BTEC

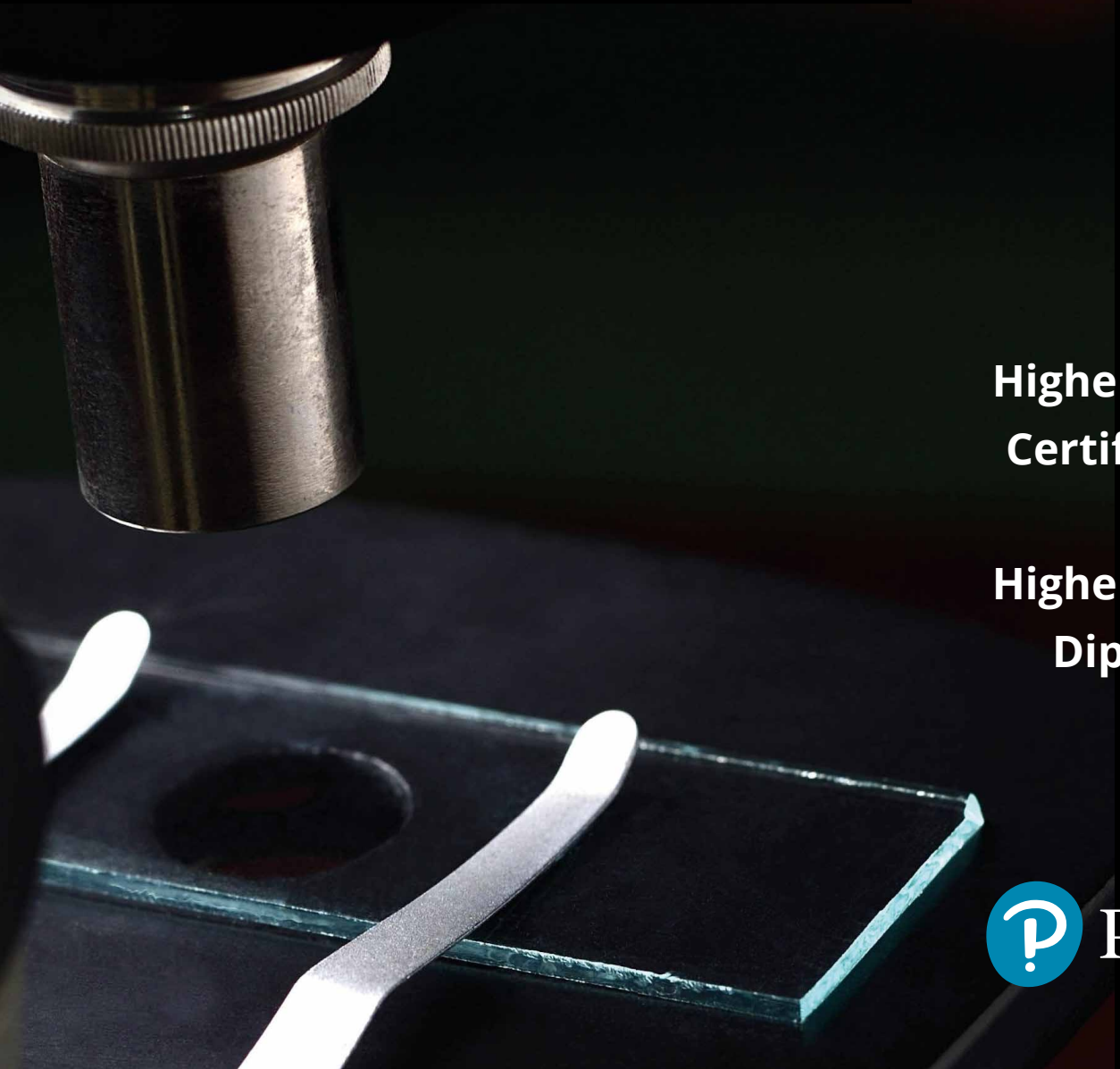
HIGHER NATIONALS

Applied Sciences

Scheme of Work

For use with the Higher National Certificate and Higher National Diploma in Applied Sciences

First teaching from September 2019



Higher National Certificate Lvl 4

Higher National Diploma Lvl 5

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1 Introduction

These Example Schemes of Work (SOW) are intended to provide you with an insight into how you might structure the delivery of the Essential Content for the units within this Higher National Qualification. They are not an indication of what you must deliver or an example of the ideal manner in which to deliver the Essential Content. Rather, we hope that these SOW will give you ideas as to the types of teaching and learning activities that might be employed to meet the requirements of providing the requisite Guided Learning Hours (GLH) for the unit. *You should ensure that the SOW you produce for your course are appropriate to your students, programme delivery plan, resources and local needs*.

2 How to Read the SOW

In order to support consistency across our qualifications, in developing these SOW, we have taken a simple approach to the structure of the SOW. This is:

- A 15-credit unit requires 60 GLH
- To deliver 60 GLH we define 20 3-hour teaching sessions
- 20 sessions x 3-hours = 60 GLH

Similarly, for a 30-credit unit:

- A 30-credit unit requires 120 GLH
- To deliver 120 GLH we define 40 3-hour teaching sessions
- 40 sessions x 3-hours = 120 GLH

This is not intended to dictate the way that you may deliver the GLH. Depending on your mode of delivery (full-time, part-time, etc.), timetable, resources and approach to the subject, you will develop your own pattern of delivery.

Keep in mind that while we are using a standard length of time for each taught session, this is not required. You may find that it is necessary, or desirable, to vary the length of taught sessions; in order to provide students with a varied timetable, to manage (physical or human) resources, or to allow greater taught provision for other units running in parallel.

3 Learning Outcomes and Assessment

The SOW includes an indication of how the taught sessions support a particular approach to assessment, by indicating the number of assignments and their relation to learning outcomes. Keep in mind that this is not a suggestion of how you must assess, but an indication of how the SOW has been designed to support the number of assessments.

In the example below, we can see that this SOW is designed to support a Single Unit Assessment; where all learning outcomes will be covered in a single assessment.

Learning Outcome (LO)	Assessment 1
LO1 Explore the role of production designer and art director within the film and television industry.	☒
LO2 Prepare design sketches for locations, sets and props, based on a given film/television treatment.	☒
LO3 Specify locations, props and visual effects required for the production of a short film or television production; monitoring budget throughout the process.	☒
LO4 Present a production design strategy, highlighting the way that it achieves a unified visual identity in support of a film/television treatment.	☒

To find out more about different types of assessment, that can be used in Higher Nationals, see the BTEC Higher Nationals - (RQF) Assessment & Feedback Guidance for Centres & Tutors.

4 SOW Sessions

Each 3-hour session, in the SOW, is in the format:

[1]	[2]	[3]
Session	**Learning Outcome(s)**	**Session Activities**
Session 4	LO2	**[4] Topic: Evaluating a film treatment** **[5] Sub-topic(s):** Relationship between genre, narrative structure and time period of own or given treatments **[6] Sample activities:** • Tutor-led activity: Seminar on evaluating the potential of a treatment looking at audience needs, psychological, atmospheric and emotional images • Group activity: Discussion of supporting the ideas development through research and the forms of research an art director can do • Individual activity: Personal research into ideas for art direction

Note the numbers in brackets are for reference, here, and do not appear in the actual SOW.

[1] Session – this is the session number. Sessions are numbered in order to ensure that we are clear that we are meeting the GLH requirements.
[2] Learning Outcome(s) - this indicates to which learning outcomes the content of this session relates.
[3] Session Activities – These are the topics, sub-topics to be covered during this session, and the activities that may support student learning during the session.
[4] Topic – This is the main topic(s) of the session. Typically, this will correspond to one (or more) of the main topics from the Essential Content of the Unit.
[5] Sub-topics – Not every session will have sub-topics, but where they are presented, they provide information about the additional detail that will be covered in the session. Again, typically, these will be drawn from the Essential Content of the Unit.
[6] Sample Activities – These provide an indication of the activities of the tutor and the students, for the given session. Depending on the nature of the session, you may find greater or lesser amounts of student or tutor activity. For example, if the main aim of the session is to introduce a body of knowledge to the students, the tutor activity may be a 'lecture'; which may mean there is less student activity. Whereas, if the session is designed to allow students to explore the application of knowledge or skill, there may be much more student activity listed, with the role of tutor being that of support.

5 Frequently Asked Questions

Q. Am I required to have 20 3-hour sessions in my teaching plan for a 60 GLH unit?

A. No. The model used in the SOW has been designed to be a simple standard that is applied to all the SOW across our Higher Nationals qualifications. You will design your SOW or teaching plan based on the specific needs of your students, timetable and resources. However, you must ensure that you are providing the requisite number of Guided Learning Hours (GLH).

Q. Should every session cover a single topic (and sub-topics) from the Essential Content?

A. No. The Essential Content, for a unit, is the list of material that Pearson has determined a student must be taught to support their achievement of the related learning outcome. However, we recognise that there will be variations in what are deemed to be the most important parts of the Essential Content. This may be based on your location, employment opportunities and progression opportunities for your students. Therefore, tutors are able to determine; keeping in mind the requirements of the Assessment Criteria, how much time should be given to the delivery of the different topics and sub-topics in the Essential Content. This will consequently determine the way that individual sessions, in a SOW, cover single or multiple topics.

Q. Can I include assessment and feedback within my SOW?

A. Yes. Supervised assessment and feedback are part of the students' learning and can; therefore, be included as part of the GLH.

Q. Are there any elements of good practice that I should include in my SOW?

A. It is advisable that you consider building the following into your SOW:

- Use your first session to introduce the subject of the unit and, most importantly, to allow time to discuss learning outcomes and assessment criteria with students. Try to make this a student-led discussion, so that you can gain an understanding how the students are interpreting the learning outcomes and assessment criteria. This understanding will help you to consider ways that you may need to adjust your learning and teaching strategy to ensure that both you and the students have a shared understanding of what learning outcomes and assessment criteria mean.
- Include some time for discussing feedback, after the assessment. This may be a group discussion; where you highlight some of the common challenges that students may have found in their assignments and some of the positive things that were common in their submissions. Or, you may timetable individual discussions with students so that you can address their specific assessment results. In either case, it will

give students some additional support for their continued development in the future.

- Remember that Guided Learning Hours are not restricted to those which are classroom based or delivered by the tutor. Guided Learning Hours include any time that a student is directly supported by a suitable member of staff. This may include time in a workshop (supported by a workshop technician), time in the library (supported by a librarian who is helping the student with research), a field/study visit (when a student may be interacting with professionals under the guidance of a member of staff), work placement supervision where the student's activities are being guided by a professional in line with the relevant learning outcomes etc. It is important to include a range of activities, that are appropriate to the specific Essential Content, and this may not always be a 'tutor-led' activity.

3 Schemes of Work

Unit 1: Fundamentals of Laboratory Techniques

Please note that Schemes of Work are for guidance and support only.
They can be customised and amended according to localised needs and requirements. All Schemes of Work can be adapted to suit specific establishment time frames in line with GLH delivery.

Scheme of Work

Programme Title:	Higher Nationals in Applied Sciences	**Level:**	4

Unit Title:	Fundamentals of Laboratory Techniques	**Tutor:**	

Unit Number:	1	**Academic Year:**	

Learning Outcomes (LO)	**Assessment 1**	**Assessment 2**	**Assessment 3**	**Assessment 4**
LO1 Carry out qualitative and quantitative analysis	☒	☐	☐	☐
LO2 Carry out synthetic chemistry techniques	☒	☐	☐	☐
LO3 Demonstrate use of microscopy and aseptic technique	☒	☐	☐	☐
LO4 Demonstrate good practice with respect to reporting, health and safety, and laboratory organisation	☒	☐	☐	☐

Sessions	Learning Outcome(s)	Session Activities
Session 1	LO1 & LO4	**Topic(s):** • Calibration of glassware • Preparation of a potassium iodate primary standard **Sample activities:** • Tutor activity: tutor introduces calibration • Independent activity: Students calibrate a pipette and burette using pure water as a standard material • Independent activity: Students follow a standard method to prepare a potassium iodate primary standard solution for use the following session
Session 2	LO1 & LO4	**Topic(s):** • Risk Assessment • Standardisation of sodium thiosulfate solution (using potassium iodate solution) and determination of the concentration of an iodine solution **Sample activities:** • Tutor activity: Tutor explains standard risk assessment methodology and students follow the guidance to carry out a risk assessment for using potassium iodate to standardise a sodium thiosulfate solution which is then used in another titration to measure the concentration of an iodine solution • Independent activity: Students carry out the standardisation of sodium thiosulfate solution and determine the concentration of iodine solution • Group activity: Students compare their results from the titration and discuss sources of error •

Sessions	Learning Outcome(s)	Session Activities
Session 3	LO4	**Topic(s):** • Report writing • Good practice in the laboratory • Checking calibration of balances and thermometers **Sample activities:** • Tutor activity: Tutor explains the features of writing a good report and evaluating the results of an experiment and having a critical approach to practical work • Independent activity: Students begin to write a report from the determination of the concentration of an iodine solution that will be submitted for formative feedback • Group Activity: Students discuss good practice in the laboratory and establish standards that they will follow • Tutor Activity: Tutor explains checking balance calibration and calibration of thermometers with input from students
Session 4	LO1 & LO4	**Topic(s):** • Titration of copper (II) sulfate solution with EDTA including risk assessment **Sample activities:** • Tutor activity: Tutor asks targeted questions to ensure that students understand risk assessment methodology and explains the principles underlying the EDTA titration • Independent activity: Students write a risk assessment for the titration of copper (II) sulfate solution with EDTA • Independent activity: Students carry out the titration and calculate the concentration of the copper (II) sulfate solution

Sessions	Learning Outcome(s)	Session Activities
Session 5	LO1	**Topic(s):** • pH titration **Sample activities:** • Independent activity: Students calibrate a pH probe as directed • Paired activity: Students, working in pairs, set up the pH probe and use it to titrate sodium carbonate solution with hydrochloric acid solution. Students use laptop computers to produce plots of pH versus volume and also differential plots using Excel • Group activity: Students discuss the results of the experiment •
Session 6	LO1 & LO4	**Topic(s):** • Determination of copper (II) using visible spectroscopy **Sample activities:** • Tutor activity: Tutor explains a typical Beer Lambert application involving ultraviolet-visible spectroscopy and explains the operation of the spectrometer • Independent activity: Students follow the given method to prepare standards using copper (II) sulfate. Students measure the absorbance using visible spectroscopy (having first determined the wavelength to choose for a fixed wavelength application) of the standards and of an unknown concentration of copper (II) sulfate. • Independent activity: Students produce a calibration graph for the copper (II) sulfate and calculate the concentration of the unknown solution. •

Sessions	Learning Outcome(s)	Session Activities
Session 7	LO1 & LO4	**Topic(s):** • Determination of nitrate in bottled water using ultraviolet spectroscopy **Sample activities:** • Independent activity: Students follow the given method to prepare nitrate standards and prepare a calibration line from the absorbance readings on the ultraviolet spectrometer. Students measure the absorbance of a range of bottled waters. • Independent activity: Students produce their calibration graphs and calculate the nitrate concentration of a range of bottled waters • Group activity: Students compare their results with each other's and with the values on the bottlers' labels
Session 8	LO1	**Topic(s):** • Paper chromatography of amino acids **Sample activities:** • Tutor activity: Tutor demonstrates how to carry out the paper chromatography of amino acids • Independent activity: Students prepare their own chromatograms (individually) and leave them to run • Tutor activity: Tutor explains how chromatography works and suggests topics for further investigation • Independent activity: Students remove chromatograms from the solvent tank, dry them and develop them, sketch results, calculate R_f values and discuss errors in chromatographic technique •

Sessions	Learning Outcome(s)	Session Activities
Session 9	LO1 & LO4	**Topic(s):** • Thin Layer Chromatography (TLC) of analgesics **Sample activities:** • Tutor activity: Tutor explains how to carry out TLC successfully • Independent activity: Students set up TLC plates with spots for aspirin, paracetamol, caffeine and a mixture • Independent activity: Students research how TLC works • Independent activity: Students develop their TLC plates, record their results, calculate R_f values and compare results. (It is important that they recognise whether they have got the results expected and evaluate the factors that make some peoples plates better than others • Independent activity: If students have got poor results, they should be encouraged to repeat the experiment to gain confidence •
Session 10	LO2 & LO4	**Topic(s):** • Preparation of cyclohexene from cyclohexanol **Sample activities:** • Group activity: Students discuss the risk assessment for making cyclohexene • Tutor activity: Tutor explains features of the equipment to be used • Independent activity: Students individually make cyclohexene •

Sessions	Learning Outcome(s)	Session Activities
Session 11	LO2 & LO4	**Topic(s):** • Preparation of cyclohexene • Preparation of antifebrin **Sample activities:** • Independent activity: Students run the infrared spectrum of cyclohexene and compare it with one from literature • Independent activity: Students ensure that they have the information that they need to write the report • Independent activity: Students carry out research on antifebrin •
Session 12	LO2 & LO4	**Topic(s):** • Preparation of antifebrin **Sample activities:** • Group activity: Students discuss the key features of the risk assessment for synthesis of antifebrin • Tutor activity: Tutor explains how to carry out techniques effectively • Independent activity: Students prepare antifebrin (individually) and measure its melting point and infrared spectrum •
Session 13	LO3	**Topic(s):** • Microscopy **Sample activities:** • Tutor activity: Tutor demonstrates the features of a microscope and how to set up a microscope • Independent activity: Students use a microscope with support from the tutor • Tutor activity: Tutor explains how to calculate magnification and students calculate magnification •

Sessions	Learning Outcome(s)	Session Activities
Session 14	LO3	**Topic(s):** • Microscopy **Sample activities:** • Tutor activity: Tutor demonstrates using a graticule and a calibrated slide • Independent activity: Students use a graticule, calibrated slide and microscope to work out the size of objects/features of prepared slides. • Group activity: Students discuss difficulties that they have experienced when using the microscopes •
Session 15	LO3 & LO4	**Topic(s):** • Making and drawing tissue slides **Sample activities:** • Tutor activity: Tutor demonstrates how to make slides (e.g. onion skin, cheek cells) • Independent activity: Students make slides • Tutor activity: Tutor describes what to look for on slides and ensures that students are able to see what they should • Independent activity: Students draw what they see on their slides under different magnifications • Independent activity: Students look at prepared, stained tissue slides •
Session 16	LO3 & LO4	**Topic(s):** • Drawing tissue slides **Sample activities:** • Tutor activity: Tutor explains how to draw tissue slides • Independent activity: Students produce labelled, scale diagrams of tissue slides • Tutor activity: Tutor supports students as appropriate

Sessions	Learning Outcome(s)	Session Activities
Session 17	LO3	**Topic(s):** • Aseptic technique **Sample activities:** • Tutor activity: Tutor introduces microorganisms and microbial grown, and demonstrates various aspects of aseptic technique • Independent activity: Students research aseptic technique, disinfection, sterilisation, autoclaving etc. • Independent activity: Students carry out operations using aseptic technique under supervision •
Session 18	LO3&LO4	**Topic(s):** • Aseptic technique **Sample activities:** • Independent activity: Students carry out operations using aseptic technique • Tutor activity: Tutor explains how to prepare a control plate, a lawn plats, a streak plate and how to dispose of waste safely • Independent activity: Students prepare control plates, a lawn plate and a streak plate. • Independent activity: Students dispose of waste safely •
Session 19	LO3 & LO4	**Topic(s):** • Streak plate **Sample activities:** • Paired activity: Students examine plates from the previous session and dispose of the waste safely • Group activity: Students discus what was seen on the incubated plates • Independent activity: Students carry out a risk assessment for the streak plate experiment. • Independent activity: Students carry out the practical work for the streak plate experiment •

Sessions	Learning Outcome(s)	Session Activities
Session 20	LO3 & LO4	**Topic(s):** ● Interpretation of streak plate **Sample activities:** ● Independent activity: Students look at and record the results of the incubated streak plate and dispose of waste appropriately ● Group activity: Students discuss the results of their streak plate and the possible improvements that they could make to technique ● Student activity: Students ensure they have all the information needed to produce their evidence ●

Unit 2: Data Handling Approaches and Techniques

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Schemes of Work

Programme Title:	Higher Nationals in Applied Sciences	**Level:**	4

Unit Title:	Data Handling Approaches and Techniques	**Tutor:**	

Unit Number:	2	**Academic Year:**	

Learning Outcomes (LO)	**Assessment 1**	**Assessment 2**	**Assessment 3**	**Assessment 4**
LO1 Demonstrate handling of data and information to scientific standards	☒	☐	☐	☐
LO2 Identify the relevance of mathematical methods to a variety of conceptualised scientific examples	☐	☐	☒	☐
LO3 Explore raw scientific data using statistical methods	☐	☒	☐	☐
LO4 Solve problems using differential and integral calculus.	☐	☐	☒	☐

Sessions	Learning Outcome(s)	Session Activities
Session 1	LO1	**Topic(s):** • SI Units, seven basic quantities, base units, derived units, prefixes and dimensional analysis **Sample activities:** • Tutor activity: tutor introduces the seven basic quantities and the associated SI units, derived units and prefixes • Paired activity: working in pairs, students use equations e.g. force = mass x acceleration; work = force x distance etc. to express units e.g. Newtons, Joules in terms of the basic units (kg, m, s etc.). Pairs also practice conversions involving prefixes e.g. mmol; cm^3; μg; etc. commonly used in the sector • Tutor activity: tutor explains how to use dimentional analysis
Session 2	LO1	**Topic(s):** • Primary and secondary data **Sample activities:** • Tutor activity: tutor explains what is meant by primary and secondary data • Group activity: working as a group, students decide whether a described type of data is primary or secondary • Paired activity: working in pairs, students looks at specific examples of primary and secondary data and write notes on the strengths and weaknesses of each type of data • Group activity: group discussion about the strengths and weaknesses of primary and secondary data

Sessions	Learning Outcome(s)	Session Activities
Session 3	LO1	**Topic(s):** • Qualitative data • Sorting qualitative data **Sample activities:** • Group activity: discussion about examples of qualitative data (after tutor has briefly introduced the notion of qualitative data) • Tutor activity: tutor introduces methods and techniques for sorting qualitative data • Paired activity: working in pairs, look at research papers where qualitative data has been collected, sorted and interpreted. The students are given some raw qualitative data and decide on how it may be sorted.
Session 4	LO1	**Topic(s):** • Quantitative data • Continuous and discrete data **Sample activities:** • Group activity: discussion about examples of quantitative data (after tutor has briefly introduced the notion of quantitative data) • Tutor activity: Tutor explains the difference between continuous and discrete data and outlines ways of analysing quantitative data • Paired activity: working in pairs, students suggest ways of analysing specific, given quantitative data

Sessions	Learning Outcome(s)	Session Activities
Session 5	LO1	**Topic(s):** • Graphs and charts **Sample activities:** • Tutor activity: tutor describes different the main types of graphs and charts and how they may be used. Tutor explains the need to label axes, including units and to provide a useful title for graphs/charts • Paired activity: working in pairs, students comment on given graphs and charts and whether the data have been presented in the most effective way • Independent activity: students research and review more types of graphs and charts and their uses
Session 6	LO2 & LO3	**Topic(s):** • The equation of a straight line • Correlation and linear regression **Sample activities:** • Tutor activity: tutor introduces the equation of a straight line (y = mx + c) for graphs drawn on squared paper • Independent activity: students plot graphs of straight lines • Tutor activity: tutor introduces scatter graphs, positive and negative correlation and outlines linear regression. Tutor identified that Excel scatter graphs may display and equation and an R^2 coefficient. • Independent activity: students construct scatter graphs for given data and comment on the correlation

Sessions	Learning Outcome(s)	Session Activities
Session 7	LO2	**Topic(s):** • Quadratic expressions **Sample activities:** • Tutor activity: tutor describes the form of quadratic expressions, the shape of the associated graphs and multiplying brackets to obtain a quadratic expression from two factors • Independent activity: students practise multiplication of brackets to obtain quadratic expressions • Tutor activity: tutor explains factorisation quadratic expressions and the roots of the expressions •
Session 8	LO2	**Topic(s):** • Solving quadratic equations **Sample activities:** • Independent activity: students find the roots of quadratic equations that may be factorised easily • Tutor activity: tutor explains how to use the quadratic formula to find roots • Independent activity: students use the quadratic formula to find roots • Tutor activity: tutor provides a real example of how a quadratic equation may be used to solve a real problem (e.g. finding the amount of product in an equilibrium reaction • Paired activity: working in pairs, students solve quadratic equations based on experimental data

Sessions	Learning Outcome(s)	Session Activities
Session 9	LO2	**Topic(s):** ● Circular (trigonometric functions) **Sample activities:** ● Tutor activity: tutor introduces the circular functions sine, cosine and tangent and shows why the term "circular" is appropriate (including a reminder of the relationship of sine, cosine, tangent to the sides of a right angled triangle). Tutor describes the shapes of the graphs of the circular functions ● Paired activity: working in pairs, students construct graphs for a range of circular functions ● Tutor activity: tutor introduces some scientific applications of circular functions. Tutor provides a list of relationships (cosine rule, sine rule) and trigonometric identities
Session 10	LO2	**Topic(s):** ● Exponential and log functions **Sample activities:** ● Tutor activity: tutor provides examples of exponential relationships, introduces the terms e^x and exp, shows examples of graphs of exponential functions ● Paired activity: working in pairs, students research applications of the exponential function in science ● Tutor activity: tutor introduces logarithms in relation to base e (ln) and base 10 (log). Tutor describes use of logarithms in science

Sessions	Learning Outcome(s)	Session Activities
Session 11	LO2	**Topic(s):** • Rules of logarithms • Arithmetic and geometric progressions **Sample activities:** • Tutor activity: tutor describes the rules of logarithms and how that facilitates further analysis of functions of the type $y = ke^{ax}$ • Independent activity: students use the rules of logarithms and solve real examples of problems using log or ln • Tutor activity: tutor introduces arithmetic and geometric progressions • Paired activity: students research scientific applications of logarithms using a scaffolded worksheet
Session 12	LO2	**Topic(s):** • Solving equations **Sample activities:** • Tutor activity: tutor solves some examples of equations involving straight lines, quadratics, circular functions and logarithmic functions • Independent activity: students solve a range of equations based on scientific applications • Group activity: discussion about the types of data analysis related to solution of equations

Sessions	Learning Outcome(s)	Session Activities
Session 13	LO3	**Topic(s):** ● Descriptive statistics **Sample activities:** ● Tutor activity: tutor introduces mean, median, mode, range, standard deviation (for the sample and for the whole population) and how that is related to the central tendency ● Paired activity: working in pairs, students use Excel spreadsheets to determine the mean, median, mode, standard deviation for sets of data and comment on the results ● Group activity: students discuss how measures of central tendency may be used on data generated from course activities
Session 14	LO3	**Topic(s):** ● Inferential statistics ● Computer software **Sample activities:** ● Tutor activity: tutor explains inferential statistics and how results from a sample may be used to predict results from a population ● Paired activity: students review journal articles describing sampling and inference ● Group discussion: students discuss appropriate sampling to allow reasonably inferences to be made ● Tutor activity: tutor outlines software available to the students at the Centre for handling statistics

Sessions	Learning Outcome(s)	Session Activities
Session 15	LO4	**Topic(s):** • Differentiation: definitions and rules for polynomials • Finding the gradient of a tangent **Sample activities:** • Tutor activity: tutor introduces differentiation in terms of finding the gradient of the tangent to a curve • Paired activity: working in pairs, students calculate the gradient of lines between two points on a curve that become increasingly close together • Tutor activity: tutor introduces the definition of the first derivative and introduces different styles of notation for the first derivative (e.g. dy/dx, $f'(x)$) and the rules for finding the first derivative for a polynomial function • Independent activity: students work out the first derivatives of polynomial functions and find the gradients of tangents to curves

Sessions	Learning Outcome(s)	Session Activities
Session 16	LO4	**Topic(s):** • Differentiation of circular, exponential, logarithmic fundtions • Differentiation: first and second derivatives • Stationary points • **Sample activities:** • Tutor activity: tutor introduces differentiation of circular functions, exponential functions and logarithmic functions. Tutor uses shapes of functions to introduce stationary points, where the first derivative is zero • Independent activity: students differentiate circular, exponential and logarithmic functions and find the stationary points for given functions • Tutor activity: tutor introduces the second derivative and shows how the first and second derivatives may be used to determine the nature of stationary points • Paired activity: working in pairs, students research the applications of rate of change and first derivatives in science •
Session 17	LO2 and LO4	**Topic(s):** • Use of differential calculus in curve sketching and solving problems **Sample activities:** • Tutor activity: tutor explains how to determine stationary points on a curve and to work out the equation of a tangent to a curve at a particular point • Independent activity: students sketch quadratic and cubic curves and find equations of tangents • Tutor activity: tutor explains solving scientific problems (e.g. rate of reaction) by using calculus • Paired activity: working in pairs, students solve applied problems

Sessions	Learning Outcome(s)	Session Activities
Session 18	LO4	**Topic(s):** ● Intetration **Sample activities:** ● Tutor activity: tutor introduces integration e.g. by finding the area under the line y = x and introducing the idea that integration is the reverse of differentiation (apart from the constant of integration). Tutor introduces the rule for finding the indefinite integral of a straightforward polynomial and the notation used in integration. ● Independent activity: students find the indefinite integrals of polynomials ● Tutor activity: tutor introduces finding the constant of integration and finding the definite integral between limits ● Independent activity: students integrate between limits and find the areas under curves.
Session 19	LO4	**Topic(s):** ● Integration and its applications **Sample activities:** ● Tutor activity: tutor introduces integrals of 1/x, circular functions, e^x and introduces how integration is related to models of growth and decay ● Paired activity: working in pairs, students research use of integration in relation to growth and decay ● Tutor activity: Tutor explains an application of integration e.g. construction of an integrated rate equation

Sessions	Learning Outcome(s)	Session Activities
Session 20	LO4	**Topic(s):** • Integration • Application of integration and differential calculus **Sample activities:** • Tutor activity: tutor reminds students of what they have learned about integration • Independent activity: students work on a range of practical problems involving integration • Group activity: students discuss the relationship between and the applications of differential and integral calculus

Unit 3: Regulation and Quality in the Applied Sciences

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Scheme of Work

Programme Title:	Pearson BTEC Higher Nationals in Applied Sciences	**Level:**	4

Unit Title:	Regulation and Quality in the Applied Sciences	**Tutor:**	

Unit Number:	3	**Academic Year:**	

Learning Outcomes (LO)	**Assessment 1**	**Assessment 2**	**Assessment 3**	**Assessment 4**
LO1 Review health, safety, environmental and other legislation relevant to a particular sector or pathway	☒	☐	☐	☐
LO2 Analyse how a specific sector is externally regulated	☒	☐	☐	☐
LO3 Illustrate the links between quality standards, continuous improvement cycles and quality systems	☐	☒	☐	☐
LO4 Explore internal regulation and relevant responsibilities of individuals in relation to a particular sector or pathway.	☒	☐	☐	☐

Sessions	Learning Outcome(s)	Session Activities
Session 1	LO1	**Topic(s):** • UK Legislation • UK Health and Safety Legislation **Sample activities:** • Group activity: Discussion about what is meant by an Act, Statutory Instrument, Regulations, European Directives • Independent activity: Students research the scope of the Health and Safety at Work Act (1974) and the range of sets of associated Regulations using Health and Safety Executive (HSE) website • Group activity: Discussion about why the Management of Health and Safety at Work Regulations (1999) (or current equivalent) are relevant to a particular scientific organisation
Session 2	LO1	**Topic(s):** • Risk assessment and COSHH assessment methodology **Sample activities:** • Independent activity: Students research hazard, risk, severity of harm, likelihood, risk assessment methodology • Paired activity: Students carry out a risk assessment for a laboratory practical activity • Group activity: Discussion, comparing methodology for a COSHH assessment and a risk assessment

Sessions	Learning Outcome(s)	Session Activities
Session 3	LO1	**Topic(s):** • Environmental Legislation **Sample activities:** • Group activity: Talk on compliance with environmental legislation from a representative from a company that is regulated to prevent significant harm to the environment. • Group activity: Discussion about specific pieces of environmental legislation • Group activity: Students work in groups with to consider potential environmental impacts for a range of scientific organisations
Session 4	LO1	**Topic(s):** • Legislation specific to a particular organisation **Sample activities:** • Group activity: Students visit a specific organisation in the science sector that must comply with health and safety, environmental and legislation that is specific to the sector (e.g. food processing, studying animals in a zoo, chemical manufacturing company that must package materials in a particular way/supply information on how a product should be used) • Group activity: Students tour the organisation with a guide or guides who have been prepared about the Unit requirements by the tutor. • Group activity: Students discuss legislation and work practices with their guide(s)

Sessions	Learning Outcome(s)	Session Activities
Session 5	LO1	**Topic(s):** • Specific actions taken by organisations and their employees in order to comply with legislation **Sample activities:** • Group activity: Discussion of actions of organisations and their employees that students observed on their visit • Paired/Group activity: Students interview a representative from a science organisation about how the organisation and their employees complies with legislation • Group activity: Discussion of similarities and differences of legislation affecting a range of organisations
Session 6	LO2	**Topic(s):** • External regulation of applied science organisations **Sample activities:** • Group activity: Talk from a visiting speaker from a relevant organisation that is heavily regulated (e.g. pharmaceutical company, food production company or contract analysis company, top tier COMAH site etc.) • Group activity: Discussion about the possible external regulatory organisations for organisations • Independent activity: Students research the role of a specific external regulatory organisation

Sessions	Learning Outcome(s)	Session Activities
Session 7	LO2	**Topic(s):** • How specific external regulatory bodies carry out their roles • Audit methodology: triangulation of records, observation of practice, information from interviewing a diagonal slice of personnel from an organisation etc. **Sample activities:** • Paired activity: Students review case studies, provided by their tutors about the way different regulators carry out their regulatory duties • Group activity: Group discussion about common approaches by the regulators • Paired activity: Students work together to determine how a particular type of audit would be conducted
Session 8	LO2	**Topic(s):** • Methodologies that organisations may adopt to ensure regulatory compliance: • Record keeping • Procedures and practices • Training • Internal Audit **Sample activities:** • Tutor activity: Tutor introduces methodologies that may be adopted by organisations • Group activity: Students discuss potential methodologies that may be adopted by specific organisations • Group activity: Students discuss potential local organisations to research and how they may do that effectively • Group activity: Group work to devise a questionnaire that may be used

Sessions	Learning Outcome(s)	Session Activities
Session 9	LO2	**Topic(s):** • Benefits of external regulatory compliance • Consequences of non-compliance **Sample activities:** • Group activity: Group discussions based on case studies on different organisations, complied by the tutor to identify positive consequences of regulatory compliance and negative consequences of non-compliance • Paired activity: Students update questionnaire from previous session to take account of the consequences of compliance/non-compliance • Independent activity: Students work on researching a specific organisation
Session 10	LO3	**Topic(s):** • Quality standards (ISO Standards) **Sample activities:** • Group activity: Working in groups, students research a specific standard and prepare a presentation on that standard • Group activity: Working in groups, students deliver a presentation on the standard • Independent activity: Students make notes on all the different standards described in the presentations

Sessions	Learning Outcome(s)	Session Activities
Session 11	LO3	**Topic(s):** • Continuous Improvement **Sample activities:** • Tutor activity: Tutor introduces the continuous improvement cycle • Paired activity: Working in pairs, students identify their own strengths and weaknesses and identify realistic personal improvement goals • Paired activity: Working in pairs, students plan for how their personal improvement goals would be achieved and how they would be reviewed
Session 12	LO3	**Topic(s):** • Quality Management Systems • How quality management systems are developed **Sample activities:** • Group activity: Group discussions about a case study describing the elements of an established quality management system in an organisation and how that system facilitates continuous improvement • Group activity: Groups present their findings to the other groups and a volunteer makes summary notes, based on common observations • Paired activity: Students amend their questionnaires to include questions, probing their chosen organisation's quality management system and the organisation's approach to continuous improvement

Sessions	Learning Outcome(s)	Session Activities
Session 13	LO1-LO4	**Topic(s):** • Benefits of accreditation to a quality standard • How quality management systems may have to be adapted and further developed to ensure accreditation **Sample activities:** • Group activity: Students discuss a case study describing what a organisation did to achieve and maintain accreditation • Group activity: A visiting speaker describes the benefits of accreditation to a quality standard • Paired activity: Students amend their questionnaire to take into account of accreditation to any of the quality standards
Session 14	LO3	**Topic(s):** • Investigating regulation and quality systems in an organisation **Sample activities:** • Independent activity (could be a paired or group activity if pairs or small groups are visiting the same organisation): Students visit applied science organisations, that individuals or small groups have researched, and observe working practices • Independent activity (as above): Students use their questionnaires as a prompt to interview relevant staff in the organisation to find out about relevant legislation, external regulation, quality systems, continuous improvement, accreditation to quality standards and internal regulation. This will include finding out about how regulation of the organisation affects how a variety of individuals carry out their roles. • Independent activity (as above): Students look at relevant computer or paper documentation that illustrates how relevant systems operate

Sessions	Learning Outcome(s)	Session Activities
Session 15	LO1-LO4	**Topic(s):** • Investigating regulation and quality systems in an organisation **Sample activities:** • Group activity: Students discuss the sort of information that they have found and identify scope for further investigation • Independent activity: Students prepare a personal action plan for finding out the additional information that they require. • Independent/paired activity: Students begin to develop a PowerPoint presentation in relation to the links between quality standards, continuous improvement cycles and quality systems (LO3)
Session 16	LO3	**Topic(s):** • The links between quality standards, continuous improvement cycles and quality systems **Sample activities:** • Independent activity: Students deliver their PowerPoint presentations on quality standards, continuous improvement cycles and quality systems • Independent activity: Students make notes on each other's presentations • Group activity: Other students ask the student delivering the presentation questions for clarification

Sessions	Learning Outcome(s)	Session Activities
Session 17	LO4	**Topic(s):** • Internal regulation of organisations **Sample activities:** • Tutor activity: Tutor outlines examples of internal regulation in organisations • Group activity: Students describe examples of internal regulation within organisations based on their research • Group activity: Groups present their findings about internal regulatory systems that they have observed in their chosen organisations. A volunteer summarises the main points for everyone.
Session 18	LO4	**Topic(s):** • How internal regulation relates to external regulation **Sample activities:** • Group activity: Discussion about how internal regulation could related to external regulation • Group activity: Groups work together to identify examples about how internal regulatory systems relate to external regulation, based on students' own research • Group activity: Groups present examples about how internal regulatory systems relate to external regulation to the other groups, based on students' own research

Sessions	Learning Outcome(s)	Session Activities
Session 19	LO4	**Topic(s):** • Actions taken by individuals as a result of internal regulation **Sample activities:** • Group activity: Visiting speakers describe how internal regulation affects how they carry out their roles and describe how internal regulation is linked to external regulation • Group activity: Students ask the speakers about aspects of internal and external regulation • Tutor activity: For everyone's benefit, tutor summarises the main outcomes of the talks from visiting speakers and student questions with input from students.
Session 20	LO1-LO4	**Topic(s):** • Continuous improvement of internal regulatory systems **Sample activities:** • Group activity: Students are presented with a case study that outlines flawed internal regulatory systems. The identify the flaws and, working in groups, devise a strategy for improving the internal regulatory systems that includes a continuous improvement cycle • Group activity: Groups of students present their strategies for the organisation described in the case study • Group activity: The groups of students answer questions from the tutor which challenge them to link internal regulation to external regulation, and the consequences for the organisation of having poor systems in place.

Unit 27: Analysis of Scientific Data and Information

Please note that Schemes of Work are for guidance and support only.
They can be customised and amended according to localised needs and requirements. All Schemes of Work can be adapted to suit specific establishment time frames in line with GLH delivery.

Schemes of Work

Programme Title:	Higher Nationals in Applied Sciences	**Level:**	5

Unit Title:	Analysis of Scientific Data and Information	**Tutor:**	

Unit Number:	27	**Academic Year:**	

Learning Outcomes (LO)	**Assessment 1**	**Assessment 2**	**Assessment 3**	**Assessment 4**
LO1 Process and analyse scientific data using statistics	☒	☐	☐	☐
LO2 Use matrix methods to solve systems of linear equations relevant to science applications	☐	☒	☐	☐
LO3 Examine how differential and integral calculus can be used to solve scientific problems	☐	☒	☐	☐
LO4 Approximate solutions of contextualised examples with graphical and numerical methods, and assess limitations and concluding results	☒	☐	☐	☐

Sessions	Learning Outcome(s)	Session Activities
Session 1	LO1	**Topic(s):** • Descriptive statistics **Sample activities:** • Tutor activity: tutor recaps descriptive statistics topics already covered in Unit 2 and extends this to variance and coefficient of variation • Paired activity: working in pairs, students apply descriptive statistics methods to a range of data sets, provided by the tutor • Group activity: discussion about the interpretation of the use of descriptive statistics methods
Session 2	LO1	**Topic(s):** • Normal distributions **Sample activities:** • Group activity: students discuss the sets of data that were analysed in the previous session and how data were distributed • Tutor activity: tutor explains normal distributions and how to test for normality and to estimate the standard error of the mean. Tutor discusses whether samples may be representative of the whole population and outlines how to determine confidence limits. Tutor outlines the use of percentiles • Independent activity: students formally determine whether data analysed were normally distributed

Sessions	Learning Outcome(s)	Session Activities
Session 3	LO1	**Topic(s):** • Probability **Sample activities:** • Tutor activity: tutor explains probability in relation to statistics using suitable examples e.g. genetics. Tutor explains probability density diagrams, cumulative probability and probability notation • Paired activity: working in pairs, students work through scaffolded worksheets about probablility and standard deviation • Group activity: students discuss the ways to interpret statements about probablity
Session 4	LO1	**Topic(s):** • z- value • Confidence limits and proportions **Sample activities:** • Tutor activity: tutor explains how to determine and interpret the z value • Independent activity: students calculate and interpret z values from data • Group activity: students discuss whether it is necessary for data to be normally distributed in order to apply a z test • Tutor activity: tutor explains how to use confidence intervals in relation to proportions • Independent activity: students work on examples involving proportions and confidence intervals

Sessions	Learning Outcome(s)	Session Activities
Session 5	LO1	**Topic(s):** • Hypothesis testing • Hypothesis testing using z-scores and the t-test • One-tailed and two-tailed tests **Sample activities:** • Tutor activity: tutor explains hypothesis testing and the null hypothesis, using z-scores and using the t-test • Independent activity: students carry out hypothesis testing using z-scores and the t-test • Tutor activity: tutor explains the use of one-tailed and two tailed tests.
Session 6	LO1	**Topic(s):** • Chi-square test • F-test **Sample activities:** • Tutor activity: tutor explains how to use the chi-squared test • Paired activity: working in pairs, students use the chi-squared test and interpret the results • Tutor activity: tutor explains how to use the F-test • Independent activity: students use the F-test and interpret the results

Sessions	Learning Outcome(s)	Session Activities
Session 7	LO1	**Topic(s):** • Statistics recap **Sample activities:** • Tutor activity: tutor recaps the hypothesis testing, significance testing, probability, inference, confidence limits • Paired activity: working in pairs, students select use and interpret results from statistical analysis methods • Group activity: students reflect on the topics that are more difficult to understand. Tutor facilitates those with a better understanding explaining difficult concepts to the whole group.
Session 8	LO2	**Topic(s):** • Introduction to matrices **Sample activities:** • Tutor activity: tutor explains matrices as arrays of numbers, describes the possible formats and description of matrices in terms of the number of rows x number of columns. Tutor explains that coordinate pairs may be represented by a 2 x 1 matrix or column vector. Tutor explains matrix addition, subtraction, multiplication (by a scalar or by another matrix), commutativity of operations, the identity matrix. • Independent activity: students add, subtract, multiply and describe matrices • Tutor activity: tutor explains how one matrix may operate on another by multiplication. For example there are matrices which operate on 2x1 column matrices to produce the reflection of that matrix in the x-axis, y-axis or line x=y

Sessions	Learning Outcome(s)	Session Activities
Session 9	LO2	**Topic(s):** • Solving systems of linear equations using matrix algebra **Sample activities:** • Tutor activity: tutor explains how to work out the determinant and hence the inverse of a 2 x 2 matrix. • Independent activity: students determine the determinant and inverses of 2 x 2 matrices • Tutor activity: tutor explains how to solve a system of 2 linear equations by using the inverse of the matrix • Independent activity: students solve systems of 2 linear equations using matrix algebra • Tutor activity: tutor explains how to construct 2 linear equations from data on absorbance by 2 different substances at two different wavelengths • Paired activity: Working as a pair, students construct 2 linear equations from data on absorbance of 2 different substances at two different wavelengths and solve the system of equations, using matrix algebra.

Sessions	Learning Outcome(s)	Session Activities
Session 10	LO2	**Topic(s):** • 3 x 3 matrices and determinants **Sample activities:** • Tutor activity: tutor explains how to construct the determinant of a 3 x 3 matrix • Independent activity: students construct the determinants of 3 x 3 matrices • Tutor activity: tutor explains how to construct the inverse of a 3 x 3 matrix • Independent activity: students construct the inverses of 3 x 3 matrices • Paired activity: students solve a system of 3 linear equations using matrix algebra • Tutor activity: tutor outlines Cramer's rule and Gaussian elimination
Session 11	LO2	**Topic(s):** • Applications of matrices **Sample activities:** • Tutor activity: tutor reviews applications of matrices mentioned and suggests possible applications to research • Paired activity: working in pairs, students research applications of matrix algebra to applied science • Group activity: students discuss applications of matrix algebra that they have found.

Sessions	Learning Outcome(s)	Session Activities
Session 12	LO3	**Topic(s):** • Differential calculus – chain rule **Sample activities:** • Tutor activity: tutor recaps differential calculus covered in Unit 2 • Paired activity: working in pairs, students work through examples of differentiation and finding the rate of change • Tutor activity: tutor introduces the chain rule and works through several examples, covering a range of functions • Individual activity: students differentiate a range of functions, using the chain rule
Session 13	LO3	**Topic(s):** • Differential calculus – product and quotient rules **Sample activities:** • Tutor activity: tutor introduces the product rule as a tool in differentiation and works through several examples involving different types of functions • Individual activity: students work through several examples involving finding a derivative, by using the product rule • Tutor activity: tutor introduces the quotient rule as a tool in differentiation and works through several examples involving different types of functions • Individual activity: students work through several examples involving finding a derivative, by using the quotient rule

Sessions	Learning Outcome(s)	Session Activities
Session 14	LO3	**Topic(s):** • Integral calculus **Sample activities:** • Group activity: working in groups, students think back to using integral calculus as part of Unit 2. A representative from each group, summarises what is remembered. • Tutor activity: tutor recaps a few integration examples and then introduces integration by substitution/parts. Tutor works through some examples. • Paired activity: working in pairs, students carry out integration by substitution/parts • Tutor activity: tutor outlines the use of partial fractions in integration
Session 15	LO3	**Topic(s):** • Integral calculus **Sample activities:** • Tutor activity: tutor how integral calculus may be used to tackle problems involving growth and decay • Paired activity: working in pairs, students tackle problems involving growth and decay, by using integral calculus • Tutor activity: tutor explains how integral calculus measures the area under the curve and outlines applications of integral calculus

Sessions	Learning Outcome(s)	Session Activities
Session 16	LO3	**Topic(s):** • Applications of integral calculus **Sample activities:** • Paired activity: working in pairs, students research applications of integral calculus in relation to the applied sciences. The pair chooses one application and prepares a presentation on it • Group activity: Pairs present their chosen application to each other • Paired activity: working in pairs, students work through some applied problems supplied by the tutor. •
Session 17	LO4	**Topic(s):** • Numerical methods **Sample activities:** • Tutor activity: tutor explains the Newton-Raphson method • Paired activity: working in pairs, students tackle examples, based on the Newton-Raphson method • Tutor activity: tutor explains Simpson's Rule • Paired activity: working in pairs, students tackled examples, based on Simpson's Rule • Group activity: students discuss how numerical methods could be used for examples in relation to the sector

Sessions	Learning Outcome(s)	Session Activities
Session 18	LO4	**Topic(s):** • Graphical methods **Sample activities:** • Paired activity: working in pairs, students tackle sector specific examples of use of graphical methods to determine solutions to problem, supplied by the tutor, related to the sector • Group activity: Students discuss where they have used graphical methods in relation to their other units • Individual activity: Students begin to collate evidence for where they have used graphical methods as part of their course
Session 19	LO4	**Topic(s):** • Error **Sample activities:** • Tutor activity: tutor works through several to show how error may be estimated • Paired activity: working in pairs, students estimate the error involved in practical calculations, using a worksheet prepared by the tutor • Group activity: students discuss how confidence limits may be expressed for activities that they have undertaken

Sessions	Learning Outcome(s)	Session Activities
Session 20	LO4	**Topic(s):** ● Validity and reliability of data and methods **Sample activities:** ● Group activity: tutor provides some examples of data gathering and analysis, with which students should be familiar. Students discuss the validity and reliability of data collected in that way and of the methods, used to analyse the data ● Paired activity: working in pairs, students review a paper or project related to work that they have carried out that has generated data. Students discuss the extent to which their data may be compared with the literature data. ● Group activity: students discuss data analysis methods most used in their sector in relation to their type, ease of use and suitability.

Unit 28: Applied Sciences Research Project

Please note that Schemes of Work are for guidance and support only.
They can be customised and amended according to localised needs and requirements. All Schemes of Work can be adapted to suit specific establishment time frames in line with GLH delivery.

Schemes of Work

Programme Title:	Higher Nationals in Applied Sciences	**Level:**	5

Unit Title:	Applied Sciences Research Project	**Tutor:**	

Unit Number:	28	**Academic Year:**	

Learning Outcomes (LO)	**Assessment 1**	**Assessment 2**	**Assessment 3**	**Assessment 4**
LO1 Examine research methodologies and approaches appropriate to applied sciences, as part of the research process	☒	☐	☐	☐
LO2 Conduct and analyse research relevant to the applied science research project topic chosen	☒	☐	☐	☐
LO3 Communicate the outcomes of the research project to identified stakeholders	☒	☐	☐	☐
LO4 Reflect on the application of research methodologies and concepts.	☒	☐	☐	☐

Sessions	Learning Outcome(s)	Session Activities
Session 1	LO1 & LO2	**Topic(s):** • Introduction to project work and research as a process **Sample activities:** • Tutor activity: Tutor introduces the framework for conducting a project e.g. rationale; theoretical, philosophical and ethical considerations; conducting a literature review/survey of previous work; hypothesis etc. • Paired activity: Working in pairs, students identify and discuss possible ways of identifying research projects relevant to their own contexts • Group activity: Students share ideas with all other students
Session 2	LO1	**Topic(s):** • Getting Started **Sample activities:** • Paired Activity: Working in pairs, students identify specific topics for projects and how they may narrow down the choice further • Tutor Activity: Tutor describes methodology for conducting a literature review • Independent activity: Students explore possible sources of information for a literature in relation to their possible project topic choices

Sessions	Learning Outcome(s)	Session Activities
Session 3	LO1	**Topic(s):** • Design of the research question **Sample activities:** • Tutor activity: Tutor describes examples of topics and associated research questions. Tutor points out that it's important to identify the scope sensibly • Paired activity: Working in pairs, students discuss possible research questions • Group activity: Students share their best ideas for possible research questions with the whole class and respond to input from the tutor and other students • Independent activity/tutor activity: Students, supported by the tutor, identify whether any specific resources will have to be sources or purchased (e.g. equipment, chemicals, bacterial cultures, polymer samples, food samples etc.)
Session 4	LO1	**Topic(s):** • Research question design and the relevance of the Saunders research onion **Sample activities:** • Tutor activity: Tutor outlines how the research question may be influenced by time, availability of equipment and materials, lack of expertise, requirements of employers (if a work-based project is being planned). Tutor describes the Saunders research onion and how it may help in planning a project. • Paired activity: Working in pairs, students identify constraints on the scope of their projects and discuss how close they are to finalising their research questions • Tutor activity: Tutor leads a discussion to highlight insightful ideas from the class

Sessions	Learning Outcome(s)	Session Activities
Session 5	LO1	**Topic(s):** • Planning, benchmarks and possible outcomes **Sample activities:** • Group activity: small group discussion about what might be involved in planning a project • Group activity: whole group discussion where each small group summarises the outcomes of its discussion for the other small groups • Independent activity: Identification of possible planning constrains, benchmarks and outcomes by individuals, with support from the tutor
Session 6	LO1 - LO3	**Topic(s):** • Stakeholder input **Sample activities:** • Group activity: talks from stakeholders and industry visitors about project planning factors • Paired activity: working in pairs, students identify stakeholders in their own proposed projects and the depth added to planning of the project as a result • Group activity: discussion about wider considerations with input (e.g. questions) from stakeholders and industry visitors
Session 7	LO1 and LO2	**Topic(s):** • Methods to be used in projects **Sample activities:** • Tutor activity: tutor describes different types of methodology and generation and use of qualitative and quantitative data • Paired activity: working in pairs, students describe the types of methodology that they are likely to use • Group discussion: discussion of how data may be analysed for different types of project

Sessions	Learning Outcome(s)	Session Activities
Session 8	LO1	**Topic(s):** • Searching the literature for examples of methodology and analysis and theory **Sample activities:** • Independent activity: students identify the most relevant sources of information for their projects • Tutor activity: tutor describes possible ways for presenting sources of information and background theory and analyses the benefits and styles of laboratory notebooks/other records for keeping track of what is being done • Paired activity: working in pairs, students discuss what is left to plan(e.g. timescale, analysis methods, sampling, analysis, health and safety etc)
Session 9	LO1 and LO2	**Topic(s):** • Hypothesis design. Relevant statistics **Sample activities:** • Tutor activity: tutor explains examples of hypotheses. Tutor explains the relevance of a null hypothesis to certain types of investigation. Tutor introduces significance testing in relation to the project. • Paired activity: working in pairs, students discuss the sort of data that they expect to collect from their project and research the applicability of different types of statistical approaches to their project. Students finalise a hypothesis. • Group activity: working in small groups, engineered by the tutor, students prepare and deliver a short presentation on one member's project, explaining the statistical methodology being considered.

Sessions	Learning Outcome(s)	Session Activities
Session 10	LO2	**Topic(s):** • Choosing a sample **Sample activities:** • Tutor activity: tutor explains different sampling approaches, relevant to the proposed project topics of the students • Paired activity: working in pairs, students decide on the sampling approach and specific sampling that they will carry out. • Group activity: students, as individuals, explain the sampling approach that they will take and receive feedback from each other, with additional input from the tutor
Session 11	LO1	**Topic(s):** • Health, safety, risk assessment and ethics in relation to the project work • Time management • Identification of relevant technical support **Sample activities:** • Tutor activity: tutor outlines expectations and responsibilities in relating to health, safety, risk assessment and ethics in relation to project work. Tutor introduces Gantt charts and other time management tools to support planning. Tutor informs students about expectations in relation to ordering materials and equipment and technician support etc. • Independent activity: students identify how they will address health, safety, risk assessment, ethics, time management and ensuring that they have the required materials, equipment and technician support. • Paired activity: students explain to another student how they will address health, safety, risk assessment, ethics, time management and resources and receive feedback

Sessions	Learning Outcome(s)	Session Activities
Session 12	LO1	**Topic(s):** • Health, safety, risk assessment and ethics in relation to the project work • Time management • Identification of relevant technical support **Sample activities:** • Independent activity: students prepare an initial risk assessment, forms for informed consent of participants (if relevant), supported by the tutor • Tutor activity: tutor reminds students of key aspects to consider in relation to planning the project and focusses on aspects that he/she has observed might not be getting enough attention • Independent activity: students submit requests for materials, equipment and technical support and construct a Gantt chart or a similar time-management tool
Session 13	LO2	**Topic(s):** • Collection of data and information **Sample activities:** • Independent activity: students carry out practical work or other surveys (as appropriate to project). Students complete a laboratory notebook or an equivalent electronic record of work being carried out. • Tutor activity: tutor facilitates independent research by the student. Tutor suggests how to develop alternative and appropriate approaches if problems arise. • Paired activity: Working in pairs, students discuss whether time-management objectives are being met/are appropriate and consider revisions to their plans

Sessions	Learning Outcome(s)	Session Activities
Session 14	LO2	**Topic(s):** • Collection of data and information **Sample activities:** • Independent activity: students carry out practical work or other surveys (as appropriate to project). Students complete a laboratory notebook or an equivalent electronic record of work being carried out. • Tutor activity: tutor facilitates independent research by the student. Tutor suggests how to develop alternative and appropriate approaches if problems arise. • Paired activity: Working in pairs, students discuss whether time-management objectives are being met/are appropriate and consider revisions to their plans
Session 15	LO2	**Topic(s):** • Collection of data and information **Sample activities:** • Independent activity: students carry out practical work or other surveys (as appropriate to project). Students complete a laboratory notebook or an equivalent electronic record of work being carried out. • Tutor activity: tutor facilitates independent research by the student. Tutor suggests how to develop alternative and appropriate approaches if problems arise. • Paired activity: Working in pairs, students discuss whether time-management objectives are being met/are appropriate and consider revisions to their plans

Sessions	Learning Outcome(s)	Session Activities
Session 16	LO2	**Topic(s):** • Collection of data and information **Sample activities:** • Independent activity: students carry out practical work or other surveys (as appropriate to project). Students complete a laboratory notebook or an equivalent electronic record of work being carried out. • Tutor activity: tutor facilitates independent research by the student. Tutor suggests how to develop alternative and appropriate approaches if problems arise. • Paired activity: Working in pairs, students discuss whether time-management objectives are being met/are appropriate and consider revisions to their plans
Session 17	LO2 & LO4	**Topic(s):** • Interim review: whether objectives are being met, reliability and validity of data collected **Sample activities:** • Tutor activity: tutor outlines aspects of progress to be evaluated (e.g. are the data collected so far appropriate to the research question; are data reliable/repeatable/reproducible; measures of validity for data. Tutor explains and encourages a reflective approach. • Paired activity: working in pairs, students discuss what they have achieved, problems encountered and their solutions, further work to be carried out etc. • Group activity: student pairs explain aspects of their progress and problems encountered that may be useful to other students. Discussion is encouraged by the tutor.

Sessions	Learning Outcome(s)	Session Activities
Session 18	LO2 & LO4	**Topic(s):** • Analysing data • Reflecting on the data analysis methods being used • Planning activities **Sample activities:** • Independent activity: students produce a summary of their data analysis methods already used and to be used in the future. • Group/tutor activity: working in groups based on similarity of project themes, students discuss the data analysis methods that they have used/will use. Tutor provides input as required. • Independent activity: students decide on possible refinements to their data collection and analysis and revise their plans for the remaining practical work
Session 19	LO2	**Topic(s):** • Collection of data and information • Data analysis **Sample activities:** • Independent activity: students carry out practical work or other surveys (as appropriate to project). Students complete a laboratory notebook or an equivalent electronic record of work being carried out. Students analyse data. • Tutor activity: tutor facilitates independent research by the student. Tutor suggests how to develop alternative and appropriate approaches if problems arise. • Paired activity: Working in pairs, students discuss whether time-management objectives are being met/are appropriate and consider revisions to their plans

Sessions	Learning Outcome(s)	Session Activities
Session 20	LO2	**Topic(s):** ● Collection of data and information ● Data analysis **Sample activities:** ● Independent activity: students carry out practical work or other surveys (as appropriate to project). Students complete a laboratory notebook or an equivalent electronic record of work being carried out. Students analyse data. ● Tutor activity: tutor facilitates independent research by the student. Tutor suggests how to develop alternative and appropriate approaches if problems arise. ● Paired activity: Working in pairs, students discuss whether time-management objectives are being met/are appropriate and consider revisions to their plans

Session 21	LO2	**Topic(s):** ● Collection of data and information ● Data analysis **Sample activities:** ● Independent activity: students carry out practical work or other surveys (as appropriate to project). Students complete a laboratory notebook or an equivalent electronic record of work being carried out. Students analyse data. ● Tutor activity: tutor facilitates independent research by the student. Tutor suggests how to develop alternative and appropriate approaches if problems arise. ● Paired activity: Working in pairs, students discuss whether time-management objectives are being met/are appropriate and consider revisions to their plans
Session 22	LO3	**Topic(s):** ● Stakeholder involvement **Sample activities:** ● Tutor activity: tutor outlines possible types of input from stakeholders (e.g. employers, environmental and companies which have provided suggestions for projects etc.) that should be considered before practical activity concludes ● Paired activity: working in pairs, students identify possible support and input that they might need from stakeholders and whether the needs of stakeholders have been met ● Independent activity: students take relevant action to maximise involvement and support from stakeholders. This could involve making an interim presentation or preparing an interim report for stakeholders.

Session 23	LO3 & LO4	**Topic(s):** • Stakeholder involvement • Use of a reflective approach **Sample activities:** • Tutor activity: tutor carries out a discussion with stakeholders (invited by the students and tutor) about what they expect to see at this stage • Independent activity: students present what they have done so far in the research project to other students, tutor and stakeholders • Group activity: students discuss the progress so far with their own stakeholders or with another stakeholder and student if the student does not have a specific stakeholder present. Group discusses what the stakeholder would like to see in the final report and presentation.
Session 24	LO2	**Topic(s):** • Collection of data and information • Data analysis **Sample activities:** • Independent activity: students carry out practical work or other surveys (as appropriate to project). Students complete a laboratory notebook or an equivalent electronic record of work being carried out. Students analyse data. • Tutor activity: tutor facilitates independent research by the student. Tutor suggests how to develop alternative and appropriate approaches if problems arise. • Paired activity: Working in pairs, students discuss whether time-management objectives are being met/are appropriate and consider revisions to their plans

Session 25	LO2	**Topic(s):** • Collection of data and information • Data analysis **Sample activities:** • Independent activity: students carry out practical work or other surveys (as appropriate to project). Students complete a laboratory notebook or an equivalent electronic record of work being carried out. Students analyse data. • Tutor activity: tutor facilitates independent research by the student. Tutor suggests how to develop alternative and appropriate approaches if problems arise. • Paired activity: Working in pairs, students discuss whether time-management objectives are being met/are appropriate and consider revisions to their plans
Session 26	LO2	**Topic(s):** • Collection of data and information • Data analysis **Sample activities:** • Independent activity: students carry out practical work or other surveys (as appropriate to project). Students complete a laboratory notebook or an equivalent electronic record of work being carried out. Students analyse data. • Tutor activity: tutor facilitates independent research by the student. Tutor suggests how to develop alternative and appropriate approaches if problems arise. • Paired activity: Working in pairs, students discuss whether time-management objectives are being met/are appropriate and consider revisions to their plans

Session 27	LO2	**Topic(s):** • Collection of data and information • Data analysis **Sample activities:** • Independent activity: students carry out practical work or other surveys (as appropriate to project). Students complete a laboratory notebook or an equivalent electronic record of work being carried out. Students analyse data. • Tutor activity: tutor facilitates independent research by the student. Tutor suggests how to develop alternative and appropriate approaches if problems arise. • Paired activity: Working in pairs, students discuss whether time-management objectives are being met/are appropriate and consider revisions to their plans
Session 28	LO2 & LO4	**Topic(s):** • Data analysis **Sample activities:** • Tutor activity: tutor ensures that students have sufficient support to be able to optimise the quality of their data analysis. • Independent activity: students analyse data using appropriate calculations and statistical techniques and produce graphical representations as required. Students reflect on practical and data analysis methodologies. • Paired activity: students show another student the sort of data analysis that they have carried out and receive feedback

Session 29	LO4	**Topic(s):** • Reflecting on performance and evaluating the research process **Sample activities:** • Tutor activity: tutor outlines aspects of reflecting on performance and evaluating the research process • Paired activity: working in pairs, students devise criteria for reflection on their own performance and support each other to reflect on their performance accurately • Independent activity: students continue to process their results, draw conclusion, and evaluate the validity and reliability of their research
Session 30	LO4	**Topic(s):** • Reflecting on performance and evaluating the research process **Sample activities:** • Tutor activity: tutor explains how to reflect on personal performance and the research process in a critical and objective way • Independent activity: students produce formal, critical and objective reflection on personal performance in relation to carrying out the research project. • Paired activity: working in pairs, students provide feedback to each other on their formal reflection on personal performance

Session 31	LO3	**Topic(s):** • Producing a presentation on the research project **Sample activities:** • Tutor activity: tutor explains best practice in terms of delivering a presentation • Group activity: students ask questions of a visitor from a science based organisation about what they would like to see in a presentation and a report • Independent activity: students begin to prepare presentations about their projects
Session 32	LO3	**Topic(s):** • Evaluation of results and outcomes of the project • Statistics revisited **Sample activities:** • Tutor activity: tutor outlines ways of assessing the validity, reliability and completeness or the results and whether the expected outcomes have been met • Independent activity: students make progress evaluating their results and the adequacy of any statistical tests used • Group activity: students discuss the statistics they have used, provide feedback for each other and receive feedback from their tutor

Session 33	LO3	**Topic(s):** • Producing a formal report **Sample activities:** • Tutor activity: tutor analyses the structure of a formal report and variations on that structure that meet the needs of stakeholder organisations • Group activity: students discuss examples of reports and scientific papers, provided by their tutor in order to establish the features of a good report • Independent activity: Students begin to write the formal report
Session 34	LO3	**Topic(s):** • Producing a formal report **Sample activities:** • Paired activity: working in pairs, students describe the progress that they are making in producing a formal report • Independent activity: students continue to produce their formal reports • Group activity: small groups discuss the parts of the reports that are difficult to write and produce a list of possible solutions to any difficulties

Session 35	LO3	**Topic(s):** • Improving the quality of reports **Sample activities:** • Group activity: working in small groups, students provide feedback on each other's reports • Tutor activity: tutor provides formative feedback on individual students' reports • Independent activity: students improve their reports
Session 36	LO3 & LO4	**Topic(s):** • Reflection, improving the reports and presentations **Sample activities:** • Tutor activity: tutor outlines specific general issues associated with the reports from the projects and recaps the main aspects of reflection on personal performance and project methodologies • Independent activity: students work on their formal report and/or presentation • Paired activity: students discuss whether one or more additional means of communicating their research outcomes will be necessary and how to record formal reflection on personal performance most effectively

Session 37	LO3	**Topic(s):** ● Presentation to stakeholders **Sample activities:** ● Independent activity: students deliver their final, formal presentation on their projects to stakeholders. (This is likely to take two sessions.) ● Group activity: students ask questions of each student on their presentations ● Independent activity: students make notes on ways that they may improve their formal reports, from what they learn from the presentations
Session 38	LO3	**Topic(s):** ● Presentation to stakeholders **Sample activities:** ● Independent activity: students deliver their final, formal presentation on their projects to stakeholders. ● Group activity: students ask questions of each student on their presentations ● Independent activity: students make notes on ways that they may improve their formal reports, from what they learn from the presentations

Session 39	LO3 & LO4	**Topic(s):** • Improving the formal project reports **Sample activities:** • Paired activity: working as a pair, students discuss areas of their project reports to improve in relation to the assessment criteria for the Unit • Independent activity: students continue to improve their reports, including the quality of reflection, discussion of the results and evaluation of the outcomes • Paired activity: pairs of students discuss improvements to project methodologies and how methodology would be improved in the future
Session 40	LO3 & LO4	**Topic(s):** • Improving the formal project reports **Sample activities:** • Paired activity: working as a pair, students discuss areas of their project reports to improve in relation to the assessment criteria for the Unit • Independent activity: students continue to improve their reports, including the quality of reflection, discussion of the results and evaluation of the outcomes • Independent activity: students finalise any remaining stakeholder communications and reflections

September 2019

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