



CfE Higher Geography

BIOSPHERE

WHAT ARE THE OUTCOMES?

1. Use a range of mapping skills and techniques in physical environment contexts by:

- ✘ 1.1 Interpreting complex geographical information from at least two sources
- ✘ 1.2 Annotating a geographical resource
- ✘ 1.3 Presenting complex geographical information
- ✘ 1.4 Analysing geographical information
- ✘

2. Draw on and apply knowledge and understanding of the processes and interactions at work within physical environments on a local, regional or global scale by:

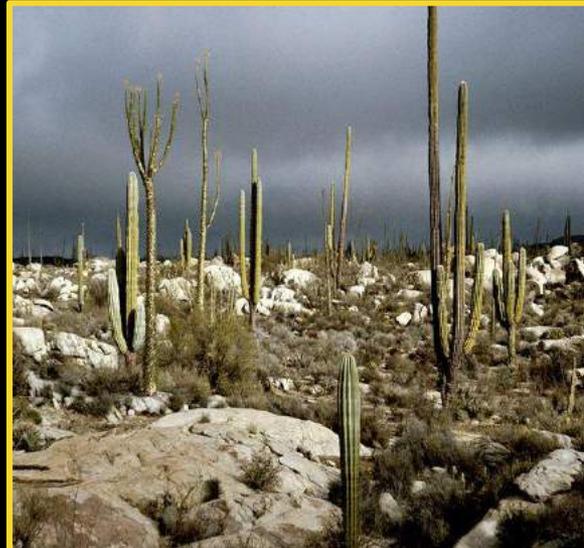
- ✘ 2.1 Giving detailed descriptions and detailed explanations of a process/interaction at work in a physical environment
- ✘ 2.2 Giving detailed descriptions and detailed explanations of the impact of weather/climate on a physical environment
- ✘ 2.3 Giving detailed descriptions and detailed explanations of a complex issue in a physical environment

Key Idea



WHAT IS THE BIOSPHERE?

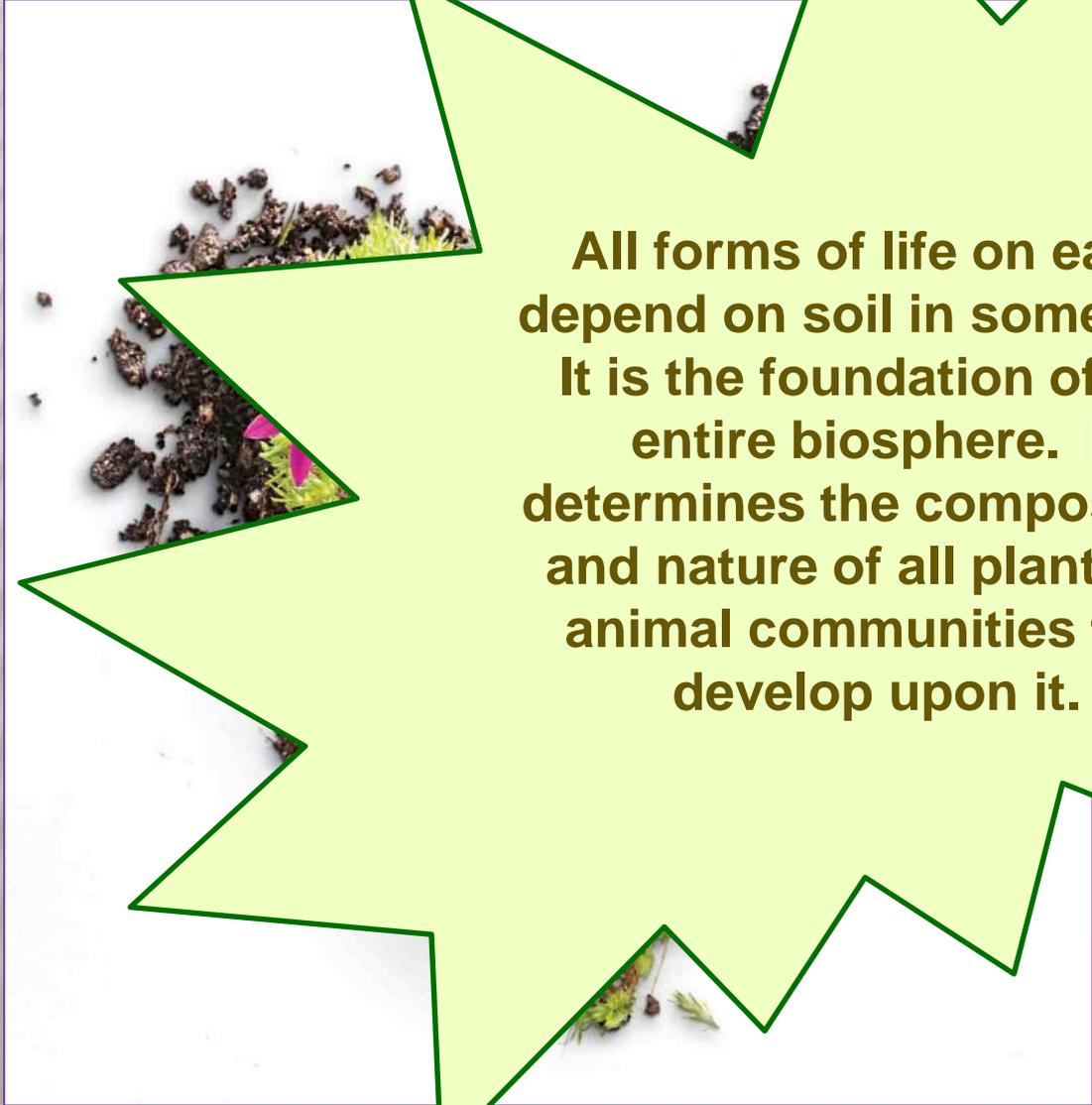
The biosphere is made up of the parts of Earth where life exists - all ecosystems. The biosphere extends from the lush dense rainforests, to the high mountaintops, to the empty desert lands, to the extensive coniferous and deciduous forests of the world.



THE SIGNIFICANCE OF SOIL

All forms of life on earth depend on soil in some way. It is the foundation of the entire biosphere. It determines the composition and nature of all plant and animal communities that develop upon it.

es soil



BUT WHAT IS SOIL?

Interesting soil fact! To form 1cm of soil could take 100-1000 years!!!!

Soil is a mixture of broken up rock, organic matter, gases and water. It is formed from the processes of weathering, erosion and decomposition of "parent rocks". The type of rock that is broken down can determine the characteristics of the soil that forms from it.

Explain what soil is and give a brief explanation for its formation



UNDERSTANDING SOIL FORMATION

SOIL INPUTS AND OUTPUTS

It takes a long time for soil to form and depends on the inputs and outputs.

Inputs

- ✦ Water
- ✦ Organic matter
- ✦ Nutrients
- ✦ Excretion from plants
- ✦ Respiration from soil animals



Outputs

- ✦ Evaporation
- ✦ Water and nutrients lost
- ✦ Nutrients taken up by plants
- ✦ Nutrients lost to water passing through soil

Draw the systems diagram. Write out definitions for the inputs and outputs.



SOIL PROFILES

Soil consists of several layers called **horizons**.

A **soil profile** is a vertical section through soils showing the soil from the surface vegetation to the bedrock.

We can work out the type of soil by examining the horizons

Take **at least half a page** in your notes. Use a **ruler** to draw a soil profile like the one shown here. It should be a large rectangle, divided into 4 sections. Note that the A_o Horizon is smaller than the other layers.



HUMUS

(A_o horizon)

TOPSOIL

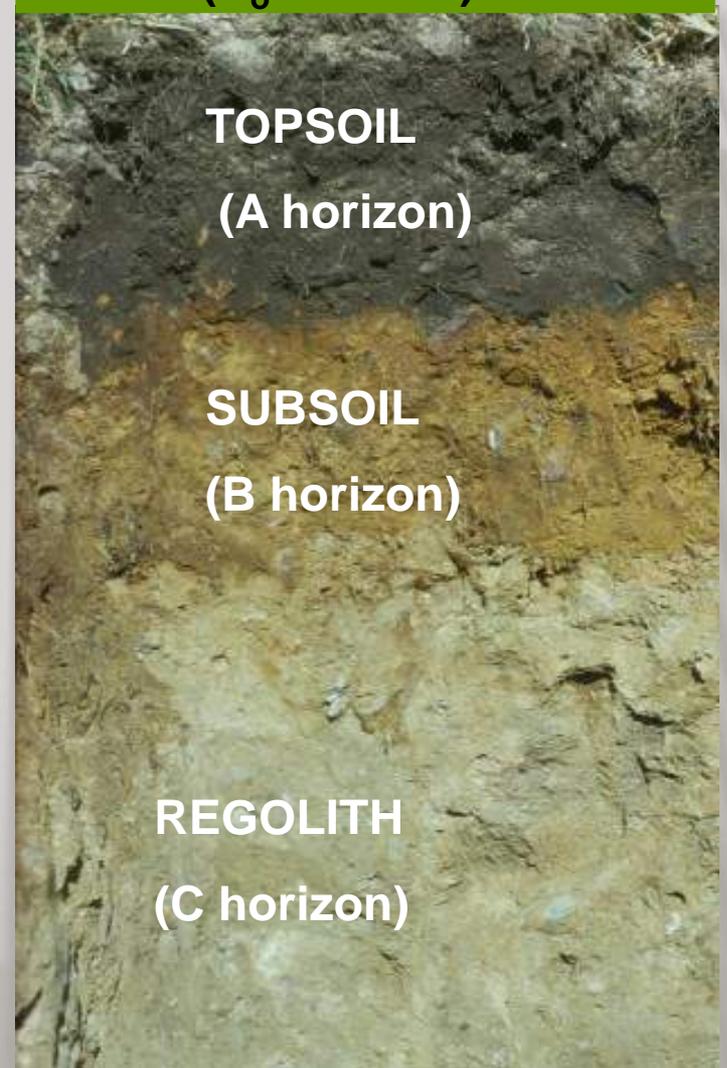
(A horizon)

SUBSOIL

(B horizon)

REGOLITH

(C horizon)



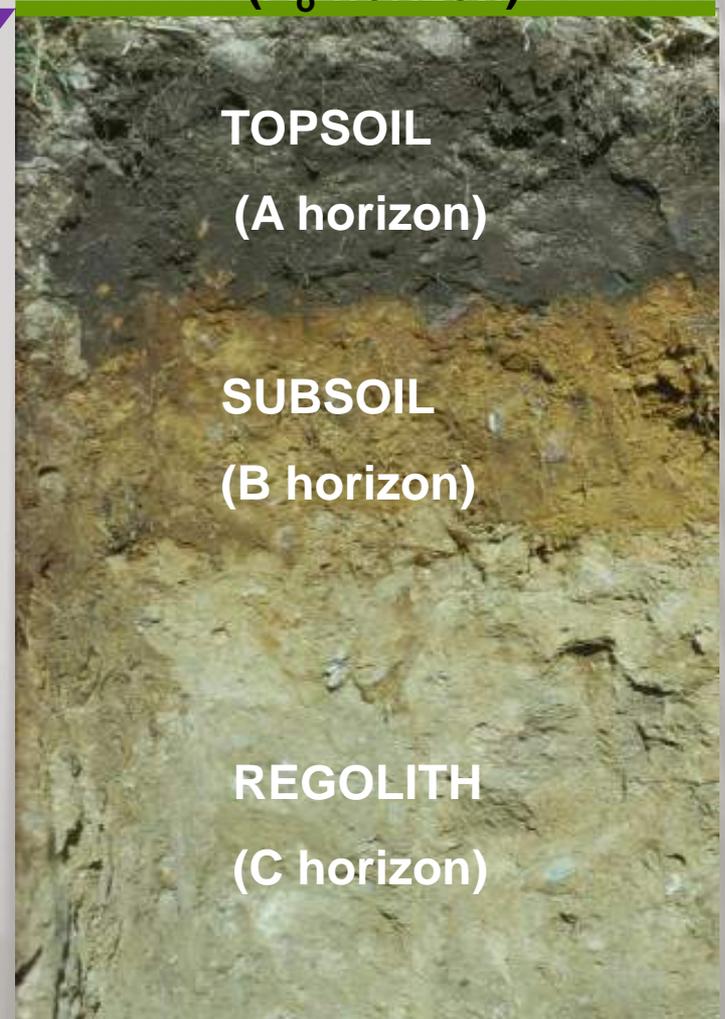
ANNOTATE YOUR PROFILE

THE A₀ HORIZON

- Closest to the surface
- Contains organic material from dead plants and organisms (**humus**)
- Depth varies depending on types of soil

HUMUS

(A₀ horizon)



ANNOTATE YOUR PROFILE

THE A HORIZON

- Top layer of soil
- Sometimes known as **topsoil**
- A mixture of humus and other mineral particles
- Usually nutrient rich and fine textured

HUMUS

(A_o horizon)

TOPSOIL

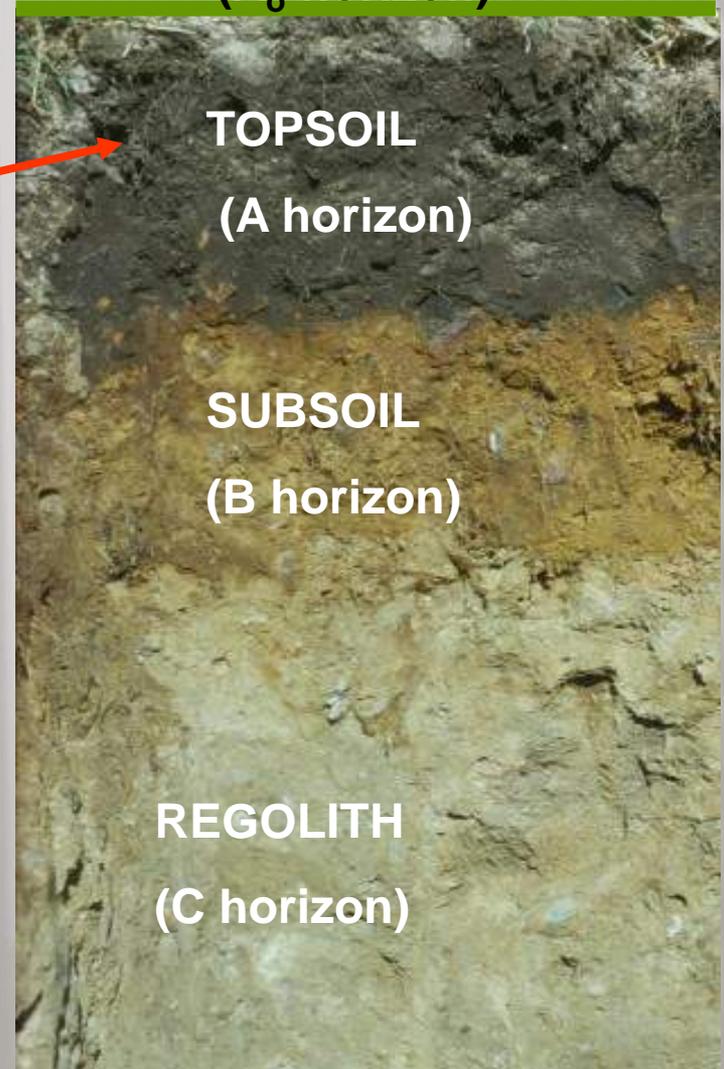
(A horizon)

SUBSOIL

(B horizon)

REGOLITH

(C horizon)



ANNOTATE YOUR PROFILE

THE B HORIZON

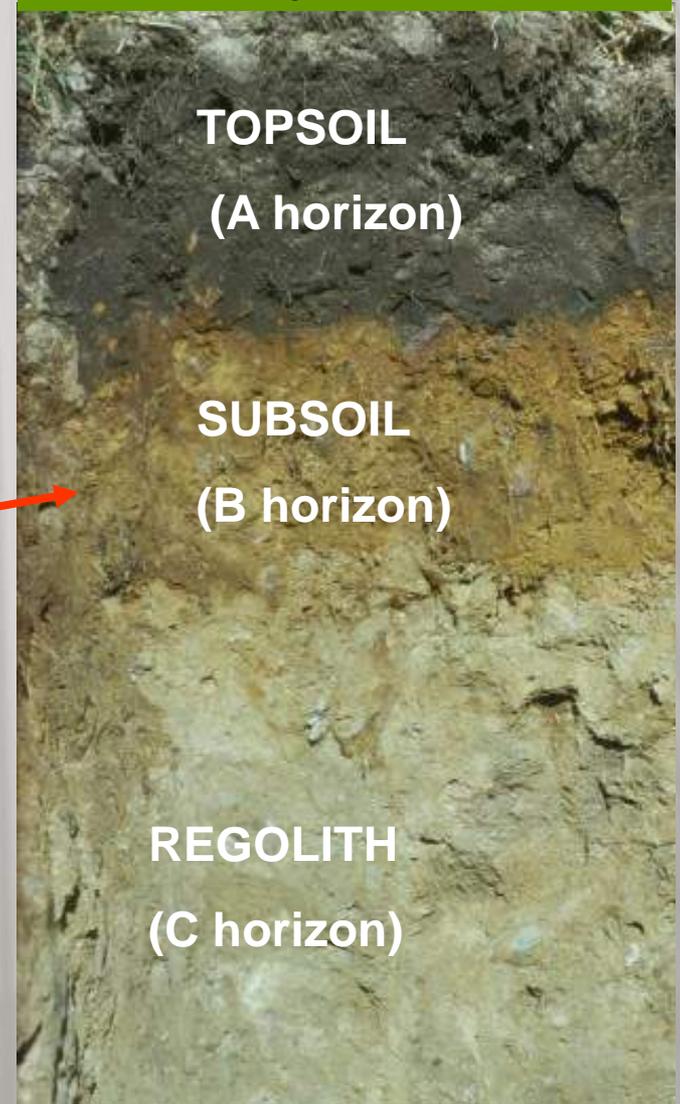
- **Subsoil** layer
- Consists of coarser materials and less organic matter.
- Soluble soil material may be **leached** out of horizon A and into B.

HUMUS
(A_o horizon)

TOPSOIL
(A horizon)

SUBSOIL
(B horizon)

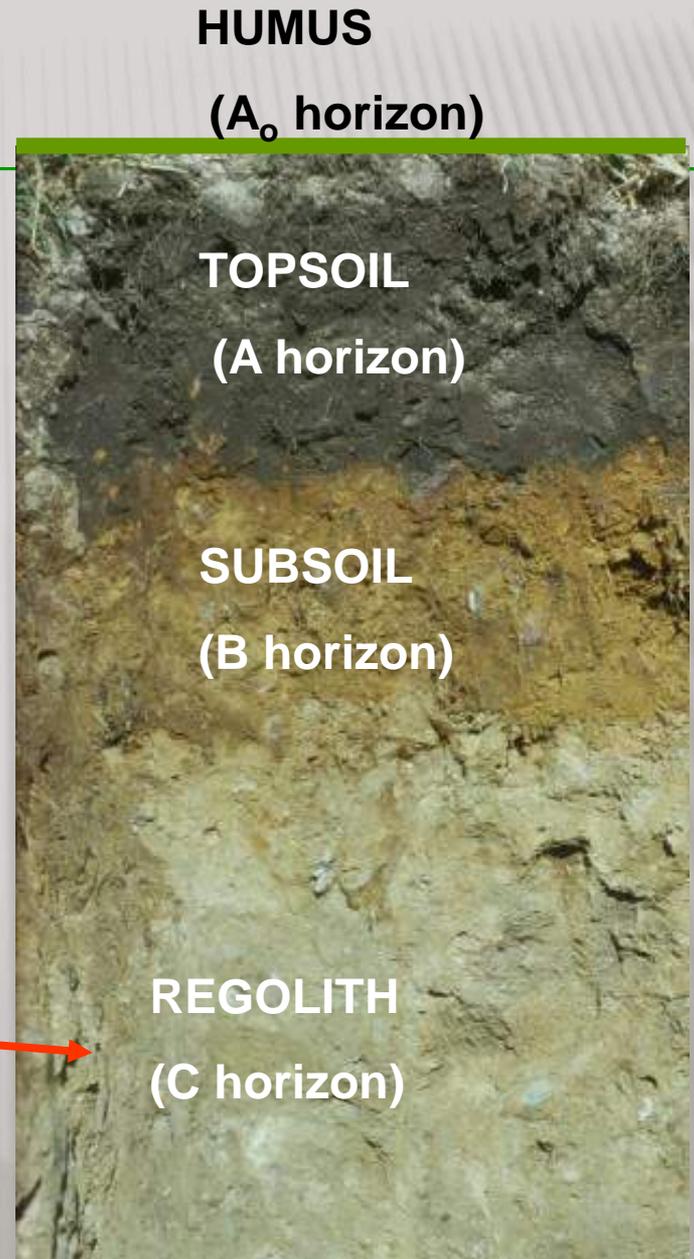
REGOLITH
(C horizon)



ANNOTATE YOUR PROFILE

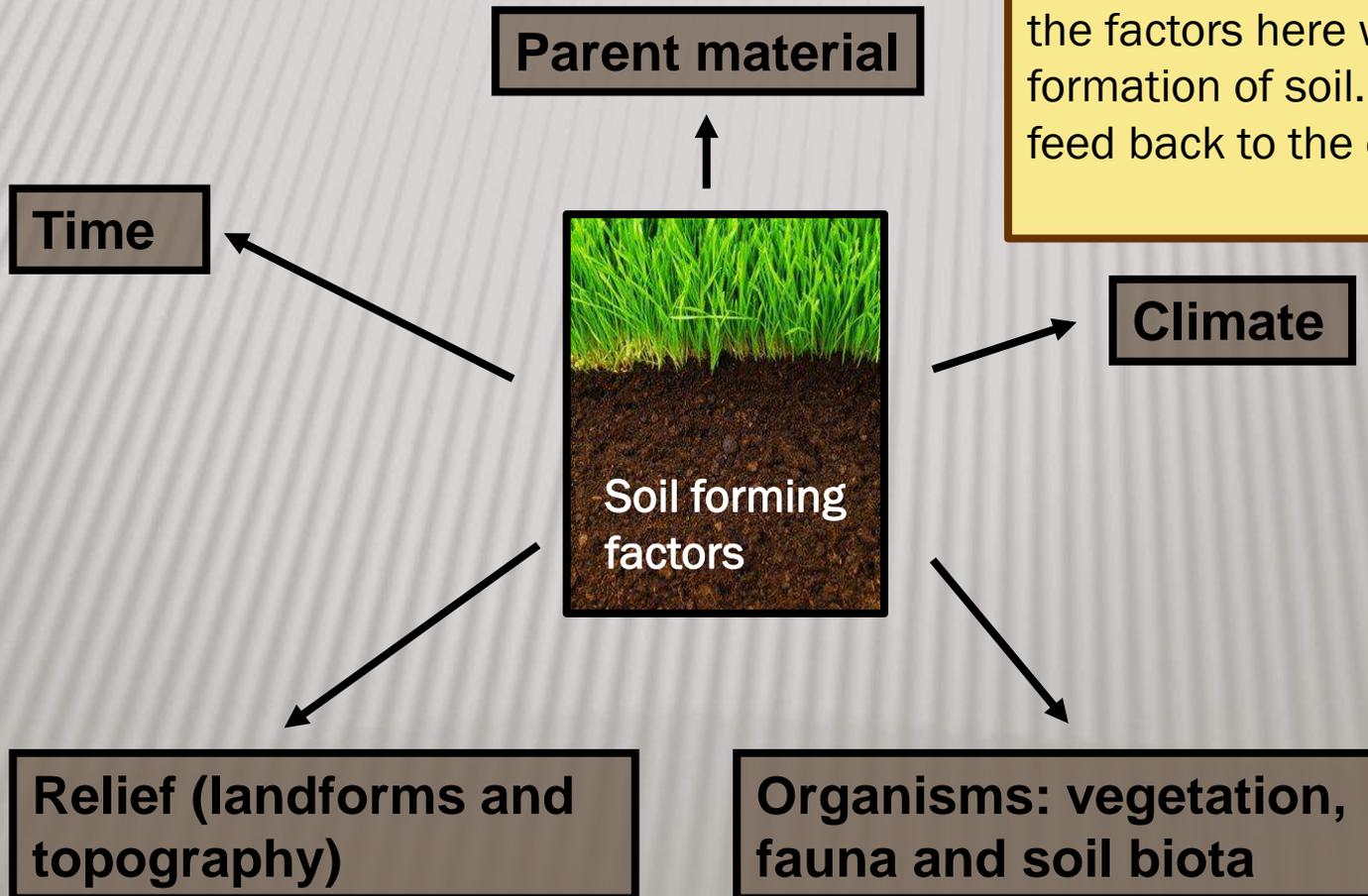
THE C HORIZON

- Also known as **Regolith** (weathered bedrock)
- Made up of weathered bedrock from the parent material.



SOIL FORMING FACTORS

Soils develop as a result of the interplay of 5 factors; Parent material, climate, organisms, relief and time.



Paired discussion:

Identify some of the ways in which the factors here will affect the formation of soil. Be prepared to feed back to the class.

Take a whole page in your notes. Either draw out the spider diagram as it is here or make it into a table



EXPLAINING THE SOIL FORMATION FACTORS

Add notes to your spider diagram or table as we discuss



Parent Material

This is the material from which the soil has developed and can vary from solid rock to deposits like alluvium and boulder clay. The parent material can influence the soil in a number of ways:

- colour
- texture
- structure
- mineral composition
- permeability/drainage



This soil has developed on Old Red Sandstone and so has derived its distinctive colour from its parent material.

EXPLAINING THE SOIL FORMATION FACTORS

Climate

Climate controls the rate and type of soil formation and is also the main determinant of vegetation that grows.

Soil climate has two major components; **moisture (precipitation) and temperature**

Precipitation influences the amount of water going through a soil and therefore the amount of leaching.

Temperature determines the rate of weathering and evaporation, as well as decay of organic matter.



EXPLAINING THE SOIL FORMATION FACTORS

Organisms: vegetation, fauna and soil microbes

Organisms influencing soil development range from microscopic bacteria to large animals including man. Micro organisms such as bacteria and fungi assist in the decomposition of plant material. This is mixed into the soil by macro organisms (soil animals) such as worms and beetles.

Soil horizons are less distinct when there is much soil organism activity.



Coniferous trees give a very acidic humus



Vegetation influences the soil in many ways. The nature of the soil humus is determined by the vegetation cover. Roots contribute dead roots to the soil, bind soil particles together and can redistribute and compress soil.

EXPLAINING THE SOIL FORMATION FACTORS

Relief

- It influences soil profile thickness i.e. as angle of slope increases so does the erosion hazard.
- it has an effect on climate which is also a soil forming factor.
- gradient affects run-off, percolation and mass movement.



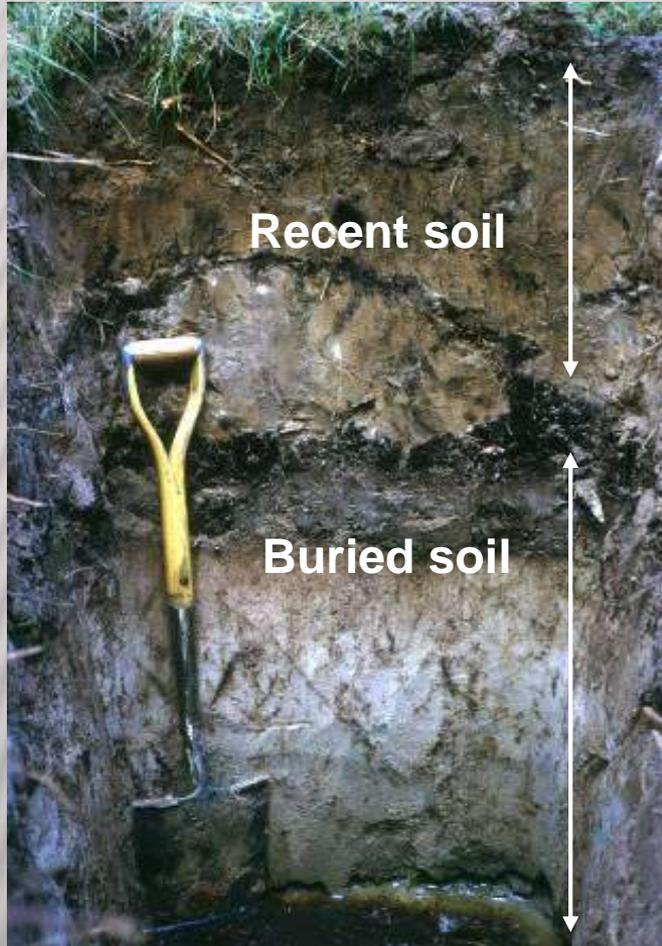
Steeper slopes can result in more run-off, less percolation, more erosion, and can create colder, wetter climates which affect what can grow as well as rates of evaporation and decay

EXPLAINING THE SOIL FORMATION FACTORS

Time

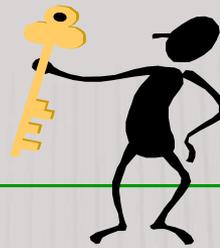
Soils develop very slowly. In Britain it takes about 400 years for 10mm of soil to develop.

Young soils retain many of the characteristics of the parent material. Over time they acquire other features resulting from the addition of organic matter and the activity of organisms.

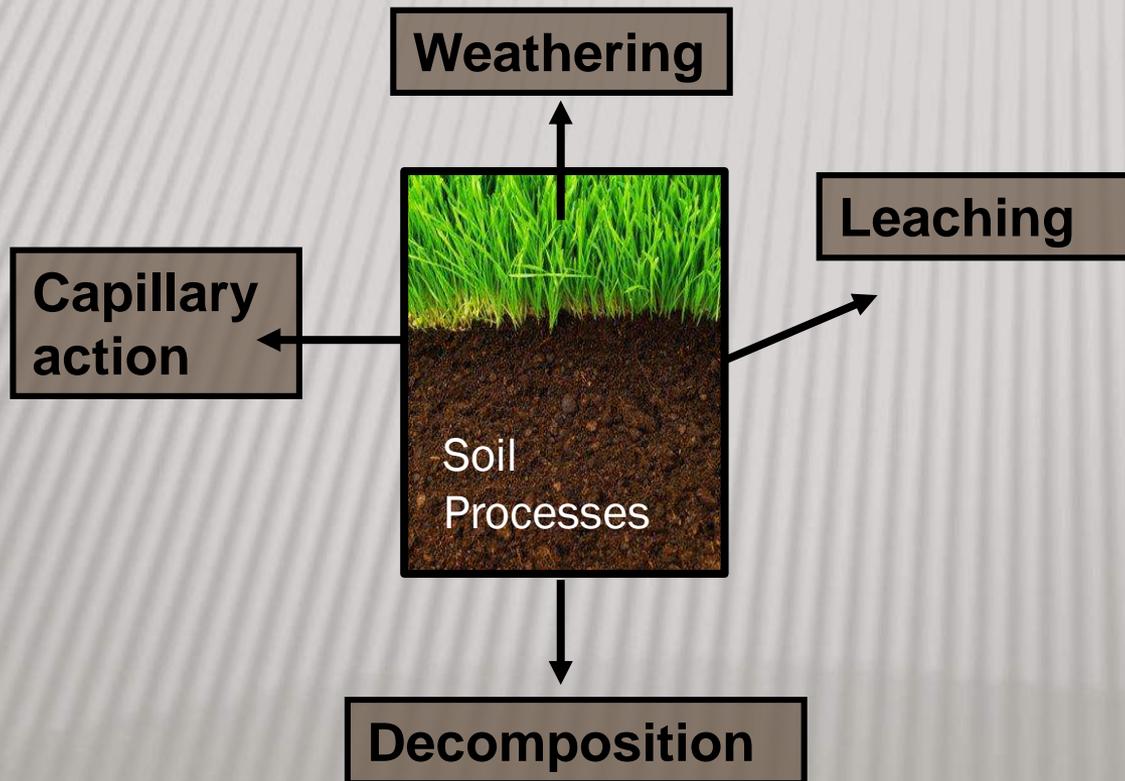


This soil profile shows a recent soil in Culbin Forest which has formed on sand overlying an ancient buried profile

KEY SOIL PROCESSES



Soils are complex and dynamic systems, in which many processes are taking place.



These 4 processes are key to understanding soil formation.

Your teacher will discuss them with you.

Match up the definitions and explanations on the next slide to each process.



SOIL PROCESSES MATCH UP!

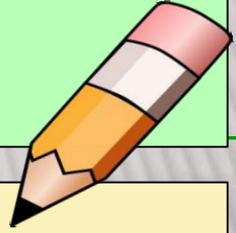
This refers to the breakdown and decomposition of rocks and minerals by factors including air, water, sun and frost.

Where evaporation exceeds precipitation, moisture moves **upwards** within the soil profile.

Wherever rainfall exceeds evaporation there is a **downward** movement of water through the soil. The water removes soluble material from the A horizon (Eluviation) and deposits it in the B Horizon (Illuvation). If the material is iron, an iron pan may form in the B horizon.

This is the breakdown of plant material into its simpler organic constituents. This is done by enzymes, earthworms, mites and other organisms, leading to the formation of different types of humus.

TEST YOUR UNDERSTANDING!



Use your notes to help you answer the following questions:

- 1) How does weathering assist in the formation of soil?
- 2) What is leaching?
- 3) Describe the 2 processes involved in leaching.
- 4) What is an Iron Pan? How does it form?
- 5) What are
 - a) a soil Profile?
 - b) soil horizons
- 11) Describe the characteristics of each of the following soil components:
 - a) A₀ Horizon
 - b) A Horizon
 - c) B Horizon
 - d) C Horizon
- 12) How might each of the following affect soil formation:
 - a) Temperature
 - b) precipitation
 - c) organisms
 - d) vegetation
 - e) evaporation
 - d) gradient

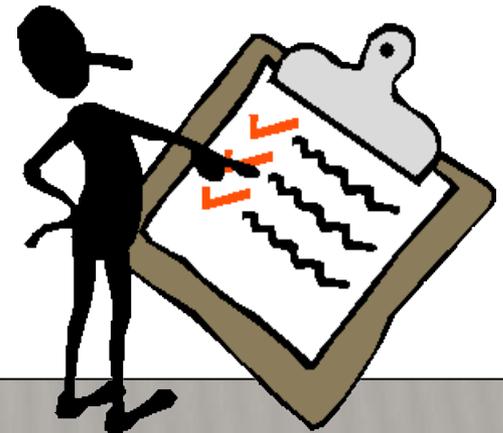
SOIL PROFILES: THE CASE STUDIES

WHAT DO YOU NEED TO KNOW?

Higher Geography requires that you apply your understanding of soil formation to 3 distinct soil case studies.

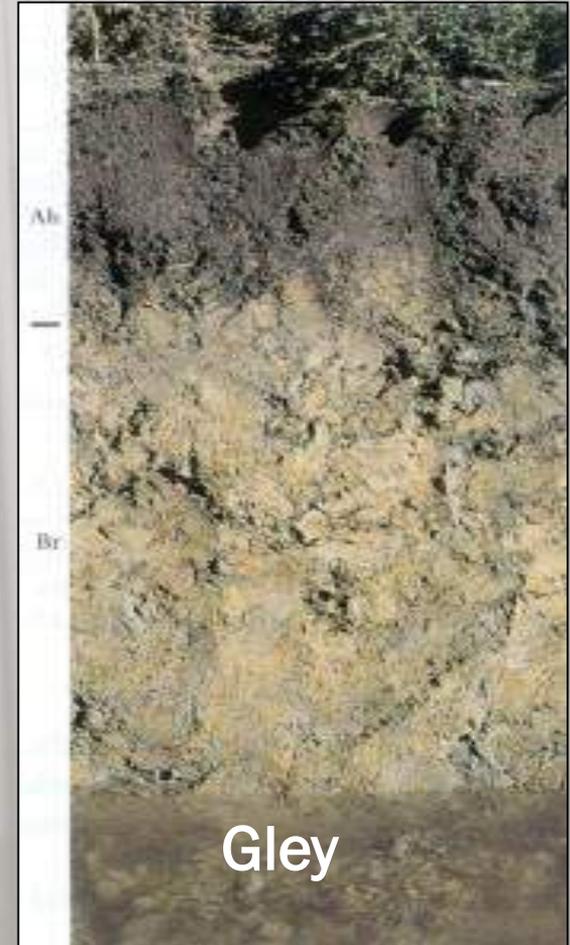
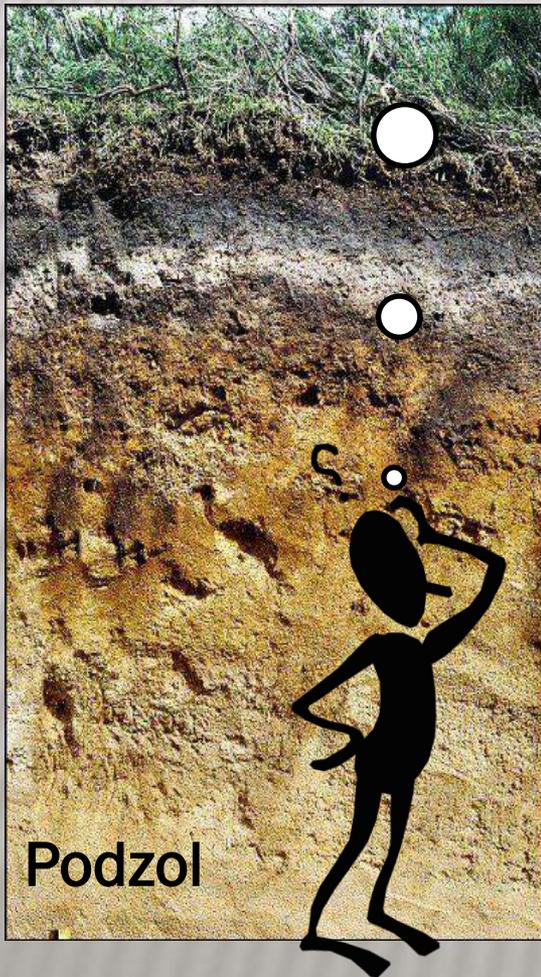
For each you need to make sure that you can draw a soil profile diagram and can explain the formation processes involved. Your case studies are:

- ❑ Podzol Soils
- ❑ Brown Earth Soils
- ❑ Gley (Tundra) Soils.



Compare the profiles.
What characteristics /
differences / similarities
can you see?

SOIL PROFILES

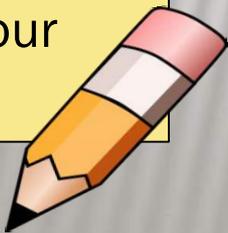


PODZOL

Draw a copy of the podzol soil profile shown here.

Don't worry about adding the labels yet. We'll add them together shortly!

Get some colours and colour your profile



Needles and pine cones decay to give an acidic Mor Humus

Soil horizons are well-defined as the cold restricts organism activity

The leached minerals are deposited in the B Horizon, giving it a red / brown colour

Parent material in C horizon tends to be glacially derived. Due to the cold temperatures it is broken up by freeze-thaw weathering

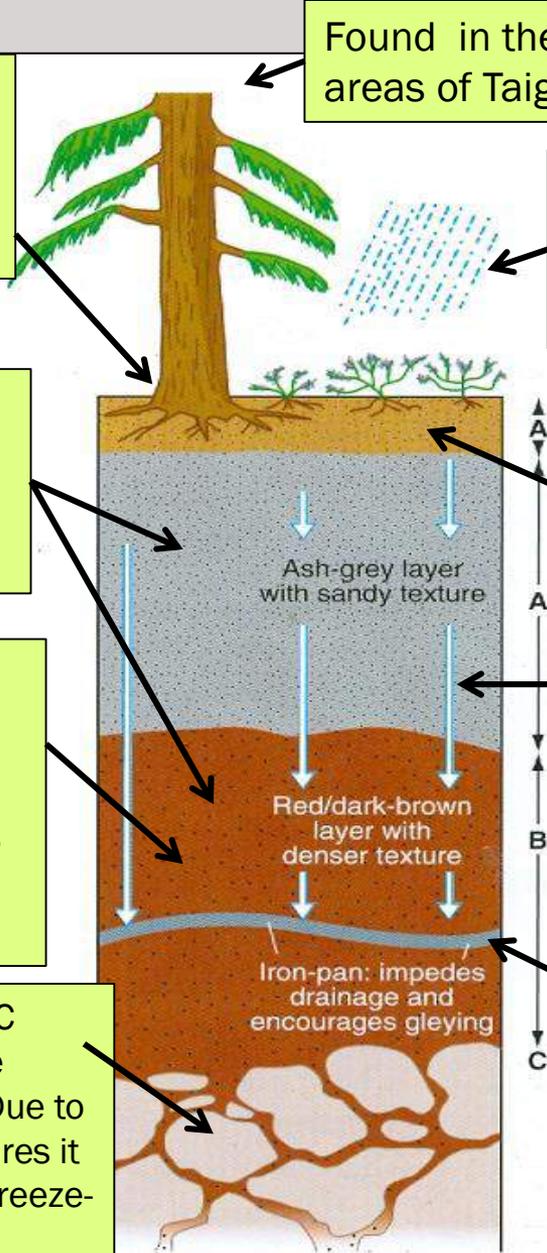
Found in the northern hemisphere in areas of Taiga or coniferous forests

Precipitation exceeds evaporation, so leaching occurs as rainwater infiltrates through the soil.

Thin humus layer as cold temperatures result in slow decay of plant material

Leaching removes iron from the A Horizon (eluviation), making it ash grey in colour

Illuviation forms an iron pan in the B-Horizon as iron is deposited. This obstructs further drainage, so the upper soil layers become gleyed (waterlogged).



BROWN EARTH

Draw a copy of the **Brown Earth soil profile** shown here.

Don't worry about adding the labels yet. We'll add them together shortly!

Get some colours and colour your profile



Mild temperatures cause rapid decay of organic material, so humus layer is thick.

Soil organisms thrive in the mild climate. They mix the soil layers so horizons are not clearly defined.

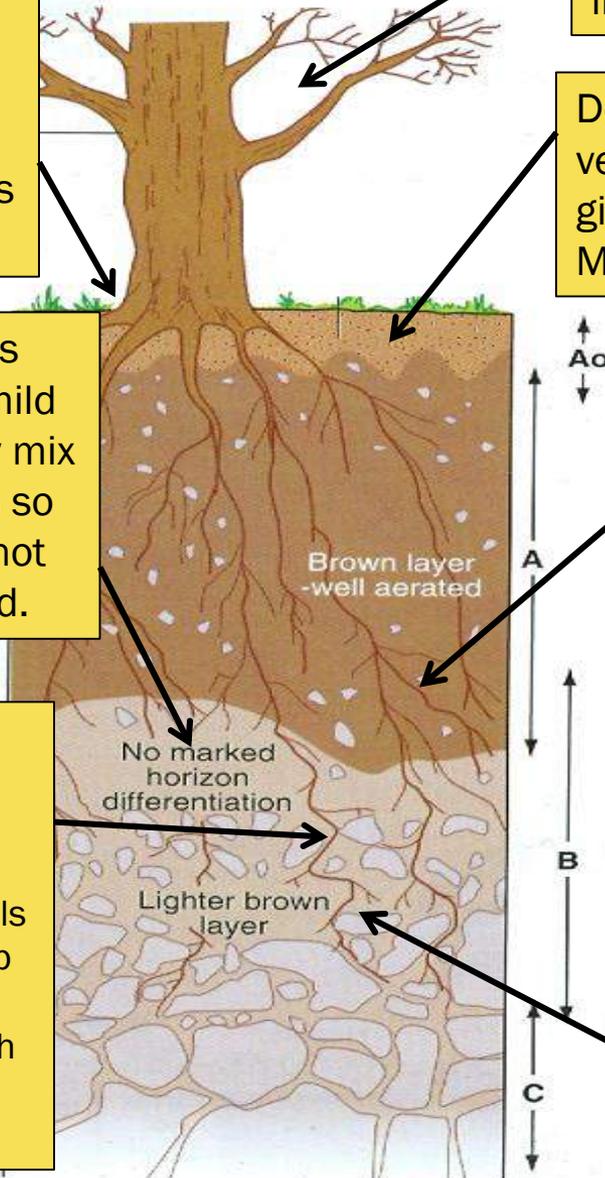
Tree roots penetrate deep into the soil, absorbing leached minerals and breaking up the parent material through biological weathering

Found under deciduous forests in milder climates

Deciduous vegetation decays to give a mildly acidic Mull humus

Precipitation is low to moderate so only small amounts of leaching occur. Not usually enough to cause an iron pan, so soils are free draining

Colour lightens with depth

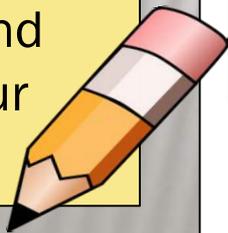


GLEY (TUNDRA)

Draw a copy of the Gley (Tundra) soil profile shown here.

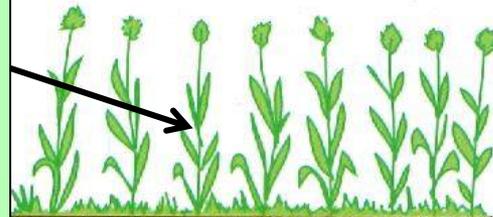
Don't worry about adding the labels yet. We'll add them together shortly!

Get some colours and colour your profile



Limited vegetation grows due to low temperatures. Only some grasses, lichens and mosses withstand the conditions

Gleying restricts oxygen so organism activity is limited. However, freeze-thaw weathering can mix the soil, making horizons unclear



Found in tundra areas where the subsoil is permanently frozen

The decay of vegetation is slow due to the cold. A dark Mor peaty humus forms.

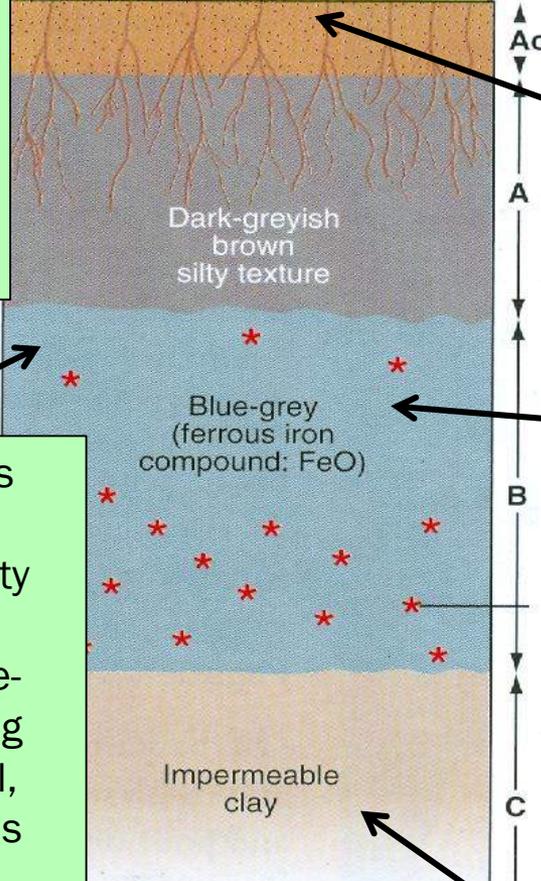
Subsoil layer consists of permafrost which restricts drainage, causing the upper B horizon and A horizon to be gleyed (waterlogged). This gives the B horizon a blue-grey colour.

Dark-greyish brown silty texture

Blue-grey (ferrous iron compound: FeO)

Impermeable clay

The parent material is impermeable clay. It can be broken up by freeze-thaw



QUESTION TIME!

Typical soil question:

Study the diagram below. Select one of the following soil types:

- i) Gley
- ii) Podzol
- iii) Brown earth

With the aid of an annotated sketch of a soil profile, EXPLAIN how the major soil forming factors shown have contributed to its Formation. (6 Marks)



CHECK YOUR ANSWERS!

Podzol (draw in the soil profile)

Podzol soils are found in a wide belt across the northern hemisphere, particularly in the areas of Taiga or coniferous Forests.

Climate – the temperatures are cold so there is a slow breakdown of organic matter, resulting in a thin humus layer (1). Precipitation is greater than evaporation so heavy leaching can occur especially after spring snow melt. (1) This removes iron from the A Horizon and deposits it in the B Horizon. The A Horizon subsequently becomes ash grey in colour and the B Horizon a reddish brown (1).

Relief and Drainage – The deposition of iron and aluminium oxides in the B Horizon can cause an iron pan to develop. This obstructs drainage and causes water logging of the upper soil layers (1).

Vegetation and organisms – Falling cones and needles from the coniferous vegetation decay to form a very acidic Mor humus (1). The cooler temperatures restrict organism activity (earthworms, rodents) which means that soil horizons are well-defined. (1)

Parent Material – Weathered parent rocks make up most of the C Horizon.

CHECK YOUR ANSWERS!

Brown Earth (draw in the soil profile)

These soils are associated with areas of deciduous forest .

Climate – the milder climate encourages more rapid decomposition of organic material. This builds up a thick humus layer (1). Precipitation exceeds evaporation, particularly during the summer months resulting in moderate leaching (1).

Relief and Drainage – leaching takes water down through the soil and causes the re-deposition of iron and aluminium. This moderate leaching however is not enough to cause an iron pan so soils are free-draining (1).

Vegetation and organisms – A mild Mull humus results from the rapid decomposition of the variety of deciduous vegetation (1). The mild temperatures cause earthworms, rodents and other soil organisms to thrive . These mix the soil and result in less well-defined horizons.(1)

Parent Material – This strongly influences soil development. Tree roots from the deciduous vegetation penetrate deep into the soil, breaking up the parent material. Consequently, weathered parent material can be found in the B Horizon (1).

CHECK YOUR ANSWERS!

Gley (Tundra) Soils (draw in the soil profile)

These soils are found in areas where the subsoil is permanently frozen (permafrost), and are associated with the Tundra climatic zone.

Climate – cold temperatures restrict the decay of what limited vegetation there is. The slow decay of mosses, lichens and marsh vegetation forms a dark acidic Mor humus (1). Thawing of the ground surface in the short summer creates melt water which is unable to drain freely through the soil. This causes water logging (1). In addition, alternative periods of freezing and thawing cause great disturbance and mixing of the soil layers (1).

Relief and Drainage – These soils are known as gley soils because the frozen sub soil layer restricts drainage causing the soil to become saturated (1).

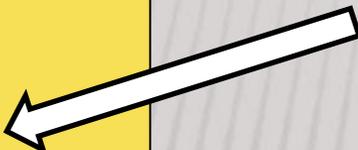
Vegetation and organisms – Organism activity is very much restricted due to the cold temperatures. The water logging of the soil also results in a lack of oxygen which further restricts organism activity (1).

Parent Material – The B and C Horizons often contain fragments of parent rock which has been broken up through weathering (1).

COMPARE AND CONTRAST!

Work in pairs or small groups

Location
Vegetation
Decomposition
Humus
Organism
activity
Temperature
Precipitation
Leaching
Illuvation
Weathering
Colour
gleying



You are going to **compare** the soils you have studied.

Choose **2** to compare with each other i.e. Podzol and Brown earth.

Using the list opposite, identify and **DESCRIBE** the key differences between the characteristics and processes in the soils (this means comparing not simply writing a list of what each has).

Now see if you can **EXPLAIN** why the soils are different (i.e. give reasons).

NOW HAVE A GO AT THIS EXAM QUESTION:

Compare the properties of 2 of the soils you have studied and **explain** the different formation processes involved. (8)

HOMEWORK AND REVISION



Things you could be asked in Biosphere:

- 1) To draw and annotate soil profiles
- 2) To explain the formation of a given soil
- 3) To compare the characteristics of 2 soils and explain their differences.

Collect a set of homework questions to help you prepare. Let's discuss what these questions are asking you to do!

HOMWORK QUESTIONS

Higher Geography

Biosphere Homework: Soils

1) Draw and **fully annotate** a soil profile of a podzol or Brown Earth soil to show its main characteristics (including horizons, colour, texture and drainage) and associated vegetation.

(6)

2) **Compare** the properties of a brown earth soil and a podzol and **explain** the different formation processes involved.

(6)

3) Explain how the major soil forming factors (relief, drainage, vegetation, organisms and climate) contribute to the properties and structure of a gley soil

(6)

What does this mean?

What does compare mean?

What must you do here?

Does this ask for a soil profile diagram? What are you asked for?