

6 SOIL AS A RESOURCE

6.1 Vocabulary

paraphrasing at sentence level

A Study the words in the blue box.

- Copy and complete the table. Put the words in one or more boxes, in each case.
- Add affixes to make words for the empty boxes. (Some will not be possible.)
- What is the meaning of each word in environmental science?
- Find a synonym for each word in the box.
- Group the words in the blue box according to their stress pattern.

aerate composition
cultivation cycle decompose
drain erode evaporate
excretion fertilize foliage irrigate
input leach recycle weather

Noun	Verb	Adjective
aeration	aerate	

B Study Figures 1 and 2 on the opposite page.

- What does Figure 1 show?
- Complete Figure 2 with labels a–g.
 - evapotranspiration
 - uptake of nutrients by roots
 - solar energy
 - recycling of organic material
 - decomposition of organic matter
 - excretion of CO_2 from plant roots
 - nutrients from weathered rock
- Discuss what Figure 2 shows using words from Exercise A.

C Student A has written about the soil system, but there are some mistakes. Change the blue words, so the sentences are true.

D Student B has also written about the soil system. Match each sentence with a corrected sentence from Exercise C.

E Look at Table 1 on the opposite page.

- Which of these four soil textures do you think is the easiest to cultivate? Why?
- Why may plants grow poorly in clay soils?
- How could a farmer improve the soil quality in sandy soils?

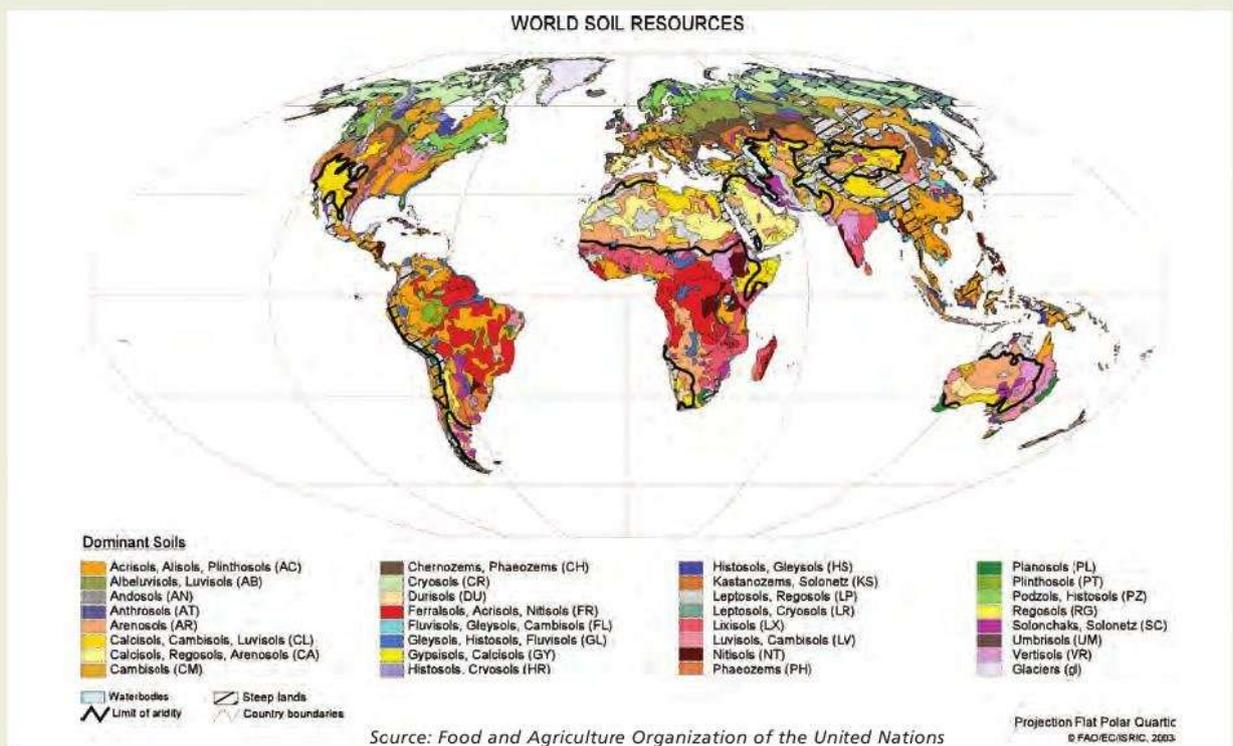
F Choose one of the soil textures illustrated in Table 1 on the opposite page. Ask and answer questions in pairs. Your partner can only ask yes/no questions to identify the soil texture you have chosen.

Student A

- Recycling of organic matter occurs in the *bedrock*.
- Air, water and solar energy first interact with the *subsoil*.
- Nutrients leach into the *topsoil*.
- Excretion of H_2O occurs in the roots of plants.
- Evapotranspiration takes place in the *roots* of plants.

Student B

- The process of transferring moisture from the Earth to the atmosphere happens in plant *foliage*.
- Organic material is continuously reused in the *topsoil*.
- Waste products such as CO_2 are discharged by plant *roots*.
- Atmospheric gases, water and energy from the Sun initially act upon the *top level* of the soil.
- Life-giving chemicals seep into the *regolith*.



Source: Food and Agriculture Organization of the United Nations

Figure 1: Soil map of the world

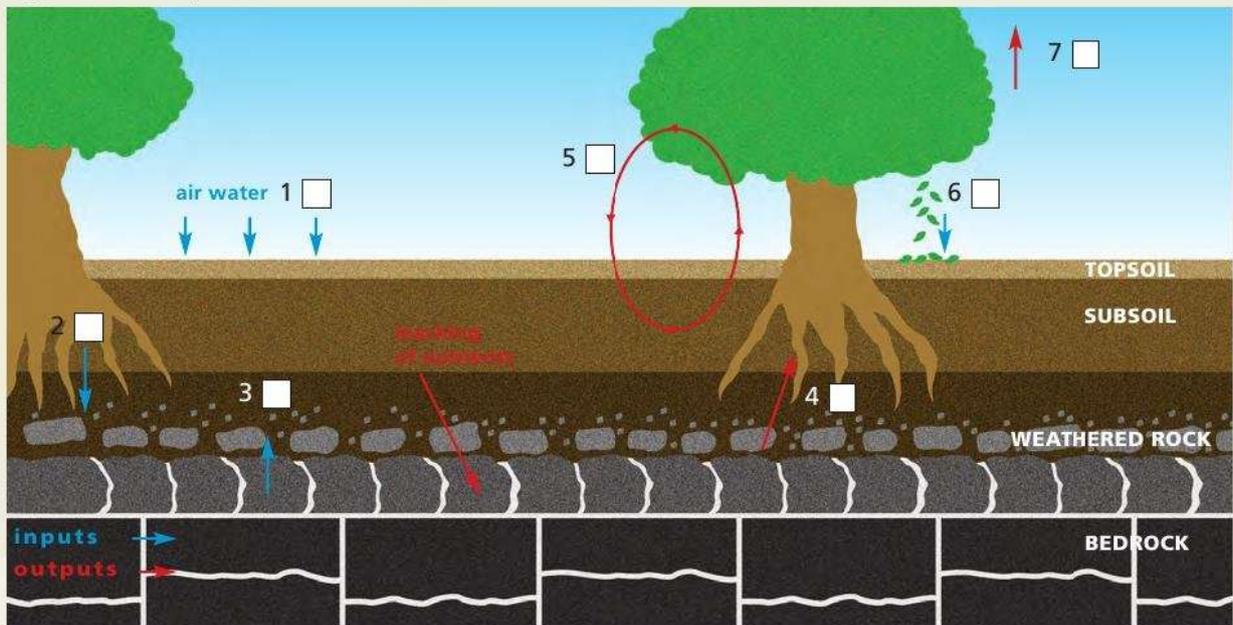


Figure 2: The soil system

Table 1: Soil properties and textures

	Water drainage rate	Water-holding capacity	Nutrients	Aeration	Ease of working
clay	poor	good	good	poor	poor
silt	average	poor	average	poor	average
sand	good	poor	poor	good	good
loam	average	average	average	average	average

6.2 Reading

identifying subject-verb-object in long sentences • paraphrasing

A Study Figure 1.

- 1 What are the three key elements of soil texture?
- 2 How can the soil texture diagram help farmers?

B Read the text under Figure 1. Plot the correct position for loam.**C** Look at the illustration, the title, the introduction and the first sentence of each paragraph on the opposite page.

- 1 What will the text be about?
- 2 Using your ideas from Exercises A, B and C1, write some research questions.

D Read the text. Does it answer your questions?**E** Study the highlighted sentences in the text. Find and underline the subject, verb and object or complement in each sentence.*See Skills bank***F** Two students paraphrased part of the text.

- 1 Which part of the text are these paraphrases of?
- 2 Which paraphrase is better? Why?

Student A

Although we can see that a complicated soil system occurs in the natural environment, ...

... it is now endangered as modern farming practices cause soil erosion.

This situation has happened because of a number of factors.

Organic matter is very important because it holds the soil structure together.

Student B

While it is clear that the soil system is a highly intricate mechanism, ...

... unfortunately, with the advent of intensive agricultural practices, soils are now threatened by erosion.

There are various factors which have led to this environmental problem.

One key element in soil is the organic material it contains as this material helps to maintain the structure of the soil.

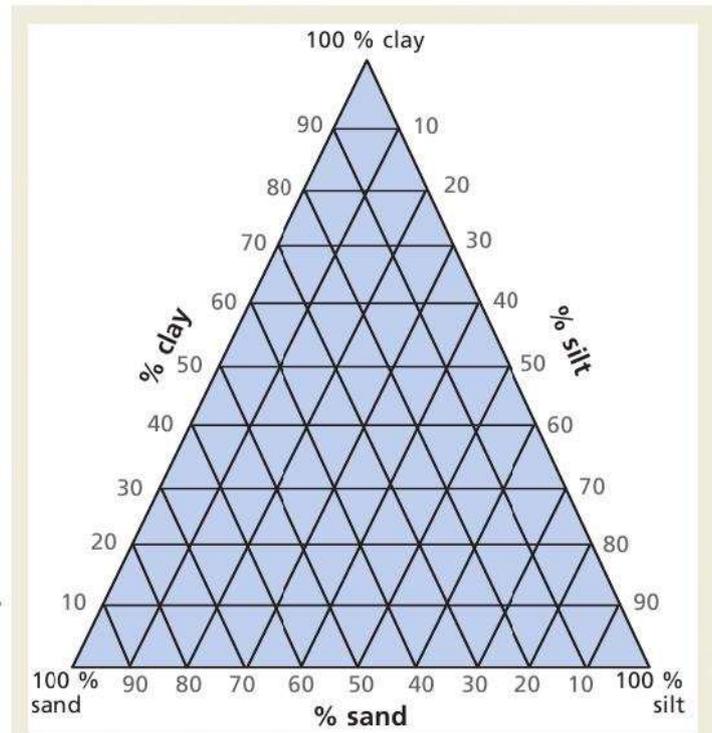


Figure 1: Soil texture diagram

Soil textures are classified by plotting the proportions of sand, clay and silt on a triangular graph. The best soil texture is loam because its clay content (20%) holds water and nutrients, its sand content (40%) ensures good drainage, and its silt content (40%) holds the clay and sand together.

G Work in groups. Write a paraphrase of a different part of the text.*See Vocabulary bank*

‘All things *come from earth,* and all things *become earth.*’

As Xenophanes knew over 2,500 years ago, soil is crucial for life on our planet. It supports vegetation and provides a home for microorganisms that decompose plant and animal life and recycle their nutrients back into the natural environment. In short, the earth we stand on is the core element in a web of life-supporting processes.

Soil is composed of air, water, organic matter, minerals and soil organisms, and the composition of this mix depends on a number of factors. Firstly, underlying rocks or sediments provide the mineral salts and weathered minerals of the soil. A second factor is climate, which affects the weathering of rock and influences the rate at which water and nutrients are removed and returned to the soil. The relief of the land plays an important role too. Aspect and altitude affect climate, and the gradient of the land influences the drainage of the soil. Another element is the amount and type of soil organisms that populate the soil. They can change the chemical content of soil in a number of ways. For example, earthworms can mix and aerate the soil, and microorganisms can return minerals and nutrients to soil when breaking down organic material. The final factor is a relatively recent addition, namely man. After the last ice age, humans gradually developed an agrarian system of food production, and abandoned a hunter gatherer existence. This has led to the intensive cultivation of land, and has resulted in severe soil erosion in many areas.

Soils are divided into layers known as horizons. As shown in Figure 1, these horizons can often be distinguished from each other by their content, structure and colour.

The topmost horizon is mainly composed of decaying organic matter. Below this you find the topsoil, which is rich in organic compounds that have leached down from the surface layer. The next layer is called the subsoil. This layer is produced from the aggregation of matter that has moved down from the topsoil. In the final layers, below the subsoil, there is an area of weathered bedrock called regolith, and below this its parent bedrock.

Another way to categorize soil is by its texture. Soil texture refers to the coarseness or size of the mineral particles in a soil, and is classified by the relative proportions of sand, silt and clay particles in the earth. Soil texture is important because it affects the structure of the soil as well as the amount of nutrients and water in the soil. Generally in farming, the ideal soil texture is loam because its clay content (20%) holds nutrients and water, its sand content (40%) allows for good drainage and aeration, and its silt content (40%) binds the sand and clay together.

Although we can see that a complex soil system exists in the natural world, this is now under threat as modern farming practices are causing soil erosion on agricultural land. This has come about for a number of reasons.

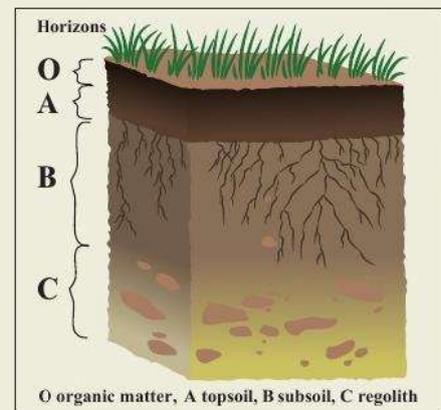


Figure 1: Cross section of soil

Organic material is crucial to soil because it binds the structure of the soil together. With the increasing reliance on inorganic fertilizers, the amount of organic matter placed on arable land has fallen considerably, and therefore the land has become more vulnerable to erosion. In addition, the removal of hedgerows, an increase in overgrazing and the growth in use of heavy machinery have all contributed to the problem.

So what can be done to reduce soil erosion and enhance soil quality?

Over the last few decades, many techniques for soil conservation have been adopted around the world to manage the problem of soil erosion. One of these is mulching, which is the practice of covering the soil with straw or compost to prevent excessive erosion and enrich the soil with additional organic material. The careful use of water in a planned irrigation system can also help farmers reduce erosion. Finally, our ancestors used farming methods which were very effective in stopping erosion. These techniques included shifting cultivation periodically and using terraces. The adoption of these traditional methods could greatly improve soil quality in areas that have suffered from erosion.

6.3 Extending skills

understanding complex sentences

- A** Study the words in box a from the text in Lesson 6.2.
- 1 What part of speech are they in the text?
 - 2 Find one or more words in the text with a similar meaning to each word.
- B** Complete the summary with words from Exercise A.
- C** Study the words in box b.
- 1 What is each base word and its meaning in environmental science?
 - 2 How does the affix change the part of speech?
 - 3 What is the meaning in the text in Lesson 6.2?
- D** Study sentences A–E on the opposite page.
- 1 Copy and complete Table 1. Put the parts of each sentence in the correct box.
 - 2 Rewrite the main part of each sentence, changing the verb from active to passive or vice versa.
- E** Look at the 'Other verbs' column in Table 1.
- 1 How are the clauses linked to the main part of the sentence?
 - 2 In sentences A–C, what does each relative pronoun refer to?
 - 3 Make the clauses into complete sentences.

a soil crucial vegetation
matter factor affect layer
categorize agricultural
increase enhance technique

If farmers want to see an _____ in their grain production, they first need to _____ the _____ in which their crops grow. This can be done in a number of ways. First, farmers should consider using soil-friendly farming _____. For example, they could leave a _____ of mulch on land between growing seasons to improve the amount of organic material in the soil. Another _____ in soil conservation is allowing local _____ to grow. This can help maintain a balance in the soil system.

b recycle natural weathered
drainage microorganism cultivation
aggregation overgrazing

6.4 Extending skills

writing complex sentences

- A** Make one sentence for each box on the right, using the method given in red. Include the words in blue. Write all the sentences as one paragraph.
- B** Study the notes on the opposite page which a student made about a case study. Write up the case study. Include the ideas from Exercise A.
- 1 Divide the notes into sections to make suitable paragraphs. Where should the paragraph in Exercise A go?
 - 2 Decide which ideas are suitable topic sentences for the paragraphs. Which idea can you use as a topic sentence for the paragraph in Exercise A?
 - 3 Make full sentences from the notes, joining ideas where possible, to make one continuous text.

Some soil scientists claim farmers use herbicides too often in minimum tillage.

Herbicides can contaminate the soil.

relative, passive In recent scientific journals

The method may leave pests in the crop residue.

The method may leave pests in the soil.

passive, ellipsis In addition

Minimum tillage requires new and expensive farm equipment.

Minimum tillage is beyond the means of most farmers in the developing world.

Leasing machinery to farmers has partially solved this problem.

relative, passive Finally, although

- A** In a basic cross section of a soil horizon, the layer which is located below the regolith is known as the bedrock.
- B** Two of the many ways in which soils can be categorized will be described here.
- C** You can also add mulch which is so useful that this technique has played an important part in the rate at which soil conservation has improved.
- D** As well as improving the organic content of the soil, a farmer must fully understand the need to maintain the drainage of the land.
- E** Having taken these steps as part of a sustainable and integrated approach, the farmer saw a sharp increase in his yields.

Table 1: Breaking a complex sentence into constituent parts

	Main S	Main V	Main O/C	Other V + S/O/C	Adv. phrases
A	the layer	is known as	the bedrock.	which is located below the regolith	In a basic cross section of a soil horizon,
B					

Reducing Soil Erosion. A case study - Minimum Tillage

- conserve soil + prevent erosion - how?
- adequate food supplies + healthy ecosystem ← protecting soil from wind & water erosion by using eco farming methods, e.g., minimum tillage (MT)
- how does MT work?
- traditional method (stages) =
 - plough field/plant crops
 - break up clumps of soil with disc so you can sow seeds
 If soil too wet in spring, process occurs in autumn → wind erosion in winter → damaged soil
- can be avoided by using MT planter machine (it works by planting over previous yr's crop residue)
- MT → important advantages
 - soil erosion ↓ by 90%
 - energy use ↓ by 80%
 - crop residue left by method ↑ habitats for insects that eat pests (↓ need for pesticides)
 - ↓ soil compaction (less heavy machinery used)
 however some drawbacks of MT

Vocabulary bank

Reporting findings

You cannot use another writer's words unless you directly quote. Instead, you must restate or **paraphrase**.

There are several useful ways to do this:

use a synonym of a word or phrase	<i>method</i> → <i>technique</i> <i>in the initial phase</i> → <i>early in the process</i>
change negative to positive and vice versa	<i>CO₂ declined</i> → <i>CO₂ didn't increase</i>
use a replacement subject	<i>nutrients may decline</i> → <i>there may be a decline in nutrients</i>
change from active to passive or vice versa	<i>a farmer can grow food more cheaply</i> → <i>food can be grown more cheaply</i>
change the order of information	<i>in the initial phase, organic material breaks down</i> → <i>the remains of plant and animal matter decay into their constituent parts early in the process</i>

When reporting findings from one source, you should use all the methods above.

Example:

Original text	<i>The use of pesticides is declining now that alternative techniques are being used.</i>
Report	<i>As a result of different farming methods, the usage of chemicals to kill pests is falling nowadays.</i>

Important

When paraphrasing, you should aim to make sure that 90% of the words you use are different from the original. It is not enough to change only a few vocabulary items: this will result in plagiarism.

Example:

Original text	<i>If soil erosion continues, does this mean more people will go hungry?</i>
Plagiarism	<i>If soil erosion does not stop, does this mean more people will starve?</i>

Skills bank

Finding the main information

Sentences in academic and technical texts are often very long.

Example:

*Since the publication of C. D. Keeling's research at Mauna Loa, Hawaii on atmospheric CO₂ emissions, many **theorists** looking at global warming have fundamentally **changed** their **ideas** concerning the driving forces behind increasing temperatures.*

You often don't have to understand every word, but you must **identify the subject, the verb and the object**, if there is one.

For example, in the sentence above, we find:

subject = *theorists*

verb = *changed*

object = *ideas*

Remember!

You can remove any leading prepositional phrases at this point to help you find the subject, e.g., *Since the publication ...*

You must then find **the main words which modify** the subject, the verb and the object or complement.

In the sentence above we find:

Which theorists? = some of those looking at global warming

How changed? = fundamentally

What ideas? = ones concerned with driving forces behind increasing temperatures

Ellipsis

Sometimes, if the meaning is clear, words are implied rather than actually given in the text.

Examples:

There were many strategies (which were) considered by farmers.

Pests may be left in the crop residue and (pests may be left) in the soil.