



DEPARTMENT OF EDUCATION

GRADE 7

SCIENCE

STRAND 4



EARTH AND BEYOND



FLEXIBLE OPEN AND DISTANCE EDUCATION
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FOR DEPARTMENT OF EDUCATION
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SCIENCE

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STRAND 4

EARTH AND BEYOND

SUB STRAND 1: THE EARTH AND ITS ORIGIN

SUB STRAND 2: SPACE EXPLORATION

SUB STRAND 3: THE EARTH, THE SUN AND THE MOON

Acknowledgement

We acknowledge the contributions of all secondary teachers who in one way or another have helped to develop this Course.

Our profound gratitude goes to the former Principal of FODE, Mr. Demas Tongogo for leading FODE team towards this great achievement.

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DIANA TEIT AKIS

PRINCIPAL



Flexible Open and Distance Education
Papua New Guinea

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TABLE OF CONTENTS

	Page
Contents.....	3
Secretary's Message.....	4
Strand Introduction.....	5
Study Guide.....	6
SUB STRAND 1: The Earth and Its Origin.....	7 - 70
☐ Lesson 1: Formation of the Earth.....	9 - 14
☐ Lesson 2: Structure of the Earth.....	15 - 20
☐ Lesson 3: The Soil.....	21 - 27
☐ Lesson 4: Rocks.....	28 - 34
☐ Lesson 5: Formation of Rocks.....	35 - 42
☐ Lesson 6: Weathering and Erosion.....	43 - 48
☐ Lesson 7: The Rock Cycle.....	49 - 54
☐ Lesson 8: Fossils.....	55 - 58
Review of Sub Strand 1.....	59 - 63
Answers to Practice Exercise.....	64 - 70
SUB STRAND 2: Space Exploration.....	71 - 90
☐ Lesson 9: The Universe.....	73 - 78
☐ Lesson 10: The Solar System.....	79 - 84
☐ Lesson 11: The Planets in the Solar System.....	85 - 90
Review of Sub Strand 2.....	91
Answers to Practice Exercise.....	92
SUB STRAND 3: The Earth, The Sun and The Moon.....	93 - 122
☐ Lesson 12: The Earth's Rotation.....	95 - 98
☐ Lesson 13: Making Night and day Time.....	99 - 101
☐ Lesson 14: The Earth's Moon.....	102 - 106
☐ Lesson 15: Seasons and Tides.....	107 - 111
☐ Lesson 16: The Lunar and Solar Eclipse.....	112 - 116
☐ Lesson 17: Man in Space.....	117 - 122
Review of Sub Strand 3.....	123 - 125
Answers to Practice Exercise.....	126 - 127
Glossary.....	128
References.....	129

SECRETARY'S MESSAGE

Achieving a better future by individual students and their families, communities or the nation as a whole, depends on the kind of curriculum and the way it is delivered.

This course is part and parcel of the new reformed curriculum. The learning outcomes are student-centred with demonstrations and activities that can be assessed.

It maintains the rationale, goals, aims and principles of the national curriculum and identifies the knowledge, skills, attitudes and values that students should achieve.

This is a provision by Flexible, Open and Distance Education as an alternative pathway of formal education.

The course promotes Papua New Guinea values and beliefs which are found in our Constitution and Government Policies. It is developed in line with the National Education Plans and addresses an increase in the number of school leavers as a result of lack of access to secondary and higher educational institutions.

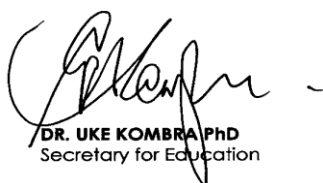
Flexible, Open and Distance Education curriculum is guided by the Department of Education's Mission which is fivefold:

- to facilitate and promote the integral development of every individual
- to develop and encourage an education system that satisfies the requirements of Papua New Guinea and its people
- to establish, preserve and improve standards of education throughout Papua New Guinea
- to make the benefits of such education available as widely as possible to all of the people
- to make the education accessible to the poor and physically, mentally and socially handicapped as well as to those who are educationally disadvantaged.

The college is enhanced through this course to provide alternative and comparable pathways for students and adults to complete their education through a one system, two pathways and same outcomes.

It is our vision that Papua New Guineans' harness all appropriate and affordable technologies to pursue this program.

I commend all the teachers, curriculum writers and instructional designers who have contributed towards the development of this course.



DR. UKE KOMBRA PhD
Secretary for Education

STRAND 4: INTRODUCTION



Dear Student,

Welcome to Strand 4 of your Grade 7 Science Course! I hope that you enjoyed studying the three earlier Strands. I also hope that this Strand, Earth and Beyond, will be an interesting and enjoyable subject to study too.

In this Strand, there are 17 Lessons on three Sub strands. The three Sub strands are:

- **The Earth and Its Origin**
- **Space Exploration**
- **The Earth, The Sun and The Moon**

There are eight Lessons in the first Sub strand. The lessons will discuss about the formation of the Earth. It will also tackle the structure of the Earth, the components of the soil, the different rocks and its cycle. You will also learn from this Sub strand about different rock formation and fossils.

The second Sub strand is composed of three Lessons and will discuss about the universe, galaxy and Milky Way. You will also learn in this Sub strand the solar system and its planets.

The last Sub strand has six Lessons. It will talk about the Earth's rotation and its Moon. You will also learn from this Sub strand the seasons and tides, the lunar and solar eclipse and man in space.

Remember, you have to do all the activities and carry out the Practice Exercises after each lesson. Answers to Practice Exercises are at the end of each Sub strand.

If you have any problems in understanding any of the lessons in this Strand, please don't hesitate to inform the Science Department at FODE Headquarters. This will help the teacher to revise the lessons for the next edition.

You may study this Strand now following the Study Guide on the next page.

All the Best!

STUDY GUIDE

Follow the steps given below and work through the lessons.

- Step 1 Start with Sub strand 1 and work through it in order.
- Step 2 When you complete Lesson 1, do Practice Exercise 1.
- Step 3 After you have completed the Practice Exercise, correct your work. The answers are given at the end of each Sub strand.
- Step 4 Then, revise well and correct your mistakes, if any.
- Step 5 When you have completed all of these steps, tick the check box for Lesson 1, on the Contents page, like this:



Lesson 1: Formation of the Earth

Then, go on to the next Lesson. Repeat this process until you complete all the Lessons on a Sub strand. When this is done, revise using the Review Section.

Remember, as you complete each lessons, tick the box for that lesson on the Contents page. This will help you check your progress.

Assignments: Sub strand Tests and Strand Tests

When you have completed all the lessons in a Sub strand, do the Sub strand Test for that Sub strand, in your Assignment Book. The Course Book tells you when to do this.

When you have completed the entire Sub strand Tests for the Strand, revise well and do the Strand Test. The Assignment Book tells you when to do the Strand test.

When you have completed the entire Assignment Book, check and revise well before sending it to the Provincial Centre.

If you have any questions, write them on the Student's page. Your teachers will advise you when he/she returns your marked Assignment.

The Sub strand Tests and the Strand Test in each Assignment will be marked by your Distance Teacher. The marks you score in each Assignment will count towards the final result. If you score less than 50%, you will repeat that Assignment.

Remember, if you score less than 50% in three Assignments, your enrolment will be cancelled. So, work carefully and ensure that you pass all Assignments.

SUB-STRAND 1

THE EARTH AND ITS ORIGIN

In this sub strand you will learn about:

- **formation of the earth**
- **structure of the earth**
- **the soil**
- **rocks**
- **formation of rocks**
- **weathering and erosion**
- **the rock cycle**
- **fossils**

SUB STRAND 1: THE EARTH AND ITS ORIGIN

Introduction

The history of the Earth describes the most important events and fundamental stages in the development of the planet Earth from its formation 4.6 billion years ago to the present day. The Earth is the only known planet where life can survive. As far as we know, there is no other planet in the universe like Earth. We have a very narrow temperature range that allows water to remain a liquid. Life has developed over millions of years because of that liquid.



There are three types of rocks: sedimentary (formed by sedimentation), igneous (formed out of the magma) and metamorphic (formed from other rocks).

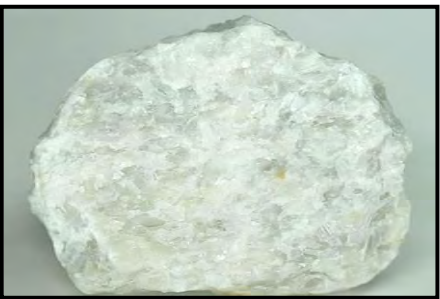


Sedimentary rocks are formed through the gradual accumulation of sediment: for example, sand on a beach or mud on a river bed. As the sediment is buried it is compacted as more and more material is deposited on top. Eventually the sediment will become so dense that it is essentially rock.

Igneous rocks are formed when volcanoes erupt, causing the magma to rise above the earth's surface. When magma appears above the earth, it is called lava. Igneous rocks are formed as the lava cools above ground. They are also formed when the melted rock, (called magma), becomes trapped deep within the earth in small pockets. As these pockets of



magma cool, they become igneous rocks.



Metamorphic rocks are rocks that have changed from igneous or sedimentary into another kind of rock. When rocks are subjected to great heat and pressure inside the Earth, they change into rocks that are very different from their original makeup. This change happens at the same time as the original rocks are in a solid state. The original rock does not melt. The new rocks that develop are called

metamorphic rock.

You know about the structure of the earth, but you may be asking,

- What are the beliefs about the formation of the earth?
- How does weathering and erosion affect the earth?
- Why is soil important?

In this Sub strand you will find the answers to these questions and all other questions relating to Earth and its Origin.

Lesson 1: Formation of the Earth



Welcome to Lesson 1, Formation of the Earth. Throughout the ages people have tried to explain why the Earth is the way it is. In this Sub strand, The Earth and its Origin, you will look at the early explanations of the world and what we understand today. You will then explore the Earth in more detail.



Your Aims:

- discuss and interpret traditional beliefs about the formation of the Earth

There are so many beliefs or legends found throughout the world on how the earth was formed. In this lesson are some stories found around the world. You may have heard or read other stories but you must learn to respect what others believe.

Ideas Left Behind

In early times, the Earth was thought to be flat. People thought that if a person went to the edge of it, that person would fall off and never be seen again. In ancient Greece, Aristotle (384-322 BC) first suggested that the Earth was a sphere. He noticed that the position of the stars shifted as he traveled from North to South, and that during a lunar eclipse the Earth cast a curved shadow on the Moon.

A fellow Greek, Eratosthenes (276-194 BC), showed by an experiment that the Earth cannot be flat. He argued that if the Earth was flat and the Sun a long way off, identical vertical sticks would cast shadows of the same length anywhere in the world. He measured such shadows at midday on the same day of the year in two Egyptian cities 800 km apart. They had different lengths, so the Earth could not be flat.

The formation of the Earth

A lot of people ask questions about how Earth came into existence. Different societies including Papua New Guinea have their own traditional beliefs about how the Earth or their own society came to be. Now let us look at some of these traditional beliefs in Papua New Guinea and in other places.

This is an aboriginal story from Australia.

Yhi the Sun god waited for Baiame the Great Spirit to tell her to go down to Earth. Yhi floated down and as she did her light spread into all the places hidden by darkness. Flowers, trees and shrubs sprang to life; insects opened their wings and flew about in her light. Ice melted and lakes overflowed, giving water to thirsty plants; fishes played in the water and reptiles and snakes found homes on dry land.

All animals- those of fur and feathers- came out of their caves and danced in the light. Yhi told the animals that she would send them summer which would ripen fruit and winter for sleeping through cold winds. Then she rose and left the Earth and sank below the western hills. All the creatures were very sad

Hours later there was a twittering of birds announcing that Yhi had returned to flood the Earth with light once more. Yhi realised that the creatures were afraid in the darkness, so she sent the morning star to tell the world she was coming and during the night she gave them Bahloo, the Moon. The creatures on Earth were happy when the moon sailed through the night sky, giving birth to stars and making a wondrous glory in the heavens.

Our next story comes from the Southern part of China

Before the Earth was made, there was nothing but only Chaos. Chaos was shaped like an egg. In the middle of this egg, Pan Ku was created. He lived there quietly for a very long time. Very slowly, Heaven and Earth were formed out of Chaos. Pan Ku now began to grow quickly. His body became the surface of the Earth forming the plains, valleys and the mountains.

His left eye became the Sun, and his right eye became the moon. His flowing blood became the rivers, lakes and oceans and his long curly hair became the grass, trees and all other green things that we see on Earth. His breath gave birth to the winds and his voice became the thunder. He was the father and the ancestor of all people and all the other living things on Earth.

Christians Belief

Now, let us read the story that comes from the ancient **Jewish** people. This is now the Christians' belief on how the Earth began. It is from the first chapter of the Bible, —Genesis”.

In the beginning, God created the Heaven and the Earth. The Earth was without form and empty and was in total darkness. On the first day, God said, —~~Let~~ there be light”, and there was light.

On the second day, God said, —~~Let~~ there be Heaven —and heaven appeared and on the third day, God said, —~~Let~~ the water under the heaven gather together in one place and let the dry land appear”. In this way, the seas and the land were made.

God saw it was beautiful. Then He said, —~~Let~~ the Earth bring forth all green things, and let every plant and tree bear fruit” and it happened as God spoke.

On the fourth day, God said, —~~Let~~ there be lights in Heaven, so that Day shall be divided from Night. These lights shall show the changing of the seasons, and the passing of the years”, and He made the Sun, the Moon and the stars.

On the fifth day, he said, —~~Let~~ the seas bring forth all fish and water creatures, and let the birds fly in the sky; and may they flourish and multiply”.

On the sixth day, God said, —~~Let~~ the Earth bring forth every kind of living creature and may they cover the Earth with their kind”. In no time, living creatures of all kinds filled the Earth.

Then he said, —~~Let~~ us make Man of our own image, and let them rule over all other creatures that have been created”. So God created Mankind, both male and female, and blessed them.

The multitude of beautiful creatures he had created pleased Him. On the seventh day, after his words of creation, God rested

Scientific Belief

Scientists believe that some 4 600 million years ago, the Sun, our Earth and other planets were formed from a cloud of very hot dust and gas particles. They do not know where this cloud of hot dust and gas came from.

Over millions of years, most of these cooled down, forming the Sun. Gradually, and the remaining cooled down, forming the Earth and the other planets.

The planet Earth is made of rocks. The earliest rocks were formed some 4, 500 million years ago. This means that the Earth is by now more than 4, 500 million years old.

The Earth's surface was not level by that time. As further cooling took place, water formed in the atmosphere and later filled the lower parts of the Earth, forming the seas and ocean. The higher parts become land.

About 200 million years ago, all land was joined together and formed one large land mass. Slowly, as millions of years went by, this large land mass split into many parts and formed the different continents we know today.

Scientists also believe that life first appeared on Earth only 4, 500 million years ago. The first lives were of simple water plants in the seas. About 500 million years ago, many types of jellyfish, sponges and worms started living in the seas. Other forms of fish started living only 100 million years later (400 million years ago).

From evidence found, scientists believed that life on land started only 350 million years ago. It is believed, man has lived on Earth for the last 200 million years only. It is also believed, true man came from the continent of Africa. After all this time in history, man is very new on Earth.



Activity: **Now test yourself by doing this activity.**

Now, answer the questions below.

1. Describe what the Sun god brought to the Earth.

2. Describe what Yhi promises she will bring.

3. Where do the Orokolo people believe their land came from?



Summary

You have come to the end of lesson 1. In this lesson you have learnt that:

- in early times, people thought that the Earth was flat.
- aristotle (384-322 BC) first suggested that the Earth was a sphere.
- the aboriginal story from Australia believed that Yhi, the Sun god brought light, moon and summer to Earth.
- from Southern China, the people believed that before the Earth was made, there was nothing but only chaos.
- in a Christian belief which was taken from the Bible, 'Genesis', god created heaven and Earth and every living and non-living things on it. And He made it only in seven days.
- orokolo people in Gulf province believed that the Earth came from the bottom of the sea.
- from the Scientists, they believed that some 4 600 million years ago, the Sun, out Earth and other planets were formed from a cloud of very hot dust and gas particles.
- Scientists also believed, true man came from the continent of Africa.

NOW DO PRACTICE EXERCISE 1 ON THE NEXT PAGE.



Practice Exercise 1

Answer the following questions:

1. Where do the Southern China people believe the earth came from?

 2. According to Jews, what was the first thing God created?

 3. On what day did God created man?

 4. According to Science, how did Earth come to be?

 5. What is the planet Earth made of?

 6. According to Science, how old is the Earth by now?

 7. What form of life appeared first on Earth?

 8. According to Science, where did the seas and the oceans come from?

-

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 1.

Answers to Activity

1. Sun god brought light and spread it into all the places hidden by darkness. All the trees, flowers and shrubs sprang because of her light. The insects opened their wings; ice melted that made the lakes overflowed, and fishes played in the water while reptiles and snakes found homes on dry land. Even animals with fur and feathers came out of the caves and danced in the light. She also brought Moon to the Earth which sailed through the night and gave birth to stars.
2. Yhi told the animals that she would send them summer which would ripen fruit and winter for sleeping through cold winds.

The Orokolo people believed that their land came from the bottom of the sea

Lesson 2: Structure of the Earth



Welcome to Lesson 2 of Strand 4. In the last lesson was it very interesting to know how the earth was formed. In this lesson you will learn about, what the earth looks like, whether it is flat or round? So in this lesson you will be able to find out the shape of this earth.



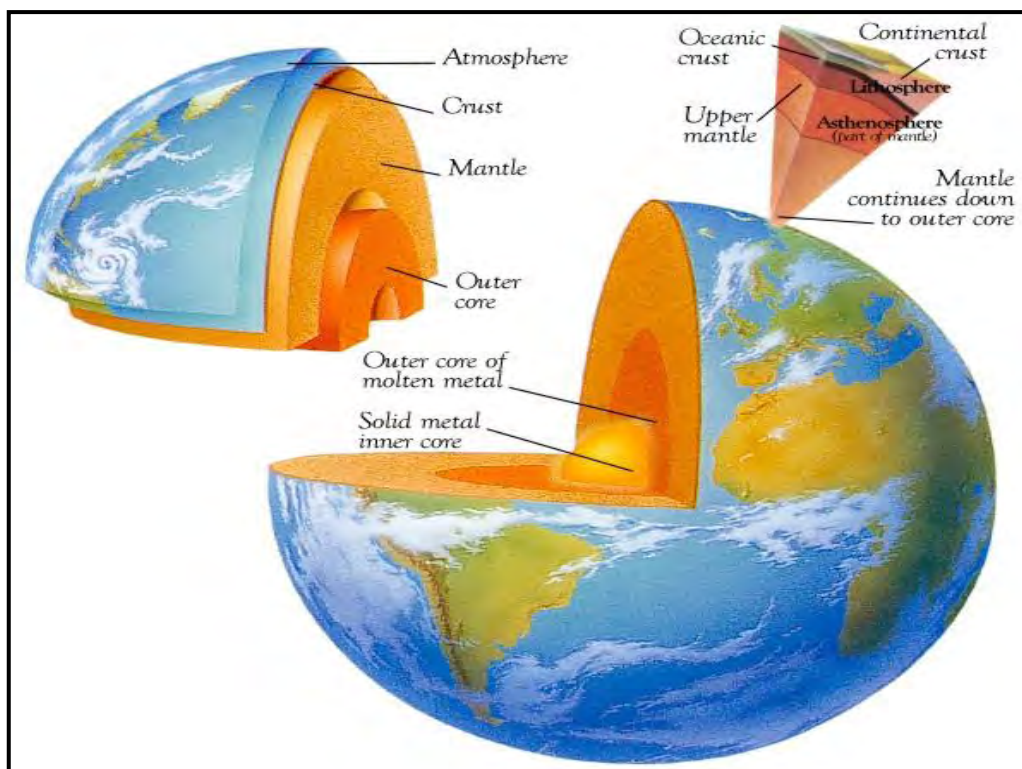
Your Aims:

- identify the structure of the Earth correctly
- describe the compositions of the different parts of the Earth

The Structure of the Earth

The age of the Earth has been estimated at about 5000 million years. It is about 12760 kilometers in diameter. There are many traditional stories about what the Earth is like but Scientists think that the Earth formed from a large cloud of very hot dust and gas. As gases and dust cooled, the Earth formed. After millions of years, as further cooling took place, water formed in the atmosphere and fell to the Earth as rain that formed lakes, rivers and seas. Gradually it contracted and condensed to form a ball-shaped with a solid surface. Very little is known about the inside of the Earth except, that it is surrounded by a thick, steamy atmosphere, very hot and parts are molten. This molten rock, called **magma**, is rock which has melted and can flow. It is usually thick and sticky, like a mashed ripe banana. Volcanoes are places where small amounts of molten rock flow onto the Earth's surface.

The Earth is made up of three main parts, namely the crust, the mantle and the core. You will learn all of these in our succeeding discussion.



Structure of the Earth

The crust

The Earth is divided into three main parts: the crust, the mantle and the core.

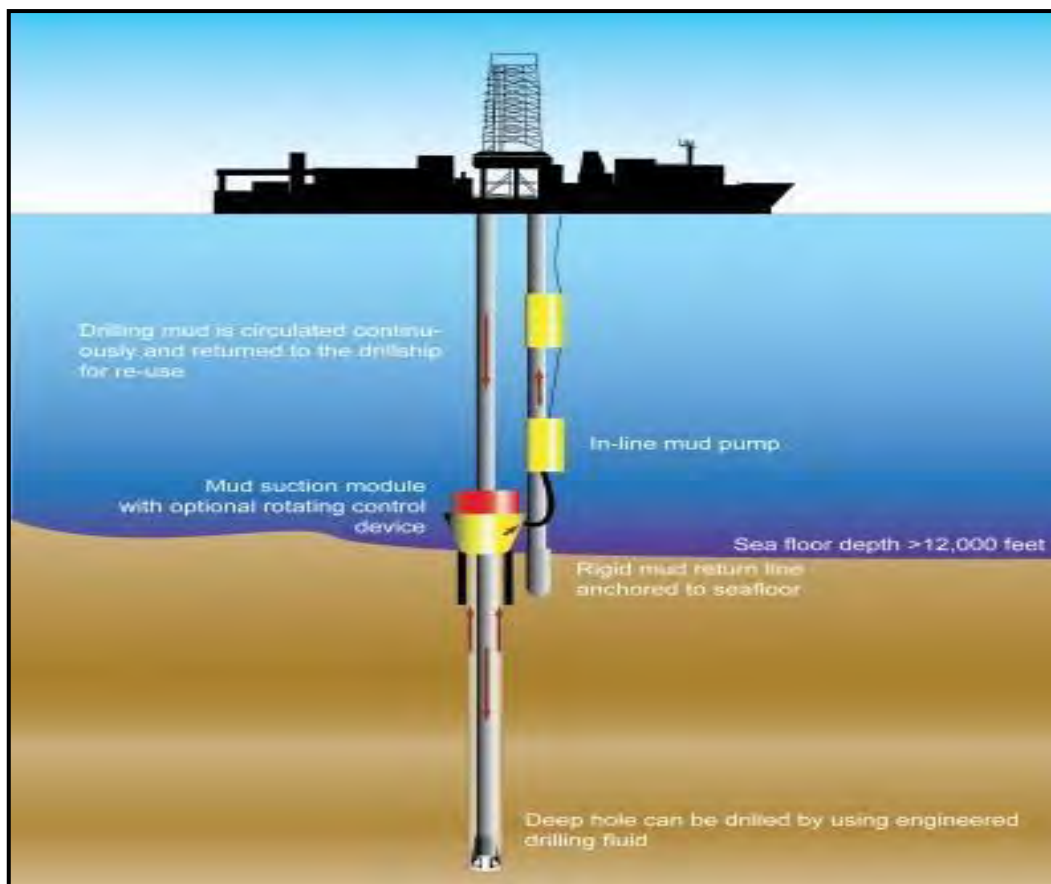
The crust is a relatively thin layer of rock that surrounds the Earth. In some places it is above the sea and forms the continents and islands of the Earth.

The crust is thickest under the continents. It may reach a thickness of more than 100 kilometres. The crust is thinnest under the ocean where it may be less than 10 kilometres thick.

Tests on the ages of the rocks in the crust have shown that the rocks of the continents are much older than the rocks under the oceans. Further tests have shown that rocks which make up the continents are different from the ocean rocks.

Oceanic rocks are darker in colour and heavier in weight. **Continental rocks** are lighter in colour and lighter in weight.

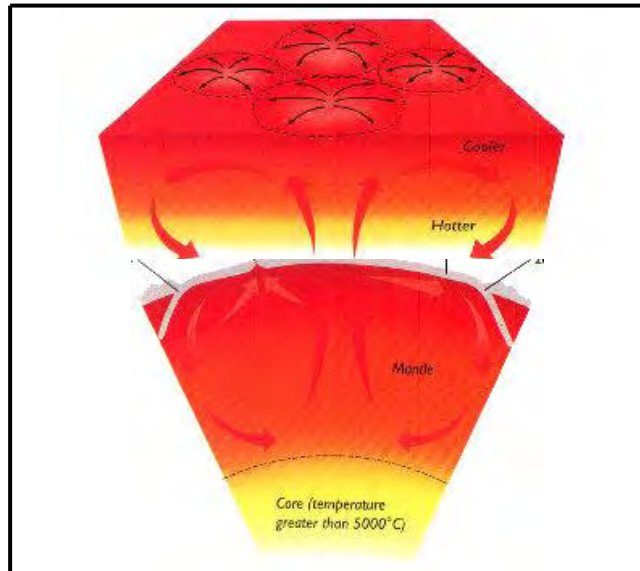
Beneath the crust is a very thick layer known as the **mantle**. Because the rocks of the crust are lighter than the mantle rocks, the crustal rocks float on the mantle. Like other floating objects, they are able to move, but the movement is very slow.



Drilling into the Earth's crust beneath the

The mantle

The mantle is a very thick layer of the Earth. It makes up about 80 percent of the Earth's volume and is approximately 2800 kilometres thick. It consists of heavy rocks which are thought to be very hot and in a semi-molten state. These rocks are like plasticine, tar or stirred sago, and come to the surface when volcanoes erupt. When they come to the surface they are called **lava**.



Convection currents in the Earth's mantle.
Movements of the crust are very slow.

The core

The core forms about 15 percent of the Earth's volume and consists of a large ball-like shape in the middle of the Earth. It has a diameter of approximately 7000 kilometres. The core consists of two parts: the inner core, which scientists think is solid and the outer core, which they think is a thick liquid.



This meteorite is thought to have the same nickel-iron composition as the core of the Earth.

Geologists use the occurrence of earthquakes to find out about the interior of the earth. When an earthquake occurs, shock waves travel around and through the Earth. Recording stations pick up the shock waves and a 'picture' of the structure of the earth can be developed.

**Activity 1: Now test yourself by doing this activity.**

Do this activity on your own.

1. Why do the continents float on the mantle?

**Summary**

You have come to the end of lesson 2. In this lesson you have learnt that:

- the age of the earth has been estimated at about 5000 million years.
- the Earth is divided into three main parts: the crust, the mantle and the core
- the crust is made from relatively thin layer of rock that surrounds the Earth. It is thickest under the continents and thinnest under the ocean.
- the rocks of the continents are different from the ocean rocks.
- the mantle is a very thick layer of the Earth. It consists of heavy rocks which are thought to be very hot and in a semi-molten state.
- the core forms about 15 percent of the Earth's volume and consists of a large ball-like shape in the middle of the Earth.
- the core consists of two parts: the inner core, which scientists think is solid and the outer core, which they think is a thick liquid.
- information on the interior of the Earth is gathered from studies of earthquakes
- the interior of the Earth is mostly molten.

NOW DO PRACTICE EXERCISE 2 ON THE NEXT PAGE.



Practice Exercise 2

Answer the following questions:

1. Draw and label the structure of the Earth.

Draw here!

2. Describe the three main parts of the Earth.

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 1.

Answer to Activity

The rocks of the crust are lighter than the mantle rocks, that is why the crustal rocks float on the mantle. Like other floating objects, they are able to move, but the movement is very slow.

Lesson 3: The Soil



Welcome to Lesson 3 of Strand 4. In the last lesson we talked about the structure of the Earth and its composition. You have identified its structure and described its different parts. You have also learned that the soil is one of the compositions of the Earth. In this lesson you will learn more about the soil.



Your Aims:

- identify the components of soil
- identify the types of soil and its distinct layers

What is Soil?

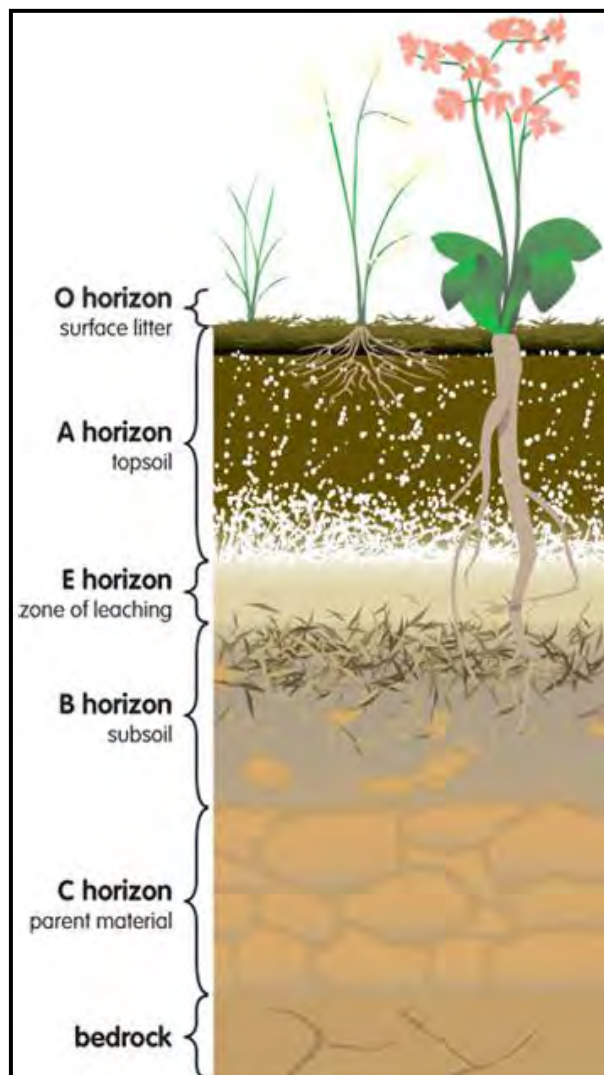
Soil is the top surface of the Earth's crust that plants grow on and animals live on.

How is soil formed?

Thousands of millions of years ago, the land was covered with bare rock. Gradually the surface of the rock was broken up by rain, wind, snow and frost into small particles. These particles were gradually piled up on top of the rock to form soil.

If you look at a new road cutting, you will see that the soil is made up of layers. At the top is the dark layer where plants and other organisms live. We call this the **top soil**. It is formed by surface weathering and the activities of the many organisms which live in it, and it contains the decaying remains of dead organisms.

Beneath the top soil is lighter-coloured layer of gravel, stones, clay and so on. This is called the **subsoil**. It contains the deeper roots of large plants, like trees, but otherwise not much lives there. Further down still is solid **rock**. This is non-porous and won't let rain through, so water tend to gather around above it. The surface of this water is called the **water table**. Their relative thickness and the position of the water table, vary a great deal from place to place.



Different layers of newly cut soil

REMEMBER

Soil is produced by the weathering of rocks.

What makes up soil?

Soil contains six main components. These are rock particles, soil water, humus, mineral salts, lime and air. We shall now look at each in detail.

1. Rock particles

These vary in size. Depending on their size, they are classified into clay, silt, sand and gravel. Clay particles are so small and can only be seen properly under a microscope. On the other hand, we have gravels which are made up of small stones.

Rock particles make up the framework of the soil. Both clay and sand are important in this respect. Clay holds on to water better than sand, thus making it sticky and helping to bind the rest of the soil together. On the other hand, sand is looser and more easily penetrated by air and water.

Good soil is a mixture of sand and clay. This is called **loam**. Loam contains roughly twice as much sand as clay. If you look at the garden soil you will notice that the particles stuck together. These are called **soil crumbs**; they make the soil rougher, helping air to get into it and water to drain through.



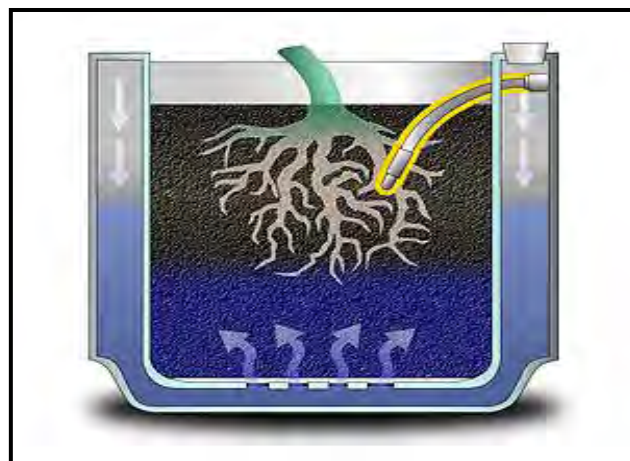
Gravel and sand particles



Loam soil

2. Soil water

Soil particles are normally surrounded by thin film of water. It is from these films that plant roots take up all the water they need. Unless the soil is too dry, these films are always present. The process which causes this is **capillary action**. It is the same process that causes water or ink to spread through a piece of paper or to rise in a narrow capillary tube.



The water in the soil is constantly on the move

3. Humus

When animals and plants die in the soil, their dead bodies gradually decay into sticky jam-like liquid called **humus**. The layer of the soil where most humus is found is the top soil. It is black, so soil that contains a lot of it tends to be a dark colour. For a gardener one of the best sources of humus is compost.

Humus makes the soil rich in nutrients which are needed for plant growth. It forms a coating round the soil particles, helping them to clump together into soil crumbs. It stores water and prevents valuable nutrients being washed out of soil when it rains.



Humus

4. Mineral salts

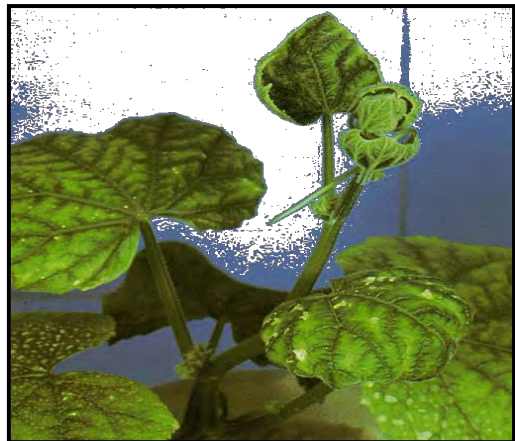
Dissolved in the soil are various mineral salts. These provide plants with important elements such as nitrogen, phosphorous and potassium, and all essential for growth.

Some minerals come from rock which formed the soil and give the soil a particular colour. Other minerals such as nitrogen salts are formed when humus breaks down. This is why humus is so good for plants.

5. Lime

Lime comes from limestone, a type of rock which contains chalk. Chalk is calcium carbonate. All good soil contains a certain amount of this important chemical substance. Lime is important for three reasons:

- A. Calcium is one of the elements which all plants need for proper growth and development.
- B. Lime helps soil particles to clump together into soil crumbs.
- C. Calcium carbonate is alkaline and prevents the soil being too acidic.



Calcium deficient

6. Soil air

In good soil there are plenty of spaces between the soil particles and crumbs. These spaces are filled with air. The oxygen in this air is needed for respiration by plant roots and the other organisms which live in the soil. Oxygen is also needed for materials to decay into humus.

What are the different types of soil?

You often hear people say that the soil in their garden is dreadful. There are many different types of soil, some are good, and some are bad. Here are the main types:

1. Sandy soil

This kind of soil contains mainly-sand. Sandy soil is loose, light and easy to dig. It contains plenty of air and it drains well. It readily loses heat and dries up quickly in hot weather. Useful chemicals are washed out of it when it rains so it is not very fertile.

2. Clay soil

This kind of soil contains a lot of clay. It holds on to water and nutrients very well, so it tends to be rich in plant food. However, it is extremely heavy and difficult to dig, being sticky when wet and hard when dry.



Clay soil



Sandy soil

3. Chalky soil

This kind of soil contains a lot of lime. It is therefore very alkaline. It is usually rather clayey and therefore difficult to cultivate.

4. Peaty soil

This kind of soil contains a lot of peat. Although peat is useful, too much of it can make the soil acidic. If you have this sort of soil in your garden you should add plenty of lime to it.

5. Ideal soil

The best soil is balanced mixture of sand, clay, humus and lime. Garden soil should contain roughly 50 percent sand, 30 percent clay, 12 percent humus and 8 percent lime. This kind of soil has a pH around neutral and a fairly loose texture. Soil crumbs form readily and the particles are of size which keep the soil well aerated and allow into drain easily. Most plants grow well in this sort of soil.



Chalky soil



Peaty soil



Ideal soil



Activity: **Now test yourself by doing this activity.**

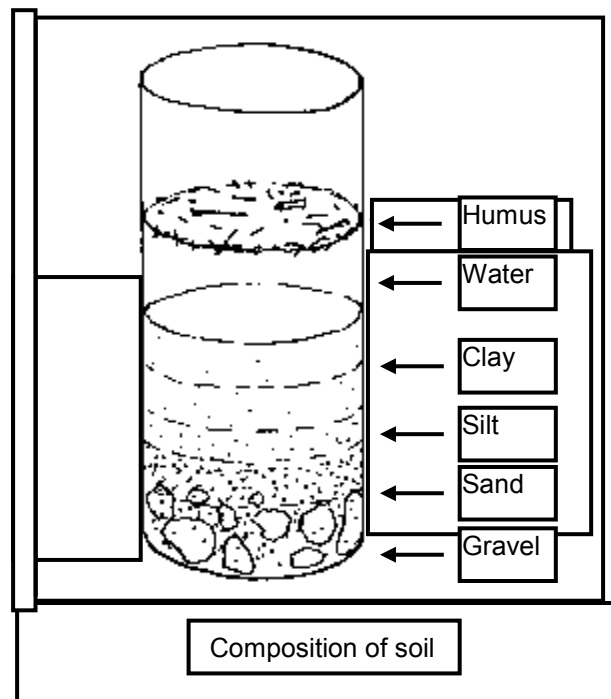
Title: Separating the components of soil

Materials: soil, water, test tube and test tube rack

Procedure:

1. Quarter fill the test tube with soil.
2. Add water until the tube is three-quarter. Notice that the air bubbles are given off.
3. Put your hand over the open end of the tube and shake well.
4. Place the tube in a rack and let the soil settle. The heaviest components of the soil will sink to the bottom and the lighter ones will float at various levels.

Question: Does the appearance of your test tube agree with the illustration?



5. Repeat this experiment with different kinds of soil and compare the amounts of the different components in each.



Summary

You have come to the end of lesson 3. In this lesson you have learnt that:

- soil is the surface of the Earth's crust where plants and animals make their homes.
- soil is made up of layers. At the top is the top soil. The subsoil is beneath the top soil.
- soil contains six main components. These are rock particles, soil water, humus, mineral salts, lime and air.
- rock particles vary in size from clay, silt, sand and gravel.
- soil particles are surrounded by thin film of water to plant roots which take up all the water they need.
- humus makes the soil rich in nutrients that are needed for plant growth.
- mineral salts provide plants with important elements for growth.
- lime contains calcium carbonate. It is important for plants growth
- good soil has soil air. There are plenty of spaces and these spaces are filled with air.
- there are different types of soil. These are sandy, clay, chalky, peaty and the ideal soil.

NOW DO PRACTICE EXERCISE 3 ON THE NEXT PAGE.



Practice Exercise 3

Answer the following questions:

1. Define soil.

2. What are the main components of soil?

3. List the different types of soils and describe them.

- ---

- ---

- ---

- ---

- ---

4. What are the six components of soil? Describe each.

- ---

- ---

- ---

- ---

- ---

- ---

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 1.

Lesson 4: Rocks



Welcome to Lesson 4 of Strand 4. In the last lesson you learnt about the different types of soil. In this lesson you will learn that soil is also made up of rocks. So, for this lesson, you will learn something about rocks.



Your Aims:

- define igneous, sedimentary and metamorphic rocks
- identify the structure of igneous, sedimentary and metamorphic rocks

Rocks and Minerals

Rock is a hard, solid part of the earth. In many areas rocks are covered by layers of soil in which plants may grow. Soil itself is made up of tiny pieces of rock usually mixed with organic matter from decaying plants and animals.

All rocks are made of **minerals**. These are the building blocks of rocks. Some rocks contain only one mineral. For example, limestone contains only calcite (calcium carbonate).

Most rocks however, are a mixture of several different minerals. For example, granite is a mixture of three minerals.



Some minerals may contain metal compounds called **ores**, which can be mined. Under certain conditions, minerals occur as large crystals. These crystals have definite shapes that can be used to identify the minerals. For example, quartz always form six-sided transparent crystals. Some minerals such as diamonds, rubies, sapphires and emeralds can be cut and polished to gemstone.



Granite



Diamond

Sorting rocks into groups

It is very difficult to sort rocks because there are many different kinds. Sometimes it is hard to tell one rock from another. That is why Geologists classify rocks into three groups. These are

- Igneous rock which is formed when molten rock material cools. Molten rock material beneath the earth's surface is called **magma**.
- Sedimentary rock which is formed by the hardening of layers of sediments. The sediments may consist of rock fragments, plant and animal skeletons or other chemicals that form on the bottom of lakes or oceans.
- Metamorphic rock which forms when existing rocks are changed heat and pressure.

Igneous rocks

Rock formed from molten material is called igneous rock. The word igneous means 'coming from fire'. When lava pours out of a volcano, it begins to cool in the air. The lava hardens and forms a type of igneous rock called extrusive rock.

Igneous rocks are also formed from magma that never reaches the surface. This is called intrusive rock because they intrude into other rock layers (intrude means 'forced in'). Examples of intrusive rocks are granite and gabbro.



Gabbro



Pumice

Hard igneous rocks like granite and basalt are used for bridges and buildings. Basalt stones are spread over tar to make the surface for bitumen roads. Basalt is also laid along railway tracks to hold the sleepers in place. Granite is used to make facings on buildings, surfaces, monuments and gravestones. Granites range in colour from light greys to medium greys and pinks.

SOME IGNEOUS ROCKS

Rock Name	Colour	Description	Intrusive or Extrusive
Basalt	Dark grey to black	Tiny crystals, dense	Extrusive
Gabbro	Green/gray to black	Large crystals	Intrusive
Granite	White /grey/pink	Medium crystals	Intrusive
Obsidian	Black /brown streaks	Glassy, no crystals	Extrusive
Pumice	Grey to white	Light, frothy, floats	Extrusive

Sedimentary rocks

Have you ever noticed that concrete paths slowly worn away in time? The action of wind and rain on concrete and rock gradually breaks their surface up into tiny pieces called **fragments**. Rock fragments can be moved from place to place by wind and water. The fragments settle in a new place and begin to pile up. The settled fragments are called **sediments**. Layers of sediment pack down and harden to form **sedimentary rock**. Because sediments take a long time to build up into layers, sedimentary rock takes thousands of years to form.



Sedimentary rock

Examples of sedimentary rocks

The common sedimentary rock is **shale**. Shale is formed from fine clay and mud particles. When grains of sand are cemented together, they form **sand stone**.

Gravel and large round particles are cemented together to form **mudstone**.

Not all sedimentary rocks are made from rock pieces. When water containing dissolved minerals evaporate, sediments may be left.



Limestone



Shale

Some sediments form from the remains of living things. **Limestone** is a sedimentary rock made from shells and skeletal remains of Dead Sea creatures. **Coal** is a sedimentary rock formed from decayed plant materials.

Sedimentary rocks like limestone and sandstone are often used as building materials. It is also used to make paints, glass, paper and toothpaste. Coal is a useful heating fuel. Some power stations use coal as a fuel.

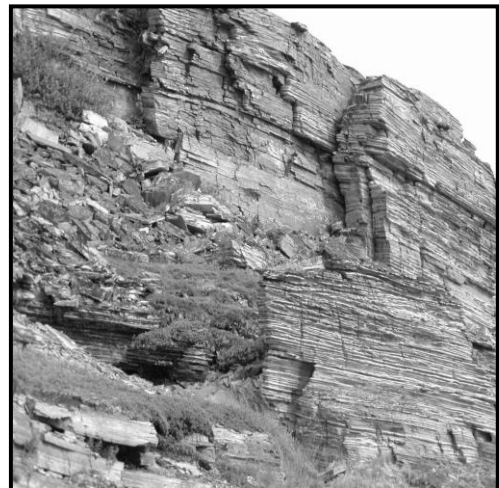
Metamorphic rocks

Heat and pressure can also change rocks. This changed rock is called metamorphic rock. Metamorphic means 'changed in form'.

Both igneous and sedimentary rocks can be changed by pressure or heat to become metamorphic rocks.

Some examples of metamorphic rocks are:

1. Quartzite is a metamorphic rock made from sandstone. Sand grains in quartzite are fused by heat and are more firmly compact than in sandstone. Therefore quartzite is harder than sandstone.
2. Slate is made from clay or shale. The layers are more compacted than in shale.
3. Marble is made from limestone. The colour of the marble depends on the minerals mixed in with the limestone.
4. Gneiss forms from granite. It looks banded and streaky because it has alternating layers of different minerals. It is coarser-grained than granite.



Slate

Slate is used for roofing and paving tiles. It is also used to make billiard table tops. Slate is generally harder than shale. Both slate and shale show layers. Marble is a popular building material. It is used to make monuments, gravestones, floors and wall panels.

**Activity: Now test yourself by doing this activity.**

A. Multiple Choice. Write the letter of the correct answer.

1. A rock that cools rapidly will probably have crystals that are

- A. Small
- B. Large
- C. Broken by the cold
- D. The same size as slow cooling rock

2. Any material that settles out of water is called

- | | |
|-------------|-------------|
| A. Sand | B. Gravel |
| C. Concrete | D. Sediment |

3. Which of the following are the three main types of rocks?

- A. magma, lave, sediments
- B. intrusive, extrusive, concrete
- C. igneous, metamorphic, intrusive
- D. sedimentary, igneous, metamorphic

4. Gravels and large round particles become cemented together to make

- | | |
|--------------|-----------------|
| A. Shale | B. Gypsum |
| C. Limestone | D. Conglomerate |

5. The two things in nature that produce metamorphic rock are

- A. Heat and water
- B. Heat and pressure
- C. Running water and air
- D. Erosion and sedimentation

6. When a river enters a lake, the rock fragments which are carried the furthest into the lake will generally be the
- | | |
|-------------|--------------|
| A. Sharpest | B. Largest |
| C. Smallest | D. Smoothest |
-

B. Complete the sentences using the words given below

sedimentary, shale, layers, limestone, cemented, under water

- Layers of sediments become pressed and _____ together to form _____ rock.
- Sedimentary rocks usually have _____ in them.
- The sedimentary rock made from mud and clay is called _____.
- The sedimentary rock made from the shells of sea creatures is called _____.
- Most sedimentary rocks were formed _____.



Summary

You have come to the end of lesson 4. In this lesson you have learnt that:

- rock is the hard, solid part of the earth made of minerals.
- some minerals may contain metal compounds called ores, which can be mined and the metals extracted.
- geologists classify rocks into three large groups. These are: Igneous, Sedimentary and Metamorphic rocks
- extrusive rock is a type of igneous rock which contains gases.
- metamorphic rocks form when existing rocks are changed by the action of great heat and pressure.
- igneous rocks are also formed from magma that never reaches the surface. This is called intrusive rock because they intrude into other rock layers
- sedimentary rocks are formed from layers of sediment that pack down and harden through thousands of years.
- the most common sedimentary rock is the shale.
- gypsum and rock salt are sedimentary rocks formed when water,
- heat and pressure can change rocks.

NOW DO PRACTICE EXERCISE 4 ON THE NEXT PAGE.



Practice Exercise 4

Answer the following questions:

1. What is a rock?

2. What are the three types of rock? Describe each of them.

3. What are the uses of igneous rock?

4. Examples of sedimentary rocks are coal, limestone and gypsum. Differentiate each one.

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 1.

Answers to Activity

Part A

1. A
2. D
3. D
4. D
5. B
6. B

Part B

- a. cemented/sedimentary
- b. layers
- c. shale
- d. limestone
- e. underwater

Lesson 5: Formation of Rocks



Welcome to Lesson 5 of Strand 4. In the last lesson you learnt about rocks and have identified different types of rocks and their structure. In this lesson you will learn about how rocks are formed?



Your Aims:

- describe the formation of igneous, sedimentary and metamorphic rocks
- list ways to identify the rocks

Igneous Rocks

Rocks that formed from the molten rock of the mantle are called **igneous rocks**. The word igneous means from fire. Examples of igneous rocks are granite and basalt. Igneous rocks are made of interlocking crystals. These form from the substances in the magma, and have definite shapes and straight sharp edges-like sugar crystals. The crystals in granite are quite large but the crystals in basalt are much smaller. Magma comes from different places inside the Earth and contains different minerals. As a result, igneous rocks with different properties are formed. The igneous rocks which form by the cooling of molten rock are classified by the size of the crystals of the minerals they contain and by the mineral composition. This indicates how and where the rocks were formed.



Basalt



Granite

When magma cools quickly it forms crystals which are very small. If the cooling is very fast then the rock called obsidian is formed. Obsidian looks like a black glass. The rock called basalt is formed when lava cools quickly on the surface of the Earth. A special igneous rock called pumice is formed when gases dissolved in the molten rock under great pressure are released when the lava erupts at the surface. Igneous rock which forms beneath the surface is called **intrusive** rocks while rocks that form above the surface are called **extrusive** rocks.

Igneous rock composition

Igneous rocks vary in colour from almost white to black. The colour indicates the minerals the rock may contain. Light coloured rocks such as granite and pumice contain a large amount of quartz. Some igneous rocks are dark coloured. These contain dark minerals which are usually heavy.

Igneous rocks are classified using both their crystal size and mineral composition. Igneous rocks with small crystals have cooled quickly and are said to be fine-grained. The table below can be used to classify igneous rocks.

CLASSIFICATION OF IGNEOUS ROCK

Crystal size	Light-coloured	————→ Dark -	coloured
Small crystals Fine grain	Rhyolite	Andesite	Basalt
Large crystals Coarse grain	Granite	Diorite	Gabbro

The volcanic rocks pumice and obsidian are usually similar in composition to rhyolite and andesite, but the crystals are too small to be seen.



Pumice



Obsidian

Sedimentary rocks

Large amounts of broken-down rock may be eroded and collected in areas where they can be cemented together again to form new rocks. These rocks are called **sedimentary rocks**. Some sedimentary rocks are formed by chemical action. Chemicals which are dissolved in water separate out and may build up thick layers of rock. Limestones and cave deposits are formed by minerals deposited from water.

Plants and animals are able to help in the formation of sedimentary rocks. Peat and coal are formed from plants. Coral and some limestones are formed from animals.



Limestone

Composition of sedimentary rocks

A sedimentary rock has three major parts; namely, grains, matrix and cement.

When a sedimentary rock is forming very small-grained material about the size of sugar crystals may fill the spaces between the larger particles. The large particles are called the grains and the small-grained materials are called matrix. A cementing material then holds the rocks together.

Some rocks consist of grains with cement only. These usually have a lot of space in them and water will soak in easily. Sandstone is an example of this kind of rock.



Sandstone

Sedimentary rocks may be given names based on the size of the grains. Very small-grained rocks are called **mudstones**. The grains that are slightly larger are called **siltstones**. Grains which have resulted from long term transport and more rounded and smooth. Those transported in a short distance are angular.

Examples of common sedimentary rocks are described below.

COMMON SEDIMENTARY ROCK

Rock	Description
Limestone	Usually formed in the sea. May have fossils.
Sandstone	Usually formed on the land or near the coast. Contains a lot of quartz.
Conglomerate	Has rounded pebbles in small-grained material. Usually formed in rivers.
Breccia	Has an angular particle in small-grained material.
Fossil limestone	Usually have many marine animals' remains such as coral and shells.
Shale	Very small-grained rock. A microscope is needed to see the grains.
Siltstone	Small-grained material. Feels slightly rough on the fingers.

Metamorphic rocks

When a caterpillar changes into a butterfly, this process is known as a **metamorphosis**. In the same way, metamorphic rocks are rocks that have been changed by heat, pressure and /or stress, as when mountains are formed.

When igneous and sedimentary rocks are buried by overlying rocks, the heat and pressure they are subjected to may cause them to change significantly. Many of the original grains or crystals gradually recrystallise into new shapes and the appearance of the rock may change completely. The beautiful white marble used for many statues is recrystallised limestone.



Mudstone



Sapphire

Most metamorphic rocks are formed during mountain building, when the Earth's crust is pushed up and down by movements in the upper mantle. Enormous pressure causes the rocks to fold and tremendous heat is generated. Chemical changes produce new minerals, and the metamorphic rocks formed are harder than the original rocks.

Another way metamorphic rocks form is when magma is forced up into the Earth's crust. The rocks in contact with this magma become very hot and are slowly changed to metamorphic rocks.

Composition of metamorphic rocks

Quartzite is a metamorphic rock made from sandstone. Sand grains in quartzite are fused by heat together more firmly than they are in sandstone. It is harder than sandstone.



Quartzite

Slate is a metamorphic rock made from clay or shale. Slate can be black, brown, green, red or blue in colour. The layers in slate are more compacted than in shale. Slate easily splits into smooth slabs.

Marble is another metamorphic rock that can vary in colour. Marble is made from limestone. The colour marble depends on the minerals mixed in with the limestone.

Gneiss is a metamorphic rock that forms from granite. Gneiss looks banded and streaky because it has alternating layers of different minerals. It is coarser-grained than granite.



Marble



Gneiss



Activity: **Now test yourself by doing this activity.**

A. Complete each sentence using the words given below.

Intrusive	lava	magma	extrusive
Minerals	molten	colour	crystal size
Round ball	mudstones	angular	siltstones

1. Igneous rocks are formed by the cooling of _____ rock.
2. Molten rocks are called _____ when they are below the surface of the Earth.
3. Molten rocks are called _____ when they are below on the surface of the Earth.
4. Igneous rock which forms beneath the surface is called _____.
5. Igneous rocks which form above the surface is called _____.

6. Igneous rocks can be classified according to _____ , _____ and _____.
 7. Very small-grained rocks are called _____.
 8. The grains that are slightly larger are called _____.
 9. Grains which have resulted from long term transport are _____ shaped.
 10. Grains which have not been transported very far are very _____ shape.
-

B. Answer the following questions briefly.

1. What is magma and how it is formed?

2. Differentiate extrusive from intrusive igneous rocks.

Extrusive rocks

Intrusive rocks



Summary

You have come to the end of lesson 5. In this lesson you have learnt that

- igneous rocks are formed by the cooling of molten rock.
- molten rocks are called magma when they are below the surface of the Earth or lava when they are on the surface of the Earth.
- igneous rock which forms beneath the surface is called intrusive and igneous rocks which form above the surface are called extrusive.
- slow cooling produces large crystals while fast cooling produces small crystals.
- igneous rocks can be classified according to crystal size, minerals and colour.
- broken-down rock produces sediment which may become a sedimentary rock.
- sedimentary rocks are classified by their origin, composition, grain size and shape.
- sedimentary rocks have different kinds of cementing materials.
- sedimentary rocks may be given names based on the size of the grains. Very small-grained rocks are called mudstones.

NOW DO PRACTICE EXERCISE 5 ON THE NEXT PAGE.



Practice Exercise 5

Answer the following questions:

1. How is igneous rock formed?

2. State the difference between magma and lava lava.

3. Basalt, pumice and obsidian are extrusive rocks. What is meant by the term extrusive?

4. How does the cooling of the igneous rock affect the size of the crystals formed?

5. What is the difference between light coloured and dark coloured igneous rock?

6. What is the difference between a breccia and a conglomerate?

7. Give the difference between a limestone and sandstone.

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 1.

Answers to Activity

A. Complete each sentence using the words given below.

1. Molten
2. Magma
3. Lava
4. intrusive
5. Extrusive
6. crystal size, minerals and colour
7. mudstones
8. siltstones
9. rounded and ball
10. angular

- B.
1. Magma is a molten rock. It release pressure which melts hot rock.
 2. Extrusive rocks – formed when magma cooled at the surface.
Intrusive rocks – formed when magma cooled at the underground.

Lesson 6: Weathering and Erosion



Welcome to Lesson 6 of Strand 4. In the last lesson you learnt about the formation of igneous, sedimentary and metamorphic rocks. You also learnt the processes of rock formation that occurs in the Earth's crust as part of the rock cycle. In this lesson you will learn more about result of weathering and erosion. As we continue to discuss the rocks, you will learn more about weathering and erosion.



Your Aims:

- define weathering and erosion
- discuss chemical and physical weathering
- identify the agents of erosion

What is Weathering?

Weathering is the breaking down of rocks into small pieces due to atmosphere. Uncovered rocks break down because of the action of wind, rain, ice and sunlight. Living things may contribute. Finally, gravity would make sure little pieces of the stone fall to the ground after they have been loosened in other ways.

Two main types of weathering

Physical weathering is the breaking up of rocks into smaller pieces. When water in small cracks freezes it expands, making the crack larger. This is called **ice wedging**. Rocks may **expand** (bigger), and **contract** (shrink) in areas of extreme daily temperature changes, such as deserts. Tree roots growing into cracks can split large boulders. Some organism burrow into rocks for shelter, and their predators chip at the rock to eat them.



Ice wedging- Physical weathering

Chemical weathering involves the changing of the chemicals in the rocks to new chemicals by the action of water and air. The **minerals** (particles that make up rocks) often become very soft during this process, or may dissolve away entirely. Chemically weathered rocks are often very brittle, and may have distinctly different colours from fresh, unweathered rock.



Caverns - Chemical weathering

Oxygen from the atmosphere can combine with minerals in the rocks and change them to new minerals. Water can also change minerals or dissolve them completely. Carbon dioxide and other atmospheric gases can combine with rainwater to form acid rain which eats away rocks.

Plants such as lichens produce chemicals that eat into the rock surface.



Lichens

What is erosion?

Erosion is the wearing away of soil and rock materials. Erosion involves loosening material and transporting it to another place. The major agents of erosion are **water**, **landslides**, **wind** and **ice**.

Erosion by water

Even tiny amounts of water can start erosion. A raindrop can hit bare soil moving soil grains a few centimetres. Rivers, great or small, wear away their own banks and beds, making their course ever wider and deeper. Waterfalls deepen their pools below. The sea waves striking the rocks on the shores forming cliffs, arches and stacks.



Rocks, pebbles and sand carried by the sea erode these cliffs.



Wolfberg Arch was shaped by wind and rain over millions of years.

Erosion by landslides

After a heavy rainfall, the weathered rock and soil on steep slopes may become unstable and move downhill as a landslide. Sometimes earthquakes can cause this material to start moving.



Earthquakes causes landslides

Erosion by ice

Glaciers and icesheets move very slowly down slopes. As they do so, they collect pieces of rocks around them crushed by the frost and carry them along. The fragments (pieces) can fall through cracks into the ice. As the ice moves, it wears more fragments out of the rocks below. These add to the 'ice file' rubbing away at the Earth. When the ice melts, the fragments in the ice begin to wash out.



Deposited rock fragments carried by Glacier

Erosion by wind

The sand dune in the photograph above is being blown by the wind. Sand is lifted off the back slope, carried over the top, and then dropped down on to the front to make a steep-angled layer. In this way, the whole dune slowly moves across the desert.

The sand grains in the dune are constantly being rubbed together, which makes them much rounder than those in river sand. In Papua New Guinea, running water and landslides are the main agents of erosion.



Sand dunes carried by wind from one side to the other



Activity: **Now test yourself by doing this activity.**

Let us do this activity. Answer the questions below.

1. Explain the difference between physical and chemical weathering.

2. How do glaciers physically break down rocks?



Summary

You have come to the end of lesson 6. In this lesson you have learnt that:

- weathering is the term used to describe all of the effects the atmosphere has on exposed rock materials. Simply, Weathering is the breakdown of rock.
- physical weathering is the breaking up of rocks into smaller pieces.
- when water in small cracks freezes it expands, making the crack larger. This is called ice wedging.
- rocks may expand (bigger), and contract (shrink) in areas of extreme daily temperature changes, such as deserts.
- chemical weathering involves the changing of the chemicals in the rocks to new chemicals by the action of water and air.
- the minerals (particles that make up rocks) often become very soft during the chemical weathering process, or may dissolve away entirely.
- chemically weathered rocks are often very brittle, and may have distinctly different colours from fresh, unweathered rock.
- oxygen from the atmosphere can combine with minerals in the rocks and change them to new minerals. Water can also change minerals or dissolve them completely.
- erosion is the wearing away of soil and rock materials. Erosion involves loosening material and transporting it to another place.
- the major agents of erosion are water, landslides, wind and ice.

NOW DO PRACTICE EXERCISE 6 ON THE NEXT PAGE.



Practice Exercise 6

Answer the following questions:

1. Define weathering.

2. What are the main agents of erosion? Describe each.

- ---

- ---

- ---

- ---

3. Which is more important in Papua New Guinea, physical or chemical weathering? Give your reason.

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 1.

Answers to Activity

1. Physical weathering is the breaking up of rocks into smaller pieces. Chemical weathering involves the changing of the chemicals in the rocks to new chemicals by the action of water and air.
2. Glaciers and icesheets move very slowly down slopes. As they do so, they collect frost shattered fragments from the rocks around them and carry them along. The fragments can fall through cracks into the ice. As the ice moves, it wears more fragments out of the rocks below.
3. In Papua New Guinea, chemical weathering is more important than physical weathering. This is because Papua New Guinea has high rainfall, high humidity and fairly high temperatures.

Lesson 7: The Rock Cycle



Welcome to Lesson 7 of Strand 4. In the last lesson, we have discussed the weathering and formation of rocks. You have learnt the chemical and physical weathering as well as the agents of erosion. In this lesson you will learn about the rock cycle and how rocks are being recycled over thousands of years.



Your Aim:

- identify and describe the rock cycle

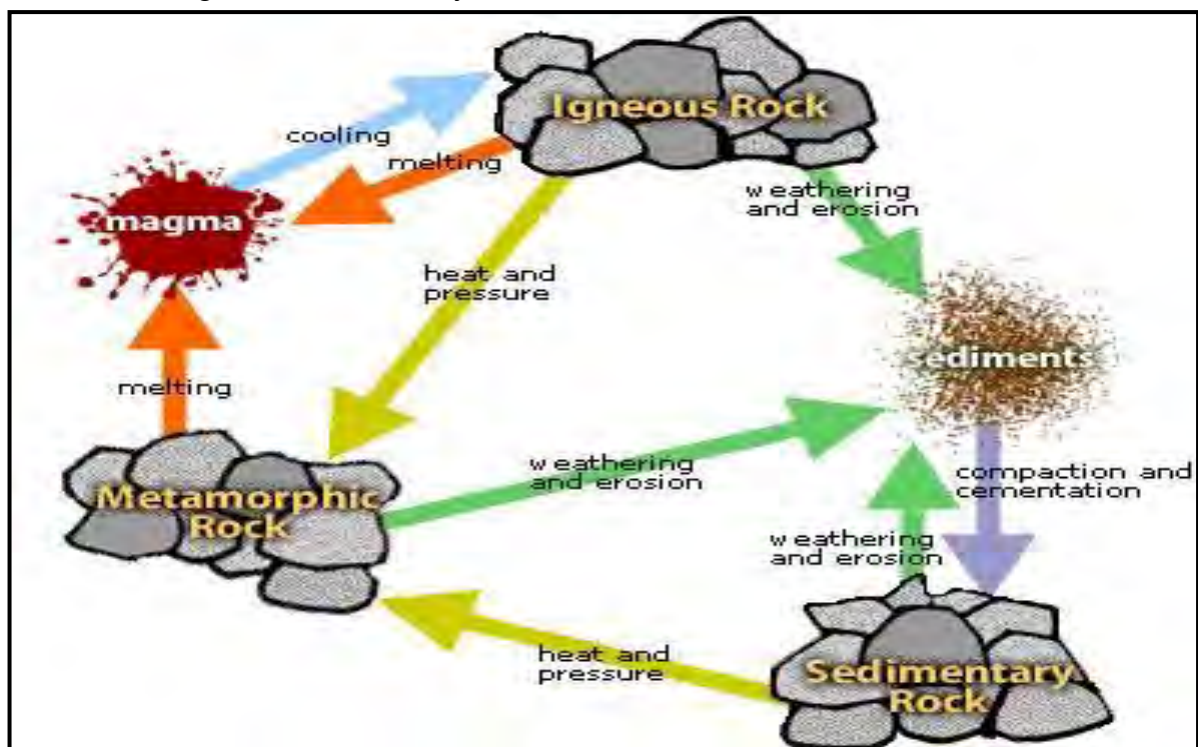
Processes of Change

Over millions of years, the earth's rocks are constantly changing. Magma from deep within the Earth rises to the surface, and cools to become igneous rock. These igneous rocks are weathered and eroded to form sediments which form sedimentary rocks.

As layers of sedimentary rocks build up, the bottom layers sink deeper and deeper into the Earth's crust, where the temperature and pressure are greater. When this happens they can be changed into metamorphic rocks. If the temperature is high enough, they may melt to produce magma again. They may also be uplifted by huge earth forces pushing the rocks upwards to form mountains.

The Earth's surface is constantly being worn down and uplifted by mountain-building forces. As this happens the rocks are changing from one form to another. The whole process is called the **rock cycle**.

Below is a diagram of the rock cycle.



The Rock Cycle

Due to changes in the crust, none of the original rocks that were first formed are now found on the surface.

As time progressed many changes occurred to the original rocks. The older rocks were changed into new rocks by a number of different processes including weathering, erosion and uplift.

Rocks are broken down by the process of **weathering**. This process goes on all the time. Rocks are attacked by chemicals or worn down by the solid material carried by wind, water and ice.



Weathering

The small pieces of material formed may be carried away. Some of the products of weathering and erosion are carried by rivers and are deposited as sediments. Over a period of times these sediments may form new rocks called sedimentary rocks.



Erosion

Although the processes of weathering and erosion occur continually, the land is never completely worn away. This is because one of the other processes which also take place within the Earth is **uplift**. This is the lifting of the land to form new mountains. These high areas of land are again weathered and the process continues.

Pressure and temperature is really high, deep within the Earth's crust. When these high pressure and temperature are applied to rocks, they form new hard rocks called metamorphic rocks. After sometime, the rocks formed might be uplifted due to the movement of the Earth's crust. These uplifted rocks are then broken down by the process of weathering and erosion and so the cycle repeats.



Rock formation

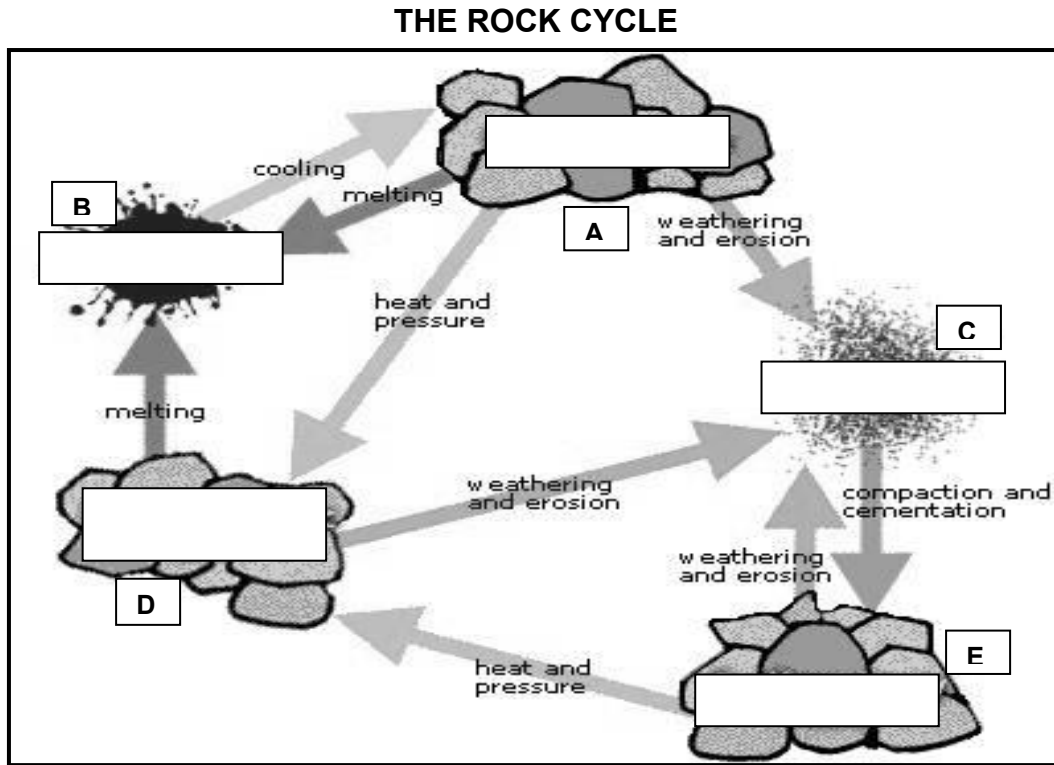


Wave formation



Activity: Now test yourself by doing this activity.

Do this activity by completing the rock cycle below.



Summary

You have come to the end of lesson 7. In this lesson you have learnt that:

- the crust of the Earth is made from rocks.
- rock cycle is the process when rocks change from one form to another.
- rocks are broken down by the processes of weathering and erosion.
- rocks can be formed by processes within the Earth.
- metamorphism is the process where high pressures and temperature within the Earth's crust are applied to rocks and produce changes.

NOW DO PRACTICE EXERCISE 7 ON THE NEXT PAGE.



Practice Exercise 7

Answer the following questions:

1. Why are the layers of sedimentary rocks not horizontal?

2. Use your knowledge of the rock cycle to explain the sequence of events which could over millions of years change a rock exposed near the top of a mountain into metamorphic rock. Describe the changes and draw a diagram.

DRAW HERE

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 1.

Answers to Activity

- A. Igneous rock
- B. Magma
- C. Sediment
- D. Metamorphic rock
- E. Sedimentary rock

Lesson 8: Fossils



Welcome to Lesson 8 of Strand 4. In the last lesson you have learnt about the rock cycle and how rocks are formed. In this lesson you will learn about fossils. Have you heard about fossils? What do you know about them? Well if you do not know in this lesson you will learn about them.



Your Aims:

- define fossils
- describe how fossils are formed
- state the process of fossilization

What are Fossils?

Fossils are plants and animal remains which are found in rocks. Fossils are evidence of living things which have been preserved in some way. Such as footprints, tracks and burrows

Some methods of preservation result in complete plants and animals being found, however most fossils are incomplete due to the breaking up of the organism before burial.

There is a better chance of fossils being formed when the plant or animal is buried quickly.



The fossil shape of a fish found in a rock

How are fossils formed?

Fossils are formed when a living organism dies and the body or part of the body is preserved in some way such as has been buried in sediment. Burial can occur on the bottom of the sea, in rivers, in lakes, on land by blown sand, falling volcanic ash. Most fossils are formed from marine organisms.

Over time, more and more sediment covered the remains. The parts of the plant or animal that didn't rot turned into fossils over time.

After a long time, the chemicals in the body of the buried animals' changes. The bone slowly decays, water mixed with minerals enter into the bone and replacing the chemicals in the bone with rock-like minerals.

The use of fossils

Fossils are used to tell the ages of sedimentary rocks and show what past climates or conditions were like. Scientist study present day animals and the conditions in which they live. This information is applied to similar animals which lived in the past. When this is done for a number of fossils, past climates can be worked out. Fossils can be used to help in the search for oil. For example, when fossils known as foraminifera are found in rock, there may be oil present nearby.



Activity: **Now test yourself by doing this activity.**

Do this activity by answering the questions correctly.

1. Explain how plants and animals could become a fossil.

2. How can fossils be used to tell us about past climates?

3. Why is it that most animals did not fossilize?



Summary

You have come to the end of lesson 8. In this lesson you have learnt

that:

- fossils are preserved remains or traces of plants and animals that lived millions of years ago.
- fossils are used to tell the ages of sedimentary rocks and show what past climates or conditions were like and what plants and animal were living at the time.
- fossils made of many different types of minerals, depending on what the surrounding rock was composed of.
- hard parts of organisms are preserved to form fossils because soft parts usually decompose.
- fossils are used to work out how long go a rock was formed and.
- most fossils are of plants and animals that are now extinct.
- very few fossils are formed compared with the number of animals that have lived.

NOW DO PRACTICE EXERCISE 8 ON THE NEXT PAGE.



Practice Exercise 8

Answer the following questions:

1. What are fossils?

2. How are fossils formed?

3. State one use of fossils?

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 1.

Answers to Activity

1. Fossils are formed when a living organism dies and the body or part of the body is preserved by being rapidly buried in sediment.
2. Fossils present day animals and the conditions in which they live. This information is applied to similar animals which lived in the past. When this is done for a number of fossils, past climates can be worked out.
3. Most animals did not fossilize because they simply decayed and were lost from the fossil record.

REVIEW OF SUB STRAND 1: THE EARTH AND ITS ORIGIN

Revise all the Lessons in this Sub Strand and then do **ASSIGNMENT 6**.

Here are the main points to help you revise.

Lesson 1: Formation of the Earth

- In early times, people thought that the Earth was flat.
- Aristotle (384-322 BC) first suggested that the Earth was a sphere.
- The aboriginal story from Australia believed that Yhi, the Sun god brought light, moon and summer to Earth.
- From Southern China, the people believed that before the Earth was made, there was nothing but only chaos.
- In a Christian belief which was taken from the Bible, 'Genesis', God created heaven and Earth and every living and non-living things on it. And He made it only in six days.
- Oroko people in Gulf province believed that the Earth came from the bottom of the sea.
- From the Scientists, they believed that some 4 600 million years ago, the Sun, our Earth and other planets were formed from a cloud of very hot dust and gas particles.
- Scientists also believed, true man came from the continent of Africa.

Lesson 2: Structure of the Earth

- The age of the earth has been estimated at about 5000 million years.
- The Earth is divided into three main parts: the crust, the mantle and the core
- The crust is made from relatively thin layer of rock that surrounds the Earth. It is thickest under the continents and thinnest under the ocean.
- The mantle is a very thick layer of the Earth. It consists of heavy rocks which are thought to be very hot and in a semi-molten state.
- The core forms about 15 percent of the Earth's volume and consists of a large ball-like shape in the middle of the Earth.
- The core consists of two parts: the inner core, which scientists think is solid and the outer core, which they think is a thick liquid.
- The interior of the Earth is mostly molten rock.

Lesson 3: The Soil

- Soil is the surface of the Earth's crust where plants have their roots and where many small animals make their homes.
- Soil is made up of layers. At the top is the dark layer where plants and other organisms live. We call this the top soil.
- The subsoil is beneath the top soil and is lighter-coloured layer of gravel, stones and clay.
- Soil contains six main components. These are rock particles, soil water, humus, mineral salts, lime and air.
- Rock particles- These vary in size. Depending on their size, they are classified into clay, silt, sand and gravel.
- Soil water- Soil particles are normally surrounded by thin film of water. From these, plant roots take up all the water they need.
- Humus- Makes the soil rich in nutrients which are needed for plant growth. It forms a coating round the soil particles, helping them to clump together into soil crumbs.
- Mineral salts - provide plants with important elements such as nitrogen, phosphorous and potassium, and all essential for growth.
- Lime – Lime comes from limestone, a type of rock which contains calcium carbonate. It is important for plants proper growth and development. It helps soil particles to clump together into soil crumbs and prevents the soil being too acidic.
- Soil air-In good soil there are plenty of spaces between the soil particles and crumbs. These spaces are filled with air. The oxygen in this air is needed for respiration by plant roots and the other organisms which live in the soil
- There are different types of soil. These are sandy, clay, chalky, peaty and the ideal soil.
- Sandy soil - This kind of soil contains mainly-sand. Sandy soil is loose, light and easy to dig. It contains plenty of air and it drains well.
- Clay soil- This kind of soil contains a lot of clay. It holds on to water and nutrients very well, so it tends to be rich in plant food.
- Chalky soil- This kind of soil contains a lot of lime. It is therefore very alkaline. It is usually rather clayey and therefore difficult to cultivate.
- Peaty soil- This kind of soil contains a lot of peat. Although peat is useful, too much of it can make the soil acidic.
- The ideal soil- This kind of soil has a pH around neutral and a fairly loose texture. Soil crumbs form readily and the particles are of size which keep the soil well aerated and allow into drain easily.

Lesson 4: Rocks

- Rock is a hard, solid part of the earth.
- All rocks are made of minerals.
- Geologists classify rocks into three large groups. These are
 - A. Igneous rock which is formed when molten rock material cools. Molten rock material beneath the earth's surface is called magma.
 - B. Sedimentary rock which is formed by the hardening of layers of sediments. The sediments may consist of rock fragments, plant and animal skeletons or other chemicals that form on the bottom of lakes or oceans.
 - C. Metamorphic rock which forms when existing rocks are changed by the action of great heat and pressure.
- Igneous rocks are also formed from magma that never reaches the surface. This is called intrusive rock because they intrude into other rock layers.
- Sedimentary rocks are formed from layers of sediment that pack down and harden through thousands of years.
- Limestone is a sedimentary rock made from shells and skeletal remains of sea creatures.
- Coal is a sedimentary rock formed from decayed plant materials.
- Heat and pressure can change rocks. This changed rock is called metamorphic rock. Metamorphic means changed in form.
- Quartzite is a metamorphic rock made from sandstone.
- Slate is made from clay or shale. Marble made from limestone. Gneiss forms from granite.

Lesson 5: Formation of Rocks

- Igneous rocks are formed by the cooling of molten rock.
- Molten rocks are called magma when they are below the surface of the Earth or lava when they are on the surface of the Earth.
- Igneous rock which forms beneath the surface is called intrusive and igneous rocks which form above the surface are called extrusive.
- Slow cooling produces large crystals while fast cooling produces small crystals.
- Igneous rocks can be classified according to crystal size, minerals and colour.
- Sedimentary rocks are classified by their origin, composition, grain size and shape.
- Sedimentary rocks may be given names based on the size of the grains. Very small-grained rocks are called mudstones. The grains that are slightly larger are called siltstones.
- Grains which have resulted from long term transport are rounded and ball shaped. Grains which have not been transported very far are very angular.

Lesson 6: Weathering and Erosion

- Weathering is the term used to describe all of the effects the atmosphere has on exposed rock materials. Simply, Weathering is the breakdown of rock.
- Physical weathering is the breaking up of rocks into smaller pieces.
- When water in small cracks freezes it expands, making the crack larger. This is called ice wedging.
- Rocks may expand (bigger), and contract (shrink) in areas of extreme daily temperature changes, such as deserts.
- Chemical weathering involves the changing of the chemicals in the rocks to new chemicals by the action of water and air.
- Oxygen from the atmosphere can combine with minerals in the rocks and change them to new minerals.
- In Papua New Guinea, chemical weathering is more important than physical weathering. This is because Papua New Guinea has high rainfall, high humidity and fairly high temperatures.
- Erosion is the wearing away of soil and rock materials. Erosion involves loosening material and transporting it to another place.
- The major agents of erosion are water, landslides, wind and ice.

Lesson 7: The Rock Cycle

- The crust of the Earth is made from rocks.
- Rock cycle is the process where rocks are changing from one form to another.
- Rocks are broken down by the processes of weathering and erosion.
- Metamorphism is the process where high pressures and temperature within the Earth's crust are applied to rocks and produce changes.
- Weathering and erosion work together. Weathering breaks up and weakens the surface of rocks. Erosion wears away and removes the loosen material.
- Some of the products of weathering and erosion are carried by rivers and are deposited as sediments. Over a period of times these sediments may form new rocks called sedimentary rocks

Lesson 8: Fossils

- Very few fossils are formed compared with the number of animals that have lived.
- Fossils are preserved remains or traces of plants and animals that lived millions of years ago.
- Some methods of preservation result in complete plants and animals being found, however most fossils are incomplete due to the breaking up of the organism before burial.
- Fossils are used to tell the ages of sedimentary rocks and show what past climates or conditions were like.
- Fossils come in many colours and are made of many different types of minerals, depending on what the surrounding rock matrix was composed of.
- Generally, hard parts of organisms are preserved to form fossils because soft parts usually decompose.
- There is a better chance of fossils being formed when the plant or animal is buried quickly.
- Most fossils are formed from marine organisms.
- Fossils are used to work out how long ago a rock was formed and what plants and animals were living at the time.
- Most fossils are of plants and animals that are now extinct.

REVISE WELL AND THEN DO SUB STRAND TEST 1 IN YOUR ASSIGNMENT 6.
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Answers to Practice Exercises 1- 8

Practice Exercise 1

1. Before the Earth was made, there was nothing but only chaos. Chaos was shaped like an egg. In the middle of this egg, Pan Ku was created. He lived there quietly for a very long time. Very slowly, Heaven and Earth were formed out of Chaos.
2. In the beginning, God created the Heaven and the Earth. The Earth was without form and empty and was in total darkness. On the first day, God said, —~~Let~~there be light”, and there was light.
3. On the sixth day, God said, —~~at~~ the Earth bring forth every kind of living creature and may they cover the Earth with their kind”. In no time, living creatures of all kinds filled the Earth.

Then he said, —~~Let~~us make Man of our own image, and let them rule over all other creatures that have been created”. So God created Mankind, both male and female, and blessed them.

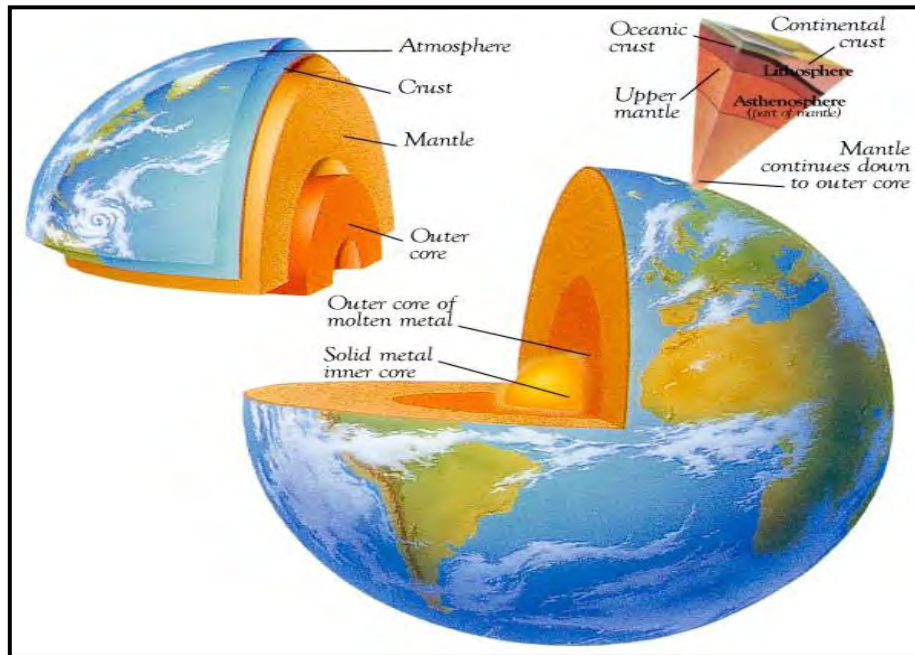
4. Scientists believe that some 4 600 million years ago, the Sun, our Earth and other planets were formed from a cloud of very hot dust and gas particles. They do not know where this cloud of hot dust and gas came from.

Over millions of years, most of these cooled down, forming the Sun. Gradually, and the remaining cooled down, forming the Earth and the other planets.

5. The planet Earth is made of rocks. The earliest rocks were formed some 4 500 million years ago.
6. This means that the Earth is by now more than 4 500 million years old.
7. Scientists also believe that life first appeared on Earth only 1500 million years ago. The first lives were of simple water plants in the seas.
8. The Earth’s surface was not level by that time. As further cooling took place, water formed in the atmosphere and later filled the lower parts of the Earth, forming the seas and ocean. The higher parts become land.

Practice Exercise 2

1. Draw and label the structure of the Earth.



Structure of the Earth

2. The **crust** - is a relatively thin layer of rock that surrounds the Earth. It is thickest under the continents and may reach a thickness of more than 100 kilometres. It is thinnest under the ocean where it may be less than 10 kilometres thick.

The **mantle** - is a very thick layer of the Earth. It consists of heavy rocks which are thought to be very hot and in a semi-molten state. These rocks are like plasticine, tar or stirred sago, and come to the surface when volcanoes erupt.

The **core** - forms about 15 percent of the Earth's volume and consists of a large ball-like shape in the middle of the Earth. The core consists of two parts: the inner core, which is solid and the outer core, which is a thick liquid.

The **rocks of the crust** are lighter than the mantle rocks, that is why the crustal rocks float on the mantle. Like other floating objects, they are able to move, but the movement is very slow.

Practice Exercise 3

1. Soil is the surface of the Earth's crust where plants have their roots and where many small animals make their homes.
2. Soil contains six main components. These are rock particles, soil water, humus, mineral salts, lime and air.
3. There are different types of soil. These are sandy, clay, chalky, peaty and the ideal soil.
 - **Sandy soil** - This kind of soil contains mainly sand. Sandy soil is loose, light and easy to dig. It contains plenty of air and it drains well.
 - **Clay soil** - This kind of soil contains a lot of clay. It holds on to water and nutrients very well, so it tends to be rich in plant food.
 - **Chalky soil** - This kind of soil contains a lot of lime. It is therefore very alkaline. It is usually rather clayey and therefore difficult to cultivate.
 - **Peaty soil** - This kind of soil contains a lot of peat. Although peat is useful, too much of it can make the soil acidic.
 - **The ideal soil** - This kind of soil has a pH around neutral and a fairly loose texture. Soil crumbs form readily and the particles are of size which keep the soil well aerated and allow it to drain easily.
4.
 - **Rock particles** - These vary in size and are classified into clay, silt, sand and gravel.
 - **Soil water** - Soil particles are normally surrounded by thin film of water.
 - **Humus** - Makes the soil rich in nutrients which are needed for plant growth.
 - **Mineral salts** - provide plants with important elements such as nitrogen, phosphorus and potassium, and all essential for growth.
 - **Lime** - It is important because all plants need for proper growth and development and helps soil particles to clump together into soil crumbs.
 - **Soil air** - In good soil there are plenty of spaces between the soil particles and crumbs. These spaces are filled with air. The oxygen in this air is needed for respiration by plant roots and the other organisms which live in the soil.

Practice Exercise 4

1. A rock is a hard, solid part of the earth.
 2. The three types of rock are igneous, sedimentary and metamorphic.
 - a. Igneous rocks are rocks which are formed when molten rock material cools. Molten rock material beneath the earth's surface is called magma.
 - b. Sedimentary rocks are rocks which are formed by the hardening of layers of sediments. The sediments may consist of rock fragments, plant and animal skeletons or other chemicals that form on the bottom of lakes or oceans.
 - c. Metamorphic rocks are rocks which are formed when existing rocks are changed by the action of great heat and pressure.
 5. Hard igneous rocks like granite and basalt are used for bridges and buildings. Basalt stones are spread over tar to make the surface for bitumen roads. It is also laid along railway tracks to hold the sleepers in place. Granite is used to make facings on buildings, surfaces, monuments and gravestones. Obsidian was used by people in times past for making knives, axes, arrowheads and other tools.
 5.
 - Gypsum is sedimentary rock formed when water containing dissolved minerals evaporates,
 - Limestone is a sedimentary rock made from shells and skeletal remains of sea creatures.
 - Coal is a sedimentary rock formed from decayed plant materials.
-

Practice Exercise 5

1. Igneous rocks are formed by the cooling of molten rock.
2. Molten rocks are called magma when they are below the surface of the Earth or lava when they are on the surface of the Earth.
3. Extrusive rocks are rocks that form above the surface of the earth.
4. Slow cooling produces large crystals while fast cooling produces small crystals.
5. The colour indicates the minerals the rock may contain. Light coloured rocks such as granite and pumice contain a large amount of quartz. Some igneous rocks are dark coloured. These contain dark minerals which are usually heavy.

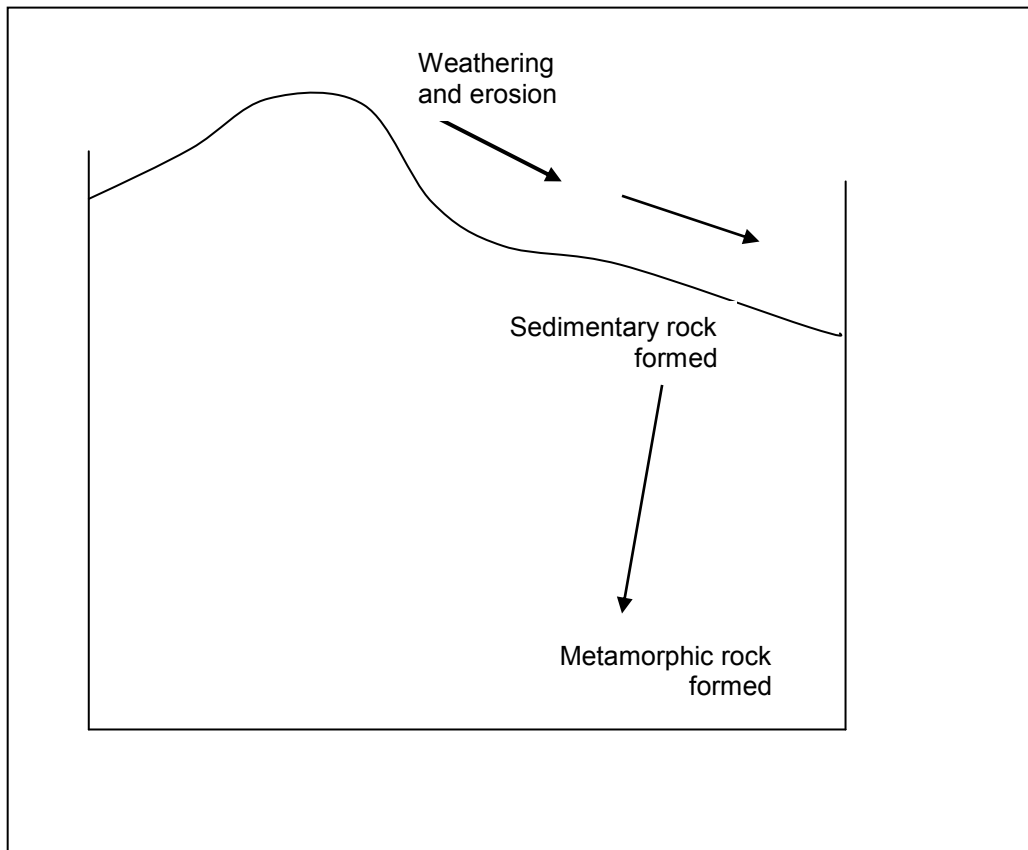
6. A conglomerate has rounded pebbles in a small-grained material.
A breccia has an angular particle in a small-grained material
 7. A limestone usually formed in the sea and may have fossils.
Sandstone usually formed on the land or near a coast and contains a lot of quartz.
-

Practice Exercise 6

1. Weathering is the breakdown of rock.
2. Physical weathering is the breaking up of rocks into smaller pieces.
Chemical weathering involves the changing of the chemicals in the rocks to new chemicals by the action of water and air.
3. Erosion is the wearing away of soil and rock materials. Erosion involves loosening material and transporting it to another place.
4. The major agents of erosion are water, landslides, wind and ice.
 - Water - tiny amounts of water can hit bare soil like a miniature meteorite, moving soil grains a few centimetres. Rivers, great or small, wear away their own banks and beds, making their course ever wider and deeper.
 - Landslides- after a heavy rainfall, the weathered rock and soil on steep slopes may become unstable and move downhill as a landslide.
 - Wind-the sand dune being blown by the wind. Sand is lifted off the back slope, carried over the top, and then dropped down on to the front to make a steep-angled layer.
 - Ice-glaciers and icesheets move very slowly down slopes. As they do so, they collect frost shattered fragments from the rocks around them and carry them along. The fragments can fall through cracks into the ice. As the ice moves, it wears more fragments out of the rocks below.
5. In Papua New Guinea, chemical weathering is more important than physical weathering. This is because Papua New Guinea has high rainfall, high humidity and fairly high temperatures.

Practice Exercise 7

1. The layers of sedimentary rock are not horizontal because they have been pushed up by the magma.
2. First, the rock would be weathered and eroded. The sediments would then be deposited in the ocean or a lake and changed into sedimentary rock. As this sedimentary rock is buried under other rock layers, it could be changed by heat and pressure into metamorphic rock.



Practice Exercise 8

1. Fossils are both plants and animals remains which are found in rocks and any evidence of life such as footprints, tracks and burrows. Fossils are evidence of living things which have been preserved in some way.
2. Fossils are formed when a living organism dies and the body or part of the body is preserved and by being rapidly buried in sediments.
3. The process of fossilization involves the dissolving and replacement of the original minerals in the object with other minerals, the filling up of spaces in fossils with minerals, in which a mineral crystal changes its form.
4. The six ways organisms can turn into fossils are
 - Unaltered preservation
 - Permineralization
 - Replacement
 - Carbonization
 - Recrystallization
 - Preservation
5. Because they are rocks! A fossilized object is just a rocky model of an ancient object. A fossil is composed of different materials than the original object was. During the fossilization process, the original atoms are replaced by new minerals, so a fossil doesn't have the same colour (or chemical composition) as the original object.

SUB STRAND 2

SPACE EXPLORATION

In this sub strand you will learn about:

- **the universe**
- **the solar system**
- **the planets in the solar system**

SUB STRAND 2: SPACE EXPLORATION

Introduction

Space exploration is the use of astronomy and space technology to explore outer space. Physical exploration of space is conducted both by human spaceflights and by robotic spacecraft. The observation of objects in space, known as astronomy and the development of large and relatively efficient rockets during the early 20th

century allowed physical space exploration to become a reality. Common thinking for exploring space include advancing scientific research, uniting different nations, ensuring the future survival of humanity and developing military and strategic advantages against other countries.



For thousands of years mankind has wondered what could be found beyond the Earth's atmosphere. Some thought the Earth was inclosed inside a glass ball, and that if a person could climb a mountain high enough they could touch the glass. Others told stories of the gods and spirits that inhabited this celestial arena.

Today we no longer wonder, we are no longer restricted to merely climbing mountains, now we can actually leave the Earth all together. NASA's Shuttle Program is one of the most exciting advancements in the world, and will, along with other programs worldwide, lead to the exploration of new worlds, and someday even new star systems.

Today only astronauts can visit Outer Space; this is because a space shuttle mission is very expensive. However NASA is developing new space crafts that will eventually replace the Space Shuttle. These space craft will make it several times cheaper to fly a space mission, and may eventually allow everyone to take a vacation in space.

You may be asking,

- What are the planets in the solar system?
- How do the universe and the solar system related?

In this Sub strand you will find the answers to these questions and all other questions relating to Space Exploration.

Lesson 9: The Universe



Welcome to Lesson 9 of Strand 4. In the last lessons you learnt about the earth and its origin. In this lesson you will learn about the universe. You will define it and explain what makes it up. You should be familiar with the terms, Galaxy and Solar System, the Sun and be able to describe them all.



Your Aims:

- define universe, galaxy, the milky way and sun
- compare scientific theory and traditional beliefs on how the earth was formed



You will learn about the Universe thoroughly, and then you can study what makes up the universe separately.

The Universe

Look up at the sky on a clear night. What you see is part of the universe. You could never see the entire universe. No one even knows whether the universe has an end not. The universe contains all matter and energy. The universe holds all space and time. You are a part of the universe. The universe includes everything in it.

What Makes Up the Universe?

Earth and all the planets in our solar system make up just a tiny part of the universe. Billions of other stars like our Sun form a group called the **Milky Way Galaxy**. With telescopes we can see billions of other galaxies.

The universe holds many strange things, such as exploding stars. It holds great clouds of gas and dust where new stars form. It also holds black holes. Black holes have a pulling force called gravity. Gravity is the force that holds you to the ground and makes things fall when you drop them. Black holes suck in all the matter around them. The gravity of black holes is so strong that nothing, not even light, can escape.

People or Scientists who study the stars are called Astronomers. Astronomers think there is even more matter in the universe than we can see. The matter we see makes up gas, dust, galaxies, stars, and planets.



Astronomers are people who study Astrology. Astronomy is the study of heavenly bodies, their motion and their relative positions

When the Universe Begin

Many astronomers think the universe began about 14 billion years ago. They think it suddenly exploded. They call this explosion the big bang. All space and time began from there. Only with a special telescope, astronomers can see the radiation left over from the big bang.

What Happened after the Big Bang?

Over millions of years after the big bang, the force of gravity pulled gases and dust together forming the stars and galaxies. The stars began to shine and our Sun and solar system was formed and life began on earth.

Will the Universe End?

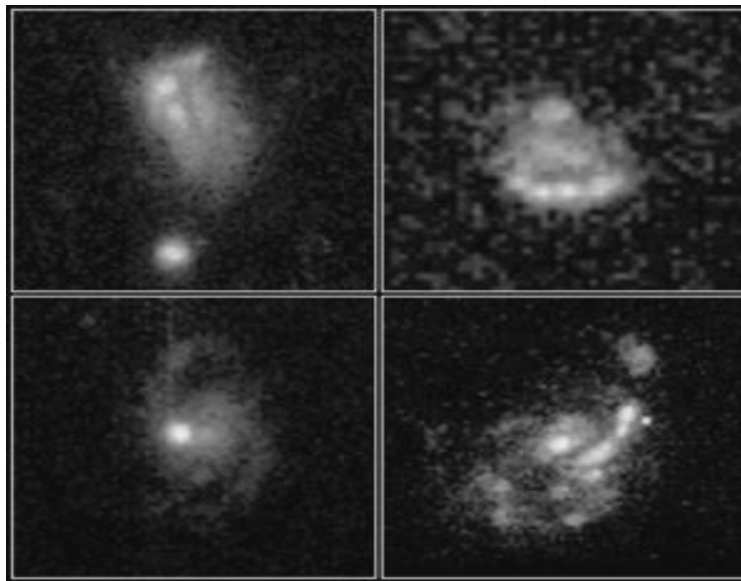
Astronomers want to know what will happen to the universe. They think it is still expanding. In fact, the universe seems to be expanding faster and faster as time goes on. Many astronomers think the universe will go on expanding.

The Galaxy

A **galaxy** is a system of stars, clouds of gas, and dust particles that move together through the universe. There are billions of galaxies in the universe.

Even small galaxies are made up of hundreds of millions of stars and may be 5,000 light-years across. (A light-year is the distance light travels in a year—about 5.8 trillion miles, or 9.5 trillion kilometres.) The largest have more than a trillion stars.

Galaxies are divided into three groups based on their shape.

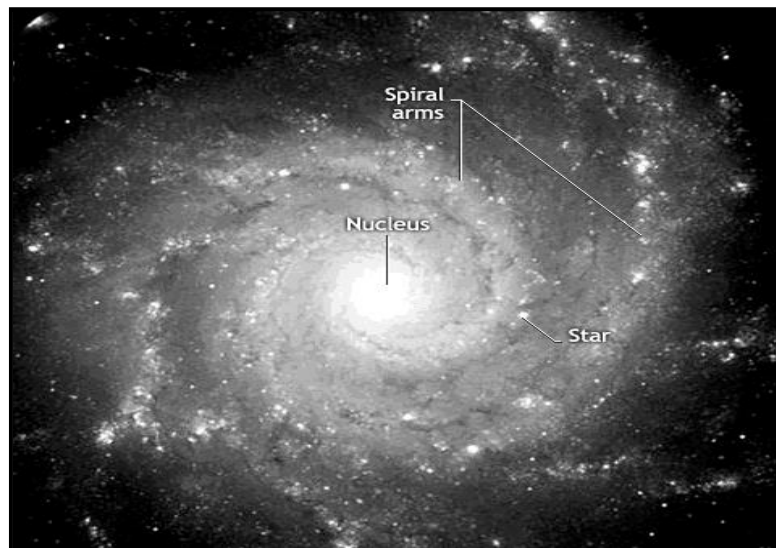


Four different types of galaxy

The Milky Way

Since ancient times people have noticed a milky band of light in the night sky. From this formation came the word galaxy, which is taken from the word for milk in the Greek language. The Milky Way is the galaxy to which the Earth belongs.

The Milky Way is a **spiral galaxy** with a diameter of about 100,000 light-years. It includes many billions of stars. Most of the stars of the Milky Way are in the centre or the flat spiral arms, but some occur in clusters above and below these areas.



The Milky Way is a spiral galaxy. Spiral galaxies look like giant whirlpools or pinwheels. They have long arms made of gas-and-dust clouds and stars. The arms spiral, or circle around, the nucleus (centre).

The Earth and the rest of the solar system are located on one of the spiral arms, about two-thirds of the way from the centre of the galaxy. As the Earth travels around the Sun, the entire solar system is travelling around the galaxy. It takes about 200 million years to complete one rotation around the centre of the galaxy. At the centre of the Milky Way is probably a massive black hole.

The Sun

The Sun is the star at the centre of the Earth's solar system. It is the source of almost all the Earth's energy. Like other stars, the Sun is a huge ball of hot, burning gases. Other stars look much smaller than the Sun because they are farther away. Heat and light from the Sun help support life on Earth.

Sunlight takes about eight minutes to travel 150 million kilometres from the Sun to the Earth. The next closest star is about 250,000 times farther away. That is why the sun is by far the brightest object in the sky.

REMEMBER

The Milky Way is the band of light that is produced by the thousands of stars that lie in the main section of our Galaxy.

The sun is about average in size for a star. Scientists classify the Sun as the type of star called a yellow dwarf. The Sun's diameter, or distance across, is 1,392,000 kilometres. This is about 109 times the distance across the Earth. The Sun's mass, or amount of matter, is about 333,000 times greater than that of the Earth.

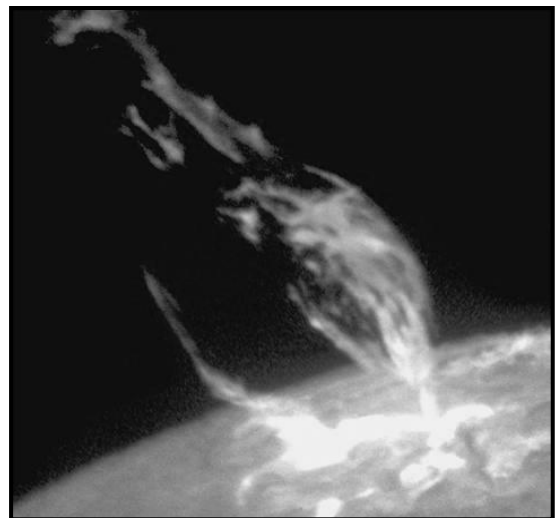
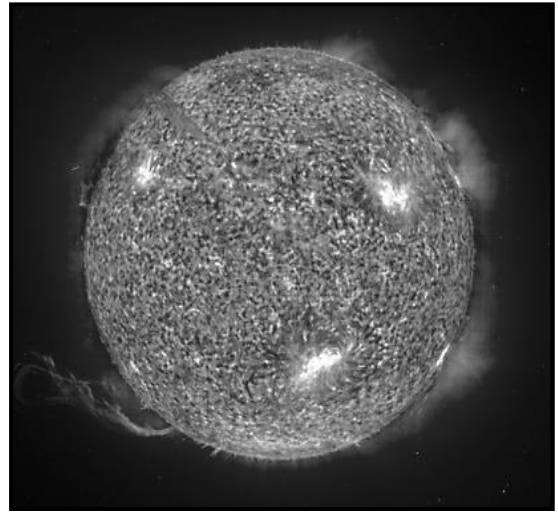
The core of the sun is about 100 times denser than water. It is also extremely hot. The temperature is probably about $15,600,000^{\circ}\text{C}$. Under such conditions, atoms cannot exist in stable form. Hydrogen particles collide and combine into helium particles in thermonuclear reactions. These reactions create enormous amounts of energy.

The outer region of the Sun that is normally visible from the Earth is called the photosphere, which means —*sphere of light*.”

At about 6000°C , the photosphere is much cooler than the core but still very hot by earthly standards. Solids and liquids cannot exist there. More than 90 percent of the molecules are hydrogen gas. Most of the rest is helium.

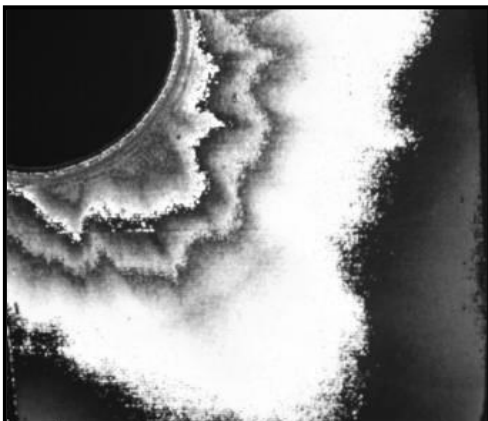
From time to time the surface of the Sun displays cooler, darker patches called sunspots. Groups of sunspots might cover thousands of miles. Sunspots appear and disappear in 11-year cycles.

Above the surface is a slightly hotter region called the chromosphere, meaning —*sphere of colour*.” This region has a reddish colour. At times great blasts of energy called solar flares erupt from the chromosphere. Solar flares can be dangerous to space travellers. The radiation from them can penetrate spaceship walls and damage body cells.



Surface of the Sun

The surface layer of the Sun is called the photosphere. Sometimes hot gas can shoot thousands of miles above the photosphere, as this picture shows.



Different layers of the corona

Surrounding the chromosphere is a faint but very hot region called the corona. With a temperature between $1,000,000^{\circ}$ and $2,000,000^{\circ}\text{C}$, the corona is much hotter than the photosphere. Without special equipment, the chromosphere and the corona are visible from Earth only during total eclipses of the Sun. You will learn more about this in lesson 17.

However, people should not view the Sun directly even during eclipses. The corona sends off tiny particles of matter into the solar system. These particles are known as the solar wind. The wind moves outward at about 400 kilometres per second. High solar winds disrupt radio signals on the Earth and cause the colourful bands of light in the polar skies known as the northern and southern lights.

The Sun has been shining for at least 4 billion years. As the ages pass, its light is getting brighter, not dimmer. Billions of years in the future, the Sun will use up the fuel at its core. As its surface burns, the Sun will swell up into the kind of star called a red giant. In this stage, the Sun's enormous shell may engulf the Earth.



Summary

You have come to the end of lesson 9. In this lesson you have learnt that:

- the Earth and the Solar System make up just a tiny part of the universe. The Universe makes up our Galaxy and millions of other galaxies.
 - the Galaxy is a system of stars, cloud of gas and dust particles that move together through the universe.
 - the Milky Way is the galaxy to which the Earth belongs.
 - the Sun is a star at the centre of the of the Earths solar system
-

NOW DO PRACTICE EXERCISE 9 ON THE NEXT PAGE.



Practice Exercise 9

Answer the following questions:

1. How was the universe believed to be formed?

2. Define the following terms

Sun

Milky Way

Galaxy

3. Fill in the missing words in the space provided

4.

a) The Sun is a _____ at the centre of the Earth's _____. It is the source of almost all the Earth's _____.

b) The _____ is a system of stars, cloud of gas and dust particles that move together the universe.

4. How are the Galaxies categorised?

5. To which group is our Galaxy belong?

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 2.

Lesson 10: The Solar System



Welcome to Lesson 10 of Strand 4. In the last lesson you have defined the Universe, galaxy and the solar system. In this lesson you will study in more detail about the solar system.



Your Aims:

- define solar system
- identify the different heavenly bodies found in the solar system
- identify the position of these heavenly bodies



What is a Solar System? Where can I find the Asteroids?

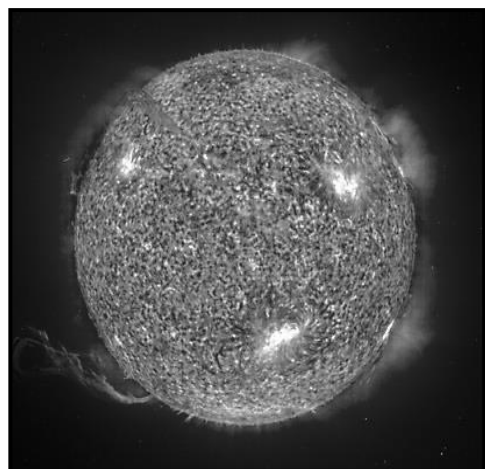
The Solar System

The Solar System is a system that consists of the Sun and everything that orbits around it. The planets and their moons, comets, asteroids, and various other objects. Our solar system includes everything that orbits around the Sun. Our solar system lies near the edge of the Milky Way galaxy. A **galaxy** is a huge collection of stars. The Milky Way is shaped like a spiral.

Astronomers had never found a solar system like ours until 1995. In the same year astronomers found a planet orbiting (going around) a distant star like our Sun. Since then, they have found other solar systems. They concluded that there are many solar systems in the universe and do not know whether there is life in them.

The Sun

As you have already learnt in lesson 9, the Sun, like other stars, is a huge ball hot of gas. Hydrogen and helium are the main gases in the Sun. Almost all the energy in our solar system comes from the Sun. The Sun changes hydrogen into helium to create light and heat. These changes take place deep inside the Sun.

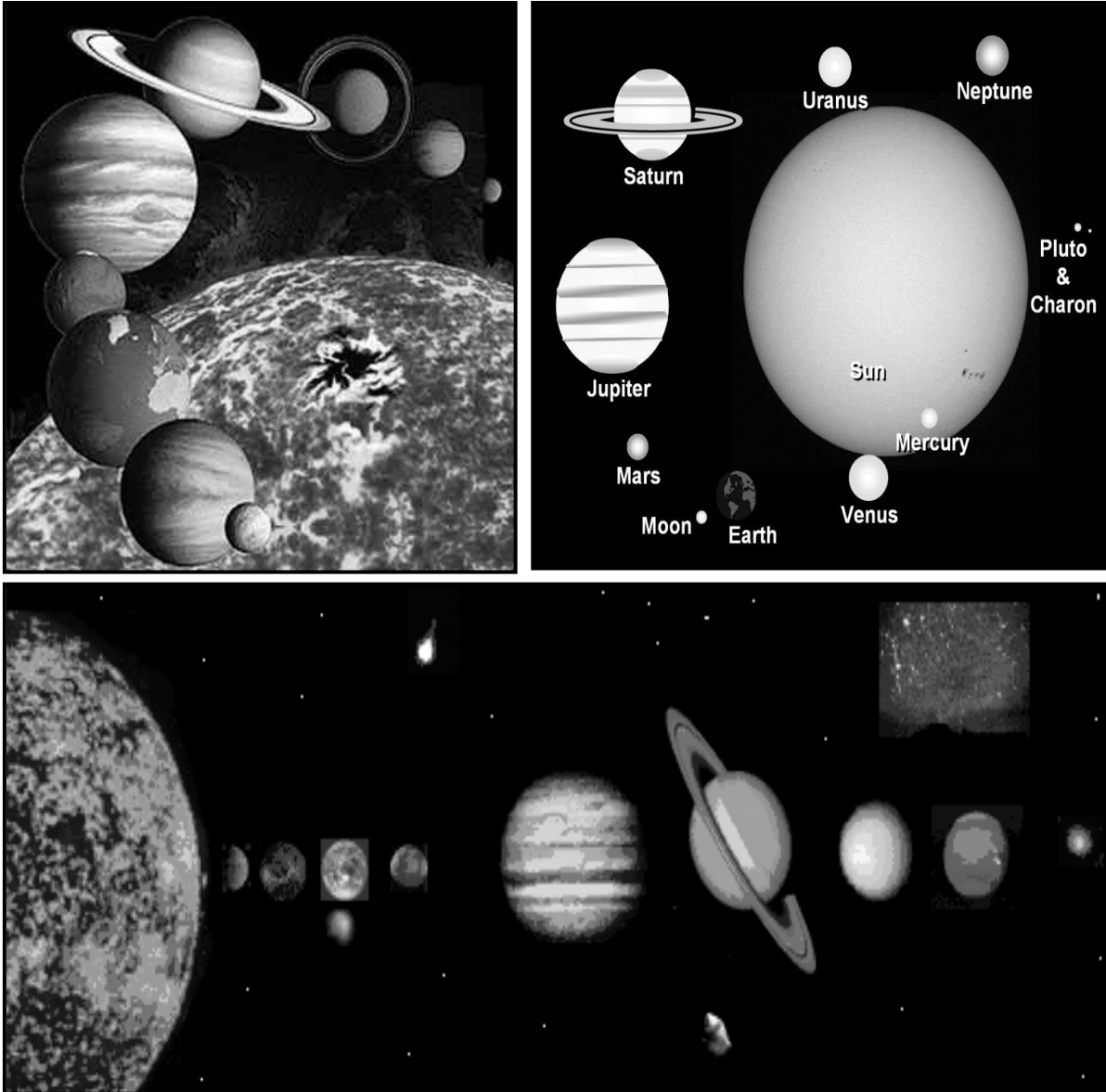


The Sun is a star at the centre of our solar system. Like other stars, the Sun is a huge ball of hot, burning gases.

The Planets

After the Sun, the largest bodies in the solar system are the planets. Eight of the nine planets in our solar system fall into two groups called the inner planets and the outer planets. The four planets closest to the Sun are called the inner planets. They are Mercury, Venus, Earth, and Mars. The inner planets are also called the rocky planets, because they are made mainly of rock and iron and resemble the Earth in composition, that is, they are rocky.

There are four outer planets: Jupiter, Saturn, Uranus, and Neptune. The outer planets are also called the gas giants because they are huge and made mainly of gas. The nine planets found in our solar system, together with their moons and satellites revolve around the Sun. They all have roughly circular orbits in the same plane, and most have at least one. They vary widely in size, temperature, composition, and distance from the Sun.



Three different impressions of the solar system

REMEMBER: The Solar System contains the nine planets and other smaller objects such as minor planets, comets, meteoroids and cosmic dust.

Asteroids

Asteroids are small pieces of rock and metal. There are thousands of asteroids in the solar system. They are believed to be debris left over from collisions between other bodies in the solar system. The largest asteroid, Ceres, is about 965 kilometres in diameter, but most asteroids are much smaller. Most of them orbit the Sun between Mars and Jupiter. Asteroids that crash into Earth are called **meteors**. Sometimes they burn up as they fall through the Earth's atmosphere. They make streaks of light in the night sky. Pieces that land on the ground are called **meteorites**.



REMEMER: Many small asteroids enter the Earth's atmosphere each day. Almost all burn up because of the friction with gas molecules in the air. An asteroid that survives the fall through the atmosphere and reaches the Earth's surface is called a meteorite.

Comets

Comets are another type of object in the solar system. Comets are usually far out in the solar system. The solar system contains billions of comets, but most of them are too small or too far from the Sun to ever be seen from Earth. Comets are dirty chunks of ice and rock that orbit the Sun in highly oval orbits. When their orbits bring them close to the Sun (called perihelion), the Sun's radiation causes them to shed particles and glow. When it comes in close, the comet starts to melt and looks like it has a long tail streaming out behind it. At this point they are visible in the sky. When their orbits take them far from the Sun (called aphelion), they cool down until their next perihelion.



In 1994 pieces of a comet called Shoemaker-Levy 9 crashed into Jupiter. The crash made huge explosions and sent up fireballs that were larger than Earth.

Haley's comet is named after English astronomer Edmond Haley. A comet becomes smaller each time it passes near the Sun. As a comet approaches the Sun, it begins to heat up.

Comets have no light of their own. Only when they come near the Sun they get bright and we see them. Haley's comet is just one of two thousand known comets. Haley found that one bright comet which had appeared in 1531reappeared again in 1986. Haley's comet comes by Earth every 76 years. It will come again in 2062. How old will you be?



The Solar Wind

An important part of the solar system is the solar wind. It consists of a continuous stream of high-energy pieces of atoms that are ejected from the Sun's hot surface and flow outward throughout the whole solar system. The solar wind is what causes auroras, or displays of collared light in the night sky. In the Northern Hemisphere these auroras are called the Northern lights.

Formation of the solar System

Astronomers think that the solar system may have come from a swirling cloud of gas and dust. First a star, our Sun, formed from a clump in the cloud. It began as a spinning ball of gas at the centre of the cloud. Then the planets, their moons, and the other objects in the solar system formed from the leftover gas and dust. Other stars and solar systems in the universe may have formed the same way. In fact, new solar systems are still forming from giant clouds of gas and dust.

**REMEMER: A comet is a ghostly looking object in the night sky.
Comets are made of frozen lumps of gas and rock.**



Summary

You have come to the end of lesson 10. In this lesson you have learnt that:

- the solar system consists of the Sun and everything that orbits around it: the nine planets and their moons, comets, asteroids, and various other objects.
- the Sun is a huge ball of burning gas and is the centre of the solar system.
- the nine planets including the Earth are found in the solar system.
- comets are made of frozen lumps of gas and rock. They are dirty snowballs. Asteroids are small pieces of rock and metal believed to be debris left over from collisions between other bodies in the solar system.

NOW DO PRACTICE EXERCISE 10 ON THE NEXT PAGE.



Practice Exercise 10

Answer the following questions:

1. What is a Solar System?

2. Define the following terms

- a) Sun

- b) Asteroids

- c) Comets

- d) Meteorite

3. The planets in the solar system are group into two groups; the inner group and the outer group. How many planets are located in the inner group? Name them.

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 2.

Lesson 11: The Planets in the Solar System



Welcome to Lesson 11 of Strand 4. In the last lesson you learnt about the solar system. In this lesson you will learn about planets that are found in our solar system. Did you know there is a new planet discovered lately? Did you also know that the planet Pluto, the furthest planet from the sun is not considered a planet anymore? However in this lesson the original nine planets including Pluto will be studied. The newly discovered planet will not be studied at the moment since it is not yet common.



Your Aims:

- identify the different planets
- describe the distances of the planets from the Sun
- identify the position of the Earth in the solar system

Planets in Our Solar System

Planets and dwarf or outer planets revolve around the Sun in our solar system are in order of their distance from the Sun, vary greatly in size, rotation, colour and composition. For instance, Mercury, a small, hot planet, is, on average, 58 million km from the Sun, while the icy dwarf planet Pluto is 5.9 billion km away. Venus rotates so slowly around its axis that one day on the planet equals 243 Earth days. Jupiter is the largest planet in the system, with a volume 1,400 times greater than that of Earth. Saturn has a broad set of rings and features more than forty satellites. Mars is orange in colour and has polar ice caps, while methane in the atmospheres of Uranus and Neptune makes these planets a bright blue-green. Frozen methane on the surface of Pluto gives the tiny world a pinkish colour.



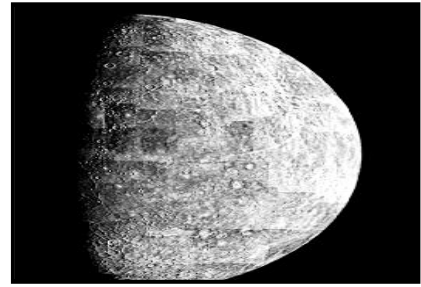
How many planets are there in our solar system?

There are nine planets in our solar system and let's have a look at them one by one in order. Let us start with the one nearest to the Sun.

After the Sun, the largest bodies in the solar system are the planets. The nine planets in the solar system are (in order from closest to the sun) Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto. They all have roughly circular orbits in the same plane, and most have at least one moon. They vary widely in size, temperature, composition, and distance from the Sun.

Mercury

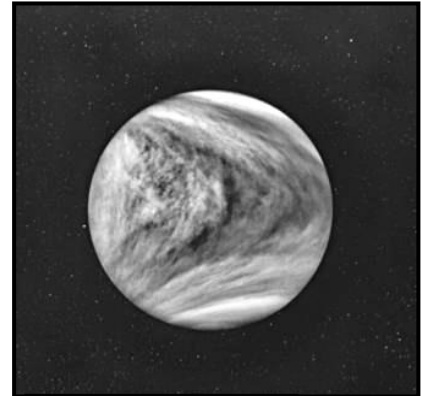
Mercury orbits closer to the Sun than any other planet and therefore it is dry, hot and virtually airless. Although the planet's cratered surface resembles that of the Moon, it is believed that the interior is actually similar to Earth's, consisting primarily of iron and other heavy elements. This composite photograph was taken in 1974 by Mariner 10, the first probe to study Mercury in detail.



Mercury

Venus

Venus is the brightest object in our sky after the Sun and Moon. Swirling or spinning clouds of sulphur and sulphuric acid obscure Venus's surface and inhibited study of the planet from Earth until technology permitted space vehicles, outfitted with probes, to visit it. These probes determined that Venus is the hottest of the planets, with a surface temperature of about 460° C. Scientists believe that a greenhouse effect causes the extreme temperature, hypothesizing that the planet's thick clouds and dense atmosphere trap energy from the sun.



Venus



The planet Venus is also known as the morning and the evening star.

Earth

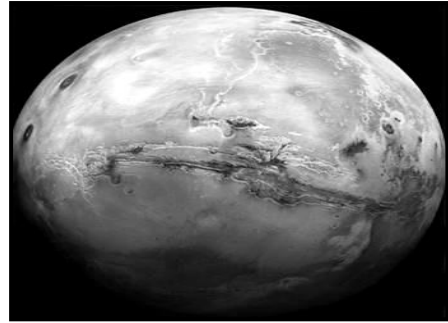
An oxygen-rich and protective atmosphere with moderate temperature, abundant water, and a varied chemical composition enable Earth to support life, the only planet known to harbour life. The planet is composed of rock and metal, which are present in molten form beneath its surface. The Apollo 17 spacecraft took this snapshot in 1972 of the Arabian Peninsula, the African continent, and Antarctica (most of the white area near the bottom)



Earth

Mars

Scientists have determined that the planet's atmosphere consists primarily of carbon dioxide, with small amounts of nitrogen, oxygen, water vapour, and other gases. Because the atmosphere is extremely thin, daily temperatures can vary as much as 100 Celsius degrees. In general, surface temperatures are too cold and surface pressures too low for water to exist in a liquid state on Mars. The planet resembles a cold, high-altitude desert.

**Jupiter and its Moons**

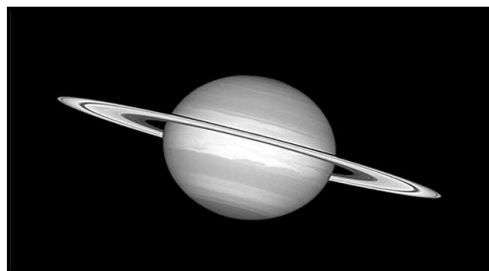
Jupiter is the largest of the planets, with a volume more than 1,300 times greater than that of Earth. Jupiter's colourful bands are caused by strong atmospheric currents and a dense cloud cover. The massive planet, upper right, is shown here with its four largest satellites or Moon.



The four satellites of Jupiter: Io, upper left, Ganymede, lower left, Europa, centre, and Callisto, lower right.

Saturn

Saturn, distinguished by its rings, is the second largest planet in the solar system. This processed Hubble Space Telescope image shows the planet's cloud bands, storms, and rings as they would appear to the human eye.



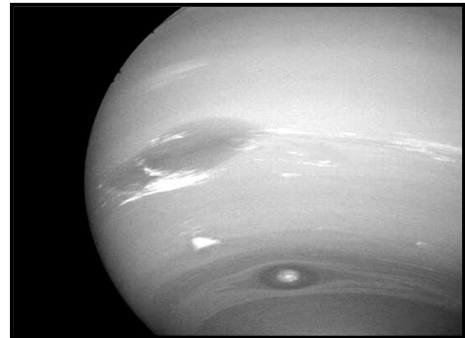
Uranus

Uranus's blue-green colour comes from the methane gas present in its cold, clear atmosphere. The dark shadings at the right edge of the sphere correspond to the day-night boundary on the planet. Beyond this boundary, Uranus's Northern hemisphere remains in a four-decade-long period of darkness because of the way the planet rotates. Scientists compiled this view of Uranus from images returned from Voyager 2 in 1986, when the probe was 9.1 million km away from the planet.



Neptune

This image of Neptune, taken by the Voyager 2 spacecraft, shows the planet's most prominent features. The large, dark oval surrounded by white clouds near the planet's equator is the Great Dark Spot, a storm similar to Jupiter's Great Red Spot. The smaller dark oval with a bright core below and to the right of the Great Dark Spot is another storm known as Dark Spot 2.



Pluto

Pluto is farther from the Sun than the major planets in the solar system, although it occasionally moves closer than Neptune due to an irregular orbit. The small, rocky, and cold planet takes 247.7 years to revolve around the Sun. This artist's impression depicts Pluto, foreground; its Moon, Charon, background; and the distant Sun, upper right.



REMEMBER: There are nine planets in our solar system, and their order from the Sun is Mercury, Venus, Mars, Earth, Jupiter, Uranus, Neptune, Pluto



I can remember the order of the nine planets by this sentence. **M**y **V**ery **E**xcellent **M**aster **J**ust **S**howed **U**s **N**ine **P**lanets.



Summary

You have come to the end of lesson 11. In this lesson you have learnt that:

- there are nine planets in the solar system.
- the nine planets in the order from the Sun are; Mercury, Venus, Earth, Mars, Jupiter, Saturn, Neptune, Pluto
- the closer the planet to the Sun the hotter it is.

NOW DO PRACTICE EXERCISE 11 ON THE NEXT PAGE.



Practice Exercise 11

Answer the following questions:

1. Name the nine planets in order from the furthest to the nearest to the sun.

2. How many moons does Jupiter have? Name them.

3. Which of the planet has rings around it?

4. Which planet is the second largest planet?

5. Which is the largest planet?

6. The brightest planet in the solar system is _____.

7. What is a planet?

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 2.

REVIEW OF SUB STRAND 2: SPACE EXPLORATION

Revise all the Lessons in this Sub Strand and then do **ASSIGNMENT 6**.

Here are the main points to help you revise.

Lesson 9: The Universe

- The Earth and the Solar System make up just a tiny part of the universe. The Universe makes up our Galaxy and millions of other galaxies
- The Galaxy is a system of stars, cloud of gas and dust particles that move together through the universe
- The Milky Way is the galaxy to which the Earth belongs.
- The Sun is a star at the centre of the of the Earths solar system

Lesson 10: The Solar System

- The solar system consists of the Sun and everything that orbits around it: the nine planets and their moons, comets, asteroids, and various other objects.
- The Sun is a huge ball of burning gas and is the centre of the solar system
- The nine planets including the Earth are found in the solar system.
- Comets are made of frozen lumps of gas and rock. They are dirty snowballs
- Asteroids are small pieces of rock and metal believed to be debris left over from collisions between other bodies in the solar system.

Lesson 11: The Planets in the Solar System

- Our planet, together with satellites and smaller bodies, forms part of the Solar System.
- The Earth is made up of three basic layers: the core, mantle, and crust.
- Most of the Earth is covered by water. This water is in the form of oceans, rivers, lakes, and groundwater. Some water is frozen
- Earth has just the right conditions for life. It is not too hot or too cold. Earth has lots of liquid water and an atmosphere (gases) that can support life.
- Earth's axis is slightly tipped, like a spinning top leaning to one side. The Earth spins or rotates on this axis. It takes 24 hours to rotate once.
- As Earth turns, half of the planet faces the Sun, and the other half faces away. It is daytime on the half facing the Sun. It is night on the half facing away from the Sun.
- Scientists think that Earth and the rest of the solar system formed from a spinning cloud of gas and dust.

REVISE WELL AND THEN DO SUB STRAND TEST 2 IN YOUR ASSIGNMENT 6.
--

Answers to Practice Exercises 9- 11

Practice Exercise 9

1. It was believed that the universe was formed by the big bang. / They thought that the universe exploded into being.
 2.
 - a) The Sun is a star. It is a huge ball of hot, burning gases
 - b) The Milky Way is the luminous band of stars encircling the heavens. These are the members of the galaxy
 - c) A Galaxy is a flat disc-shaped spiral structure, with a slight bulge at the centre. It is a system of stars, cloud of gas and dust particles that move together in the universe.
 3.
 - a) Star, Solar System, Energy
 - b) Galaxy
 4. By their shapes
 5. The Milky Way
-

Practice Exercise 10

1. The Solar System is a system that consists of the Sun and everything that orbits around it: the nine planets and their moons, comets, asteroids, and various other objects.
 2.
 - a) The Sun is a huge ball of hot, burning gases. It is the source of almost all the Earth's energy.
 - b) Asteroids are small pieces of rock and metal believed to be debris left over from collisions between other bodies in the solar system.
 - c) Comets are objects made up of gas, ice and dust. They travel around the Sun in an orbit.
 - d) An asteroid that survives the fall through the atmosphere and reaches the Earth's surface is called a meteorite.
 3. Four are Mercury, Venus, Mars and Earth.
-

Practice Exercise 11

1. Pluto, Neptune, Uranus, Saturn, Jupiter, Mars, Earth, Venus, Mercury
2. Three. Ganymede, Europa, and Callisto,
3. Saturn
4. Saturn
5. Jupiter
6. Venus
7. A planet is a heavenly body revolving in definite orbits about the Sun. Planets of our Solar system are the second largest after the Sun.

SUB STRAND 3

THE EARTH, THE SUN AND THE MOON

In this sub strand you will learn about:

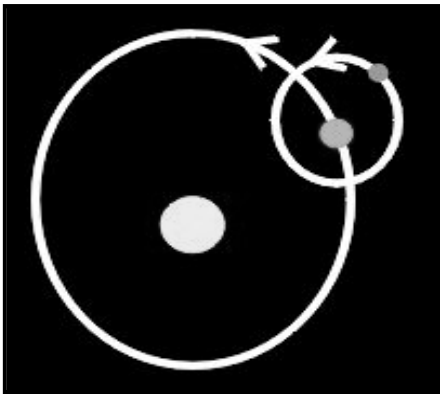
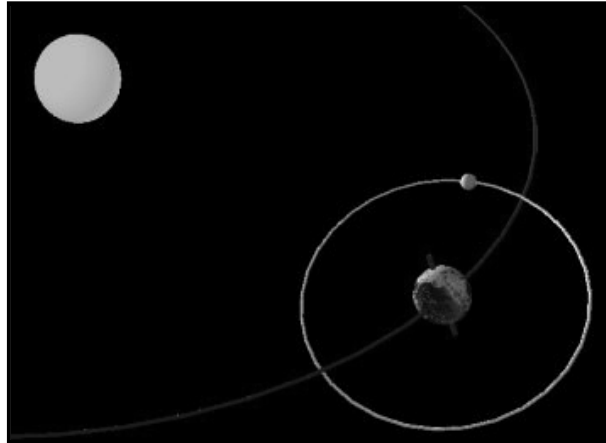
- **the Earth's rotation**
- **making day and night time**
- **the Earth's Moon**
- **seasons and tides**
- **the lunar and solar eclipse**
- **man in space**

SUB STRAND 3: THE EARTH, THE SUN AND THE MOON

Introduction

Earth, which is our base from which we look into space, is constantly moving. Understanding this movement is one of the most useful and important things in astronomy.

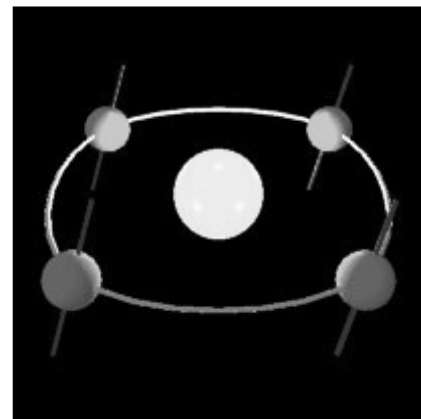
The Earth orbits the Sun in an elliptical orbit and the Moon orbits the Earth with the same kind of orbit. Looking down from the North Pole, the Earth spins in a counter clockwise direction on an imaginary line called its axis once every day. This accounts for the fact that the Sun rises in the east and sets in the west. The Earth's axis is tilted with respect to the plane of its orbit. If we position ourselves high above the North Pole, we would see that the Earth orbits the Sun in a counter clockwise motion,



coming to the same position among the stars every 365.26 Earth days. We would also see that the Moon also orbits the Earth in a counter clockwise motion.

The average distance from the Earth to the Sun, the semi major axis of its orbit was not known until recently and it is called the astronomical unit or AU. The distances of the other planets to the Sun are usually measured in astronomical units. Because of the tilt of the Earth, not every place on Earth gets light every day. Also, some places have extremely short days.

As the Earth revolves around the Sun, the place where light shines the brightest changes. This motion gives us the different seasons. For instance, the poles receive less light than does the equator because of the angle that the land around the poles receives the Sun's light. When the North Pole is tilted toward the Sun, the northern hemisphere is presented to the Sun at a greater angle than the southern hemisphere and the northern hemisphere gets warmer. When this happens, the northern hemisphere gets summer while the southern hemisphere gets winter. When the South Pole is tilted toward the Sun, the two seasons reverse hemispheres.



You may be asking,

- How the Earth rotates?
- What are lunar and solar eclipses?
- What causes tides?

In this Sub strand you will find the answers to these questions and all other questions relating to the Earth, Sun and the Moon.

Lesson 12: The Earth's Rotation



Welcome to Lesson 12 of Strand 4. In the last lesson you learnt about the planets in the solar system. In this lesson you will learn about the rotation of the Earth. Did you know that you are always rotating with the Earth yet you don't feel it? If you do not have any idea or you do know are little than this lesson will help you learn about how long and why planet Earth rotates including other heavenly bodies.

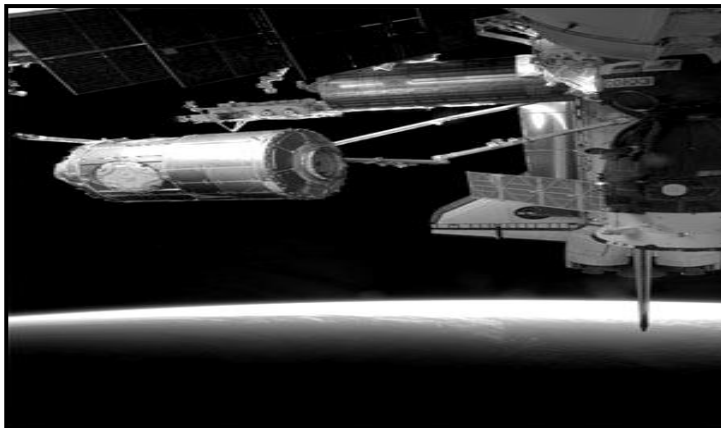


Your Aims:

- describe the Earth rotates
- describe the position of the Moon and the sun in relation to the position of the Earth

What Kinds of Things Orbit in Space?

The Moon, space shuttles and artificial satellites orbit Earth. Everything in our solar system orbits around the Sun. This includes asteroids, comets and planets. Moons orbit planets, which orbit the Sun.



How are orbits shaped?

An orbit can be shaped like a circle. Most orbits are oval-shaped like a racetrack. Planets, asteroids, and comets in our solar system have oval-shaped orbits. Another name for the oval shapes of orbits is ellipse.

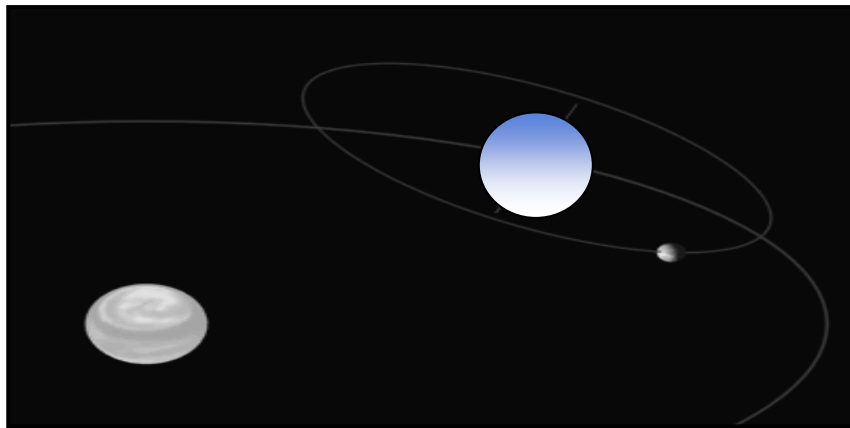
Some orbits are bigger ovals than others. The bigger the oval, the longer it takes something to orbit the Sun. It takes Earth one year, or 365 days, to go around the Sun. It takes Pluto 248 years to orbit the Sun. Pluto has an orbit that takes it very far from the Sun.

Most comets orbit the Sun in huge oval paths. Sometimes the orbital paths of these comets take them close to the Sun in the centre of our solar system. Sometimes their paths take them out to the edge of our solar system.

How do satellites orbit Earth?

Weather satellites, communications satellites, and other types of satellites take different paths around Earth. Some satellites orbit directly above Earth's equator. The equator is an imaginary line around the middle of the planet. The orbits of other satellites take them over the North and South poles.

Some communications satellites orbit at the same speed that Earth turns. They look like they are not moving. A satellite has to move at just the right speed to stay in its orbit above Earth.



The diagram shows a satellite orbiting the Earth

What keeps things in orbit?

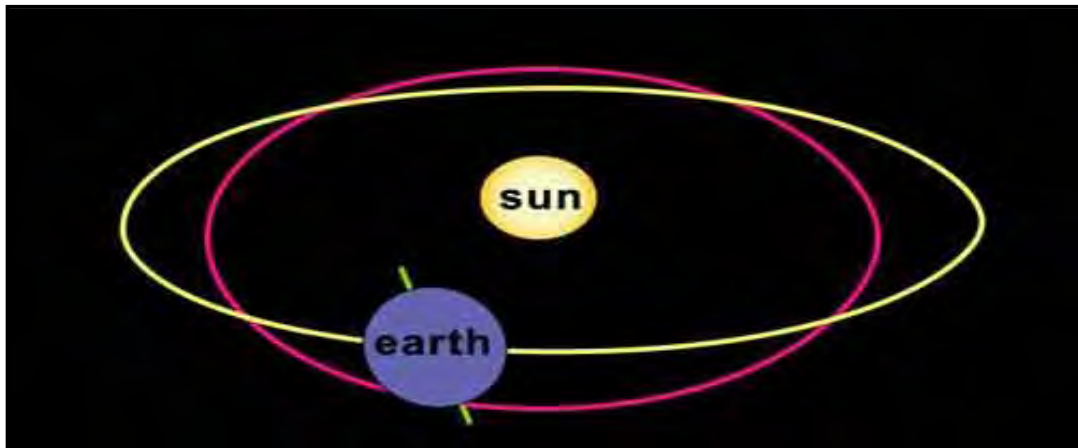
The force of gravity holds satellites, Moons, planets, and stars in orbit. Gravity is a force that pulls one thing toward another. When you throw a ball up in the air, Earth's gravity pulls it back down to the ground. The bigger something is, the stronger is its force of gravity.

The sun is very large and its gravity pulls on planets and everything else in the solar system. The sun's gravity makes the planets travel in a curved path around the sun. Earth's gravity holds the Moon and artificial satellites in curved paths around Earth. When a spacecraft goes fast enough, it can overcome the pull of the Earth's gravity. Rockets can make spacecraft move fast enough to head toward distant planets. Sometimes satellites in low orbits around Earth slow down. This happens when the satellites brush against faint air. Earth's gravity pulls slow-moving satellites down. The satellites fall toward Earth. Sometimes the satellites burn up in the air. Sometimes the satellites crash into the ocean.

Like all planets in our solar system, the Earth is in an elliptical or oval orbit around our sun. In Earth's case, its orbit is nearly circular, so that the difference between Earth's furthest point from the sun and its closest point is very small. Earth's orbit defines a two-dimensional plane which we call the ecliptic.

It takes roughly 365 days for the Earth to go around the Sun once. This means that the Earth is rushing through space around the Sun at a rate of about 67,000 miles per hour! The time it takes for the Earth to go around the sun one full time is what we call a year.

The combined effect of the Earth's orbital motion and the tilt of its rotation result in the seasons.



The earth is in an elliptical or oval orbit around the sun



Summary

You have come to the end of lesson 12. In this lesson you have learnt that:

- an orbit is a curved path going around something in space.
- an orbit can be shaped like a circle. Most orbits are oval-shaped like a racetrack.
- the Earth's orbit is nearly circular, so that the difference between Earth's furthest point from the sun and its closest point is very small. Earth's orbit defines a two-dimensional plane which we call the ecliptic.
- the combined effect of the Earth's orbital motion and the tilt of its rotation result in the seasons.

NOW DO PRACTICE EXERCISE 12 ON THE NEXT PAGE.



Practice Exercise 12

Answer the following questions:

1. Define orbit.

2. Describe the Earth's orbit.

3. List some of the objects that orbit in space.

4. How long does it take to orbit the Sun? _____

5. Draw a diagram to show how the Earth orbits the Sun.

A large, empty rectangular box with a black border, intended for the student to draw a diagram of Earth's orbit around the Sun.

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 3.

Lesson 13: Making Night and Day



Welcome to Lesson 13 of Strand 4. In the last lesson we discovered why planet Earth rotates and its effect on the Earth.

In this lesson you will do some activity on how to make night and day. You have already learnt the reason why we have nights and day.



Your Aim:

- perform a simple experiment to demonstrate night and day

How does day and night appear?



The aim of the activity below is to use a model to explain how the Earth's movement in space causes day and night.



Activity: Now test yourself by doing this activity.

Making Day and Night

You will need

1. A nice round fruit(about 7 cm in diameter)
2. Knitting needle or a long billum needle
3. A torch
4. 2 pins

Method

1. Carefully push the needle through the centre of the fruit. Be careful-it has a sharp point – Now you have a model of the Earth. There is no real axis going through the centre of the Earth. The model simply helps you understand how the Earth rotates. NOTE: Instead of the fruit ball and skewer you could use a geography globe
2. Draw a map of Papua New Guinea and Australia on the bottom half (Southern Hemisphere) of the fruit. Also draw in the directions North, South, East and West.

Represent yourself by a pin stuck in the fruit on where you live.

3. Turn on the torch. Hold the ball in the light. And observe the light.
 - What does the lighted half of the ball represent? What does the dark side represent?
-

4. Tilt the top of the ball away from the torch, keeping the pin representing you on the dark side.

- What happened at this time?

Turn the ball slowly from west to east.

Notice that the sun rises in the east.

5. Keep turning slowly until your pin reaches the lighted side of the ball.

- What happens at this time?

- In which direction will you look to see the sun rising?

6. Watch your shadow (from the pin) as you move from sunrise to sunset.

- How does its length and position change?

- How can you tell from you shadow when its midday.

7. Do all the places in PNG have day and night at the same time? Do all the places in Australia have day and night at the same time?

We should now know from the activity above how night and day is made.



Summary

You have come to the end of lesson 13. In this lesson you have learnt that:

- Earth makes a complete turn on its axis every 24 hours.
- as Earth turns, half of the planet faces the Sun, and the other half faces away. It is daytime on the half facing the Sun. It is night on the half facing away from the Sun.

NOW DO PRACTICE EXERCISE 13 ON THE NEXT PAGE.
--



Practice Exercise 13

Answer the following questions.

1. Do all the parts of the world experience day and night at the same time?

 2. In PNG, which province sees the sun rising first?

 3. Which province will be the last place to experience the last light?

 4. What causes the day and night?

-

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 3.

Lesson 14: The Moon



Welcome to Lesson 14 of Strand 4. In the last lesson you have demonstrated what causes nights and days on Earth. In this lesson you will look at the structure of the Moon, its orbit and the phases of the Moon.



Your Aims:

- describe the Moon and its structure
- describe the Moon's orbit and phases

People used to talk about —~~the~~ “the man in the Moon.” They would joke about the Moon being made of cheese with holes in it.

Although the Moon may seem small and unimportant compared to the rest of the universe, however its size and location make it very important to the Earth. Like the Sun it can be seen clearly in the sky. Because of this, humans have been fascinated by the Moon since ancient times. It has been studied from the Earth and space that in fact, more than 70 spacecraft have been sent on missions to the Moon. In addition, the Moon is the only place outside of the Earth that has been visited by humans.

The average distance of the Moon from the Earth is about 384,400 kilometres. This may seem like a great distance. However, compared to the distance of the Earth from other planets, the Moon is actually quite close.



A view of the near side of the Earth's moon shows some of the satellite's many craters.

REMEMBER: The Moon is the second brightest thing in our sky, after the Sun. The Moon doesn't make its own light. Light rays from the Sun bounce off it and make it shine. The Moon is closer to Earth than any other body in our solar system.

Physical features

The Moon is slightly more than one fourth the size of the Earth. It is made of solid rock. The surface is covered with a layer of dust consisting of fine-grained rock fragments. The Moon's landscape features include craters, mountain peaks, deep narrow valleys, and plains, which are sometimes called Maria.

1. Highlands

When looking at the Moon from the Earth, some areas appear light-colour and other areas appear dark-colour. The light areas of the Moon are the highlands. These highlands are covered with thousands of craters, some of them overlapping one another. Astronomers are not sure about their origin, though many believe that they are the result of meteorites hitting the Moon's surface. The highlands also contain mountain ranges.

2. Plains

The dark areas on the Moon are large plains, or Maria. The word Maria is the plural of the Latin word mare, which means —sea. It is believed that these plains are craters that were filled with lava billions of years ago.

Temperature

The Moon's temperature varies greatly depending on whether it is facing the Sun. When the surface faces the Sun during the Moon's day, the average temperature is about 107° C. At night on the Moon, when the Sun's rays do not reach the Moon's surface, the temperature cools to about –153° C.

Orbit and Spin

Like the planet, the Moon has two types of movement, known as orbit and spin. The orbit is the path that the Moon travels around the Earth. It takes the Moon about 27 days to make one orbit of the Earth.

The Moon also spins on its axis. The axis is an imaginary line that passes through its poles. It takes the Moon about the same amount of time to make one complete revolution on its axis as it takes it to orbit the Earth. For this reason, the same side of the Moon always faces the Earth.

REMEMBER: Like the planets, the moon has two types of movement, known as orbit and spin.

Formation of the Moon

No one knows for sure how the Moon was formed. By studying Moon rocks, scientists have learned that the Moon is about the same age as the solar system. They think that at that time something as big as a planet crashed into Earth when it was still molten. The collision blasted huge pieces of Earth into space and some of the pieces came together to make the Moon which also created the Moon's orbit around the Earth. Scientists continue to study Moon rocks for clues. There is still much to learn about the Moon.

REMEMBER: It is the relative positions of the earth, sun and the moon which cause moon phases in the sky. The phases of the moon depend on how much of the sunlit side of the moon faces the Earth.

Phases of the Moon

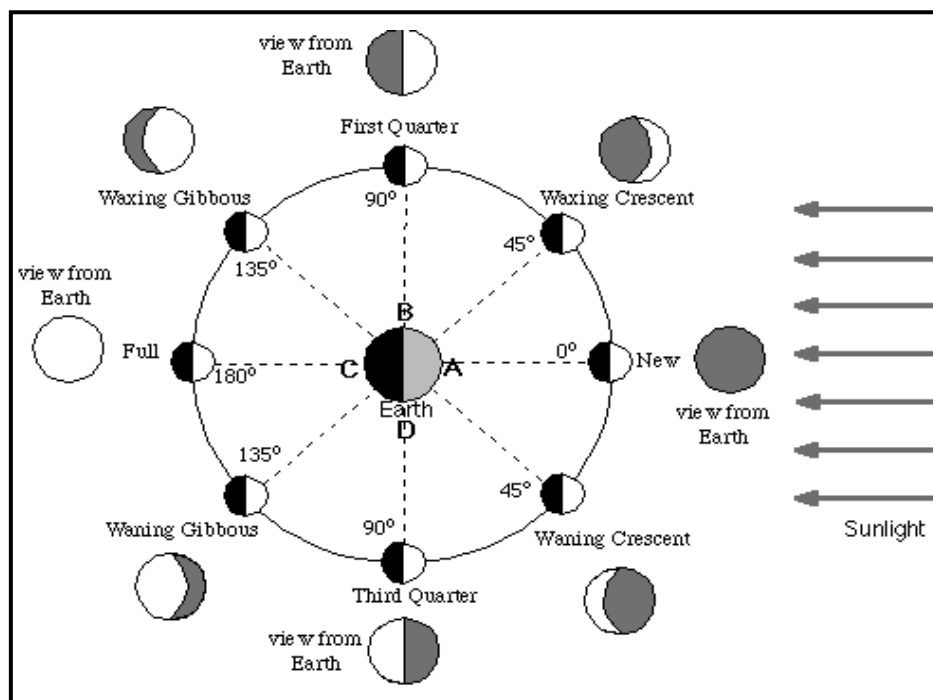
When viewed from the Earth, the Moon appears to go through different **phases**. Sometimes it looks like a full circle while other times it appears as only a thin crescent. This is because the Moon reflects the light from the Sun.

As the Moon travels around the Earth in its orbit different parts of the Moon are exposed to the Sun's light. When the Moon is on the other side of the Earth from the Sun, the Sun is shining directly on the Moon, and the Moon looks full. However, when the Moon is between the Sun and the Earth, the Moon looks dark since the Sun is behind the Moon.

In each cycle of the Moon's orbit around the Earth, the Moon displays four main phases: new (when the side of the Moon that faces the Earth is dark), first quarter, full, and last quarter. It takes the Moon about 29 days to complete this cycle. The phases of the Moon are the same everywhere on Earth, depending on the position of the observer.



Phases of the moon in 29



The phases in the Moon are; New Moon, Waxing Crescent, First Quarter, Waxing Gibbous, Full Moon, Waning Gibbous, Third Gibbous, and Wanning Gibbous. It takes the Moon to revolve around the Earth, about 29 days.

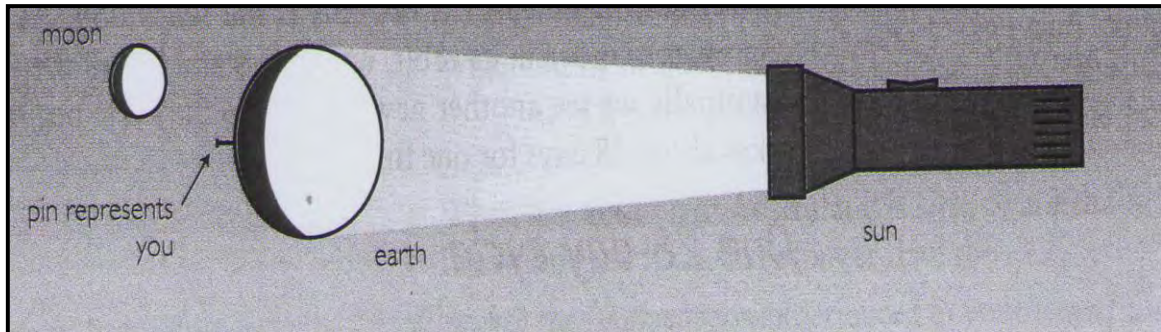
REMEMBER: It takes the moon about 29 days to complete this cycle. That is, as well as orbiting, the moon also spins on its axis



Activity: **Now test yourself by doing this activity.**

Phases of the Moon

For this activity you will need a partner, a globe, a small ball, a bright torch.



1. Arrange this equipment as shown in the picture.
2. Place the pin on the night side of the globe as indicated in the diagram.
3. Make a series of observations of the Moon's phases over a month.
4. Record the date, time and shape of the Sunlight side every two days starting from the new Moon in the West.

Note: The phases can even be seen during the day

One 29-day Cycle

First Quarter	Moonrise is about midday Reaches its highest position in the sky about Sunset Sets about midnight
Full Moon	Moonrise is about Sunset Reaches its highest position in the sky about midnight Sets about Sunrise
Last quarter	Moonrise about midnight Reaches its highest point in the sky about Sunrise Sets about midday

NOW DO PRACTICE EXERCISE 14 ON THE NEXT PAGE.



Practice Exercise 14

Answer the following questions:

1. What causes the phases of the Moon?

 2. How long does it take for the Moon to complete its set of phases?

 3. Is the Moon a luminous or a non-luminous object? Give your reason for your answer.

 4. Explain how the Moon was formed.

 5. List down the phases of the Moon in order.

A. _____	E. _____
B. _____	F. _____
C. _____	G. _____
D. _____	H. _____
 6. Define and explain the following terms.

Highlands

Maria

-

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 3.

Lesson 15: Seasons and Tides



Welcome to Lesson 15. In the last lesson you have looked at the Moon and its different phases. In this lesson you will look at the effects the Moon has on Earth.



Your Aims:

- define tides and seasons
- describe the relationship between the Sun and the Moon and how it causes tides
- state that seasons are caused by the Earth's orbit around the Sun



What causes seasons and tides?

Tides

Along the coastal areas the sea level changes on regular bases. The rise and fall of the sea level is called the **tide**. The greatest height reached as the water rises is known as **high tide**. The lowest level reached as the water falls is known as **low tide**. This is caused by the gravitational attraction of the Moon and the Sun.

Winds and currents move the surface water causing waves. The pull of the gravity of the Moon causes the oceans to bulge (or move towards) the direction of the Moon. Another bulge occurs on the opposite side, since the Earth is also being pulled toward the Moon (and away from the water on the far side). Ocean levels fluctuate daily as the Sun, Moon and Earth interact causing the world's oceans to rise and fall.



What are lunar tides?

There are many tides that occur on our coast lines. Lunar tide is a tide caused by the Moon. Tides are created because the Earth and the Moon are attracted to each other, just like magnets are attracted to each other. The Moon tries to pull at anything on the Earth to bring it closer. But, the Earth is able to hold onto everything except the water. Since the water is always moving, the Earth cannot hold onto it, and the Moon is able to pull at it. Each day, there are two high tides and two low tides. The ocean is constantly moving from high tide to low tide, and then back to high tide. There is about 12 hours and 25 minutes between the two high tides.



High Tides



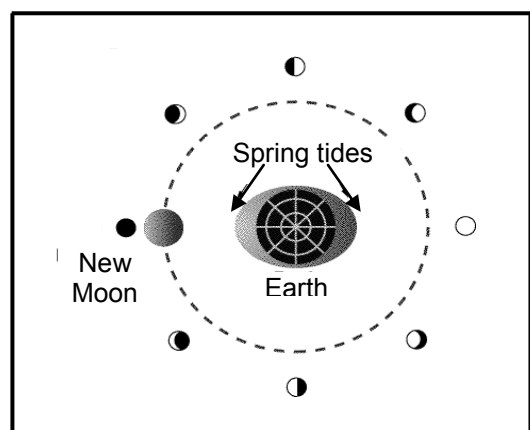
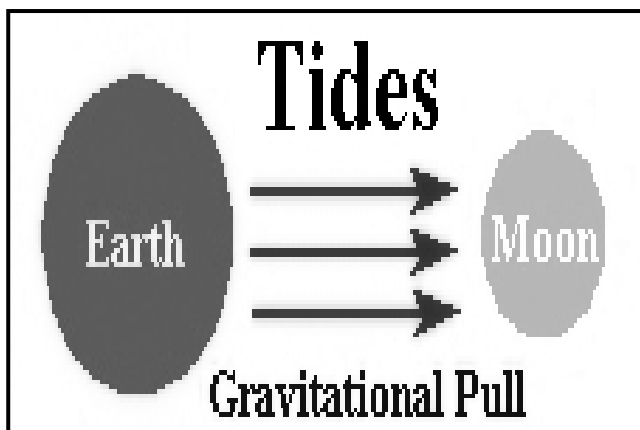
Low Tides

Different types of tides

When the Sun and Moon are aligned, there are exceptionally strong gravitational forces, causing very high and very low tides which are called **spring tides**. When the Sun and Moon are not aligned, the gravitational forces cancel each other and the tides are not so high and low. These are called **neap tides**.



The name spring tide has nothing to do with that season of the year.

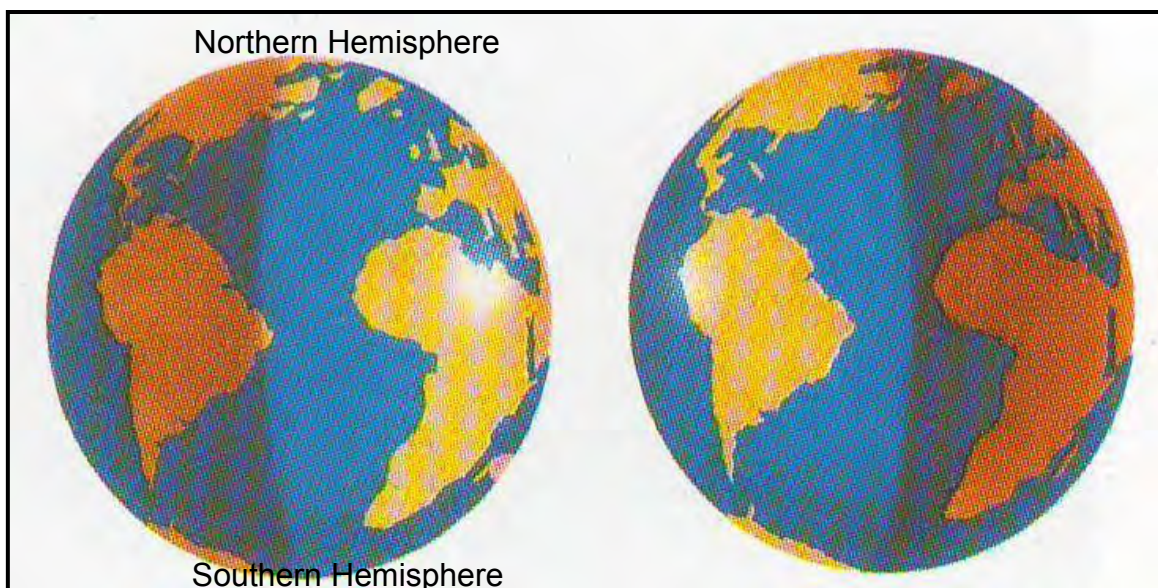
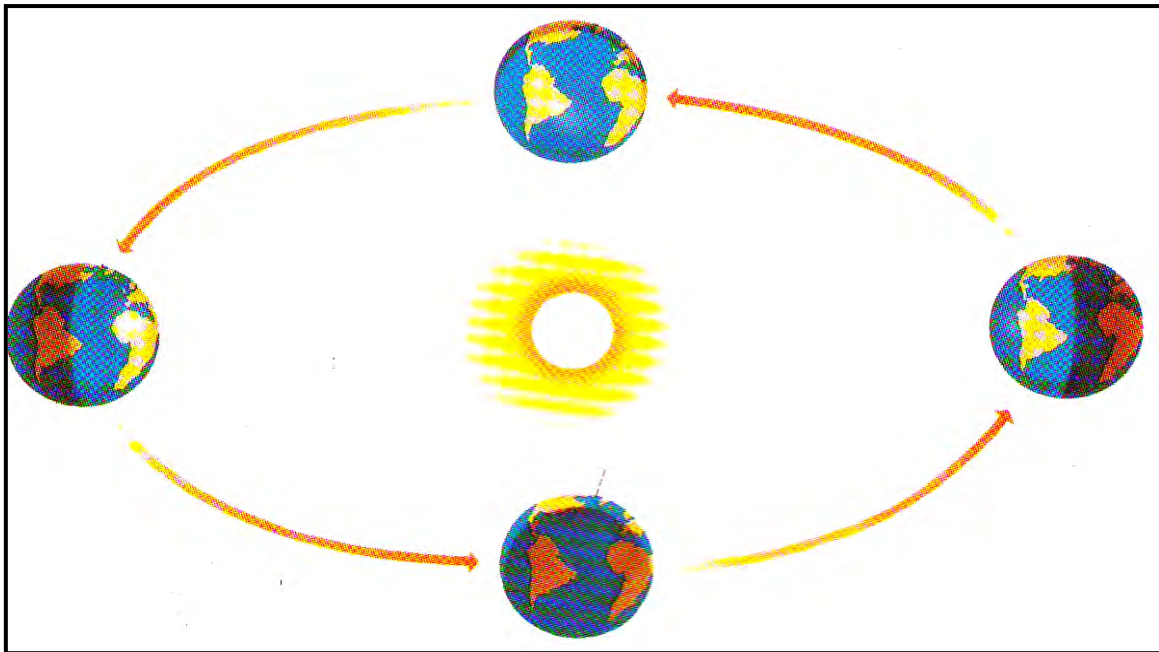


Seasons

Seasons are caused by the combination of the tilt of the Earth's axis and the Earth's revolution around the Sun. The particular season depends on whether the Earth's axis is tilted towards the Sun or away from it.

There are four seasons in a year, spring, summer, autumn and winter. Summer is much warmer than winter, and the days are longer. In Papua New Guinea we do not experience the four seasons, however we experience only two seasons that is the wet and dry seasons.

In the given diagram the southern Hemisphere is tilted towards the Sun. This means the Northern Hemisphere is tilted away from the Sun.





Summary

You have come to the end of lesson 15. In this lesson you have learnt that:

- the Moon is the single most important factor for the creation of tides.
- the Moon is pulling upwards on the water while the Earth is pulling downward, thus we have tides.
- whenever the Moon, Earth and Sun are aligned, the gravitational pull of the Sun adds to that of the Moon causing maximum tides.
- spring tides happen when the Sun and Moon are on the same side of the Earth (New Moon) or when the Sun and Moon are on opposite sides of the Earth (Full Moon).
- since the Moon moves around the Earth, it is not always in the same place at the same time each day.
- seasons are caused by the combination of the tilt of the Earth's axis and the Earth's revolution around the Sun.

NOW DO PRACTICE EXERCISE 15 ON THE NEXT PAGE.



Practice Exercise 15

Answer the following questions:

1. Define the following

a. Spring tide

b. Neap Tide

2. When does the neap tide occur?

3. When does the spring tide occur?

4. List down the four seasons?

5. What causes the seasons?

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 3.

Lesson 16: The Lunar and Solar Eclipse



Welcome to Lesson 16 of Strand 4. In the last lesson you learnt about how the gravitational effects of the Moon causes the tides in the sea and oceans. In this lesson you will explain and differentiate solar and lunar eclipses and describe how they occur.



Your Aims:

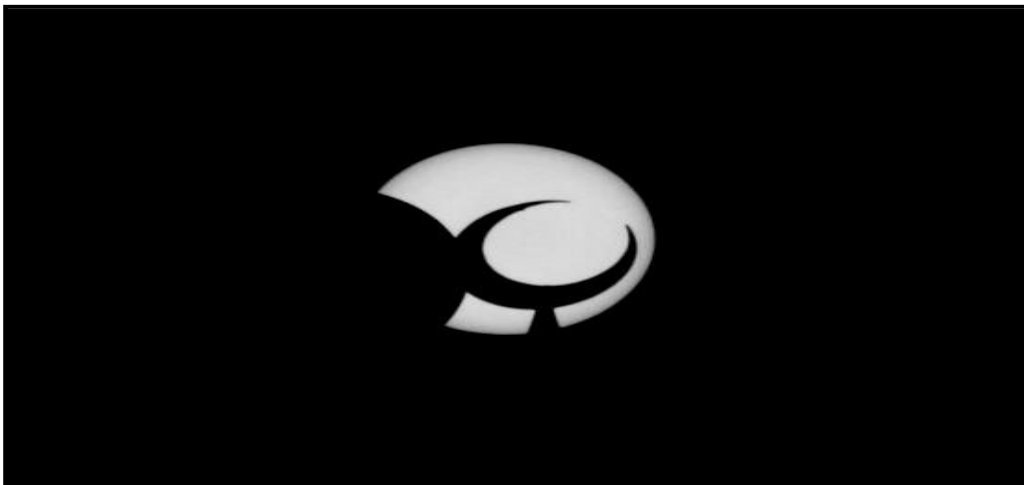
- define solar and lunar eclipse
- differentiate solar and lunar eclipse
- describe the position of the Sun, Moon and earth during an eclipse

Whoever has seen a total eclipse of the Sun has been fascinated by the experience. During such an event day turns to night as the Moon passes between the Sun and the Earth, blocking the Sun from the view of observers on Earth. This is called a solar eclipse. In general, an eclipse occurs whenever three objects in the sky line up in a row. The most familiar eclipses involve the Sun, the Moon, and the Earth, but they can involve other celestial or heavenly bodies as well.

In ancient times, solar eclipses inspired tremendous fear and wonder. People did not understand why the skies sometimes darkened in the middle of the day. They believed that the Sun had abandoned the Earth. Thus the word eclipse, which comes from Greek words meaning —to leave,” was used to describe this event. Today, most people understand that an eclipse is simply a scientific event that can be explained.

Eclipses

Sometimes the position of the Moon in relation to the Sun and Earth results in an eclipse. In astronomy, an eclipse occurs when one body is either completely or partially hidden from view by another body.



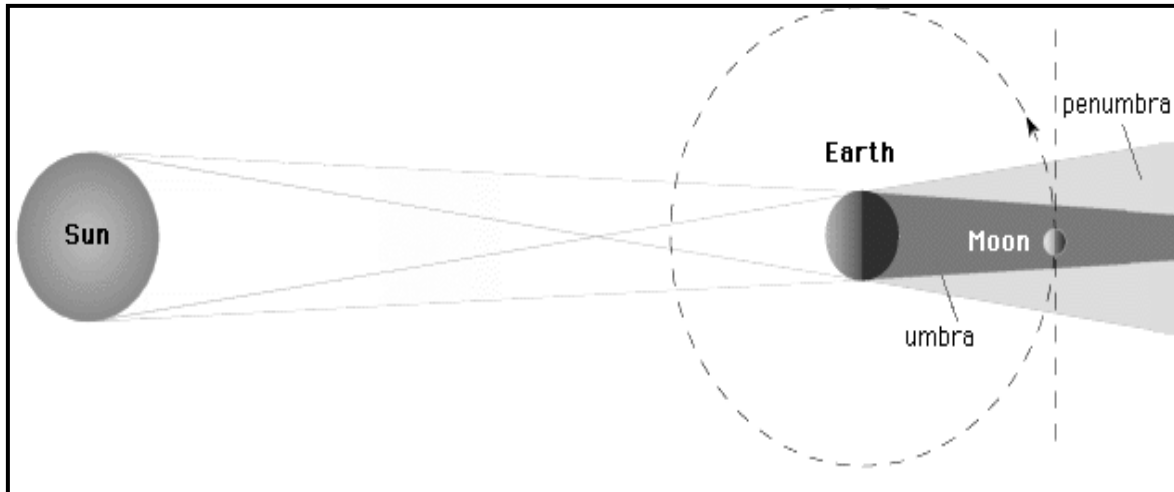
A crescent on the minaret of a mosque is reflected in the eclipse.

REMEMBER: An eclipse occurs when one body is either completely or partially hidden from view by another

Lunar eclipse

When the Earth comes between the Moon and the Sun, it prevents the Sun's rays from reaching the Moon. The Moon is then in the shadow of the Earth and is hidden from view. This is known as a lunar eclipse.

Lunar eclipses only occur when the Moon is full. During a lunar eclipse, the Sun,

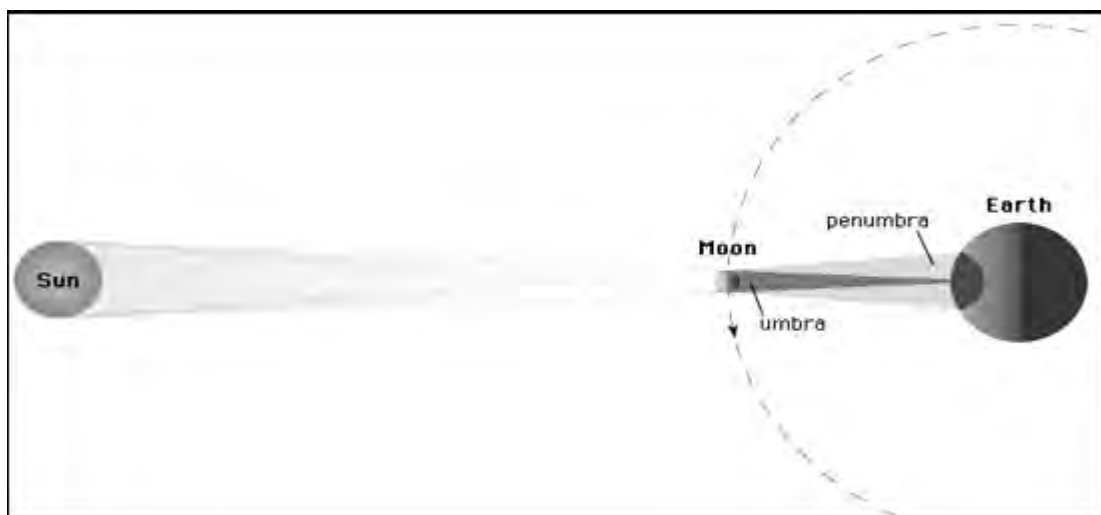


The diagram shows the lunar eclipse

Earth, and Moon once again line up. This time, however, the Earth is in the middle position between the Moon and Sun. When this occurs, the Earth blocks the Sun's light from reaching the Moon. This causes the Earth's shadow to be cast onto the Moon.

Solar eclipse

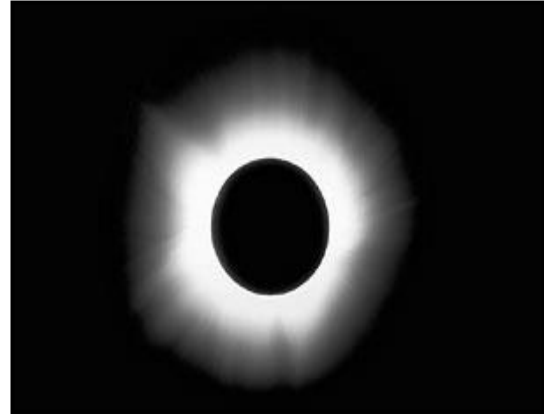
If the Sun, Earth, and Moon line up in a perfectly straight line, then the Sun's light is blocked completely. This is called a total eclipse. As the Moon moves in front of the Sun, the sky grows gradually darker. Finally the Moon moves into position, blocking out the Sun's light completely. This moment is called totality.



The diagram shows the solar eclipse

At this moment the Moon appears as a perfectly round black circle with what appears to be a ring of fire around it. This ring is the Sun's corona—the rays that surround the Sun's body.

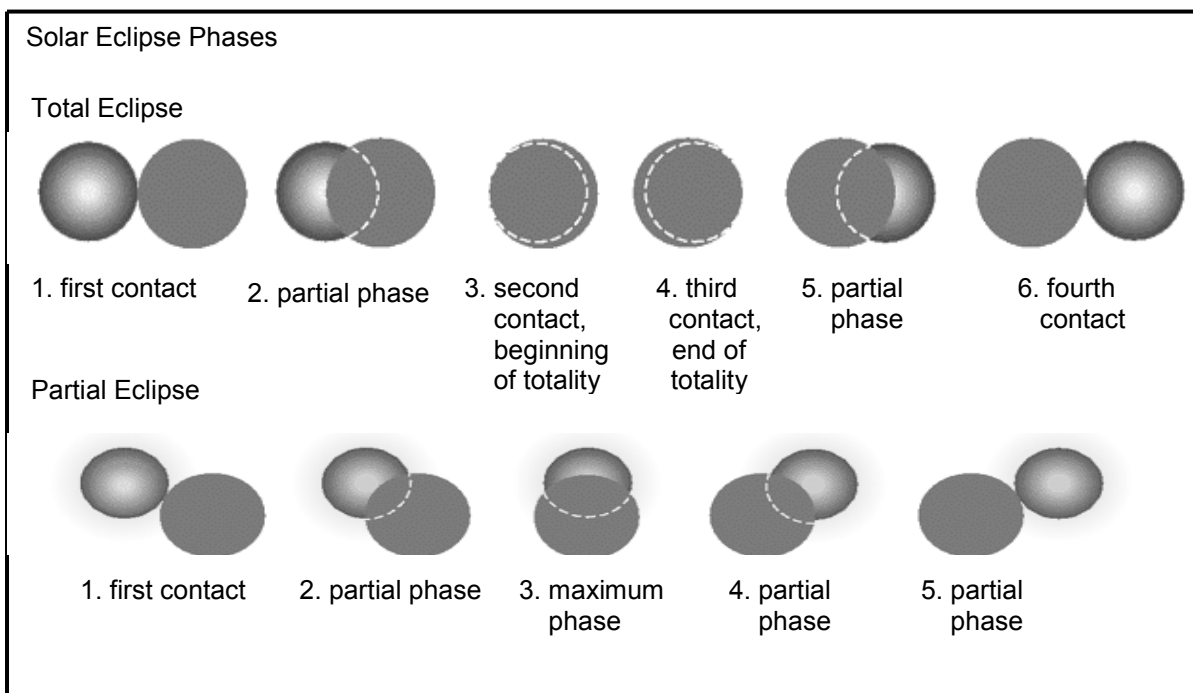
REMEMBER: Solar eclipse occurs when the Moon is in the middle position between the sun and earth.



Totally Eclipse of the Sun

Safety When Viewing an Eclipse

Looking directly at a solar eclipse is extremely dangerous and should never be attempted. The powerful rays from the eclipsing Sun will burn the eyes, causing serious and permanent damage. Wearing Sunglasses or trying to view the event through exposed film or smoked glass is also dangerous, as these items offer no true protection. Solar eclipses should only be viewed through special devices that allow the viewer to see the event indirectly. Lunar eclipses are completely safe to view with the naked eye.



REMEMBER: Lunar eclipses only occur when the moon is full. The lunar eclipse occurs when the Earth is in the middle position between the sun and moon.



Summary

You have come to the end of lesson 16. In this lesson you have learnt that:

- solar eclipse occurs when the Moon is in the middle position between the Sun and earth.
- lunar eclipses only occur when the Moon is full. The lunar eclipse occurs when the Earth is in the middle position between the Sun and Moon.
- an eclipse occurs when one body is either completely or partially hidden from view by another body.

NOW DO PRACTICE EXERCISE 16 BELOW.



Practice Exercise 16

Answer the following questions:

1. Explain what happens during a

a) Lunar Eclipse

b) Solar Eclipse

2. Define eclipse

3. What type of eclipse is safe to look at with a naked eye? _____

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 3.

Lesson 17: Man in Space



Welcome to Lesson 17 of Strand 4. In the last lesson you learnt about the different types of eclipse. In this lesson you will explore more about space. Hey believe it or not man had explored the space and have walked on Moon. You are therefore welcome to explore the space through lesson 17.



Your Aims:

- define astronomy, satellite, space, probes, shuttles, rocket, and astronauts
- state the reasons for men venturing into space

For thousands of years mankind wondered what could be found beyond the Earth's atmosphere. Some thought the earth was enclosed inside a glass ball, and that if a person could climb a mountain high enough they could touch the glass. Others told stories of the gods and spirits that first inhabited this universe. Today people no longer wonder, because we now can actually leave the Earth. Astronauts or have now advanced into more modernised technology.



But before we actually try to see how this is achieved, let's look at some of the important terms.

Four hundred years ago, Galileo Galilei kicked off a new age of astronomy when he first used his telescope to study the Moon and the planets of our solar system. Astronomy is the scientific study of the motion of the Sun, Moon, planets and stars.

Space Station

A space station is a spacecraft in a fixed orbit around the Earth. Astronauts can live on a space station for days or months at a time while they gather scientific data and perform experiments.

Probes

We have continued to send unmanned space vehicles or probes or space robot to view the Solar System and land on other planets. Some of their names are Mariner, Pioneer 10 and 11, Viking 1 and 2, Pioneer Venus 1 and 2, Voyager 1 and 2, Magellan, Galileo, Explorer, Ranger, Surveyor, Lunar Orbiter, and Clementine.

Space Shuttle

A shuttle is an ingenious cross between an airplane, and a rocket. The shuttle blasts into space on big rockets. Unlike previous spacecraft, which used Lander ships and could only be used once, the shuttle can land on Earth like an airplane and be used again. The first shuttle flew into space in 1981.

The shuttle has a big area called a cargo bay to hold large equipment. Astronauts on space shuttles launch satellites from the cargo bay. Some satellites study Earth from space, while others relay phone calls and other communications. Astronauts can also launch space telescopes from the shuttle.



The U.S. Space Shuttle Columbia completed its first mission in April 1981 and made several successive flights. It was followed by the Challenger, which made its first mission in April 1983. There after there have been many successful flights in a number of different shuttles.

What are satellites?

Satellites are objects in outer space that fly around planets in circular paths called orbits. Artificial satellites are made by people. Thousands of satellites are zooming around our planet right now.

The first artificial satellite, Sputnik 1, was launched by the Soviet Union in 1957. Sputnik 1 broadcasted a steady signal of beeps. It circled Earth for three months and then fell back into the atmosphere the air that surrounds Earth and burned up. Since Sputnik 1, more than 5,000 satellites from many countries have been launched. Artificial satellites now orbit the Sun, Mars, Venus, and other planets and their Moons. Most satellites, however, orbit Earth. High above your head thousands of satellites circle the planet every day.



Satellites orbiting the earth

How do satellites get into space?

Satellites need to reach a height of at least 200 kilometres to orbit. They also need to travel faster than 29,000 kilometres per hour. A satellite any lower or slower would soon fall back down to Earth. It takes a rocket to bring satellites up to that height and speed. Most satellites are launched from the ground. Some small satellites can be launched from high-flying planes. This uses less fuel. Other satellites are launched using a space shuttle or other piloted rocket. This way, astronauts on the space shuttle can make sure the satellite is working and gets into the right orbit.



Satellites orbiting the earth

How do satellites work in space?

Space is a difficult place to be. You can't plug in a cord in outer space, so satellites need to take a power source with them. It's hard to get satellites pointed in the right direction because there's nothing to turn them with. Satellites need to work in the freezing cold of Earth's shadow as well as in the blazing heat of the Sun's rays. They also need to be tough enough to survive collisions with tiny asteroids (space rocks)!

Most satellites use both power from the Sun and batteries to work. They catch the Sun's energy using large flat solar panels. Satellites keep these panels pointed at the Sun. They use batteries when the Sun doesn't shine on them.

No air flows past satellites to cool them. To keep from getting too hot in the Sun, satellites have panels that open and close. This lets heat escape. Satellites often spin so the Sun doesn't make one side so hot that it melts.

Rocket

A rocket looks like a long tube. Most rockets have fins on the back end to help them fly straight. Rockets that carry fireworks can be short, only a few inches long. They are usually made of cardboard. Rockets that go into space are huge. They are made mostly of metal.

Rockets burn fuel. Many different chemicals can be used as rocket fuel. The burning fuel makes hot gases. The gases blow out of the bottom end of the rocket. The hot gases shooting downward make the rocket go upward.

People use rockets to carry things through air and space. Different kinds of rockets carry different things.

Sounding rockets carry instruments to measure air pollution, rays from space, and weather. Lifesaving rockets carry ropes to ships stranded offshore. Distress rockets signal for help.



The most powerful rockets carry satellites and spacecraft into space. Many spacecraft use smaller rockets called thrusters to move around once they're in space. Rockets can also be used as weapons. The rocket weapons are called missiles. Most of the rockets made are missiles. Missiles are rockets that carry bombs.

**Activity: Now test yourself by doing this activity.**

You can see how a rocket moves by blowing up a balloon. Hold the end of the balloon tightly so the air cannot get out. Then let go. The air rushes out of the opening in the balloon. The air rushing out makes the balloon fly around. A rocket, like a balloon, has a small opening. The opening in a rocket is called a nozzle. Hot gases blasting out of the nozzle make the rocket move.

How do you launch a space rocket?

Big rockets are launched from launch pads. A rocket stands on the pad next to a tall tower. The towers have elevators to take workers up and down. Gigantic tractors called crawler transporters bring big rockets or the space shuttle to a launch pad.

Controllers count the seconds before launch as they finish checking everything. —“Five, four, three, two, one” Bridges that connect the tower to the rocket swing away. —“Ignition!” The rocket engines fire. The spacecraft lifts off into the sky.

Firing one rocket does not always provide enough power to send a spacecraft far from Earth. The most powerful rockets often have different stages. Stages are separate rockets stacked on top of each other.

Reasons for Space Exploration

Men and women are being sent into space for educational purposes as we discussed above, the Shuttle Program is one of NASA's most exciting endeavours. Through the work done by astronauts during these shuttle missions scientists learn the effects of weightlessness on humans, they learn how to make better equipment, they develop invaluable medical, and technological advances, and they set the stage for future exploration.

Satellites are used for a great many things. Communications satellites beam TV, radio, and telephone signals all around the world. Navigational satellites help people know where they are and get where they are going. Weather satellites take pictures of clouds and storms from above to help make weather forecasts. Spy satellites look down and snoop on other countries. Other satellites help scientists to study Earth and other planets.

Only astronauts can visit Outer Space, This is because a space shuttle mission is very expensive. However NASA is developing new space crafts that will eventually replace the Space Shuttle such as the x34 and x33. These space craft will make it several times cheaper to fly a space mission, and may eventually allow everyone to take a vacation in space. Maybe one day you will be able to have a nice holiday in space.





Summary

You have come to the end of lesson 17. In this lesson you have learnt that:

- satellites are objects in outer space that fly around planets in circular paths called orbits. Artificial satellites are made by people.
- astronomy is the scientific study of the motion of the Sun, Moon, planets and stars. People who study astronomy are called astronomers.
- a shuttle is an ingenious cross between an airplane, and a rocket. The shuttle blasts into space on big rockets.
- a space station is a spacecraft in a fixed orbit around the Earth.
- unmanned space vehicles or probes or space robot are sent continuously into space.
- men and women are being sent into space for educational purposes.

NOW DO PRACTICE EXERCISE 17 ON THE NEXT PAGE.



Practice Exercise 17

Answer the following questions:

1. Define the following.

a. Astronomy

b. Astronauts

c. Cosmonauts

d. Satellites

2. Describe how a space shuttle takes off and lands.

3. Give the main reason why man visit the space

CHECK YOUR WORK. ANSWERS ARE AT THE END OF SUB STRAND 3.

REVIEW OF SUB STRAND 3: THE EARTH, THE SUN AND THE MOON

Revise all the Lessons in this Sub Strand and then do **ASSIGNMENT 6**.
Here are the main points to help you revise.

Lesson 12: The Earth's Rotation

- An orbit is a curved path going around something in space.
- An orbit can be shaped like a circle. Most orbits are oval-shaped like a racetrack
- The Earth's orbit is nearly circular, so that the difference between Earth's farthest point from the Sun and its closest point is very small. Earth's orbit defines a two-dimensional plane which we call the ecliptic.
- The combined effect of the Earth's orbital motion and the tilt of its rotation result in the seasons

Lesson 13: Making Night and Day Time

- Earth makes a complete turn on its axis every 24 hours. As Earth turns, half of the planet faces the Sun, and the other half faces away. It is daytime on the half facing the Sun. It is night on the half facing away from the Sun.

Lesson 14: The Earth's Moon

- The Moon is the second brightest thing in our sky, after the Sun. The Moon doesn't make its own light. Light rays from the Sun bounce off it and make it shine. The Moon is closer to Earth than any other body in our solar system.
- Like the planets, the Moon has two types of movement, known as orbit and spin.
- It is the relative positions of the earth, Sun and the Moon which cause Moon phases in the sky. The phases of the Moon depend on how much of the Sunlit side of the Moon faces the Earth.
- It takes the Moon about 29 days to complete this cycle. That is, as well as orbiting, the Moon also spins on its axis.

Lesson 15: Seasons and Tides

- The gravitational force of the Moon is one ten-millionth that of earth, but when you combine other forces such as the earth's centrifugal force created by its spin, you get tides.
- The Sun's gravitational force on the earth is only 46 percent that of the Moon. Making the Moon the single most important factor for the creation of tides.
- The Sun's gravity also produces tides. But since the forces are smaller, as compared to the Moon, the effects are greatly decreased.
- Tides are not caused by the direct pull of the Moon's gravity. The Moon is pulling upwards on the water while the earth is pulling downward. Slight advantage to the Moon and thus we have tides.
- Whenever the Moon, Earth and Sun are aligned, the gravitational pull of the Sun adds to that of the Moon causing maximum tides.
- Spring tides happen when the Sun and Moon are on the same side of the earth (New Moon) or when the Sun and Moon are on opposite sides of the earth (Full Moon).
- When the Moon is at first quarter or last quarter phase (meaning that it is located at right angles to the Earth-Sun line), the Sun and Moon interfere with each other in producing tidal bulges and tides are generally weaker; these are called neap tides.
- Spring tides and neap tide levels are about 20% higher or lower than average.
- Offshore, in the deep ocean, the difference in tides is usually less than 1.6 feet
- The surf grows when it approaches a beach, and the tide increases. In bays and estuaries, this effect is amplified. (In the Bay of Fundy, tides have a range of 44.6 ft.)
- The highest tides in the world are at the Bay of Fundy in Nova Scotia, Canada.
- Because the earth rotates on its axis the Moon completes one orbit in our sky every 25 hours (Not to be confused with Moon's 27 day orbit around the earth), we get two tidal peaks as well as two tidal troughs. These events are separated by about 12 hours.
- Since the Moon moves around the Earth, it is not always in the same place at the same time each day. So, each day, the times for high and low tides change by 50 minutes.
- The type of gravitational force that causes tides is known as "Tractive" force.

Lesson 16: The Lunar and Solar Eclipse

- Solar eclipse occurs when the Moon is in the middle position between the Sun and earth.
- Lunar eclipses only occur when the Moon is full. The lunar eclipse occurs when the Earth is in the middle position between the Sun and Moon.
- An eclipse occurs when one body is either completely or partially hidden from view by another body.

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Lesson 17: Man in Space

- Our planet, together with satellites and smaller bodies, forms part of the Solar System.
- Astronomers study the heavenly body.
- Astronauts are people who go into space.
- Cosmonauts are people from Russia who go into space.
- Satellites are objects or planets that orbit another planet or object.
- A shuttle is an ingenious cross between an airplane, and a rocket. The shuttle blasts into space on big rockets and lands like a plane.
- People go into space especially for educational purposes.

REVISE WELL AND THEN DO SUB STRAND TEST 3 IN YOUR ASSIGNMENT 6.
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Answers to Practice Exercises 12- 17

Practice Exercise 12

1. An orbit is a curved path going around something in space.
2. The Earth's orbit is nearly circular, so that the difference between Earth's farthest point from the Sun and its closest point is very small. Earth's orbit defines a two-dimensional plane which we call the ecliptic.
3. Space shuttle, satellites, space ships, meteors, planets etc
4. One year or 365 days



Practice Exercise 13

1. No
 2. Bougainville
 3. Sundaun Province
 4. The Earths' rotation
-

Practice Exercise 14

1. It is the relative positions of the earth, Sun and the Moon which cause Moon phases in the sky. The phases of the Moon depend on how much of the Sunlit side of the Moon faces the Earth.
2. It takes the Moon to revolve around the Earth, 29 days 7 hours and 43 minutes. / accept 29 days or 28 days
3. It is a non-luminous object. It gets its light from the Sun.
4. From the collision of huge debris on the still molten Earth. The collision blasted huge pieces of Earth into space. Some of the pieces came together to make the Moon which also created the Moon's orbit around the Earth.
5. New Moon, Waxing Crescent, First Quarter, Waxing Gibbous, Full Moon, Waning Gibbous, Third Gibbous, and Wanning Gibbous
6. a. Highlands are the light areas of the Moon are known as the highlands.
b. Maria are the dark areas of the Moon

Practice Exercise 15

1. a. Spring tide is a high tide
 b. Neap Tide is a low tide
 2. Neap tides occur during quarter Moons. Neap tides happen when the Moon is in its first and third quarters.
 3. Spring tides occur during the full Moon and the new Moon.
 4. Spring, summer, autumn, winter
 5. Seasons are caused by the combination of the tilt of the Earth's axis and the Earth's revolution around the Sun. The particular season depends on whether the Earth's axis is tilted towards the Sun or away from it.
-

Practice Exercise 16

1. a) Lunar Eclipse Lunar eclipses only occur when the Moon is full. The lunar eclipse occurs when the Earth is in the middle position between the Sun and Moon.

 c) Solar eclipse occurs when the Moon is in the middle position between the Sun and earth.
 2. An eclipse occurs when one body is either completely or partially hidden from view by another body.
 3. Lunar Eclipse
-

Practice Exercise 17

1. a. Astronomy is the study of heavenly body.

 b. Astronauts are people who go into space.

 c. Cosmonauts are people from Russia who go into space.

 d. Satellites are objects or planets that orbit another planet or object.
2. A shuttle is an ingenious cross between an airplane, and a rocket. The shuttle blasts into space on big rockets and lands like a plane.
3. People go into space especially for educational purposes.

GLOSSARY

Astronauts	somebody trained to travel and perform tasks in space
Astronomy	the scientific study of the universe, especially of the motions, positions, sizes, composition and behaviour of astronomical objects
Cosmonauts	an astronaut in the space programs of Russia and the former Soviet Union
Eclipse	the partial or complete hiding from view of an astronomical object, e.g. the Sun or Moon, when another astronomical object comes between it and the observer
Galaxy	group of billions of stars and their planets, gas, and dust that extend over many thousands of light-years and forms a unit within the universe.
Lunar Eclipse	an eclipse of the Moon caused by Earth passing between the Sun and the Moon and casting its shadow on the Moon
Neap Tide	tide that shows the least range between high and low and occurs twice a month between the first and third quarters of the Moon
Milky Way	the spiral galaxy to which Earth and its solar system belong, appearing as a faint band of light in the night sky
Orbit	the path that an astronomical object such as a planet, Moon, or satellite follows around a larger astronomical object such as the Sun
Seasons	traditional division of the year based on distinctive weather conditions. In temperate regions, there are four seasons, spring, summer, fall, and winter, while in tropical countries there are often only two, a dry season and a rainy season.
Solar Eclipse	an eclipse in which the Moon blocks all or part of the Sun's light from reaching the Earth's surface, because it passes directly between the Earth and the Sun
Solar System	the Sun and all the planets, satellites, asteroids, meteors, and comets that are subject to its gravitational pull
Spring Tides -	a tide that occurs near the times of the new Moon and full Moon and has a greater than average range
Tides	the cyclic rise and fall of the ocean or another body of water produced by the attraction of the Moon and Sun, occurring about every twelve hours
Universe	the totality of all matter and energy that exists in the vastness of space, whether known to human beings or not

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FODE PROVINCIAL CENTRES CONTACTS

PC NO.	FODE PROVINCIAL CENTRE	ADDRESS	PHONE/FAX	CUG PHONE (COORDINATOR)	CUG PHONE (SENIOR CLERK)
1	ALOTAU	P. O. Box 822, Alotau	6411343/6419195	72228130	72229051
2	BUKA	P. O. Box 154, Buka	9739838	72228108	72229073
3	CENTRAL	C/- FODE HQ	3419228	72228110	72229050
4	DARU	P. O. Box 68, Daru	6459033	72228146	72229047
5	GOROKA	P. O. Box 990, Goroka	5322085/5322321	72228116	72229054
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22	WEWAK	P. O. Box 583, Wewak	4562231/4561114	72228122	72229062

FODE SUBJECTS AND COURSE PROGRAMMES

GRADE LEVELS	SUBJECTS/COURSES
Grades 7 and 8	1. English
	2. Mathematics
	3. Personal Development
	4. Social Science
	5. Science
	6. Making a Living
Grades 9 and 10	1. English
	2. Mathematics
	3. Personal Development
	4. Science
	5. Social Science
	6. Business Studies
	7. Design and Technology- Computing
Grades 11 and 12	1. English – Applied English/Language & Literature
	2. Mathematics - Mathematics A / Mathematics B
	3. Science – Biology/Chemistry/Physics
	4. Social Science – History/Geography/Economics
	5. Personal Development
	6. Business Studies
	7. Information & Communication Technology

REMEMBER:

- For Grades 7 and 8, you are required to do all six (6) subjects.
- For Grades 9 and 10, you must complete five (5) subjects and one (1) optional to be certified. Business Studies and Design & Technology – Computing are optional.
- For Grades 11 and 12, you are required to complete seven (7) out of thirteen (13) subjects to be certified.

Your Provincial Coordinator or Supervisor will give you more information regarding each subject and course.

Notes: You must seek advice from your Provincial Coordinator regarding the recommended courses in each stream. Options should be discussed carefully before choosing the stream when enrolling into Grade 11. FODE will certify for the successful completion of seven subjects in Grade 12.

GRADES 11 & 12 COURSE PROGRAMMES			
No	Science	Humanities	Business
1	Applied English	Language & Literature	Language & Literature/Applied English
2	Mathematics A/B	Mathematics A/B	Mathematics A/B
3	Personal Development	Personal Development	Personal Development
4	Biology	Biology/Physics/Chemistry	Biology/Physics/Chemistry
5	Chemistry/ Physics	Geography	Economics/Geography/History
6	Geography/History/Economics	History / Economics	Business Studies
7	ICT	ICT	ICT

CERTIFICATE IN MATRICULATION STUDIES		
No	Compulsory Courses	Optional Courses
1	English 1	Science Stream: Biology, Chemistry and Physics
2	English 2	Social Science Stream: Geography, Intro to Economics and Asia and the Modern World
3	Mathematics 1	
4	Mathematics 2	
5	History of Science & Technology	

REMEMBER:

You must successfully complete 8 courses: 5 compulsory and 3 optional.