Unit 1: Plant and Soil Science

Delivery guidance

This unit will give learners an overall understanding of the way plants' and soils' different structures and functions influence land management. The areas of study they will cover include:

- plant structure and function at the cellular and whole organism level
- plant processes and nutrition
- plant reproductive systems
- soil types, textures and structures
- biological and chemical activities affecting soil health and fertility, including the effect of pH levels
- soil management as a plant growth medium.

Approaching the unit

The unit focuses on the aspects of plant and soil science that inform land management practices. This will give learners the fundamental knowledge of the science they will need in their role in a land-based industry, and they will be able to build on this when they go on to further study or progress along their chosen path in the sector.

There are opportunities throughout the unit for practical and laboratory-based activities, industry involvement, individual research, group work and whole-class activities. In particular there are many opportunities to invite sector specialists in to talk or for the centre to pay them visits, where the centre has access to those resources. Access to laboratory facilities and external and internal growing areas will make the delivery of this unit more practicable. You may find it useful to issue learners with laboratory notebooks, as this will allow them to easily keep their notes and diagrams together when working in laboratory surroundings.

Delivering the learning aims

Learning aim A will develop an understanding of plant structures and systems. A practical approach is the best way to deliver this section. You can ask learners to examine plant cells and structures under the microscope. This could be through prepared samples that you give learners and samples they have prepared themselves. Some of the specialised cells in the leaf, e.g. guard cells in stomata, are straightforward to examine in samples the learners have prepared themselves. Other cells, e.g. cambium, may be easier to examine in provided slides, depending on the facilities available to cut sections of suitable thickness.

You can deliver the section on plant structure and function by asking your learners to examine plants that have been grown previously for them to use and that demonstrate the different structures required. These may be grown especially for the course or obtained from local contacts and suppliers. It would be beneficial to use examples that the learners are familiar with and are commercially relevant to your locality.

Plant processes should be examined practically and there are many long-established techniques that could be used, depending on the equipment and plant material that

you have available; for instance, using potometers to investigate transpiration rates in different conditions. Where suggested techniques must be adapted to locally available plant material, it is a good idea to trial the technique before using it with learners. In the website links listed in the 'Resources' section, there are methods for different practical activities that can be adapted to local situations.

To examine plant nutrition, you could set up plants growing in different media with planned deficiencies; this may well have to be done at the start of the unit so the results are available at the correct time for delivery.

You can teach plant reproduction by asking the learners to use several practical approaches. The structure of reproductive parts and parts of the seed are best taught by examination of different flowers and seeds, and it would be best to choose examples that are relevant to your location. You can cover the process of germination and the factors that affect the rate of germination by setting up experiments in the laboratory to examine germination in all its stages.

In learning aim B your learners will look at the importance and use of soil. They will consider the characteristics of soil and the importance of fertility, linking this to plant health and the successful growth of plants. Your learners will benefit from having different soil types to examine and an outdoor site to examine soil profiles. This work could also be used to examine the impact of animals and vegetation on the soil. Your learners could research the effects of soil degradation/fertilisation on yields for different systems; this may be on an international basis, or limited to a locality that is relevant to your learners. The effect of changes in pH on plant growth could be investigated practically. To investigate the effect of applying different materials to soil, your learners could set up experiments in situ, or use laboratory-based tests.

You could deliver learning aim C through external speakers and visits to relevant organisations. Farmers and horticulturalists based in your locality could be invited in to explain how they manage their soil and other substrates they may use to grow plants, and discuss the problems they may have with that. Visits to sites such as farms, formal gardens and market gardens that are relevant to your learners could be used to look at the effect of different management systems for plant growth media. You could ask learners to research different methods of soil management to optimise plant growth for different, named plants.

Assessment model

Learning aim	Key content areas	Recommended assessment approach
A Understand plant structures and systems	**A1** Plant cell structure and specialisations **A2** Plant structure and function **A3** Plant processes **A4** Plant nutrition **A5** Reproduction systems	This unit is assessed through a Pearson Set Assignment.
B Understand the importance and use of soil	**B1** Soil types and texture **B2** Soil structure **B3** Biological and chemical activities affecting soil health and fertility **B4** Soil acidity and alkalinity	
C Understand management of plant growth media	**C1** Soil management	

Assessment guidance

Your learners will be assessed by a Pearson Set Assignment that will be assessed, by you, against the assessment and grading criteria in the unit.

For the assessment, learners spend ten hours researching plant structures and systems. Once this is complete, they have 3 hours to complete the assessment task detailed in the assignment brief.

There is a SAM (sample assessment material) available on the Pearson website that shows how the assessment will be structured. You are advised to study this and use it with your learners to prepare them for the live assessment they will be presented with. Throughout the delivery of the unit you should continually reinforce learners with the need to be able to apply the information they have to different situations, as being able to regurgitate facts will not be enough on its own to pass the assessment.

As well as the factual content of the specification, you should spend time with your learners looking at the assessment criteria and explaining the requirements of the verbs for the different levels of outcome. This will ensure they understand the different demands of, for example, 'identify', 'explain' and 'analyse'. This will help your learners to complete the Pearson Set Assignment that covers the appropriate criteria.

Getting started

This gives you a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 1: Plant and Soil Science

Introduction

Outline the content of the unit and then ask the learners to match their prior knowledge from previous courses they have taken and their wider experience to the specification. Following on from this, hold a discussion about the criteria and associated verbs – for example, what is required by 'analyse' or 'plan'. This will allow the learners an understanding of what is expected.

Then go on to use the sample assessment material as a teaching and learning resource throughout the unit.

Learning aim A – Understand plant structures and systems

- You can teach this learning aim through a mixture of teacher-led input, research, practical observation and experimentation. Task 1 in the SAM is based on the content of this section and could be used to explain to learners how they will be assessed and the expectations of the assessment. In particular, it could be used to explain how the command terms in the criteria work, and what they mean in terms of what is expected of learners. The underlying scientific principles and knowledge could be taught both formally and through requiring your learners to research for themselves. This also gives opportunities for group work and the sharing of information between learners.
- There are a lot of opportunities for hands-on learning through practical lessons, both observing botanical samples, which covers A1, and carrying out investigations in A2 and A3. The observation could be at both microscopic and whole plant levels. To allow your learners to get the full benefit of this approach requires considerable forward planning to ensure that suitable plant samples are available at the different times they are needed on the course. Fast growing *Brassica rapa* cultivars are available if the centre has the facilities to grow them; these are potentially useful for various investigations in the unit. Both centre staff and learners may also have access to commercial crops. Learners could be encouraged to bring their own samples in to share with the group. This would be particularly useful when looking at A3 and A4.
- For some of the investigations into, for example, vascular bundles, it would be useful if your learners could have access to prepared slides as making their own, while a skill in itself, may detract from the information they need to take from the exercise. This is particularly relevant to A2 and A5.

Learning aim B – Understand the importance and use of soil

- This is also a very practical-based part of the course. Your learners would benefit from having a 'hands-on' experience with soil types and you need to ensure that the different soil types are available.
- B1 is concerned particularly with soil types and texture, and lends itself to a very practical approach to learning. Depending on your location, this may mean producing your own soil samples with commercially available sand, etc., to mirror soil from natural sources.
- Access to an area where learners can dig pits to examine soil profiles would enable a very practical coverage of B2. If time or resources prohibit this, at a very minimum a selection of photographs would be useful, but observation of profiles in situ would be a far more useful experience. This would make B2 much more realistic and relevant for learners.
- B3 is about the biological and chemical activities that affect soil health and fertility. The role of organisms and how they interact with the vegetation could be investigated by practical examination of different soil samples. This could be in situ and under microscopes in the laboratory. Approach the carbon and nitrogen cycles through group work and presentation in the classroom, and encourage learners to make links between the practical activities they have undertaken and the two cycles.
- To investigate soil acidity and alkalinity, and the effect on plants and soil, set up growing media with different pH levels, and using quick growing crops record observations on health and yield over time; this would cover the content in B4 and the investigations could be extended to look at the effect of lime, etc. If the relevant materials are used in the local land-based industries, talking to practitioners and observations on local farms would reinforce the importance of this area of the subject.

Learning aim C – Understand management of plant growth media

- This learning aim is where learners start to apply the information they have learnt so far in the unit to real situations. There is an opportunity to ask sector experts to come in and talk about practice on the field, and the issues they have to deal with on a day-to-day basis. Discussion in class about the different pressures in the industry between maximum cropping and environmental pressures would help learners apply the knowledge they have learnt throughout the unit.
- The effect of fertiliser runoff and leaching is a huge one that affects many areas of the sector. You could use the SAM, especially Task 2, to show how this section of the content is applied to situations and how they will be required to make links in the assessed work they will have to do.
- C1 is about soil management and in particular the effects of management on the previous aspects of soil science they have investigated. Depending on the time available, either growing fast-growing crop plants in different conditions (this could be done in groups so a wider range of conditions is covered) or observation of crops in different situations that have been set up previously could help learners appreciate the effect of management strategies on soil quality and therefore the associated plant growth.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

This unit is mandatory for all the pathways – agriculture, horticulture and land-based studies – and gives underpinning scientific knowledge for the majority of the units that are available in the suite.

The agriculture pathway can lead to careers in crop and livestock production, both of which need an understanding of plant and soil science. The links to all careers in horticulture are many and vital to understanding the job roles. Many roles in other land-based careers also benefit from an understanding of the plant and soil science that underpins so much of the sector.

There are links to many of the units, especially to the plant and crop production units, and the agricultural practice and production units.

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC International qualifications in Agriculture/Horticulture/Land-based Studies. Check the Pearson website (http://qualifications.pearson.com/endorsed-resources) for more information as titles achieve endorsement.

Websites

The Royal Society of Chemistry: go to The Royal Society of Chemistry website's Teaching & Learning page, then click on the button to redirect you to their Education website. Once you are redirected, search for 'plant science practicals' in their search bar. The first link offers several teacher and student sheets for a series of experiments that help students to learn and understand the physical and chemical processes that occur in plants, and how these relate to a plant's structure and functions. Learners could also search for 'Challenging Plants: Soil Science – Practicals' in their search bar. This resource explores the nature of soil particles (inorganic and organic) and of the ways in which soil water can affect plant growth and, in particular, the availability of nutrients essential for the growth of quality crops in high yield. An understanding of the media in which plants grow helps scientists to exploit their potential.

Stem Learning: go to the Stem Learning website, search for 'Science and Plants for schools', then use the filters in the column on the right to select the 'resource collection' option and '16–19' age category. The first link, titled 'Science & Plants for Schools (SAPS): secondary and post-16 resources', gives innovative and reliable practical activities to engage students with biology, focusing on plant science. Where appropriate, the resources include detailed background information for teachers and technicians, and questions to stimulate discussion with and between students.

The British Society of Soil Science: this website gives links to resources and information for teachers and students.

Pearson is not responsible for the content of any external internet sites. It is essential for tutors to preview each website before using it in class so as to ensure that the URL is still accurate, relevant and appropriate. We suggest that tutors bookmark useful websites and consider enabling students to access them through the school/college intranet.