

Soil Characteristics | A1 Sample answer

Soil characteristics are affected by their immediate environment and by a combination of processes operating in that environment. Examine any three soil processes that affect soil characteristics.

Three processes that affect soil characteristics are: Weathering and erosion, humification and leaching. These processes affect characteristics such as the texture, structure, moisture, colour, PH value and humus content of the soil.

One of the four main materials that make up the composition of soil is mineral particles. Weathering and erosion breaks down rock into particles over long periods of time. The size and texture of these particles depends on the parent material. Erosion breaks down the rock to form particles that vary in size from boulders to tiny particles of clay. These are then transported from their place of origin and deposited. This includes alluvium transported by rivers, loess by wind and boulder clay by glaciation.

Mechanical weathering includes freeze thaw in upland areas and exfoliation in areas where there is a high daily temperature range such as the Sahara desert. Freeze thaw occurs when rain gets trapped in holes or pores in the rock. As the temperature falls below freezing at night the water freezes and expands its volume by around 7%. This weakens the rock. As this process is repeated particles which are broken off to form Scree. Scree accumulations can be found at the bottom of Croagh Patrick.

Exfoliation is caused by temperature variations. Heat causes the rock to expand. At night, the temperature drops the rock contracts. The outer layers contract more quickly than the inner layers forming weaknesses and fractures and flaking occur.

The characteristics of the minerals are not changed but through heating and cooling and expansion and contraction the particles break down to grains of sand or clay. The texture of the soil depends on the proportion of sand silt and clay. Sand particles are the largest and coarsest particles. They feel gritty. Silt Particles are medium sized. They feel soft and silky. Clay particles are the smallest and smoothest particles they feel Sticky.

Sandy soils are mainly composed of sand particles. These particles are loose with large pores between them. This allows water to drain away freely meaning the soil may become leached.

Clay soils have very small particles that stick together. They Retain moisture and become heavy. This means that the soil can become waterlogged. The soil tends to be very sticky and can be difficult to cultivate. When they are dry the soil shrinks and cracks. This makes it difficult for plant roots and water to penetrate the ground.

Loam soils are made up of equal amounts of sand silt and clay. They retain some moisture but are also free draining. Loam soils can be found in the Paris basin. They retain nutrients and are a very fertile soil.

Chemical weathering causes rocks to decompose. Carbonation occurs when rainwater reacts with carbon dioxide in the air to form a weak carbonic acid. This reacts with the calcium in limestone dissolving it and removing it in solution. Calcium is important to soils as it affects the ph. value of the soil. Alkaline soils are limey and contain high levels of calcium. The Ph. value of a soil determines which plants and living organisms can live in the soil.

Hydrolysis occurs when rainwater breaks down granite. Water reacts with the feldspar in the rock which is good at bonding. It turns it into kaolin which is not good at bonding. The rock then breaks down into clay which retains moisture and can become waterlogged.

Oxidation affects the colour of the soils as well as the structure. It occurs when oxygen in the atmosphere reacts with the iron in the soil and rock. The iron rusts causing the rocks to crumble more giving the soil a crumb structure. The crumb structure has small rounded grains similar to breadcrumbs and is found near the surface where the roots have been growing. It is excellent for drainage and air movement. The rusting also gives the soil a reddish brown colour.

Humification is important as it increases the fertility of the soil. It occurs when organic matter is broken down and decomposes to form humus. Another element of the composition of soil is organic matter which consists of plant litter as well as waste products of the remains of creatures living in the soil. The humus is then washed into the soil by rainfall or mixed into the soil by animals and micro-organisms living in the soil. Humus releases nutrients into the soil in soluble form so that they can be absorbed by the plant roots. Humus also increases the soils ability to retain moisture. It has a gel like texture that holds particles together and also gives a crumb structure to the soil. Humification occurs rapidly in humid climates such as in the amazon rain forest. Humification almost ceases in arctic climates such as the Antarctic.

The presence of humus gives the soil a black/brown colour. The exact colour varies depending on the amount of humus in the soil and its stage of breakdown. Soils that are rich in humus are very fertile.

Leaching is the removal of nutrients from the soil by water. It is most common on steep slopes and upland areas with heavy rainfall such as in the west of Ireland. When rainfall exceeds evaporation the water moves down through pores in the soil, soluble minerals and organic matter are moved through the soil.

Leaching affects the humus content. It is important as it washes nutrients through the soil increasing its fertility. Excessive leaching can wash nutrients out of reach of plant roots causing the soil to become infertile. Pesticides and fertilisers can be leached out of the soil contaminating ground water.

Podsolization is an extreme form of leaching. It is most common where the vegetation is coniferous forest or peat and where there is a very high annual precipitation. Rainwater becomes more acidic as it passes through the bed of organic matter on the surface. This rainfall is then able to remove almost all the minerals and nutrients from the soil. After losing all of its nutrients except for the more resistant quartz the A horizon has an ash grey colour.

The minerals are then deposited in the B horizon which becomes darker in colour. When iron oxide is one of these minerals it gives the soil a red colour. It also cements grains of soil together to form a hardpan. Hardpan hampers drainage, makes cultivation difficult and may lead to waterlogging.

Lateralization is another severe form of leaching that is associated with tropical and equatorial climates such as the amazon rain forest. It occurs when temperatures are high there is a high level of rainfall and there is a lot of plant litter on the ground. Chemical weathering occurs at a rapid rate due to the hot conditions. This results in a very deep soil. All the minerals except iron and aluminium oxide are leached deep into the ground. This means that the horizons are poorly developed and the soil does not retain its fertility. The iron rusts again giving the soil a red colour.

Leaching also affects the PH value of the soil. The more acidic the soil is the fewer living organisms are present in the soil. The organisms are important as plant roots help to bind loose soil particles and prize open compacted soil. This prevents soil erosion which is common in the horn of Africa where overcropping and overgrazing are prominent. Plants also return nutrients to the soil after they die and decompose. Worms and termites mix and aerate the soil. The more acidic the soil is the fewer living organisms present in the soil. Crushed lime must be added to reduce the level of acidity. Neutral soils are the best soils.