Model Assignment

Assessment Material

OCR Level 1/2 Cambridge National Certificate in Science in the Workplace

Unit R074: How scientists use analytical techniques to collect data – Ecology

Please note:

This OCR model assignment may be used to provide evidence for the unit identified above. Alternatively, centres may 'tailor' or modify the assignment within permitted parameters (see Information for Teachers). It is the centre's responsibility to ensure that any modifications made to this assignment allow learners to show that they can meet all of the learning outcomes and provide sufficient opportunity for learners to demonstrate achievement across the full range of marks.

INSTRUCTIONS TO TEACHERS

The OCR administrative codes associated with this unit are:

- Unit entry code R074
- Certification code J816

The accreditation numbers associated with this unit are:

- Unit reference number M/504/3039
- Qualification reference 600/7042/0

Duration: Approximately 6 hours laboratory time, plus 4 hours writing up time

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Assignment for the learner

The Laboratory Notebook

Ecologists are scientists who study organisms and their habitats. As part of their studies, they have to take samples and measurements from the habitats they are studying.

They must carry out careful analyses of samples collected.

These analyses must be based on recognised standard procedures.

The equipment the scientists use must be able to measure to an appropriate degree of accuracy.

Findings from their analyses may be published in the scientific community, so they must be certain that:

- all results, observations and measurements of their analyses are recorded carefully and in detail
- their calculations, conclusions and judgements are based on careful and correct analysis of the evidence
- they recognise and allow for any limitations in the techniques or equipment used and how these affect conclusions

You are going to prepare an ecologist's laboratory notebook recording your analyses of samples collected from a habitat you have studied.

Read through all of the tasks carefully, so that you know what you will need to do to complete this assignment.

Your task

Part 1 – Preparing for the analysis

You are going to prepare an ecologist's laboratory notebook recording your analyses of samples collected from a habitat.

The samples collected from the habitat, or additional samples provided include:

- some of the plants present, including some that are in flower
- a sample of honey or nectar from a plant
- soil from the habitat
- a sample of rain water collected
- sample(s) of water from a pond or stream at the habitat

For each sample, you must decide on the technique to use to analyse it.

Prepare a full Risk Assessment before you begin any practical work.

You should record the decisions and Risk Assessment in your laboratory notebook.

Part 2 – Carrying out the analyses

For each of the samples, carry out the analysis.

Record the procedure you used along with your measurements and observations in your notebook in as much detail as you think is required.

Some of the analyses require the data to be processed.

In your processing of data from an analysis, you could:

- carry out any calculations required
- draw any graphs that help you to interpret the results.

Record these in your laboratory notebook.

Part 3 – Conclusion and evaluation

In your Conclusion and Evaluation, you should:

- draw conclusions from the analysis of each piece of evidence
- present your findings in your laboratory notebook
- evaluate your results and the techniques you used.

Record your conclusion and evaluation in your laboratory notebook.

Part 4 – Improved analysis

Ecologists often use alternative techniques to improve the accuracy and sensitivity of their analyses.

In your notebook, for each technique you have used, explain how alternative techniques used by ecologists give improved results.

Information for Teachers

OCR Level 1/2 Cambridge National Certificate in Science in the Workplace

Unit R074: How scientists use analytical techniques to collect data – Ecology

Teacher guidance on using this assignment

1 General guidance

1.1 OCR assignments are available to download free of charge from our website: www.ocr.org.uk

1.2 OCR assignments are intended to be used for summative assessment of learners. The OCR specification for this qualification gives more information on the arrangements for assessing internally assessed units.

1.3 This assignment has been designed to meet the full assessment requirements of the unit. Learners will need to take part in a planned learning programme that covers the underpinning knowledge, understanding and skills of the unit.

1.4 This assignment requires learners to:

- use good laboratory practice to carry out a series of analyses;
- use the techniques of chromatography, visual and microscopical analysis, qualitative chemical analysis, titration and colorimetry;
- collect, process, analyse and interpret data from the analyses;
- draw evidence-based conclusions;
- evaluate the quality of results and findings and suggest and justify improvements to the analytical techniques;
- explain how alternative techniques used by ecologists give improved results.

1.5 This assignment consists of one task – the production of a laboratory notebook - divided into five types of analysis centred on an ecological investigation. The assignment is investigated through Parts1, 2, 3, and 4. The parts should be taken in this order.

2 Before carrying out the assignment

2.1 Learners should be provided with a copy of the *Information for Learners* section of this assignment.

2.2 Learners will not need to carry out any preparations prior to undertaking the assessment tasks, such as collating resources to use in the assessment.

2.3 We have estimated that it will take approximately 10 hours to complete this assignment. This is the recommended time but centres can decide how the time can be allocated between each part or individual task in the assessment. Centres are also permitted to spread the overall assessment time across several sessions and therefore it is permissible for evidence to be produced over several sessions.

2.4 It is expected that before learners attempt this assignment task they will have received general preparation in their lessons. The details of good laboratory practice, practical techniques, the development of skills associated with these techniques, and the methods and choice of equipment for the task should be covered when teaching the particular part(s) of the specification which the assignment relates to, and should be completed prior to undertaking the task.

2.5 Learners should be made aware of the: health and safety issues associated with this task; need to provide a quantitative evaluation of the data collected; sources of experimental errors.

2.6 Learners should also be made aware of the marking criteria for this task.

3 When completing the assignment and producing evidence

3.1 Centre staff may give support and guidance to learners. This support and guidance should focus on checking that learners understand what is expected of them and giving general feedback that enables the learner to take the initiative in making improvements. However, where more specific support is provided so that learners are able to make progress with the task or to ensure safety, this must be reflected in the marks awarded. It is not acceptable for teachers/deliverers to provide answers or to work through answers in detail.

3.2 Part 1 requires learners to use the principles of good laboratory practice to select appropriate equipment, prepare any standard solutions required, write a risk assessment and select appropriate sampling procedures.

Part 1 is expected to take 1.5 hours.

3.3 Part 2 requires learners to carry out their analyses, and make and process measurements and observations.

Learners may work in groups of no more than 3 on their practical work (2 is recommended). They must record their results individually. The analyses should be planned and conducted in supervised lessons.

Teachers are responsible for ensuring appropriate health and safety procedures and all appropriate steps taken to reduce risks are carried out, including a risk assessment for the task, prior to learners attempting the practical work. It is the centre's responsibility to ensure the safety of all learners involved in any investigation.

The work of individual learners may be informed by working with others but each must provide an individual response. Learners should be made aware of the time allowed for carrying out this part of the task. Learners' access to resources is determined by those available to the centre.

Learners' work should be available for Part 3.

3.4 In processing data, learners will have opportunities to use mathematical and graphical skills: calculation of Rf values; magnification and scale; means of titres and concentration of an acid; calculations of concentration when preparing standard solutions; the production and use of calibration curves; calculating error.

Learners must not be instructed whilst carrying out these analyses.

Part 2 is expected to take 5 hours.

3.5 In Part 3, learners will draw conclusions and present findings. They will discuss the validity of their results and findings, and relate this to limitations of the analytical procedures used. At higher levels, they will be expected to suggest possible improvements to apparatus and techniques.

Learners will need access to their individual responses from Parts 1 and 2.

Learners must complete all work independently. Learners should be made aware of the time allowed for carrying out this part of the task.

Learners must not be instructed whilst carrying out the conclusion and evaluation.

Part 3 is expected to take 2 hours.

3.6 In Part 4, learners will carry out research to explain how alternative techniques used by ecologists give improved results, drawing on the perceived limitations of the techniques they have used.

Learners will need access to their individual responses from Parts 1 - 3.

Learners must complete all work independently. Learners should be made aware of the time allowed for carrying out this part of the task.

Learners must not be instructed whilst carrying out this part of the task.

Part 4 is expected to take 1.5 hours.

3.7 We have specified what evidence the learner is expected to produce, but it is important to note that if it is possible to generate the evidence in a variety of formats, then the learner is free to use the format that is most appropriate for them. Centres must advise learners as to the most appropriate format of evidence. Format must not be confused with the content or the type of datafile to be produced. Guidance on suitable formats of the evidence is provided in the section *Evidence Summary*.

4 Presentation of work for marking and moderation

4.1 Centres wishing to produce digital evidence in the form of an e-portfolio should refer to the appendix in the specification on guidance for the production of electronic assessment

4.2 Centres may wish to discourage learners from excessive use of plastic wallets for presentation of their evidence as this may hinder the assessment process. Instead centres may wish to encourage learners to present their work so that it is easily accessible, e.g. spiral bound, stapled booklet, treasury tag.

5 Scope of permitted model assignment modification

The model assignment is very self-contained in its present form. The set of tasks form a coherent whole addressing all the learning outcomes and allowing access to the full range of marks.

You **must not** change the following:

- the learning outcomes
- the marking criteria
- the requirements for supervision and authentication as described in the specification (section 'The internally assessed units').

Permitted changes:

The model assignment can be modified in terms of the areas described below at the permission of OCR but centres must be sure that learners still have the opportunity to cover all of the learning outcomes and to access the full range of marks:

- The learner's assignment, which can be contextualised or amended to suit local needs.
- To allow for differences in the materials, equipment and facilities at different centres. For example, Bunsen burners may not be available, but alternative methods of sterilising equipment may be used.

OCR has ensured that in the language used and the tasks and scenario provided we have avoided discrimination, bias and stereotyping and support equality and diversity. In the development of qualifications and assessments we use the guidance given in the Ofqual publication *Fair access by design*, notably this includes:

- using language and layout in assessment materials that does not present barriers to learners
- using stimulus and source materials in assessment materials (where appropriate) that do not present barriers to learners.

If centres wish to adapt the model assignment we strongly advise that staff responsible for modifying the model assignment and quality assuring it refer to the publication *Fair access by design.*

If modifications are made to the model assignment, whether to just the scenario or to both the scenario and individual tasks, it is up to the centre to ensure that all learning outcomes can be met and that learners can access the full range of marks.

Evidence summary

When completing this assignment it may be possible to generate evidence for completing a task in a variety of formats. This list is not exhaustive.

Part number	What do learners need to produce (evidence)
Parts 1 - 4	Evidence will be in the form of a laboratory notebook (a notebook or loose-leaf pages), with associated risk assessments, procedures used, diagrams, photographs, tables of results, graphs, artefacts (e.g. chromatograms), pictures or flowcharts, conclusions and evaluations, and a review of professional analytical techniques.

Apparatus and materials

- Plants collected from the habitat, for the recording of features visually and microscopically, and for photosynthetic pigment extraction (Note 1)
- Amino acid mixture or nectar collected from plant or honey (Note 2)
- Chromatography tanks with lids (with suitable means of support if using paper)
- Chromatography paper or thin-layer plates
- Suitable solvent systems
- Amino acid standards
- Mortars and pestles
- Silver sand
- Solvent to extract photosynthetic pigments, e.g. propanone (acetone)
- Ninhydrin solution in spray, 200 mg in 100 cm^3
- Access to fume cupboard
- Micropipettes or capillary tubes (for application of samples to chromatogram or collection of nectar sample)
- Light microscopes (to x400 if possible)
- Microscope slides and cover slips
- Nail varnish (for microscopical observation of stomata)
- Forceps, pointed
- Eyepiece graticules (optional) (Note 3)
- Sources of the following ions: aluminium, Al^{3+}; barium, Ba^{2+}; calcium, Ca^{2+}; copper, Cu^{2+}; iron(II), Fe^{2+}; iron(III), Fe^{3+}; lead, Pb^{2+}; lithium, Li^{+}; potassium, K^{+}; sodium, Na^{+}; zinc, Zn^{2+}. (Note 4)
- Soil sample(s), each sample containing a single ion from above
- Hydrochloric acid
- Potassium or sodium salts: carbonate, CO_3^{2-} , chloride, Cl^{-}, sulphate, SO_4^{2-}
- Water samples, collected from habitat, or one prepared to contain one of above ions and one that contains iron(III)
- Access to deionised water
- Access to digital balances
- Burettes, 50 cm^3
- One-mark pipettes, 25 cm^3
- Sodium hydroxide
- Water sample, e.g. ‘acid rain’ for titration, e.g. 0.001 mol dm^{-3}
- Indicators: bromothymol blue, methyl orange, phenolphthalein.
- Graduated pipettes, e.g. 1 cm^3 with fillers

- Volumetric flasks
- Water sample(s), 'contaminated' with iron(III)
- Colorimeters and cuvettes
- Ammonium or potassium thiocyanate solution
- Iron(III) standard solutions
- 10 cm^3 syringes
- Test tubes and racks
- Measuring cylinders, including 50 cm^3
- Rules
- Pencils
- Digital cameras and/or scanners
- Beakers
- Forceps
- Filter paper
- Scissors
- Bunsen burner
- Heat proof mat

Learners plan their own analyses and may therefore require access to other apparatus at the discretion of the centre.

Notes:

Note 1: Students should record features of the plants collected/provided.

Use the leaves for separation of (lipid-soluble) photosynthetic pigments. Alternatively, seaweeds give good separations.

Microscopical observations should be based on adaptations to the environment; candidates could, for instance, record observations of stomata.

Note 2: Teachers should discuss the importance of these analyses, e.g. differences in nectar composition from one plant to another are important in insect-plant relationships, but it may be best to carry out the chromatography on amino acid mixtures, simply to illustrate the principles behind the separation of colourless mixtures.

Alternatively, though they may not be directly related to the habitat studied, TLC or paper chromatography of amino acids in honey, derived from nectar, illustrates the principles well. If attempted, the chromatography of nectar should be carried out as a demonstration. Clearly, in the latter, small volumes are involved, but ninhydrin is capable of visualisation of very small amounts of amino acids. Choose a plant with large, clearly-visible nectaries, e.g. hairy willowherb, *Epilobium hirsutum*. Collect nectar using a micropipette or on filter paper.

Note 3: Simple estimations of size and scale can be made from measurements of the field of view of a microscope at a certain magnification using a rule placed on the stage. The dimensions of the sample can be estimated from the proportion of the field of view occupied. Learners working at higher levels should be given the opportunity to calibrate eyepiece graticules.

Note 4: Chlorides of metal cations are usually best, because of their solubility and volatility.