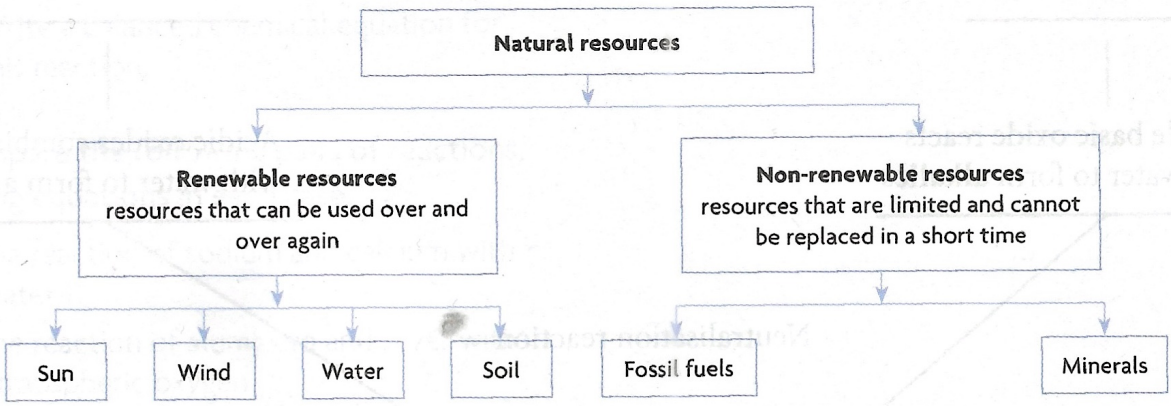
CHAPTER 5

Fuels and Energy

Sunlight is the source of life on earth. All green plants take energy from the sun and use it during photosynthesis to make and store food. Resources like sunlight, water, air, soil, fossil fuels and minerals that are obtained from the environment for the use of living organisms, including man, are called **natural resources**. Natural resources provide energy. Some of these resources are plentiful, but others, like fossil fuels and minerals, if not used judiciously, will run out at some stage.



We are consuming some natural resources like forests, land and water much faster than the rate at which nature can regenerate them. If we are not very careful, we will exhaust them soon. These are **exhaustible resources**. Sunlight, which is available to us all the time, never gets exhausted. It is an **inexhaustible natural resource**.

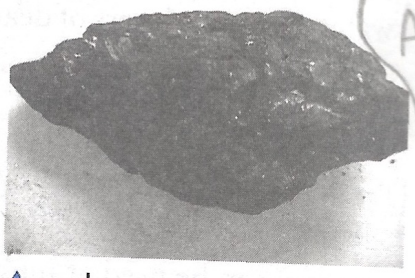
Fossil Fuels

A fuel is a substance that is used to produce heat energy by burning. Coal, oil and natural gas are fuels that are formed underground from the remains of plants and animals that lived millions of years ago. For this reason they are known as **fossil fuels**.

Coal is formed from trees and plants that were living about 300 million years ago. As the trees and plants died, they sank to the bottom of shallow swamps. Over hundreds of years they were covered by sand, clay and other minerals.

▲ The picture shows a piece of coal containing a network of fossilised fern leaves. This is proof that the coal was formed from plant remains.

As more and more rocks piled up on top, the lower layers were compressed. The temperature also rose as they sank deeper. Under high temperature and high pressure, these dead plants and trees were slowly converted into coal.



▲ coal

Coal is found underground in mines. It mainly contains carbon and carbon compounds. The most common forms of coal are **lignite** and **anthracite**. Coal is widely used as a fuel for the generation of electricity in thermal power plants. Many major industries, like the steel industry, burn coal to heat their furnaces. Coal is one of the largest sources of carbon dioxide emissions that are responsible for climate change and global warming.

Exercise 1

Find out the names of at least 3 places in India where coal is mined.

When coal is heated to a very high temperature without air, it produces many useful by-products. One of these is a grey hard porous rock called **coke**. Other products are **coal tar** and **coal gas**.

Coke is produced by heating coal to a very high temperature in the absence of air. 98% of coke is carbon. It is a good fuel and burns without smoke. It is largely used in extracting iron from its ore. It is also used in the manufacture of steel.

Coal tar is a brown or black coloured thick liquid, which has a strong odour. It is a mixture of different carbon compounds and is used in the preparation of dyes, explosives, paints, synthetic fibres, drugs and pesticides.

Coal gas is an inflammable gaseous fuel. In the nineteenth and twentieth century, it was used extensively for lighting, cooking and heating. Today it has been largely replaced by **natural gas**.

Exercise 2

State whether the following statements are 'true' or 'false'. Rewrite the wrong statements correctly in your notebook.

i. Sunlight is available to us all the time. Hence it is an exhaustible source of energy.
ii. One of the most important uses of coal is in cooking.
iii. Fossil fuels are formed from the remains of living organisms.
iv. Coke is an almost pure form of carbon.
v. Coke, coal tar and coal gas are the products obtained from coal.
vi. Coal tar is a ~~gas~~ whereas coke is a ~~liquid~~.
vii. Coal gas is an inflammable liquid fuel.
viii. Substances which burn to produce heat are called fuels.

Oil and **natural gas** are also fossil fuels. These were formed millions of years ago from the remains of tiny plants and animals that lived in the sea. When they died, their bodies sank to the seabed. Layers of

mud and sand piled up on top of them and crushed the remains. Heat and the pressure of the sediment and water above the layers of dead organisms turned them into oil and gas. The oil and gas seeped into the spaces available in porous rocks nearby and were trapped there. Deposits of oil and gas are usually found close together.

Oil is drilled out from under the ground. The crude oil that flows out is black and thick. It is called **petroleum**. The word petroleum comes from the latin terms *petra* meaning rock, and *oleum* meaning oil. Before it can be used, it must be **refined**. At the **refinery**, crude oil or petroleum is separated into several products by a process called **fractional distillation**. After refining, these different components are sold separately, depending on the use they are best suited for.

Exercise 3

Read the paragraph and look at the diagram on the next page carefully. Then answer the questions in your notebook.

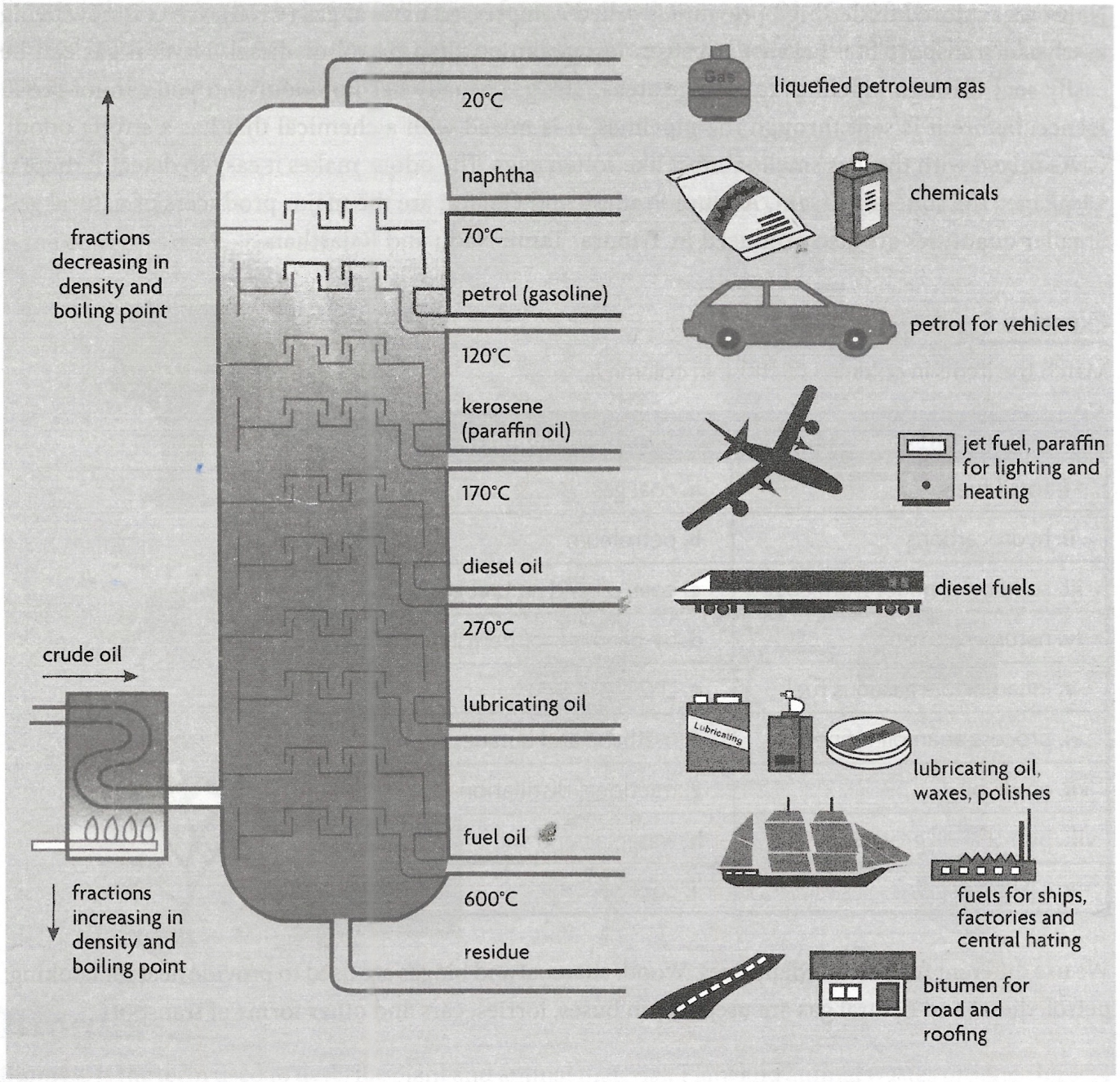
Crude oil or petroleum that is obtained from the oil well is a mixture of many liquids. Each liquid boils and changes into vapour at a different temperature. This temperature is the boiling point of that liquid. The crude oil heated to a temperature of 400°C is fed in at the bottom of the **fractionating column** and heated further. The liquid that has the lowest boiling point changes into vapour first and rises upwards. The next volatile liquid changes into its vapour state at a higher temperature and rises. At different parts of the column as the vapours rise, they cool and condense separately into liquids on 'trays' and are collected separately. A few gases reach the top of the column without condensing.

i. What happens to the temperature inside the column starting at the bottom and going to the top?
ii. Why do different gases condense to liquids on different trays in the column?
iii. Which is more volatile: petrol or diesel oil?
iv. What can you say about the boiling points of the liquids that collect at the bottom as residue?

Today, **natural gas** is widely used in our country. A mixture of gaseous hydrocarbons, it is lighter than air. **Hydrocarbons are compounds of carbon and hydrogen only**. One of the main constituents of natural gas is **methane**, a hydrocarbon. The chemical formula of methane is CH_4. It is a highly flammable gas.

When hydrocarbons burn, they combine with oxygen to form carbon dioxide and water. This process produces a lot of **heat energy**. Thus hydrocarbons are widely used as fuels.

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O + \text{heat energy}$$



▲ a simple fractionating column

Liquified petroleum gas (LPG), the cooking gas used in homes, is **butane** (C_4H_{10}), another hydrocarbon. Butane gas can be easily compressed into a liquid and stored in cylinders. When burnt, it liberates a lot of energy as heat and light.

Exercise 4

i. Complete this equation:

$C_4H_{10} + O_2 \rightarrow$ _____

ii. Heat is given out in these reactions. What are such reactions called?

Natural gas stored under high pressure is called **compressed natural gas (CNG)**. CNG is now being used as a transport fuel because it causes less pollution than petrol or diesel. Natural gas can be easily sent through pipelines to storage areas. The gas usually has no odour and you cannot see it. Hence, before it is sent through the pipelines, it is mixed with a chemical that has a strong odour. CNG mixed with this gas smells almost like rotten eggs. The odour makes it easy to detect if there is a leakage. The states of Assam, Andhra Pradesh and Gujarat are the major producers of natural gas. Smaller quantities are also produced in Tripura, Tamil Nadu and Rajasthan.

Exercise 5

Match the items in column I to those in column II.

Column I	Column II
i. fossil fuels	**a.** coal gas
ii. hydrocarbons	**b.** petroleum
iii. solid by-product from coal	**c.** coal, oil and natural gas
iv. natural resources	**d.** by-products of petroleum refining
v. inflammable gaseous fuel	**e.** LPG
vi. process at an oil refinery	**f.** methane and butane
vii. crude oil	**g.** fractional distillation
viii. petrol and kerosene	**h.** water, air and soil
ix. C_4H_{10}	**i.** coke

We use different fuels in our daily lives. Wood, charcoal and biogas are used to provide heat for cooking; petrol, diesel and natural gas are used to run buses, lorries, cars and other forms of transport.

Exercise 6

Classify the following into solid, liquid and gaseous fuels. petrol, CNG, coal, kerosene, wood, cattle dung cakes, diesel, piped natural gas, *gobar* gas, hydrogen, cooking gas

Exercise 7

Can you think of one advantage of using liquid or gaseous fuels rather than solid fuels?

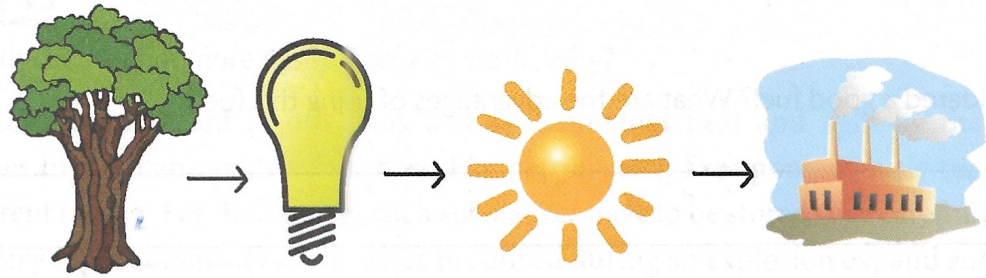
Another common fuel, wood, comes from plants that have grown recently or are still alive. Trees capture the energy of sunlight and some of this is stored in the wood. When wood is burnt, this energy that came from the sun within the past few years, is released. Thus, wood is a non-fossil fuel. **Charcoal** that is made by heating wood slowly with very little air is also a non-fossil fuel. Charcoal contains only carbon.

Since all plants and animals derive their energy from the sun, the energy of the fossil fuels is also indirectly derived from the sun. Thus, **the sun is the major source for most of the energy we use.** The sun's energy reaches us through a series of conversions called **energy chains.**

Exercise 8

The three energy chains drawn here have their pictures and words in the wrong order. Rewrite the words in the correct order below each chain.

i.



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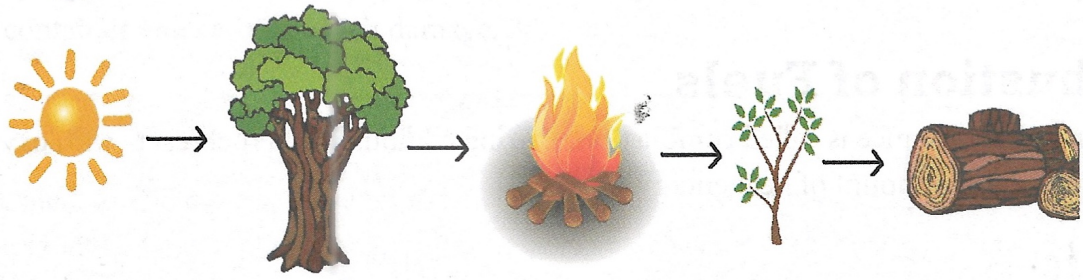

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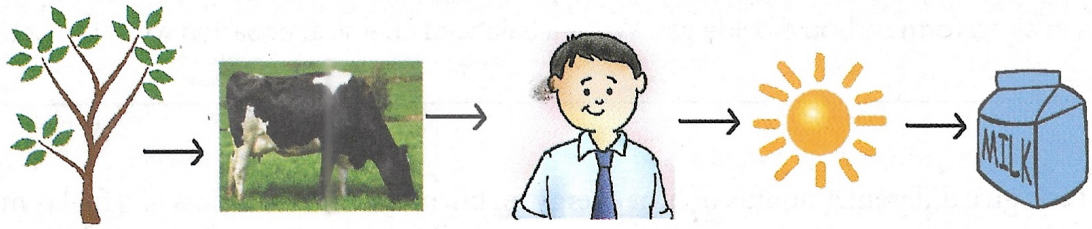


Biogas

Biomass is the term used to describe plant and animal material. Plant and animal wastes produce **biogas** or **methane**, when they rot. It can be collected and used for heating. It is the oldest source of heat energy for domestic heating. Even today it is widely used as a fuel.

Biomass, like wood or cattle dung, is used directly to produce heat. Cattle dung is moulded into cakes and then dried in the sun. The dried cakes are then burnt to produce heat. In most of our villages, wood, agricultural wastes and cattle dung are used as fuels in small open furnaces called *chulhas*. However, these have some disadvantages. A major portion of the heat is lost to the surroundings. A lot of smoke is produced which is hazardous to health. Today, smokeless

▲ *chulha*

chulhas which are more efficient, are available. They leave the kitchen clean and the health hazards to the women who cook and children who are nearby are considerably reduced.

Biogas is prepared on a large scale in a biogas plant and supplied through a network of pipelines. While burning, this gas does not produce smoke. It does not leave any residue and is cheaper than most common fuels. The residue left in the tanks after the production of biogas is used as manure for agriculture. The use of biogas can prevent deforestation and reduce the dependence on kerosene in rural areas.

Exercise 9

Why is biogas considered a good fuel? What are the advantages of using this fuel?

Combustion of Fuels

The burning of a substance is called **combustion.** During combustion, a fuel reacts with oxygen in the air, liberating a large amount of heat energy.

Exercise 10

Coal burns in air to form carbon dioxide gas. Write a balanced chemical equation for this reaction.

Different fuels give different amounts of heat energy on burning. The usefulness of a fuel is measured in terms of its calorific value. **The calorific value of a fuel is defined as the amount of heat evolved when one gram of the fuel is burnt completely in oxygen.** The calorific value of hydrogen is 150 kJ/g. This means that when one gram of hydrogen burns completely in oxygen, it liberates 150 kJ of heat energy.

Exercise 11

Which produces more heat energy—one gram of methane or one gram of petrol? (Calorific value of methane is 55 kJ/g and that of petrol is 50 kJ/g.)

Combustion will only take place if you have a **combustible** or an **inflammable** substance. The substance must catch fire easily. Paper, cloth, kerosene, petrol, etc, are combustible substances.

Combustion will only take place if there is oxygen present. Oxygen is a supporter of combustion.

For combustion to start, the substance has to be heated to a certain temperature. In other words, the substance will not burn until it reaches its **ignition temperature.** This is the lowest temperature at which the substance catches fire.

Exercise 12

i. In your notebook, list the three conditions needed for combustion to take place.

ii. Wood and kerosene are both used as fuels. Which one do you think has a lower ignition temperature and why?

iii. If a little kerosene is poured onto wood, the wood catches fire more easily. Why do you think this happens?

Exercise 13

A dry cloth catches fire more easily than wet cloth. Why?

Combustion is important in our daily life, as it provides heat and light by the burning of fuels. Sometimes highly flammable substances, like petrol, catch fire spontaneously on their own without any apparent reason. For this reason, such substances have to be stored very carefully. **An explosion is a form of very rapid combustion.** The gases produced during an explosion expand enormously, bursting out of the container and causing much damage.

Activity 1 What happens when a candle burns?

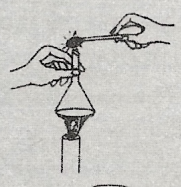
You will need: a candle firmly fixed on a stand, a piece of stiff white paper about 15 cm square, some ice, a glass funnel, a metal plate, tongs or clothes clip, matches

As you finish each part of the experiment described below, answer the questions in your notebook.

i. Light the wick of the candle and observe carefully what happens.
The heat from the burning wick makes the _____ wax turn into a liquid.

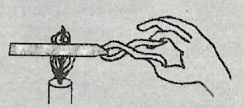
ii. Blow out the candle and quickly bring a lighted match just above it. What happens?
The liquid wax changes on heating into a _____ which catches fire. These hot _____ rise and are still above the candle. They catch fire again from the lighted match and set fire to the wick again.

iii. Hold a funnel inverted above the flame. Hold a lighted match in the hot air coming out of the funnel. What happens? What gas might cause this happen? Where does this gas come from?



iv. Place the cubes of ice in the glass and hold it some distance above the flame. What do you see outside the glass? Where did this substance come from?

v. Use the tongs to hold the metal plate in the flame for a few seconds. What do you find? Where did this substance come from?



vi. Push the piece of white card sideways into the flame and remove it quickly before it burns. Which is the hottest part of the flame? This will scorch the paper the most.

vii. Now observe the flame carefully and see if you can observe the different parts of it.

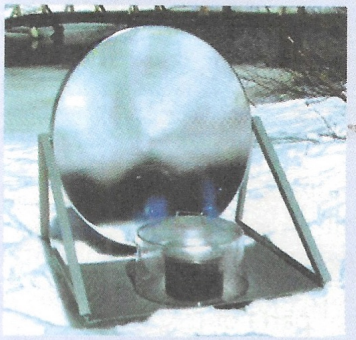
Did you know?

The burning of petroleum oil and coal often produces smoke which, in turn, pollutes the air. Petroleum and coal are fossil fuels which are formed over millions of years. They are non-renewable and their supply is limited. Scientists all over the world continue to look for better sources of energy, which will be easily available, in unlimited quantities and will not spoil the environment or cause pollution. Here are some modern methods of harnessing other forms of energy from nature.

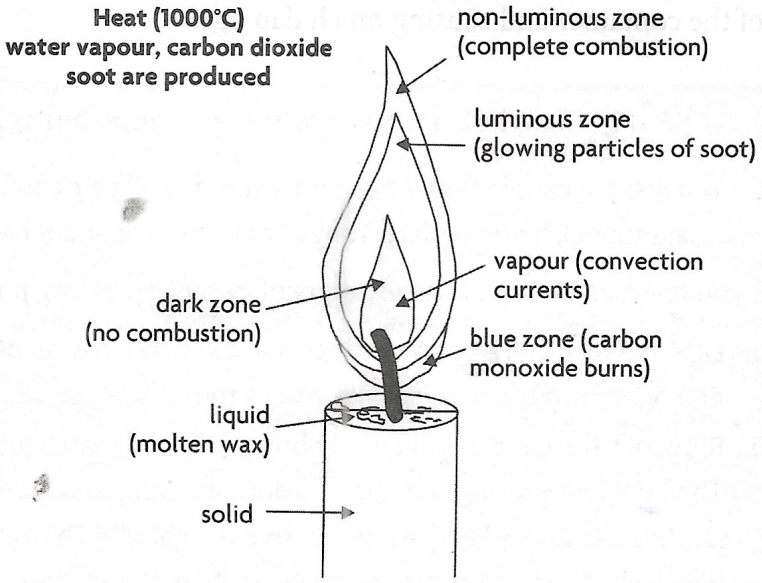
Solar Energy

The sun is directly or indirectly the source of all the energy that we use. Today, as man uses more and more energy, scientists continue to look for better ways of tapping the energy of the sun.

Solar energy can be used directly to heat water. This hot water may be used as such in homes or used to generate steam in order to produce electricity. Solar dishes and parabolic reflectors are used to concentrate the sun's energy and focus it. The reflectors are so designed that they can follow the sun from dawn to dusk.



Wax is a hydrocarbon. When the wick is lit, the solid wax melts and becomes a liquid. This liquid soaks into the wick and is vaporised in the heat. The flame is a zone of combustion of these vapours of wax. When a candle burns, the carbon from the wax combines with oxygen in the air. As a result of this **oxidation**, the carbon gets changed into carbon dioxide. At the same time hydrogen from the wax combines with oxygen to form water vapour. During combustion of a hydrocarbon, it may burn incompletely. This forms soot (carbon). Sometimes when not enough oxygen is available for burning, carbon monoxide may form. It is a very poisonous gas. It reduces the ability of the blood to carry oxygen.



▲ Candle flame
(Practise this drawing.)

The outermost zone of the candle flame is called the **non-luminous zone**. It surrounds the entire flame. The wax vapours in this layer get enough oxygen from the air around them. Hence complete combustion takes place here. This is the hottest part of the flame. Inside this zone is a yellow part of the flame called the **luminous zone**. Here the wax vapours cannot get enough oxygen from the air to burn up completely. Some carbon particles are left unburnt, which get hot and glow, emitting yellow light. Just

around the wick is a **dark zone** where there is no combustion. In this area no oxygen is available for the burning to take place. The blue colour at the bottom is due to the combustion of carbon monoxide.

What makes a good fuel?

These are some questions that will help you decide.

- Does it light easily?
- Does it burn steadily?
- Does it give out much energy?
- Does it pollute the air?
- Does it leave much ash behind?
- Is it easily available?
- Is it expensive?
- Is it safe and easy to store?
- Is it easy and safe to transport?
- Is it better used for something else?

Exercise 14

Candle wax and petrol both produce the same gases on heating. But why is petrol a better fuel than wax?

Suppose we want a fuel to propel a rocket away from the surface of the earth. The fuel must produce a large amount of energy in a very short time so that the gases produced will expand rapidly and move away from the rocket very quickly. This kind of fuel would not be good for cooking and for keeping us warm. Rapid burning is not required here.

Exercise 15

Which is a better fuel: biogas or wood? Give reasons in support of your answer.

Combustion is not always welcome. Burning needs three things: fuel, oxygen, heat. So to put out a fire we must:

- cut off the fuel supply.
- get rid of the heat.
- cut off the air supply.

Solar energy can also be converted directly into electricity, using **photovoltaic** or **solar cells**. The electricity is stored in batteries and used as needed. Have you seen traffic lights powered by solar cells in your city?

Solar energy can be used directly for cooking as well.

Wind Energy

In earlier years, people used windmills to grind corn and pump water. Modern windmills can be used to turn turbines and generate electricity.

▲ The fire triangle shows the three things needed for burning. Removing any of them will put out a fire.

Have you ever seen an accident caused by fire? **Find out the emergency numbers of the fire control room in your city and the nearest fire station.**

Exercise 16

When a person's clothes catch fire, you should quickly wrap him in a thick blanket and roll him on the ground. Why?

Exercise 17

Water should not be used to put out electrical fires or burning oil; instead sand, soil or foam from a fire extinguisher should be used. Why?

Problems Caused by the Use of Fossil Fuels

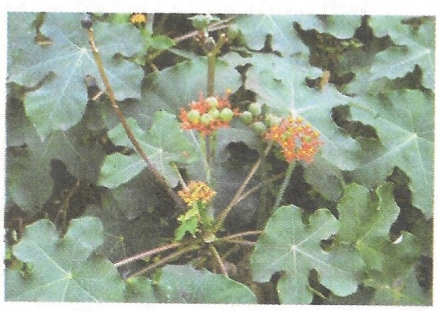
Exercise 18

Burning fossil fuels in power stations and motor vehicles releases a lot of carbon dioxide into the atmosphere. This is causing the earth to warm up. How is this creating a problem in our atmosphere?

The burning of fossil fuels also causes the release of other gases, like sulphur dioxide which is responsible for **acid rain**. When coal burns in an insufficient supply of oxygen, it produces carbon monoxide which is poisonous.

It takes million of years for the formation of fossil fuels. We are now using up the fuels that were made that far back in time. They are not renewable; once they are gone they are not easily made again. So, it is best not to use fossil fuels in excess. We can save fossil fuels by conserving energy.

Petrol used as a fuel in cars burns very fast, but not always completely. The burning of petrol, a hydrocarbon, produces carbon dioxide and water vapour. Due to its incomplete combustion, some carbon monoxide and other unburnt substances are also produced. Carbon monoxide is a poisonous pollutant in the atmosphere.



▲ *Jatropha* plant

Using wood for fuel leads to the indiscriminate cutting down of trees. Some fast-growing plants are now being grown on spare land specifically to be cut down and used as a source of energy. These 'forest farms' provide extra income for farmers. Certain plants are also being grown to produce alternative fuels for transportation. Oil from the *Jatropha* plant is being tried by the Indian railways as an alternate fuel. In Brazil, sugarcane is fermented to produce alcohol which is used instead of petrol. Other fuels that could be used to replace gas in the future are also being studied.

Activity 2 Local Fuel Supplies and Uses of Fuels in India

Find out the answers to these questions. Then discuss them in class to get a picture of how fuels are used in our country.

i. What fuels do people in your city use in their homes for cooking and heating?

ii. What fuels are used in public buildings such as schools and hospitals?

iii. What fuels are used for different forms of transport such as buses, cars, trucks, planes, etc?

iv. What fuels are used for generating electricity in power stations in your city?

v. Are there any other important uses of fuels?

vi. Try to find out where these fuels come from. Are they imported from another country or are they produced locally?

Fire Safety Quiz

"Fire is a Good Servant, But a Bad Master – Prevent Fires at Home and in Your Neighbourhood"

Answer this quiz to find out whether you are well-prepared to prevent fire or not. Discuss your answers in class.

Given below are situations that might happen in your home.

1. You notice sparks in the electric toaster used at home. Which of these actions should you take and in what order?
   i. Inform your mother and get it tested by an electrician.
   ii. Leave it alone, thinking that it only happens sometimes.
   iii. Switch off the toaster.
2. There is a strong smell of cooking gas in your kitchen, when your mother goes in for the first time in the morning. What should she do?
   i. Open the doors and windows wide.
   ii. Make sure that the gas supply is turned off at the cylinder.

Did you know?

The Chemical History of a Candle Flame was the title of a series of lectures on the science of a candle flame given by Michael Faraday at London's Royal Institute in 1860–61. This was the origin of the lectures for young people that are still given there every year and bear his name. The lectures were first printed as a book in 1861. The six lectures include the function of the candle wick, the carbon content in atmosphere, the production of carbon dioxide from coal gas and sugar; the properties of carbonic acid, respiration and its comparison to combustion and much more. He performed 22 experiments along with numerous illustrations. According to Faraday, 'There is not a law under which any part of this universe is governed which does not come into play and is not touched upon during the time a candle burns.'

iii. Light the gas stove and carry on with making the morning tea.
iv. Inform the gas agency or the emergency number immediately.

3. While lighting crackers at *Diwali,* it is important to make sure that:

i. crackers are kept at a safe distance from lighted candles.
ii. the people who are lighting them do not wear flowing clothes.
iii. all matches are properly put out before they are thrown away.
iv. a bucket of water is kept nearby to put out any fire that might start.

4. A chain smoker in your family carelessly leaves lighted cigarettes in various places.

i. You do not bother about this habit.
ii. You provide enough ashtrays at various places.
iii. You ensure that all cigarettes are properly extinguished.
iv. You do not allow the cigarettes to be thrown into waste paper baskets.

5. You have many electrical appliances in your kitchen and only one plug.

i. You use more than one from the same plug at the same time.
ii. You use them one after the other.
iii. You get the electrician to fix more plugs, so that you can use more than one at a time.

6. When you plug an appliance into a socket in the kitchen or bathroom, you ensure that:

i. the plug fits tightly.
ii. your hands are dry.
iii. the switch is turned off before you disconnect or connect any appliance.
iv. none of the above.

7. You have just bought a new electrical appliance and it does not have a proper plug.

i. You push back the plastic covering on the wires and push them into the socket.
ii. You make sure that a proper plug is fixed on it before using it.
iii. You connect it along with several other appliances to the single plug in the kitchen.

8. Which of the following are good fire safety practices?

i. Switch off the mains supply in case of fire.
ii. Papers, clothes, flammable liquids should be kept away from heaters and gas stoves.
iii. LPG stoves should always be placed on raised platform and never on the floor.
iv. Keep a fire extinguisher at home and ensure that it is always in working condition.
v. Never allow young children to play with matches.

9. You live on the top floor of your building and there is a fire escape ladder outside the building.

i. You place plenty of flower pots on the ladder.
ii. You store a lot of unwanted rubbish on the steps.
iii. You keep the steps free of all extra items which may prevent your using them.

10. To ensure fire safety in your colony

i. you write to your colony office to organise regular safety drills

ii. you feel that it is enough if you are careful, no matter what your neighbours do.

iii. you keep the telephone numbers of the local fire station handy.

iv. you make sure that dried garden waste materials are properly disposed off.

CHECK IT OUT

1. Neyveli (Tamil Nadu), Raniganj (West Bengal), Warangal, Cuddapah (Andhra Pradesh), Jharia (Jharkhand), Korba (Chattisgarh) **2.** *i. False. Sunlight is available to us all the time. It is an inexhaustible source of energy. ii. False. Coal is used widely in thermal power plants for generating electricity. iii. True; iv. True v. True vi. False. Coal tar is a liquid whereas coke is a solid form of carbon. vii. False. Coal gas is an inflammable gaseous fuel. viii. True* **3.** *i. The temperature decreases inside the column going from the bottom to the top. ii. As each gas reaches a height where the temperature is equal to or just below that substance's boiling point, it will condense to form a liquid. For example, water boils at 100°C and forms steam. When steam rises, if it touches a surface cooler than 100°C, it condenses into liquid water at that temperature. iii. Petrol is more volatile than diesel oil. If left in an open container it vaporises without heating. The more volatile substance changes to a gas at a lower temperature. Likewise the vapour will condense at a lower temperature. Hence petrol condenses nearer the top of the column than diesel oil. iv. Their boiling points must be much higher than the temperature at the bottom of the fractionating column.* **4.** *i.* $2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O$ *ii. Reactions where heat is given out are termed* **exothermic reactions.** **5.** *i-c; ii-f; iii-i; iv-h; v-a; vi-g; vii-b; viii-d; ix-e* **6.** *Solid fuel – coal, wood, cattle dung cakes; Liquid fuel – petrol, kerosene, diesel; Gaseous fuel – CNG, piped natural gas, gobar gas, hydrogen, cooking gas* **7.** *Liquid and gaseous fuels can be easily transported over large distances through pipelines. Liquid and gaseous fuels leave little waste material after heating whereas solid fuels leave a large amount of ash after burning.* **8.** *i. sun → tree → coal → power house → electric bulb ii. sun → small plant → tree → log → fire iii. sun → plant → cow → food → child* **9.** *Biogas does not produce smoke on burning. The use of biogas would also prevent deforestation and reduce the dependence on kerosene in rural areas.* **10.** $C + O_2 \rightarrow CO_2$ **11.** *One gram of petrol produces 50 kJ of heat energy whereas one gram of methane produces 55kJ of heat energy. So methane will produce more energy.* **12.** *i. The three conditions needed for combustion to take place are oxygen, fuel and heat. ii. Kerosene has a lower ignition temperature than wood as it catches fire more easily than wood. iii. When heated the kerosene catches fire easily. This in turn heats the wood up to its ignition temperature. Then the wood catches fire.* **13.** *A wet cloth does not burn because the water present in it prevents it from attaining its ignition temperature.* ***Activity 1.*** *i. The heat from the burning wick makes the* **solid** *wax turn into a liquid. ii. The candle starts burning again. The liquid wax changes on heating into a* **vapour** *which catches fire. These hot* **vapours** *rise and are still above the candle. They catch fire again from the lighted match and set fire to the wick again.*

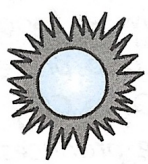
iii. The burning match is put out. Carbon dioxide, a hydrocarbon, is produced by the burning of the wax. This extinguishes the flame. iv. Water droplets condense outside the chilled glass. The burning of wax produces both carbon dioxide and water vapour. v. The metal plate gets coated with soot. This is made up of carbon particles found in the hydrocarbon, wax. vi. The paper is scorched in a ring. This means that the outer parts of the flame are hotter than the inner part. ***14.*** *Petrol burns far more quickly than candle wax. Also the burning of petrol does not leave behind any soot or residue like melted wax.* ***15.*** *Biogas is obtained from plant and animal wastes while wood is obtained from cutting down trees. Thus using wood is more expensive than biogas. Also biogas burns cleanly and completely. It does not pollute the surroundings. The burning of wood produces both smoke and ash.* ***16.*** *Covering the person with a thick blanket cuts off the air supply and stops fire from spreading.* ***17.*** *Water should not be used for oil or petrol fires, because oil or petrol will float on water and spread the fire even further. Electrical short circuits can be caused by water. If sand or foam from a fire extinguisher is used, they will cut off the supply of oxygen. This will put out the fire.* ***18.*** *This is called the* **greenhouse effect**. *It is causing the temperature of the earth's atmosphere to rise and the melting of polar ice caps. This is bringing about a lot of change in the climatic conditions in various parts of the earth.* **Answers to Fire Safety Quiz**

1. iii, i 2. i, ii, iv 3. i, ii, iii, iv 4. ii, iii, iv 5. ii, iii 6. ii, iii, i, 7. ii 8. i, ii, iii, iv, v 9. iii 10. i, iii, iv

BECOME A YOUNG SCIENTIST

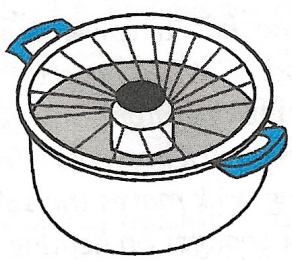
Here is an interesting experiment for you to try out.

You can use solar energy to obtain distilled water. You should try this out on a bright, sunny day, preferably in summer.



You will need: a large pan (borrowed from the kitchen), clear plastic film, a cup or glass, sellotape or thread, a stone

What To Do: Set up the apparatus as shown in the figure.



Fill tap water or muddy water up to a depth of about 5 cm in the large pan. Place the glass or cup in the middle, as shown. Make sure that it will not topple over. If required, you can place a weight inside it.