

# COAL AND PETROLEUM



Articles/ Activities (A)  
 Articles/ Materials used  
 30-40 years ago (B)  
 Articles/ Materials used Today (C)

Deekshita is struggling to take down a pickle jar and the jar which at the top most section of a shelf.

Grandfather: Be careful, it may fall down and break.

Deekshita: No, I am taking down a plastic jar. It won't break.

Deekshita realizes that Grandfather was thinking of the clay jars that were used in olden days. Now a days plastic jars are used and they are unbreakable.

What else has changed, she wondered? Help Deekshita to find out.

## Activity-1

### Identifying articles and materials used for various purposes

Have a look at table 1. Column (A) gives the names of some activities and items. Ask your grandparents or other older people about the names of the materials which is used for the items given in column (A), and write them in column B. Then in column C, write the names of materials being used at present. Few examples are given to guide you.

		Table-1		
Articles/ Activities (A)		Articles/	Materials	used
Articles/ Materials used		30-40	years	ago (B)
Today (C)				
Containers for storing pickle Packing food Water pipes in the house Hair combs Vessels for cooking food Fuels used to cook food Fuel used in a train engine Luggage for carrying clothes Water buckets,Pails Water storages in houses		Clay jars		
		for	a	journey
		Plastic tiffin boxes		
		Copper vessels		Steel
		Coal		
Metal trunks				
Construction material Jewellery Furniture (chairs, cots)				

From activity 1, you have a long list of materials. Some of them like wood, metals (iron, silver, gold etc) were used ten years, fifty years and even hundred years ago. Do your grandparents remember using plastic when they were young?

Now think and write the answers:

- How many of these materials were available 10 years ago?
- How many of these materials were available 50 years ago?
- How many of these materials were available 100 years ago?

In case you have any doubt, you can take the help of your social teacher and your elders too.

you find that some materials such as wood and gold that are used today, were also used even thousands of years ago. But others like plastics are of recent origin.

The progress in science and technology gives us new products every day. The branch of science which deals with materials is called material science.



Do you know?

Windmills Wind is an important natural resource. Sail boats and sailing ships have been using wind power since thousands of years. Wind mills were used to grind corn and to pump sea water to make salt.



## Sources of materials

We know that we get wood from trees. Do you know that we get metals like iron, copper from their ores? Which material is used to make plastic or glass?

Do you remember reading about petrochemicals in the chapter on synthetic fibres and plastics. How do we obtain various materials?

Table 2 gives some answers.

	Table 2	
	Material	How is it obtained?
rapidly	Glass	By melting sand with other materials and then, cooling it
	Clay	By mixing the mineral kaolinite with water
	Wood	From dried up trees
	Plastics	From petrochemicals
	Metals	From their respective ores

After looking at table 2, you find that the materials used earlier were obtained from soil (clay, sand), water, ores, etc. Soil, water and air were not only sources of materials used earlier but also sources of energy. Now, plastic has replaced many materials used earlier. Petrochemicals are used for making plastics. Many materials that we use for different purposes today come from various sources present in nature. Therefore, soil, water, air, petrol etc. are called natural resources.

## Exhaustible and Inexhaustible Resources

Now, we have to think about few questions to understand about need and importance of natural resources.

- Will the above resources be available for ever?
- Won't we ever run out of air?
- Won't we ever run out of water?

- Can these resources be exhausted by human activities?
- Do we have unlimited supply of coal and petroleum?

Some energy sources like air and water are not exhaustible on usage. Hence these are called Inexhaustible resources coal and petroleum etc, are the energy sources which are exhaustible on usage. If this situation continues, in future we might have to depend on solar energy.

Is wood an inexhaustible resource? Think about using wood for making furniture.

- What will happen if all the forests are cut down and the wood is used for various purposes?
- How long do you think it would take to grow the forests again?

There are many resources like trees which will be depleted if we don't make judicious use of them.

- How long the fossil fuel like petroleum will be available? Is it inexhaustible?

We need petroleum not just as a fuel but also for several other uses as we will see later in this chapter.

Resources therefore can be classified as inexhaustible and exhaustible depending on whether they are expected to last forever or not.

## Activity-2

List out the natural resources which are limited and which are abundant and record them in table-3.

**Table -3**

Resources Abundant .....
Resources Limited .....

### Is petroleum exhaustible?

If we see the history of petroleum production, from 1859 to 1969, the total production of oil was 227 billion barrels. (*In the oil industry the barrel is the unit for measuring petroleum volume and one barrel equals 159 litres*). 50 percent of this total was produced during the first 100 years (1859-1959), while the next 50 percent was extracted in just ten years (1959-1969). Today our consumption rate of oil is far excess than that of the rate of its formation. Earth takes more than one thousand years to form the oil that we consume in one day. By about 2015, we would have consumed half of the total reserves of the oil. It would become more and more difficult to extract oil in future.

- What will happen if fossil fuel like coal and petroleum are completely exhausted?
- What would be our future energy resources?

The entire Research and Development (R&D) in the field of sources of energy shows that at the present rate of use of the conventional energy sources like fossil fuels will not last for long. Presently only 10% of non-conventional energy resources like solar energy, wind energy, tidal energy, etc, are used. These are inexhaustible resources and abundantly available in nature.

- Are the fossil fuel resources available plenty to meet the future energy needs?
- What actions required to meet the future energy needs?

### **Bio -diesel an alternative fuel source**

Bio-fuels are one of the major non-conventional energy resources. They are **non-toxic** and **renewable**. Bio-diesel is one of the bio-fuel which is an alternative or additive fuel source to the standard diesel fuel which is used now. It is made from the biological ingredients instead of petroleum or crude oil. Bio-diesel usually made from the plant oils or animal fat through a series of chemical reactions. It is safe and can be used in diesel engines.(But bio-diesel requires more cultivatable land which may effect shortage of food production in future.)

## Coal, petroleum and natural gas as fuels



Fig-1

Earlier people used kiln (*poyyi*) for cooking food but now people use gas stoves or kerosene stoves. Earlier food was cooked using wood as fuel, then coal now kerosene and LPG are being used.

Fuel is needed not only for cooking but also for transport. Different vehicles (train, bus, cars, two-wheelers) are used for travelling long distances and they use different fuels. People also travel by ships. What fuel is used there? Fuel is also required for electricity generation.

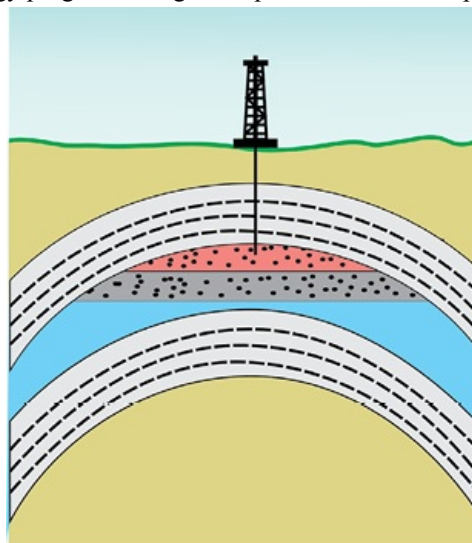
Earlier you read that wind power was used in wind mills. Then the steam engine which used coal was invented during the industrial revolution.

During this period steam engine was used to power everything from cloth looms to vehicles on land and water.

Coal was the most important fuel in the 19<sup>th</sup> Century. It is an exhaustible resource but we can meet our needs for another 250-300 years at the current rate of use. Till 1950, coal accounted for half of the electricity generation in the world.

Coal was replaced by petroleum with the invention of more efficient engines in different vehicles. Now, coal is mostly used to produce electricity in thermal power plants.

Petrol and diesel which are used in vehicles today are obtained from mineral called petroleum. Petroleum has been known almost since prehistoric times. More than 4000 years ago, asphalt (Petroleum Product) was used in the construction of walls and towers of Babylon. There are also records from ancient China about shallow wells being dug to get petroleum. But what did our ancestors do with this petroleum? They mainly used for making their wooden boats waterproof, as a fuel for lamps and in some traditional remedies. We realized the importance of petroleum only after science and technology progressed to give us petrochemicals and petrol to run engines.



**Natural gas is another important fuel**

Natural gas is found trapped between impervious rocks, sometimes along with petroleum and sometimes without petroleum. Previously, this gas was allowed to escape or even burnt while pumping out the petroleum.

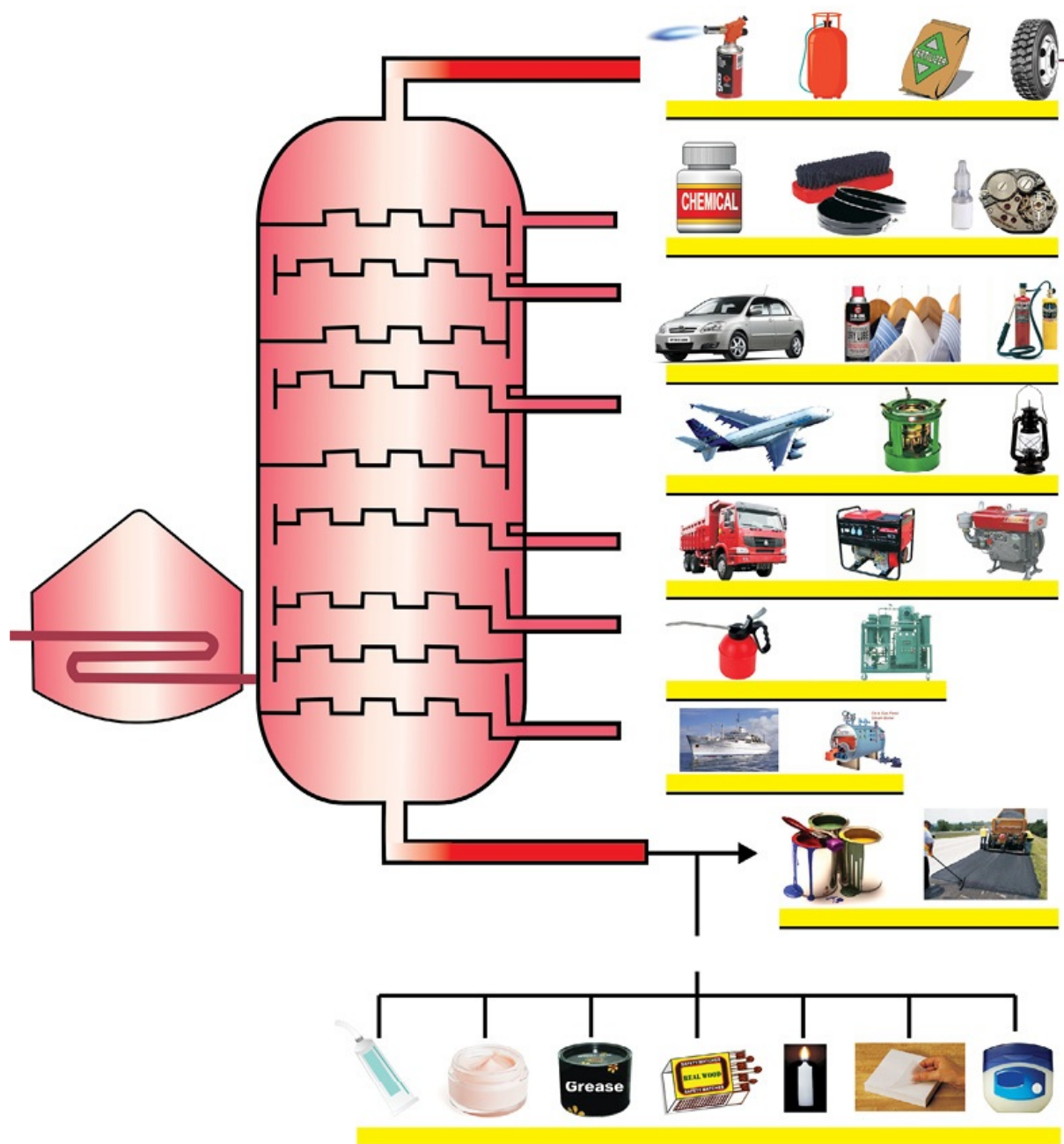
Now, the natural gas is treated as equally precious because it is safer for the environment. Natural gas is stored under high pressure as compressed natural gas (CNG).

The exploration for more petroleum and natural gas are going on under the super vision of ONGC (Oil and Natural Gas Corporation ) throughout India. In India gas fields have been discovered in Tripura , Mumbai High, Krishna, Godavari delta and Jaisalmer.

### Other uses of coal, petroleum and natural gas

Most of us think petroleum is a source of fuel. But advances in our understanding of various chemical processes has led to the use of both coal and petroleum as the starting materials for a wide variety of products.

Petroleum is a complex mixture. It is separated into various components by a separation technique known as **fractional distillation**.



Look at the figure-2. We can see the various products which are now being obtained from petroleum. Initially, the separation techniques available were not advanced and could separate only a few components from the petroleum

mixture. One of the first fractions to be separated from petroleum was kerosene which was found to be better fuel than the petroleum. Now, we can separate many more components. Fuel gas, petrol, diesel etc. are all obtained from petroleum mixture. These components of petroleum are then used to obtain other products.

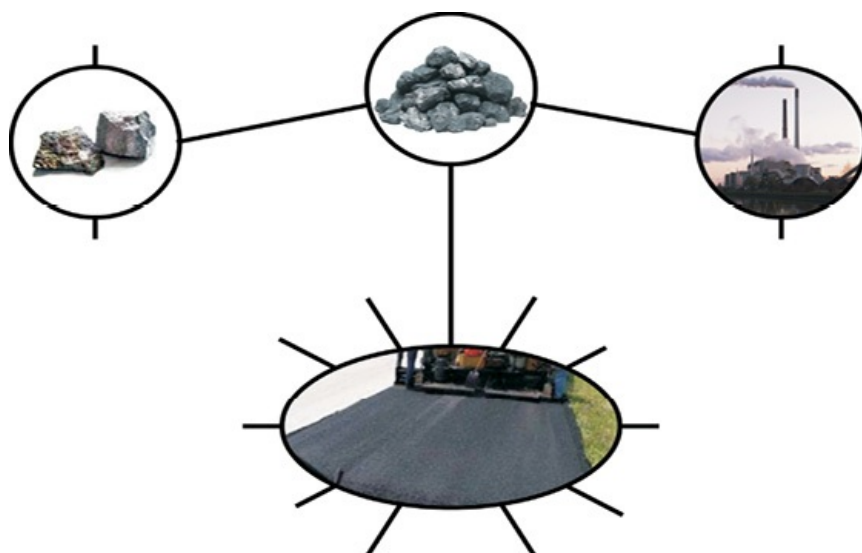
### Activity-3

#### Identifying various uses of petroleum.

Look at the figure-2 and find the other uses of petroleum and its products. Fill in the table.

Table -4

Name of the petroleum product	Uses
Petrol	
Fuel	Oil
Kerosene	
Diesel	Oil
Paraffin Wax	



#### Coal tar

It is a black coloured thick liquid with an unpleasant smell. It is a mixture of about 200 substances. Products obtained from the coal tar are used as starting material for manufacture of various substances like Synthetic dyes, drugs, explosives, perfumes, plastics, paints, and roofing materials etc. Interestingly naphthalene balls used to repel moths and other insects are also obtained from coal tar.

#### Coal gas

Coal gas is obtained during the processing of coal to get coke. It is used as a fuel in many industries situated near the coal processing unit.

### Activity-4

#### Identifying uses of coal products.

Observe the figure-3 and list out the uses of coal products in the following table 5. You can collect more information by discussion with elders and with your friends.

Table-5

	Coke	Coal Tar	Coal
Gas			





### Lab Activity

**Aim:** To show that when we heat high quality coal (carbon content is more) a gas evolves which can burn.

**Material required:** Two boiling tubes, Rubber corks, iron stands, delivery tube, jet tube, Bunsen burner.

**Procedure:** Take a spoon of powdered coal into a hard boiling tube and fix it to a stand as shown in the figure. Close the test tube with a rubber cork and connect it to another boiling tube which is partially filled with water and has fixed to other stand, with the help of 'U' shaped delivery tube as shown in the figure. Arrange a jet tube to the cork of second boiling tube. Heat the boiling tube containing coal strongly with the help of Bunsen burner.

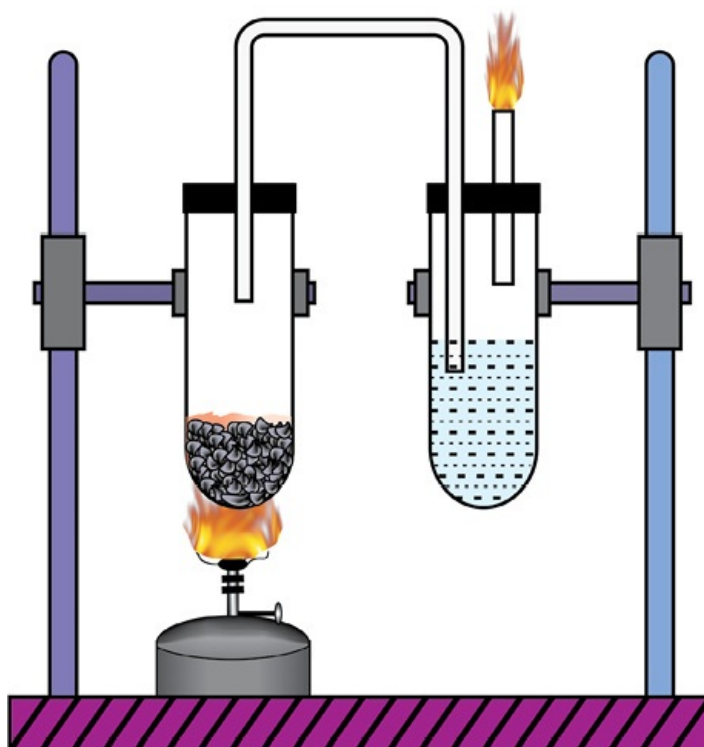


Fig-4: Burning the coal

- What do you observe?

You may notice that the brownish black vapours evolved in the first boiling tube.

These vapours are passed through water in the second boiling tube. Colourless gas bubbles evolve from the water. If you burn the gas that is evolving through the jet tube, you can witness a bright flame at the nozzle.

Repeat the above experiment by using lime water, soap water instead of water used in second boiling tube.

- What do you observe? Give reasons for the changes you observed in two experiments.
- What inference can you draw from these two experiments?

### Natural gas and petrochemicals

Natural gas is not just an important domestic and industrial fuel but also used in the manufacture of fertilizers.

**Petrochemicals:** The useful substances which are obtained from petroleum and natural gas are called petrochemicals. These are used in the manufacture of detergents, synthetic fibers (Polyester, Nylon, Acrylic polythene etc). (Due to its great commercial importance petroleum is also called as **liquid gold**).

### Some petrochemical products

Petrochemicals are used in preparation of various articles as substitutes for materials like wood and metals which are limited. They are also used to manufacture several new products that cannot be obtained from wood, soil, metals etc. The table below shows how petrochemicals are now used in all walks of life.

	Table - 6		
other sectors	Agricultural Sector	Industrial sector	Domestic and
equipments,	Plastic tubes, case,	Cars, motor boats,	Medical
bedding,	baskets, storing box,	communication devices,	apparels like cloths,
paints,	cultivation implements,	construction materials,	socks, furniture, ,
Road, fibre,	fertilizers.	paper industry, belt and	washing liquids,
medicines,		straps, tyres.	cosmetics,
etc.			polishing liquids

Look at the table given above. Think of all materials which you use in a day. Can you imagine spending a day without using petrochemical products? List how often you use products obtained from petrochemicals. Can you imagine life 100 years ago when these are not available?

We use so many products now, which we did not have 100 or even 50 years ago. Increased consumption has lead to increased production of waste material which created disposal problems. For example, for the last 30 years the use of materials obtained from coal and petroleum to make a wide variety of cheap plastics has revolutionised the manner in which hundreds of materials are manufactured. These materials also created a major pollution to the environment.

- How are coal and petroleum formed?

To understand this, explore the processes by which coal and petroleum are formed.

### Formation of coal

The plants in large and dense forests in low lying wetlands got burried under the soil due to the natural processes like floods and earthquakes. As more soil deposited over them, the organic matter was compressed. The temperature also rose. As the organic matter sank deeper and deeper, under high pressure and high temperature, these dead plants slowly converted to coal. As coal contains mainly carbon, the slow process of conversion of dead vegetation into coal is called **carbonisation**. Since coal was formed from the remains of vegetation, it is also called **fossil fuel**.

### Formation of petroleum

Petroleum was formed from the remains of tiny organisms called **plankton** that were found in the bottom of seas and oceans. Plankton have tiny droplets of oil inside their bodies.

As these organisms died, their bodies settled at the bottom of the see or ocean and covered with layers of sand and clay. Over millions of years, due to absence of air, high temperature and high pressure these dead organisms transformed into petroleum and natural gas.

Like coal and petroleum natural gas were also formed from the dead remains (fossils) of living organisms, they too are known as fossil fuels.

### Why are coal and petroleum so versatile?

Coal consists of mainly carbon while petroleum consists of a mixture of compounds called hydrocarbons (they contain mainly hydrogen and carbon). These compounds make good starting materials for other compounds based on carbon. Carbon is very versatile and is the basis for most of the materials. Therefore, coal and petroleum too are very important starting materials for synthesising variety of useful compounds.



Do you know?

**Alternatives to natural gas.**



The gas resources which are not conventional like natural gas are known as Non-conventional gas resources . Our country has enormous non-conventional gas resources like coal bed methane, and gas hydrates. These are not in commercial production phase due to the lack in proper technology. In the future, when the oil era is expected to end, the only way to meet the energy demands will be by producing this non-conventional gas.

### Conserving coal and petroleum

Why does the price of petrol go up all the time? In simple terms, the price of anything depends on how much of it is available and how essential it is. Both coal and petroleum are exhaustible resources, but we need them, both as fuel and as starting materials for synthesising new compounds. Since supplies are limited they are becoming more expensive as the demand for them increases. We have to conserve these resources as much as possible, and also look for alternatives for these resources.

Let us look at the issue of conservation. We can reduce the consumption of both coal and petroleum by either opting for a different model of development which does not depend on these resources or reduce the wastage of these resources. Since the first option is right now impracticable, second option of reducing wastage is to be practiced. The governments of many countries are working on this problem of finding alternative technologies to reduce the use of fossil fuels.

### Misuse of energy resources and consequences

In our daily life while doing various day to day activities we use many types of energy resources and fuels without giving a thought about the exhaustibility of these resources and consequences. For example in urban areas dryers are used in washing machines which consumes electric energy, eventhough abundant source of heat energy in the form of sunlight is available around us. Similarly motor bikes are used even for shorter distances. Walking shorter distances or using bicycles saves not only fuel but also keeps good health.

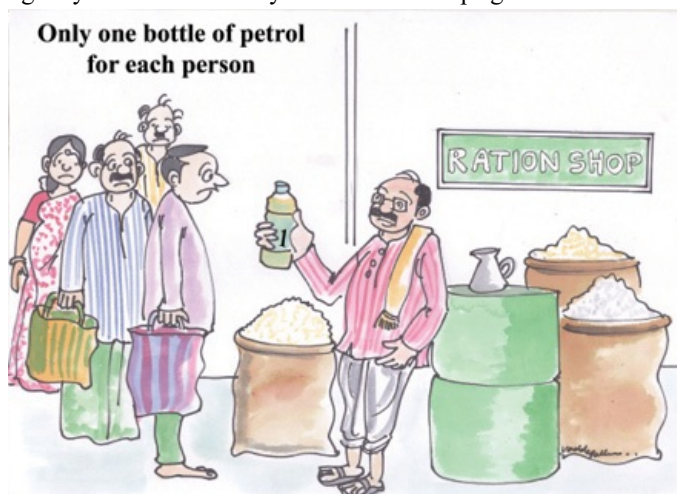


Fig-5

- Can you give some more examples where energy or fuel resources are misused in our daily life?
- Can you suggest alternate ways to save the fuel resources?
- How is biodiversity effected by excessive use of fossil fuels?

### Group discussion on misuse of fuel resources and its consequences.

Discuss in small groups how fuel resources are being misused in our daily life while doing various activities like...

- a) transportation,
  - b) cooking
  - c) industrial use
- What are the consequences of misuse of fuels? Prepare a report.
  - What methods could you suggest to prevent the misuse of fuels?

### Harmful effects caused during use of fuels

Most of the harmful effects are due to carelessness of handling petroleum products. For example, crude oil and

refined fuel spills into sea from tanker ship by accident causes damage to natural eco system and kill sea birds, mammals, shell fish and other organisms.

Utilisation of these fuels leads to some more harmful effects. Let us see that

- Burning fuels releases carbon dioxide, a green house gas, which causes climate changes and leads to global warming.
- Coal fired power plants emits mercury, selenium, arsenic, lead in addition to green house gases which are harmful to human health and environment.

Many paints made from petroleum and heavy metals release toxic products into air. These toxic products cause a variety of health problems including heart, lungs damage, nausea and dizziness.



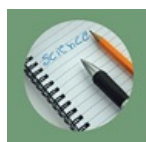
#### Key words

*Natural resources, exhaustible resources, inexhaustible resources, petroleum, fractional distillation, natural gas, CNG, coke, coal gas, coal tar, carbonisation, plankton, fossil fuels, petrochemicals.*



#### What we have learnt

- Natural resources can be classified into Exhaustible and inexhaustible resources.
- Fossil fuels are formed from the dead remains of living organism under the earth over millions of years.
- Coal, petroleum and natural gas are fossil fuels.
- Coke, coal tar and coal gas are the products of coal.
- Petroleum is formed at the bottom from the remains of tiny organism called plankton.
- Petroleum gas, Petrol, Diesel, Kerosene, paraffin wax, lubricating oil are obtained by refining of petroleum.
- The natural gas is found sometimes along with petroleum and sometimes without petroleum.
- The useful substances which are obtained from petroleum and natural gas are called petrochemicals.
- Excessive use of fossil fuels causes air pollution, greenhouse effect, global warming and many health problems.
- Fossil fuel resources are very limited. We should think for the alternatives.
- Advances in science and technology have changed our lives.



#### Improve your learning

1. Complete the given analogy (AS<sub>1</sub>)

- coal : exhaustible : : \_\_\_\_\_ : inexhaustible
- coal tar : \_\_\_\_\_ : : coke : manufacture of steel
- petrochemical : plastic : : CNG : \_\_\_\_\_
- carbon dioxide : global warming : : \_\_\_\_\_ : nausea

2. Match the following (AS<sub>1</sub>)

- i. natural resource [ ] a. carbonisation
- ii. coal [ ] b. plastic chair
- iii. petrochemical product [ ] c. krishna, godavari delta
- iv. natural gas [ ] d. Plankton
- v. petroleum [ ] e. water.

3. Multiple choice questions. (AS<sub>1</sub>)

i. Which one of the following is less polluting fuel? [ ]

a. Natural gas b. coal c. kerosene d. petrol

ii. The main constituent of coal is [ ]

a. Carbon. b. oxygen c. air d. water

iii. Which one of the following material is used for making shoe polish? [ ]

a. Paraffin wax b. petrol. c. diesel d. lubricating oil

4. Fill in the blanks. (AS<sub>1</sub>)

- i. \_\_\_\_\_ was used in manufacture of steel.
- ii. The biproduct of coal used in synthetic dyes and paints is \_\_\_\_\_.
- iii. Coal was formed in areas where large amounts of \_\_\_\_\_ was buried under the earth.
- iv. \_\_\_\_\_ gas which causes climate change and global warming.

5. Name the petroleum products used for roads surfacing. (AS<sub>1</sub>)

6. Explain the process of formation of petrolleum in Earth? (AS<sub>1</sub>)

7. Project Work (AS<sub>4</sub>)

Compare a CNG run vehicle with that of a diesel run vehicle. What difference do you notice in both cases with respect to pollutants released, level of pollution and cost of fuel. Prepare a report on your findings. You can take the help of a driver to make a report on your observation.

Name of the fuel	Cost of the fuel as on today	Pollutants liberated
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Diesel/Petrol.		
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CNG		
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8. Project Work (AS<sub>4</sub>)

Choose five families of your neighbourhood, collect the information about the measures that they adopt to conserve energy resources in transport and cooking.

Name of the family	Number of members in family	No of vehicles using	Amount spent for Fuel in one month
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Make a report on your observation

9. The following Table shows the total power shortage percentage in India from 1991-1997. Show the data in the form of a Bar graph taking shortage percentage for the years on the Y-axis and the years on the X-axis. (AS<sub>4</sub>)

S.No.	Year	Shortage (%)
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1	1991	7.9
2	1992	7.8
3	1993	8.3
4	1994	7.4
5	1995	7.1
6	1996	9.2
7	1997	11.5

- a) Is the shortage percentage of power increasing or decreasing?
- b) If shortage percentage of power increases year by year, how will it affect on human life? Explain.
10. Draw a flow chart showing Exhaustible and Inexhaustible resources and their use. (AS<sub>5</sub>)
11. Collect information about places where we get coal, petroleum and natural gas in Andhra Pradesh and mark the places on outline map of Andhra Pradesh. (AS<sub>5</sub>)
12. How do you appreciate the efforts of human beings to discover an alternate energy sources to Coal and Petroleum for their daily use? (AS<sub>6</sub>)
13. Harshith said to his father, "Daddy we can save more fuel by using bicycle instead of bike for going to nearby places?" How do you appreciate Harshith's comment? (AS<sub>6</sub>)
14. Why should people look for alternative sources of fossil fuel? (AS<sub>7</sub>)
15. Assume that you are a driver, what measures do you take to save petrol and diesel? (AS<sub>7</sub>)
16. "Crude oil and refined fuel when spills into the sea from tanker of ships by accident". Discuss the consequences of this on environment. (AS<sub>7</sub>)
17. "The use of CNG and LPG as fuels for automobiles helps us to minimize air pollution and maintains ecological balance". Do you agree with this statement? If yes, explain. (AS<sub>7</sub>)