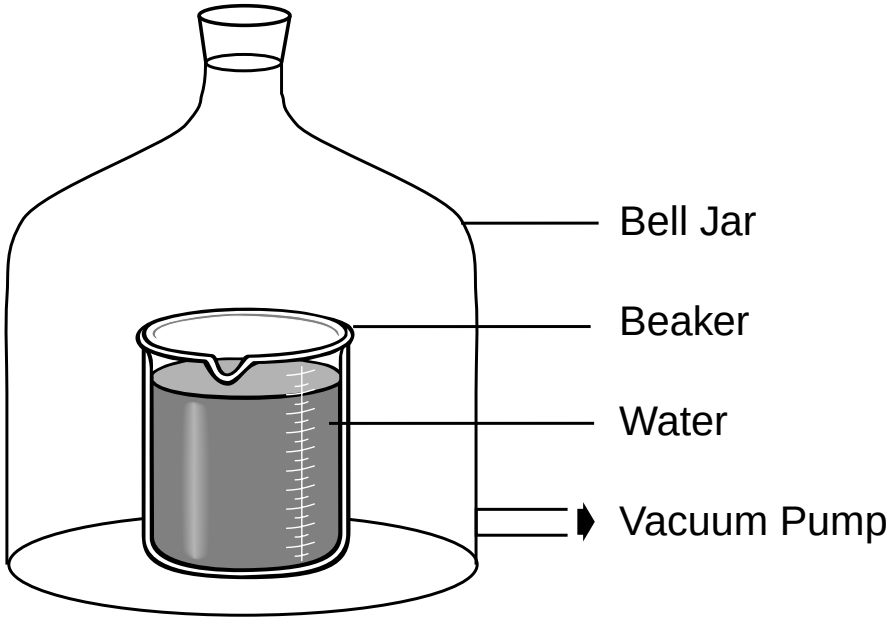
**AIM**

**Will a release in pressure cause a liquid to boil?**

**METHOD**

Place a beaker of water into a bell jar attached to a vacuum pump. Start the pump and reduce the pressure in the jar.

Observe the jar and the beaker for signs of boiling or evaporation.




**RESULT**

1. Describe the appearance of the water in the beaker. .....

.....

2. Describe any appearance of steam or evaporation. .....

.....

**CONCLUSION**

1. Would you say that the water boiled? ..... Why? .....

.....

2. Would you be prepared to put your hand in the water? .....

Why? .....

3. Circle the following statement which you believe to be true.

- Boiling depends upon temperature.
- Boiling depends upon pressure.
- Boiling depends upon heat and pressure.

# COOLING OFF

**AIM**

**Why is it important to allow free evaporation of sweat from the body if we want to keep cool?**

**METHOD**

1. Place a drop of alcohol onto the most heat sensitive part of your arm, wait and observe.
2. Place some wet cotton wool onto the end of a thermometer and measure the temperature over a 2 minute period.
3. Place the same amount of wet cotton wool onto a thermometer again, but this time blow onto the cotton wool and record any temperature changes over the 2-minute period.

**RESULT**

1 When I placed the alcohol onto my arm and left it there it .....

.....

**2**

| time | temperature |
|---|---|
| start | |
| 30 sec. | |
| 60 sec. | |
| 90 sec. | |
| 120 sec. | |

**3**

| time | temperature |
|---|---|
| start | |
| 30 sec. | |
| 60 sec. | |
| 90 sec. | |
| 120 sec. | |

**CONCLUSION**

1. Did the alcohol evaporate?..... This evaporation makes your arm feel..... Evaporation takes heat away from your arm.

2. Blowing onto the wet cotton wool increases the rate of evaporation. Did this increased rate of evaporation cause greater cooling?.....

**KEEPING COOL**

Use the following words to complete the passage below:

**evaporating**

**circulation**

**open**

**hot**

**cool**

**rate**

**cooling**

**sweat**

Sweat ..... from our bodies causes our bodies to cool down. Anything which hampers this .....of evaporation will affect our body's .....system. When working in very .....conditions such as experienced by fire fighters we should dress in such a way so as to obstruct as little as possible the escape of heat from the body by the evaporation of ..... . Firefighters should have trouser legs and shirt or overall sleeves .....at the cuffs, and shirt and overall necks left free to permit maximum .....of air and allow evaporation of sweat from the body to ..... the body down.

# WATER

Water occupies over three-quarters of the earth's surface. Water is the major component of all living things. The water in a plant's body is absorbed through its roots. Animals obtain their water by drinking or by eating plants and other animals. We can survive for a short time without food but we cannot survive very long without water. The moisture content of plants is a major determining factor in bush fire behaviour.

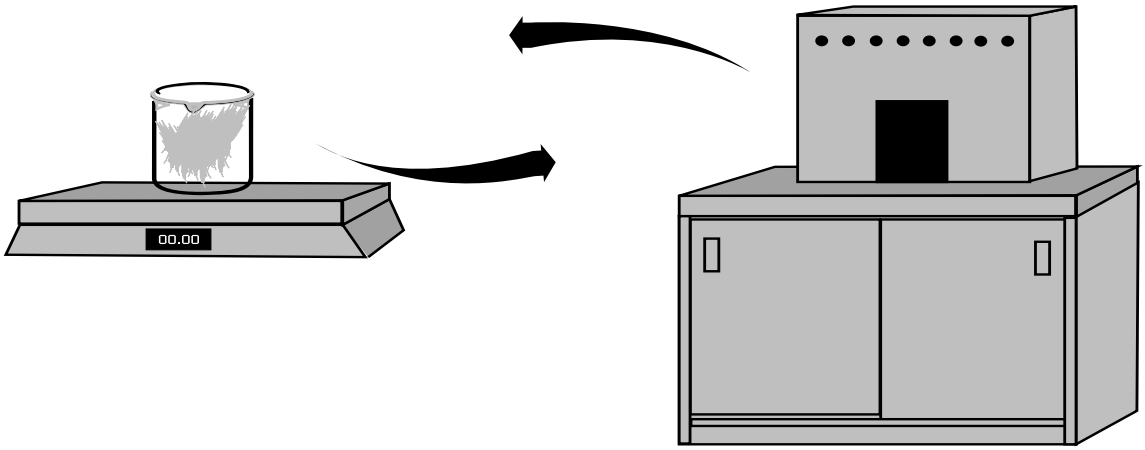
## WATER IN LIVING THINGS

### AIM

**How much water is in the body of a plant?**

### METHOD

1. Determine the mass of a handful of fresh green grass clippings.
2. Place the clippings into a clean dry beaker and place into a drying oven until the grass is completely dried out.
3. Determine the mass of the dried clippings.
4. Calculate the mass of water in the green plants.
5. If time permits, repeat steps 1-4 for some other local plants. (Discuss the variables with your teacher first).




### RESULT

(1) MASS OF FRESH CLIPPINGS ..... g

(2) MASS OF DRY CLIPPINGS .....g

DIFFERENCE (1) - (2) = ..... g OF WATER

In ..... grams of fresh grass there are ..... grams of water.

$$\frac{\text{mass of water}}{\text{mass of fresh grass}} \times 100 = \%\text{ of water}$$

X 100 = ..... % of water

**CONCLUSION**

1. The percentage of water in the green living grass is ..... %. How does this compare to the percentage of water in other living things? .....
   .....
   .....

2. List some factors, which might alter the amount of moisture in grasses and other plants: .....
   .....
   .....
   .....

**The amount of moisture in grasses and other vegetation is a determining factor in bush fire behaviour. The rate at which a fire will spread increases dramatically when the fuel moisture content falls below 6-8%. This increase is due to:**

- **Increased ease of ignition**
- **More effective radiation**
- **Greatly increased combustion rates**

## IS IT SAFE TO BURN?

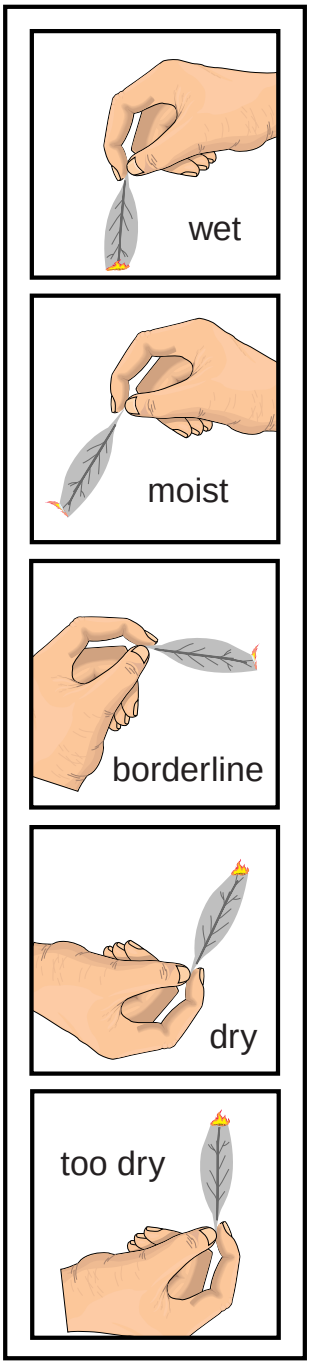
### AIM

**Can I accurately predict whether or not it is safe or practical to undertake a burn to reduce the amount of fuel?**

( This is known as hazard reduction burning)

### METHOD

- Choose several dead leaves from a variety of trees in your vicinity.
- Sheltered from any wind, light the end of the dead leaf and once lit take the ignition source away. (Ideally this should be done in the laboratory under controlled conditions and must be done with supervision by your teacher)
- Record the way in which your leaves burn according to the information in the following table.




**LEAF BURNS ONLY IF STRAIGHT DOWN (OR NOT AT ALL)**
All fuels too wet if this leaf in area to be burnt. O.K. if only in WET TYPES not to be burnt.

**LEAF BURNS IF ANGLED DOWNWARDS BUT NOT IF LEVEL**
Fine fuels in this leaf's position will only burn if on slope or in wind.
O.K. if the leaf from BOTTOM of litter in burn area, or from WET TYPES not to be burnt.

**LEAF BURNS IF LEVEL BUT NOT ANGLED UPWARDS** Fine fuels in this leaf's position will burn but very slowly unless helped by wind, slope and fuel continuity. If on top of litter layer, wait another day.

**LEAF CAN BE ANGLED UPWARDS AND STILL BURN**
Fine fuels in the same positions as this leaf are dry enough to burn.
O.K. if this leaf is from TOP of litter. RISKY if from BOTTOM.

**LEAF BURNS IF HELD STRAIGHT UP** All fine fuels very dry and flammable.
Fire will run up stringy bark trees. Embers and burning material will escape, especially if windy. **DON'T BURN**

**RESULT**

| Type of leaf | locality | how it burns |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

**CONCLUSION**

Indicate, giving reasons, whether you think it would be suitable to undertake a hazard reduction burn today. .....

.....

.....

**Fuel reduction burning is usually carried out when the upper litter is dry and the litter next to the soil is moist. In these conditions fires burn quietly during daylight but go out at night.**

**INSTANTLY VAPORISING WATER**

**When a fire occurs in a flammable or combustible liquid some heating of the liquid takes place. If the liquid becomes heated to above 100 degrees Celsius any water entering the liquid may vaporise. When water vaporises it expands 1700 times. This sudden expansion may cause quantities of the burning liquid to be ejected out of the container.**

**NEVER PUT WATER ONTO BURNING LIQUID FIRES**

How much water would be in one cup of water? ..... ml

How much space would this cup of water occupy if it were to expand 1700 times? ..... L

## BURSTING OF CYLINDERS

Any sealed container is likely to burst when exposed to fire. Pressure release devices on some types of gas cylinders may relieve internal pressure, but the cylinder may still fail if the fire's heat is sufficient to weaken the cylinders metal shell.

**Examine the gas storage facility or gas bottle at your school and see if you can recognise a pressure relief device.**

When a cylinder fails a substantial amount of the liquid inside of the cylinder will immediately vaporise and expand.. When this occurs with a flammable gas, a large fireball will be formed, in some cases it could injure people 500 metres away.

Name different objects, which would be 500 metres away from the school's gas cylinder

1. .....
2. .....
3. .....
4. .....
5. .....
6. .....
7. .....
8. .....
9. .....
10. .....

The remnants of the cylinder may rocket over several hundred metres, trailing burning contents as they go. This phenomenon is called a boiling liquid expanding vapour explosion, or BLEVE.

Is there any likelihood of a BLEVE happening in your town? .....

.....

In groups decide upon a list of planning proposals that would reduce the chances of a BLEVE occurring?

.....

.....

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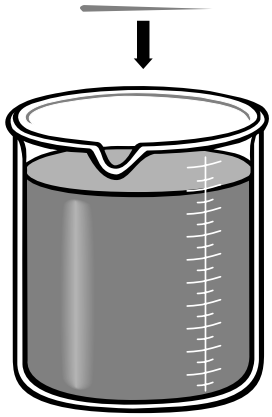
# WALKING ON WATER

**AIM**

**How do water striders and other water walkers get across the surface of water and will this be affected by the addition of detergent?**

**METHOD**

- Fill a beaker with water and carefully place a pin onto the surface.
- Add extra pins.
- Add a few drops of detergent to the water.



**RESULT**

1. Describe what you did to get the pins to float. .....

.....

.....

2. What happened when you added extra pins? .....

.....

3. "ZOOM" onto the pin on the surface of the water. DRAW how the pin sits on the surface of the water. Place labels on your diagram to show what you see.

4. What affect did adding detergent have? .....

.....

**CONCLUSION**

1. What seems to be on the surface of the water? .....
2. When detergent is added what do you think happens on the surface of the water? .....

.....

.....

Use the following words to complete the passage below: (words may be used more than once)

**detergents**

**wetting**

**chemicals**

**larger**

**cling**

**droplets**

**skin**

**tension**

**particles**

**water**

**surface**

The ..... which appears to be on the surface of water is caused by WATER TENSION. This causes the particles of water to .....onto each other and can stop the water from mixing with other particles. Water ..... form due to ..... tension. ..... have the affect of disturbing water .....and the “skin” of water would tend to disappear.

Firefighting vehicles use ..... agents in the water. Wetting agents are ..... which, when added to water, break the surface .....causing the ..... to spread out and so cover a ..... area.

## FORMING COMPOUNDS

**AIM**

**Can I determine how much oxygen combines with magnesium to form a new compound?**

**METHOD**

- Clean a piece of magnesium ribbon (try dipping it into some dilute hydrochloric acid).
- Accurately measure the mass of the magnesium using a triple beam balance. Describe how you are going to do this. .....

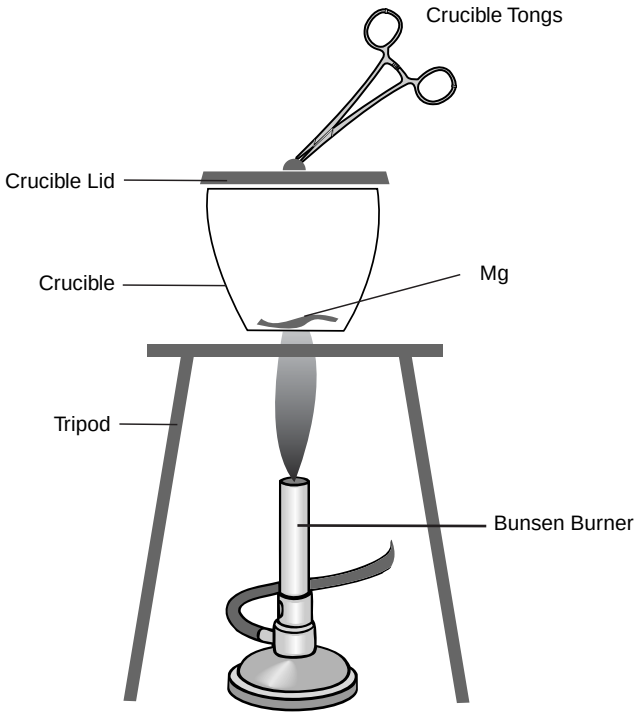
  .....

  .....

  .....

  .....

- Check your measurement with that obtained on an electronic balance.
- Similarly obtain the mass of a clean dry crucible.
- Heat the magnesium in the crucible with the lid on.
- Periodically lift the lid.
- Continue to do this until all of the magnesium has reacted.
- When cool measure the mass of the products of the reaction.
- Write your observations in the space provided and complete the taste.




**RESULT**

Observations: .....

.....

.....

**CONCLUSION**

- Why did you periodically lift the lid of the crucible? .....
  .....
  .....
  .....

- What element does the magnesium combine with to form the ash? .....
  .....
  .....

- In this experiment I found that ..... grams of magnesium reacted with ..... grams of .....
  ..... to form ..... grams of .....

MAGNESIUM + ..... ➞ MAGNESIUM OXIDE

**Extension Work**

**Given that the valency of magnesium is +2 and the valency of oxygen is -2, write the formula for magnesium oxide.**

.....

**Now write a balanced equation for the complete reaction.**

# BURNING SUGAR

**AIM**

**Which elements combine together to form sugar?**

**METHOD**

- Place a spoonful of sugar into a test tube.
- Use a Bunsen burner to heat the test tube containing the sugar.
- Hold a second test tube containing ice above the first.
- Draw a labelled diagram of your experiment.

**RESULT**

**Observation**

Change in colour of sugar .....

Smell .....

What formed on the cold test tube .....

**CONCLUSION**

The product, which formed on the cold test tube, was .....

The chemical formula for this substance is .....

The product left in the test tube was like ..... .The chemical symbol for this is .....

When you heated the sugar you decomposed it into simpler substances. The elements present in these simpler substances are ..... and .....

The chemical formula for sugar is $C_{12}H_{22}O_{11}$.This means that it is made up ..... atoms of C....., ..... atoms of H..... and .....atoms of O.....

**Naturally occurring substances normally burn to form $CO_2$ and $H_2O$.**

**In a bush fire the smoke is a mixture of this and carbon.**

**Fire is a chemical reaction which reduces complex organic molecules into simpler inorganic molecules**

Do you know the difference between the terms ORGANIC and INORGANIC?

ORGANIC = .....

.....

INORGANIC = .....

.....

.....

Do you know the difference in the terms complete and incomplete combustion?

Complete Combustion = .....

.....

Incomplete Combustion = .....

.....

material

science

**SYLLABUS CORE CONTENT COVERED BY THESE EXERCISES INCLUDE:**

4.28.2.1 (b) List substances that act as fuels, the conditions under which they burn and relate these to everyday situations

(c) Identify fossil fuels and describe some of their uses

5.24.2 c) Carry out chemical reactions between different elements and between elements and compounds including:

(i) Reactions involving oxygen, including combustion and corrosion

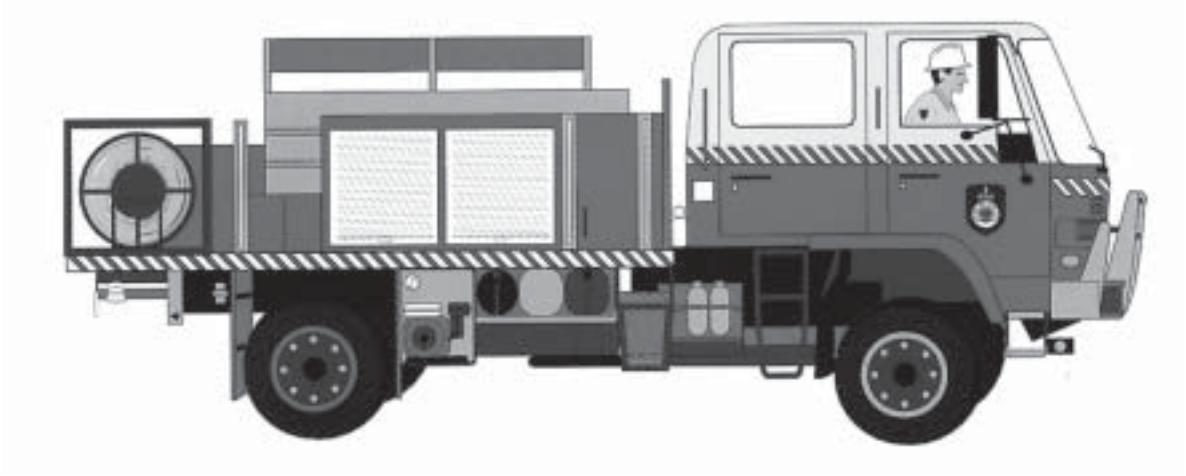
(d) Classify compounds as organic or inorganic based on common characteristics including the presence or absence of carbon

(e) Give common examples of organic and inorganic compounds and where they occur

**WHAT CARS ARE MADE OF**

In the following diagram of a bush fire vehicle, identify the materials, which are used in its manufacture.

List them in the table, which follows. eg.



| name of part | what it is made of | name of part | what it is made of |
|---|---|---|---|
| **eg. tyre** | **rubber** | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

Use the table below to answer the questions about the physical properties of metals.

| metal | symbol | cost $/kg | density | strength |
|---|---|---|---|---|
| aluminium | Al | 2 | 2.7 | 80 |
| copper | Cu | 4 | 8.9 | 150 |
| iron | Fe | 0.02 | 7.9 | 120 |
| tin | Sn | 8 | 7.3 | 30 |
| zinc | Zn | 2 | 7.1 | 150 |

1. Which is more dense, iron or aluminium? .....

2. From the table construct a profile comparing iron and aluminium.

.....

.....

.....

.....

3 Aluminium is now used in the manufacture of water tanks on bush fire vehicles. List some reasons why you think that aluminium is used for this purpose and why some other metals aren't quite as suitable. .....

.....

.....

.....

.....

4. What disadvantages might be involved in using aluminium to build these water tanks? .....

.....

.....

.....

.....

5. Using a current newspaper, find the current cost (in Australian dollars/kg) of the metals in the above table. Put your ..... findings in the table below.

CURRENT PRICES OF METALS (__/__/__)

| **METAL** | **COST (Australian $/kg)** |
|---|---|
| Aluminium ..... | |
| Copper ..... | |
| Iron ..... | |
| Tin ..... | |
| Zinc ..... | |

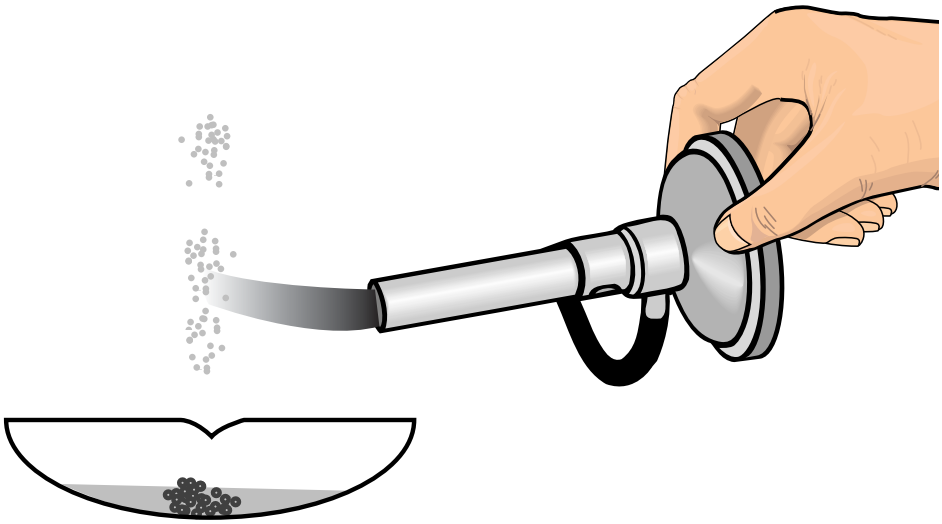
## WHAT METAL IS BURNING?

### AIM

What causes the different coloured flames to appear when we burn different objects?

### METHOD

- Obtain samples of various metallic salts.
- Place some hydrochloric acid and zinc into a clean evaporating basin.
- As it effervesces hold the Bunsen flame above the bubbles.
- Sprinkle a small sample of one of the metallic salts (e.g. CuSO4) onto the bubbles and once again hold the flame above.
- Clean out the evaporating basin and repeat the procedure with different metallic salts.
- Alternatively, your teacher may have prepared spray bottles containing solutions of metallic salts which can be sprayed directly into the blue flame of the Bunsen burner.
- Record your results in the table below.



### RESULTS

| METALLIC SALT TESTED | COLOUR OF FLAME |
|---|---|
| ..... | ..... |
| ..... | ..... |
| ..... | ..... |
| ..... | ..... |
| ..... | ..... |
| ..... | ..... |
| ..... | ..... |
| ..... | ..... |
| ..... | |

**CONCLUSION**

1. Different metals burn with their own characteristic flame colour. Suggest some practical implications of this procedure. .....

2. Explain how this could help police to solve crimes. .....

3. When glossy magazines burn they often emit spectacular, coloured flames. Why? .....

4. Use the library or your textbook to research the characteristic flame colours of the various metals (e.g. calcium, strontium, sodium) and record your findings in the table below.

| METAL | FLAME COLOUR |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

How does your research compare with the results of the experiment? .....

**During structural fires there are many different coloured flames.**

**This indicates to the firefighters that some metals or metallic ions may be involved in the fire.**

**Some of these metallic ions may be constituents of some nasty chemicals so the firefighter should beware.**

# RUST

**Rusting is a chemical reaction between the elements iron and oxygen.**

**Iron can also be made to combine with oxygen by burning.**

**Another name for this process is oxidation.**

**IRON + OXYGEN → IRON OXIDE**

**Applying the same principles that are used in fire extinguishment**

**(interrupting the fire triangle by excluding oxygen)**

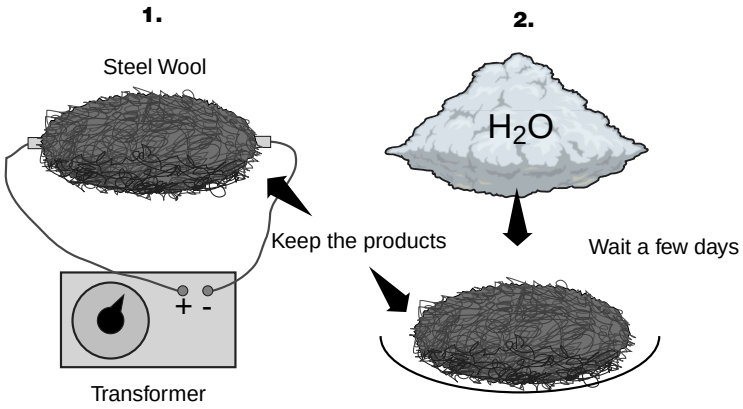
**should provide us with methods to prevent rust.**

## COMPARING BURNING AND RUSTING

### AIM

Are burning and rusting essentially the same process?

### METHOD




### RESULT

List your observations in the following table.

| burning steel wool | rusting steel wool |
|---|---|
| ..... | ..... |
| ..... | ..... |
| ..... | ..... |

### CONCLUSION

1. Are the products formed during burning and the products formed during rusting essentially the same sort of thing? .....

   Describe their appearance: .....

   .....

2. Why was the steel wool teased out in each case? .....

   .....

   .....

3. How could the oxygen be prevented from getting to the steelwool to stop it from rusting and stop it from burning? .....

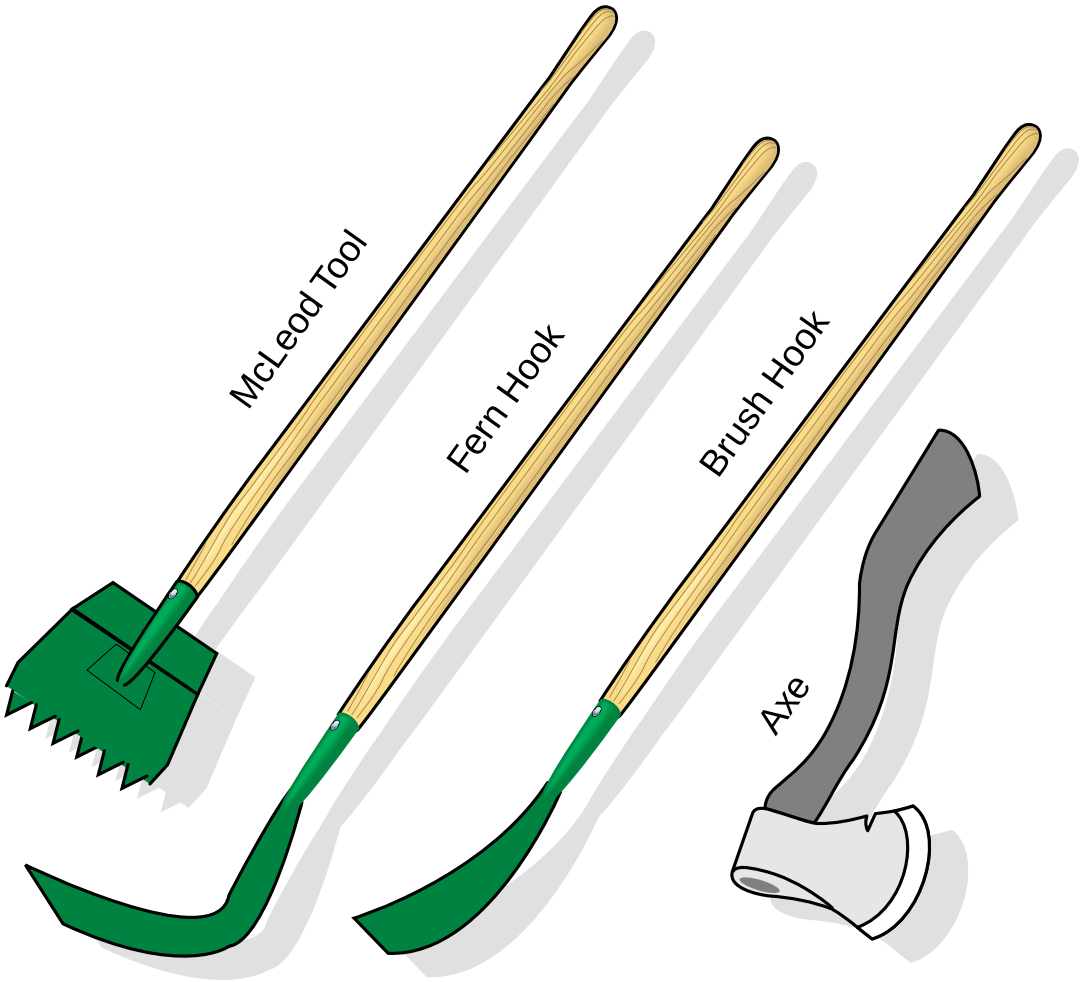
.....

.....

.....

.....

**The following diagrams show some hand tools used by the Rural Fire Service firefighters.**




Outline some ways in which each of these handtools could be prevented from rusting. .....

.....

.....

.....

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.....

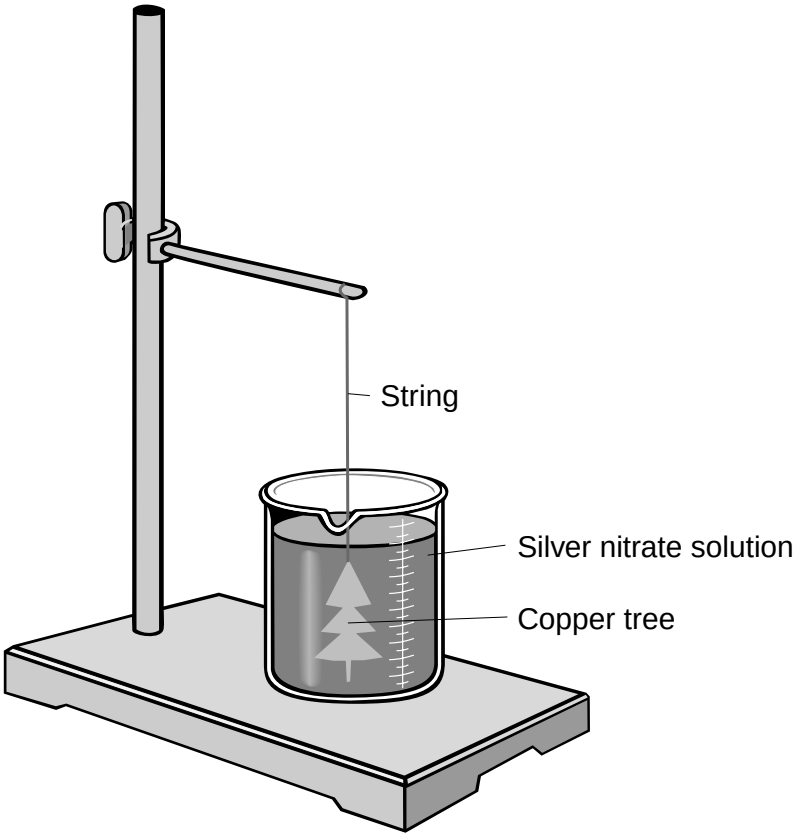
.....

**METALS SWAPPING PLACES**

**AIM**

Can a metal in solution swap places with a solid metallic element?

**METHOD**




RESULT

.....

.....

.....

**CONCLUSION**

The more reactive a metal is, the more likely it is to form compounds. From a table listing the reactivity series of metals, find which is the most reactive between copper and silver. .....

In this reaction the metals swapped places.

COPPER + SILVER NITRATE → SILVER +..... NITRATE

Rewrite this equation using symbols and formulae for each of the elements and compounds.

.....

Explain what your prediction would be if an iron nail was placed into a solution of copper sulfate. .....

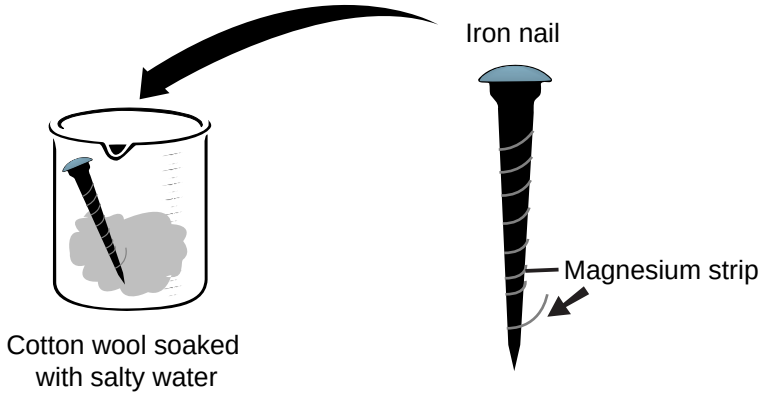
.....

.....

.....

.....

**TRY THIS:**




Observations: .....

.....

.....

.....

.....

.....

Explanations: .....

.....

.....

.....

.....

.....

It is important to ensure that different types of metals don't come into contact in damp corrosive environments. Rural Fire Service tankers could fall into this category. Foam used as a wetting agent is corrosive and needs to be rinsed away from metallic parts with clean water. Tankers sometimes fill from dams, springs, gullies and swamps, which may contain brackish or ion laden water. If objects made of different metals were to come into contact in this environment there would be a swapping of places of these metals. Proper care and maintenance lessens the chances of this happening.

Suggest some places in and around your home and in your cars where metals could swap places.

*Sometimes we use this swapping of metals as a means of preventing corrosion.* .....

.....

.....

.....

.....

.....

**HOUSE DESIGN AND MODIFICATION IN BUSHFIRE PRONE AREAS**

**Building houses in Bush Fire prone Areas**

To reduce the chance of embers getting underneath a house, it is safest to build on a reinforced concrete slab. If the slab is above ground level, it should rest on non-flammable supports, and the space between the ground and the floor should be bricked up. Timber should not be used at ground level. Any timber used in raised floors and flooring supports should be treated to a fire resistant standard.

Fit vents under the floor and in the walls. Protect eaves and roof with spark proof metal screens. Metal plates that can be fixed into place in times of bush fire emergency will add an extra level of safety. Fit external hinged doors with a spark proof metal screen door so that burning material cannot blow in at the top and bottom.

Avoid decorative timber work such as trellis and latticework on the exposed sides of a building. Timber balconies and verandahs can also trap windborne sparks, so keep them to a minimum.

Steel roofing material is the safest under extreme bush fire conditions but corrugations in the roofing material can allow sparks to enter the roof space. Slate or tiled roofs need a supporting structure that is able to keep sparks out and withstand high temperatures. Tiles must be fixed firmly in place to stop them becoming dislodged in the winds, which accompany bush fires. Wood shingles and bituminous roofing are the most vulnerable roofing materials and should not be used.

1. Complete the following table, by using the information in the passage above.

| part of house | material used | advantages | disadvantage | comments |
|---|---|---|---|---|
| roof | | | | |
| walls | | | | |
| floor | | | | |
| sub-floor | | | | |
| screens | | | | |
| trellis | | | | |
| windows | | | | |
| gutters | | | | |
| eaves | | | | |

**(IF YOU WANT TO FIND OUT MORE ABOUT THIS, THE RURAL FIRE SERVICE HAS PUBLICATIONS ENTITLED • BUSH FIRE PROTECTION FOR NEW AND EXISTING RURAL PROPERTIES • BUSH FIRE PROTECTION FOR NEW AND EXISTING URBAN HOMES.**

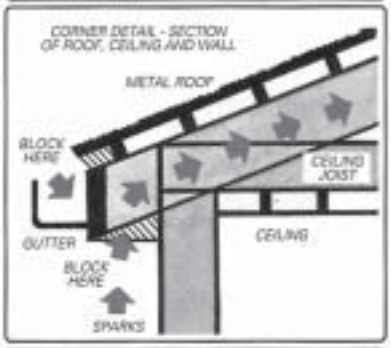
These are free publications and are available in class sets.

**The following diagrams illustrate design features, which can reduce fire risk in wildfire prone areas.**

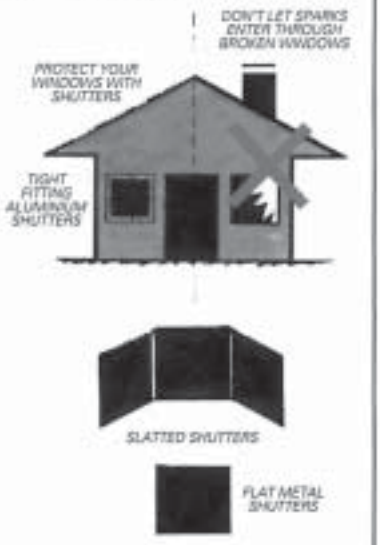
## Home Safety

**Tips that can save lives**
Simple measures – flyscreens on windows, weather stripping, gutters clear of leaves – can make all the difference in a wildfire. Here are some useful pointers which are just as useful for old houses as for newly-built ones.


**Screen out fire**
Amazingly, ordinary wire (not synthetic) flyscreens can help save your house. Fitted on every window, they reduce radiant heat (so that grass does not crack) and keep out flying embers. Screens are useful on all outside doors, too. Fine metal fly wire mesh covers should be fitted to all vents to keep out sparks; for chimneys, use a wire mesh capping outside and a fly wire spark screen inside, flush with the fireplace. Doors and windows should be weather stripped.

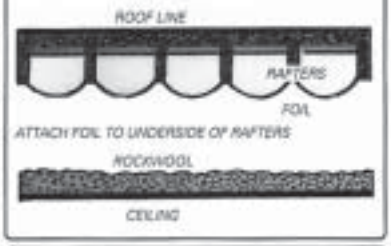




**Big windows need shutters**
To protect windows from fire, consider fitting solid shutters. Besides their value in a fire, they will also keep the house cool. Shutters should be flat and made from fire-resistant materials.

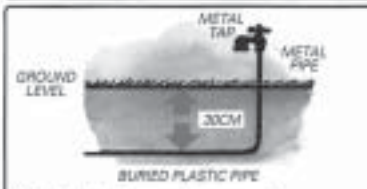



**Leaf-free gutters**
Leaves in the guttering can help a fire get into your roof. You'll need to keep cleaning out the leaves all through summer. An easier way is to fit a leafless guttering system, or leaf guards.


**Ceiling safety**
In established homes, burning embers may get into the roof through cracks under the tiles. You can reduce this fire risk by lining the ceiling space with rockwool, and attaching a layer of aluminium foil to the underside of the rafters.




**LP gas bottles**
Locate LP gas bottles on the south or east side of the house (furthest away from the likely source of fire). Don't put them under the verandah. Make sure the pressure relief valve is pointing away from the house, and that there is no flammable material for at least six metres in front of the valve. Set the bottles on a concrete or brick base, and fix them to a strong metal pipe. Don't worry about them—they're not likely to explode in a fire.


**Plastic pipes have melting moments**
Watch out for exposed plastic water pipes and hoses. In the heat of a fire, they may melt just when you need them most. Bury plastic pipes at least 30cm underground to avoid damage.


**✔ REMEMBER . . .**

- ☐ wire screens, shutters and weather strips keep out sparks
- ☐ keep leaves out of the gutters
- ☐ avoid plastic pipes—or bury them
- ☐ make the ceiling safe
- ☐ take care with gas bottles

## BUILDING MATERIALS

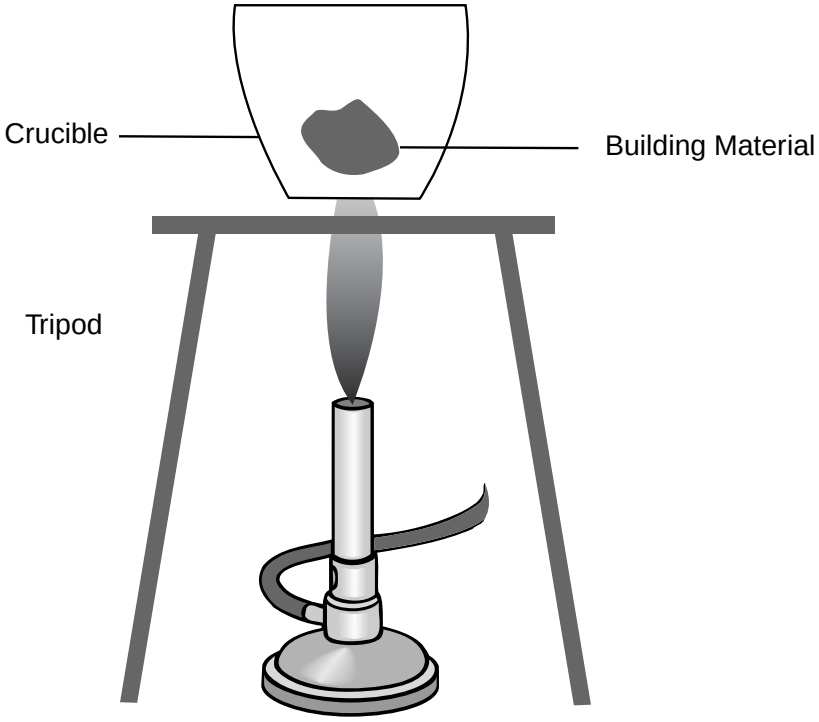
**AIM**

Which building materials are the best to use in buildings in bush fire prone areas?

**METHOD**

CAUTION: Avoid using treated logs, which have been impregnated with preservative as they give off toxic gases when burnt.

- Discuss with other members of your group and with your teacher the concept of a fair test. Design a fair test before you undertake the following experiment.
- Select samples of various materials, which are used in house construction. Include items such as: hardwoods, softwoods, fibreboard, masonite, chipboard, flyscreens, cladding, gyprock etc.
- Place your sample into a crucible and heat until it either bursts into flames or undergoes some measurable change.




**RESULTS**

| material tested | change which occurred | time taken | other observations |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

.....

**CONCLUSION**

1. List the variables you controlled in this experiment to ensure that it was a “fair test”. .....

.....

.....

.....

.....

.....

.....

.....

2. Explain the importance of undertaking controlled experiments to ensure fair tests? .....

.....

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.....

3. Which building products would be the best to use in buildings in bush fire prone areas? .....

.....

.....

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.....

.....

.....

.....

.....

Why? .....

.....

.....

.....

# MAKING CONCRETE

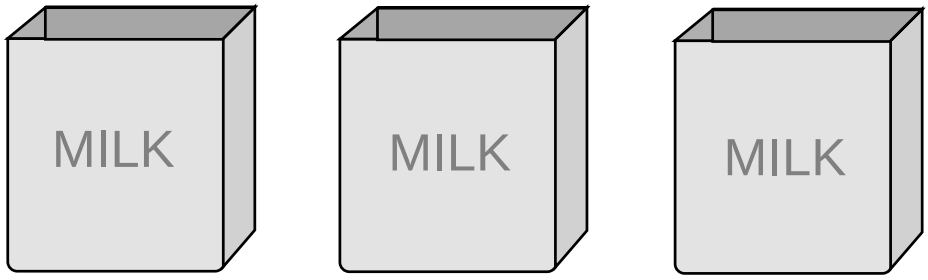
**In bush fire prone areas, new homes will be safer on slab foundations of reinforced concrete, especially if the slab is at ground level.**

## AIM

The aim of this experiment is to find the appropriate proportions of cement and sand and gravel required to make the strongest cement.

## METHOD

- MATERIALS : cement dry sand fine gravel rubber gloves milk cartons
- Prepare moulds by cutting 3 or 4 milk cartons in half.




- Prepare different mixtures of cement, sand and gravel.
- Add water to each mixture so that they are of the same constituency (paste) and place these into separately labelled moulds.
- Once the concrete has set remove it from the mould.
- Drop each sample taken from the mould onto a hard concrete surface and record any damage to your samples.
- You may think of other ways in which you could compare the hardness of samples.

## RESULT

| my concrete sample | hardness test result | rating 1-5 |
|---|---|---|
| ..... | | |
| ..... | | |
| ..... | | |
| ..... | | |
| ..... | | |
| ..... | | |

Any other observations: .....

.....

## CONCLUSION

1. While testing your concrete types, which variables did you control to ensure that your experiment was a fair test? .....

.....

.....

.....

.....

2. Compare your findings to those recommended by the cement manufacturer as stated on a cement bag. .....

.....

.....

.....

.....

3. What is meant by the term “reinforced concrete”? .....

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4. Why should homes in bush fire prone ares be built on slab foundations of reinforced concrete? .....

.....

.....

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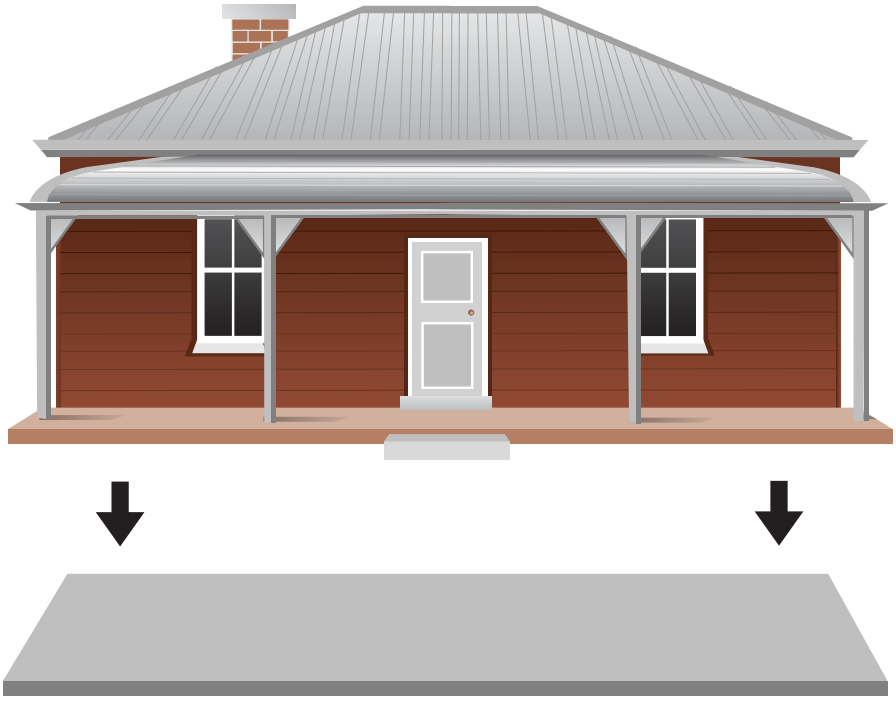


**PLASTICS**

We are living in a plastic world. We eat off plastics, we wear them, we cook with them, and we use them to entertain us. Plastics are used extensively in the home, office and factory.

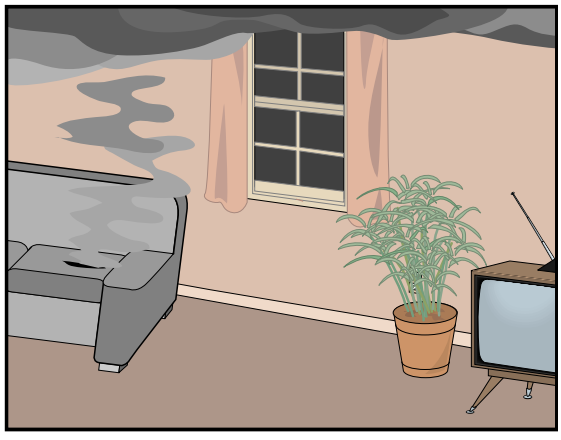
If your school has a plastics identification kit you will be able to recognise the great range of plastics and the uses to which they are put.

**Construct a table, which outlines these plastics and their uses.**

| article | type of plastic | why use plastic |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

Consider your average lounge room. Make a list of objects, which rely upon plastics in their manufacture.

1. .....
2. .....
3. .....
4. .....
5. .....
6. .....
7. .....
8. .....
9. .....
10. .....
11. .....
12. .....



If a fire begins burning in a lounge room and the room is fairly airtight, the fire may not be able to burn freely because of diminished levels of oxygen in the room. Instead, the room may enter a hot smouldering stage.... In some cases the temperature may be in excess of 500 degrees Celsius.

If you were to go into that room (never attempt this!), list some of the changes that you would see happening to the furniture in the room.

.....

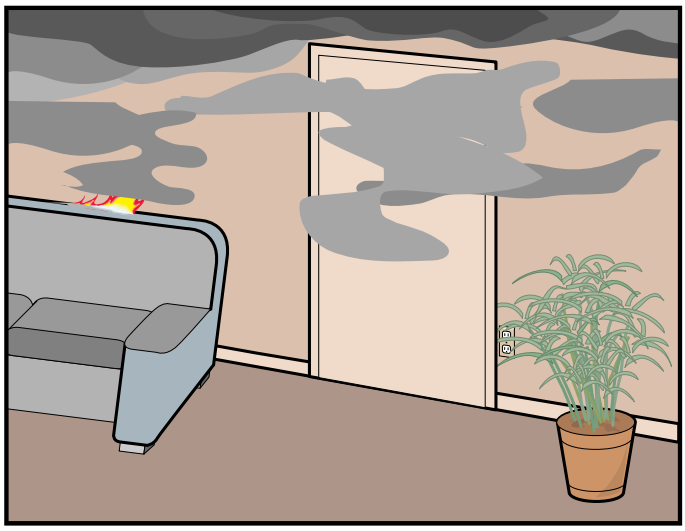
.....

.....

.....

.....

.....



What might be the result if someone opened a door to this room and allowed oxygen to enter the room?

.....

.....

.....

Two structural fire fighting terms are “flashover” and “backdraft”. Find out what these terms mean.

backdraft .....

.....

flashover .....

.....

**The smoke produced by a fire in a house may contain these substances:**

**Carbon monoxide  Carbon Dioxide  Carbon Particles  Sulfur Dioxide**

**Water Vapour  Hydrogen Cyanide  other gases**

What might be the source of a lot of these smoke constituents? .....

.....

What effects would they have on the human body and the environment? .....

.....

# RECOGNISING PLASTICS.

**AIM**

The aim of this experiment will be to classify some plastics according to the way in which they react when they are heated.

**METHOD**

- Collect small quantities of different types of plastics.
- Touch each sample with a hot stirring rod. This will tell you if they are thermosoftening or thermosetting.
- Compare the ease with which each plastic catches fire when it is placed into the Bunsen flame (be careful not to drop molten plastic everywhere).
- Observe the burning characteristics:

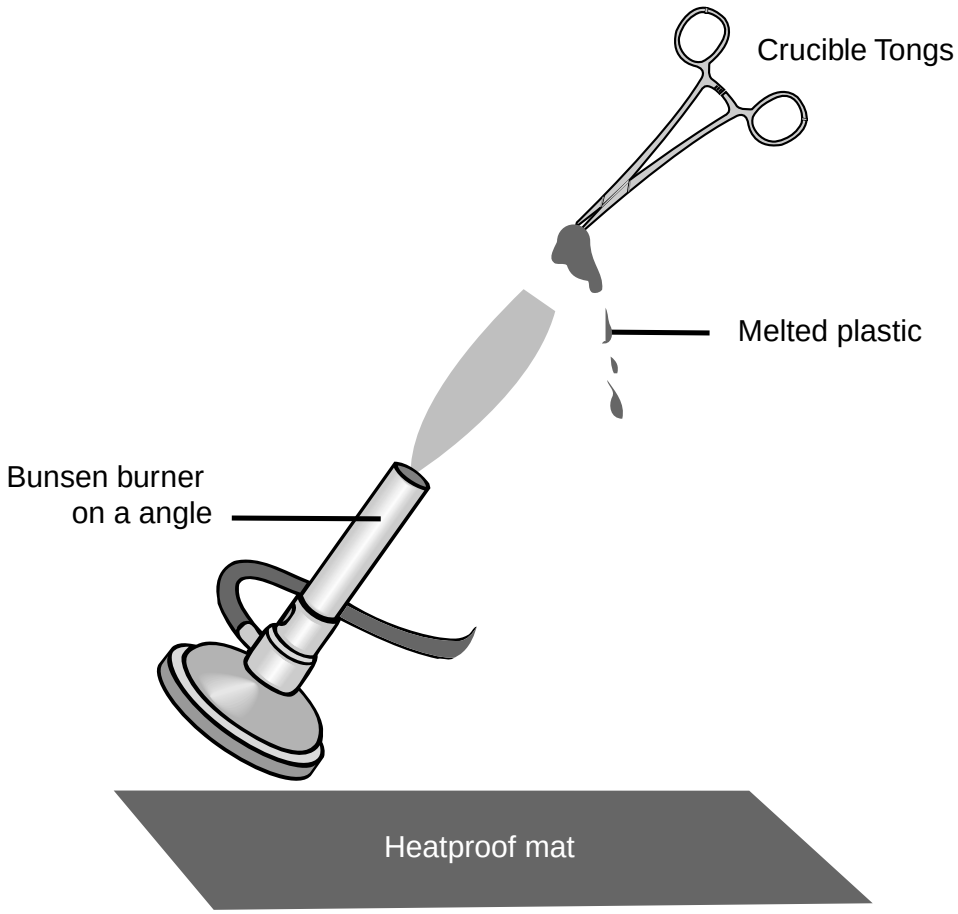
  *how well it burns*

  *colour of flame*

  *smoke*
- Test products of burning for acidity.

## DANGER:

**TOXIC FUMES MAY BE PRODUCED WHEN PLASTICS BURN. THE PRODUCTS OF BURNING MAY ALSO BE TOXIC OR CORROSIVE SO BE CAREFUL.**



## RESULT

| | sample 1 | sample 2 | sample 3 | sample 4 | sample 5 |
|---|---|---|---|---|---|
| melts | | | | | |
| does not melt | | | | | |
| ignites easily | | | | | |
| does not ignite easily | | | | | |
| burns freely | | | | | |
| does not burn freely | | | | | |
| colour of flame | | | | | |
| colour of smoke | | | | | |
| smell | | | | | |
| melts and drips | | | | | |
| acidic products | | | | | |

**CONCLUSION**

Using a key to plastics identify each one.

**PLASTICS**

| | | **Go to** |
|---|---|---|
| 1. | (a) burns when taken out of the flame | (2) |
| | (b) does not burn when taken out of the flame | (3) |
| 2. | (a) burns with an orange or yellow flame | (4) |
| | (b) burns with a blue flame. Produces white smoke and smells like burning candle | Polythene |
| 3. | (a) slow to burn | (5) |
| | (b) melts and drips, burns with a blue flame and smells like burning hair | Nylon |
| 4. | (a) sweet smell, clear edges around flame | Acrylic |
| | (b) mild smell, black sooty lumps float in air | Polystyrene |
| 5. | (a) flame is yellow with a green tinge and produces acidic products | PVC |
| | (b) yellow flame with spurts, strong smell | Formaldehyde |

Use the following table to record your results

| sample number | name |
|---|---|
| 1 | |
| 2. | |
| 3 | |
| 4 | |
| 5 | |

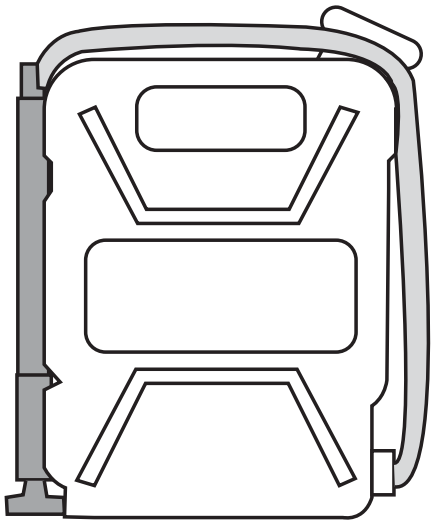
- What is the difference between thermosetting and thermosoftening plastic? .....
  .....
  .....
  .....
  .....
  .....
  .....
  .....
  .....

- Following a factory fire a fire fighter complains of having a stinging, burning sensation on her face and hands.
  What could be a possible cause of this? .....
  .....
  .....
  .....
  .....
  .....
  .....
  .....
  .....

**Technical Details**

Knapsack Spray

The high density polythene container (with U.V. inhibitor) has a moulded recess to hold the pump and hose when not in use. It also features an inbuilt carrying handle, adjustable terylene straps with shoulder supports and large filler neck for quick and easy filling. Knapsack sprays have been used extensively for over 60 years prior to the 1960's they were made out of sheet metal. Durable plastic knapsack spray are now preferred for their lighter weight and lowest cost.



# CARBON COMPOUNDS

Carbon compounds are a group of organic molecules which have the element carbon forming their central structure. Each carbon atom has the ability to combine with 4 other atoms to form chains and rings.

If the elements present in the organic carbon compound are only carbon and hydrogen they are called hydrocarbons. There are 3 basic types of hydrocarbons : ALKANES, ALKENES, AND ALKYNES.

Alkanes have only single bonds between the carbon atoms. C-C

Alkenes contain a double bond. C=C

Alkynes have a triple bond. C C *(draw the triple bonds between the carbon atoms)*

Alkynes are more reactive then alkenes, which are more reactive than alkanes.

The following table shows the formulae and the structure of the first six hydrocarbons with increasing numbers of carbon atoms (1-6) *(ask your teacher to show you how to draw structural formulae)*

| c atoms | name | formula | | name | formula | | name | formula | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | methane | $CH_4$ | | | | | | | |
| 2 | ethane | $C_2H_6$ | | ethene | | | | $C_2H_2$ | |
| 3 | propane | $C_3H_8$ | | | | | propyne | | |
| 4 | butane | | | butene | | | | $C_4H_6$ | |
| 5 | pentane | | | | $C_5H_{10}$ | | | | |
| 6 | hexane | $C_6H_{14}$ | | | | | | | |

A hydrocarbon was analysed and found to have 8 carbon atoms and had only single bonds. From the trends you should have recognised in the table it would be:

| name | formula | structure |
|---|---|---|
| | | |

The following table lists some alkanes, their physical properties and uses. Fill in the blanks and answer the questions, which follow the table.

| **c atoms** | **formula** | **name** | **melting p** | **boiling p** | **uses** | **State** (S,L or G) |
|---|---|---|---|---|---|---|
| 1 | | | -182.5 | -161.5 | natural gas | |
| 2 | | | -183.3 | -88.6 | | |
| 3 | | propane | -187.7 | -42.1 | | |
| 4 | $C_4H_{10}$ | | -138.4 | -0.5 | | |
| 5 | | | -129.7 | 36.1 | | |
| 6 | | | -95.3 | 68.7 | | |
| 7 | $C_7H_{16}$ | | -90.6 | 98.4 | | |
| 8 | | | -56.8 | 125.7 | | |
| 16-20 | | grease | variable | variable | | |
| 20-30 | | paraffin | variable | variable | | |

(you may have to research the uses of some of these alkanes.)

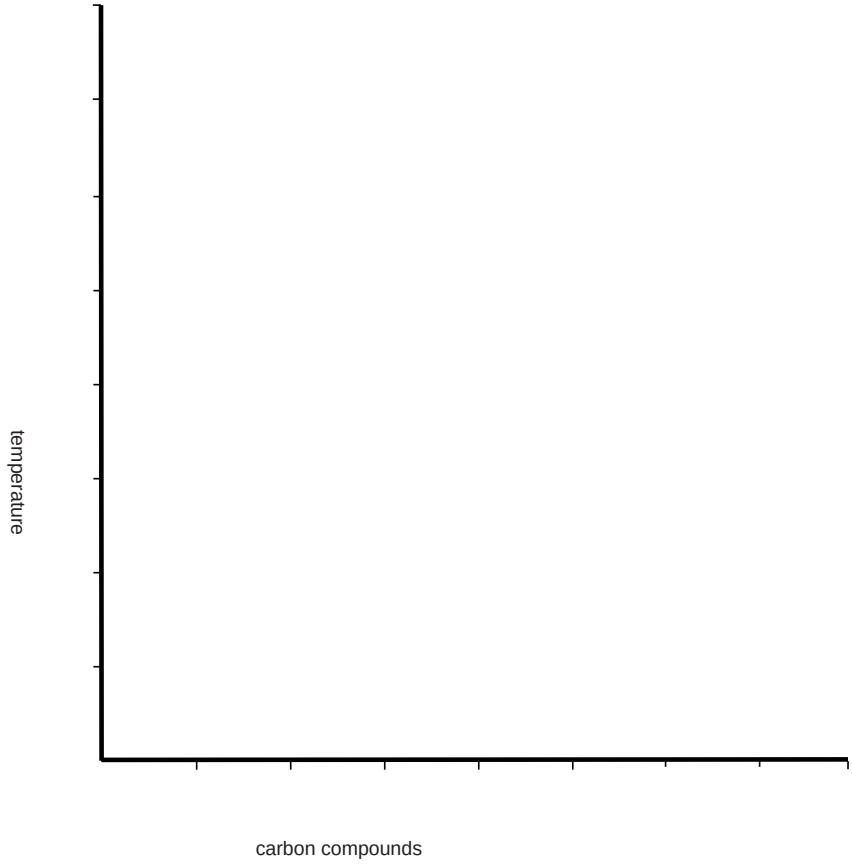
1. Categorise these alkanes as being solids, liquids or gases at room temperature. (Fill in the last column of the table)

2. When alkanes are heated in air they form carbon dioxide and water. What substance is in the air which is largely responsible for this? .....

3. Write a chemical equation to show what happens to propane when it burns in air.

.....

4. Use the data in the table to draw a graph to show the relationship between the number of carbon atoms and the melting and boiling points of the first 8 alkanes.



Write a generalised statement about the relationships shown in the graph. .....

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## FLAMMABILITY OF ALKANES

### AIM

Is hexane more flammable than pentane?

### METHOD

1. Dip a small square (1cm) of filter paper into some hexane.
2. Hold the square in some tongs and place into a Bunsen flame.
3. Record the time taken for the paper to burst into flames.
4. Repeat the procedure using pentane instead of hexane.

### RESULT

| name | formula | structure |
|---|---|---|
| time taken to burst into flames | | |
| ..... | ..... | ..... |
| ..... | ..... | ..... |
| other observations | | |
| ..... | ..... | ..... |
| ..... | ..... | ..... |

### CONCLUSION

1.Which alkane is the most flammable? .....

2. If you tested octane in the same way, what result would you expect to obtain? .....

.....

Alkanes are mostly used as fuels. Fires involving these fuels are classified as CLASS B or CLASS C fires.

Which fire extinguishers would be suitable to user on such fires? .....

.....

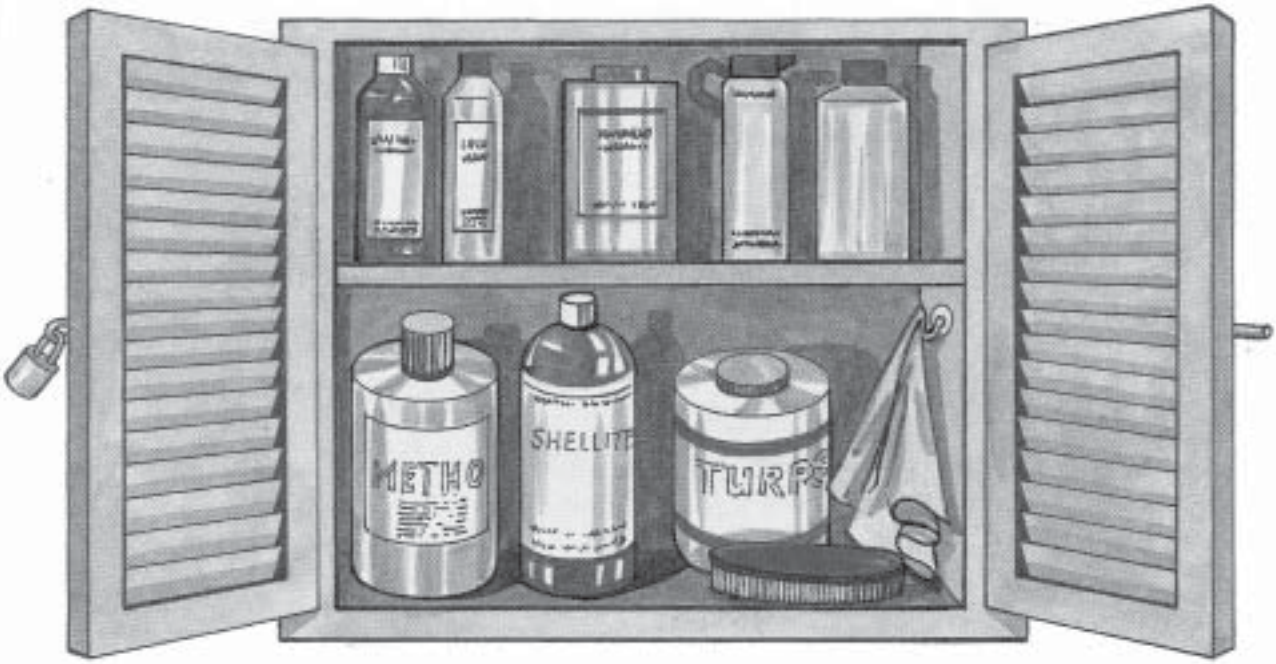
.....

**USING FLAMMABLE LIQUIDS SAFELY**

Flammable liquids can be dangerous if handled or stored carelessly.

- Flammable liquids should be stored in approved containers, which have caps that prevent vapour escape.
- All containers should be clearly labelled to indicate their contents.
- Containers should be stored out of the reach of children, in a well-ventilated area and away from heat and ignition sources.
- Pour flammable liquids in a well-ventilated area.
- Containers of flammable liquids should not be left open.
- Spillages should immediately be mopped up.
- When refuelling appliances and machinery ensure that they have cooled down and that the correct type of fuel is used.
- Do not use flammable liquids to relight fires.
- Large quantities of flammable liquids should be stored away from the home in a secure well-ventilated environment.




List the flammable liquids that are stored in and around your house. .....

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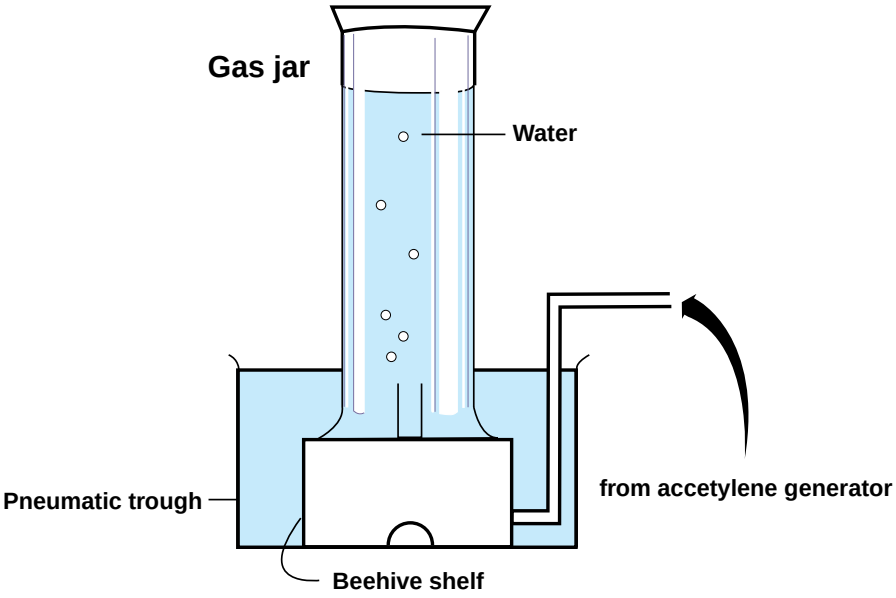
.....

# ACETYLENE

The following diagram illustrates how acetylene can be collected in the laboratory.




Suggest a reason why acetylene and many other gases are collected in this way. .....

.....

.....

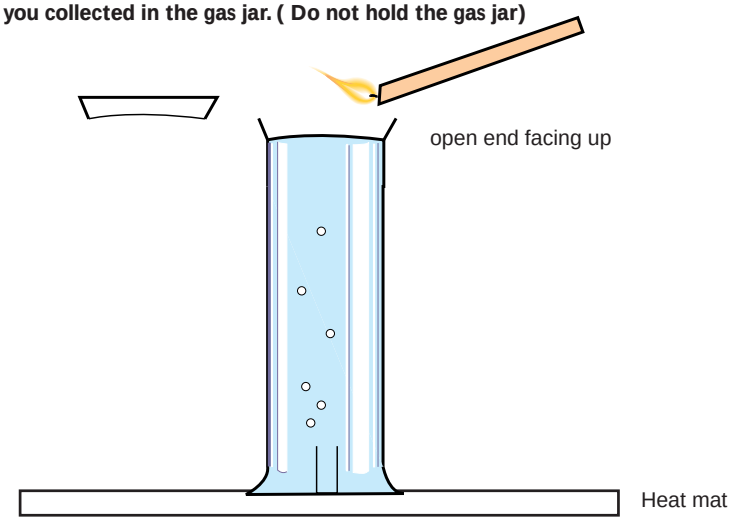
.....

**Use this method to collect gas from the gas tap in the laboratory.**

If the acetylene collected in the gas jar was ignited it would burn with an orange flame which produces lots of sooty residue.

The sooty residue is called .....

**Try igniting the gas you collected in the gas jar. ( Do not hold the gas jar)**



**Acetylene is a very reactive gas. When it burns in the presence of oxygen it does so with a very hot flame which is capable of cutting through metals.**

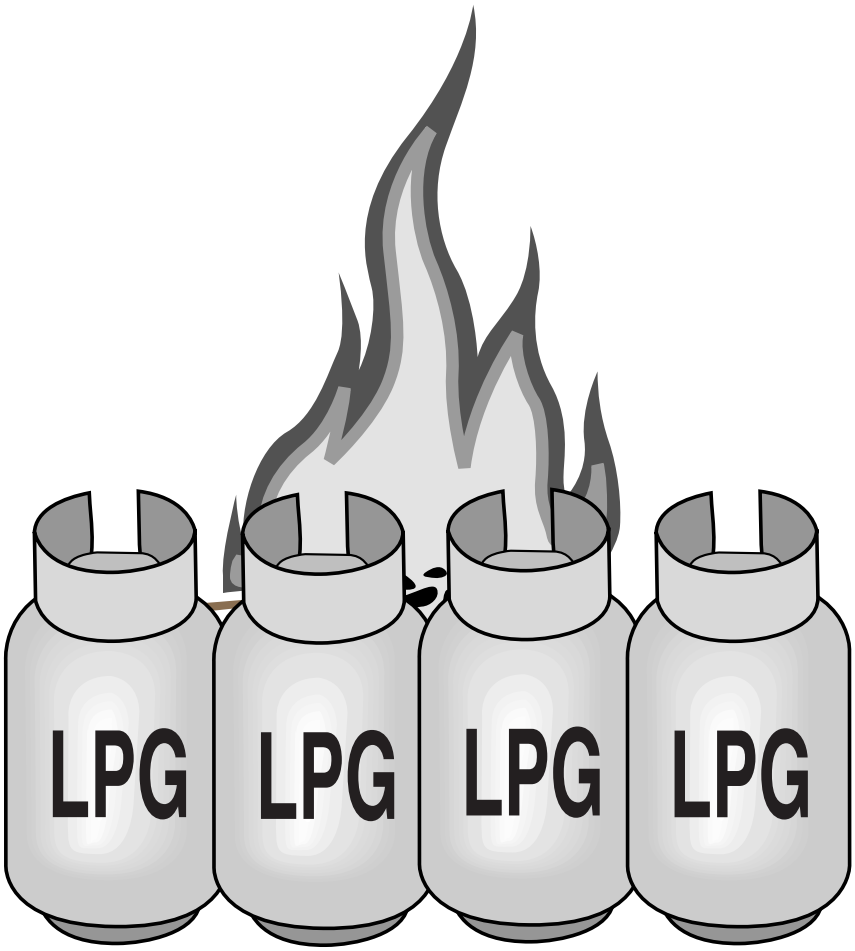
**Acetylene can decompose when subjected to heat. This reaction may continue even if the cylinder is subsequently cooled during the fire, and may lead to an explosive failure of the cylinder up to 48 hours later. Acetylene cylinders exposed to fire should, if safely possible, be kept cool with water for at least 12 hours.**

The systematic name for acetylene is ethyne. What is the chemical formula and structure of this hydrocarbon?

| name | formula | structure |
|---|---|---|
| | | |

**Research:**

Find out about carbide lamps and their uses. What dangers were experienced by the users of carbide lamps?



# WHAT CLOTHES BURN?

An experiment was undertaken to compare the flammability of certain types of clothing material. The results from this experiment are shown in the following table.

| material | time to burn(sec) |
|---|---|
| wool | 20 |
| cotton | 10 |
| nylon | 30 |
| polyester | 15 |

These materials were treated with a special fire retardant chemical and the experiment was repeated. The new results were:

| material | time to burn |
|---|---|
| wool | 150 |
| cotton | 50 |
| nylon | 45 |
| polyester | 35 |

Which materials provide the best fire retarding properties after treating with fire retarding chemicals? .....

.....

.....

.....

YOU SHOULD ALWAYS WEAR WOOL OR PURE COTTON TO PROTECT YOU FROM RADIANT HEAT. SYNTHETICS WILL MELT AND BURN. NATURAL FIBRES ARE MUCH HARDER TO IGNITE. AVOID WEARING SYNTHETIC MATERIAL NEAR ANY TYPE OF FIRE.

A fire fighter's turnout jacket used in structural fires is made of wool treated with a fire retardant chemical. Do you think that this woollen jacket would be suitable for fighting bush fires? .....

Why? .....

.....

.....

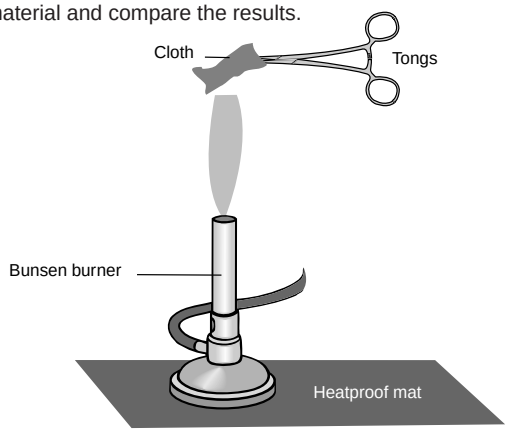
# THE BEST MATERIAL

**AIM**

To compare the flammability of several different types of fabric.

**METHOD**

- Collect a variety of different types of clothing material (try to have some which have been treated with a fire retardant chemical eg. fire brigade overalls. Your local brigade or Fire Control Centre may have used or damaged items).
- Cut the samples into small squares. (Control your variables to ensure a fair test).
- Hold the fabric over the Bunsen flame and observe how it burns.
- Repeat this for each type of material and compare the results.




**RESULT**

| material | time to burst into flames | other observations |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

**CONCLUSION**

Using the results obtained from your experiment and the results shown on the previous page answer the following questions:

Which cloth was the most flammable? .....

Which cloth was the least flammable? .....

From which material would it be best to make a child's pyjamas? .....

Why?. .....

How effective was the fire retardant chemical? .....

**Firefighters are trained to cover themselves with woollen blankets if they are trapped in their vehicles during a fire. If they are wearing their bright yellow overalls, which have been specially treated with a chemical called "PROBAN" they will be offered a reasonable amount of protection. Firefighters are trained to avoid this sort of entrapment. Through sometimes unavoidable it is never recommended that anyone should place themselves in this situation.**

# acids & bases

## SYLLABUS CORE CONTENT COVERED BY THESE EXERCISES INCLUDE:

4.22.2 (d) Classify compounds into groups based on common characteristics including acids, bases and salts.

(e) Describe the role of common indicators in distinguishing between acids and alkalis.

**RECOGNISING ACIDS**

Make a list of places in and around the house where acids may be found:

| name of acid | where it is found? |
|---|---|
| ..... | ..... |
| ..... | ..... |
| ..... | ..... |

Dangerous acids should have a labels attached to them warning people of their dangers. LOOK for a label on a laboratory container, which is used to store acids and draw the label in the space below.

Design your own safety label and draw it below.

**Acids are used extensively in industry. RESEARCH some uses of at least two different acids used in industry. Find out how they are transported. Find out about some accidents involving acids.**

- Acid spills, like all other hazardous chemical spills are dealt with by a specialised unit of the NSW Fire Brigades called HAZMAT.
- What is HAZMAT an abbreviation of? .....
- Where is the location of the closest HAZMAT Unit to you? .....
  .....

A set of Standard Operating Procedures (SOP's) ensure that all firefighters at an incident understand the sequence of events to ensure safety for all involved and a faster containment of the incident. If you were the manager of HAZMAT in NSW, what standard operating procedures would you devise to ensure the safety of firefighters and of the general public at an incident ?

**MY SET OF STANDARD OPERATING PROCEDURES**

- .....
- .....
- .....
- .....
- .....
- .....
- .....
- .....
- .....
- .....
- .....
- .....
- .....

.....

**If your local Rural Fire Brigade were called to an incident involving a large acid spill, they also would have a set of standard operating procedures aimed at containing the spill and ensuring safety until HAZMAT arrives.**

List some ways in which your local Rural Fire Brigade could contain the spill and ensure the safety of everyone in the vicinity.

- .....
- .....
- .....
- .....
- .....
- .....
- .....
- .....
- .....
- .....
- .....
- .....
- .....

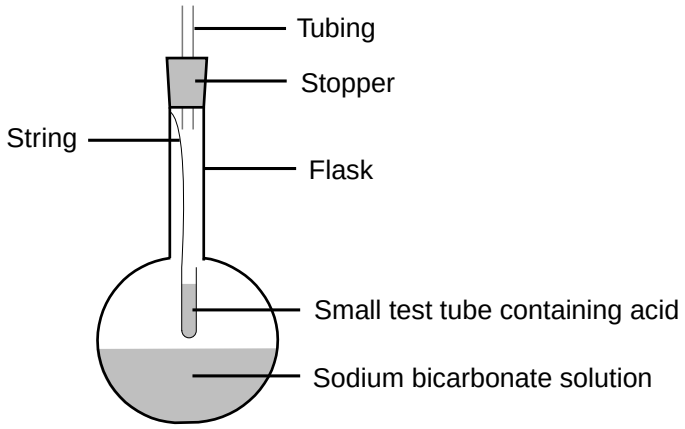
## MAKING A MODEL FIRE EXTINGUISHER

### AIM

To make a model soda-acid fire extinguisher.

### METHOD

- Set up the equipment as shown in the diagram.




- Turn the “extinguisher” upside down and point it into a sink or you could take it outside and try to extinguish some burning paper, under supervision.

### TAKE CARE

- when working with acids
- don’t point the extinguisher at anyone
- wear safety goggles
- report any spills to your teacher

### RESULTS

My observations: .....

.....

.....

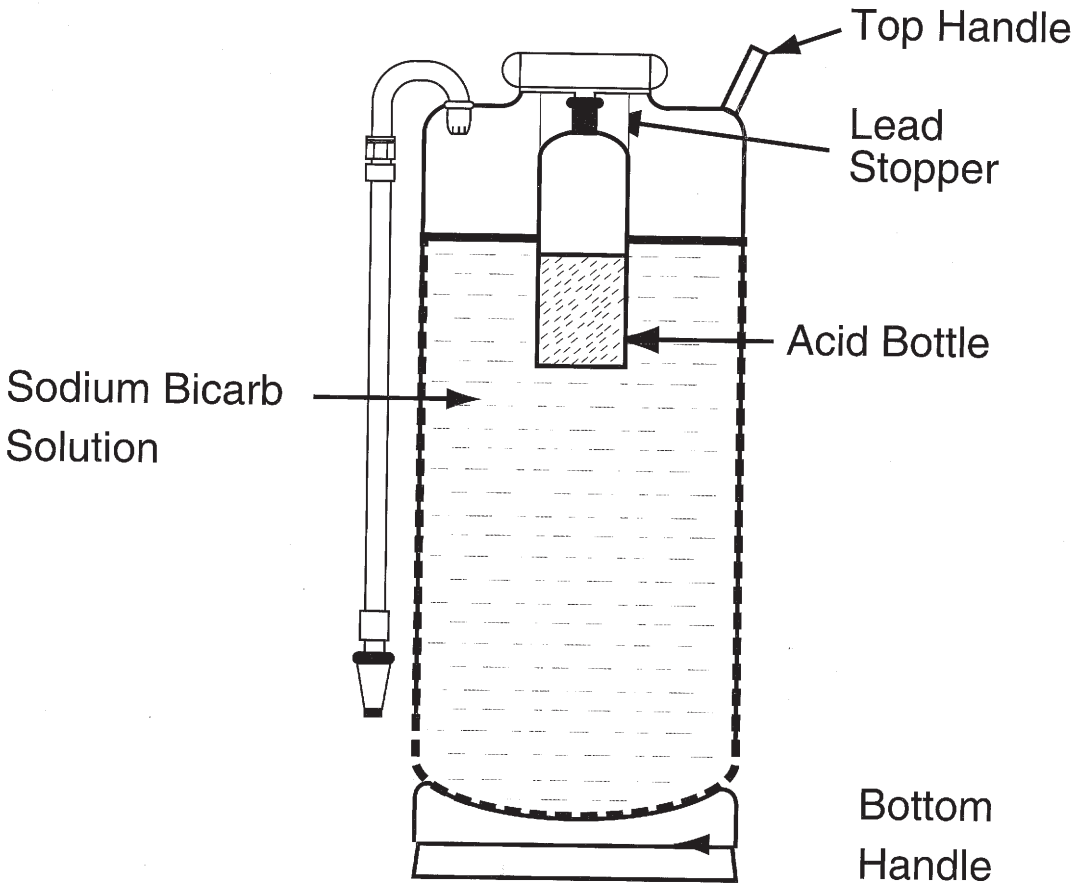
.....

My diagram showing what happened:

**CONCLUSION**

1. ACID + CARBONATE → ..... + WATER + SALT
2. $CO_2$ gas creates a P..... E inside of the flask, which causes the contents to be expelled.
3. The following diagram shows a cut out view of a typical reversible type of fire extinguisher.

## Typical Reversible Type Fire Extinguisher




This type of extinguisher is not used much anymore. Can you suggest some reasons for this and what types of extinguisher are used instead? .....

.....

.....

.....

.....

.....

## TYPICAL PROPERTIES OF ACIDS

**UNSCRAMBLE THE FOLLOWING WORDS IN BRACKETS TO COMPLETE THE SENTENCES**

- Acids taste ..... (rsuo)
- Acids ..... cells. (ikll)
- Acids react with ..... (aelsmt), to produce ..... (noydhrge)
- Acids are ..... (tnrueadseli) by bases, to form .....(lats) and (rtewa)
- Acids react well with .....(aaeosrcnbt) to produce ..... (eiaddc nobiorx) gas.
- Acids change the colour of .....(srandiicto)
- Acids have a pH less than ..... (evens)

**Complete the following table, which provides information about some different acids and where they may be found**

| acid name | chemical formula | strength | location |
|---|---|---|---|
| hydrochloric | | | stomach |
| | $H_2SO_4$ | | battery |
| | $HNO_3$ | | fertiliser factory |
| acetic | | weak | |
| formic | HCOOH | | |
| | $C_6H_8O_7$ | | lemons |

## BATTERY ACID

**AIM**

Does the acid in a car battery behave the same as the acids in the science laboratory?

**METHOD**

- Use a pipette to carefully draw some acid out of a car battery.
- Place the acid into a test tube, place a stopper onto the test tube, and label it as “battery acid”.
- Rinse out the pipette.
- Test the acid you collected with litmus paper and universal indicator.
- Add small quantities of the acid to (i) carbonate solution, (ii) basic solution, and (iii) zinc.

**RESULT**

**CONCLUSION**

1. Is battery acid weak or strong? ..... Some reasons for making this choice are: .....

.....

.....

2. The products formed when the acid is added to the carbonate are:

.....

.....

3. The reaction between the acid and the base is called a .....

reaction. The products formed during this reaction are .....

.....

4. The gas formed when the acid reacted with the zinc is most likely to be ..... I could recognise this gas from other gases because .....

Do you think that battery acids could form a hazard following a motor vehicle accident? ..... What precautions should be undertaken by fire brigades and other emergency personnel at these accident scenes? .....

.....

.....

.....

.....

.....

Design a set of safety rules, which should be adhered to when battery acid is added to batteries, or when battery acid level is checked. .....

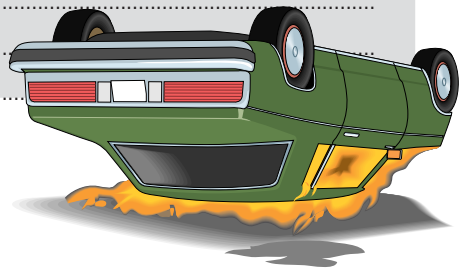
.....

.....

.....

.....

.....



"VITON"

**AIM**

Do certain components used in car parts produce toxic acid substances when they burn or when they are strongly heated?

**METHOD**

- Collect small samples of different car components that will burn. Include such items as:

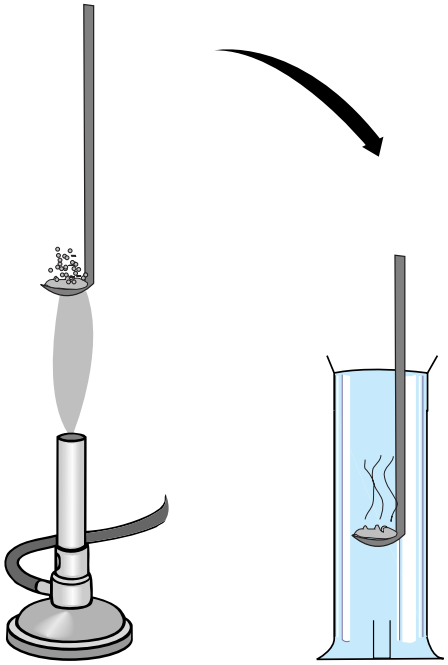
  ***gaskets, O rings, electrical componentry, plastics, vinyls, rubber***

- Place small samples into a deflagrating spoon and heat strongly with a Bunsen flame until the sample either ignites or begins to give off fumes.

**Make sure that you follow all safety precautions.**

Perform this experiment in a fume cupboard.

- Place the deflagrating spoon into a gas jar into which you have placed some moist red and blue litmus paper.
- Test the products after heating and/or burning to see if they are acidic or basic.



**RESULT**

| item tested | observation on heating/burning | effect on litmus |
|---|---|---|
| ..... | ..... | ..... |
| ..... | ..... | ..... |
| ..... | ..... | ..... |
| ..... | ..... | ..... |

.....

**CONCLUSION**

Do any of the substances produce acidic or basic fumes when they are either heated or burnt? .....

.....

.....

.....

Apart from carrying hazardous cargo some vehicle components produce hazardous substances when involved in a fire. “VITON”, a plastic used in some gaskets, “O” rings, electrical items and other components, can decompose into hydrofluoric acid when strongly heated. This is a strong acid and contact with the skin can lead to severe injury even though it may not cause an immediate sensation of burning or stinging. While attending motor vehicle accidents/fires, firefighters should always wear protective clothing and avoid contact with fire residues.

**An interesting exercise would be to find out if any plants produce toxic substances when they burn.**

The following diagram shows some firefighters attending a motor vehicle accident. How many hazards can you recognise?

| hazard | why it is a hazard? |
|---|---|
| ..... | ..... |
| ..... | ..... |
| ..... | ..... |
| ..... | ..... |
| ..... | ..... |
| ..... | |

# FIRE FIGHTING FOAM

**AIM**

Is the foam, which is used for fire fighting purposes, an acid or a base?

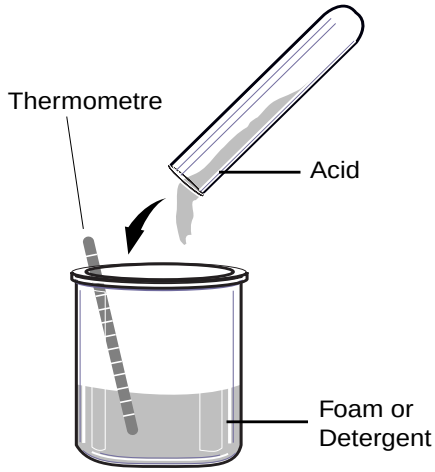
**METHOD**

1. Obtain a sample of firefighting foam from your local Rural Fire Brigade.

   They should have two types: AFFF (Aqueous Film Forming Foam) used in structural fires and BFFF (Bush Fire Fighting Foam) used for bush fire suppression

   **If you cannot obtain any foam you could use normal washing up detergent or dishwasher liquid.**

2. Test your foam with a variety of indicators (litmus, phenolphthalein, methyl orange, universal indicator).
3. Measure the temperature of the foam then slowly add some hydrochloric acid to the foam and record any temperature changes. Repeat by adding some sodium hydroxide to the foam and recording any temperature changes.




4. Make comparisons between any different types of foam and/or detergents.

**RESULT**

| foam type | detergent type | phenolphthalein | methyl orange | adding acid |
|---|---|---|---|---|
| ..... | | | | ..... |
| ..... | | | | ..... |
| ..... | | | | ..... |
| ..... | | | | |

**CONCLUSION**

From the results obtained comment upon what you believe the foam to be: ..... Give reasons for your answer.

.....

.....

.....

# fire

## & the human body

## SYLLABUS CORE CONTENT COVERED BY THESE EXERCISES INCLUDE:

5.25 (a) Describe cells, organs and/or systems in flowering plants and humans which transport materials

(i) Identify materials carried in transport systems

(ii) Describe how the structure of the transport system aids their function

(iii) Relate structures of blood components to their functions

**HEAT AND OUR BODIES**

We are mammals. The characteristics, which make us mammals, are:

- We suckle our ..... . (gyuon)
- WE ARE WARM BLOODED.
- We have ..... (ruf) or ..... (rahi) on our bodies.

Being warm blooded means that .....

.....

The average body temperature of humans is .....

The body temperatures of 10 of my classmates are:

| name | temperature | name | temperature |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

Our bodies maintain their temperature at a constant temperature by:

p_rs_ _ _ _ng  pa_t_n_  sh_v_ _ing

Our body cells cannot function properly if our body's temperature becomes too high or too low.

**For this activity you will need two volunteers:**

**VOLUNTEER 1:**

**Place as many clothes as possible on this person and get them to stand in front of a heater or out in the sun.**

**VOLUNTEER 2:**

**Remove as many clothes as is decently possible, stand them in icy cold water, dampen their body and place them in front of a fan.**

**NB: Volunteers must be monitored constantly to ensure their safety and well being.**

**THE HOT BODY**

| time | pulse | body temp (ºC) | observations |
|---|---|---|---|
| 1 min | | | |
| 2 min | | | |
| 3 min | | | |
| 4 min | | | |
| 5 min | | | |
| 6 min | | | |
| 7 min | | | |
| 8 min | | | |
| 9 min | | | |

1. How is heat absorbed from the environment? .....

.....

2. Does the body heat actually change? .....

3. List the ways in which a hot body works to keep body temperature normal: .....

.....

.....

**THE COLD BODY**

| time | pulse | body temp (ºC) | observations |
|---|---|---|---|
| 1 min | | | |
| 2 min | | | |
| 3 min | | | |
| 4 min | | | |
| 5 min | | | |
| 6 min | | | |
| 7 min | | | |
| 8 min | | | |
| 9 min | | | |

1. Does the body heat actually change? _____

2. List the ways in which our body works to maintain constant body temperature. .....

.....

.....

.....

3. Why does the skin appear blue? .....

.....

.....

.....

Complete this passage by adding words from the list below.

Heat ..... and associated heat illness are fairly common conditions, which affect ..... and anyone placing themselves in a hot ..... If heat stress is left undetected or ..... it can quickly lead to a life ..... situation. Body heat results from ..... work. Heat is also ..... from the environment as ..... heat from a fire or the ..... The body also gains heat by ..... if the air ..... is above 31 degrees ..... The body controls its temperature by ..... and altering the flow of ..... through the body. The ..... increases its rate, and pumps the blood near to the skin and, at the same time the body sweats.. The face becomes ..... As the sweat ....., it draws heat from the body in the same manner that a canvass water bag keeps the water ..... If water is not taken regularly, sweating will lead to ..... of the body and heat ..... will result.

| | | | | |
|---|---|---|---|---|
| **blood** | **flushed** | **sweating** | **stress** | **untreated** |
| **absorbed** | **convection** | **illness** | **evaporates** | **firefighters** |
| **threatening** | **radiant** | **temperature** | **dehydration** | **cool** |
| **heart** | **environment** | **muscular** | **sun** | **Celsius** |

**GETTING SICK FROM HEAT**

The symptoms of **heat stress** are:

WEAKNESS

DIZZINESS

NAUSEA

If the body continues to overheat, **heat exhaustion** will result. The symptoms change accordingly:

WEAK PULSE

SHALLOW BREATHING

CLAMMY SKIN

PALE FACE

From the above indicators list some signs/symptoms and their causes.

| **signs/symptoms** | **what causes them** |
|---|---|
| ..... | ..... |
| ..... | ..... |

.....

The brain recognises that the body is overheating due to stress and dehydration. It slows down the system.

**Discuss and list what you should do if you are suffering these symptoms or if someone you know may be suffering from heat exhaustion. (refer to a first aid book).**

.....

.....

.....

.....

.....

If the symptoms of heat exhaustion are not treated the patient will progress into state of **heat stroke**. The brain has become affected and no longer instructs the body to cool down. The symptoms are:

**RAPID AND STRONG PULSE** **HOT, DRY SKIN** **HIGH TEMPERATURE** **FLUSHED FACE**

| **Sign/Symptom** | **What causes it** |
|---|---|
| rapid and strong pulse | ..... |
| hot, dry skin | ..... |
| high temperture | ..... |
| flushed face | ..... |

| **Condition** | **Treatment** |
|---|---|
| heat stress | • move the patient away from the ..... environment<br>• sit the patient in the .....<br>• minimise clothing |
| heat exhaustion | • give regular sips of plain .....<br>• seek medical .....<br>• lay the ..... in the shade<br>• ..... or loosen clothing<br>• ..... with cool water and fan to increase ventilation and ..... |
| heat stroke | • give frequent drinks of water<br>• URGENT MEDICAL ATTENTION IS ESSENTIAL<br>• call for an .....<br>• lay the patient in the shade<br>• remove and/or loosen clothing<br>• sponge with water and fan to increase evaporation<br>• give frequent drinks of water<br>• THE BODY MUST BE ..... IMMEDIATELY |

During the last 24 hours I have had the following drinks.

| Drink | Volume (ml) | Drink | Volume (ml) |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

TOTAL VOLUME = ..... AVERAGE/HOUR = .....

**Strenuous exercise in a heated environment will result in body fluid losses of up to 1 litre per hour.**

**You must drink enough water to replace the fluids you have lost.**

List some reasons why water is such an important chemical in our bodies. .....

.....

.....

.....

The following diagram illustrates the concepts of heat stress and fluid needs. In the space beneath the diagram write, in your own words, to give meaning to the illustration.

.....

.....

600ml

- Losses "per hour" due to normal fire fighting

600ml 600ml 600ml

- Losses "per hour" under extreme conditions

Firefighter Fluid Loss Rates

**Use these words to complete the exercise below. (these words may be used more than once)**

| | | | | |
|---|---|---|---|---|
| $CO_2$ | pulmonary | valves | radial | pulse |
| veins | atrium | oxygen | carotid | thin |
| left | arteries | aorta | cells | body |
| muscular | oxygen | right | ventricle | vessels |
| pressure | | | | |

## HOW BLOOD CIRCULATES THROUGHOUT THE BODY

Blood flows back to the heart through ..... Veins are relatively ..... walled vessels but their inside diameter may be large. Veins contain ....., which ensures that blood flows in one direction. Blood in veins is generally not under ..... and relies upon the movement of skeletal muscles to force blood through the veins. Blood in the veins is deoxygenated which means it is low in ..... but high in ..... Smaller veins unite, gradually forming larger veins, which enter the ..... chamber of the heart.

The right ..... is the collecting chamber of the heart. Blood is transferred from the right atrium into the right ..... Valves ensure a one way passage between the various chambers of the heart. Blood is forced from the right ventricle through a large artery called the ..... artery. Arteries always carry blood away from the heart. The pulmonary artery is the only artery in the body, which transports deoxygenated blood. The deoxygenated blood is transferred to the alveoli in the lungs where it becomes oxygenated (the blood offloads its ..... and takes on a new load of ..... ).

Newly oxygenated blood returns to the heart through the ..... (the only vein in the body to transport oxygenated blood).

Blood re-enters the heart through the ..... atrium and is transferred to the left ..... The left side of the heart is largest because blood from here has to be pumped to all parts of the ..... Strong contractions of the left ventricle force blood out from the heart through the ..... The aorta distributes blood to all other ..... which distribute it to all other parts of the body.

Arteries are the strongest of the blood ..... and their walls contain elastic and ..... tissue. As the blood is forced along the arteries by the action of the heart, the muscular wall expands and then returns to its normal size. This wave of pressure is called the ..... Two good places to check the pulse are the ..... artery and the ..... artery.

Arteries divide into arterioles, which become progressively thinner until they become capillaries. Capillaries are tiny blood vessels, which permeate throughout the cells and tissues of the body. They consist of thin layers of ..... through which exchange of fluids and gases can occur. Once the capillaries have given up their load of oxygen and other substances needed by the cells and taken on carbon dioxide and other wastes they rejoin to form veins.

# weathering & erosion

**SYLLABUS CORE CONTENT AREAS COVERED BY THESE EXERCISES INCLUDE:**

**4.26.3** a) Weathering and erosion.

(i) Describe and compare effects of different weathering agents.

(ii) Explain the difference and identify the relationship between weathering and erosion.

(iii) Relate weathering and erosion to the formation of landforms in the local area.

(iv) Describe how weathering and erosion can lead to the formation of sediments.

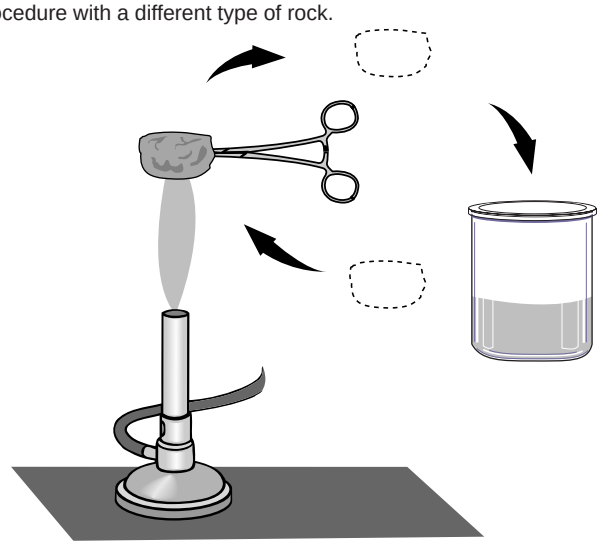
## HEAT AND ROCKS

### AIM

To examine the affect of alternate heating and cooling of rocks.

### METHOD

- Obtain 2 or 3 samples of different types of rocks. They should be big enough so that they can be comfortably held in crucible tongs.
- Wear safety goggles while doing this activity and make sure that everyone else in the room is also wearing them.
- Heat the rock strongly in the Bunsen flame.
- Carefully place the rock into the beaker of water. Don't let it drop and hang onto it with the tongs.
- Repeat the procedure 10 to 15 times.
- Repeat the whole procedure with a different type of rock.



### RESULT

| Rock type | Observations |
|---|---|
| ..... | ..... |
| ..... | ..... |

.....

**CONCLUSION**

1. Was any particular rock type more vulnerable to “cracking up” in this experiment? ..... Explain:

.....

.....

2. When a rock is heated it ..... and when it is cooled it .....

3. Alternate heating and cooling of rocks causes them to f___a___t___r___.

4. What processes in nature heats up rocks? .....

5. What processes in nature cools rocks down? .....

6. The highest daytime temperature, which has been recorded in your area, is ..... The lowest night time temperature, which has been recorded in your area, is ..... Would this be enough to break open rocks?

7. The breaking of large rocks into smaller rocks is called weathering. What sort of areas would be more vulnerable to weathering by alternate heating and cooling of rocks? .....

8. How could bush fires contribute to this type of weathering? .....

.....

**Research the types of landform patterns, which may result from this type of weathering**

**• ONION SKIN WEATHERING**

**• EXFOLIATION**

Write your findings here .....

.....

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**BUSH FIRES AND SOIL EROSION**

Bush fires have the potential to affect soil erosion. Sandstone soils are particularly vulnerable to soil erosion.

Combinations of steep slopes and potentially unstable soils means any disturbance of the vegetation cover can lead to serious soil erosion problems. Soil erosion also presents problems further downstream through flooding and siltation.

Soil erosion is often promoted by bush fires, particularly when soon followed by heavy rainfall. The removal of vegetation cover and the litter layer affects infiltration rates and runoff. Water is less likely to be held by the soil and erosion occurs on hillsides.

To minimise the adverse affects of bush fires on soil erosion it is recommended that:-

- Strategic hazard reduction and fire trail construction should occur to reduce the effect of high intensity fires within sensitive catchment areas.
- Avoid burning and trail construction during months characterised by heavy rainfall.

1. Write the meanings of these words as they are used in the passage.

potential .....

erosion .....

vulnerable .....

siltation .....

litter .....

infiltration .....

hazard reduction .....

catchment .....

2. Describe the soils, which are more likely to be eroded. .....

.....

3. Under what geographical conditions is erosion more likely to occur? .....

.....

4. Explain how bush fires can promote soil erosion. .....

.....

5. During which months of the year should hazard reduction and trail construction be undertaken? .....

.....

Explain why you chose these months. .....

.....

.....

 

# "RUNNING OFF" FROM BUSH FIRES

**AIM**

Does the removal of leaf litter during a bush fire contribute to erosion by increasing the amount of runoff?

**METHOD**

- Set up two identical stream trays. Ensure that both have a similar layer of leaf litter.
- Burn the leaf litter on one of the trays.
- Place the trays on a slight angle.

  Sprinkle the same amount of water onto each tray and record the volume of water collected at the base of the tray in a specified time.
- Change the slope of the stream tray and once again collect water at the base of the tray.

**RESULT**

| | **stream tray with leaf litter intact** | **stream tray with leaf litter burnt** |
|---|---|---|
| volume of water collected ..... | | |
| other observations ..... | | |
| ..... | | |
| ..... | | |

- The time taken to collect the volume of water was .....
- Over the same time period when the slope of the tray was changed I obtained these results:

| | **stream tray with leaf litter intact** | **stream tray with leaf litter burnt** |
|---|---|---|
| volume of water collected ..... | | |
| other observations ..... | | |
| ..... | | |
| ..... | | |

**CONCLUSION**

1. Did removal of the leaf litter affect runoff rates? ..... By how many times? .....

2. Which word, or words means the opposite to runoff? .....

3. If this was a real hillside, describe other factors, which would affect the rate of runoff. .....

.....

4. How would places downstream be affected? .....

.....

## References

**(Workbook 1 & Workbook 2)**


- Ardley N -101 Great Science Experiments Dorling Kindersley Ltd London
- Australian Fire Authorities Council (Fire Prevention 1 Advanced Bush Firefighter Training Manual-Part. 6) Comm of Aust. 1995 Longman Aust. 1995
- CSIRO Insects Of Australia- A Textbook for Students and Research Workers. Douglas, Prew Waterhouse 1970
- Country Fire Authority (CFA) Effects of Heat 1995
  Radiant heat -The killer In a bushfire. 1998
- Microsoft Encarta
- NSW Rural Fire Service Basic Firefighter Manuals
  Village Firefighter Manual
  Officer Training Modules
  Bush Fire Protection for New And Existing Rural Properties
  A State Ablaze-The.January 1994 Fires
  Fire! The Australian Experience
  Bush Fire Puzzle Book
  Specialist Training Manual- Rural Fire Driving
  Smokeys Activity Book
  The Burning Question
  Bush fire Pretection for New and Existing Houses in Urban Areas
  Controlling Bush Fires (Fact Sheet No 25)
  Alexander Bunyip Project (out of print)
- Shadwick B Science Skills Perspective Book 1 Science Press 1998
- Shadwick and Barlow Science Perspectives Book 1 Science Press 1998
- Stannard and Williamson Science Now Books 1-4 McMillan Ed Aust. 1991
- State Forests Bush Telegraph Feb. 1998 State Forests Of NSW.
- Vreeze et. al. Science and Technology Books 1 and 2 Lufts, Pruss and Gilbert 1992
- Weldon The Wildfires Of 1994 Beaut Books 1994

**NSW RURAL FIRE SERVICE**

**PUBLIC EDUCATION RESOURCES**

1. Bush fire danger season / Total fire bans
2. Barbecues & campfires
3. Tree selection for fire-prone areas
4. Trees & fire resistance
5. Regeneration & care of fire-damaged trees
6. LP gas safety
7. Bush fire readiness checklist
8. Home fire safety checklist
9. Bush fire preparedness. Your family, Your pets
10. Industrial & commercial fire prevention in bush fire prone areas
11. After the fire guide
12. Equipment & machinery use in bush fire prone areas
13. Holiday fire safety
14. Personal safety equipment
15. Hazard reduction
16. Preschoolers & Fire Safety
17. What is Community Fireguard?
18. Publications & Educational Resources
19. Fires in pine forests
20. Vehicles: How they can both protect you and cause bush fires
21. First aid during bush fires
22. Why flammable liquid need careful handling for those who live in bush fire prone areas
23. Additional fire protection for your home
24. The effects of weather on bush fires
25. Controlling bush fires
26. Survival flow chart
27. Before you light that fire
28. Bush Fire Operations, Planning ...
29. Bush Fire Risk Mgmt Planning
30. A guide to the Rural Fires Act 1997
31. What does that mean? Terms used by NSW Rural Fire Service
32. Incident Control Systems

**Fireguard for Kids Resources**

- Fireguard for Kids Kit (Whole)
- Fireguard for Kids Kit (Refill)

**For Children**

- Bush Fire Puzzle Book
- Smokey's Activity Book
- Smokey's Home - Story Book
- Sticker - Children's Fire Safety
- Magnet - Animation / Hotline
- Poster - Fire Awareness Week (Annually)
- Word Puzzle Activity Sheet
- Word Search Activity Sheet
- Bookmark
- Rulers
- Balloons
- Showbags

**Books and Booklets**

- NSW RFS Corporate Folder
- Bush Fire Protection for new and existing houses in urban areas
- Bush Fire Protection for new and existing rural properties
- The Burning Question
- Fifty Years of Fire
- Fire! The Australian Experience
- A State Ablaze
- Brochure - Join your Local RF Brigade
- Fire Prevention Presentation Handbook
- Fire Safe, Book 1 (Primary Teachers)
- Fire Safe, Book 2 (Primary Teachers)
- Fire Safe, Book 3 (Primary Teachers)
- Fire Science, Book 1 (Secondary Teachers)
- Fire Science, Book 2 (Secondary Teachers)
- Geography Resource for Secondary Teachers

**Other Resources**

- Sticker - Corporate "Heart of NSW"
- Sticker - Corporate "Peace of Mind"
- Magnet - '000' Emergency
- Poster - Fire Safety (Several Versions)
- Poster - Join your Local RF Brigade

N.B. These resources are under constant review and may be updated or altered from time to time.

All titles are free, many available in class sets.