

# 3

## Chapter

# Coal and Petroleum

We'll cover the following key points:

- Coal
- Petroleum
- Natural gas



Hi, I'm EeeBee

Do you Remember:

Fundamental concept in previous class.

In class 6<sup>th</sup> we learnt

- Non-Renewable Resources

Still curious?  
Talk to me by  
scanning  
the QR code.



## Learning Outcomes

**By the end of this chapter, students will be able to:**

- Define fossil fuels and understand how they form from decomposed plants and animals.
- Learn about the chemical composition of coal and its extraction process through mining.
- Identify the four stages of coal formation: peat, lignite, bituminous, and anthracite.
- Understand the process and products of coal's destructive distillation and assess the environmental impacts of coal mining and usage.
- Learn methods for conserving energy and recognize the importance of using renewable energy sources.

## Guidelines for Teachers

The teacher can introduce exhaustible and inexhaustible resources, explain coal's composition, mining, destructive distillation, and environmental impacts. They can cover petroleum's properties, occurrence, and fractional distillation, along with natural gas's composition, uses as a cleaner fuel, and emphasize energy conservation and renewable sources. This approach integrates science with sustainability awareness.

## NCF Curricular Goals and Competencies

- CG-1 (C 1.1): Investigates the realm of matter, including its components, properties, and behaviors.
- CG-5 (C 5.1): Develops an understanding of the connections between science, technology, and society.



## Mind Map

# COAL AND PETROLEUM

## Natural Resources

- Exhaustible Natural Resources
- Inexhaustible Natural Resources

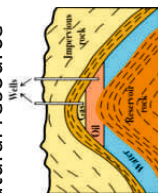
## Petroleum

### Definition

Petrol and diesel are obtained from a natural resource called petroleum.

### Refining of petroleum

Petroleum and natural gas deposits



## Natural Gas

- Natural gas is stored under high pressure as compressed natural gas (CNG).
- CNG is used for power generation

**Note :-** In our country, natural gas has been found in Tripura, Rajasthan, Maharashtra and in the Krishna Godavari delta.

## Coal

### i. Coke

It is a tough, porous and black substance. It is an almost pure form of carbon.

### ii. Coal Tar

It is a black, thick liquid with an unpleasant smell.

### iii. Coal Gas

Coal gas is obtained during the processing of coal to get coke.

## Some Natural Resources are Limited

In India, Petroleum Conservation Research Association advises people how to save petrol / diesel while driving. Their tips are

- Drive at a constant and moderate speed as far as possible.
- Switch off the engine at traffic lights or at a place where you have to wait.
- Ensure correct tyre pressure.

S. No.	Constituents of Petroleum	Uses
1.	Petroleum Gas in Liquid form (LPG)	Fuel for home and industry
2.	Petrol	Motor fuel, aviation fuel, solvent for dry cleaning
3.	Kerosene	Fuel for stoves, lamps and for jet
4.	Diesel	Fuel for heavy motor vehicles, electric generators
5.	Lubricating oil	Lubrication
6.	Paraffin wax	Ointments, candles, vaseline etc.
7.	Bitumen	Paints, road surfacing

## Introduction



*Coal*



*Petroleum*

The earth is a beautiful planet which provides a large number of natural resources that humans need to fulfil their various requirements. These resources are called **natural resources**. These include air, water, soil, minerals, forest, sunlight, etc. On the basis of the availability, natural resources are broadly classified into following two classes:

- Inexhaustible natural resources
- Exhaustible natural resources

### Inexhaustible Natural Resources

The resources which are present in unlimited quantity in nature and are not likely to be exhausted by human activities are called inexhaustible natural resources. Examples are: sunlight, air.

### Exhaustible Natural Resources

The resources which are present in limited amount in nature and can be exhausted by human activities are called exhaustible natural resources. Examples of these resources are forests, wildlife, minerals, coal, petroleum, natural gas etc.

In this chapter we will learn about some exhaustible natural resources like coal, petroleum and natural gas. These were formed from the dead remains of living organisms (fossils). So, these are all known as **fossil fuels**.

### In History...

Coal and petroleum have been pivotal in shaping industrial progress. Coal, one of the oldest sources of energy, was first used during the Industrial Revolution in the 18th century, powering steam engines and factories.

Its extensive use in industries like iron and steel manufacturing helped fuel economic growth. **Petroleum**, discovered in the mid-19th century, became a major source of energy, especially after the invention of the **internal combustion engine**.

The drilling of oil wells in Pennsylvania in 1859 marked the beginning of the global petroleum industry, transforming transportation, industry, and economies worldwide.

### KEYWORDS

**Petroleum:** Liquid fossil fuel for energy production.

**Internal combustion engine:** A heat engine that generates power by burning fuel with air inside a combustion chamber, driving a piston or rotor.

## Coal

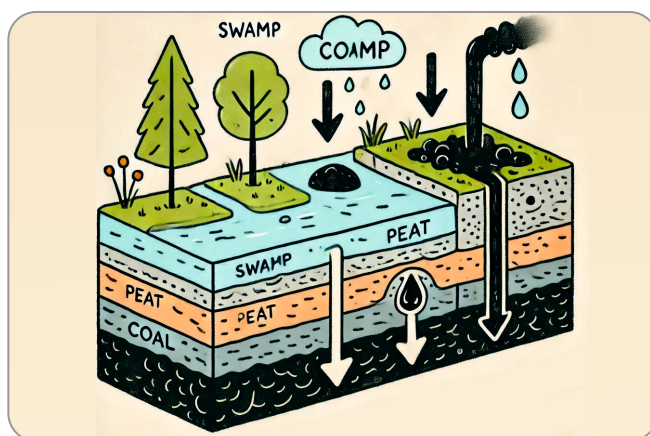
One evening, Riya sees her father adding coal to the barbecue and becomes curious.



Coal is a hard and black colour material obtained from mines. Perhaps you all may have seen coal, or heard about it. Coal is one of the most important fossil fuels used to cook food. Earlier, it was used in railway engines to produce steam to run the engine. It is also used in thermal power plants to produce electricity. Coal is also used as a fuel in various industries. In India, coal mines are mainly located in Jharkhand, Odisha, Madhya Pradesh and West Bengal.

### Formation of Coal

About 300 million years ago the earth had dense forests in low lying wetland areas. Due to natural processes, like flooding, these forests got buried under the soil. As more soil deposited over them, they were compressed. In course of time they sank deeper and deeper and pressure and temperature also increased. Under high pressure and high temperature, these dead plants got slowly converted to coal. As coal contains mainly carbon, the slow process of conversion of dead vegetation into coal is called carbonisation. Since it was formed from the remains of vegetation, coal is also called a fossil fuel. Coal mainly consists of carbon, hydrogen, oxygen and small amounts of nitrogen and sulphur are also present. There are three main varieties of coal.



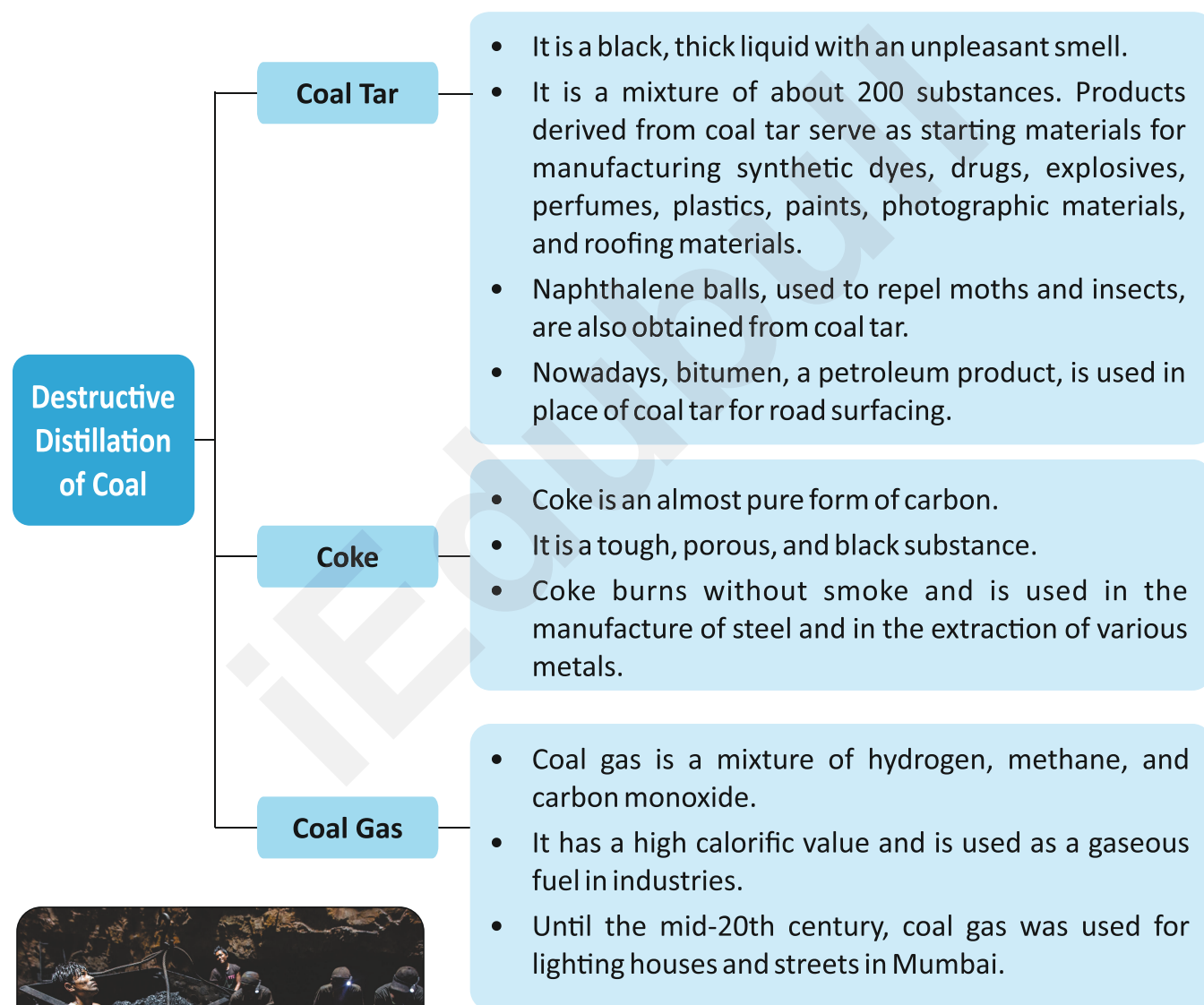


They vary according to their carbon content.

- Anthracite is the best variety of coal which contains up to 96% of carbon.
- Bituminous coal has about 70% to 80% carbon.
- Lignite has about 60% to 65% carbon.
- Peat has about 70% to 80% carbon.

## Destructive Distillation of Coal

When coal is strongly heated in absence of air, it gives coke, coal tar, coal gas and ammonium compounds. This is known as the destructive distillation of coal.



*A coal mine*

## Did you know

### Coal: Nature's Hidden Power

Coal is a dense energy source formed from compressed organic material, with the ability to release immense heat when burned. Its carbon-rich composition makes it a key player in electricity generation and industrial processes. Surprisingly, coal can also be processed to produce synthetic fuels and chemicals. Despite its utility, managing coal's environmental impact is critical, with advancements like carbon capture offering sustainable solutions.

### Let's recall what we know

#### Apply Concept in Context

Apply

1. How can understanding different types of coal aid in choosing suitable fuel sources for various applications?
2. Are natural resources renewable indefinitely?

**Skills Practiced:** Critical and logical thinking, Identification, Application thinking

#### Examine Further

Analyse

1. In what ways does the carbon content in coal influence its effectiveness as a fuel?
2. What are the environmental consequences of relying on coal as a primary source of energy?

**Skills Practiced:** Critical analysis, logical reasoning, brainstorming

#### Self-Assessment Questions

Evaluate

1. What are fossil fuels?
2. List the four stages of coal formation, specifying the carbon content of each stage.
3. Summarize the coal formation process briefly.

#### Think like a scientist

Create

Research the process of coal formation and its significance. Create a visual poster, infographic, or storyboard that illustrates this process in an engaging way. Present your completed work to the class and explain the importance of coal in energy production.

**Skills Practiced:** Brainstorming, research, digital literacy, creativity

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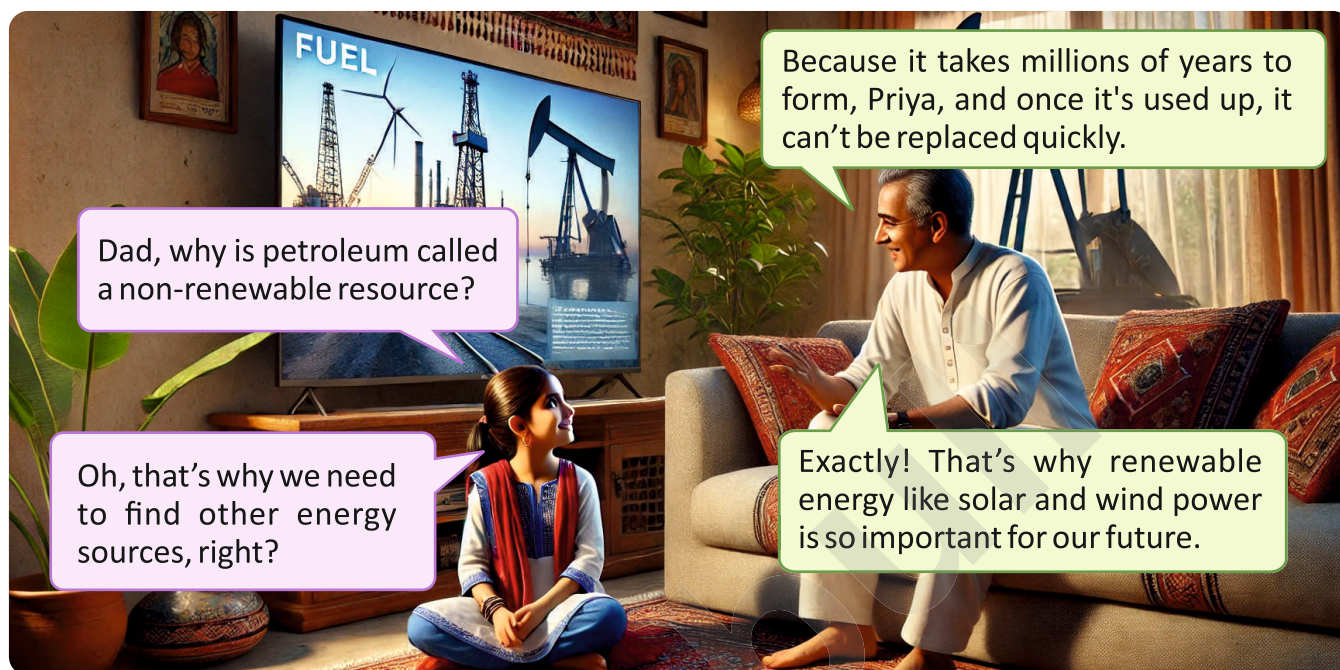


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**Bloom's  
Taxonomy**

## Petroleum

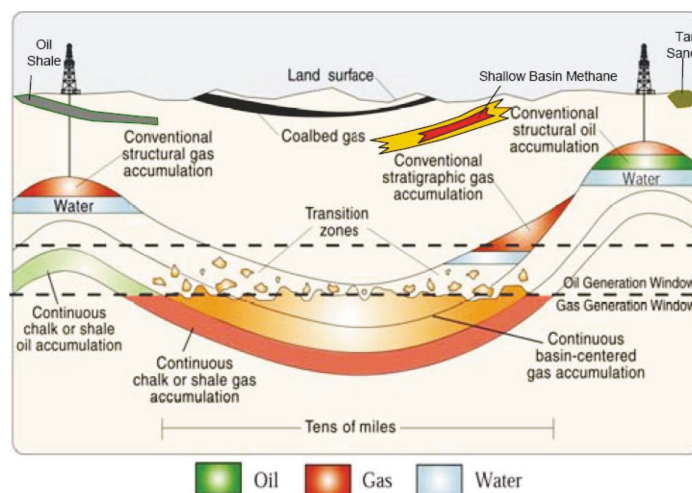
One evening, Priya is curious while watching a documentary about fuel and asks her father, Arjun, a question.



Petroleum is a viscous black liquid. It is found deep below earth's crust entrapped under rocky strata. It is taken out by drilling wells. In its crude form, the oil is called petroleum (Latin, *petra* = rock; *oleum* = oil) or crude oil. Petroleum is a natural resource from which petrol, diesel and kerosene are obtained. We all know that petrol is used as a fuel in light automobiles such as motor cycles/ scooters and cars. Heavy motor vehicles like trucks, buses, tractors etc. run on diesel. Kerosene is used to produce heat or light.

### Formation of Petroleum

Petroleum was formed from organisms living in the sea. As these organisms died, their bodies settled at the bottom of the sea and got covered with layers of sand and clay. Over millions of years, absence of air, high temperature and high pressure transformed the dead organisms into petroleum and natural gas. The given figure shows the deposits of petroleum and natural gas. The layer containing petroleum oil and gas is above that of water because oil and gas are lighter than water and do not mix with it.



*Petroleum and natural gas deposits*

The world's first oil well was drilled in Pennsylvania, USA, in 1859. Eight years later, in 1867, oil was struck at Makum in Assam. In India, oil is found in Assam, Gujarat, Mumbai High and in the river basins of Godavari and Krishna.

## Refining of Petroleum

Petroleum is a dark oily liquid. It has an unpleasant odour which is largely due to the presence of sulphur compounds. It is a mixture of various constituents such as petroleum gas, petrol, diesel, lubricating oil, paraffin wax, etc. The process of separating the various constituents/ fractions of petroleum is known as refining of petroleum. It is carried out in a petroleum refinery. Various constituents of petroleum and their uses are given in table.



*Petroleum refinery*

### Various constituents of petroleum and their uses

S.No.	Constituents of petroleum	Uses
1	Petroleum Gas in Liquid form (LPG)	Fuel for home and industries
2	Petrol	Motor fuel, aviation fuel, solvent for dry cleaning
3	Kerosene	Fuel for stoves, lamps and for jet aircrafts
4	Diesel	Fuel for heavy motor vehicles, electric generators
5	Lubricating oil	Lubrication
6	Paraffin wax	Ointments, candles, vaseline etc.
7	Bitumen	Paints, road surfacing

## History of Petroleum Refining

The refining of crude petroleum began with the drilling of the first oil wells in Ontario, Canada, in 1858, followed by Titusville, Pennsylvania, U.S., in 1859. Before these developments, petroleum was scarce, obtained only from natural seepage, and primarily used for medicinal and niche purposes. The discovery of "rock oil" in northwestern Pennsylvania made crude oil widely available, driving the creation of more sophisticated processing techniques. Early refineries relied on simple distillation units, or "stills," to heat crude oil and condense the vapors into different liquid components. Among these, kerosene became the most important product, valued for its cleaner, more plentiful, and higher-quality alternative to whale oil and animal fat for lamps.



## Did you know

### The Power of Petroleum

Petroleum is a versatile resource formed from ancient organic matter buried for millions of years. It's the backbone of fuels like gasoline and diesel, but it also powers the creation of everyday items like plastics, medicines, and cosmetics. One barrel of crude oil can produce over 6,000 products! Surprisingly, petroleum even plays a role in creating synthetic fabrics and food preservatives, making it an invisible yet vital part of modern life.

### Let's recall what we know

#### Apply Concept in Context

Apply

1. How does the boiling point of each component in petroleum determine its usage in various applications?
2. Why are petroleum and natural gas commonly found above water layers?

**Skills Practiced:** Critical and logical thinking, Identification, Application thinking

#### Examine Further

Analyse

1. What makes petroleum refining essential? Why isn't crude oil suitable for direct use?
2. Evaluate the environmental effects of extracting and refining petroleum.

**Skills Practiced:** Critical analysis, logical reasoning, brainstorming

#### Self-Assessment Questions

Evaluate

1. Define petroleum.
2. Where is petroleum located within the Earth's crust?
3. Briefly describe how petroleum is formed.
4. Outline the refining process.

#### Think like a scientist

Create

Create a poster, infographic, or flowchart that visually represents the process of petroleum formation and refining. Display your work to the class and explain each stage involved.

**Skills Practiced:** Brainstorming, research, digital literacy, creativity

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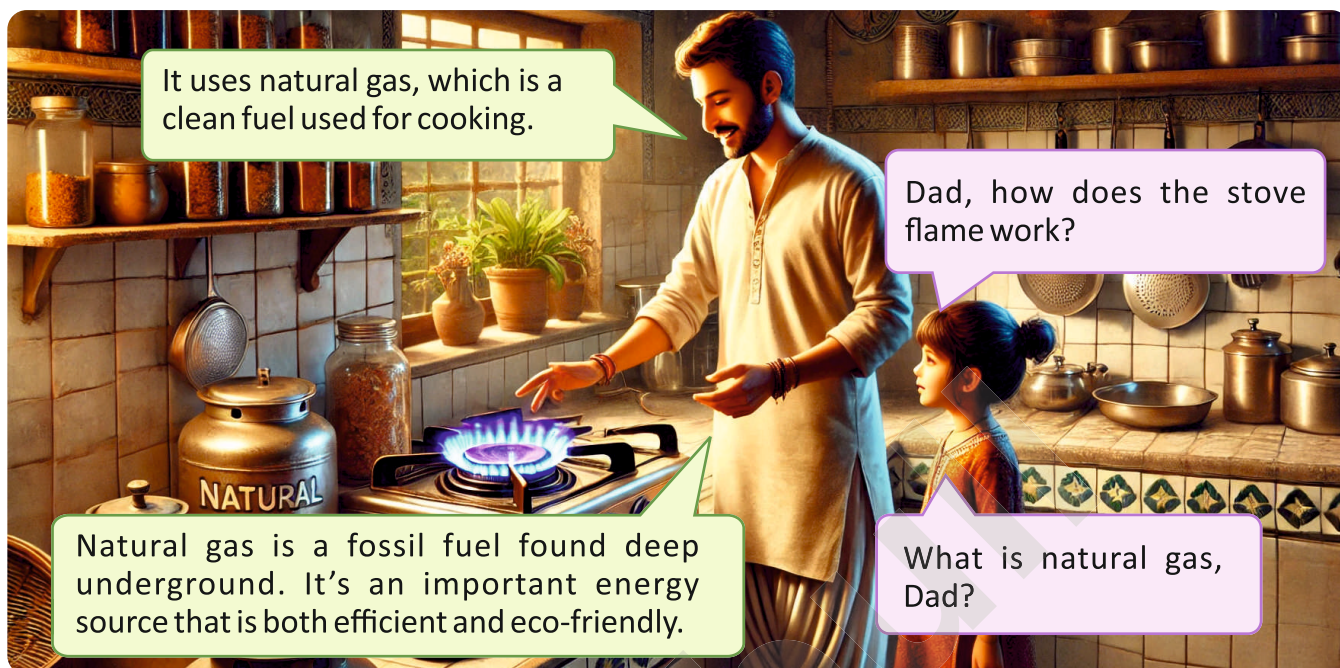


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## Natural Gas

Riya is watching her father, Amit, light the kitchen stove and notices something.

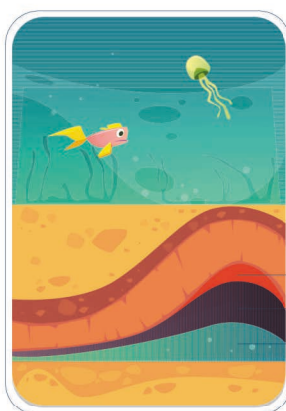
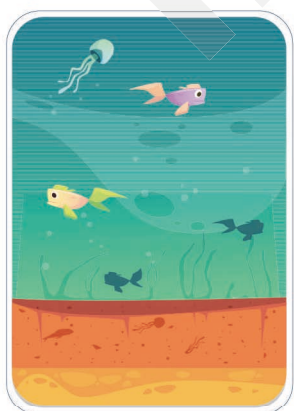


It is a gaseous, versatile, abundant, and relatively clean fossil fuel as compared to petroleum and coal. It is usually found along with crude petroleum in oil wells.

Natural gas burns readily in the presence of air to liberate a large amount of heat. This makes natural gas an excellent fuel for domestic and industrial use. It burns without any smoke and does not leave any ash behind. Natural gas storage and transportation are simplified as it can be delivered through a network of pipes and used directly for combustion. Natural gas piped to homes, factories, and industries from the source is referred to as piped natural gas (PNG). In India

*Anaerobic decomposition  
of deceased aquatic  
organisms*

*Formation of  
fossil fuel*



*Millions of Years*

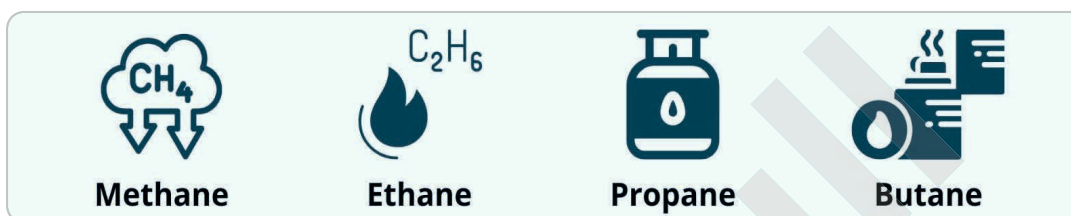
*Formation of petroleum and natural gas*

PNG is presently being supplied to cities like Delhi, Mumbai, and Vadodara. The network is growing gradually. Natural gas serves as the raw material for manufacturing many chemicals and fertilizers. Natural gas is compressed under high pressure to form CNG (Compressed Natural Gas) which is used as an ideal automobile fuel instead of petrol or diesel.

What makes **CNG** an ideal fuel? It is a cleaner, less polluting, and safer fuel than other fuels and can be used directly.

In India, natural gas wells have been found in Tripura, Jaisalmer; offshore areas of Mumbai, and the Krishna-Godavari delta.

Their formation is a very slow process and conditions for their formation cannot be created in the laboratory.



### Some natural resources are limited

Natural resources like coal and petroleum takes millions of years to form from dead organisms. But its consumption speed is higher. The known reserves of these fossil fuels will last at most a few hundred years. Thus these natural resources are limited. It is therefore necessary that we use these fuels only when absolutely necessary. Moreover, burning of these fuels is a major cause of air pollution. Their excessive use is also linked to **global warming**. So in order to protect environment, for smaller risk of global warming and for the availability of fossil fuels for longer period of time we must use these fuels judiciously.

In India, the Petroleum Conservation Research Association (PCRA) advises people how to save petrol/diesel while driving. Their tips are:

- Drive at a constant and moderate speed as far as possible,
- Switch off the engine at traffic lights or at a place where you have to wait,
- Ensure correct tyre pressure, and
- Ensure regular maintenance of the vehicle.

### PCRA

PCRA was established in 1976 as a registered society under the Ministry of Petroleum and Natural Gas. Its goals are to promote the conservation of petroleum products and the protection of the environment, energy security, and sustainable development.

#### KEYWORDS

**CNG:** A clean and efficient fossil fuel used as an alternative to gasoline or diesel, primarily in vehicles.

**Global Warming:** The long-term increase in Earth's average temperature due to human activities and greenhouse gas emissions.

## Let's recall what we know

### Apply Concept in Context

Apply

1. Where in India are CNG pipelines predominantly located?
2. Which renewable energy sources can be used to reduce dependence on traditional electricity sources?

**Skills Practiced:** Critical and logical thinking, Identification, Application thinking

### Examine Further

Analyse

1. What qualities make natural gas a more environmentally friendly choice for vehicle fuel?
2. Identify some fuel alternatives to fossil fuels that can be adopted in the transportation sector.

**Skills Practiced:** Critical analysis, logical reasoning, brainstorming

### Self-Assessment Questions

Evaluate

1. Why is it essential to prioritize efficient and mindful use of fossil fuels?
2. What are the main components found in natural gas?
3. Provide a few practical strategies for saving energy.
4. According to PCRA guidelines, what steps can individuals take to reduce petrol and diesel usage?

### Think like a scientist

Create

Create a visual chart, poster, or pamphlet that explains India's policies on the efficient and sustainable use of fossil fuels. Highlight key conservation techniques and explain their impact. Share your creation with the class and discuss how it can inspire responsible energy use.

**Skills Practiced:** Brainstorming, research, digital literacy, creativity

SCAN TO ACCESS



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# SUMMARY



## Coal

### 1. Formation:

- Formed from the anaerobic decomposition of ancient plant material buried under layers of soil and rock for millions of years.
- Stages of coal formation: Peat → Lignite → Bituminous → Anthracite, with increasing carbon content and energy density.

### 2. Types of Coal:

- **Anthracite:** High carbon, high energy, least impurities.
- **Bituminous:** Commonly used for electricity and steel production.
- **Lignite:** Low-grade coal with higher moisture.
- **Peat:** Precursor to coal with the least energy content.

### 3. Uses:

- Power generation in thermal plants.
- Raw material in steel and cement production.
- Source for coal tar, coke, and synthetic gas.

### 4. Environmental Impact:

- Major contributor to air pollution and greenhouse gases.
- Mining causes habitat destruction and water pollution.

### 3. Products:

- **Fuels:** Gasoline, diesel, kerosene, jet fuel.
- **Petrochemicals:** Plastics, synthetic fibers, pharmaceuticals, cosmetics, and fertilizers.
- Lubricants and asphalts.

### 4. Applications:

- Transportation, heating, electricity generation, and industrial manufacturing.

### 5. Environmental Impact:

- Oil spills harm marine life.
- Emissions from burning petroleum contribute to air pollution and climate change.

## Natural Gas

### 1. Formation:

- Created alongside coal and petroleum from decomposed organic matter.
- Primarily consists of methane, with small amounts of ethane, propane, and butane.

### 2. Types of Natural Gas:

- **Conventional:** Easily extracted from underground reservoirs.
- **Unconventional:** Includes shale gas, tight gas, and coalbed methane.
- **Renewable Natural Gas (RNG):** Produced from organic waste.

## Petroleum

### 1. Formation:

- Derived from the anaerobic decomposition of marine organisms buried under sediment over millions of years.
- Transformed by heat and pressure into crude oil and natural gas.

### 2. Extraction:

- Extracted from oil wells, offshore rigs, and oil sands.
- Requires refining through processes like distillation, cracking, and reforming.

### EeeBee: Your AI Buddy

Explore! **Coal and Petroleum** with EeeBee AI Buddy.

Hi Friend! Use prompts to ask me questions about the chapter we just finished! eeee, lets go!

Start by Scanning this QR Code:





Gap Analyzer™  
Take a Test



# EXERCISE

That turn curiosity into confidence—let's begin!



## A. Choose the correct answer.

1. Which of the following is a by-product of coal?

(a) Coal gas

☐

(b) Natural gas

☐

(c) Petroleum

☐

(d) Kerosene

☐

2. Which product is obtained by refining petroleum?

(a) CNG

☐

(b) Diesel

☐

(c) Coal tar

☐

(d) Coal gas

☐

3. What is the major constituent of natural gas?

(a) Propane

☐

(b) Methane

☐

(c) Butane

☐

(d) Ethane

☐

4. Which of the following is a non-renewable resource?

(a) Solar energy

☐

(b) Wind energy

☐

(c) Petroleum

☐

(d) Hydropower

☐

5. How is coal formed?

(a) From decayed aquatic organisms

☐

(b) From ancient vegetation buried under pressure and heat

☐

(c) From volcanic ash

☐

(d) From compressed rocks

☐

## B. Fill in the blanks.

1. Coal is formed from the remains of \_\_\_\_\_.

2. The process of separating petroleum into useful products is called \_\_\_\_\_.

3. Natural gas mainly consists of \_\_\_\_\_.

4. Coke is a pure form of \_\_\_\_\_, used in the steel industry.

5. A cleaner alternative to petrol and diesel is \_\_\_\_\_ gas.

## C. Write True or False.

1. Petroleum is also known as "black gold."

\_\_\_\_\_

2. Coal gas is used as fuel for vehicles.

\_\_\_\_\_

3. Natural gas is a renewable source of energy.

\_\_\_\_\_

4. Bitumen, a petroleum by-product, is used for road construction.

\_\_\_\_\_

#### D. Define the following terms.

1. Fossil fuels
2. Fractional distillation
3. Natural gas
4. Coal tar
5. Non-renewable resources

#### E. Match the columns.

##### Column A

1. Bitumen
2. Coke
3. Petroleum
4. Natural gas
5. Diesel

##### Column B

- (a) Compressed natural gas
- (b) Road construction
- (c) Steel manufacturing
- (d) Refining crude oil
- (e) Fuel for heavy vehicles

#### F. Give reasons for the following statements.

1. Coal and petroleum are considered non-renewable resources.
2. Natural gas is preferred over other fossil fuels in some industries.
3. Fractional distillation is used in petroleum refining.
4. Excessive use of fossil fuels harms the environment.
5. Bitumen is used for road construction instead of other petroleum by-products.

#### G. Answer in brief.

1. What are the primary uses of coal?
2. Explain the process of obtaining petroleum products through fractional distillation.
3. List the advantages of natural gas over coal and petroleum.
4. What are the harmful effects of using fossil fuels on the environment?
5. How does coal gas differ from natural gas in its usage?

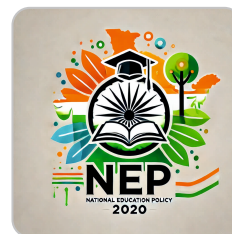
#### H. Answer in detail.

1. Explain the formation of coal and its types.
2. Describe the refining process of petroleum and the products obtained from it.
3. What are the main uses of natural gas? Discuss its environmental advantages.
4. Why is it important to conserve fossil fuels? Suggest methods to reduce their usage.
5. Discuss the impact of fossil fuels on climate change and the importance of adopting renewable energy sources.



**Cooler Report Cards!**

Your report cards will now reflect not just your marks but also your skills, values, and teacher's and peer's feedback. It's all about the real you!



## Skill-based Activity



### Oil Spill Clean-Up Simulation

**STEM**

**Scenario:** Imagine you are a scientist working on sustainable energy solutions. Your task is to investigate the use of coal and petroleum and explore how their consumption impacts the environment and society.

**Questions:**

**Science:** Explain the process of formation of coal and petroleum. Why are they classified as non-renewable resources?

**Technology:** What technological advancements have been made to reduce the environmental impact of using coal and petroleum? Provide examples such as cleaner fuels or carbon capture techniques.

**Mathematics:** If a factory consumes 5,000 tons of coal annually, and burning one ton of coal releases 2.86 tons of CO<sub>2</sub>, calculate the total CO<sub>2</sub> emissions for one year. Suggest ways to minimize these emissions.

**Skills Covered:** Creativity, Observation, Critical Thinking, Data Analysis, Responsibility, Research

### Formation of Coal

**Art**

Build a detailed model to demonstrate the process of coal formation over millions of years. Use materials such as layers of clay, sand, and organic plant matter to represent the transformation of matter under immense heat and pressure. Clearly show the different layers of coal formed during the process.

**Skills Covered:** Creativity, Imagination, Problem-solving, Environmental Awareness

### Energy Detectives: The Story of Coal and Petroleum

**Group Activity**

**Instructions:** Divide the class into groups of 4-5 students. Each group will act as a team of "energy detectives" tasked with investigating different aspects of coal and petroleum. Each group must research and present their findings. Use the following guiding questions to prepare:



### Group 1: Formation Detectives

How are coal and petroleum formed?

What are the natural processes and timeframes involved in their formation?

### Group 2: Extraction Experts

How are coal and petroleum extracted from the Earth?

What tools and methods are used in the extraction process?

### Group 3: Usage Analysts

What are the primary uses of coal and petroleum in daily life?

Discuss their role in electricity generation, transportation, and industries.

**Skills Covered:** Critical thinking, Planning, Collaboration, Communication, Creativity, Teamwork, Problem-solving, Responsibility

## Environmental Hazards from Fossil Fuels

Case to Investigate

Identify and analyze the environmental hazards caused by the extraction and usage of fossil fuels (e.g., oil spills, mining-related accidents). Prepare a report on these hazards and propose effective solutions to minimize their impact on the environment.

**Skills Covered:** Observation, Critical thinking, Research, Analytical skills, Communication

## Impact of Fossil Fuels on Global Warming

Aligning with SDGs

**Question:** Explain how the burning of fossil fuels contributes to global warming. What are the possible solutions and precautions that can be taken to reduce its impact? Discuss your ideas with reference to sustainable development goals.

### Aligned with SDGs:

SDG 7: Affordable and Clean Energy (Promoting renewable energy sources), SDG 11: Sustainable Cities and Communities (Encouraging eco-friendly practices), SDG 13: Climate Action (Combating global warming and reducing emissions)

**Skills Covered:** Research, Brainstorming, Problem-solving, Presentation skills

## Analyzing Carbon Footprints

Integrated Learning

Examine the global carbon footprint and its impact. Create a chart listing the top 10 countries contributing the highest carbon emissions, including their per capita emissions. Compare the data through a graph, analyze trends, and discuss how these rankings align with global efforts to reduce carbon emissions.

**Integrated Learning:** Environmental Science

**Skills Covered:** Brainstorming, Research, Investigation, Critical Thinking