

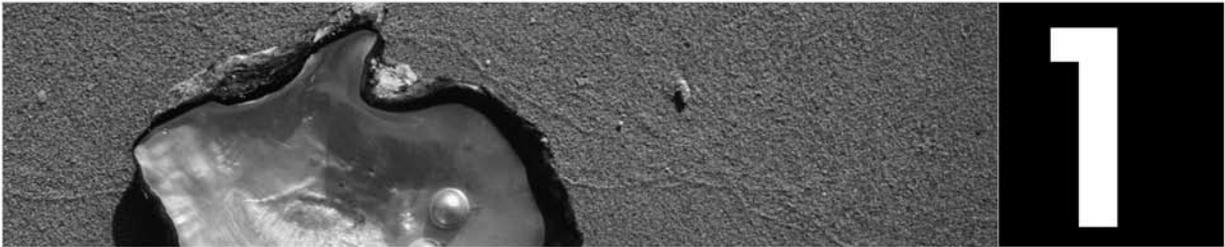
GEOGRAPHY

Teaching Guide

Alive

PETER MOSS

Revised Edition



A Geography Course for Secondary Schools

OXFORD
UNIVERSITY PRESS



CONTENTS



Page

2 The Universe

5 The Earth

9 The World of Rocks

12 Plate Tectonics

14 Mountains

16 The World of Water

19 The Water Table

21 Smaller Bodies of Water

24 The Sea

26 Currents

28 The World of Air

30 Winds

32 Weathering, Erosion, and Deposition

36 The World of Maps

39 Longitude and Latitude

42 Weather and Climate

45 Natural Vegetation—Tropical

49 Natural Vegetation—Temperate

51 The World of Work

55 Industries and Services

57 Settlements

60 Lesson Plans

78 Assessments



THE UNIVERSE

Pupil's Book 1-6

Distance

Even adults find it extremely difficult to grasp the vast distances that make up the Universe. A light-year, for example, is totally incomprehensible to us because we have nothing to relate it to.

We can measure the speed of light very accurately indeed: it travels 299,792.458 kilometres/second. This measurement is so accurate that it is now used to define the scientific length of a metre. A metre is the distance light will travel in $1/299,792,458$ seconds. This highly accurate measurement is a long way off from Napoleon's definition. When the metric system was initially introduced in the early 19th century, it was thought that the distance between the North Pole and the Equator was $1/100,000,000$ metres.

Nebula and galaxy

The words nebula and galaxy are loosely interchangeable. Although we often refer to the Milky Way as 'the Galaxy', there are many others in outer space. The Andromeda Nebula, the closest to the Earth at two million light-years away, was first described by the Muslim scholar As-Sufi in his Book of Fixed Stars in AD 964. It was not rediscovered until 1612, after the invention of the telescope.

The planets

Five of the planets were known in antiquity: Venus, Mars, Mercury, Saturn, and Jupiter. Uranus was discovered in 1781 and Neptune in 1846. Because all the planets exert a gravitational pull, the last two to be discovered were forecast long before instruments were sophisticated enough to detect them. The orbits of those that could be observed showed inexplicable variations, which seemed to indicate that there were other planets affecting them.

Magnets

Magnets always amuse pupils. A quite dramatic experiment is to place a magnet under a sheet of paper and sprinkle iron filings on top, obtained perhaps from the school laboratory. The filings will arrange themselves in patterns showing the lines of magnetic force.

Gravity

Pupils will find it hard to believe that in a vacuum all bodies fall at the same speed under the influence of gravity. A lump of lead and a feather released together will hit the bottom at exactly the same time. In real life, of course, the passage through air will slow down the lighter body.

If a tunnel could be made right through the Earth to the opposite side, an object dropped in it would shoot past the centre, nearly to the other side, and then fall back, going to and fro until it finally came to rest in the centre. One can compare this with a pendulum: a weight on a piece of string pulled to one side and released will shoot past the centre and then come back. It will overshoot the other side and repeat the process, slowing down gradually until it comes to rest vertically.

Centrifugal force

Centrifugal force (from the Latin *fugo* or 'I flee from') means 'flying from the centre'. This can easily be demonstrated in class with a weight on the end of a piece of string. (Do not use anything too heavy or it might do some damage when released!)

Weightlessness

This topic intrigues children, who love speculating how high a person can jump on different planets. However, it is also a very serious practical consideration for astronauts. Ask pupils to make a list of problems that astronauts would encounter in everyday life in a spaceship. Some suggestions include: (a) They float in the air and have to hold onto handles to move about. (b) Blowing strongly from the mouth will send them backwards in a kind of rocket propulsion. (c) Eating and drinking are serious problems, so food is generally packed in tubes which are squeezed into the mouth. (d) Astronauts can digest food because the digestive system depends on muscular contraction and not on food simply falling down the intestines. However, toilet facilities are a problem. Astronauts are often given food with very low residue although that creates other health problems.

The problems of weightlessness have still not been properly evaluated. As longer and longer space voyages are undertaken, it is essential that scientists come up with a workable solution. The main consideration is human muscles which, unless exercised, start to wither away. In the earlier days of space exploration, men often had to be supported, or even carried, out of the capsules on their return. Now exercise machines are fitted into spaceships so that astronauts can at least keep relatively fit. Even more insidious is the loss of calcium in the bones, which weakens the skeletal structure and leads to symptoms similar to osteoporosis.

Answers to Pupil's Book page 7

1. The Moon—non-stop 24 hours a day would take 7 years 109 days. Mars, as it is nearest to Earth, over 100,000 years. And at the same time it is ten times as far away.
2. Eight; elliptical orbits (a) Mercury (b) Venus (c) Earth (d) Mars (e) Jupiter (f) Saturn (g) Uranus (h) Neptune
3. (a) A year is the time the planet takes to make one orbit round the Sun.
(b) Earth—365.3 days, Neptune—60, 191 days, Mercury—88 days
4. (a) The length of a day is determined by the time the planet takes to make one complete rotation.
(b) Earth 24 hours; Jupiter: 10 hours; Venus: 8 months
5. (a) Gravity is a force which pulls everything towards itself.
(b) If there was no gravity or centrifugal force everything would just float about in the air whenever it was put.
6. (a) Centrifugal force is the force which tries to pull everything away from the centre.
(b) Centifugal force balances the force of gravity and makes us able to walk and move.
7. A planet is a body which rotates in an orbit around a sun. A star is another sun in the universe—if we could see them it will have its own planets going around it.
8. Individual work

Additional exercise

MCQs

Choose the correct answer:

1. In order to measure the distance in space, the scientists use a unit of measurement called:
 - a. kilometre
 - b. light years
 - c. metre **(light years)**

2. The planets move around the Sun in:
 - a. a circle
 - b. an elliptical orbit
 - c. a square **(an elliptical orbit)**

3. Our Moon turns on its axis once in:
 - a. 27.25 days
 - b. 30 days
 - c. 25.5 days **(27.25 days)**

4. A _____ consists of a 'head' made of dust and ice and a 'tail' of shiny, bright particles of gas.
 - a. meteor
 - b. planet
 - c. comet **(comet)**

5. Centrifugal force is the opposite of:
 - a. electricity
 - b. gravity
 - c. motion **(gravity)**

THE EARTH

Pupil's Book 8-15

The edge of the world

It seemed obvious to earlier people that the Earth was flat. Wherever they went (as long as they were not climbing mountains), the land was level. They knew too that if they climbed a tree and slipped, they fell to the ground. In the same way, they thought that they would fall off the edge of the world—although no one ever seemed to have thought where they would fall to. Pupils might remember from their history lessons that when Alexander the Great was in northern India he wanted to go to the edge of the world, which he thought was somewhere to the east—probably where Calcutta is today.

The early Greeks

The Greek philosopher Pythagoras (of theorem fame) postulated a spherical Earth in 6th century BC; Aristotle in the 4th century BC agreed. In the 3rd century BC, Eratosthenes calculated that the circumference of the Earth was the equivalent of 46,250,000 metres. Today we know that the actual length is 40,075,000 metres. It is incredible that he was able to come this close to the real figure without the sophisticated instruments we have today.

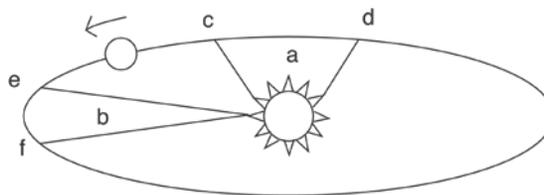
Early people's views of the Sun and the Moon

Early people saw the obvious movements of the Sun and the Moon in the night sky. The Moon particularly intrigued them because of its phases. To them, the logical answer to this puzzle was that the Moon was being eaten by a monster or dragon. The Sun, like the Moon, was personified as a god. The Greeks called their Sun god Apollo, who drove a golden chariot across the sky. The Moon, on the other hand, was usually associated with a goddess—Luna or Diana.

From early times, the Moon has been associated with madness; if one slept facing the full Moon, one was supposed to become mad. The word 'lunatic' comes from luna, the Latin word for the Moon.

Kepler

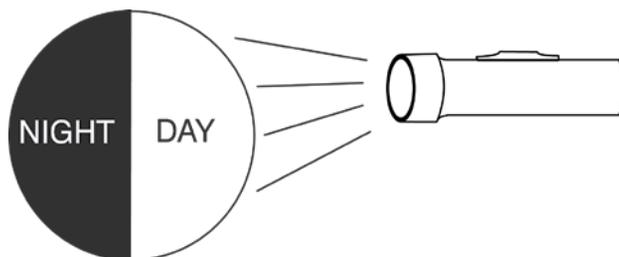
The 16th/17th century German scientist, Johannes Kepler (1571-1630), made the first important mathematical discoveries about the orbits of the planets. Kepler's laws enabled future astronomers to make more advanced discoveries. The first two laws recognized the elliptical orbits of planets, while the third related the distance of the planets from the Sun to their orbital periods. Kepler was also the first to suggest that tides were caused by the gravitational pull of the Moon.



Kepler's Equal Areas in Equal Times. The areas (a) and (b) swept out by each planet in the same time are equal. This means that the planet must have been travelling much faster from (c) to (d) than from (e) to (f).

The effect of day and night can be easily demonstrated in class with a globe (or a large ball) and a torch. If the room can be darkened, the demonstration will be much more effective.

At this stage, it is better to ignore the tilting of the Earth, which will be dealt with in the section on climate (the Poles have months of continuous darkness and continuous daylight).



Seasons

This is an important aspect of geography, but a difficult one to convey to pupils. If possible, a globe or a large ball can be pressed into service again, with conspicuous lines drawn on the ball to indicate the Equator and Tropics. The main thing in a demonstration of this sort is to make sure that the axis is kept inclined at the same angle.

Latitude is mentioned on page 12 of the Pupil's Book (23.5° north and south of the Equator). Although latitude is dealt with later (p.79), it might be worth explaining briefly here. Take a vertical cross-section of the Earth with the Equator as a diameter. From the centre of the 'Earth', mark off with a protractor the degrees. Lines vertically straight up and down to the poles will be at 90° to the Equator line. These are called 90° North or South. Thus, 45° North will form a line that runs through northern Japan, southern France and Ottawa, Canada; 45° South will run through southern New Zealand and southern Argentina and Chile. A good Mercator map should make this clear. An angle of 23.5° North and South extended to the surface of the Earth forms the Tropics of Cancer and Capricorn. Although, of course, there is no marking on the surface of the Earth, these lines indicate the furthest points north or south where the Sun is overhead.

Stars and star signs

Some people believe that the constellation or group of stars which were high in the sky at the moment of their birth influence what kind of people they are, and what their futures might be. Ask pupils if they believe in this theory.

This is how a well-known astrologer in the west suggests that the dates of our birth influence our lives. What follows is only a broad outline of three zodiac signs. In return for payment, this astrologer gives customers a much fuller interpretation based on their exact time of birth.

- | | |
|----------------------------------|--|
| 19 February to 19 March | Pisces: Sensitive, intuitive, creative. Needs a strong partner as not good at practical affairs. |
| 21 August to 20 September | Virgo: Useful, likes to serve. Painstaking in detail. Critical. Hard-working. |
| 21 October to 20 November | Scorpio: Strong, a survivor, loyal and determined. But do not cross them. Secretive. |

Sun and climate

Emphasize that towards the polar regions the heat from the Sun has to pass through a much thicker layer of cloud and dust so that more warmth is lost or reflected. In addition, more heat is lost because the same amount of energy is spread over a larger area due to the slope of the globe. You can demonstrate this by holding a hand vertically in front of an electric fire (or even the Sun) and then tilting it so that it is at 45° or more to the heat. Ask pupils if they feel any difference.

Global warming is dealt with more fully later but might be worth mentioning here as it relates to the blanket of air round the Earth. Some of the heat which reaches Earth from the Sun is re-radiated back into space as infra-red rays. Fortunately, the layer of atmosphere, and especially the carbon dioxide in it, stops a great deal of this heat from disappearing into space. The heat is trapped in the atmosphere rather like the warmth in a greenhouse. If it were not for this, the average temperature of the Earth would be about -73°C. All the oceans would be frozen. Today, we are pouring more and more carbon dioxide into the atmosphere by burning fossil fuels in factories and motor vehicles. The increased amount of carbon dioxide in the atmosphere is like putting another thick blanket on a bed—it keeps in more heat.

As a result, the temperature of the Earth is steadily rising (global warming) and it is reckoned that by the middle of the 21st century, the average temperature will have risen by 5°C. Ask pupils what the effects of this will be: melting of much of the polar ice caps with a dramatic rise in sea levels, flooding countries such as Bangladesh; a change of climate which will affect crops; drier seasons.

Perhaps discuss what can be done about this: the whole world knows what is happening, but leaves it to everyone else to do something about it. The United States is the worst culprit, producing about one-quarter of all the carbon dioxide pollution on Earth. Yet it refuses to do anything significant about it. Less wealthy countries argue that they don't want to give up burning fossil fuels because they need to catch up with more developed countries. In any case, they argue, they produce far less pollution than more developed nations.

Answers to Pupil's Book page 16

1. (a) Seen from a height, the horizon is always curved; (b) when you see a ship approaching land, you first see the tip of the masts, then the funnel, then the bridge, and finally the whole ship; (c) photographs from space show that the Earth is clearly a sphere.
2. (a) The Earth is spinning on its axis and also spinning round the Sun in orbit. (b) In Pakistan, you are moving approximately 1400 kilometres/hour as the Earth revolves on its axis, and 108 000 kilometres/hour as the Earth orbits the Sun. (c) Because everything else is travelling at the same speed.
3. 23.5° to the vertical; this causes the Earth to experience different seasons.
4. See page 10 of the Pupil's Book. The Sun can only light up half of the world at a time. The side facing the Sun has day, while the side away from the Sun has night. As the Earth revolves, these light and dark areas move round the globe.
5. (a) The Tropics are two imaginary lines 23.5° north and south of the Equator. These represent the furthest point north (Cancer) and south (Capricorn) that the Sun is directly overhead at midsummer and midwinter. (b) No.

6. See page 15 of the Pupil's Book.
7. Individual work. Pupils should be asked to consult the *Oxford School Atlas for Pakistan* (OUP).

Additional exercise

MCQs

Choose the correct answer:

1. The _____ is the center of the Solar System.
 - a. Earth
 - b. Sun
 - c. Moon **(Sun)**
2. The axis of the Earth is tilted at:
 - a. 23.5°
 - b. 25.7°
 - c. 30° **(23.5°)**
3. The _____ is an imaginary line running round the Earth half way between the North and South poles.
 - a. Tropic of Cancer
 - b. Tropic of Capricorn
 - c. Equator **(Equator)**
4. The weather in the tropics remains:
 - a. warm all the year round
 - b. very cold
 - c. rainy throughout the year **(warm all the year round)**
5. To reach the surface of the Earth, the heat from the Sun passes through a layer of air called:
 - a. atmosphere
 - b. clouds
 - c. space **(atmosphere)**

THE WORLD OF ROCKS

Pupil's Book 17-20

The weight of the Earth

'Specific gravity' is the relationship between the weight of a substance and that of an equal volume of water. As early as the 18th century, it was calculated that the specific gravity of the Earth as a whole was 5.2—that is, it weighed 5.2 times as much as an equal body of water. However, the specific gravity of the crust which scientists could only estimate by digging, was just 2.7. The interior, therefore, had to contain something much heavier than the crust. It is impossible to get anywhere near the interior of the Earth. If the world was reduced to the size of a standard globe (about 50 centimetres in diameter), the deepest hole that human beings have dug would be the equivalent of 1 millimetre deep. Scientists now know that the interior of the Earth is largely made of iron, which has a specific gravity of 7.86. Iron, it would seem, is the most common element in the Universe.

Magnetic compass

Some pupils might be familiar with the magnetic compass, and many of them may possess one at home. If so, ask them to bring it to school so that the others can take a look.

Magnetic north

The mass of iron in the Earth's core forms a gigantic magnet. The magnetic North Pole does not coincide with the physical North Pole. It is about 1200 kilometres south-west of the physical North Pole, between northern Canada and the North Pole itself. The actual position is under the sea, some 4000 metres deep, covered with packed ice. It is in darkness for six months of the year.

The magnetic north is moving slightly all the time. Scientists are puzzled by why the polarity has reversed in the course of the Earth's history: the 'north pole' of the magnet has gone to the south. The changes for reversal of polarity (a compass would point to the 'south pole') takes about 5000 years. The reversal occurs at irregular intervals from 40,000 years to 35,000,000.

Oceanic and continental crusts

Most of the Earth's surface is oceanic crust, i.e. rocks under the water. These are mainly basalt, a very hard igneous, rock. This comes through the crust from the interior through the mid-ocean trenches. The rock of the continental crust (i.e. the land on which we live) is much more varied and includes sedimentary, igneous, and metamorphic rocks. Sedimentary rock is the most common rock exposed on the surface of the Earth's crust. It is formed by weathering or decomposition of igneous or metamorphic rocks but only forms a very minor part of the total rock content of the Earth. It is very visible—the Himalayas, for example, consist of sedimentary rock.

Sedimentary rocks

Although this seems like an obvious point, make sure you have a clear glass bottle when doing the sedimentation experiment. Get as large a bottle as possible—a litre bottle would be best. You may

need to experiment with several different handfuls of soil to get the right layering because some soils are homogenous and show little differentiation.

Salt: In some lakes the salt content is so high that the water is relatively thick, so much so that a person cannot sink in it, but just floats on the surface. Nothing can live in this water—the Dead Sea is the best example of this.

The location of sedimentary rocks in Pakistan can be seen on page 7 of the *Oxford School Atlas for Pakistan*. Virtually the whole country is made up of sedimentary rocks of different geological periods.

Answers to Pupil's Book page 21

1. See page 17 of the Pupil's Book.
2. Sedimentary rocks are formed
 - a. by tiny particles of rock washed down by rivers that settle on the bottom of the seas and lakes. Earth movement buries them and under great pressure they turn into rocks.

River flooding covers the land with fertile soil. Again under pressure this turns into rock.

The bodies of billions of tiny sea creatures fall to the bottom of the ocean and under pressure their skeleton or shells are compressed into rock.

Salt in tiny amount is washed down into lakes and inland seas. When the water evaporates it leaves a layer of salt behind.
 - b. Examples of sedimentary rocks are: (i) sandstone (ii) slate and shale (iii) coal (iv) salt.
3.
 - a. Igneous rocks: (Fire rocks) Molten rocks from the interior of the Earth sometimes break through cracks in the crust and cool. This very hard rock is called igneous rock.
 - b. The word 'ignis' comes from the Latin word for fire.
4.
 - a. Metamorphic rocks are rocks which are deep underground, are subject to great heat and pressure and have changed from one form to another.
 - b. (i) marbles (ii) diamond (iii) slate
5. All are the same chemical—carbon. They are different because all except wood have been subjected to different levels of heat and pressure underground.
6. Individual work

Additional exercise

MCQs

Choose the correct answer:

1. The hard surface of the Earth that we live on is called:
 - a. the lithosphere
 - b. the atmosphere
 - c. the core **(the lithosphere)**
2. Sandstone, shale, and limestone are examples of:
 - a. sedimentary rocks
 - b. igneous rocks
 - c. metamorphic rocks **(sedimentary rocks)**
3. Hard rocks like graphite or marble are:
 - a. sedimentary rocks
 - b. igneous rocks
 - c. metamorphic rocks **(metamorphic rocks)**
4. In Pakistan, metamorphic rocks are found in:
 - a. Punjab
 - b. Sindh
 - c. Balochistan and Khyber Pakhtunkhwa (Balochistan and Khyber Pakhtunkhwa)
5. Under heat and pressure, soft rocks like limestone turn into:
 - a. slate
 - b. marble
 - c. graphite **(marble)**

PLATE TECTONICS

Pupil's Book 22-26

Movements of the Earth's surface

This is probably quite a difficult concept for pupils to understand. The lithosphere on which we live is broken up into a number of huge 'plates' which float on the semi-liquid interior of the Earth, rather like icebergs in the northern and southern oceans. These plates drift slowly—perhaps only a few centimetres a year.

The proto-continents

Scientists believe that originally there were only two great land masses on Earth—Laurasia, consisting of North America, Europe, and Asia, and Gondwanaland, consisting of South America, Africa, India, Australia, and New Zealand. These two were separated by a hypothetical ocean called Tethys. At some distant time in the past, South America broke off and drifted westwards to meet up with North America which had also broken away. The whole of the subcontinent drifted northwards and met the Laurasia landmass with a terrific crash which threw up the great chain of mountains from the Pyrennes and the Alps, through the Middle East to the Himalayas.

If you look at the map on pages 72 and 73 of the *Oxford School Atlas for Pakistan*, you can see that the bulge of South America seems to fit into the hollow of western Africa. This was the germ that prompted 19th century geologists to evolve the theory of the two proto-continents mentioned above.

Fault lines

Point out that the collision between two tectonic plates gives rise to folding. The Himalaya/Karakoram Ranges are classic examples of these. Also, using the map on page 22 of the Pupil's Book, show how neatly the areas of volcanic/earthquake activity fit into the plate boundaries. Point out the fault line that runs through western Pakistan. Perhaps there are documentary accounts of the famous Quetta earthquake of 1935 available in Pakistan. There must be photographs of the series of quakes in Afghanistan in 1998. To allay fears, explain how modern buildings (even high skyscrapers) are earthquake-proof. In the Californian earthquakes of the 1990s, even the tallest buildings in San Francisco remained intact, in spite of swaying a little.

Volcanoes

Volcanoes always interest children. To demonstrate the characteristic conical shape of a volcano, get some very dry, powdered sand and let it trickle from a container on to a table. Note how it forms a cone of about 110°. The ash and debris from a volcano settles normally at this angle, although it may be distorted by any flow of magma.

Answers to Pupil's Book page 27

- Tectonic plates are great masses of the Earth's mantle that are 'floating' like icebergs on the semi-liquid interior of the Earth.
 - Sometimes one plate is forced downwards into the hot interior of the Earth where it melts and comes to the surface as lava. Sometimes the plates meet head-on and are forced up into the air as mountains.
- Tectonic plates meet in northern Pakistan and Afghanistan. The Himalayas are the result of rocks being pushed up by plate collision.
- Earthquakes are caused by plates moving sideways and rubbing against one another. This creates giant jerks in the Earth's crust.
- Earthquakes occur where tectonic plates meet.
- Earthquakes that occur under the sea often cause tidal waves or tsunamis.
- Refer to the map on page 26 of the Pupil's Book.
- Individual work. Encourage pupils to do some investigating on their own or in pairs.
- Individual work

Additional exercise

MCQs

Choose the correct answer:

- Tectonic plates are:
 - great land masses
 - gigantic icebergs
 - oceans **(great land masses)**
- When two land plates collide:
 - mountain ranges of folded rocks are formed
 - it rains a lot
 - deep holes are made in the Earth **(mountain ranges of folded rocks are formed)**
- When an earthquake occurs under the sea, they sometimes cause a sea storm called:
 - tsunami
 - cyclone
 - dust storm **(tsunami)**
- Earthquakes occur mainly along the:
 - seashores
 - mountain ranges
 - fault lines **(fault lines)**
- Today buildings are made in a special way so that in an earthquake they do not:
 - sway
 - collapse
 - rise **(collapse)**

MOUNTAINS

Pupil's Book 28-30

Answers to Pupil's Book page 31

1. (a) Fold mountains (b) Block mountains or Fault mountains (c) Volcanoes
2. Fold mountains are formed when two tectonic plates meet head-on. The edges are forced up into the air.
3. Young fold mountains have sharp peaks and (usually) an angular outline. They are often very high (like the Himalayas in Asia and the Andes in South America). Older fold mountains are lower and have more rounded outlines because they have undergone weathering over several million years.
4. Individual work. The Himalayas, the Hindu Kush, and the Karakoram Mountain Ranges are all fold mountains.
5. Individual work
6. Because of pressures under the Earth's crust, two long, roughly parallel cracks appear in the Earth's surface. The land between the cracks either slips downward to form a rift valley, or is pushed upward to form a block mountain.

Additional exercise

MCQs

Choose the correct answer:

1. Mountains take up about _____ of all land area.
 - a. one-fifth
 - b. half
 - c. quarter **(one-fifth)**
2. The Himalayas are the most famous _____ mountains in the world.
 - a. fold
 - b. block or fault
 - c. volcanic **(fold)**
3. Fold mountains normally appear where:
 - a. two plates meet
 - b. land meets the ocean
 - c. two continents meet **(two plates meet)**

4. Block or fault mountains are found:
 - a. in the forests
 - b. where the tectonic plates meet *(where there are no plate boundaries)*
 - c. where there are no plate boundaries
5. Molten rock pours out as lava through a:
 - a. fold mountain
 - b. volcano
 - c. block or fault mountain *(volcano)*

THE WORLD OF WATER

Pupil's Book 32-35

Water vapour

The presence of water in the invisible space between the spout of a kettle and its steam can be demonstrated by placing a large knife where there appears to be nothing. Water (in the form of condensation) will appear on its surface.

Hot and cold air

Ensure that pupils know that warm air dissolves more moisture than cold air. It is estimated that 496,000 cubic kilometres of water evaporates annually from the oceans and remains in the air an average of 10 days. It can travel up to 1000 kilometres before being deposited as precipitation.

In the cold upper air, water vapour begins to condense because the cooler air will not hold as much water. Drops of water between 0.01 and 0.001 centimetres in diameter can float in the air and become visible as clouds. Any droplets larger than this are too heavy to remain floating and fall to Earth as rain or, in colder climates, as hail or snow. A very high proportion of this rain falls back into the oceans: much of that which falls on land evaporates immediately back into the atmosphere. Some is taken up by plants and is transpired through their leaves as water vapour. Some rain that falls to the ground remains in the upper surfaces of the soil where it is absorbed by the roots of plants. More filters through the soil and finds its way back to the sea by underground passages. Still more finds its way into rivers and so directly back into the oceans.

Some idea of the amounts we are dealing with can be given by the Amazon River in Brazil, which pours over 150,000 cubic metres of water into the sea every second. This is about 20 per cent of all the surface water running off the Earth. The Indus empties about 6200 cubic metres a second and the Nile 3100.

Record breakers

Just for fun, the pupils might like to know that the world record for recorded rainfall was in Assam, northern India, in 1861, when 26,900 millimetres of rain fell in one year. This would mean almost 15 times the height of the figures in the drawings on page 34 of the Pupil's Book. But this was of course exceptional.

The record for rain in a single 24-hour period is on Reunion Island in the Indian Ocean: on 15/16 March 1952, 1870 millimetres of rain fell. This is again more than the height of an average man.

Answers to Pupil's Book page 36

1. (a) seas and oceans
(b) rivers
(c) lakes and inland seas
(d) snow and ice
(e) glaciers
(f) water vapour (invisible)
2. Invisible water vapour cools and condenses into larger and larger droplets. The smaller droplets are visible as clouds, but they are still light enough to remain floating in the air. When the tiny droplets condense further, they become larger drops, which are too heavy to float, so they fall as precipitation.
3. (a) Some water evaporates back into the air, either directly or through plants
(b) Some water runs off into rivers and then back to the sea.
(c) Some water soaks into the ground where it is used by plants, or finds its way back to the sea by underground routes.
4. Individual work. You might have to help pupils find the average annual rainfall figures for their area.
5. Individual work. Snow is formed by water freezing into a crystal pattern. Ask pupils to find pictures of close-ups of snow crystals and then ask them to design their own patterns. Alternatively, they can make paper cut-out snowflakes. To make a paper cut-out, cut a sheet of white paper into a circle of 10 centimetres radius. Fold several times, and cut random patterns. When you unfold it, you will have a 'snowflake'.
6. a. The water cycle. Refer to page 33 of the Pupil's Book.
b. (i) The warmth of the Sun makes the water in oceans, lakes, and rivers evaporate.
(ii) The water vapour rises into the atmosphere, where it often condenses into droplets to form clouds.
(iii) When the clouds cool, the droplets run together and fall as precipitation to the ground.
(iv) Some water makes its way back to the oceans by soaking into the ground or running into rivers.
(v) Most water goes back, into the atmosphere through transpiration through the leaves of plants.

Additional exercise

MCQs

Choose the correct answer:

1. When water vapour condenses on a large scale, it becomes visible as:
 - a. clouds or fog
 - b. rain
 - c. snow **(clouds or fog)**

2. The biggest bodies of water are the:
 - a. rivers
 - b. seas and oceans
 - c. lakes **(seas and oceans)**

3. In Pakistan, rainfall is very seasonal. Most of it falls during:
 - a. summer
 - b. winter
 - c. monsoon **(monsoon)**

4. Geographers usually call rain, snow, and hail:
 - a. precipitation
 - b. evaporation
 - c. run-off **(precipitation)**

5. If the air is cold the rain drops freeze and fall as:
 - a. water
 - b. water vapour
 - c. snow or hail **(snow or hail)**

THE WATER TABLE

Pupil's Book 37-38

Permeable and impermeable strata

A simple experiment will help to demonstrate the concept of impermeability. Cut the top off of a large plastic bottle. Fill half of it with gravel or soil. Put a layer of clay/plasticine across the gravel, pressing very tightly to the sides of the bottle to make a watertight seal. Fill the rest of the bottle with sand. About 1.5 centimetres above the junction of the sand and clay, make a hole through the side of the bottle. Pour water (coloured water, if you prefer) into the bottle. Ask pupils to watch as the water reaches the impermeable layer and starts to build up above it, until it reaches the hole (the 'spring') and trickles out.

Answers to Pupil's Book page 39

- Permeable: will allow water to pass through
 - impermeable: will not allow water to pass through.
- Soil retains water through molecular attraction. If the gap between two solid pieces of material is 2 to 3 millimetres or less, water will not run through it but will remain suspended between the two.
- The water-table is the top layer of water that builds up in soil when the water reaches an impermeable layer. The water-table goes up and down according to the amount of rain which has fallen.
- deep down underground
 - much nearer the surface
- People dig wells in order to reach the water-table so that they can use the water for cooking, drinking, agriculture, and other purposes.
 - Dig wells deeply until the permanently saturated layer is reached.
- Refer to page 37 of the Pupil's Book.

Additional exercise

MCQs

Choose the correct answer:

1. Rocks that allow water to pass through them are called:
 - a. permeable rocks
 - b. impermeable rocks
 - c. granite **(permeable rocks)**
2. Rain water soaks through layers of permeable rock such as:
 - a. sandstone or limestone
 - b. granite
 - c. clay **(sandstone or limestone)**
3. When water soaked in by permeable rock cannot go any further it comes out in the side of a hill or valley as a:
 - a. spring
 - b. ocean
 - c. sea **(spring)**
4. A well has to be deep enough to reach the:
 - a. water table
 - b. permeable rock
 - c. sea **(water table)**
5. Clay and granite are examples of:
 - a. permeable rock
 - b. impermeable rock **(impermeable rock)**

SMALLER BODIES OF WATER

Pupil's Book 40-45

Course of a river

Make sure that pupils know the terms tributary, confluence, catchment area/drainage basin, estuary, and delta. You can demonstrate how the material carried down by rivers is deposited with the same bottle of water and soil used in the sedimentation experiment on page 18 of the Pupil's Book. Give the bottle a good shake (to represent fast running water) so that the material remains in suspension. Then place the bottle on its side and allow it to stand. The sediment will settle out on your very own flood plain.

Ensure that pupils know the importance of rivers: reasons (a) to (c) on pages 40-41 of the Pupil's Book are the most important to Pakistan—especially irrigation. Power from rivers in the form of hydel is absolutely essential in a land like Pakistan which is desperately short of fossil fuels for power stations, although the discovery of natural gas has somewhat relieved this shortage.

Emphasize the important part rivers play in shaping the surface of the Earth: eroding the beds and sides, transportation of debris from higher to lower levels, the building of plains, etc.

Glaciers

Glaciers cover a remarkable 11 per cent of the Earth's surface but hold an even more remarkable 75 per cent of all fresh water. About 99 per cent of all glacial ice is in Antarctica and Greenland but every continent—except Australia—has some glaciers in the highest mountains. If the glaciers were all to melt, it is estimated that the height of the sea would rise by 50 metres, inundating every major coastal city in the world. Some idea of the mass of this ice can be gained by the fact that there are 14 million square kilometres of ice in Antarctica with an average thickness of 2000 metres, and 1.8 million in Greenland with an average thickness of 3000 metres. Antarctic glacial ice, as a whole, is more than 14 times the size of Pakistan.

Modern glaciers are the remains of the last Ice Age which ended about 10,000 years ago and covered one-third of the Earth's surface while it lasted. There was a mini Ice Age from the 16th to the 19th centuries, which reached a peak at about 1750. This, however, was nothing compared to the real thing. We live in a period when the world is warming up and the glaciers are melting at an alarming rate, helped by global warming (see p.86).

Glaciers slipping along their beds are like gigantic files or sandpaper, scouring away the sides and beds with rocks frozen into the ice. It might be worth collecting photographs of Pakistani glaciers.

Answers to Pupil's Book page 46

- (a) springs (b) melting glaciers (c) overflow from a lake
- Drainage basin: the area of land which is drained by a river and its tributaries.
Tributary: a smaller river or stream which flows into a larger one.
Confluence: the place where two rivers meet, usually important when they are large rivers.
Estuary: the mouth of a river where salty sea-water and fresh water mix. It is often funnel-shaped.
Delta: a fan-shaped area of fertile alluvial material which the river has brought down but which cannot be swept away with tides. The river itself enters the sea through a maze of channels.
- (a) provide water for human consumption and irrigation
(b) drain the surrounding land so that it is not too marshy for crops
(c) in earlier days, provided power by driving water mills, today some provide power through hydroelectric stations
(d) provide cheap transport
(e) provide food in the form of fish
(f) recreation (boating, swimming, fishing)
- Irrigation (because the great majority of Pakistan's agriculture depends on water from irrigation); hydroelectric power (because almost half of Pakistan's electricity comes from this source—47 per cent comes from expensive imported oil).
- (a) Valleys and gorges (b) When the river slows down, it sometimes creates level plains.
(c) Oxbow lakes (d) Fertile flood plains (e) Sedimentary rock (by carrying down articles and depositing them).
- Some reasons include: supply of water for people and animals; water for the fields; transport in small boats made of skin, reeds, or wood; food (fish and water fowl); rushes which grew near river banks (to build huts and boats and for making baskets and mats).
- Individual work. Possible rivers for this exercise include: the Indus, the Nile, or the Amazon.
- (a) Glaciers in Pakistan are only found in high mountains where the temperature is always low.
(b) A glacier is made of snow which is packed down harder and harder over the years until it turns into a 'river' of solid ice.
(c) They erode the Earth's surface to make valleys; they form lakes or rivers; they lock up vast amounts of fresh water.
(d) individual work. Pupils should be asked to mark the general area on an outline map of Pakistan. There is no need to identify particular glaciers by name.

Additional exercise

MCQs

Choose the correct answer:

1. Most rivers begin as:
 - a. springs
 - b. wells
 - c. seas

(springs)

2. Mark the statement that is incorrect.
 - a. Rivers can be used to generate electricity.
 - b. Fishing is an important industry associated with rivers.
 - c. River water cannot be used by humans.

(River water cannot be used by humans.)

3. The bending of a river is called:
 - a. valley
 - b. gorge
 - c. meandering

(meandering)

4. The plains around river Indus are:
 - a. barren
 - b. flat and fertile
 - c. very difficult for farming

(flat and fertile)

5. The Niagra falls in North America are:
 - a. glaciers
 - b. lakes
 - c. waterfalls

(waterfalls)

An experiment

Ask pupils to boil a few litres of sea water or let it evaporate naturally in the sunshine. This experiment will convince them of the reality of salt in the sea. Perhaps the water from most of the coastal regions of Pakistan, especially in the Karachi area, should not be tasted, as it probably contains vast amounts of unpleasant substances as well.

Tides

Tides are not easy for pupils to understand and only those along the relatively short stretch of coastline will be familiar to them. However, throughout the world, tides are very important, with approximately two high and two low tides every twenty-four hours. These do not occur at the same time, but gradually move forward. As well as enabling larger ships to enter harbour, tides also deposit and clear away rubbish from beaches. The deposition today consists largely of plastic, bottles, wood, and debris thrown overboard from ships which, after immersion in the strong salty water, is reasonably harmless from a bacterial point of view. However, the same tides sweep away a great deal of organic material from beaches. The most significant is sewage, which in some places is still dumped untreated into the sea.

Answers to Pupil's Book page 52

1. 7.1 square centimetres water; 2.9 square centimetres land
2. The seabed looks much like the land surface of the Earth, except that it is exaggerated. The 'peaks' are higher and the 'valleys' deeper.
3. (a) Rivers bring down minute amounts of salt washed from rocks. While we cannot taste the salt in river water, in the sea it builds up over millions of years. Water—pure water—evaporates and the salt is left behind. Plants and sea creatures use some of the salt and some is broken down by chemical action until a balance has been reached.
(b) We use sea salt in cooking, preserving foods, and making chemicals. Sea water is evaporated by storing it in shallow ponds or by boiling it. The water evaporates and the salt is left behind.
4. rise and fall; twelve hours; Moon, Sun; higher, spring; lower, neap.
5. The sea heats up and cools down much more slowly than land so that its temperature does not vary much throughout the year. Land temperatures vary greatly between day and night, summer and winter. Land which is near the sea is influenced by the relatively even sea temperature: land which should be very hot is cooled by the sea and land which should be cold is warmed.

6. Continental shelves are the relatively shallow waters which often surround large land masses. Here, the temperature is slightly warmer, so animal and vegetable life thrives. They are rich fishing grounds.

Additional exercise

MCQs

Choose the correct answer:

- There are _____ oceans on Earth.
 - 2
 - 5
 - 6

(5)
- Under the sea there is:
 - flat land
 - mountains and valleys
 - forests

(mountains and valleys)
- Continental shelves are important because:
 - they are a rich source of fish
 - no fish is found here
 - the water is very deep

(they are a rich source of fish)
- The tides are caused by the:
 - flowing water
 - gravitational pull of the Moon
 - gravitational pull of the Earth

(gravitational pull of the Moon)
- In most countries salt is obtained:
 - by evaporating sea water
 - from springs
 - waterfalls

(by evaporating sea water)

Land masses and currents

Point out the disparity of land masses north and south of the Equator. These masses of land interfere with the natural flow of currents in the northern hemisphere.

Ask pupils to look at page 76 of the *Oxford School Atlas for Pakistan*. While the general oceanic currents in the northern hemisphere rotate clockwise, and in the southern hemisphere anticlockwise, this smooth pattern can become disrupted around the subcontinent.

Answers to Pupil's Book page 57

- Large masses of water in the sea which move steadily in definite directions
 - Surface currents are caused by prevailing winds dragging the surface water along. Deep water currents are caused by differences of temperature or salinity.
- Ocean currents in the northern hemisphere generally move in a clockwise direction, while those in the southern hemisphere move in an anti-clockwise direction. In the northern hemisphere in particular, this general principle is sometimes affected by masses of land which limit the free flow of water, forcing it to move in the opposite direction.
- Influence climate: cold currents cool countries; warm currents warm countries. This is the most important point and should be stressed.
 - Currents carry things from one country to another—coconuts were spread all over the Pacific area by floating on currents in the sea.
 - Currents probably enabled early explorers to cross from South America to the Pacific islands in small canoes.
 - Currents can spread pollution from one country to another.
- Currents in the subcontinent change direction according to the season of the year, moving clockwise in winter and anti-clockwise in summer.
 - The change is caused by the monsoon winds which blow from the south and south-west in the summer and from the north or north-east in winter. These drag water in their direction.
- Individual work

Additional exercise

MCQs

Choose the correct answer:

1. Movement of broad masses of water in definite directions is called:
 - a. currents
 - b. contacts
 - c. transportation **(currents)**

2. In surface currents the water moves:
 - a. horizontally
 - b. vertically
 - c. diagonally **(horizontally)**

3. The currents in the Northern hemisphere generally move in:
 - a. clockwise direction
 - b. anticlockwise direction
 - c. straight lines **(clockwise direction)**

4. Warm currents can make the climate _____ than it would normally be at that latitude.
 - a. warmer
 - b. colder
 - c. milder **(warmer)**

5. The currents around the sub-continent change direction according to the:
 - a. prevailing winds
 - b. monsoon season
 - c. landform **(prevailing winds)**

Weight of air

Pupils are sometimes confused by this and cannot understand why we are not crushed by the weight of air on us. The experiment with paper on page 58 of the Pupil's Book might help. Air pressure (i.e. weight) presses on the outside of our bodies, and also from the inside (through the nose and mouth).

Rare gases

It might be worth mentioning that among the very rare gases found in air are neon (0.0018%) and argon (much less than neon). These gases are extremely useful. Glass tubes filled with neon gas give off a red glow when an electric current is passed through them. They are very widely used in advertising signs in cities. Other colours for signs can be obtained by putting neon gas in coloured glass tubes which alter the natural red light. Argon, another inert gas, is used for putting in electric light bulbs to prevent the incandescent filament from burning out.

Mercury and aneroid barometers

The ordinary mercury barometer is really just a pair of scales. A tube that is about 800 millimetres long and open at one end is filled completely with mercury. A thumb is placed over the open end and this is inverted into a bowl full of mercury. The mercury in the tube drops about 40 millimetres, leaving a vacuum at the top. The mercury in the bowl acts as one pan of a pair of scales, and the mercury in the column as the weights. As the weight of air becomes lighter (i.e. lower pressure and bad weather) the mercury in the tube falls. The reverse happens when the air is heavier (i.e. high pressure and good weather), so the mercury rises.

The mercury barometer is, of course, very fragile and clumsy, requiring a stable position in order for it to function effectively. The robust aneroid barometer is the more favoured option today. This consists of an airtight metal box with a flexible top. The box contains a partial vacuum. When the pressure is high, it presses on the flexible top, pushing it inwards. By means of a cord and pulleys, this turns the hand on the dial. When the pressure is low, the top of the box pushes outwards and the hand moves the other way. The aneroid is not quite as accurate as the mercury barometer.

Answers to Pupil's Book page 60

1. Let each square centimetre represent 4 per cent.
(a) Nitrogen: of no use to animals but invaluable to plants. (b) Oxygen: the gas that supports all life on Earth.
2. Individual or group work. Measure the classroom. For every square metre, there will be about 10,000 kilogrammes (or 10 tons) of air.
3. bars; millibars

4. (a) Air is measured (or weighed) by instruments called barometers.
(b) A mercury barometer weighs air by seeing how tall a column of mercury it will balance. An aneroid barometer consists of a thin metal box, partly empty of air. The pressure of the air squeezes the box so that it varies in size. The squeezing is connected to a needle which indicates the pressure.
(c) The aneroid barometer is much easier to use than the mercury barometer, which requires very careful handling.
5. Lines drawn on a map joining up places which have an equal barometric reading. Forecast the weather.

Additional exercise

MCQs

Choose the correct answer:

1. Air is made up of about 78 per cent:
 - a. nitrogen
 - b. oxygen
 - c. carbon dioxide **(nitrogen)**
2. The air extends more than _____ kilometres into the air.
 - a. 1000
 - b. 1500
 - c. 2000 **(1000)**
3. Air pressure is measured with an instrument called:
 - a. thermometer
 - b. barometer
 - c. measuring tape **(barometer)**
4. _____ barometers are more commonly used.
 - a. Aneroid
 - b. Mercury **(Aneroid)**
5. Air pressure is measured in units called:
 - a. bars
 - b. kilometre
 - c. kilograms **(bars)**

Cyclones and anticyclones

Perhaps mention that the prefix anti is a Latin word meaning roughly 'the opposite of'.

Remembering which way round cyclones and anticyclones turn is something children seem unable to manage. I always use the screwdriver analogy: screwing down clockwise increases the pressure, hence anticyclone or high pressure, with good weather. Unscrewing anticlockwise decreases the pressure, hence a cyclone or low pressure, with bad weather. In the southern hemisphere, the positions are reversed.

Air and heat

If you can bring a bicycle pump to class, you can easily demonstrate that air gets hot when it is compressed (i.e. an anticyclone). Put the thumb firmly over the outlet of the pump, and pump vigorously a number of times. The barrel of the pump will become quite hot.

Source

The energy source of a cyclone is still something of a mystery. It is believed to be derived from the evaporation of water, as cyclones always start at sea, normally off the east coast of continents. Cyclones soon die out over land, after releasing vast amounts of precipitation. There are relatively few anticyclones in the southern hemisphere. The Caribbean, the southern United States, and eastern Asia are subject to violent cyclones or hurricanes/typhoons.

Answers to Pupil's Book page 66

1. Trade winds are winds that blow steadily all year round towards the Equator. They are called trade winds because in the days of sailing ships they blew boats in the direction they wanted to travel to for trade.
2. Surface winds blow along the surface of the Earth. Sometimes they blow in the same direction all year round; sometimes they blow mainly in one direction for one part of the year, and in another direction for the other part. (For example, the monsoons in the subcontinent. In other places, the winds are likely to blow in different directions from day to day.) Wind speeds can vary from dead calm to sometimes 100 km/h.

Upper atmosphere winds blow 10,000 metres above the Earth's surface. They are caused by the rotation of the Earth and blow steadily in the same direction all year round. They can reach speeds of 350 to 450 km/h. They are referred to as the jet stream.

3. a. high. widely-spaced. gentle. fine and warm. clockwise; anticlockwise.
b. low. close together. strong. wet and windy. anticlockwise; clockwise.

Additional exercise

MCQs

Choose the correct answer:

1. Air normally flows from:
 - a. low pressure to high pressure
 - b. high pressure to low pressure
 - c. high pressure to high pressure **(high pressure to low pressure)**

2. Winds are pulled at an angle of:
 - a. 45°
 - b. 90°
 - c. 180° **(45°)**

3. Winds that blow at a height of 10,000 metres or more are called:
 - a. jet stream
 - b. air stream
 - c. aeroplane stream **(jet stream)**

4. The winds that blow from the land to the sea are called:
 - a. sea breezes
 - b. land breezes
 - c. onshore breezes **(land breezes)**

5. The eye of the cyclone is the area of very _____ pressure at its centre.
 - a. high
 - b. low
 - c. moderate **(low)**

WEATHERING, EROSION, AND DEPOSITION

Pupil's Book 67-72

Class demonstrations

If the experiment to show the expansion of freezing water and its power to break up rocks has not already been done in science class, it can be done here. Make sure the bottle is absolutely full of water, and that a screw cap, not a cork, is used, as this will merely be pushed out. Put the bottle in a strong plastic bag and then put it in the freezer. Show it to pupils. Point out how the water, once frozen into ice, has expanded.

Also try getting a piece of iron—or thick wire—which you can bend reasonably easily and bend it to and fro. After a while, you will see stress marks at the bend, and then in a few more bends it will break. Explain how this happens with rocks.

To demonstrate the power of chemicals, put a few marble chips in a test tube and then carefully add hydrochloric acid. It may fizz up so make sure that the tube is pointing away from you. Do this over a sink or bowl. If left for a few hours, the marble (or any other limestone) will vanish completely.

If you are able to find a piece of stone with a crack in it, you can put the seeds of a vigorous plant in the crack, water them and allow them to germinate. With luck, you may be able to demonstrate the immense erosive powers of a growing plant.

Erosion

The sheer force of water, particularly in the upper reaches of rivers on steep slopes, grinds away material from the bed and sides of the stream. The stones carried along the bed also grind away other rock. Perhaps pupils living near fast-running rivers can see the rounded stones on the bed where all protrusions have been eroded away.

The same applies to the sea, particularly on the coast, where tides carry large rocks to and fro, rounding off some and smashing up others. Most beaches which are not sandy are full of flat pebbles.

Wind is a relatively minor agent of erosion, as it occurs mainly in desert/arid areas where there is little vegetation to break the air flow. Roots hold the soil together, but in the drier areas the fierce winds can blast sand against the foot of standing rocks until it undercuts them. They fall over and the blasting starts on a new surface.

Glaciers

The rocks embedded in these frozen 'rivers' act as files or sandpaper, gouging out the river bed through which they pass. When they melt, they leave behind not only the boulders but also masses of clay which they have ground up.

Deposition

The erosive action of rivers is covered in the relevant chapter. (See page 42 of the Pupil's Book.) This is especially important in Pakistan where the mud deposited after flooding is an essential part of the agricultural scene.

Groynes

The sea can move billions of tons of stone to build up new coastlines. The tides on the south coast of England, for example, do not move at right angles to the shore, where they would just pile up the rocks they carry. Here the tides are at an angle to the coastline, so the pebbles are driven along, in this case, eastwards. Wooden barriers called groynes are erected to stop this shore drift. Show pupils the picture on page 72 of the Pupil's Book.

Deforestation

This is something that can well be discussed in class as it is a major problem today. Deforestation or the cutting down of trees that form a barrier against soil erosion is a real ecological tragedy. Without the protection of leaves, rain—usually violent in tropical forests where deforestation largely occurs—washes nutrients out of the soil and into rivers. It is estimated that in the 1990s, despite pious international conferences on conservation, 100,000 square kilometres of rainforest were disappearing annually. At present, Brazil is the worse offender as 30 per cent of the world's equatorial rainforest is in that country. Only 2 per cent of the coastal rainforest in Brazil remains. Australia, Malaysia, and Indonesia also have bad track records. Thailand and Myanmar have been careless in the past and as a consequence much of their rainforest has already disappeared. Pakistan and India cleared away the majority of their forests long ago. The land is now used for cattle ranching and crop growing. In Brazil, much of the land is being used for growing the coca plant for cocaine.

Although governments can issue orders to the contrary, unscrupulous big business knows that once the trees have been cut down, little can be done about it. Because trees once cut will not grow again, much deforestation is done in secret and is revealed only as a fait accompli.

Quite apart from the loss of forests and the consequent soil erosion is the loss of what might be valuable medicinal plants, especially in the Amazon rainforest where there are hundreds of potentially useful varieties. Quinine is only one of a number of vitally essential drugs that are obtained from the rainforest.

Overgrazing

Overgrazing is another man-made disaster: North Africa was the main grain growing region of the ancient Roman empire, but the goats of nomads chewed all the vegetation in sight, and the Sahara Desert was the result. Pakistan has the same problem, especially in Balochistan where overgrazing is creating new deserts.

Chemical pollution

Chemical pollution has contributed to man-made erosion as well: crude industrial processes release gases into the atmosphere which dissolve in precipitation to form acids. These destroy whole forests. Eastern Europe is a particularly bad example of this.

The slash-and-burn technique

This is one of the oldest clearing techniques in the world. Native peoples in forests burned an area of trees, planted the land with crops for a year or two, and then moved on, allowing the land to regenerate. This was acceptable at the time because it was on such a small-scale—10 to 20,000 square metres at most. The real problem lies with big commercial enterprises that clear thousands of square kilometres of forest away in a few weeks with gigantic machines.

Answers to Pupil's Book page 73

- Building up: fold mountains created by tectonic plates; volcanic activity; block mountains.
Breaking down: weathering; erosion; transportation; deposition.
- (a) Temperature changes: constant heating and cooling breaks up rock. Rocks split as water in cracks expands on freezing.
(b) Chemicals: natural gases such as carbon dioxide dissolve in water to form acids [$\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3$]. These attack certain rocks and break them down. Nitrous oxide, a mainly man-made gas, also forms an acid which kills vegetation and allows rocks to break up.
(c) Animals and plants: plant roots expand in cracks in rocks and split them. Animals burrow into the earth and allow weathering agents to work deep underground.
- (a) erosion (i) rivers (ii) seas and oceans (iii) wind (iv) glaciers
(b) (i) Rivers: the force of water washes away the banks and beds of rivers. Stones being rolled along the bed by the force of the water break up smaller stones.
(ii) Seas and oceans: the force of the waves cuts into cliffs and undermines them so that they collapse into the water. Waves and tide action make stones and pebbles smash into one another.
(iii) Wind: especially in desert areas. Particles of grit, stone, and sand are blown along at great speed and cut into rocks, wearing them away.
(iv) Glaciers: like rivers, glaciers grind away at the sides and beds of the valleys along which they are moving. Huge pieces of rock frozen into glaciers cut into the valley floor and sides.
- Man-made erosion is that which is created by human action. It includes: deforestation; chemicals; overgrazing.
- Try to bring out the conflicting demands of higher standards of life: cars, electricity, etc.—with the damage these cause to the environment. Mention might also be made of the destruction of the ozone layer and the danger of increased exposure to ultraviolet rays (global warming).

Perhaps highlight the problem of developing countries and developed countries: why should poor countries be deprived of the luxuries that richer countries, like the United

States, enjoy? One-quarter of the world's energy resources is consumed by the United States, which only represents 4 per cent of the world's population.

Additional exercise

MCQs

Choose the correct answer:

- The process by which rocks are broken up over a long period of time is called:
 - breakage
 - weathering
 - contracting **(weathering)**
- Nitrous oxide dissolves in the moisture of the air and falls to the Earth as:
 - pure water
 - acid rain
 - hailstones **(acid rain)**
- Wearing away of rocks broken by weathering is called:
 - erosion
 - deposition
 - breakage **(erosion)**
- Depositing of rock debris by agents of erosion is called:
 - erosion
 - deposition
 - weathering **(deposition)**
- Deforestation is a:
 - serious environmental problem
 - health hazard
 - source of fertile soil **(serious environmental problem)**

THE WORLD OF MAPS

Pupil's Book 74-77

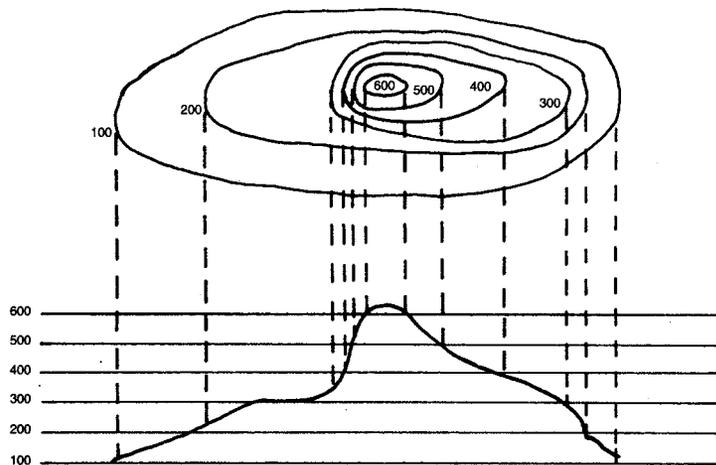
Scale

Pupils should be encouraged to make a scale map of their own classroom or any other room in the school. The ambitious might even make a map of one floor, or a room at home.

Point out the different scales used in maps and why they are necessary. It would be impossible to retain the detail of a town map on a larger area. Similarly, the relatively little detail of a world map would be useless for a map of a small locality.

Contour lines

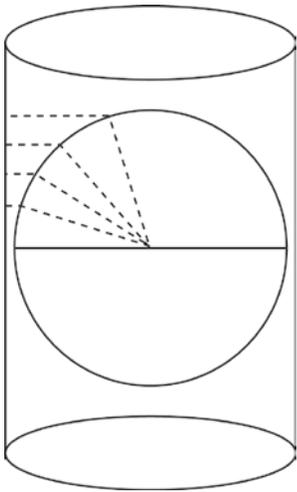
Show pupils how to derive a ground level view of a hill in contours. Mark off the ground level and a suitable number of heights as parallel lines, while choosing a scale that will fit reasonably. Draw a line across the contours. Then drop vertical lines from the contours to the appropriate parallel lines. Mark with dots, and then do the profile.



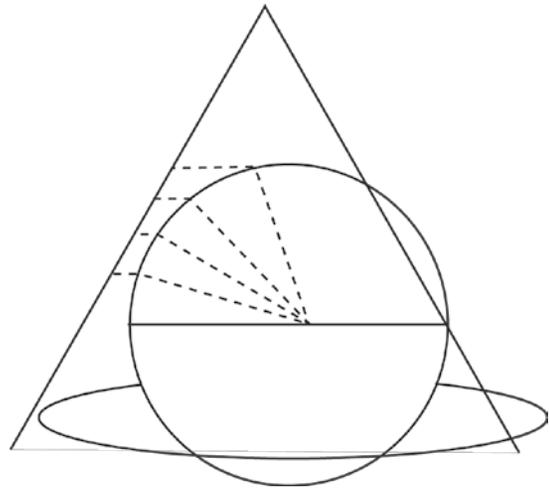
Projections

These are very complex, and only the simplest will be dealt with here. Make sure pupils recognize the impossibility of flattening out a spherical object into a two-dimensional drawing. Maps of a relatively small area can be made assuming that the covered land is flat. But when larger areas have to be mapped, the situation becomes more complicated. Geographers make maps with the aid of projections. The simplest is the cylindrical projection, in which it is postulated that the Earth is wrapped in a cylinder which touches land at the Equator. The viewer is assumed to be standing at the centre of the Earth, and lines are projected from there to the surface. These lines are then projected on to the sheet of paper. It is obvious that at latitudes further from the Equator the map becomes very inaccurate, distorting the areas of the features more and more as one goes further north or south.

On a typical cylindrical projection (the most famous is that of the 16th century Dutch geographer Mercator), Greenland seems to be larger than the whole of South America whereas, in reality, it is smaller than the Arabian peninsula. In Mercator's projection, all lines of latitude (horizontal) and longitude (vertical) are parallel. Mercator's projection is still widely used for navigation, and routes can be plotted in straight lines.



Mercator's Projection



Conical Projection

Some geographers have tried to overcome the limitations of cylindrical projection by using a conical projection. In this, a cone, with its vertical axis aligned along the north-south polar axis, touches the sphere along the most important line of latitude in that particular map. Places are then projected as before. This reduces some of the distortion, but it can only cover a more restricted area. It would be impossible to cover both hemispheres.

More recent projections assume that the surface of the globe is peeled off rather like an orange and the segments flattened onto paper. This does present a more accurate picture of the world, but distances—especially at sea—are very distorted.

Answers to Pupil's Book page 78

1. Individual work. Ask pupils to indicate the positions of windows and doors with thicker lines.
2. (a) Approximately 375 kilometres, depending on which route pupils select.
- (b) Once again, this answer depends on the route. However, if pupils selected the most direct route by road, they are likely to pass through Muzaffargarh and Dera Ghazi Khan, along with a host of smaller towns which pupils might wish to list.
- (c) From the fairly rich and fertile land around Multan, pupils will travel across small rivers and pass through the Sulaiman Range. Once in Balochistan, they will travel on fairly high ground (1000 metres above sea level), in a drier region that is significantly

less populated (dotted with small towns that are few and far between). This exercise will help demonstrate how a flat, two-dimensional map can give us a wonderful three-dimensional picture of the world.

3. Individual work. Their answers should follow the pattern of 2 (c) above but in more detail. Pupils can make a scrapbook of their 'journey', collecting photographs from magazines and other sources.
4. (a) Colour and contour
(b) Colour should be used on large-scale maps because having masses of contour lines would be too confusing. Contour lines are ideal for small-scale maps where a limited area is being covered and we want to find out the varying heights.

Additional exercise

MCQs

Choose the correct answer:

1. A plan of an area is called:
 - a. map
 - b. legend
 - c. geographical features **(map)**
2. If a small area is shown in great detail it is called:
 - a. small-scale map
 - b. large-scale map
 - c. drawn to the right proportion **(large-scale map)**
3. Symbols on maps and atlases are called:
 - a. geographical features
 - b. keys
 - c. scale **(keys)**
4. The two ways of indicating height on a map are by:
 - a. colour and contour
 - b. scale and proportion
 - c. large scale and small scale maps **(colour and contour)**
5. One of the earliest projections by a Belgian man called Mercator was made in the:
 - a. 16th century
 - b. 15th century
 - c. 18th century **(16th century)**

LONGITUDE AND LATITUDE

Pupil's Book 79-82

Like stalactites and stalagmites, children often cannot remember which is longitude and which latitude. A useful memory aid: as all lines of longitude go right round the Earth through both poles, they are LONG. Lines of latitude decrease in size as they near the Poles.

Longitude

The Greenwich Observatory in London was chosen by an international conference in Washington DC in 1884 to be the 0° line of longitude because of the early work done in London on creating a sufficiently accurate clock. While sailors could determine latitude easily enough by finding the angle between the Sun and the horizon at midday (or with the help of certain stars), longitude could not be determined accurately except by comparing time differences at different positions very accurately. Because the navy was vitally important to Britain, the government offered a reward of £20,000 (1.6 million rupees at the present rate of exchange) to the person who could invent a sufficiently accurate clock. This was an incredibly huge sum at the time. The prize was claimed by a John Harrison in 1761/62. His chronometer (chronos, which is Greek for 'time', and meter which is 'to measure') was tested and found to be only five seconds off on a voyage from Europe to Jamaica and back, which involved several months of sailing. Like all governments, the British at the time wanted the clock but did not want to pay the reward they had offered, and instead gave Harrison one-quarter of it. It took him ten years to get the rest. Now longitude could be determined fairly accurately by measuring the time difference between the starting point and the destination. Today, of course, radio can give an absolutely correct time anywhere in the world.

Latitude

Point out how parallels of latitude become smaller and smaller in diameter from the Equator to the Poles, where they are just a point. In theory, if one stands at the Pole and turns round one revolution, one has gone right round the world. For many centuries, sailors had been able to calculate latitude by measuring the angle of the Sun at midday. The Sun reached its highest point at midday: after that, sailors measured latitude by reading off the angles between that and the horizon.

Once latitude and longitude could be ascertained, one's real position on the Earth's surface could be worked out and recorded in charts which, from the 18th century onwards, became more and more accurate.

Time changes

Any pupils who have travelled long distances by air will know the problems associated with time changes. In reality, every place should have its own time, but as this would be totally confusing, it has been agreed to divide the world into twenty-four specific time zones.

Jet lag

A matter of interest, perhaps, rather than geographical necessity. The body has its own internal clock which regulates much of our activities, especially sleep. When people travelled by ship over long distances, the speed—even on the fastest of boats—was slow enough for the body to compensate for the changes in time zones. By aircraft, however, one can leave Karachi, for example, and fly to Europe, which is five time zones away, but in practice reach London at virtually the same time by the clock as one left Pakistan. Thus, if one had breakfast before one started, one would be in London just at the right time for a second one! Over longer distances—say Pakistan to the United States—the problem is even more severe as the body clock cannot keep time with the ordinary clock. One wants to sleep at strange times, and at night one is wide awake. This is called jet lag, and can affect people for up to a week before the body clock and the time clock adjust themselves.

Answers to Pupil's Book page 83

- 24 N, 67 E
 - 33 N, 73 E
 - 31 N, 74 E
 - 35 N, 74 E
 - 25 N, 68 E
 - 28 N, 68 E
 - Individual work

Please note that these coordinates are approximations only.

- 07:00
 - 20:00
 - 14:00
 - 14:00
 - 22:00 (Although Melbourne is officially 22:00, the clocks there would be set at 22:30.)
 - 04:00
- Greenwich Mean Time. (Set in London, where the 0° line of longitude is.)
- An imaginary line that goes through 180° longitude to prevent confusion between days. It zigzags a little to avoid going through land.
 - Going eastwards, you would 'lose' a day—your date would change from 15 to 14 August.
 - Going westwards, you would 'gain' a day—your date would change from 15 to 16 August.

Additional exercise

MCQs

Choose the correct answer:

1. Imaginary lines running round the Earth from North to South are called:
 - a. lines of latitude
 - b. lines of longitude
 - c. grids **(lines of longitude)**
2. Latitude is measured from 0° , which is at the:
 - a. Equator
 - b. North Pole
 - c. South Pole **(Equator)**
3. A special device called _____ can tell you exactly where you are in seconds.
 - a. Global Positioning System
 - b. sextant
 - c. astrolabe **(Global Positioning System)**
4. London time is called:
 - a. Time Zone
 - b. Local Time
 - c. Greenwich Mean Time **(Greenwich Mean Time)**
5. The International Date line goes straight through _____ longitude.
 - a. 90°
 - b. 60°
 - c. 180° **(180°)**

WEATHER AND CLIMATE

Pupil's Book 84-87

It is almost impossible to isolate any single cause of climatic differences. Pages 84-86 of the Pupil's Book list the numerous factors that are involved.

The main topics to focus on in this chapter are global warming and the depletion of the ozone layer. Both topics will provide ample opportunity for much classroom discussion.

Global warming

On page 15 of the Pupil's Book, we saw how particles and clouds in the atmosphere reflect or absorb much of the heat from the Sun. Without these, the temperature could rise to 500°C. With the increased pollution from particles emitted from vehicles and factories, one would think the reflection would increase. However, another aspect of the modern world is outstripping this. The increase of carbon dioxide from the burning of fuels and chemicals (especially from motor vehicles) is far outstripping this effect. Carbon dioxide has the effect of making a blanket round the Earth, and while it lets through much of the heat of the Sun, it prevents re-radiation from the surface. The heat is trapped inside the atmosphere rather like the heat in a greenhouse is trapped by glass—hence it is called the greenhouse effect. The increased thickness of the layer of carbon dioxide is rather like an extra blanket or duvet on a bed—the occupant just gets warmer. No one knows what this is going to mean in the long-term: a rise of 0.5°C in less than a century does not seem much, but in global and geological terms it is dramatic.

Ask pupils what they think the increase in temperature will mean to the Earth. The obvious answer is the melting of ice caps and glaciers, which seems to be taking place at considerable speed. The sea level is rising about 2 millimetres a year: some of this (0.2 to 0.6 millimetres) is due to the physical expansion of sea water as it slowly heats up. But the major part (1.8 to 1.4 millimetres) is due to melting glaciers.

The main glaciers which might melt are those on high mountains in regions other than the polar areas. Scientists estimate that if all of the land glaciers melt, the sea would rise by 0.6 metres. Although this does not seem much, millions of square kilometres of land would be permanently inundated as a result.

The main cause for concern are polar glaciers, where the great bulk of the world's fresh water is locked up. There are already strong signs, particularly in the southern hemisphere, that the glaciers are breaking up as they reach the seas, and huge icebergs—the size of small countries—are breaking away. There is no doubt that the edges of these glaciers are melting with relative speed. Scientists argue that as the atmosphere warms up, it absorbs more moisture which will fall as snow in the polar regions. This will accumulate and harden to form further glaciers, so perhaps a balance will be reached. However, some estimates put the rise in the sea level worldwide at about 30 centimetres by the year 2050.

Ozone depletion

This is a completely separate atmospheric problem. In the atmosphere, between 10 and 50 kilometres up, is a layer rich in ozone. Ozone is actually oxygen, but with an extra atom in each molecule. Chemically, it is O₃ instead of the normal O₂. We can breathe ozone without harm—it is even used as an air disinfectant. Ozone, however, limits ultraviolet (UV) radiation from reaching the Earth from space. UV radiation is invisible but does serious damage to the skin, causing darkening (the much sought-after tan) but more insidiously, melanoma or skin cancer and cataracts of the eye. An increase in the amount of UV radiation is extremely dangerous.

Certain widely used chemicals—chlorofluorocarbons or CFCs—which power spray cans and are the active chemicals in refrigerators were found to destroy the ozone layer. With the vast increase in the use of both of these, the CFCs in the atmosphere were increasing dramatically. An international conference in the 1980s decided that their use should be minimized. Although their use is now controlled, they still exist and continue to harm the environment by allowing UV radiation to reach the surface of the Earth.

Answers to Pupil's Book page 88

1. Weather is the meteorological conditions (temperature, rain, sun, wind, etc.) on any one day. Climate is the average of these conditions over a number of years.
2. (a) latitude (b) height above sea level (c) distance from the sea (d) ocean currents (e) rainfall (f) prevailing wind direction (g) aspect (h) shelter by mountains
3. Climate is important because it influences the whole way people live in any particular area. It determines the type of housing, what work people do, how they dress and eat, and what crops they grow.
4. (a) latitude (b) height above sea level (c) distance from the sea (d) currents (e) prevailing winds
5. (a) Northern central Asia—Siberia (b) Bitterly cold for much of the year, with short summers
6. (a) Asia (part of the islands of Brunei, Malaysia, Borneo) (b) Tropical—hot, wet, and sticky.
7. (a) Asia (Tibet) (b) Because of its height above sea level (5000 to 6000 metres), the climate would be cold with dry, bitterly cold winds.
8. (a) Global warming is the steady warming up of the Earth's surface (about 0.5°C since 1900). (b) Increased amounts of carbon dioxide from motor vehicles, industry, and the general burning of fossil fuels such as oil and coal are 'blanketing' the Earth. This prevents the heat of the Sun from being re-radiated back into space so the temperature on Earth rises. (c) Two major effects: climate changes; melting of the polar ice caps, resulting in a rise in the sea level and the flooding of low-lying countries such as Bangladesh and the Netherlands.

Additional exercise

MCQs

Choose the correct answer:

1. Daily changes in the atmosphere are called:
 - a. weather
 - b. climate
 - c. season **(weather)**

2. Higher above the sea level the climate becomes:
 - a. cooler
 - b. warmer
 - c. stays the same **(cooler)**

3. Meteorologists call water that falls from the sky:
 - a. rainfall
 - b. precipitation **(precipitation)**
 - c. snowfall

4. The heating of the Earth's surface due to carbon dioxide emissions is called:
 - a. global warming **(global warming)**
 - b. ozone layer
 - c. precipitation

5. A serious problem caused by pollution is the wearing away of the:
 - a. mountains
 - b. ozone layer
 - c. land **(ozone layer)**

NATURAL VEGETATION—TROPICAL

Pupil's Book 89-93

Tropical rainforests

These are the greatest reservoir of natural life on Earth. In the Amazon rainforest alone (easily the largest in the world), there are over 2500 species of trees. It is reckoned that hundreds of thousands of different plant, animal, and insect species have made their home there. Thousands of these have never been recorded or identified, and this constitutes the biggest environmental risk: countless invaluable herbal plants with possible medicinal value are being destroyed by our carelessness.

Surprisingly, the soil is not particularly fertile. Gigantic trees exist mainly on the decaying vegetation scattered on the floor, and on the endless rain. Trees grow rapidly, reaching towards the light, so that their trunks are generally straight and free from knots, making them very suitable for high quality furniture. Because they are so tall and top heavy, many species have buttressed trunks at ground level to stabilize them. The creepers which use trees to climb to the light can be as much as 20 centimetres in diameter. The canopy is generally so dense that only about 1 per cent of the light above the leaves reaches the ground. Trees found in the rainforest include: myrtle, laurel, palm, acacia (in the lighter areas), mahogany, and rosewood (extremely valuable trees for the furniture industry), rubber, and Brazil nut.

The simple slash-and-burn agricultural system of the indigenous peoples, especially of the Brazilian rainforest, did little damage as it was on such a limited scale. The wholesale and widespread decimation of forests by commercial clearing is an ecological disaster.

Monsoon forests

This is important as the Indian subcontinent naturally falls in this region, though much of the forest has been sacrificed to agriculture over the centuries. Because rainfall is less and generally seasonal, many of the trees shed their leaves to prevent transpiration in the dry season and to avoid the damage of gales at this period.

These forests have been dramatically exploited—cleared for agriculture and heavily depleted of valuable teak trees, which are extremely slow-growing. But again, commercial greed for the much sought-after teak pays little respect to ecology. Teak is a very strong hardwood suitable for furniture and shipbuilding. Teak beams have been found in temples and palaces in Asia well over 1000 years old, and they are still sound. The timbers of the groynes on page 72 of the Pupil's Book are also of teak.

Bamboo is another characteristic plant of this region. This is the universal plant, ranging from 40 centimetres to 40 metres in height. The seeds and shoots of this plant are used as food, the leaves as fodder. The trunks make not only high quality paper, but provide the material for almost everything else in simpler communities, including buildings, scaffolding, furniture, and boats.

Because monsoon forests are less dense, and the trees generally lower than the true rainforest, the floor is much more thickly covered with tangled growth. This is the type of terrain that is popularly thought of as the 'jungle'.

Tropical grasslands

These have various names in the different continents in which they are found: savannahs, pampas etc. The differences between them are slight, usually with reference to the number of trees. Further from the Equator they have marked seasons: a hot dry season and a wet season. They cover a wide range of vegetation from scattered trees, rich grass, poorer grass, and scrub with hardy thorn bushes. Grass itself was late in the evolutionary history of the Earth, originating only about 66 million years ago. These are the lands where 'big game' can be found: herbivores from mighty elephants through deer to tiny creatures, and the great carnivores that prey on them. Naturally, there is considerable cattle farming. When the land has been cleared, a wide variety of crops can be grown, often with the help of irrigation. Parts of the subcontinent come into this vegetation band.

Tropical deserts

Deserts are almost entirely created due to lack of rain. Slight rainfall allows some plants to briefly flower for a few days during which they also produce seeds. These seeds can often live dormant in the earth for many years before the conditions are right for germination. More permanent plants are usually deep-rooted to reach the water-table. These are generally low thorn shrubs with few or no leaves. Thorns themselves are modified leaves and protect the plant from animals. In America, plants have devised a different tactic—the thick, fleshy, leafless stems of the cacti. These store water when there is any, and so survive over long periods. Photosynthesis often takes place in the green stems of desert plants.

The desert is not a flat endless waste as often depicted. Dunes, created by the wind, can be 200 metres high. There is hardy plant life in many places—sparse shrubs or cacti—and a whole myriad of animal life. Animals are normally small rodents, reptiles and birds. Rodents and reptiles tend to spend the day underground where it is cool and emerge at night. Animals have a number of different ways of conserving the scarce water available in desert conditions: camels can turn their body fat into water, but many others have efficient biological systems by which they take most of the water they need from their own urine and recirculate it.

In general, deserts have little agricultural use. In most favoured places, there is coarse grazing for tough animals such as goats. Dates and a limited variety of fruits are found in oases. Deserts sometimes have valuable mineral deposits like the oil of Libya and many other Gulf states. Unfortunately, this stratum does not seem to yield much oil in Pakistan.

Answers to Pupil's Book page 94

1. (a) Amazon rainforest in Brazil; central Africa; parts of south-east Asia
 - (b) Tall, largely evergreen trees with few branches below the canopy. Little vegetation on the ground, but masses of creepers climbing up tall trees to the sunlight above. Some trees have flowers and fruit growing from tall trunks.
 - (c) They are struggling to reach the sunlight. Below the crown of leaves, the forest is dark and gloomy, so that little photosynthesis can take place. (Explain this term to pupils: it is how plants make food with the help of sunlight.)
 - (d) Very few animals except insects and reptiles—snakes and lizards. In the canopy live monkeys and birds.
2. (a) Monsoon (tropical deciduous) forest
 - (b) Trees are generally deciduous, lower and more widely-spaced than in tropical rainforests. Because there is more light on the floor of the forest, there is dense and tangled vegetation.
 - (c) Most of the trees have been cut down to clear land for agriculture. Some valuable timber was cut down long ago for furniture and other uses.
 - (d) Rice, wheat, tobacco, cotton, etc.
3. (a) South America, Africa, the subcontinent, south-east, Asia, and Australia
 - (b) There are two distinct seasons: a hot dry period when the Sun is overhead, or the closest it gets to that region; a cooler, wet period when the Sun is in the opposite tropical region.
 - (c) Plenty of grass means that animals can graze freely. That means that the predators who prey on these herbivores are also found there in great numbers.
 - (d) Tourism is often an important industry in these areas, but rice, maize, wheat, sorghum, and peanuts are also produced. The major agricultural activity is cattle farming so products related to this—meat, leather, etc.—are also manufactured.
4. (a) The absence of rain
 - (b) The clear cloudless sky causes these changes in temperature. The absence of cloud means the ground heats up very quickly during the day but, just as quickly, loses heat when the Sun sets in the evening.
 - (c) They sometimes contain valuable reserves of minerals, such as oil.
 - (d) Pupils will have to think about this as the answer is not mentioned in the text: fossil fuels are produced over millions of years from the remains of dead plants and animals. The climate of desert areas with rich mineral deposits must have been very different millions of years ago: lush in vegetation and probably teeming with animal life.

5. A safari is a sight-seeing expedition to observe African animals in their natural habitats. Encourage pupils to be as creative as possible in their individual accounts.

Additional exercise

MCQs

Choose the correct answer:

1. Tropical rainforests are found close to the:
 - a. poles
 - b. Equator
 - c. seas

(Equator)

2. _____ per cent of all the species of climbing plants are found in the tropical rainforests.
 - a. 90
 - b. 80
 - c. 100

(90)

3. Rainforests are an excellent source of valuable:
 - a. timber
 - b. rain
 - c. animals

(timber)

4. Tropical grasslands are located:
 - a. near the poles
 - b. in the southern hemisphere
 - c. inside the tropics but further away from the Equator

(inside the tropics but further away from the Equator)

5. The Thar/Cholistan area in Pakistan is a typical example of a:
 - a. Tropical grassland
 - b. Tropical desert
 - c. Tropical rainforests

(Tropical desert)

NATURAL VEGETATION—

TEMPERATE Pupil's Book 95-99

The fairly rare Mediterranean climate is what many people consider the ideal climate, with warm dry summers (20 to 25°C) and mild wet winters (8 to 13°C). Ask pupils where these areas of Mediterranean climate usually occur: the coastal areas on the western side of continents. This climatic region coincides with generally very fertile soil, so that countries with a Mediterranean climate produce a wide range of fruits and vegetables. Exploiting these (marketing fresh fruits, canning, wine-making, pressing olive oil, and packaging dried fruit) leads to great prosperity. Because of the climate, these countries are also highly desirable destinations for holiday-makers so the income generated from tourism is quite considerable.

Answers to Pupil's Book page 100

- They are fertile because of the warm summers, mild winters, and good rainfall. This mild climate is excellent for agriculture and the soil is rich in nutrients.
 - Fruits and fruit-related products (oranges, lemons, apricots, peaches, figs, grapes); nuts (almonds, chestnuts, walnuts); vegetables; rice; wheat, especially for pasta; olive oil, etc.
- Once found in the eastern United States, western Europe, and eastern Asia. Now very little remains.
 - Most of these forests have been cut down for agricultural purposes or for timber.
 - Grains (like wheat, oats, rye, and barley); root crops (sugar beet and turnips); flax; apples, pears, plums, cherries, and bush fruits; sheep and cattle farming.
- Because they are far from the moderating influence of the sea, there are large differences in summer/winter temperatures. Rainfall, which occurs in summer, is light. This harsh climate is not conducive to the growth of trees. The land is covered with grasses of different varieties, depending on location.
 - Prairies in North America; pampas in South America; steppes in central Asia; veldts in southern Africa.
- They form a band right across the northern hemisphere, north of the temperate forests and temperate grasslands.
 - Coniferous trees, like pine, spruce, and fir. These are evergreen and have needles instead of leaves.

- (c) These trees are cone-shaped so that heavy snow falls off of them without causing damage. They have needles instead of leaves: these needles reduce the transpiration of water and do not break under the heavy weight of snow.
 - (d) Coniferous timber is used for building purposes, for telegraph poles, and for making paper, cardboard, and rayon.
5. Individual work. Encourage pupils to be as creative as possible and to decorate their answers with drawings and/or photographs.

Additional exercise

MCQs

Choose the correct answer:

1. The conditions of the Mediterranean climate are ideal for:
 - a. agriculture
 - b. mining
 - c. construction **(agriculture)**
2. Temperate forests have:
 - a. warm summers and cool winters
 - b. mild summers and mild winters
 - c. cool summers and warm winters **(warm summers and cool winters)**
3. The trees of temperate forests are:
 - a. as densely packed as those of tropical forests
 - b. not as densely packed as those of tropical forests
 - c. not very useful **(not as densely packed as those of tropical forests)**
4. Coniferous forests form a band right across the:
 - a. northern hemisphere
 - b. southern hemisphere
 - c. Equator **(northern hemisphere)**
5. The coldest city in the world is Noril'sk in Russia, the temperature here can be as low as:
 - a. -40°
 - b. -80°
 - c. -60° **(-80°)**

THE WORLD OF WORK

Pupil's Book 101-104

Primary work

Point out that these (with the exception of mining/oil production) are the bedrock of human civilization. These are activities that, even in rudimentary form, humanity has carried on since the earliest days. After the domestication of animals and, much later, settled agriculture (about 10,000 years ago), primary work increased immensely. Primary activities are actually the activities on which we all depend. Discuss with pupils whether these absolutely fundamental workers should be the highest paid of all when in practice they are usually the very lowest wage earners on Earth (with the exception of miners and oil producers). Why are the people who perform these vitally important activities so poorly paid? Probably the answer is that they are not considered highly-skilled jobs. But let the average city clerk have a go at felling a tree, managing herds of cattle, or planting crops!

Secondary work

This is the towering edifice built on the foundations of primary work—processing and manufacturing the raw materials of the Earth into products that we can use. Secondary work can range from purely repetitive unskilled labour to the most highly-skilled activities in the world.

Services

This is the most rapidly growing sector of labour. As standards rise, we demand more and more care, attention, health services, shops, leisure activities, entertainment, etc.

Ask pupils to talk about the relative value of jobs. Is a popular singer or entertainer, earning many millions of rupees a month, really worth so much more than the person who provides fresh water, teaches us (sore point), nurses us when sick, or cleans the streets? Can pupils suggest a hierarchy of 'real' rewards for work? What about politicians? Do they earn their money, and how? How much does prestige in a job compensate for monetary reward? Would it be possible to have a society in which everyone was paid much the same?

Agriculture

Pages 16, 17, and 18 of the *Oxford School Atlas for Pakistan* should be looked at in conjunction with pages 24 to 26. Encourage pupils to relate crops to climatic regions (although the issue is confused in Pakistan by irrigation). This might be the right time to point out the problem of intensive irrigation—salinity. The water in the surface layers of the soil evaporates in the hot sun, leaving behind a concentration of salt. More water rises from deeper layers, and this too evaporates, leaving behind its salt. Gradually, the salinity of the soil increases to such an extent that it is virtually unusable if untreated. Water from even lower depths has to be pumped up to 'wash' the salinity out of the upper soil. This will be discussed in detail when we look more closely at Pakistan in Book 2.

Fishing

Although fishing is not a major activity in Pakistan (it employs only 0.25 per cent of the population), it manages to produce 540,000 tons of fish a year: 73 per cent sea fish and 27 per cent freshwater fish. The majority of fish caught in the world today is not eaten but used commercially. By far the largest proportion is used as fish meal (cooked and ground up fish) for feeding animals and for fertilizer. Vast quantities are used for producing oil which is suitable for cooking, margarine, cosmetics, paint, soap, and candles. In Pakistan, about one-third of the fishermen work at sea and two-thirds on the rivers. Many of these fishermen only catch fish for their own families and local needs.

In general, the seas are being overfished. International conferences that aim to limit the amount caught have achieved little to date.

Livestock

Today, the great majority of livestock is reared on farms, although there is some nomadic grazing in western Pakistan and in central Asia. Animals are reared on commercial foods when natural vegetation is exhausted. Enclosed farming enables the stock to be improved by selective breeding. Livestock is important in Pakistan for food, milk, leather, and for pulling carts and ploughs. Local breeds are generally of low quality, but new breeds are being introduced to improve the stock. There are a number of government breeding stations which cross-breed in the hope that the new animals will produce more milk or prove to be stronger. Buffaloes are the main source of milk and meat. Sheep are kept for meat and wool (the production of the latter has doubled in relatively few years). Sheep have the ability to survive on poor soils which cannot support cattle, like the western regions of Pakistan and the Thar Desert. Goats are being discouraged by the government, for although they produce both meat and milk, they graze intensively, eating everything in sight and thereby contributing to soil erosion.

Poultry is an important part of the Pakistani agricultural economy: virtually every rural family has chicken and so do about 20 per cent of city dwellers. Chicken form an important food item, as they are fed on household scraps and need no special housing system. It is interesting that the wide availability of poultry—either one's own or purchased—has kept down the prices of other meats.

Mining, oil, and natural gas

The minerals that are available in any country are, of course, a matter of luck. They are so valuable that vast amounts of money are spent on locating them. Pakistan's oil output is about 21 million barrels a year: Saudi Arabia, in comparison, produces 2555 million. Libya, fifteenth on the world table of oil producers, still manages to produce 480 million barrels a year. Pakistani engineers are exploring off the sea coast but have found little so far, although the geology of the region seems to indicate that it is an extension of the oil-rich Gulf states.

Answers to Pupil's Book page 105

1. Primary: farming, fishing, forestry, mining, quarrying, herding, oil production
Secondary: all industrial processes; manufacturing of all kinds; building
Tertiary: services, including law and order; medical services; education; communications; catering; entertainment; banking and finance; art and music
2. (a) Climate: some crops grow well in hot climates (e.g. sugar and rice); others like cooler weather (e.g. wheat).
(b) Soil: some crops need very rich soil (e.g. cotton), while others can grow in poor soil (e.g. millet).
(c) Terrain: the tea plant does well on steep slopes and prefers well-drained roots; rice requires heavy, wet soil.
(d) Availability of irrigation: cotton and most other crops in Pakistan
3. Timber is the raw material for paper, cardboard, and rayon (artificial silk), as well as being essential for building, furniture, and packaging. In some places, it is the only source of fuel for heating and cooking.
4. Trees, especially the valuable hardwood variety such as teak and oak, take several hundred years to grow to maturity. Wood is being used far more quickly than it can be replaced.
5. Today, large and highly efficient fishing boats equipped with electronic aids can remove fish from seas and rivers far more quickly than they can be replaced by breeding. Some species of valuable fish for food are in danger of extinction. Fish farming, like animal farming, is being practised, but the quality of the fish has fallen and there is a constant struggle against disease because of overcrowded tanks.
6. The natural vegetation there (grass) is highly suitable for grazing. There are fewer pests and diseases there than in hotter climates.
7. (a) More efficient than coal or wood for heating
(b) Easier to extract—coal mining is a dangerous occupation.
(c) Natural gas especially, and oil in particular, are fairly easy to transport over long distances in ships.
(d) Gas and oil can be sent over relatively short distances by pipeline. This is cheaper to operate than transporting coal by train.

Additional exercise

MCQs

Choose the correct answer:

1. Agriculture, herding, fishing, forestry, etc. are called:
 - a. primary work
 - b. secondary work
 - c. tertiary work **(primary work)**
2. Service related activities such as education, banking, entertainment, etc. are called:
 - a. secondary work
 - b. primary work
 - c. tertiary work **(tertiary work)**
3. In colder parts of the world certain crops that require warm conditions, can be grow in:
 - a. greenhouses
 - b. fields
 - c. slopes **(greenhouses)**
4. In many parts of the world fish are now being farmed in huge:
 - a. underwater cages
 - b. lakes
 - c. seas **(underwater cages)**
5. Chopping down trees can turn fertile land into:
 - a. oasis
 - b. desert
 - c. lagoon **(desert)**

Secondary work

Go through the various factors desirable for the location of industry on page 106 of the Pupil's Book. Discuss these with pupils and then examine pages 30 and 31 of the *Oxford School Atlas for Pakistan*. Choose your local area, and explain why certain industries are located there and which factors are paramount.

Services

Ask pupils to look at the figures on page 108 of the Pupil's Book, pointing out the proportions involved in each aspect—agriculture, industry, and services. Can they suggest what these figures might indicate? The proportion involved in service industries should indicate a higher standard of living because people have more money to spend and expect more to be done for them (servants, restaurants, entertainment, taxi drivers and so on). This is borne out in the United States where 77 per cent of the workforce is employed in the service sector. Thailand, with about 37 per cent employed in the service sector, is a poorer country. Ask why American industry employs only 21 per cent of the workforce, which is equal to that of Pakistan. It probably means that industry is more efficient and more highly automated. The same applies to agriculture: only about 2 in every 100 people in the United States work on the land. Their farms are large-scale enterprises with huge amounts of mechanical equipment.

Answers to Pupil's Book page 109

- Proximity to source of raw material to reduce the cost of transportation: food processing near fruit growing areas; iron and steel near mines; textiles near cotton producing regions.
 - Proximity to good energy source: oil, natural gas, and electricity are easy to transport but need maintenance. Coal is very difficult and expensive to transport.
 - Good communications: ports, rivers, good rail links for transporting raw materials and finished products. Today, good air communications and electronic communications are also important.
 - Proximity to workers and facilities for their use.
- This should be done as a discussion question or individual work. One could make a good case for (a), (b), and (c) above because labour can be encouraged to move elsewhere and/or facilities can be developed for them wherever the plant is set up.
- Individual work: encourage pupils to use their atlas to help locate suitable sites. Ask them to list the factors to consider in each case.
- Cottage industry is the small-scale manufacture of crafts. Usually the owner and his or

her family are the only employees. (Point out the pictures on page 107 of the Pupil's Book.) They are usually skilled craftsmen who often have a subsidiary occupation like farming. Typical products include: carpets, shoes, embroidery and embroidered clothes, sports equipment, furniture or wooden items, basic tools, pottery, garments and textiles, and some food items like chutney.

- The main thing to emerge from the chart are the figures for developing and developed countries. Developed countries (Germany and the United States) spend a higher percentage on services. The less-developed countries have not yet achieved that level of wealth, so they have to concentrate on trying to produce it through primary and secondary activities. Agriculture does not (at least at the basic level) require as much capital investment as industry does. The developed countries have a much lower dependence on agriculture for their wealth and concentrate on industry. This is a high value area. They can purchase their food requirements from other countries.

Additional exercise

MCQs

Choose the correct answer:

- Karachi is an important:
 - port city
 - agricultural city
 - mining city

(port city)
- _____ industry is an important industry of Pakistan.
 - Cottage
 - Heavy machines
 - Paper

(Cottage)
- The three main manufacturing centers for cotton industry are:
 - Karachi, Hyderabad, and Faisalabad
 - Lahore, Islamabad, Quetta
 - Karachi, Islamabad, Peshawar

(Karachi, Hyderabad, and Faisalabad)
- People who work in services industry do not actually produce goods. They produce:
 - services
 - agriculture
 - medicines

(services)
- The tertiary sector is becoming important because people are expecting:
 - more education
 - more entertainment
 - a better standard of living

(a better standard of living)

SETTLEMENTS

Pupil's Book 110-114

Early communities

Pupils may remember from their history lessons that in general early settlements were along major rivers like the Indus, Tigris, and Euphrates, and the Nile. This was natural as a river environment provided the simplest way of fulfilling people's needs, especially if the river flooded annually to provide rich fertile soil.

Riverine cities

Encourage pupils to use their atlas and pick out important Pakistani cities that are situated on rivers. Ask them to discuss the factors involved in selecting an appropriate site next to a river.

Coastal cities

One of the major coastal cities of importance in Pakistan is Karachi. Ask pupils why it was not built further south.

Singapore is a typical example of a town as crossroad or naval port. It was a station on the Asia/Europe route and, as such, was heavily fortified as a naval base by the British.

Market towns

Again, let pupils pick out some important Pakistani cities which rely on markets, and then see how these relate to the maps on pages 24 to 27 of the *Oxford School Atlas for Pakistan*.

Industrial towns

Ask pupils to examine the maps on pages 30 and 31 of the *Oxford School Atlas for Pakistan*, for towns, and then relate them to the products on pages 24 to 27.

It might be worthwhile drawing maps on tracing paper and then marking towns associated with various agriculture-based industries on it: perhaps one map for cotton, another for wool and jute, another for sugar, another for leather, another for silk and rayon, etc. Once ready, superimpose these on the relevant maps on pages 24 to 27 of the *Oxford School Atlas for Pakistan*. Ask pupils to relate the industries with the region in which they occur, or give other reasons why they are there.

New towns

Ask pupils why Islamabad was built. Tell them to collect photographs of different parts of Islamabad. Set up a wall chart with a street map of the city, and link the photographs with arrows to their positions on the map.

Answers to Pupil's Book page 115

1. Water for drinking, irrigation, and animals; clay for building; availability of food—water, birds, and fish; rushes for buildings, baskets, mats, etc.; transport on canoes and rafts
2. Sheltered harbour for boats to load and unload; transport links into the interior for goods to be traded. Often the mouth of a large river was a suitable location.
3. Usually they begin with the availability of minerals (metal ores, coal, iron, etc.); availability of raw materials (cotton, wool, leather, foodstuffs); good communication links with markets or ports for export; good supply of labour, especially skilled labour like weavers, spinners, and metal workers.
4. Modern warfare (bombing from the air, long-distance missiles) sadly makes traditional defences useless.
5. Several reasons are possible: to mark a new beginning; to ensure that the capital is independent from provinces/states within the country, etc.
6. To supply travellers with food, water, and lodging. Today, travel is much faster and people do not need to rest in between if they are travelling by air. Alternatively, they are provided with food and rest while on their selected method of transport—sleeping and dining cars on long-distance train routes, etc.
7. Individual work. Encourage pupils to obtain data from various sources to support their answers.
8. Individual work. Much creative thought can be put into this!

Additional exercise

MCQs

Choose the correct answer:

1. 10,000 years ago people began to settle in one place because they discovered:
 - a. farming
 - b. mining
 - c. fishing **(farming)**
2. Villagers in Pakistan often have:
 - a. lower standard of living than city dwellers
 - b. higher standard of living than city dwellers
 - c. all the facilities that the city dwellers enjoy **(lower standard of living than city dwellers)**

3. Centres of large agricultural areas often grew into:
 - a. public health centres
 - b. port cities
 - c. market towns or cities **(market towns or cities)**
4. An example of a gap town in Pakistan is:
 - a. Faisalabad
 - b. Karachi
 - c. Peshawar **(Peshawar)**
5. Towns that naturally grow up along trade routes to supply food, water, and shelter for travellers are called:
 - a. industrial cities
 - b. oasis towns
 - c. new towns **(oasis towns)**

LESSON PLAN

Topic: The Universe

Time: 40 minutes

Learning outcomes:

By the end of the lesson students should be able to:

- describe the different heavenly bodies and explain the role of each of them in the make-up of the Universe
- explain the role of gravity and centrifugal forces in the processes of the Earth

Resources: textbook, slides or illustrations of the various heavenly bodies, model of the solar system

Introduction: 5 minutes

Show pictures of the different heavenly bodies. These can be used to initiate the lesson and interest the students in the topic.

Explanation: 30 minutes

Prior reading of pages 1 to 6 of the textbook is required. The teacher can then use a model of the solar system to show the students the position of the planet on which we live relative to the Sun and the other planets.

- Features of the planets and other heavenly bodies can then be explained.
- A video downloaded from the Internet could be shown to reinforce the explanation.
- Start with the Earth, the feature which is most familiar to the students, and then go on to the more unfamiliar features.
- Student input is essential to make the lesson interactive: they should discuss the illustration on page 2 of the textbook as well as the model provided by the teacher.

Recapitulation: 5 minutes

- A slide show can be used to sum up and reinforce all the new concepts.

Homework:

- Read pages 1–6 of the textbook.
- Students should draw a plan of the Solar System in their notebooks.
- Attempt questions on page 7.

LESSON PLAN

Topic: The Earth

Time: 40 minutes

Learning outcomes:

By the end of the lesson students should be able to:

- describe the shape of the planet Earth and explain how the imaginary lines drawn on the Earth help us to understand the various natural phenomena
- describe the two different movements of the Earth and explain the effects of these movements on the Earth

Resources: textbook; a poster showing a diagram of the Earth's rotation round the Sun and how it revolves on its own axis; globe; world map

Introduction: 5 minutes

The globe can be used to demonstrate the shape and the tilt of the Earth, and students can be asked to observe the lines drawn on the globe.

Explanation: 30 minutes

Prior reading of pages 8 to 15 of the textbook is required.

- Basing the lesson on the globe, explain to the students the various features of the Earth and ask them questions.
- List the features on the board.
- Use a chart to explain how the movements of the Earth bring about day and night and the seasons.

Recapitulation: 5 minutes

- The teacher should draw the position of the Earth at the times of equinoxes and solstices and the students should describe the effects of these upon the Earth.
- Students can use chart paper to draw the effects of equinox and solstice on Earth and present it to the entire class.

Homework:

- Read pages 8–15 of the textbook.
- Draw a diagram showing the Earth's revolution.
- Attempt questions on page 16.

LESSON PLAN

Topic: The world of rocks

Time: 40 minutes

Learning outcomes:

By the end of the lesson students should be able to:

- identify the different layers of the Earth's crust
- describe the different kinds of rocks and explain the distinguishing characteristics of each type

Resources: textbook; slide show of layers of the Earth/types of rock; chart showing the rock cycle; specimens or pictures of different types of rock

Introduction: 5 minutes

Use pictures or samples of rocks to initiate the topic and to draw attention to the different features of the various types of rock. Ask students to list these features separately for each type.

Explanation: 30 minutes

Prior reading of pages 17 to 20 of the textbook is required.

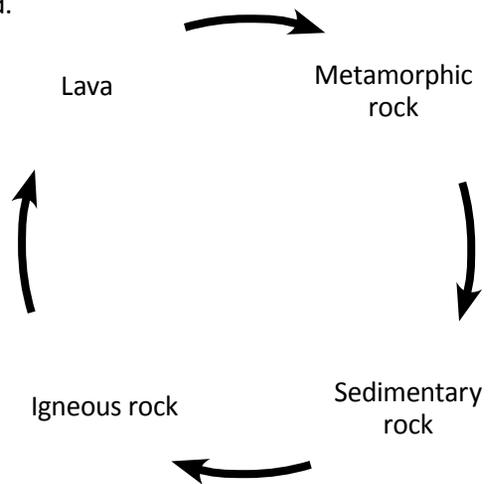
- Use a chart to show the various layers of the Earth's structure.
- Highlight the main features of each of these layers and list them on the board.
- Relate the crust to the different types of rocks.
- Teach the rock cycle drawn on the right, to explain the formation of these rocks.
- Explain the links between these types.

Recapitulation: 5 minutes

Students can be given a short quiz in which they will draw the rock cycle in their journals.

Homework:

- Reading of pages 17 to 20 of the textbook
- Draw a labelled diagram of the structure of the Earth.
- Collect pictures of various types of rocks and paste them in notebook.
- Attempt questions on page 21.



LESSON PLAN

Topic: Plate tectonics

Time: 40 minutes

Learning outcomes:

By the end of the lesson students should be able to:

- explain the relationship between tectonic plate distribution and movements
- describe the tectonic plate movements and the impact of these on our environment
- explain the causes and characteristics of earthquakes

Resources: textbook, charts, video clips explaining plate tectonics and how geological features are formed, world map, an outline world map on which to locate geological features for each student

Introduction: 5 minutes

Discuss the structure of the Earth and emphasise how the crust is divided into different tectonic plates.

Explanation: 30 minutes

Prior reading of pages 22 to 26 of the textbook is required.

- Explain the process of plate movements.
- Illustrate on the board or using posters, etc. the geological features that are formed by plate movements, e.g. fold mountains.
- Describe the formation of volcanoes and various important fold mountains, e.g. the Himalayas. These features should be located on a world map.
- Differentiate between fold mountains and fault lines.
- The students can mark the plate boundaries on the outline world maps and name them. The directions of the plate movements should also be marked.
- The students should draw diagrams in their notebooks to explain the formation of fold mountains.

Note: If necessary, this lesson can be taught in two sessions.

Recapitulation: 5 minutes

- Revise all the features/concepts learned. Ask students to draw the features and differentiate fold mountains from the ones formed by faulting.

Homework:

- Reading of pages 22 to 26 of the textbook
- Draw the plate boundaries on the blank world map and name the plates.
- Attempt questions on page 27.

LESSON PLAN

Topic: Mountains

Time: 40 minutes

Learning outcomes:

By the end of the lesson students should be able to:

- differentiate between fold and block mountains
- describe the process of their formation

Resources: textbook, world map, pictures of different types of mountain ranges

Introduction: 5 minutes

Revise the process of plate movement and how this results in different geological features; focus on fold mountains, block mountains and volcanoes; show pictures of different mountain ranges and identify the type of formation for each.

Explanation: 30 minutes

Prior reading of pages 28 to 30 of the textbook is required.

- Discussion on the formation and characteristics of different types of mountains
- Illustration on the board by the teacher to explain their formation
- A video clip showing the process of their formation can be shown to the students
- Students should mark the ranges of fold mountains on the blank world map.
- Diagrams showing the formation of fold/fault mountains and rift valley can be drawn in students' notebooks.

Recapitulation: 5 minutes

- Elicit answers from the students in order to revise the chapter.

Homework:

- Reading of pages 28 to 30 of the textbook
- Attempt questions on page 31.

LESSON PLAN

Topic: The world of water

Time: 40 minutes

Learning outcomes:

By the end of the lesson students should be able to:

- identify the uses of water in our lives
- describe different bodies of water
- explain the process of the water cycle and precipitation

Resources: textbook, charts showing the water cycle, pictures of various bodies of water, rainfall tables for different areas of the country

Introduction: 5 minutes

Discuss the different forms in which water is found on Earth (bodies of water). These can be listed on the board and each type briefly defined. Show pictures depicting the various bodies of water.

Explanation: 30 minutes

Prior reading of pages 32 to 35 of the textbook is required.

- Group work: Divide the class into groups of three or four to discuss the ways in which water is used in daily life and the importance of water in our lives. Groups can then share their ideas with the whole class.
- The water cycle can be explained through a diagram on the board. Each stage, such as evaporation, transpiration, runoff, etc., should be clearly illustrated on the diagram.
- Tables showing the amount of rainfall, specifically of your locality/city/province, can be studied in order to help students to relate it to their own lives.

Recapitulation: 5 minutes

- Sum up the concepts taught including the significance of water in human life, the different bodies of water, the various processes of the water cycle, and precipitation in the students' own area.

Homework:

- Reading of pages 32 to 35 of the textbook
- Students should draw a diagram of the water cycle in their notebooks.
- Attempt questions on page 36.

LESSON PLAN

Topic: The water table

Time: 40 minutes

Learning outcomes:

By the end of the lesson students should be able to:

- differentiate between permeable and impermeable rocks
- define the water table and describe the fluctuations in the water table
- identify the sources of ground water

Resources: textbook, chart

Introduction: 5 minutes

Discuss what happens to rain water when it reaches the surface of the Earth.

Explanation: 30 minutes

Prior reading of pages 37 and 38 of the textbook is required.

- Use charts to explain how water is absorbed into the soil; explanation of the water table is essential at this point.
- Discuss the various reasons for the fluctuation of the water table.
- Students should list the important terms in their notebooks and write a definition for each of them.

Recapitulation: 5 minutes

- Revise the features of permeable and impermeable rocks.
- Review what is meant by the water table and outline the reasons for its fluctuation.

Homework:

- Reading of pages 37 and 38 of the textbook
- Attempt questions on page 39.

LESSON PLAN

Topic: Smaller bodies of water

Time: 40 minutes

Learning outcomes:

By the end of the lesson students should be able to:

- explain the importance of rivers
- describe the features of a drainage basin
- describe a river system and the course of a river from the source to the mouth
- explain how erosional and depositional land features are formed

Resources: textbook, chart

Introduction: 5 minutes

Discuss where and how streams occur.

Explanation: 30 minutes

Prior reading of pages 40 to 45 of the textbook is required.

- In groups, students should discuss the importance of rivers and then share their ideas with the rest of the class.
- Important features listed on the chart
- Use an illustration to explain the various features that form a drainage basin.
- Divide the basin into three parts—the upper, middle, and lower courses. For each course, explain the shape of the basin and the features formed.

Recapitulation: 5 minutes

- Review the changes at the different parts of a river basin as the river flows towards the sea.

Homework:

- Reading of pages 40 to 45 of the textbook
- Attempt questions on page 46.

LESSON PLAN

Topic: The sea

Time: 40 minutes

Learning outcomes:

By the end of the lesson students should be able to:

- describe the various features of the sea bed
- explain how tides are formed

Resources: textbook, chart, world map, video downloaded from the Internet

Introduction: 5 minutes

The world map can be used to locate and name the five oceans of the world and illustrate how they comprise 71% of the Earth's surface.

Explanation: 30 minutes

Prior reading of pages 47 to 51 of the textbook is required.

- Use the chart to explain the various features of the seabed.
- Draw a diagram on the board to explain the influence of the tides.

Recapitulation: 5 minutes

- Review the main feature of the sea in terms of the land shapes underwater and the rise and fall of the tides.

Homework:

- Reading of pages 47 to 51 of the textbook
- Attempt questions on page 52.

LESSON PLAN

Topic: Currents

Time: 40 minutes

Learning outcomes:

By the end of the lesson students should be able to:

- explain how the ocean currents influence the temperatures of coastal areas

Resources: textbook, world map showing the movements of the currents with warm and cool currents highlighted, blank outline world map for each student

Introduction: 5 minutes

Use the map showing the movements of the ocean currents to introduce the lesson.

Explanation: 30 minutes

Prior reading of pages 53 to 56 of the textbook is required.

- Explanation of the ocean currents and how the temperatures of the different regions of the world make them warm or cold.
- Describe the types of currents, using a diagram on the board.
- Demonstrate thermal convection using a bowl or tube containing hot and cold water. If you put your hand or finger into it, you will feel that the cold water has sunk while hot water remains at the top.
- Explain how a warm current changes the temperature of the coastal areas when it enters a cold region.
- Students should mark the important warm and cold currents on the blank world map and stick them in their notebooks.

Recapitulation: 5 minutes

- Review the lesson through a quiz.

Homework:

- Reading of pages 53 to 56 of the textbook
- Attempt questions on page 57.

LESSON PLAN

Topic: The world of air

Time: 40 minutes

Learning outcomes:

By the end of the lesson students should be able to:

- explain what air is and how it is made up of different gases
- describe, identify, and compare the instruments used for measuring air pressure so that it can be represented on a map

Resources: textbook, atlas, world map, barometer

Introduction: 5 minutes

Discuss ways of moving through the air such as in an elevator or aeroplane.

Explanation: 30 minutes

Prior reading of pages 58 to 59 of the textbook is required.

- Using a diagram on the board, explain how the movement of air causes winds.
- List on the board all the gases that make up the air.
- Demonstrate how barometers are used to measure air pressure.
- Use an atlas to explain how isobars are used to show data concerning differences in air pressure in different parts of the world.
- Students should draw a labelled diagram of a mercury barometer in their notebooks.

Recapitulation: 5 minutes

- Quick quiz to review understanding of the main points of the lesson.

Homework:

- Reading of pages 58 to 59 of the textbook
- Attempt questions on page 60.

LESSON PLAN

Topic: Winds

Time: 40 minutes

Learning outcomes:

By the end of the lesson students should be able to:

- explain what winds are
- describe the movements of winds and how they influence surrounding areas
- explain the creation of strong and less strong winds

Resources: textbook, chart of planetary wind belt, world map, video clip showing the formation of a cyclone

Introduction: 5 minutes

- Discuss students' ideas on how winds are created.

Explanation: 30 minutes

Prior reading of pages 61 to 65 of the textbook is required.

- The chart of the planetary wind belt can be used to explain the movements of winds.
- Land and sea breezes can be explained through a diagram on the board.
- The world map can be used to show the directions of monsoon winds.
- The creation of cyclones can be taught using the video clip.

Note: This lesson can be taught as two separate sessions since it will take some time to explain monsoons.

Recapitulation: 5 minutes

Quick quiz to review understanding of the main points of the lesson:

- a. creation of land and sea breezes and the time of the day when they occur
- b. reasons for summer monsoon winds
- c. causes of cyclones and reasons why they are hazardous

Homework:

- Reading of pages 61 to 65 of the textbook
- Attempt questions on page 66.

LESSON PLAN

Topic: Weathering, erosion, and deposition

Time: 40 minutes

Learning outcomes:

By the end of the lesson students should be able to:

- differentiate between weathering and erosion
- explain how the two processes play their roles in destroying and forming landscapes on the Earth's crust

Resources: textbook, pictures showing unusual erosional features, slide show

Introduction: 5 minutes

- Pictures showing the erosional and depositional features on the Earth's crust can be used to arouse interest in how these features were formed—old and new pictures of the same site can be useful.

Explanation: 30 minutes

Prior reading of pages 67 to 72 of the textbook is required.

- Explanation of the terms weathering and erosion using images on the computer. These can be animated or simply diagrams.
- Students can be asked to describe the effect of each process on the Earth.

Recapitulation: 5 minutes

- A chart can be used to sum up the main teaching/learning points of the lesson.

Homework:

- Reading of pages 67 to 72 of the textbook
- Attempt questions on page 73.

LESSON PLAN

Topic: The world of maps/Longitude and latitude

Time: 40 minutes

Learning outcomes:

By the end of the lesson students should be able to:

- explain how maps are a graphical representation of the surface of the Earth
- distinguish between the different features of a map and explain their purposes
- identify lines of longitude and latitude and explain how places can be located using these imaginary lines
- calculate world times using these imaginary lines

Resources: textbook, world map, globe

Introduction: 5 minutes

- A world map can be used to introduce the topic

Explanation: 30 minutes

Prior reading of pages 74 to 77 of the textbook is required.

- First draw a plan of the school or classroom to show how actual size is represented by scale.
- Next, different elements of maps can be added to the plan and the significance of each discussed.
- The globe can be used to show the imaginary lines, and their significance and purpose can be explained.

Recapitulation: 5 minutes

- Students can list the important elements of a map in their notebooks.
- Students can be asked to make a map of their school.

Homework:

- Reading of pages 74 to 82 of the textbook
- Attempt questions on page 78 and 83.
- Students can draw the longitude and latitude of the Earth.

LESSON PLAN

Topic: Weather and climate

Time: 40 minutes

Learning outcomes:

By the end of the lesson students should be able to:

- differentiate between weather and climate
- explain the factors that affect the temperature of a place
- explain how and why future climate change is a cause of concern now

Resources: textbook, charts illustrating factors that are affecting the climate

Introduction: 5 minutes

- Draw the students' attention to the day's weather and then move on to discuss different climates. What is differential climate?

Explanation: 30 minutes

Prior reading of pages 84 to 87 of the textbook is required.

- List all the elements of weather on the board and then explain how temperature is influenced by different factors. These factors can be explained through illustrations on the chart.
- Explain how location affects the local temperature.
- Students can be challenged by thought-provoking questions to stimulate their interest in the topic.
- A short panel discussion on the effects of climatic changes can be organized.

Recapitulation: 5 minutes

- Ask students at random to explain the factors affecting temperature, using the chart. All the factors affecting temperature should be reviewed through this activity.

Homework:

- Reading of pages 84 to 87 of the textbook
- Attempt questions on page 88.
- Students can draw a diagram illustrating the factors affecting temperature.

LESSON PLAN

Topic: Natural vegetation—tropical and temperate

Time: 40 minutes

Learning outcomes:

By the end of the lesson students should be able to:

- describe the distribution of tropical and temperate forests throughout the world
- compare the characteristics of different types of forest
- explain how vegetation adapts to the climate

Resources: textbook, world map, pictures showing the variety of vegetation types in the two different regions

Introduction: 5 minutes

- Use the world map to identify the different climatic regions of the world.

Explanation: 30 minutes

Prior reading of pages 89 to 99 of the textbook is required.

- Discuss the differences in temperature and precipitation between tropical and temperate regions.
- Describe and explain the differences in vegetation from one region to the other.
- Ask the students to compare the structures of the trees and other forms of vegetation from one region and the other.
- Research work can be undertaken to discover which animal species exist in the different regions.

Recapitulation: 5 minutes

- Review the distribution of vegetation in the two types of forest.
- Review how vegetation survives in each region.
- Discuss how animal species thrive in each region.

Homework:

- Reading of pages 89 to 99 of the textbook.
- Attempt questions on pages 94 and 100.
- Research the species that thrive in tropical and temperate regions and collect pictures of the types of vegetation found in the different regions. Paste these pictures in their notebooks.

LESSON PLAN

Topic: The world of work—industries and services

Time: 40 minutes

Learning outcomes:

By the end of the lesson students should be able to:

- describe the three broad categories of economic activity that make up the production process
- explain the significance of forestry and fishing in Pakistan’s economy and how these activities help to bring products onto the market

Resources: textbook

Introduction: 5 minutes

- Discussion of the significance of work, how work can be divided into industries and services

Explanation: 30 minutes

Prior reading of pages 101 to 108 of the textbook is required.

- The topic will be taught through group work. The class will be divided into groups of three students each. Each group will be given a specific area of economic activity to research using the Internet and the library. The results of the research will be discussed as a group. One person from each group will present the group’s findings and conclusions to the rest of the class.

Later, a whole class discussion can be held on the benefits of these economic activities for the country.

Recapitulation: 5 minutes

- A summary of each group’s research can be compiled on the board.

Homework:

- Reading of pages 101 to 108 of the textbook
- Attempt questions on pages 105 and 109.

LESSON PLAN

Topic: Settlements

Time: 40 minutes

Learning outcomes:

By the end of the lesson students should be able to:

- describe and explain the distribution of the world's population
- define the different types of settlement
- explain the characteristics of rural and urban settlements

Resources: textbook, video clip, map showing world population distribution

Introduction: 5 minutes

- Discussion of the villages/towns students belong to. How many people inhabit their villages/towns, what are the major occupations, do they all speak the same language?

Explanation: 30 minutes

Prior reading of pages 110 to 114 of the textbook is required.

- The map can be used to introduce population distribution—explore the reasons for differences by referring to the map.
- Detailed discussion can take place later in class to analyze the factors influencing concentrations of population.
- Pictures showing rural and urban settlements should be presented. Ask students to identify the characteristics of each and build the lesson on their input.

Recapitulation: 5 minutes

- At random students can be asked to give the reasons for population distribution and the characteristics of urban and rural settlements.

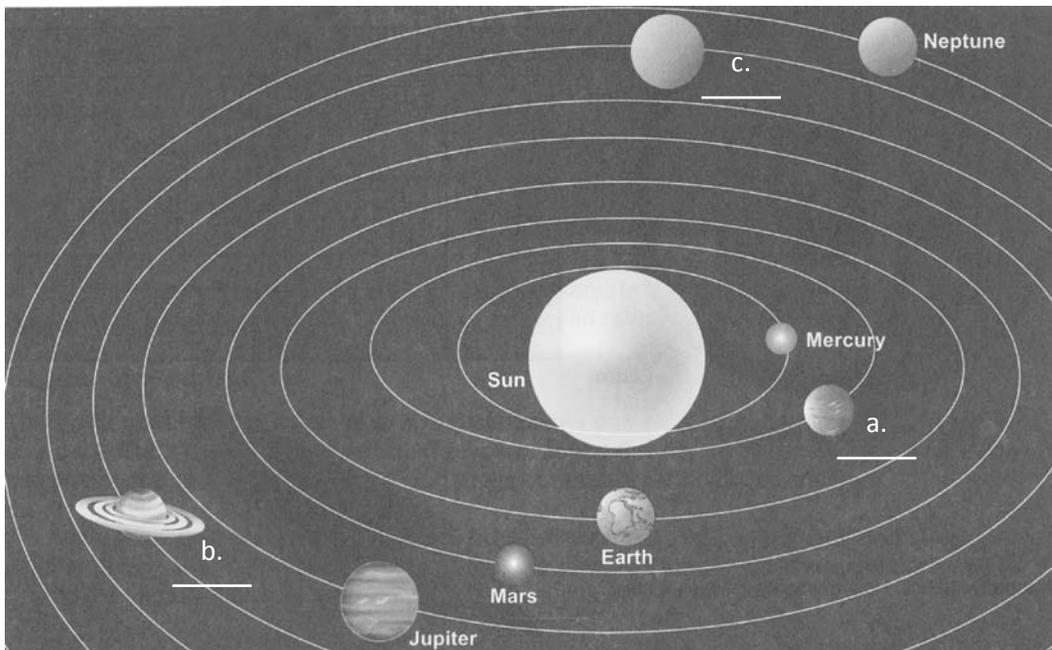
Homework:

- Reading of pages 110 to 114 of the textbook
- Attempt questions on page 115.

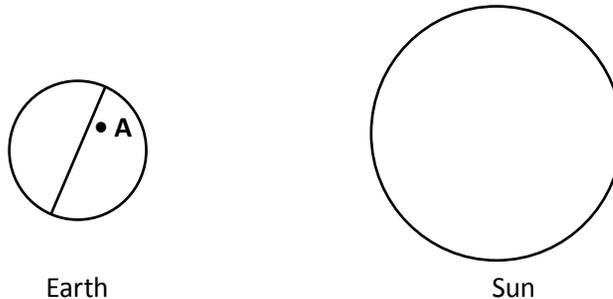
ASSESSMENT FOR UNITS 1-2

(Pages 1 to 16)

1. Define in your own words the following terms:
 - a. light year
 - b. nebulae
 - c. centrifugal force
 - d. comet
 - e. meteorite
2. Fill in the blanks so that the sentences below are true.
 - a. Some scientists hold the view that the Universe came into existence through a massive explosion called the _____.
 - b. The planets revolve round the Sun in an _____ orbit.
 - c. The planet that is closest to the Sun is _____.
 - d. The _____ is an imaginary line on the Earth's surface to mark the North and South Poles.
 - e. The _____ is a layer of air that surrounds the Earth and which is vital for the survival of all living things.
3. The diagram below shows the eight planets of the Solar System. Write in the missing names of the planets.



4. Identify the imaginary lines on the Earth's surface described below.
 - a. It is tilted at a fixed angle of 23.5° to the plane of its orbit.
 - b. It divides the Earth into the northern and southern hemispheres.
 - c. It marks the limit of the movement of the Sun on 21st June and 22nd December.
5. Explain the difference between the Earth's rotation and its revolution. Specify the time taken to complete each and describe its effects on the Earth.
6. This diagram shows one position of the Earth as it revolves around the Sun. Study the diagram and answer the questions below.



- a. On which date does the Earth reach the position shown?
- b. What will the season be at location A? Give reasons for your answer.
- c. What would be the effect on the lengths of the day and night if the Earth was not tilted?

Answers

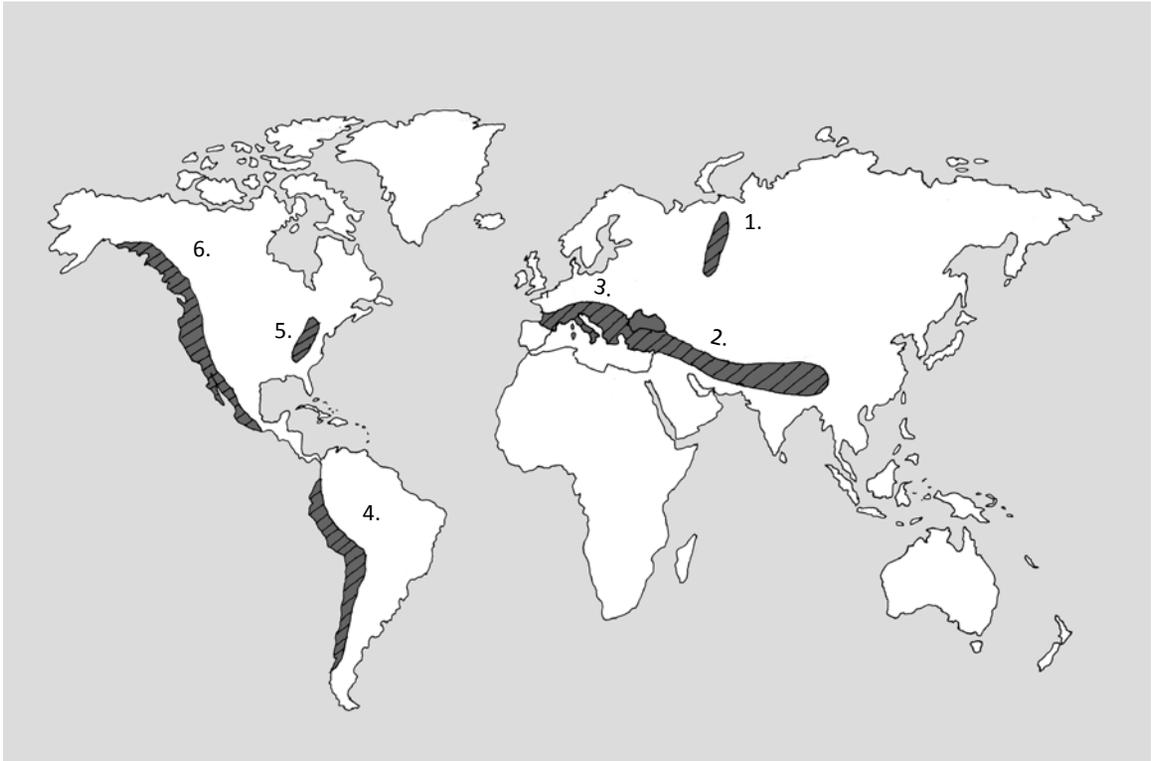
1.
 - a. the distance light travels in a year
 - b. clusters of stars
 - c. the opposite of gravity; this force pushes everything away from the centre.
 - d. a great ball of dust and ice and a tail of shiny bright particles of gas, going around the Sun
 - e. pieces of rock debris from outer space crashing onto the Earth
2.
 - a. Big bang
 - b. elliptical
 - c. Mercury
 - d. axis
 - e. atmosphere
3.
 - a. Venus
 - b. Saturn
 - c. Uranus

4.
 - a. Axis
 - b. Equator
 - c. Tropics
5. In rotation, the Earth moves on its axis and takes 24 hours to complete one full turn. The side of the Earth that faces the Sun experiences day, while the side in shadow experiences night; twilight and dawn are two short periods between day and night and night and day respectively.
In revolution the Earth completes its journey round the Sun. The time taken is 365.3 days. The effects of this revolution are the different seasons in different parts of the world. Places that are near the Sun experience summer and those far away experience winter.
6.
 - a. June 21st
 - b. Summer, as it is facing the Sun directly
 - c. All places will then have the same season throughout the year and equal lengths of day and night.

ASSESSMENT FOR UNITS 3-5

(Pages 17 to 31)

1. In the table below, name the six well-known fold mountains that are shown on the world map by the numbers 1–6.



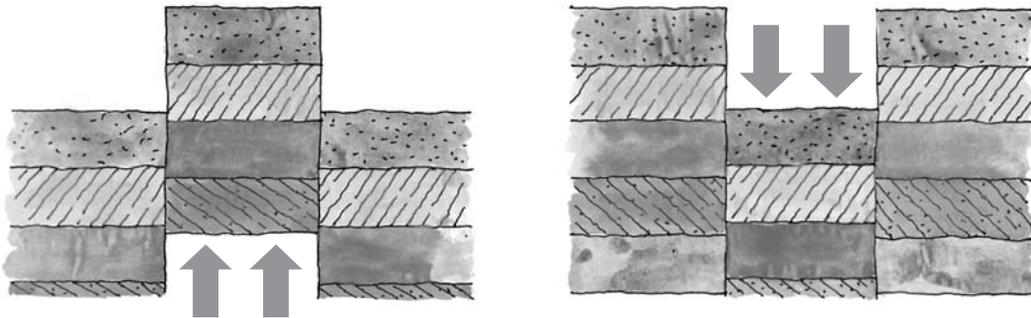
Fold mountains

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

2. Complete the table below to show whether the given rocks are metamorphic, igneous, or sedimentary.

Rock	Type
granite	
shale	
schist	
limestone	
quartzite	
basalt	
gneiss	

3. Study the following figure that shows one of the major processes of mountain formation and answer the questions below.



- Name the type of mountain that is formed by this process.
 - Describe the formation process.
 - Explain how this type of mountain is different from any other type.
4. Explain the cause of a tsunami such as the one that occurred on 26th December 2004 which resulted in the loss of thousands of lives and property in South East Asia and caused a decline in the important tourist industry there.
5. Fill in the blanks so that the sentences are true.
- The _____ mountains were believed to be the chimney of God's blacksmith.
 - The instrument used for measuring the tremors of the Earth is called a _____.
 - The areas of _____ and _____ in Pakistan were seriously affected by an earthquake in 2005.

- d. _____ rocks are formed by the intense heat and pressure inside the Earth.
- e. The Earth has been divided into many parts. The one that is made up of large bodies of water is called the _____.



6. Explain how a geological feature like the one shown in the picture above might be formed?

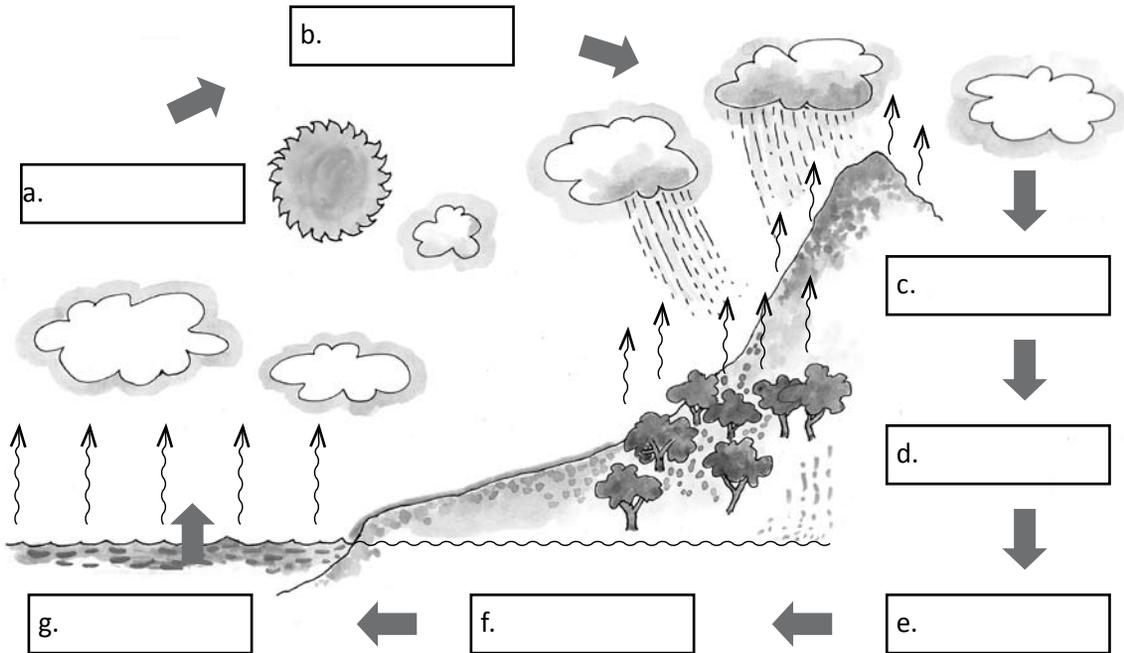
Answers

1. 1. Urals 2. Himalayas 3. Alps 4. Andes 5. Appalachians 6. Rockies
2. a. igneous b. sedimentary c. metamorphic d. sedimentary
e. metamorphic f. igneous g. metamorphic
3. a. fault or block mountains
b. Two long cracks occur on the crust due to plate movements. The land between them may be pushed up to form low mountains. At times, the land between the cracks may drop to form a steep-sided depression called a rift valley.
c. Here the crust cracks whereas in the other case the crust simply folds.
4. These are fold mountains. Rocks are forced into the air and folded by pressure. The pressure is applied during the movement of the crust where the two plates move towards each other
5. A tsunami is caused by an earthquake. It occurs along the fault margin where the tectonic plates meet. The tectonic plates rub against each other, creating gigantic jerks in the crust of the Earth. It makes the crust shake.
- 6 a. volcanoes b. seismograph c. Muzaffarabad, Balakot d. metamorphic
e. lithosphere

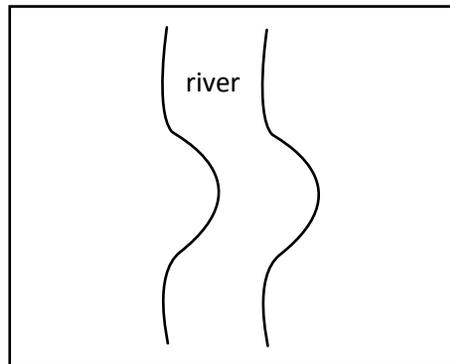
ASSESSMENT FOR UNITS 6-10

(Pages 32 to 57)

- Label the diagram below with the terms that describe the process shown.



- Draw a clearly-labelled diagram showing the features of a drainage basin.
- The figure shows the course of the river.



- Describe the formation of the feature shown in the diagram
- Explain how this feature may change as the river flows toward the sea.

4. Name the following geological phenomena:
- moving blocks of ice on a mountain.
 - water falling from a great height, for example from a cliff
 - rocks that are found near the bedrock
 - land consisting of fertile particles of soil carried by a river from the hills and mountains
5. Explain the following natural occurrences:
- Glaciers are only found in the polar regions and high altitude regions.
 - The water table in coastal areas rises and falls seasonally.
 - A well dug near the foothills of a mountain range provides water throughout the year.
 - The coastal areas of Norway experience milder winters than the inland areas.

Answers

- Water evaporates from the seas as vapour and becomes visible as clouds.
 - The moisture falls as rain or snow.
 - Some of the water evaporates from the surface of the Earth.
 - Some is taken in by plants and given out through transpiration.
 - Some water is soaked into the ground and finds its way back into the sea as groundwater.
 - Surface water runs off into rivers and finds its way to the seas and lakes.
 - In the sea or lake the whole process begins again.
- Refer to the diagram on page 41 of the textbook. The students should mention source, tributaries, mouth, confluence, and watershed of a river.
- The feature shown is a meander. The river makes a series of bends as the speed reduces. These bends of a river are called meanders. When a river bends, its speed is reduced and it therefore deposits on its bank. On the outside of a bend the speed of a river is fast and it therefore erodes its bank.
 - Sometimes the bend in a river becomes so sharp that the water takes a short cut across the neck to straighten itself out. The loop is cut off and becomes a lake. This is called an oxbow lake.
- glacier
 - waterfall
 - metamorphic
 - flood plain
- These places are very cold and this feature moves from a high altitude region.
 - This is because of high and low tides that are caused by the gravitational pull of the moon and Sun. It is also caused by the seasonal movement of the winds.
 - This is because it is permanently saturated by water.
 - Coastal areas are influenced by the ocean currents. Norway is located in the colder regions of the world but its coast remains warm during winters as the warm current influences its coast.

ASSESSMENT FOR UNITS 11-13

(Pages 58 to 73)

1. Explain the difference between the following pairs of terms:
 - a. weathering and erosion
 - b. cyclones and anticyclones
 - c. a mercury barometer and an aneroid barometer
2. Give one word to classify the following:
 - a. winds moving towards the coast at a speed of 200-300 km/h
 - b. the splitting of huge rocks by plants
 - c. rock debris deposited by rivers
 - d. the cutting down of large areas of trees
 - e. the breaking up of coastal cliffs
 - f. lines on a map that join places with the same air pressure
3. Give reasons for the following:
 - a. Hot air rises.
 - b. The trade winds blow towards the Equator.
 - c. Rocks in desert regions break.
 - d. Acid rain destroys large areas of forest.
4.
 - a. On a blank outline map of the world, mark the direction of the July and January winds travelling from and toward South East Asia.
 - b. Describe the movements of the summer and winter monsoons of Asia.

Answers

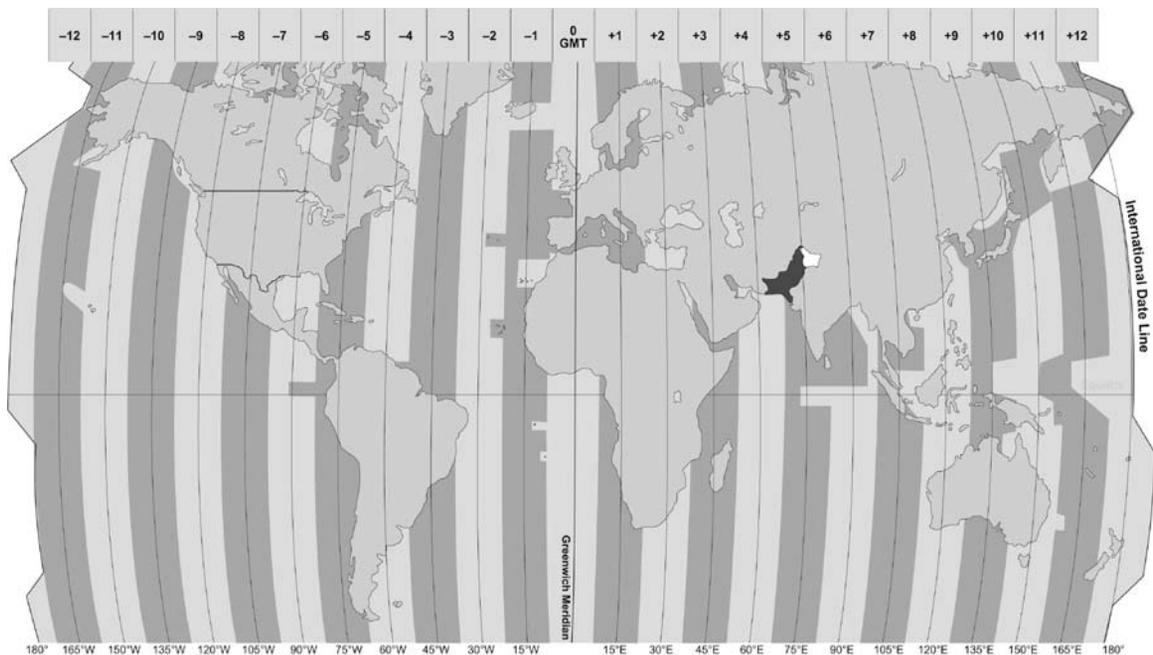
1.
 - a. Weathering is the breaking up of rocks over a long period of time into smaller segments. Here the rocks remain in their original site. Erosion on the other hand, is the weathering away of the rocks.
 - b. An anticyclone is the movement of air in a clockwise direction whereas in a cyclone there is an anticlockwise movement of the air.
 - c. They both measure air pressure but one contains mercury while the other one consists of a thin metal box.

2.
 - a. tropical storm
 - b. weathering
 - c. deposition
 - d. deforestation
 - e. erosion
 - f. isobars
3.
 - a. It is thinner and lighter.
 - b. There is low pressure and high pressure winds moves towards low pressure winds.
 - c. The expansion and contraction of the rock during the hot days and cold nights make the rocks very weak.
 - d. The rain contains nitrous oxide which washes away all the nutrients in the soil.
4.
 - a. Refer to page 63 of the textbook.
 - b. In July, Asia has its summer season so there is low pressure. Season in the southern hemisphere is cool, so high pressure prevails there. The winds start from the high pressure area and move towards Asia. As they travel over the ocean they pick up moisture and bring rain towards Asia. The opposite happens in January when Asia is cooler and has high pressure and the southern hemisphere is warm and has low pressure.

ASSESSMENT FOR UNITS 14-16

(Pages 74 to 88)

- List three facts that will differentiate between latitude and longitude.
 - Why is the International Date Line not straight?
- Identify the following elements of a map through their descriptions.
 - It is used to represent the actual size of the area shown on the map.
 - It is used to show large areas of the map in detail.
 - They represent height on the map.
- Explain what these abbreviations stand for:
 - GPI
 - GMT



- If the time in London is 12 noon, what will the time be in
 - Karachi?
 - New York?

5. Give reasons to explain the following natural occurrences.
 - a. Places at a higher altitude experience colder temperatures than those at lower altitudes.
 - b. Places near the sea have a more moderate climate than those further inland.
 - c. The climate in mountainous regions can be warm and dry.

Answers

1.
 - a. Lines of longitude are imaginary lines that run from north to south while lines of latitude run from west to east. Lines of longitude are called meridians while lines of latitude are called parallels.

There are 360 degrees of longitude and 180 degrees of latitude.
 - b. This is to avoid crossing through any landmass. When we cross the International Date Line either eastward or westward, a day is changed so it would be very confusing to have two different days within a same continent.
2.
 - a. scale
 - b. large scale
 - c. contours
3.
 - a. Global Positioning Instrument
 - b. Greenwich Mean Time
4.
 - a. 5 p.m
 - b. 7 a.m
5.
 - a. Temperature drops about 6.5 degree for every kilometre increase in height. With increase in height there is less gas in the atmosphere, resulting in less absorption of temperature.
 - b. The sea takes longer to heat in summer and longer to cool down in winter.
 - c. The climate can be warm and dry if the mountains do not encounter rain bearing winds.

ASSESSMENT FOR UNITS 17-18

(Pages 89 to 100)

1. Differentiate between the following characteristics of a tropical rainforest area and a tropical desert area.

	Tropical rainforest	Tropical desert
location		
temperature		
rainfall		

2. a. How is natural vegetation different from cultivated vegetation?
b. Name any three areas of tropical grassland in the world.
c. How does the presence of tropical grassland encourage tourism in the areas you have named in part (ii)?
d. Name three areas of temperate grasslands in the world.
3. Identify the following from the descriptions given below:
a. mosses and lichen survive in short summers here
b. land rich in mineral deposits with an average temperature of -10°C
c. vegetation such as pine, spruce, and fir
d. trees that prevent the sunlight from reaching the ground
e. vegetation such as oak, maple, and hickory

Answers

1. Location: $0-10^{\circ}$ north or south of the Equator/ $10-25^{\circ}$ north or south of the Equator
Temperature: $24-26^{\circ}$ uniform through the year/in winter 25° , in summer 56°
Rainfall: 2000 to 3000 mm/less than 25mm
2. a. Natural vegetation grows naturally depending upon rain and temperature while cultivated vegetation is planted and looked after by humans.
b. South America, Central Africa, Australia, the Subcontinent
c. These areas are rich in animal life (wild cattle, deer, buffalo, giraffe, etc.). Many people go to see some of the rare animal species there.
d. North America, South America, Central Asia, South Africa
3. a. Taiga
b. Tundra
c. coniferous
d. canopy layer
e. deciduous trees

ASSESSMENT FOR UNITS 19-21

(Pages 101 to 115)

1. Classify the following economic activities according to type.

Activities	Primary	Secondary	Tertiary
teacher training			
catering			
coal mining			
farming			
carpentry			
chemical engineering			
security services			
music industry			

2. Explain in your own words the following terms:

- a. terrain
- b. irrigation
- c. reforestation
- d. open-cast mining

3. Fill in the blanks so that the sentences are true.

- a. Wells that are dug deep into the ground are called _____.
- b. A place where plants are grown in a maintained temperature is a _____.
- c. _____ are filled with nutrients required by the plants for growth.
- d. An industry where production takes place on a small scale is called _____.
- e. _____ is the farming practice by which only sufficient goods for the farmer's own needs are produced.
- f. Cities that are built away from the country-side are called _____.

4. Give reasons for the following:

- a. Towns are established near to oases.
- b. Good communication links are essential in an industrial city.
- c. A good source of water is a major attraction when choosing a site for a settlement.
- d. Trees are removed from large areas of land.
- e. Farmers used to wander from place to place with their livestock.

Answers

1.

Activities	Primary	Secondary	Tertiary
teacher training			YES
catering		YES	YES
coal mining	YES		
farming	YES		
carpentry		YES	
chemical engineering		YES	
security services			YES
music industry			YES

2. a. landscape

b. An artificial way of supplying water using the network of canals

c. Replanting of trees

d. Huge machines scrape away the top layer of rocks until the mineral is exposed.

3. a. artesian

b. greenhouse

c. fertilizers

d. cottage

e. subsistence

f. urban centres

4. a. Towns are established near to oases because humans cannot exist without a good supply of water.

b. Industrial cities need good transport links in order to move the raw materials to the factories and finished products to the markets and good telephone/IT links so that they can communicate with their customers.

c. Water is essential, and can also be a source of employment, e.g. fishing, farming, etc.

d. For the purpose of using that land for cultivation to fulfil the growing demand for food

e. As they used to live in deserts where there was no supply for water.

