UNIT 2

THE FORCES THAT CHANGE THE SURFACE OF THE EARTH

Unit Outcomes

After studying this unit you will be able to:

- Explain the forces that change the surface of the earth and their effects;
- Measure distance and area on a map.

2.1 Lesson

External Forces and their Effect on Human Life

Competencies: After studying this lesson, you will be able to:

- Describe the external forces that change the surface of the Earth.
- Discuss the effects of erosion and deposition on land surfaces.

Key terms

- Erosion
- Deposition
- Glaciers
- Loess

External forces

- What do you mean by external forces?
- What are external forces?
- What is the relationship between denudation, erosion and deposition?

External forces are the forces that act upon the earth's surface from outside. These include erosion transportation and deposition. These forces level the ups and downs of the earth's surface. External forces involve erosion and deposition.

Erosion

- Define the term erosion.
- Discuss the different forms of erosion.
- Describe any erosion which you have seen in your school compound or home area.
- Describe the cause and consequences of erosion?

Erosion is the movement of broken rock and soil particles from one place to another by running water, wind, ice or sea waves. **Running water** cuts valley channels into a level surface. Over time down cutting action of water creates a network of streams and rivers that drain water from the land. **Wind blown sand and silt** or **loess**, is another form of erosion. Loess materials are believed to be carried long distance, usually by wind, and laid down as new soil or sand dunes in far away places.

In North America and Eurasia thousands of years ago, moving **sheets of ice** called **Glaciers** plowed and scraped the landscapes of Canada, Western Europe, and Russia like huge earth moving machines.

Case study

Erosion by Run-Off

Running water is perhaps the most important force of erosion. When water falls as rain and hits the ground, it breaks the soil up into small pieces. A great many drops collect into little streams which begin to dig into the land. At first, only scratches appear. But these scratches soon become gullies. The gullies become deeper and deeper. When there is heavy rain, the good top soil is washed away more quickly; it flows as mud towards the gullies. This happens for many years until only the rocks that were under the soil appear on the surface of the land.

We find the deepest gullies in regions where long droughts are followed by very heavy rainfall. We can see gullies in many parts of Ethiopia where there is no thick vegetation to keep the soil in place. This harmful erosion is caused sometimes by the raindrops hitting the soil and sometimes by sheets of water. This surface run off can cause more or less harm according to the amount and the speed of the water.

Case study

Silt Deposition by a River

Rivers erode more quickly and strongly than rain fall. So the water erodes more, and also transports the eroded material. A slow stream can carry clay. When it goes twice as quickly, it can carry sand. When the current reaches a speed of two kilometers an hour, it can carry pebbles. These materials or “loads” are deposited at the banks of the rivers, flood plains (land likely to be flooded) and deltas. The thin layer of silt deposited over the flood plain often increases the fertility of the land (e.g. the Huang He in China). Successive flooding means that flood plain builds up in height as in the lower Nile valley.

Finally, to have more understanding about erosion look at Fig. 2.1, 2.2 and 2.3.

Fig 2.1 Erosion by sheet flow

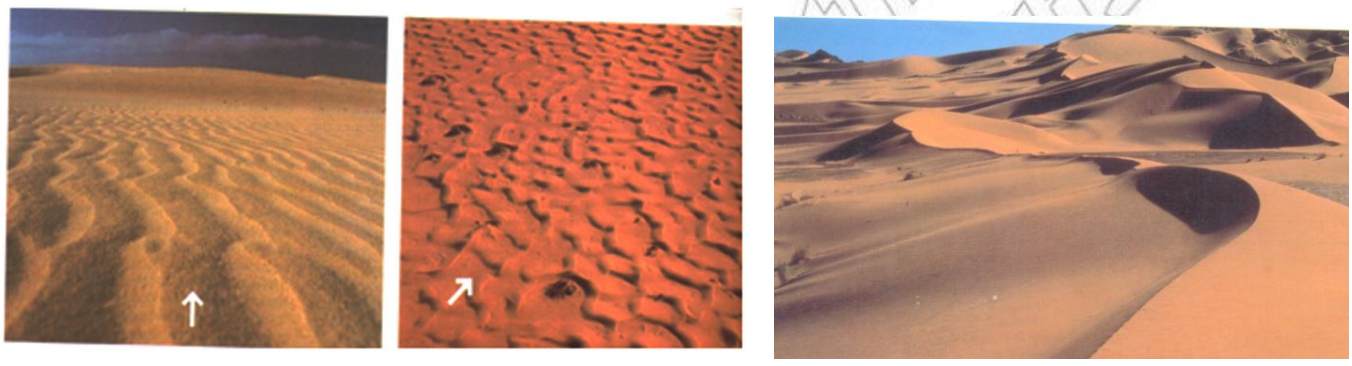


Fig.2.2. Wind Erosion

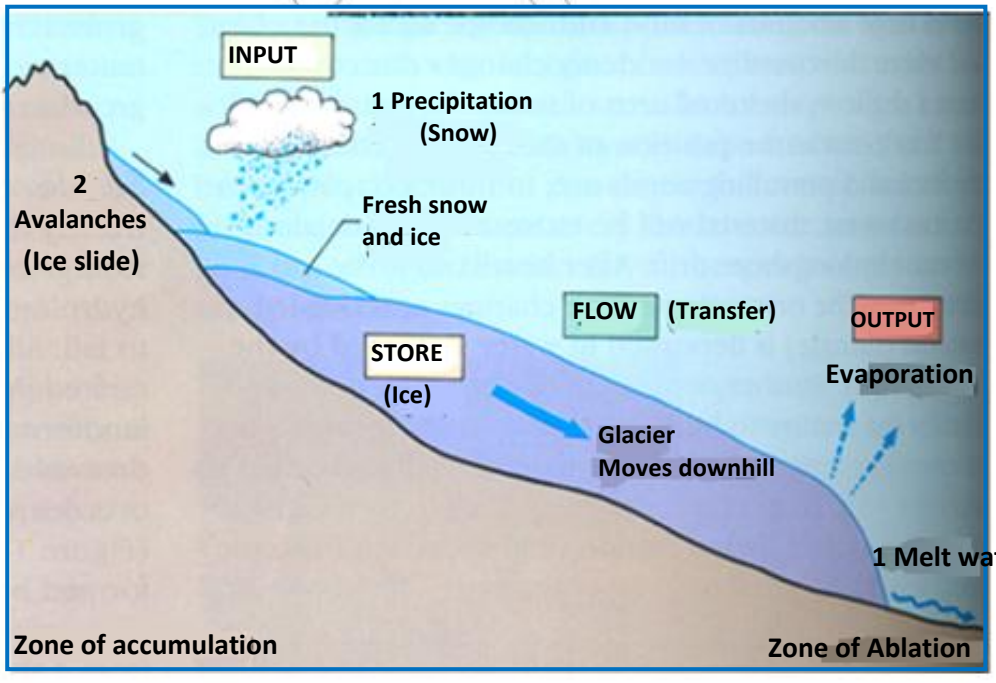


Fig. 2.3 Glacier system

Do the following:

- **Collect pictures and photographs showing different forms of erosion.**
- **Bring them to class and ask your teacher to help you identify and categorize them into their proper class or type.**

◈ Deposition

- **What is deposition?**
- **What do we call the deposition created due to: water erosion, wind erosion and ice erosion.**

Deposition is the final result of erosion. Rocks, sands and silt picked by water, wind and ice are deposited in a number of ways. Stream and rivers carry sand and silt down stream from uplands to lowlands, as shown in (Fig 2.4). They drop these materials wherever the volume or the speed of the flow of water lessens, and the eroded material can no longer be carried.

The newly deposited soils form **alluvial plains** along stream beds, in the foothills, or **pedmont**, at the base of mountain, and on coastal plains. Where powerful rivers, such as Mississippi, Nile or Amazon rivers, enter ocean, large **delta** or **flat lowlands** made up of these deposits, may extend far out to sea.

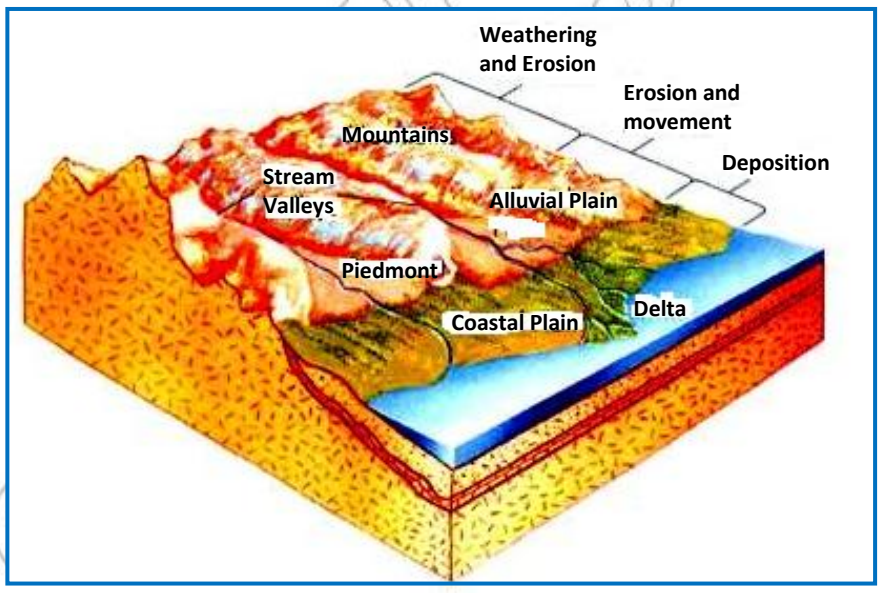


Fig. 2.4 Erosion and deposition reshape the earth

◈ Effects of erosion and deposition on human life

- **What effect can erosion and deposition have on human life?**

◈ Effects of Erosion

Twenty nine percent of the earth's surface is land, and only 11 percent is classified as prime agricultural land. It can take one to four centuries to produce 1 cm of soil, and between 30 and 120 years to produce enough soil for farming. Yet as Fig. 2.5 shows, human development is ruining this essential ingredient. It is estimated that by 2000 A.D one-third of the area that was ploughed in 1980 will have been reduced to dust. By the year 2020 another 30 percent could be lost. Erosion is most rapid in areas where land is mismanaged and where climatic conditions are extreme, especially in places where the rainfall is seasonal and unreliable. Where the vegetation cover is removed there will be no replacement of humus, no interception by plants, no roots to bind the soil together, and the surface will be left exposed to winds that are strong and will pick up the finer material. If rainfall occurs as heavy thunderstorms and in areas of steep slopes, the soil will be washed downwards. In both cases, the land will be reduced to bare rock or left with deep unusable gulleys. This reduces cultivable land and hinders agricultural production. Finally, it leads to famine and drought.

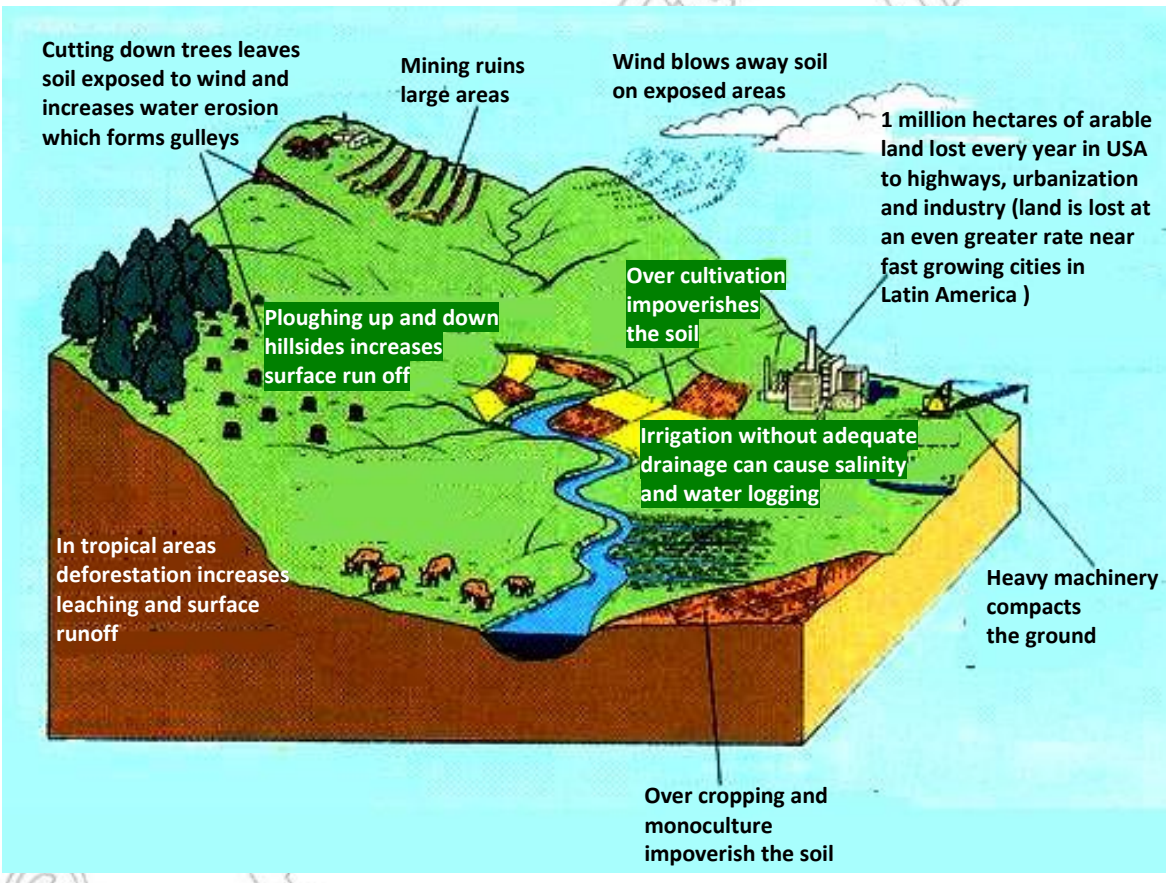


Fig 2.5 some causes and effects of soil erosion

What is then the end result of all these? Of course, the major outcome is desertification. There are several definitions of the term desertification. Taken literally it means turning the land into desert. It is a process of land degradation, mainly in semi-arid lands where rainfall is unreliable, caused by human mismanagement of a fragile environment.

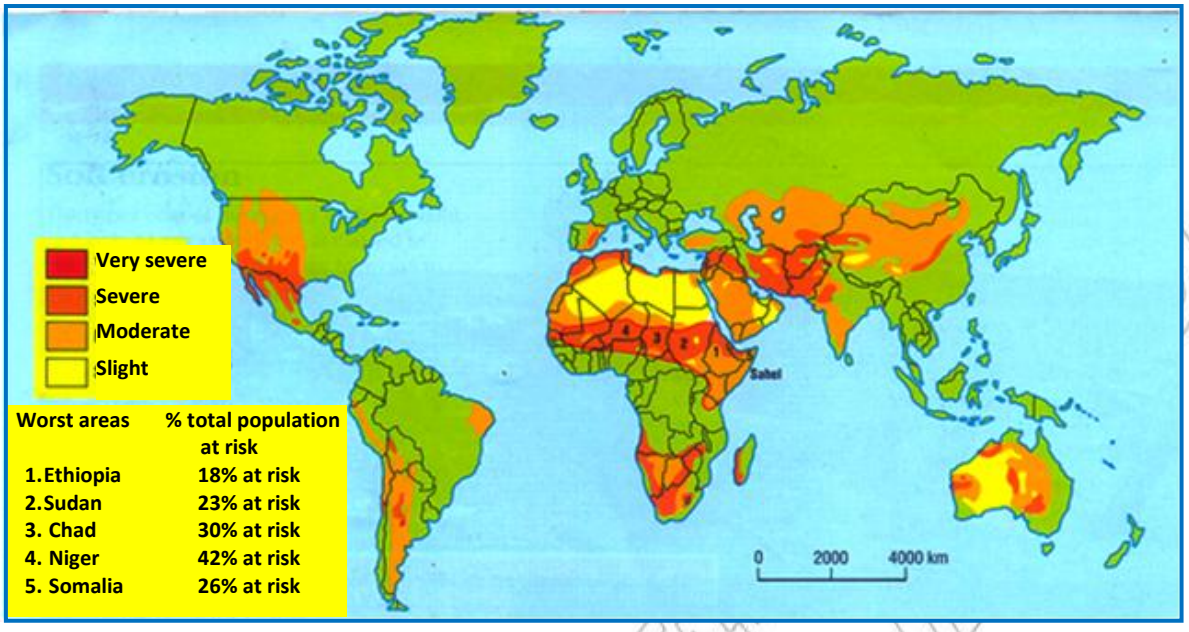


Fig 2.6 Areas at risk from desertification

Desertification will lead to displacement of people, famine and hunger and of course, finally mass death of people and animals.

Fig 2.7 Desertification in Niger

Case study

Erosion in Ethiopia

Early in the twentieth century, 40 percent of Ethiopia was covered with forest. Today the figure is not much more than 2 percent. Somewhere in 1901 Ethiopia had been most fertile and in the heights of commercial prosperity. The whole of the valleys and lower parts (slopes) of the mountains have vast grain fields. The neighboring mountains, were well wooded. The numerous springs and small rivers gave ample water for domestic and irrigation purposes and the water meadows produce an inexhaustible supply of good grass for the whole year.

Around 1985 the same area was turned out to be vast barren plain with circular moving dust that was once top soil. The mountains were bare of vegetation and river courses dry. Life becomes hard and people start to be displaced. Drought and hunger have become common features in many parts of the country.

It is very important to remember the 1983 drought. It made thousands of people of northern Ethiopia to leave their homes to find food. Each day up to 3000 people set off on a walk of up to six weeks over mountains, through deserts with temperatures over 45^0c, and without food and water, to reach refugee camps in the Sudan. Many died on the way (around 200,000) through hunger, exhaustion, etc. a fifth of those who stayed behind died so because they were too weak to move.

◈ Effects of Deposition

So far you have been discussing about the effects of erosion on human life. Another thing that you need to see is the effects of deposition on human life.

- **What do you think will the effects of deposition be on human life?**

In places like Sudan and Egypt, fertile soils carried by the Blue Nile and white Nile from Ethiopia and some East African highland countries respectively are deposited at the banks and delta of the Nile river. This made life comfortable for large number of people in the middle of the desert.

On the other hand, in some countries of south east Asia, like Bangladesh, are found on the deltas of several Himalayan rivers including Ganges and Brashmaputra. As increasing amount of silt is transported from the deforested highlands, the tributaries of these rivers are blocked as their beds are raised adding to the risk of flooding from the sea.

Lesson 2.1 Review

Activity 2.1

A. Questions based on facts:

- What are the two categories of forces that change the surface of the earth?
- What do you understand by the term external force?
  - Can you explain some example of external forces?
  - Explain what erosion and deposition are and their effects on human life.

B. Group discussion:

- Discuss the outstanding erosional problems in your locality.
- Try to identify causes of erosion in your locality.
- Enumerate the possible measures that can be taken to solve the problems.

C. Individual work:

- Visit your locality and write a short note on what you have observed during your visit on matters related to erosion.
- Report your findings to your classmates and invite them for further discussion on the Issue.

2.2 Lesson

Internal Forces and their Effects on Human Life

Competencies: After studying this lesson, you will be able to:

- Describe the internal forces that change the surface of the Earth.
- Express the effect of the internal forces of the Earth on land surfaces and human life.

Key terms

- Lava
- Magma
- Folding
- Faulting

Internal Forces

- What do you know about the internal forces that shape the surface of the earth?
- Can you mention the names of these forces?

Internal forces are sometimes called endogenic forces. They drive energy from the interior part of the earth. They form the ups and downs on the earth's crust. These ups and downs are the results of folding, faulting, earthquake and volcanism.

A. Folding

- Define the term folding.
- What are the causes for folding?

Folding occurs when rock layers are pushed by the earth movement from one or two sides. A fold is a bend in rock. The process of folding is the result of compressional force.

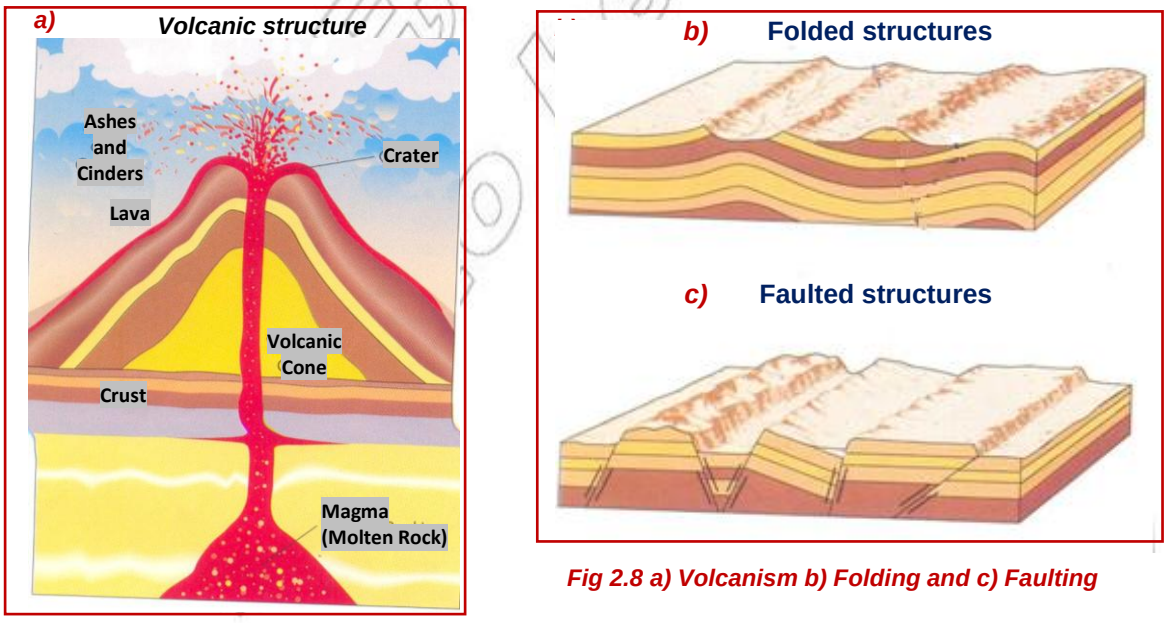


Fig 2.8 a) Volcanism b) Folding and c) Faulting

B. Faulting

- **What do we mean by the term faulting?**
- **What are the causes for faulting?**
- **Can you mention some examples of landforms created due to faulting.**

Faulting takes place when tectonic pressure causes rock masses to push together or pull apart.

Blocks of the crust bounded by roughly parallel faults may be raised, or lowered, or tilted. The basins occupied by the Red sea, and the great "rift valleys" of East Africa are the results of faulting.

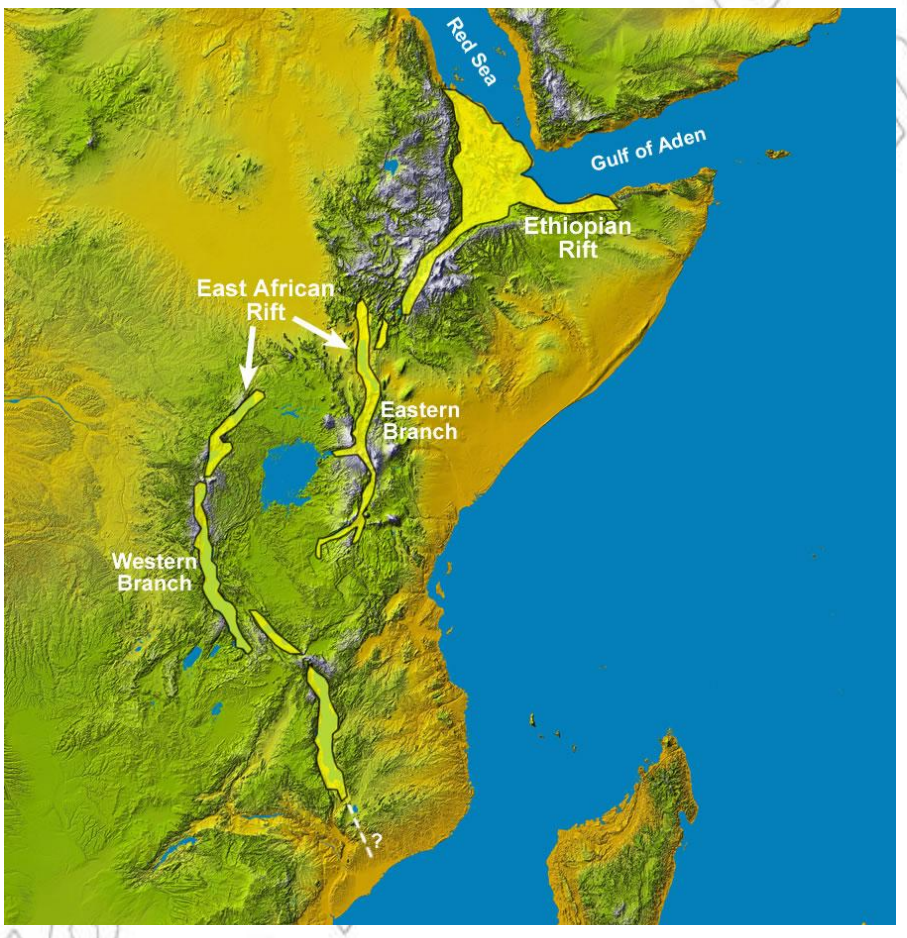


Fig 2.9 Rift valleys of Africa

C. Volcanism

- **Explain the process of volcanism.**
- **Do you know some volcanic areas in Ethiopia? Can you mention the names of the lakes found there?**

Volcanism is the process by which molten rock (magma) is forced out to the surface of the earth.
Heat from the upper levels of the mantle forces its way to the surface at weak places in the earth's crust leading to volcanism. The out pouring of this liquid (molten) rock onto the surface is called **lava**. **Magma** is the molten rock when it is underground.

Case study

Volcanic in Vesuvius and Pompeii

Violent eruptions have been the cause of several appalling catastrophes. Examples often cited are the eruptions of Vesuvius (Italy) 79 A.D, which buried the city of Pompeii and many of the inhabitants beneath layers of ash, that of krakato near Java in 1883, one of the most violent explosions ever witnessed by man.

- **Discuss the advantage and disadvantages of volcano.**

Case study

Erta Ale

The active volcano Erta Ale is the world's only below sea level volcano and the world's only permanent lava lake. Erta Ale is a techno colored landscape, incredible mineral deposits, sulfur lakes and bubbling sulfur springs, are fascinating sight.

Erta Ale means "the mountain that smokes" in the Afar language. Visiting Erta Ale is one of the breath taking events in the middle of the desert, the best time to visit the Erta Ale is at dawn. Upon arrival the edge of the crater opens an exciting spectacle. Several craters emit fumes sign of a massive volcanic activity.

Fig 2.10 Erta Ale

D. Earthquake

- **What is an earthquake?**
- **How does it develop?**
- **Discuss what effect it has on people who live near a live volcano.**

An earthquake is an unpredictable event in which masses of rock shift below the earth's surface, releasing enormous energies. An earthquake is the result of the sudden release of stored energy in the Earth's crust that creates seismic waves. Earthquakes are accordingly measured with a seismometer, commonly known as a seismograph. Scientists assign a magnitude rating to earthquakes based on the strength and duration of their seismic waves. A quake measuring to 5 would be considered minor or light; 5 to 7 is moderate to strong; 7 to 8 is major and 8 or more is great.

At the Earth's surface, earthquakes may manifest themselves by a shaking or displacement of the earth's crust. Sometimes, they may lead to loss of life and destruction of property. An earthquake is caused by tectonic plates getting stuck and putting a strain on the ground. The strain becomes so great that rocks give way by breaking and sliding along fault planes. Some 80 percent of all the planet's earthquakes occur along the rim of the Pacific Ocean, called the "Ring of Fire" because of the preponderance of volcanic activity there as well. Most earthquakes occur at fault zones, where tectonic plates; giant rock slabs that make up the Earth's upper layer; collide or slide against each other. These impacts are usually gradual and unnoticeable on the surface. However, immense stress can build up between plates. When this stress is released quickly, it sends massive vibrations, called seismic waves, often hundreds of miles through the rock and up to the surface. Other quakes can occur far from faults' zones when plates are stretched or squeezed.

Lesson 2.2 Review

Activity 2.2

A. Questions based on facts:

- Give example of land forms which are results of folding and faulting in Ethiopia?
- What are the effects of internal forces (volcanism, and earthquakes) on human life?
- Describe and explain the cause of volcanic actions
- What is the difference between Magma and Lava?

B. Group discussion:

- Let us say our country Ethiopia faced an earthquake problem similar to the earthquake problem that Haiti or Japan faced in 2010 and 2011 respectively.
  - What would be your role as a citizen?
  - What would be the role of the society?
  - and what must be the role of the international community at large in tackling the problem? Make a serious discussion and exchange ideas with your classmates.

C. Individual work:

- Describe any erosion which you have seen recently in your locality, try to give the causes of the erosion and hint as to where the eroded material went.

Finally report your findings to your class mates and invite them for further discussion on the topic.

- Compare and contrast the damages that may be caused by an earthquake and volcanic incident.

D. Things to do:

- Draw a diagram of volcano showing the core, Magma and lava pouring in to the top.
- Identify volcanoes of East Africa.

2.3 Lesson

Measuring Distance and Area on Map

Competencies: After studying this lesson, you will be able to:

- Define a scale
- Name the different methods (ways) of expressing linear scale.
- Compute scale conversion
- Calculate ground distance and area of regular shaped figures from a map.

Key terms

- Horizontal distance
- Imperial unit
- Metric unit

A. Meaning of scale

- **What is scale?**

The scale gives the relationship which exists between the distance of two points on the map and the distance between the same two points on the ground. For example, if the distance between two points is 120 meters on the ground say from your classroom in a straight line to the school's flag pole. This distance on the map is shown as 2 centimeters. Then 1 cm on the map is representing 60 meters on the ground. The scale of the map is written as 1 cm to 60 m.

$$\text{Linear Scale} = \frac{\text{Distance on Map}}{\text{Distance on Ground}} \qquad \text{Areal Scale} = \frac{\text{Area on Map}}{\text{Area on Ground}}$$

◈ Ways of Expressing Linear Scale

Linear scale can be expressed or represented in three ways on a map:

◈ Scale statement

A simple statement of fact giving in words the relationship between the map and the ground that the map represents. For example, "one centimeter to one kilometer" means that one centimeter on the map represents one kilometer on the ground.

◈ Graphic scale

A diagram is usually found at the bottom of a map. The diagram is given to facilitate the reading of distance when using the map. This diagram is called graphic scale. In graphic scale, a line is drawn and is then divided into appropriate units depending on the scale statement. The left hand division is sub-divided into fraction so that distances taken from the map are more easily converted into the distances they represent on the ground. For instance, if the scale statement is "1 cm to 1 km," a line three or four cms long will be drawn and divided into units of one cm, as this map measurement represents one kilometer on the ground.

Example: The graphic scale for 1cm to 2km can be drawn as follows:

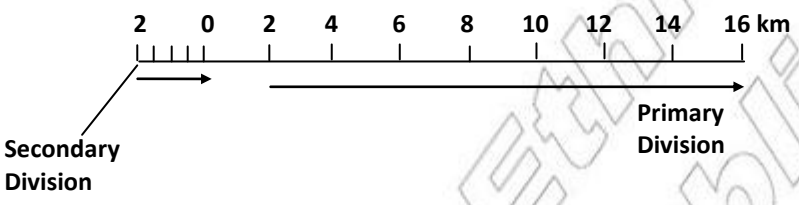


Fig 2.11 Graphic scale

◈ The Representative Fraction Scale (R.F)

The representative fraction gives the numerical proportion of distance on the map to distance on the ground. For example, if the scale statement is one centimeter to a kilometer, the distance on the map is one centimeter and the distance on the ground is one km. The representative fraction is, therefore, expressed as 1:100,000. The distance on the map is always expressed as 1, and it is always the numerator of the fraction. The denominator states how many times the distance on the map must be multiplied to give the distance on the ground.

Example: Given that the scale statement is 1 centimeter to 1 kilometer; find the representative fraction of the map.

- Change the ground measurement to the same unit as the map measurements; that is 1 kilometer to centimeters, which is 100, 000 centimeters.
- Express the map measurement as 1.
- Therefore, the representative fraction is 1: 100, 000 or $\frac{1}{100,000}$ the denominator of the fraction being the ground measurement shown in the same unit as the map measurement, in this case centimeters.

◈ Scale Conversion

Before we go directly into the discussion of conversion of scale it will be very important to have some idea about measurement units. There are two units of measurement or two major systems of measurement. They are metric units and imperial units.

- **Metric units:** 1km=1000m=10,000 dm =100,000 cm= 1,000,000mm;
  It is used in many parts of the world. Scientists use this system of units.
- **Imperial units:** 1 mile = 63, 360 inches

1 inch = 2.5 cm ⇒12 inches = 30 cm	1 m= 100 cm
1 foot = 0.3 m	1 km= 1000 m
1 mile = 1.6 km ⇒ 5 miles = 8 km	1 km = 100, 000 cm
1 km = 0.4 mile	1 mile = 63, 360 inches
1 km^2 = 2.5 Gasha = 100 hectar	

Conversion of scale:

Conversion of scale refers to changing one form of scale into another. It is possible to convert a scale given in one way into another form by following the rules set out below.

Exercises

Try to convert the following scales from one form to another.

a) **From scale statement to representative fraction:**
   Given: 1cm to 5km
   1cm to 10km

b) **From representative fraction to Scale statement**
   Given: 1:300,000
   1: 250,000

c) **Construct a graphic scale**
   Given: 1:5,000,000 **1cm to 10 km**
   1: 20,000,000

Have you tried to work out the above given exercises? How are they? Have you found them difficult? If so study the following examples carefully, and then go back and attempt to work out the exercises once again.

i) From R.F to scale statement:

To change R.F into scale statement, divide the denominator by 100,000 cm and multiply by 1km (for metric units) and 63, 360 inch multiply by 1 mile (for Imperial units).

Example 1: 1: 100,000(metric)

$$= 1 \text{ cm to } \frac{100,000\text{cm}}{100,000\text{cm}} \times 1\text{km}$$

= 1 cm to 1 km

Example 2: 1: 250, 000

$$= 1 \text{ cm to } \frac{250,000\text{cm}}{100,000\text{cm}} \times 1\text{km}$$

= 1 cm to 2.5 km

Example 3: 1: 316, 800 (Imperial)

$= 1 \text{ in} = \frac{316{,}800 \text{inches}}{63{,}360 \text{ inches}} \times 1 \text{ mile}$

= 1 inch to 5 mile

ii) Scale statement into R.F

To change the scale statement, multiply the second number by 100,000cm (for metric units) and 63, 360 inches (for imperial units) and omit the units.

Example 1: 1 cm to 2 km

= 1 cm to 2 ×100,000 cm

= 1 cm to 200,000 cm

= 1: 200,000

Example 2: $2^1/_2$ cm to 2 km

= 2.5 cm to 2 km×100,000 cm

= 2.5 cm to 200, 000 cm

= 1: 80, 000

iii) R.F and scale statement to Graphic scale

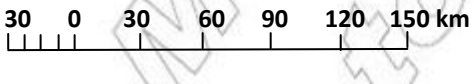
Graphic scale: This method of showing a scale uses the drawing of a line at the bottom of the map which is divided in a unit length like centimeters or inches. Each length represents a certain distance on the ground. In the example below the line is divided into an interval of 1 cm. Each interval represents about 100 km on the ground. The graphic scale does not start from zero (0). One unit length to the left of zero is divided into four or quarters. This gives you the chance to read a fraction of a unit length. In the example below a quarter or one fourth of the unit length means about 25 kms.

Example 1: Given: 1:3,000,000

Change the given R.F to scale statement

$\frac{3{,}000{,}000}{100{,}000} = 30\text{km}$, which is 1cm to 30km

Example 2: Change the given graphic scale into R.F.



- **Try to convert the following linear scales into areal scales**

  Given: 1:500,000 R.F

  1cm to 8km scale statement

◈ Areal scale

Just as distances on a map are in some scale related to ground distances they represent, so likewise are the areas on a map and on a ground. The relation between map area and ground area is simple: The areal scale will be in the ratio of 1 to the square of the denominator of the R.F: For example if a map had a

linear scale of 1:1000 then 1 square unit on the map would represent 1,000,000 square units on the Earth. This relation is usually assumed, not stated. It has this important consequence. Given the same size map sheet, the earth areas covered by maps of different scales vary as the square of the ratio of their linear scales. For example, Map "A" which is 2ft by 2ft. with an R.F of 1: 25, 000, covers only one fourth the earth area that is covered by map "B", which is 2ft by 2ft, but has an R.F of 1: 50,000. (study Fig. 2.12).

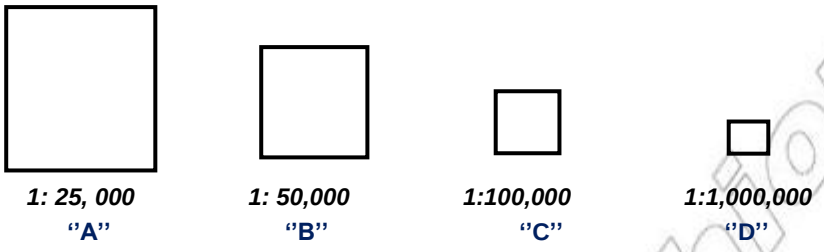


Fig. 2.12 The size of maps of the same Earth area (or the Earth area covered by maps of the same sheet size)vary as the square of the ratio of their linear scales.

Example

Linear scale

- **Given: 1:5,000**

  Change the linear scale into Area scale

Areal scale will be the ratio of 1 to the square of the denominator of the R.F

Therefore, the linear scale 1:5,000 will be $\frac{1}{(5000)^2}$ in areal scale

Areal Scale = 1 square unit on the map would be 25,000,000 square units on the earth

◈ Finding Ground Distance from a Map

- **Find the ground distance between place "A" and place "B" from a map in which the map distance between the two places is 6 cms and the scale of the map is 1:200,000.**

A map distance is a distance obtained between two or more points through measurement on a map and expressed either in centimeters or millimeters. A map distance calculated in relation to the scale given is called **horizontal distance or horizontal equivalent** and is expressed in meters or kilometers. Therefore, horizontal distance could be realized interms of distance along a straight line and distance along an irregular line.

◈ Distance Along a Straight Line

Such a distance may be observable between two towns or farm estates etc. These built up areas may be shown on a map with dots put apart (Fig 2.13).

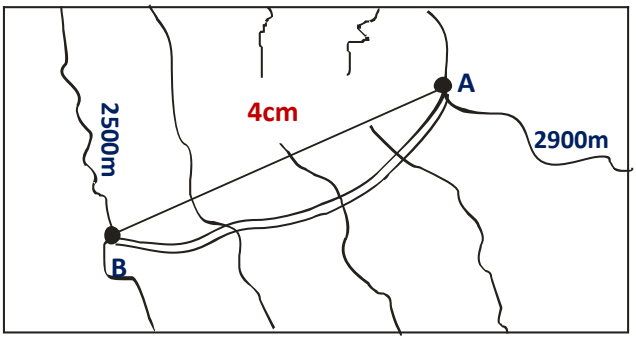


Fig 2.13 Distance along a straight line

Procedure:

- Join points "A" and "B" with a pencil line
- Measure the line with a ruler
- Relate the measured distance to the scale given
- Finally, calculate the horizontal distance (HD) either in kilometers or meters.

Scale (given): 1: 100,000

Measured distance (A to B)= 4 cm

1 km = 100,000 cm (known)

1 cm = 100, 000 cm (scale given)

4 cm = ?

$$\frac{4\text{cm}\times 100{,}000\text{cm}}{1\text{cm}} = 400{,}000\text{cm}$$

Divide $\frac{400{,}000}{100{,}000}$ to change it into km

$\therefore$ HD= 4 km

◈ Distance Along Bending or a Curved Line

This includes the distance along a road, railway, river etc. Such distances are measured with the help of a piece of thread or pair of dividers, or the edge of paper. Then, with the help of a ruler and the scale given, you can calculate the ground distance.

Example: What is the total ground distance shown on the Fig 2.14, between place ''A'' and place ''B''?

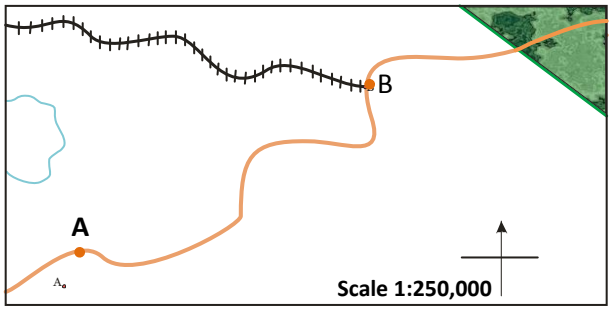


Fig 2.14 A map for measuring curved line distance

Step 1: Divide the road (from "A" to "B" by pencil marks into portions that are nearly straight)

Step 2: Carefully, measure each of these sections with a pair of dividers and ruler, record each distance, or transfer the section directly onto the edge of a piece of paper.

Step 3: Using a ruler find the total distance of the road on the map. Let us assume the distance measured is 14 cms. Therefore, the total length of the road on the ground is:

$$= 14 \times \frac{250,000}{100,000}$$

$$= 35\text{km}$$

◈ Area of Regular shape

Area refers to the total occupancy of portion of land on a given map. With the help of the given scale, it is possible to measure the area of a piece of land.

On a map, areas can be understood in terms of areas with regular and irregular shapes.

◈ Areas with regular shape

The following formulae are used to calculate areas of some regular shaped figures as you have learnt in mathematics and physics.

Regular Shape	Area Formula
Square	S^2
Rectangle	$L \times W$
Triangle	$\frac{1}{2}bh$
Circle	πr^2

◈ Square Shaped Piece of Land

$A = S^2$ (change the sides to km by using the scale of the map for all figures)

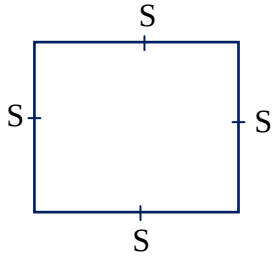


Fig 2.15 Square shape figure

◈ Area of Triangular Piece of Land

$A = \frac{1}{2} \times b \times h$ (base and height are changed to km by using the scale)

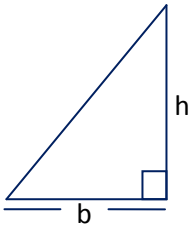


Fig 2.16 A right-angled triangle.

(One angle measured 90°)

◈ Rectangular Piece of Land

A = Length × Width

A = L× W

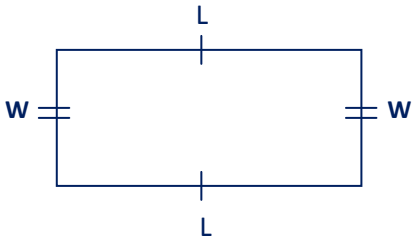
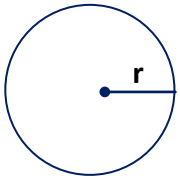


Fig 2.17 A Rectangular shape

◈ Area of Circular Piece of Land



Area = πr^2

Fig 2.18 Circular shape

Exercises

- A certain school's football field has a length of 10cm and a width of 5cm on a map. The scale given on the map is 1:2,000,000. Find out the area of the football field.
- An orchard has a length of 5cm in all its four sides on a map. The scale of the map is 1:100,000. Calculate the area of the farm?
- Nearby the city of Addis Ababa there is a circular lake with a radius of about 10cm on a map. The scale given on the map is 1:50,000. Find out the area of the lake?
- A parking lot has the shape of a right angle triangle where by the base is 6cm and the height is about 10cm on a map. The scale of the map is 1:25,000. What is the area of the parking lot?

N.B In your attempt to find out the areas of regular-shaped figures you have to give due attention to the following three things:

1. **The formulae given above for each of the regular shaped figures.**
2. **Changing the sides to km by using the given scale.**
3. **Studying the examples.**

Please study the following examples:

Example 1: Area of a rectangle

Given: Scale = 1:50,000

Length = 3cm

Width = 1cm

$L = \frac{3 \times 50{,}000}{100{,}000} = 1.5\text{km}$

$W = \frac{1 \times 50,000}{100,000} = 0.5km$

$A = L \times W$

$A = 1.5km \times 0.5km$

$= 0.75\ km^2$

Example 2: Area of a Square

Given: S = 5cm

Area = S^2

Scale = 1 : 250,000

= 1 cm = 250, 000

5 cm = ?

$= \frac{5 \times 250,000}{1 \times 100,000} = 12.5km$

S = 12.5km

$S^2 = 12.5 \times 12.5\ km^2$

$A = 156.25\ km^2$

Example 3: Area of a Triangle

Given: Area = ½ bh

Scale = 1:300,000

Base = 3cm

Height = 4 cm

Area = $\frac{1}{2}$ bh

Base = $\frac{3 \times 300,000}{100,000} = 9km$

Height = $\frac{4 \times 300,000}{100,000} = 12km$

Area = $\frac{1}{2}$ bh

$A = \frac{1}{2} \times 9km \times 12km$

$= \frac{108}{2}$

$A = 54\ km^2$

Example 4: Area of a circle

$A = \pi r^2$

Given: r = 8cm

Scale: 1 :125,000

r = 1cm = 125,000

8 cm = ?

$= \frac{8 \times 125,000}{1 \times 100,000}$

= r = 10 km

$$A = \frac{22}{7} \times (10)^2$$
$$= \frac{2200}{7} km^2$$
$$= 314.2\ km^2$$

◈ Comparison of Scales

Large scale and small scale maps

Maps are often described as being large, medium or small scale, although there is no precise division among them. Their distinction is important. **Large scale** refers to those maps in which the RF is large in the sense that the fraction (RF) $\frac{1}{25,000}$ is larger than the fraction $^1/_{500,000}$. Most detailed topographic survey maps of rural and urban areas are made at scales considerably larger than 1:125,000, and these maps would be classed as large scaled.

- **Large scale > 1: 50,000**
- **Medium scale 1: 50,000 – 250,000**
- **Small scale < 1:250,000**

The differences among small- scale; medium, and large-scale maps are not only from the difference in the amount of information they can show but also from the greater degree of generalization that must be employed in small-scale maps.

Lesson 2.3 Review

Activity 2.3

A. Questions based on facts:

- What is the purpose of a linear and an areal scale?
- Explain the three ways of expressing scale by giving appropriate examples.
- How many units of measurement (systems of measurement) do we have? Can you mention their names?
- What type of map portrays the surface factures of relatively small areas?
- What are the important factors in calculating the areas of regular shaped figures from maps?
- Decide what type of scale to use in your attempt to show the foot ball field of your school on a map. Explain why you have decided to use this type of scale.
  - Change the following R.F scales into statement scale?
    a) 1:250,000
    b) 1:500,000
  - Change the following statement scales into R.F?
    a) 1cm to 25km
    b) 1cm to 125km
  - Draw the graphic scale for the following R.F?
    a) 1:750,000
    b) 1:800,000
  - Find the straight line distance from a map between place "A" and Place "B" when the distance between the two places is 12cm and the scale of the map is 1:500,000?

B. Group Discussion:

- It is necessary to use different scales to depict different feature on maps. Discuss why it is necessary.
- Let us say you have three different maps at hand i.e. world, Africa and Ethiopia. Which map do you think is drawn in small scale? Why?

Summary

- External forces are the forces that act on the surface of the earth from outside. The agents of external forces include running water, wind, moving ice, Sea waves, etc.
- Erosion is the movement of broken rock from one place to another by running water, wind, ice, or ocean currents. Windblown sand and silt or loess is another form of erosion. Of course moving sheets of Ice (glaciers) are other agents of erosion.
- Deposition is the final result of erosion. Rocks, sands and silt are picked up by water, wind, ice, and sea waves are deposited at a lower and level destinations.
- Internal forces drive energy from the interior part of the earth. They form the ups and downs on the crust. They include folding, faulting, earthquakes, and volcanism.
- Folding and faulting are processes that create land forms when a force inside the earth causes rock in the crust to bend (folding) and break (faulting).
- Heat from the upper levels of the mantle forces its way to the surface at weak places in the earth's crust leading to volcanism.
- Earthquakes occur where two areas of the earth's crust try to move in different directions. If friction prevents movement between these two areas then pressure will buildup. When pressure is eventually released by a sudden earth movement, the result is an earthquake.
- The scale of a map gives the relationship which exists between the distance of two points in a map and the distance between the same two points on the ground.
- There are two forms of scale. i.e linear (map scale) –example 1:1000. The areal scale will be in the ratio of 1 to the square of the denominator of the linear scale. For example if a map has a linear scale of 1:1000 then 1 square unit on the map would represent 1:1,000,000 units on the earth.
- Linear scales are expressed in three ways on a map. i.e. As R.F (representative fraction, scale statement and graphic scale. It is possible to change one form of scale into another.
- Map distance (HD) could be realized in terms of distance along a straight line and distance along an irregular or curved line.

Glossary

- ***Delta:*** **an area where a river divides into several smaller rivers that flow into the sea.**
- ***Deposition:*** **a process in which layers of a substance form gradually over a period of time.**
- ***Erosion:*** **the process by which the surface of land or rock is gradually damaged by water, wind etc and begins to disappear.**
- ***Faulting:*** **a fault is a crack on the earth's crust formed due to tensional or compressional forces.**
- ***Folding:*** **occurs when rock layers are pushed by earth movement from one or two sides. It is the result of compressional force.**
- ***Glacier:*** **a very large mass of ice that moves very slowly.**
- ***Horizontal distance:*** **is the distance or position that is straight and parallel to the ground.**
- ***Imperial unit:*** **relating to a system of measurement in which mass is measured in pounds, length is measured in feet.**
- ***Loess:*** **strong, out blowing winds pick up large amounts of debris and redeposit it in areas far beyond its sources.**
- ***Lava:*** **liquid molten rock pouring on to the surface of the earth**
- ***Magma:*** **hot liquid rock inside the earth.**
- ***Metric unit:*** **relating to a system of measurement in which mass is measured in kilograms, length is measured in meter.**

UNIT 2

Review Questions

I, True or false Item

Instruction: Write True if the statement is correct or write False if the statement is wrong.

_____ 1. Water is the most active erosional agent in desert regions.

_____ 2. Ertale is an alluvial plain area in Afar administrative region.

_____ 3. 1km^2 is the same as 2.5 Gasha or 100 hectares.

_____ 4. Desertification cannot displace people.

_____ 5. An earthquake is an unpredictable event.

II. Matching Item

Instruction: Match the correct terms under column "B" with the definitions under "A"

"A"	"B"
_____ 1. Underground molten rock	a) Faulting
_____ 2. Takes place as the collision and dismantle of rock masses	b) Folding
_____3. Occurs when rock layers are pushed by earth movement from one or two sides.	c) Glacier
_____ 4. Cooled and hardened molten rocks.	d) Lava
_____ 5. Wind deposited fertile soil	e) Loess
	f) Magma
	g) Alluvial
	h) Volcano
	i) Erosion

III. Multiple choice Item

Instruction: ***Choose the right answer and write the letter of your choice on the space provided.***

_____1. Which one of the following is not caused by the clearance of trees and bushes?

a) less rainfall intercepted
b) surface run- off increased
c) less water for soil, animals and plants
d) creating fertile soil for farming

_____2. Which one of the following is not an effect of erosion?

a) drought and hunger
b) formation of vast barren plain with eddies and spiraling dust.
c) no grazing land for animals
d) formation of permanent settlement

_____3. Which one of the following is not the effect of deposition?

a) alluvial plain along stream beds
b) piedmonts at the base of mountains
c) delta or flat flow lands at the mouth of a river
d) land slide and mass movement

_____4. Which one of the following is a large scaled map?

a) <1:250,000
b) > 1:50,000
c) 1:500,000 – 250,000
d) 1:250,000

_____5. What do we call the process by which molten rock is forced out to the surface of the earth

a) Lava
b) Magma
c) Volcanism
d) Faulting

IV. Fill in the blank Item

Fill in each of the blank spaces with appropriate words.

1. The compression of rock into a series of folds by the movement of crystal plates is called _____.
2. Sheet of moving ice is called _____.
3. The physical effect of wind and water on the earth's surface creating changes in the landscape is called _____.

V. Short answer questions

Give short answer to each of the following questions:

1. What are the forces that act on the surface of the Earth from outside? Can you mention them?
2. What kind of erosion is responsible for the formation of dunes made of sand and cause the formation of loess?
3. What do we call to the process by which molten rock spills over the earth's surface?
4. Identify Ertale of Ethiopia, whether it is the result of volcanism or an earth quake.

Check List

Put a tick (✓) mark in each of the boxes for activities you can perform

I can

1. Describe the external forces that change the surface of the earth. ☐
2. Realize the effects of erosion and deposition on land surface. ☐
3. Describe the internal forces that change the surface of the earth. ☐
4. Express the effects of the internal forces of the earth on land surface and human life. ☐
5. Define a scale. ☐
6. Name the different ways /methods/ of expressing linear scale. ☐
7. Compute scale conversion. ☐
8. Calculate ground distance and area of regular shaped figures from maps. ☐