Name: KEY

Date: _____

Class: _____

IB Environmental Systems and Societies

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.

Some Intro. Ideas. ⇒ Soils, who cares?

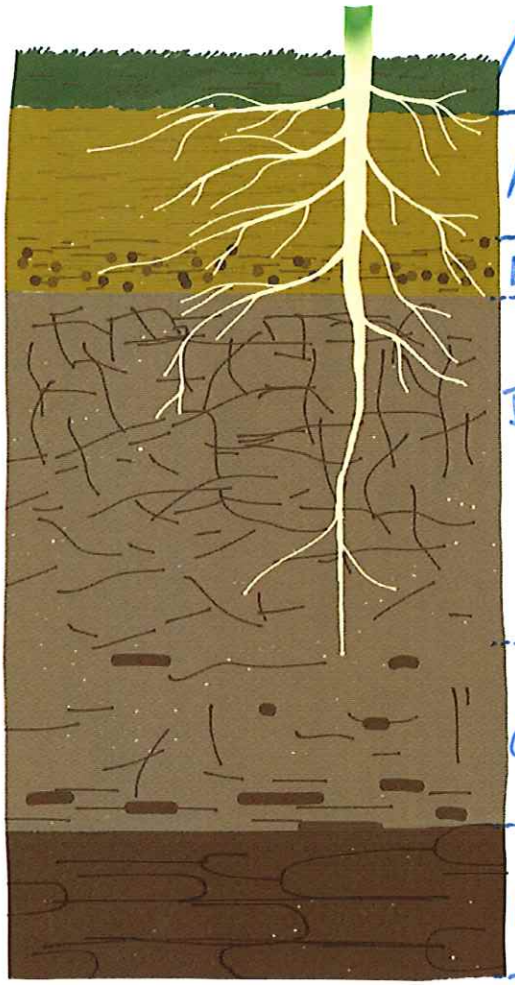
- All food we consume depends on it (plants & animals)
- habitat for many organisms
- massive filter for cleaning water
- If healthy it can be a sink to store Carbon.

Components:

1) inorganics → sand, silt, clay, rock, minerals,
   → provide structure
   → affects erosion & water/nutrient holding
2) organics (humus) → decay of past living matter = nutrients (i.e. leaves, sticks, worm poop, compost, manure, etc.)
3) organisms → mix the soil
   → N fixing bacteria
   → decompose organics
4) water - dissolves minerals for uptake
5) air - O_2 for organisms & plant respiration.

The soil profile

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



O horizon → Organics not decomposed fungi, bacteria, and diff. animals will break this down. Provides protection to soil erosion

A organic rich + dark in color. If water doesn't drain then decomp. won't happen.

E shows depletion of nutrients (light in color)

B Usually where clay + nutrients are deposited from above. Usually redder in color (iron)

C Broken parent material can provide minerals. Also deposit minerals carried down by H_2O

R Parent material (Bedrock) In the beginning of soil development this is the start (succession)

Important Notes:

. There are many types of soils with different sized horizons or some missing entirely. For instance in Leysin the soils are maybe 10-20 cm before rock is hit!

* water + nutrients can move up or down through the horizons. It is called <u>translocation</u>

Evaporation > precipitation * when water evaporates it leaves behind salts it was carrying = salinization.

Precip. > Evap. * when water flows through the soils and past the roots = leaching + nutrients are lost to groundwater.

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 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 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: 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:

storage

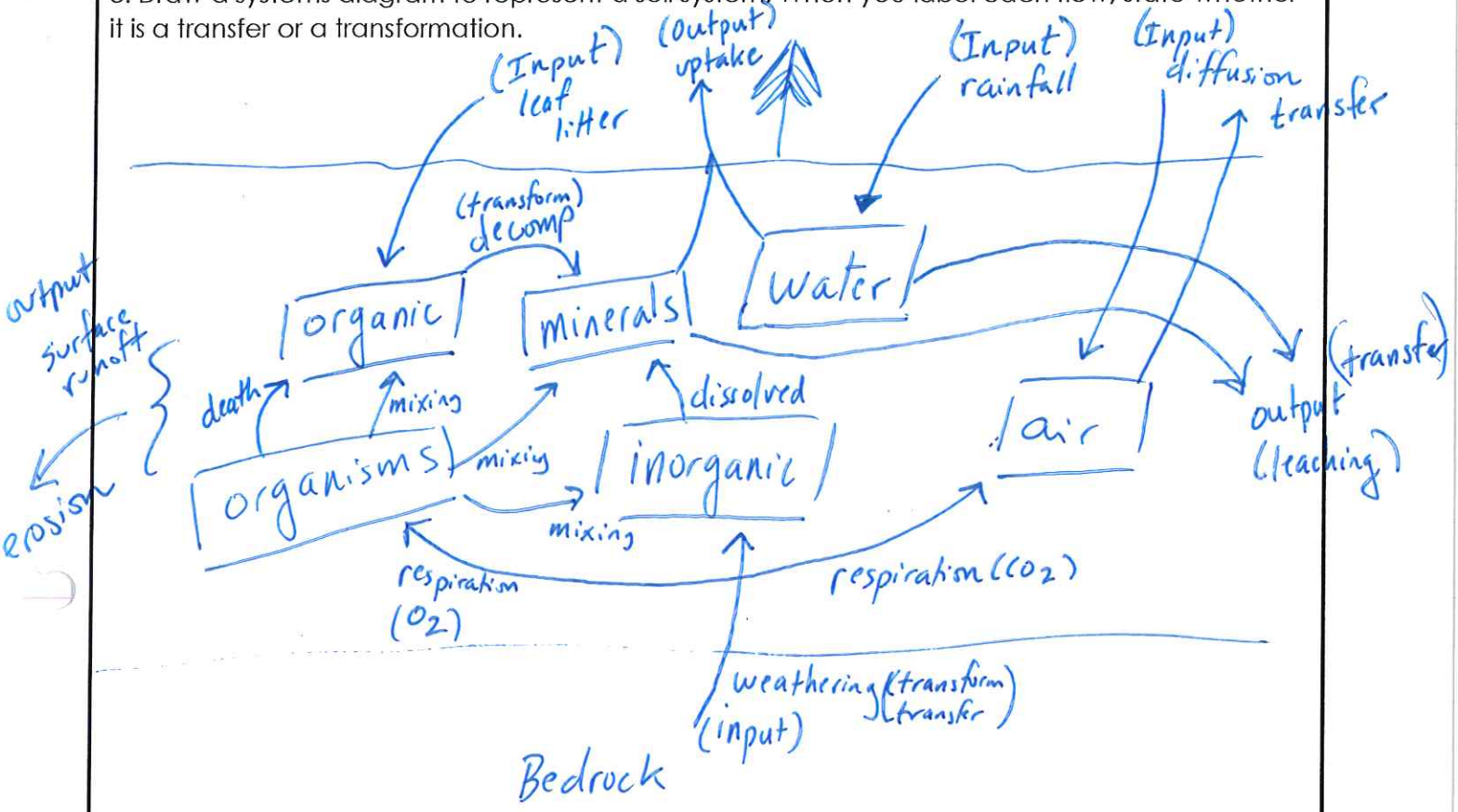
transfer

transformation

O output

I input

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 composed of both living & non-living & the interactions between these are diverse, interconnected and complex. Without ALL aspects of soil given equal importance then the system will not function optimally. This is just like a the traditional sense of an ecosystem.

rock particles:
humus:
water
air
organisms

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 mm
2. Silt	0.002 - 0.05 mm
3. Sand	0.05 - 2mm

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

Type 1

Clay soils will be slippery + sticky when wet. When dry they will form large hard blocks. Porosity is high but permeability is very low. Workability for agriculture is low.

Type 2

Silt soils are very fine but not as sticky. Can help bind sand together Good at holding moisture. Most important sediment for good soils.

Type 3

Sand soils have high porosity & high permeability ∴ low in nutrients due to leaching.

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

Different sized screens are stacked from biggest to smallest. Shake the soil through until all particles are sorted by screen size. Measure proportions.

The jar method .

- Dump soil sample (dried) into water column.
- Shake + then let settle
- Forms 3 layers (sand on bottom / silt / clay on top)
- Measure % of each layer

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.

Feature	Clay soil	Sandy soil	Loam
Drainage	very poorly due to the small pore spaces resulting in low permeability	very good due to high permeability	moderate but usually is sufficient
H_2O holding.	Due to low permeability it can hold water well once it is in But infiltration is slow.	Very bad due to high permeability leaching water right through.	Good due to its ability to accept H_2O + small enough pore spaces to hold it.
Minerals & fertility	Can accumulate + store minerals but bound so tightly that plant roots can not access it ∴ infertile * This can lead to acidification of soils + become very troublesome for plants	prone to leaching due to high permeability Nutrients solvable in water are lost to the groundwater, NPK into ↑ = eutrophication	will be the best at holding available NPK and allowing plants to uptake. = high fertility ∴ a good input of organics can be supported from dead + decaying plant material.