

6

From Raw Materials to Useful Products

Link it!

Natural resources
Grade 3, Unit 12

Raw materials

In Grade 3, you learnt that the Earth's natural resources provide us with useful products we need to live.

- Name these kinds of natural resources.

Air, water, rocks, fossil fuels, living things (plants, animals)

Study the pictures below. They show how Mr Caveman lived in the past and how Mr Modern lives today.



Mr Caveman's family



Mr Modern's family

Mr Caveman – animal skins for clothes, stone for cutting, meat, wood for burning, stones for fireplace. Mr Modern – manufactured food, metal knives, gas cooker, glass window, ceramic tiles on floor, plastic objects, etc.

- List some of the materials or products used by Mr Caveman and Mr Modern.
- Which of these things come directly from nature? Which have been made in factories?

From nature – animal skins, meat, wood, stones. From factories – packaged food, all the products, clothes and appliances in Mr Modern's home.

The things people get from the Earth to make useful products are called **raw materials**.

In the past, raw materials were used just as they were found in nature. Thus Mr Caveman and his family used wood for fires, stones for knives and animal skins for clothes.

Today, raw materials are changed into many new kinds of useful products in factories. These include plastics for tables and chairs, glass for windows, steel for knives, ceramic floor tiles and newer kinds of fabrics for clothes.

In this unit, you will learn how raw materials are changed into some of the many useful products we use today.

Useful products from water

Water is a natural resource. In Grade 3 and Grade 5, you learnt about the uses of water.

- List 10 or more uses of fresh water. Refer to Grade 5, Unit 11.

Salt is obtained from seawater. We use it for cooking and to flavour food.



Using salt

Salt is also a useful raw material. It is used to make other products. Two of these products are **chlorine gas** and **bleach solution** (also called **chlorine bleach**). They are made by passing electricity through salt solution.

salt solution $\xrightarrow{\text{electricity}}$ chlorine and bleach solution

Changing raw materials into useful products uses both **physical** and **chemical** changes.



Link to

Physical and chemical changes
Grade 5, Unit 5



- Natural resources provide us with food, energy and materials for making things.
 - Name the five kinds of natural resources on Earth.
 - Give examples of the natural sources that provide us with (i) food, (ii) energy, and (iii) materials.
- Indonesia has many natural resources. Name some of them.

- (a) Air, water, rocks, fossil fuels, living things (plants, animals).
(b) Food – plants, animals. Energy – fossil fuels. Materials – rocks, plants.
- E.g. coal, oil, timber, rattan, gold and other metals, many kinds of foods. Refer to Grade 3, Unit 12.



A bottle of household bleach solution



Untreated water from streams and rivers may contain harmful micro-organisms. We should **not** drink it.

Chlorine

Chlorine gas is poisonous. Chlorine is dissolved in our drinking water to kill germs (harmful micro-organisms) such as bacteria. The water is then safe to drink. Chlorine is also added to the water in swimming pools to kill micro-organisms that might harm swimmers.



Tap water from the city water supply is treated with chlorine.

Chlorine is used to treat swimming pool water.



The word 'bleach' means 'to remove colour' and 'to make white'.

Bleach solution

Bleach solution also kills germs. We use it at home to clean floors, bathrooms and tables.

Bleach solution is also used to remove colour stains from cotton fabrics and to make them whiter.



Germs live on tables and floors. Washing them with bleach helps to kill the germs.

Cotton clothes bleached with chlorine.



Useful products from rocks

Rocks are an important natural resource. Two uses of rocks are for building materials and to obtain metals.

Building materials from rocks

Building materials, such as clay, marble and limestone come from rocks.

Clay has been used for thousands of years as a raw material for bricks. Clay is mixed with water and heated to make the bricks.

Link it!

Rocks
Grade 5,
Unit 10



A building made from bricks.



A brick

Clay is also a raw material for the making of **cement**. The other raw materials are limestone and water.



limestone



clay



water



cement

The limestone is broken into small pieces and mixed with clay and water. The mixture is heated to a high temperature. A chemical change takes place to form cement.

Concrete is made by mixing cement, sand, stones and water. This mixture sets hard to give a very strong building material. Large amounts of concrete are used today.

The History Museum in Jakarta is made from concrete.



Thinking

Limestone and marble are two kinds of rocks.

1. What kind of rock is each?
2. Name a famous building made from each of these rocks.

1. Limestone – sedimentary rock.
Marble – metamorphic rock.
2. Limestone – pyramids of Egypt.
Marble – Taj Mahal in India.

Link it!

Metals
Grade 3, Unit 6
Grade 4, Unit 8

Metals from rocks

Rocks are used as raw materials to obtain metals. For example, iron.

To make iron, three raw materials are needed: a rock that contains iron, coke (a kind of carbon) and limestone.

These raw materials are mixed and heated in a large tower called a **blast furnace**. In the blast furnace, chemical changes take place to produce iron.



A rock containing iron.



A blast furnace



The Eiffel Tower is made of steel.

Most iron is changed into steel. Steel is a raw material. It has many uses, such as making bridges, cars, ships, buildings and tools.

Iron and ordinary steel rust. Stainless steel does not rust. Cutlery and medical instruments are made from stainless steel.



Cutlery is made of stainless steel. This steel does not rust.



This ship and the cranes used to load the ship are made of steel.



1. Can you name some other uses of steel?
2. What properties of steel make it suitable for the uses in the pictures on the left?

1. E.g. cars and other vehicles, railway lines, steel reinforcing rods for building, pipes, roofing metal, food cans, nails, magnets, medical instruments.
2. Ships, cranes, bridges, Eiffel tower – strength, hardness, malleable. Cutlery – hard, does not rust, shiny.

Useful products from living things

Plants and animals are natural resources. In Grade 3, you learnt about the uses of plants and animals as raw materials for foods and for building materials. Many of these raw materials are used as they are found in nature.

- List 10 or more useful products obtained from plants and animals. *Refer to Grade 3, Unit 12.*
- List some useful products obtained from the coconut tree. *Refer to Grade 3, Unit 12, Activity 1.*

Raw materials from plants and animals are used to make other useful products. Two examples are **soap** and **margarine**.

Soap

Soaps are made from animal fats or plant oils. Examples of plant oils are olive oil, palm oil and coconut oil. The fat or oil is heated with a substance called sodium hydroxide. A chemical change takes place to form the soap. That is:



Margarine

The raw materials used to make margarine are plant oils and hydrogen. Hydrogen gas is bubbled through the liquid oil. The liquid then changes into a solid.



The more hydrogen added to the plant oil, the harder the margarine. Vitamins, colourings, salt and other substances may then be added to the margarine.

Link it!

Uses of plants and animals
Grade 3, Unit 12



Soap



Margarine



Oils obtained from plants are also called **vegetable oils**.

Making useful products using micro-organisms

Micro-organisms are used to make useful products. They do this by a process called **fermentation**. Fermentation is a chemical change that changes **sugars** into other substances.

Three products are **alcohol**, **bread** and **yoghurt**. Let us look at each of them.

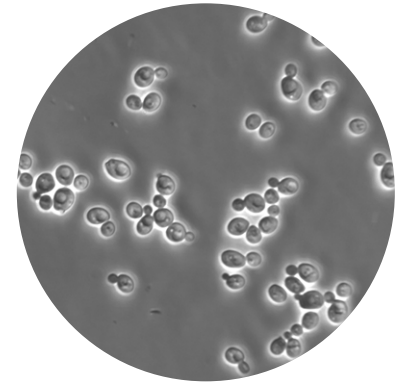
Alcohol

Yeast is a micro-organism. It is a fungus. It is used to make alcohol.

- How does this happen?

Described below

Many fruits, such as grapes, contain sugar. Yeast changes the sugar into alcohol. At the same time, carbon dioxide gas is formed. That is:



Yeast as seen under a microscope.



Dry yeast



Alcohol is used in paints and perfumes.



In some countries, alcohol is used as a fuel for cars.



Alcohol is also called **ethanol**.

Alcohol is also found in many drinks, such as beer, wine and brandy. These drinks are made using fermentation of sugars in fruits and other foods.



Wine is made from grapes.



Fun Science

Alcohol has harmful side effects like drugs. Alcohol is harmful to a person's body, his family and to society.

People who drink too much alcohol can not speak or walk properly. Alcohol can damage the brain, heart, stomach and other parts of the body. Drinking alcohol also causes road accidents.

Under Islamic law, drinking alcohol is forbidden (*haram*).



Bread

Fermentation using yeast is also used to make bread.



Yeast makes bread rise.



Bread

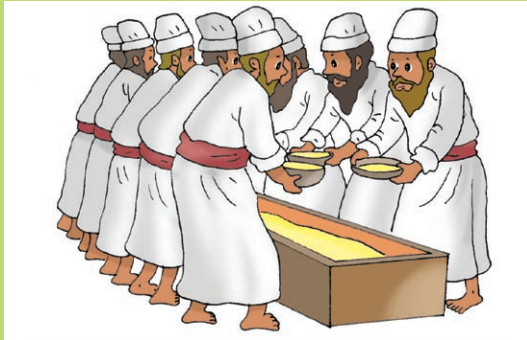
Yeast, flour and water are mixed to form **dough**. When left in a warm place, the yeast acts on sugars in the dough. Carbon dioxide is given off which makes the dough 'rise.' This is because the gas forms many spaces inside the dough. These spaces make the bread lighter and easier to eat.

The dough is then baked in an oven. This cooks the dough and evaporates the alcohol produced during the fermentation. So bread contains **no** alcohol.



Fun Science

Yeast has been used since ancient times to make useful products.



The Babylonians used yeast to make beer about 8 000 years ago.



The use of yeast for bread making was first carried out in Egypt about 6 000 years ago.

Yoghurt

Bacteria are also micro-organisms. Fermentation using bacteria is used to change milk into yoghurt.

To make yoghurt, special bacteria are added to milk. The bacteria change **lactose**, a sugar in milk, into **lactic acid**. This acid causes the milk to form a soft solid which we call yoghurt.

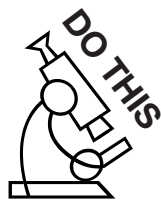
lactose \longrightarrow **lactic acid**

As lactic acid gives yoghurt a sour taste, sugar and flavours are often added.

Yoghurt can be made from the milk of various animals including cows, sheep, goats and water buffalo.



A fruit-flavoured yoghurt



Take a container of yoghurt. Look for the words 'live culture'. If these words are present, then the yoghurt contains bacteria. The container may also give the names of these bacteria. One example might be *Bifidobacteria*. Your teacher will help you to identify these name.

Examples of bacteria in yoghurt are *bifidobacteria*, *lactobacillus acidophilus*, *lactobacillus bulgaricus* and *streptococcus thermophilus*. Pupils do not have to memorise these names.

Fun Science

Thousands of years ago, people had a problem. A family can only drink so much milk in a day. The rest of the milk from their animals is wasted as it goes bad under the hot sun. But, by accident, they discovered how to change milk into yoghurt. The lactic acid in yoghurt kills micro-organisms that make milk go bad. Thus the milk is preserved and is not wasted.

Thinking

1. Explain why fermentation is a chemical change.
2. Can you name another food made using bacteria?

1. New products are formed, e.g. alcohol, carbon dioxide (in fermentation of fruits), lactic acid (fermentation of milk).
2. Cheese (Grade 3, Unit 3). Some brands of soy sauce are made by fermenting soybeans using both bacteria and yeast.

Useful products from fossil fuels

Fossil fuels are another natural resource.

- There are three fossil fuels. What are they? *Coal, crude oil, natural gas*

Crude oil is a fossil fuel. It is a raw material. From crude oil, many useful products are obtained. These include **fuels** and **plastics**. Let us look at each of them.

Fuels from crude oil

Crude oil is not one substance. It is a mixture of many different substances.

Crude oil is separated in an **oil refinery** by a process called **fractional distillation** (See Page 88). This is a physical change.

The crude oil is heated to about 350°C. At this temperature, the crude oil evaporates and forms a mixture of gases.

The hot gases go into a large tower. As they rise up the tower, the mixture separates. Most of the gases cool and turn back into liquids.



The Blue Sky oil refinery in Indramaya City, West Java.

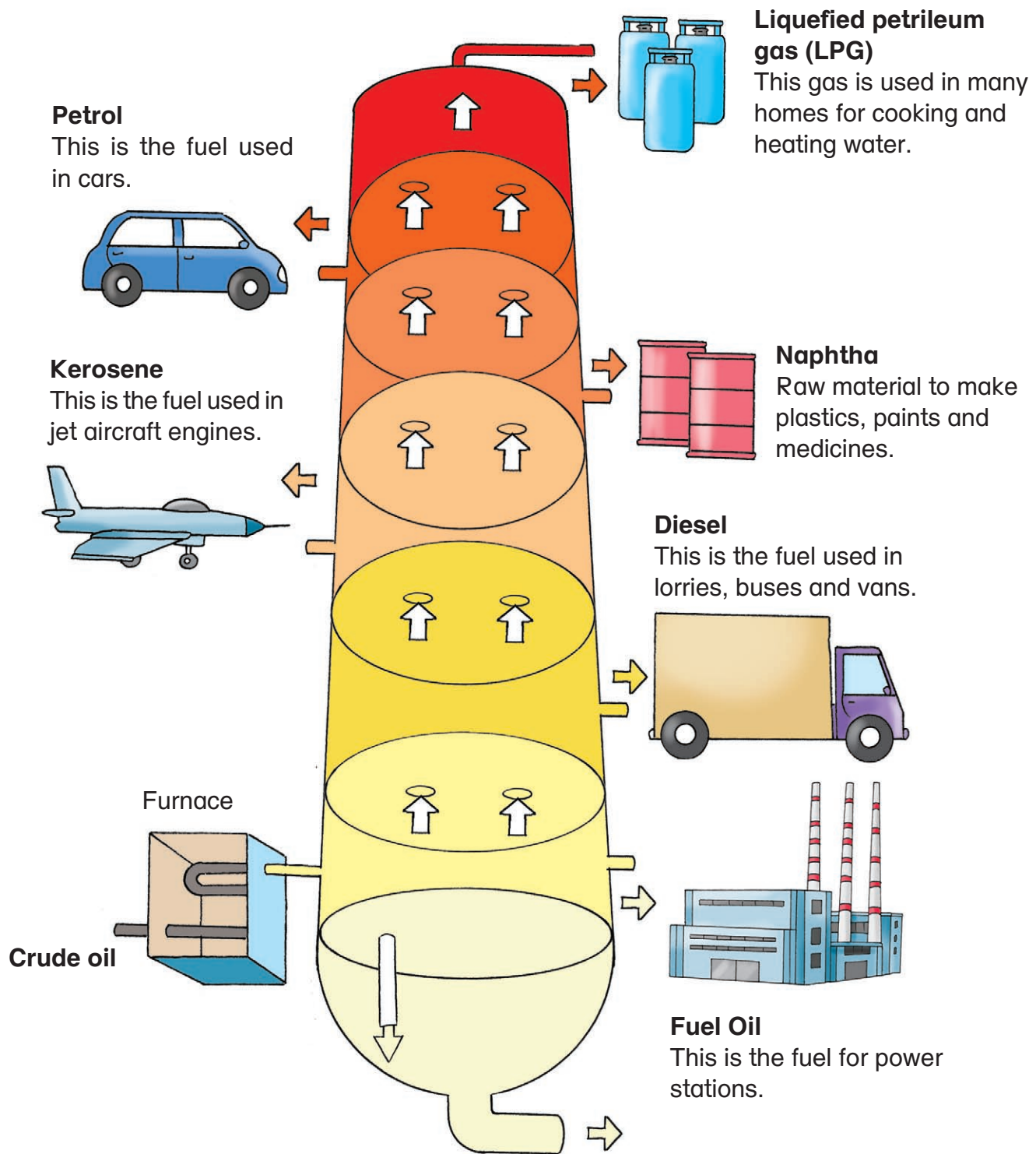


Link it!

Fossil fuels
Grade 3, Unit 12

Grade 4, Unit 11

In a tower like this, many useful fractions are separated from crude oil.



Plastics from crude oil

Plastics are synthetic (man-made) materials. They are not found naturally in the Earth.

Naphtha, obtained from crude oil, is a raw material used to make many kinds of plastics.

The pictures show common plastics and some of their uses.

Uses of perspex: E.g. Car lamp covers, watch glass, advertising signs, windows instead of glass, some furniture.

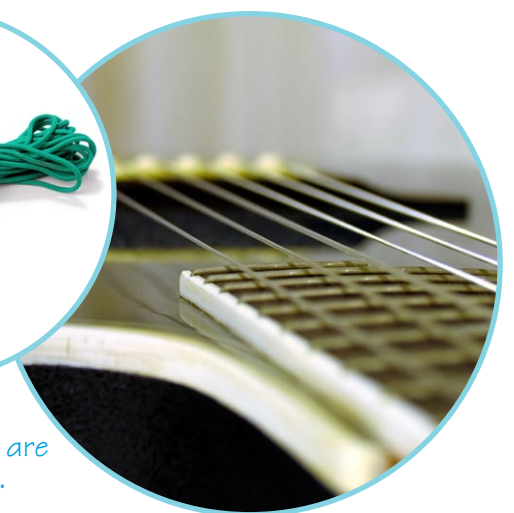


This ruler and lamp cover are made of **perspex**.

This plastic cup and food box are made of **polyethene**.



This plastic cup and food box are made of **polystyrene**.



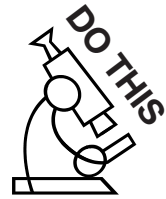
This rope and guitar strings are made of **nylon**.



These pipes and containers are made of **PVC (polyvinyl chloride)**.



Javanese traditional costume made from natural materials.



Look at the labels on some clothes.
What materials are they made from? Are they natural or synthetic materials?
Are any of the clothes made from a mixture of materials?

Wool

- Why do people wear clothes made of wool?

Wool is warm, soft and lasts a long time.

It absorbs perspiration from the body and keeps the wearer dry and comfortable.

Cotton

- Why do people wear clothes made of cotton?

Cotton is soft and comfortable and has good strength.

It is a good heat insulator. This gives protection from heat in summer and cold in winter.

Like wool, cotton absorbs perspiration, which keeps the wearer more comfortable.



Wool fabric

Cotton tablecloth



Cotton shirt

Polyester shorts



Polyester

- Why do people wear clothes made of polyester?

Polyester is very strong.

Unlike natural materials, it does not rot and is not eaten by insects.

It dries quickly when wet.

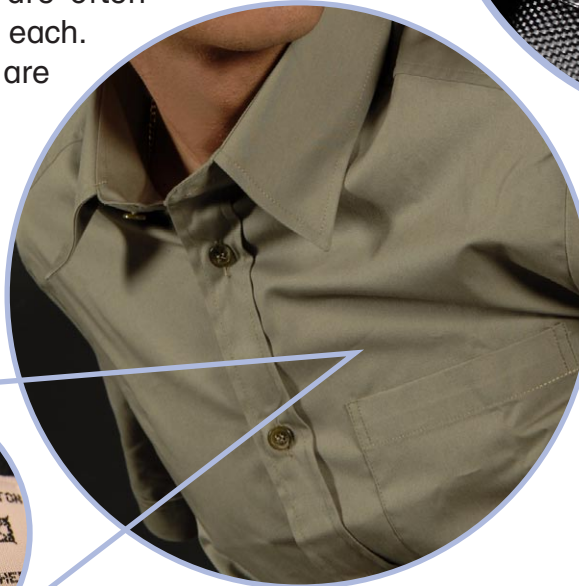
It is easier to wash and clean than wool and cotton.

However, polyester does not absorb perspiration. Polyester clothes feel hot and uncomfortable in hot temperatures.

Combining fabrics

Natural and synthetic materials are often mixed to get the best features of each. For example, cotton and polyester are mixed.

As this fabric in the picture contains cotton, it absorbs perspiration and is comfortable to wear. As it contains polyester, it is very strong and is easy to wash.



A label from a shirt showing it is a mixture of cotton and polyester.



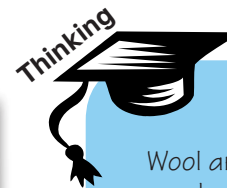
Polyester fabric

Fun Science

Wool, as clothing is being used for over 12 000 years. The first wool factory was established in England in 50 A.D. by the Romans. Cotton cloth has been used for 5 000 years. Polyester is a synthetic material. It was first produced in 1953.



A wool dress



The materials trap air within the fabric. The air is a poor conductor of heat (an insulator) and prevents heat from moving through the material.

Wool and cotton are poor conductors of heat. Explain why.



My Conclusions

1. Raw materials are substances used to make new products.
2. Water is a raw material in the production of salt, chlorine gas and bleach solution.
3. Rocks provide raw materials for building and for obtaining metals.
4. Micro-organisms are used to produce useful products by fermentation. Yeast produces alcohol and bread. Bacteria produce yoghurt.
5. Crude oil is a mixture of substances. The mixture is separated in an oil refinery by fractional distillation to give many useful fuels.
6. Naphtha, also obtained from crude oil, is the raw material for the production of many plastics.
7. Plastics have properties that make them useful for making a wide variety of products.
8. Clothing is made from natural materials such as cotton and wool, and synthetic materials such as nylon and polyester. Natural and synthetic materials are often mixed to get the best features of each.

STRETCH YOURSELF

WB ★ Activity 6 & 7

I. The story of a fibre

Choose **one** natural or synthetic fibre, such wool, cotton, silk, nylon or polyester.

- (a) From books or the Internet, find out where it comes from, its characteristics (properties) and its uses.
- (b) Prepare a talk to give to your classmates. Or, prepare a poster with the information you collect. Try to include pictures in your poster.

You may find the following website useful: [Refer to the website for information.](#)

<http://www.fabrics-manufacturers.com/natural-fabrics.html>

2. Clothing survey *This is an extension of a 'Do this!' Activity.*

Carry out a survey of your clothes at home.

(a) Look for the label to see what materials the clothes are made of.

(b) Describe how the material feels (soft, rough, smooth, etc.).

(c) Are there any special instructions, e.g. for washing or drying?

Record your findings in a table.

3. Life without crude oil

From crude oil, we get materials to make plastics, fabrics and paints and many fuels. Suggest what life might be like without crude oil.

E.g. Life could revert to the way it was 100 years or so ago. For example, the use of wood as a fuel for cooking and heating, the use of animals for transport, plant oil for lamps. As fuel from crude oil is used in power stations to generate electricity, we would have to find alternative ways to do this, for example, more wind turbines, nuclear and hydroelectric power stations otherwise we could not use modern electrical appliances. We would also have to revert to natural materials, such as wood, rubber and metals for making things that now are made from plastic.

New words

raw material

chlorine bleach

coke

blast furnace

margarine

vegetable oil

sodium hydroxide

fermentation

alcohol

dough

lactose

lactic acid

oil refinery

fractional distillation

naphtha

perspex

polythene

polystyrene

nylon

polyester

polyvinyl chloride (PVC)