Chapter 11: Weathering and Erosion

Section 1: Weathering and Soil Formation

We will study some of the processes that contribute to soil formation

***"Minerals form rocks.

The decomposition of rocks and minerals will form soils"

- Minerals are considered a non- renewable resource, so the unplanned exploitation of this resource will affect the soil formation in many areas of the world". If there are no soils, there will be no vegetation.
- Vegetation also plays an important role in protecting the soil from erosion, in fertilizing the soil and it is also the home of many organisms

Weathering

***Weathering is a mechanical or chemical process that breaks rocks into smaller pieces, contributing to the formation of soil.

There are 2 types:

Mechanical Weathering

- **Mechanical weathering** breaks rocks into smaller pieces without changing them chemically.
- The small pieces are identical in composition to the original rock.

Chemical Weathering

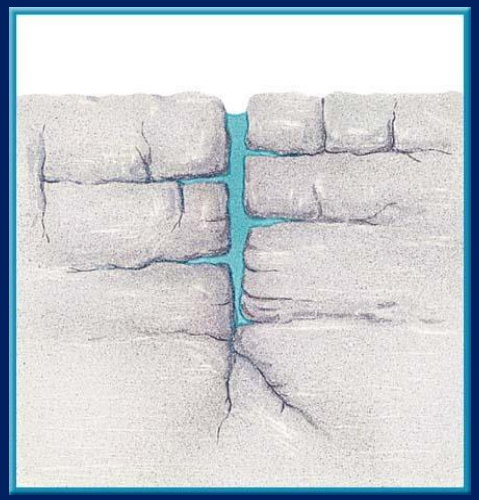
- **Chemical weathering** occurs when the chemical composition of rock changes.

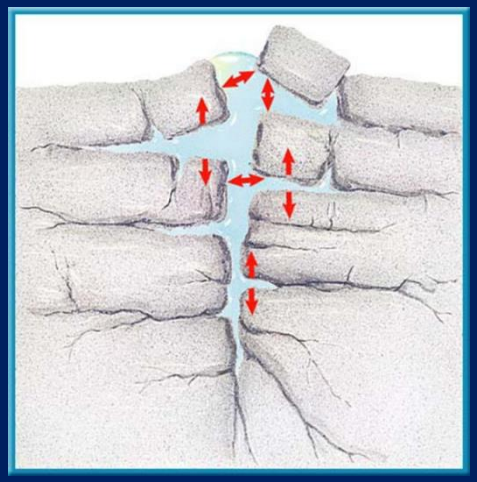
Causes of Mechanical Weathering

There are 3

1

1.Ice Wedging – read page 317 – figure 2

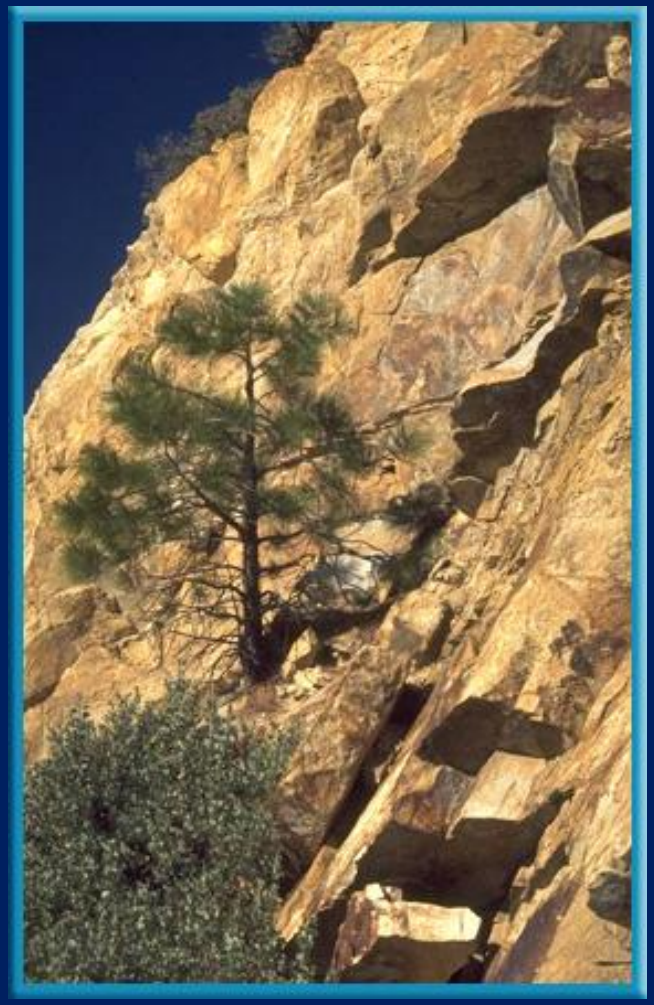




Freezing and thawing break up rocks
Ice crystals occupy more space than water, exerting pressure on the rock .

2. Plants

- Plant roots grow deep into cracks in rock
- Roots become thicker and longer, exerting pressure and breaking the rock apart.



3. Animals

- Animals can break rocks apart when digging burrows

Causes of Chemical Weathering
There are 3

1. Natural Acids

- Some rocks react chemically with natural acids in the environment.
- These acid dissolve rocks
- **EX: carbonic acid**

- Carbonic acid is the result of the reaction between water and carbon dioxide

2. Plant Acids

- Many plants produce a substance called tannin.
- In solution, tannin forms tannic acid.
- This acid dissolves some minerals in rocks and the rock can break

3. Effect of Oxygen

- Oxidation is the effect of chemical changes caused by oxygen.

- Some minerals contain **IRON,** that can react with the oxygen in the air
- This weakens the rock and the rock can break

Soil

- **Soil** is a mixture of weathered rock, organic matter, water, and air that supports the growth of plant life.

***Organic matter includes decomposed leaves, twigs, roots, dead animals and other materials.

Important Aspects:

Soil is formed at a rate of only 1 cm every 100 to 400 years.
It takes 3000 to 12 000 years to build soil that can sustain crops.

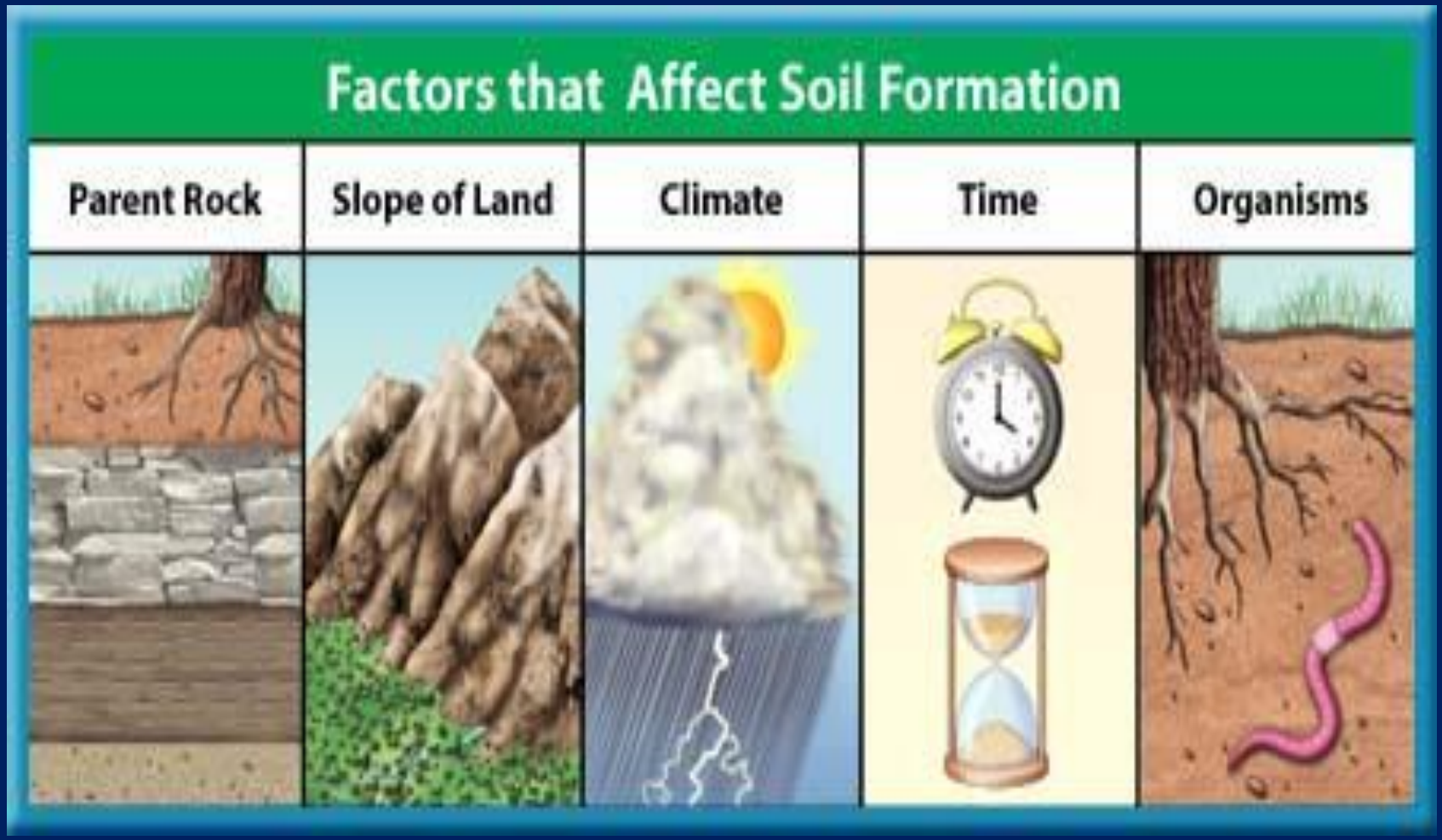
*****The soil covering the surface of the earth has taken millions of years to form.

This means that soil is a nonrenewable resource. If we do not protect the soil, a time will come when there would not be enough soil left to sustain life on earth.

**How do we protect soil ?

- By rotating crops
- By avoiding deforestation

Factors that affect soil formation



1) Parent Rock and soil formation:

- Parent rock is **the rock that will be weathered, forming the soil**
- The type of soil will depend on the type of rock .

2) The Slope of the Land and soil formation

****Definition of Topography:

- Field of science that studies the shape and the characteristics of the surface of the Earth and other planets

2) The Slope of the Land and soil formation

- On hillsides, soil has little chance of developing.

- This is because **rock fragments move downhill constantly.**

2) The Slope of the Land and soil formation

In areas where the land is flat:

- **More sediments will deposit forming rocks**
- The rocks will become soil

3) Climate affects soil formation for several reasons

a) Climate affects the **chemical** weathering of rocks which is important for soil formation

Hot weather –

Increases the rate of chemical reactions-

and also the chemical weathering of rocks

3) Climate affects soil formation for several reasons

b) Climate affects the **mechanical** weathering of rocks which is important for soil formation

Hot weather –

More evaporation – more rain – plants will grow more – more action of roots breaking rocks and forming soil

3) Climate affects soil formation several reasons

c) Climate affects the **mechanical weathering** of rocks which is important for soil formation

Cold weather –

will cause water turning into ice, increasing the mechanical weathering due to ice wedging

4) Time and soil formation

We already know that it takes thousands of years for some soil to form.

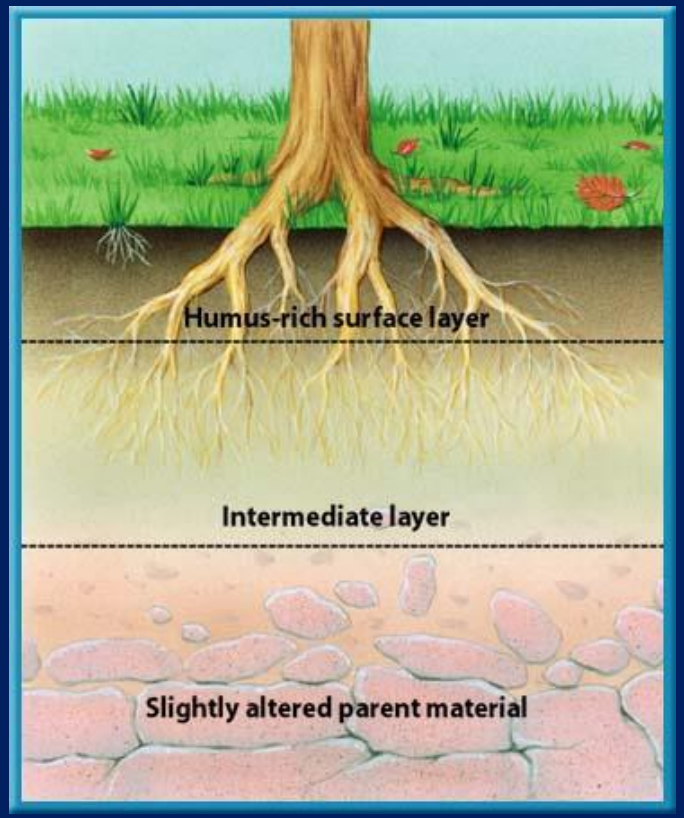
- **Deforestation is a problem because:**

Vegetation plays an important role in protecting the soil from erosion, in fertilizing the soil and it is also the home of many organisms.

**Why does vegetation fertilizes the soil ?

because of the formation of Hummus

1) Humus is a top layer found in soil. It is made of decomposed organic matter (dead plants and animals)
2) Hummus provides nutrients that help plants grow
3) Hummus helps soil hold water



5) Effect of Organisms in soil formation

- Organisms influence soil development.

Ex: Lichens

Read page 321

- Lichens can remove nutrients from rocks that are breaking down

- **This action of the lichens will start forming a thin soil , allowing other plants to grow.**
- The roots of these plants further break down the parent rock, creating more soil

Lab: Drainage Rate of Soils
Important aspects

- **Erosion:** it is the weathering away and removal of rock, sediment and soil by water, wind, ice and gravity.
- **Runoff:** water that flows over Earth surface carrying soil and nutrients to other areas including bodies of water.

- **Erosion and Runoff are responsible for the loss of nutrients and soil.**

- Properties of Soil such as **drainage rate, porosity and permeability** will play a role on the level of **erosion and runoff** happening in the area.
- The wrong use of soils will affect these properties and have an impact on the amount of erosion and runoff.

- **Drainage rate:** it is how fast water can flow thru the particles of soil.

- In soils with a low drainage rate, less water will penetrate the soils. There will be more erosion and runoff in the area and as a consequence, more loss of soils and nutrients.

- The opposite will happen in soils with a high drainage rate.

- **Porosity:** it is the space between the particles of soil.

- Soil that is not compacted, tends to have a higher porosity and a higher drainage rate. (less erosion, less runoff and less loss of nutrients and soil)
- The opposite will happen in soils that have been over used and are compacted.

- **Permeability:** it is the relative ease water can flow through the soil.

- More porosity, more permeability, higher drainage rate – less erosion and runoff, less loss of soil and nutrients.