

# Unit 4: Understand the Principles of Soil Science

<b>Unit code:</b>	<b>T/600/9579</b>
<b>QCF Level 3:</b>	<b>BTEC National</b>
<b>Credit value:</b>	<b>5</b>
<b>Guided learning hours:</b>	<b>30</b>

## ● Aim and purpose

This unit aims to introduce learners to the investigative skills and knowledge in soil science and how these can be applied in practice. It is designed for learners in centre-based settings looking to progress into the sector or onto further/higher education.

## ● Unit introduction

Soil characteristics affect the growth and development of plants, which in turn affects soil characteristics. This unit enables learners to develop an understanding of this relationship, which is of fundamental importance to the environmental and land-based sector.

Learners will explore, through experimentation, the physical and chemical characteristics of a range of soil types. They will gain an understanding of the effect of a range of soil characteristics on the growth and development of plants, which provides a basis for soil management techniques. They will investigate the impact that plant selection has on soil characteristics, which enables an understanding of crop rotation principles to be gained.

## ● Learning outcomes

**On completion of this unit learners should:**

- 1 Be able to investigate soil characteristics
- 2 Understand how soil characteristics affect plant growth and development
- 3 Understand how soil characteristics affect plant selection.

# Unit content

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## 1 Be able to investigate soil characteristics

*Soil types:* loams, clays, silts, sands, organic soils

*Soil characteristics:* properties of soil particles eg clay, silt, sand; water holding capacity; aeration; stability; organic matter; pH; soil structure eg crumb structure, aggregate sizes, plough pans

## 2 Understand how soil characteristics affect plant growth and development

*Soil type and condition:* soil type; soil condition (stability, availability of nutrients and water, effects of organic and inorganic fertiliser application, pH, organic matter)

*Soil structure and drainage:* effects of soil structure on plants (rooting depth, availability of plant nutrients, drainage, waterlogging)

## 3 Understand how soil characteristics affect plant selection

*Plant selection:* the effect of a range of plants; principles of crop rotation; different cultivation methods linked to plant selection, eg methods of planting and harvesting

## Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:	To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:
<b>P1</b> compare the characteristics of different soil types [IE]		
<b>P2</b> carry out experiments to determine the characteristics of a soil sample [IE, SM]		
<b>P3</b> explain how soil type and condition affect plant growth and development [IE]		
<b>P4</b> explain how soil structure and drainage can affect plant growth and development [IE]	<b>M1</b> discuss the optimum soil characteristics for growth of a selected plant species	<b>D1</b> explain how soil can be improved to enhance plant growth and development.
<b>P5</b> explain how cultural techniques affect soil characteristics. [IE]	<b>M2</b> discuss how organic and inorganic fertiliser use affects soil condition.	

**PLTS:** This summary references where applicable in the pass criteria, in the square brackets, the elements of the personal, learning and thinking skills. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

# Essential guidance for tutors

## Delivery

Delivery of this unit will involve practical assessments, written assessment, visits to see a range of suitable soil types and will link to industrial experience placements.

As learners will be engaged in practical activity and site visits there should be an emphasis on safe working practices, including the use of appropriate personal protective equipment (PPE), and appropriate risk assessments should be undertaken.

For learning outcome 1, learners will need to investigate a range of soil types and carry out supervised basic soil experiments to identify different soil characteristics. These could include investigating the proportion of sand, silt and clay through suspending in water, investigating the water holding capacity of different soil types, and determining soil pH.

Learning outcome 2 explores the effects of soil characteristics on plant growth and development. This could be supported by some controlled experiments, where learners grow plants in different soil types. Delivery of this outcome could also be enhanced by visits to see different types of plants growing in different soil types. Visiting expert speakers, such as soil scientists or agronomists, could be useful, and could describe practical aspects of managing soil structure and plant nutrition.

Learning outcome 3 covers the effect that choice of plant has on soil characteristics. This should include consideration of the range of consequential effects of plant choice, for example methods of planting and harvesting, use of machinery, plant requirement for supplementary nutrients. Delivery is likely to include both classroom activity and site visits, and could be linked to learners' work placements. A guest speaker, particularly one able to discuss the relative merits of crop rotation, would add further interest to delivery.

## Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value**.

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Intro to unit.
<b>Assignment 1: Soil Experiments</b> (P1, P2)
Introduction to topic and brief.
Lab practical: physical exploration of soil types.
Theory: classifying and categorising soil.
Lab practicals and assessments: soil properties.
Individual research/tutor support/assignment completion.
<b>Assignment 2: Soil Impact on Crop Growth</b> (P3, P4, M1, D1)
Introduction to topic and brief.
Theory: soil conditions for optimal plant growth for eg crops, amenity stock, grass.

Topic and suggested assignments/activities and/assessment
Class activity: impact of soil types, structure and drainage on plant growth.
Guest speaker – soil management to enhance plant growth.
Class activity: impact of soil condition on plant growth.
Visit to see different plants and soil types.
Individual research/tutor support/assignment completion.
<b>Assignment 3: Crop Impact (P5, M2)</b>
Introduction to topic and brief.
Theory: principles of crop rotation, reasons for not needing rotation.
Classroom activity: impact of different machinery use on soil.
Theory: impact of different plant types on soil.
Individual research/tutor support/assignment completion.
Unit review.

### Assessment

To achieve a pass learners must meet all five pass criteria.

For P1, learners need to compare a range of soils, as identified in the unit content. Assessment evidence could be a report on soil types, or a leaflet or annotated poster, but would be of most relevance if linked to the practical soil experiments required for P2.

For P2, learners need to carry out a range of experiments on different soil types. As a minimum this should include two different experiments and three distinctly different soils. These experiments should be supervised, and with due emphasis on health and safety.

For P3 and P4, learners, need to explain how soil characteristics affect plant growth and development. For P3, the characteristics are soil type and condition and, for P4, soil structure and drainage. It would be beneficial to use one piece of assessment evidence for both criteria, which could be a case study, written report or presentation. Evidence should include the effects of soil on at least two distinctly different plant cultivars, for example a root crop and a cereal. These may be selected by the tutor or agreed through discussion with the learner.

For P5, learners need to explain how the choice of plant at a given site can affect the soil characteristics. Evidence could be in the form of a case study, written report, annotated poster or presentation.

To achieve a merit learners must meet the two merit criteria as well as fully meeting the pass criteria.

For M1, learners need to discuss the optimum soil conditions required for the growth of a selected plant species. This should ideally be extended evidence from P3 and P4.

For M2, learners need to discuss the effect of using organic and inorganic fertiliser on soil characteristics. This should ideally be extended evidence from P5.

To achieve a distinction learners must meet the distinction criterion as well as fully meeting the pass and merit criteria.

For D1, learners need to show further application of their knowledge of soil characteristics, by discussing how soil can be improved to enhance plant growth. This should ideally be extended evidence from M1.

## Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2	Soil Experiments	Carry out the experiments identified by your tutor on the selected soil types. Following your experiments, write up your results, including your conclusion on the characteristics of the selected soil samples, and a description of the major characteristics of a range of soil types.	Supervised experiments. Written report.
P3, P4, M1, D1	Soil Impact on Crop Growth	For the plant species selected, discuss how soil characteristics affect growth and development. Include in your report the optimum soil conditions for plant growth. Explain how soil can be enhanced to provide these optimum conditions for growth.	Written report.
P5, M2	Crop Impact	Prepare a verbal presentation on the reasons for crop rotation. Include in your presentation the impact that three different crops have on soil characteristics, and the effect of organic and inorganic fertiliser on soil condition.	Verbal presentation with supplementary notes.

## Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC Land-based sector suite. This unit has particular links with:

Level 2	Level 3
Introduction to Animal and Plant Biology	Undertake an Investigative Project in the Land-based Sector
	Undertake and Review Work Experience in the Land-based Sector

## Essential resources

Learners will need access to a range of soil samples, showing different soil types and properties. They will also need appropriate soil science equipment to complete soil experiments.

Access to library resources and the internet for research and reference must be available.

## Employer engagement and vocational contexts

Learners will need to study plant types that are of most relevance to their vocational area. Employer engagement would be beneficial, both in providing access to sites with different soil types and growing crops, and as invited guest speakers.

## Indicative reading for learners

### Textbooks

Ashman M and Puri G — *Essential Soil Science* (Blackwell Science, 2008) ISBN 978-0632048854

Davies B, Eagle D and Finney B — *Soil (Resource Management Series)* (Farming Press, 2002)  
ISBN 978-0852365595

Green N P O, Stout G W and Taylor D J — *Biological Science 1 and 2, 3rd Edition* (Cambridge University Press, 1997) ISBN 978-0521561785

Roberts M and Ingram N — *Biology* (Nelson Thornes, 2001), ISBN 0748762388

Roberts M, Reiss M and Monger G — *Advanced Biology* (Nelson Thornes, 2000) ISBN 9780174387329

Soffe R — *The Agricultural Notebook, Twentieth Edition* (Blackwell Science, 2003) ISBN 978-0632058297

White R — *Principles and practice of Soil Science* (Blackwell Science Ltd, 2005) ISBN 978-0632064557

### Journals

*Arable Farming*

*Crops*

*Crop Science*

*Farmers Guardian*

*Farmers Weekly*

*Landwards*

### Websites

<a href="http://www.bbsrc.ac.uk">www.bbsrc.ac.uk</a>	Biotechnology and Biological Sciences Research Council
<a href="http://www.defra.gov.uk">www.defra.gov.uk</a>	Department for Environment, Food and Rural Affairs
<a href="http://www.hse.gov.uk">www.hse.gov.uk</a>	Health and Safety Executive
<a href="http://www.lantra.co.uk">www.lantra.co.uk</a>	Lantra Sector Skills Council
<a href="http://www.pda.org.uk">www.pda.org.uk</a>	Potash Development Association
<a href="http://www.rothamsted.ac.uk">www.rothamsted.ac.uk</a>	Rothamsted Research
<a href="http://www.saps.plantsci.cam.ac.uk">www.saps.plantsci.cam.ac.uk</a>	Science and Plants for Schools
<a href="http://www.soils.org.uk">www.soils.org.uk</a>	British Society of Soil Science

## Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are ...
<b>Independent enquirers</b>	comparing soil characteristics carrying out soil experiments explaining the impact of soil characteristics on crop growth explaining the impact of crop selection on soil
<b>Self-managers</b>	carrying out soil experiments.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are ...
<b>Independent enquirers</b>	researching soil characteristics researching the relationships between soil and crop growth
<b>Creative thinkers</b>	suggesting possible experiments to carry out
<b>Reflective learners</b>	evaluating the success of soil experiments
<b>Self-managers</b>	planning and carrying out assessment work.



## ● Functional Skills — Level 2

Skill	When learners are ...
<b>ICT – Find and select information</b>	
Select and use a variety of sources of information independently for a complex task	researching soil characteristics researching the relationships between soil and crop growth
<b>ICT – Develop, present and communicate information</b>	
Enter, develop and format information independently to suit its meaning and purpose including: <ul style="list-style-type: none"> <li>• text and tables</li> <li>• images</li> <li>• numbers</li> <li>• records</li> </ul>	presenting experimental results
Bring together information to suit content and purpose	presenting experimental results
Present information in ways that are fit for purpose and audience	presenting experimental results
<b>English</b>	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	carrying out a verbal presentation about crop rotation and the impact of crop selection on soil characteristics
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	researching soil characteristics researching the relationships between soil and crop growth
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	completing written assignment work.