Name: ______________________

Date: ________________

Class: __________

IB ESS

5.1 Introduction to Soil Systems

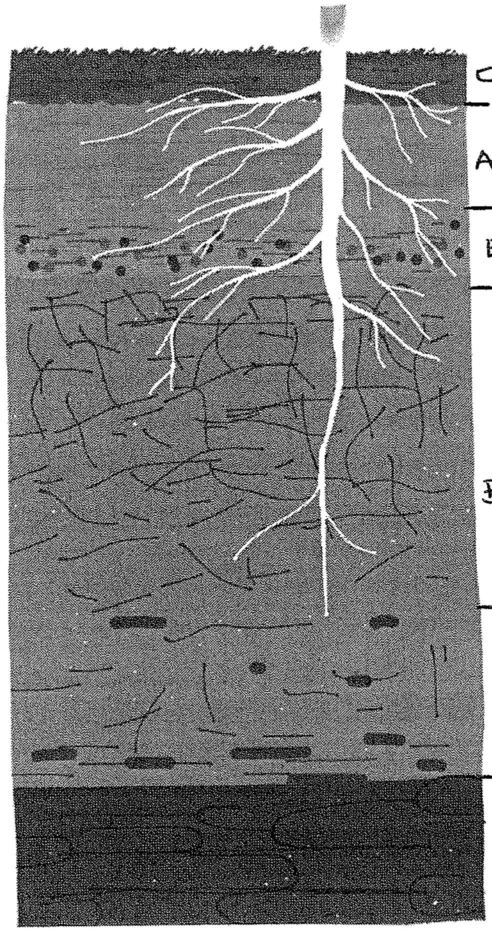
Significant ideas:

The soil system is a dynamic ecosystem that has inputs, outputs, storages and flows.

The quality of soil influences the primary productivity of an area.

The Soil Profile

1. Label the diagram below with the following parts. Include a brief description of each horizon.



O leaf litter rich in organic matter

A mineral horizon at the surface showing organic matter enrichment (humus)

E subsurface horizon, showing depletion of organic matter, clay, iron and aluminium compounds
Also known as eluvial or leached horizon

B subsoil horizon showing enrichment of clay material, iron, aluminium or organic compounds
Also known as illuvial or deposited horizon

C horizon of loosened or unconsolidated material

R hard bedrock

The Soil "System"

1. Read the description of the soil system below. Using coloured pens/highlighters, label all of the inputs, outputs, storages and flows. Don't forget to complete the key.

Soil is made of many materials. Material such as leaf litter enters the soil and contributes to the organic matter. Inorganic material such as minerals move through the soil with water if they are dissolved. They enter from the bedrock below. Water can enter or leave as rainfall or through evaporation, and this can influence the direction of movement of minerals. Soil is generally porous (though some soils more so than others). This means that air is usually able to diffuse into the soil.

There is biomass in the form of living organisms, which transfer throughout the soil as they are mobile, and can help move materials around within the soil. This is known as biological mixing. Material may also be moved through the system by non-living things; rainwater can carry suspended material to different places. This is known as translocation.

Within the soil there is the break down of organic matter by decomposers in the process of decomposition. There is also a natural process of nutrient cycling, which often involves living organisms. The nitrogen cycle is a good example of the complex series of transformations that nutrients might go through. Not all transformations within the soil require living organisms, however. For example, chemical weathering will change materials into different forms.

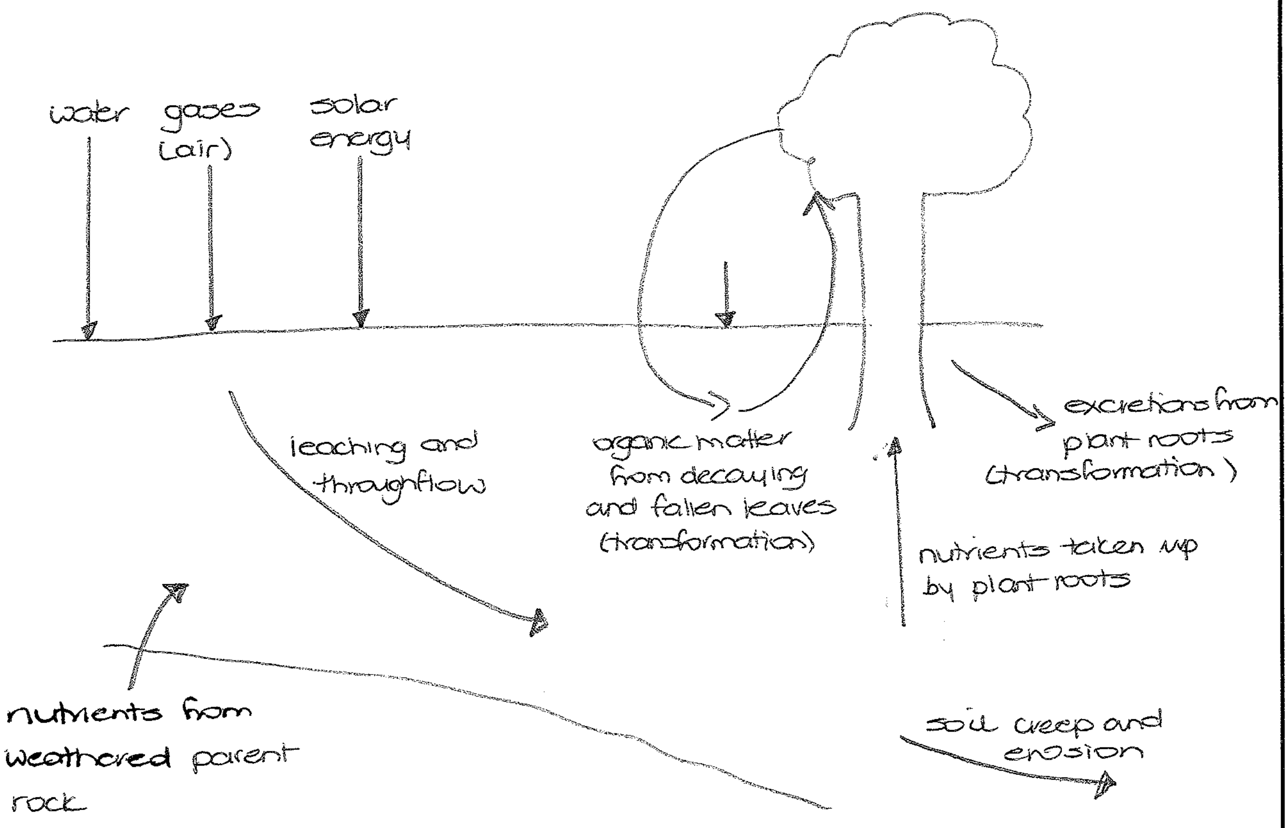
Plants take material from the soil; photosynthesis requires the uptake of water by roots. Furthermore, plants need a range of minerals to form biological compounds, and these minerals are also supplied by uptake through roots.

Lastly, material may leave the system through soil erosion. This can happen because of surface run-off, and may be influenced by a reduction in natural plant life as roots tend to stabilize soil.

KEY:

Storages: organic matter, organisms, nutrients, minerals, air, water
Inputs: organic material (leaf litter), inorganic material (from parent material) precipitation, energy
Outputs: erosion, uptake by plants
Transfers: biological mixing, translocation + leaching
Transformations: Decomposition, weathering, nutrient cycles

3. Draw a systems diagram to represent a soil system. When you label each flow, state whether it is a transfer or a transformation.



4. Merriam-Webster dictionary defines *Ecosystem* as:

"The complex of a community of organisms and its environment functioning as an ecological unit."

Explain why the soil system can be viewed as an ecosystem.

It is made up of minerals, organic matter, gases and liquid which forms the habitat for many living organisms including bacteria, fungi, earthworms and other invertebrates such as springtails, mites, spiders, snails

Soil Texture

1. The mineral content of soil varies amongst different soil types. However, mineral particles can be broadly categorized based on their size.

a) Complete the table below to show the type and associated size of the three types of soil particle.

Particle Type	Particle size (mm)
1. clay	< 0.002
2. silt	0.002 - 0.05
3. sand	0.05 - 2

b) Briefly outline the properties of soils composed of the particle types listed above:

Type 1 Clay

Poor - water infiltration rate, aeration and ease of working

Good - water holding capacity and nutrient status

Type 2 Silt

Medium - water infiltration rates, nutrient status and ease of working.

Poor medium - water holding capacity and aeration

Type 3 Sand

Good - water infiltration rates and aeration and ease of working

Poor - water holding capacity and nutrition status.

2. Soils are unlikely to be composed of one particle type only, but a combination of each. The relative amounts of each particle dictate the type of soil (and its properties).

Use a soil texture triangle to identify the type of soil with the following particle compositions.

You will find a soil texture diagram in your textbook, or you can do an online search.

Particle Composition (%)			**Soil type**
Clay	**Silt**	**Sand**	
50	50	0	silty clay
30	30	40	clay loam
20	40	40	loam
60	20	20	clay

3. Describe how you could test for particle composition of soil using the following methods:

Sieves

Dry out the soil and pass it through a series of sieves of decreasing mesh size - first 2mm, then 0.5mm and finally 0.005mm - separating the soil into its portion of clay, silt and sand particles

The jar method

Place a sample of soil in a jar, fill it with water, shake it vigorously then leave to settle.
The heaviest particles will settle first (sand) and the finer particles will settle last.

For both methods you can then measured the relative abundance of each of the particle sizes.

4. **Describe** and **explain** the relative fertility of clay soil, sandy soil and loam (loam includes a mixture of soil particles).

HELP: You will know you've provided enough information if you state the fertility levels of each soil type, and discussed the water holding capacity, drainage, porosity, mineral content, and potential to hold organic matter in each type, and linked these factors to the primary productivity of the soil.

Soil texture is an important property of a soil, as it determines the soil's fertility and the primary productivity.

Loam soils are ideal for agriculture

: The sand particles ensure good drainage and a good air supply to the roots. The clay particles retain water and supplies nutrients so they are fertile. The silt particles help to hold the sand and clay particles together and they can be worked easily. This results in high primary productivity

Clay soil while having better nutrient status and water-holding capacity has poorer infiltration rate, aeration and ease of working. This results in quite low primary productivity.

Sandy soils have good infiltration rates, aeration and ease of working but have low primary productivity due to low water-holding capacity and nutrient status.