# Unit 9: Biomedical Science

## Delivery guidance

### Approaching the unit

This is an introductory unit and previous knowledge assumed is in terms of your learners' experience of level 2 science. Your learners will be looking at the applications of science in some specialised areas. It is not intended to prepare them for direct entry into biomedical science but rather as an introduction so they can make a reasoned choice about which branch of biomedical science would be of interest for further study. It is not possible to cover all the main branches of biomedical science, so in this unit, areas such as haematology, histology and cytology are chosen as exemplars. Although your learners will be familiar with these areas from possible contact with their local health service, there are a number of other industries involved in biomedical science and you should encourage your learners to consider them when doing research for this unit. It is sometimes difficult to have access to biomedical laboratories/facilities so you may have to rely on input from speakers and other sources of information. Your learners must do laboratory work within your centre in order to meet the criteria and understand the procedures carried out in haematology and cytology. Strict adherence to COSHH and health and safety regulations is required.

### Delivering the learning aims

For **learning aim A**, first see the warning below about working with human body fluids such as blood. Although it is possible to use blood samples from scientific suppliers or to use artificial blood, check your health and safety regulations before doing so. You can use prepared microscope slides and photomicrographs of blood to introduce blood components and follow this up with research by your learners. As they do this research and look at the slides, your learners can investigate diseases and problems associated with the blood components. Again using prepared slides, your learners can practise doing blood counts as an introduction to some of the diagnostic techniques in a haematology laboratory. Visits to such a laboratory or hearing from speakers about their work would be useful at this point.

**Learning aim B** requires a lot of tutor input, backed up by visits to suitable laboratories and from visiting speakers. Work experience would allow some of the techniques to be observed or even practised but it will mostly be covered by research. Using prepared slides to compare normal and abnormal tissues will help your learners to appreciate histology and cytology.

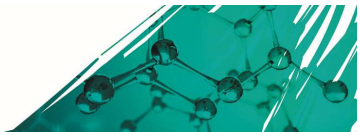
You can approach some of learning aim B using practical work so your learners appreciate the work done in histology and cytology. Use pre-prepared slides and materials to avoid any health risks. Your learners will need to do some research about how cytology and histology are used for detecting and diagnosing disease. Making your learners aware of the huge increase in data being handled is important and input from a specialist in informatics would be useful. Your learners will be aware of reports going missing, etc. but they need to know how this vast amount of data is handled and cross-referenced so that best use can be made of it from a patient and practitioner point of view.

**Learning aim C** first sees the warning below about working with human body fluids such as urine. Simulated samples can be bought or made up, in which case a range of practical work can be done. Pre-prepared slides of urine with blood cells, microorganisms etc. can be used as part of urine analysis.

Visiting speakers, visits to analytical laboratories and work experience would add to the vocational aspects of this aim. Using case studies concerning patients with symptoms, their laboratory results etc. will help your learners put the work into context. Remember that it is the doctor who interprets and does the diagnosis, but the results give the material for the doctor to work with.

Your learners should have access to a suitable laboratory where they can carry out urine analysis and write up reports on their findings. Observation of their practical work is expected, and this could be recorded to help in verification later on. Your learners will also need to do some research so they can include in their report how results are used in the diagnosis of any health changes in the patient. Visits to suitable laboratories, work experience and talks from visiting speakers will all help put this aim into a vocational context

For practical work, you must follow all relevant COSHH and health and safety regulations, some of which will vary depending on the country you teach in. Always check first before doing any work with body fluid products.



## Assessment model

| Learning aim | Key content areas | Recommended assessment approach |
|---|---|---|
| **A** Understand the principles of haematology and its use in medical diagnosis | **A1** The components of blood<br>**A2** Changes to blood components and composition<br>**A3** Diagnostic techniques used in haematology | Practical work to investigate microscopically the components of blood and use of diagnostic techniques to identify disease. Observation records will be required.<br>A report explaining blood component structure and function along with causes and consequences of dysfunction.<br>Analysis of the use of diagnostic blood tests for different diseases. |
| **B** Examine the use of histology and cytology in medicine | **B1** Tissue investigation and consequences of diagnosis<br>**B2** Role of informatics and record keeping | A report/presentation on the implications for society, the health service and individual patients of using histology and cytology in detecting and diagnosing disease occurrence, including how information is used and communicated to key stakeholders. |
| **C** Examine the use of urinalysis as an analytical and diagnostic tool | **C1** Urine composition<br>**C2** Urinalysis | Practical work and a report on the use of urinalysis in diagnosing changes of health status. |

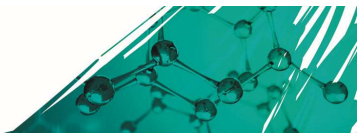
## Assessment guidance

This is a mandatory, internally set and assessed unit for the Foundation Diploma, Diploma and Extended Diploma programmes. It consists of three learning aims. There is a maximum of three summative assessments – one for each learning aim.

Learning aim A requires learners to be able to carry out diagnostic haematology tests. Any practical work must be observed and validated by learner evidence in their report and observation records. They must also produce a report which explains the structure and function of the main components of blood, and how diseases affect the composition of the blood. To access higher grades, the basis of the diagnostic tests must be discussed and evaluated.

For Learning aim B, learners must use their research to produce a report or presentation that explains the use of disease screening, analytical investigations of tissue sampling and informatics when handling data. For the higher grades, the interpretation of informatics from diagnostic testing and how this is used as a tool for planning appropriate treatment must be analysed and the implications of early screening and disease diagnosis must be evaluated.

For Learning aim C, the assignment has practical and written elements: learners must carry out simple urinalysis, identifying the changes in three or more substances in samples of urine and suggesting what these changes indicate in relation to health. They must also produce a report that explains how the composition of urine may vary. To access higher grades, they will analyse how results of urinalysis are used to diagnosis health status changes and evaluate the use of urinalysis in domestic and clinical settings.



# Getting started

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

## Unit 9: Biomedical Science

### Introduction

You could start with a general brain storming session on what biomedical science means to your learners. Use this to build up a mind map/spider diagram/flow chart of the factors that make up biomedical science in terms of what their local health service supplies, and what your learners and their families may have experienced. This gives the learners some ownership of the subject matter. Make sure you include the main items such as haematology, histology, cytology and analysis and diagnosis. You will need to make sure your learners understand these terms, possibly by setting it as a quick research activity for 15 minutes, and then using it as a summary feedback to finish the session.

## Learning aim A – Understand the principles of haematology and its use in medical diagnosis

Refer to your introductory session and the use of haematology as a tool in biomedical science.

**A1**

- Revise the structure of blood, which your learners will have covered in previous work undertaken for GCSE or similar programmes. Do this briefly by way of a quiz or building up a chart of blood components and their functions. Make sure your learners use the correct biological terms, such as erythrocytes.
- At some time during this work, a visit to a laboratory or having guest speakers who work in such laboratories will put the material into context.
- Examine microscope slides or photomicrographs of these blood components. Ask your learners to explain the structure and functions of each of the main blood components.
- Give learners some unlabelled prepared slides as a test of being able to identify blood components. The idea is to make sure your learners know what normal blood should be like. You could also test they know the functions of these components.

**A2**

- As a class activity, do a brainstorming session on what your learners know about diseases and disorders of blood.
- Show your learners the effect of some diseases/disorders on blood components, using videos, microscope slides, etc. Use this as a discussion with your learners.
- Set your learners some research work to do on the effect of diseases and disorders for a later session.
- Use some case studies to help your learners understand the signs/symptoms/effects of blood diseases/disorders. The research they have done should be of help.

**A3**

- Ideally, work experience in a haematology laboratory would be vocationally relevant to correctly carrying out diagnostic tests on blood. If this is not possible then set up your laboratory to mimic a haematology laboratory where blood samples are received for analysis. You will need to observe your learners as they carry out the diagnostic tests. Make sure they

record what they are doing and the outcomes. You can record their work for verification later on.

- Use the practical work to discuss the basic tests and encourage learners to evaluate the effectiveness in terms of detecting diseases.

## Learning aim B – Examine the use of histology and cytology in medicine

**B1**

- Refer back to the terms 'histology' and 'cytology', and discuss with your learners what they mean. Put them into context by setting your learners some research about the techniques used. Give each learner an area to research, e.g. types and methods of sample removal. Be prepared to guide your learners about which websites to use and the key words to enter for a search.
- To follow up their research, give your learners a case study to discuss in small groups that will test their knowledge of tissue investigation and diagnosis. You will need to give sufficient information in the case study about symptoms, etc. so your learners can decide which tissue investigations they might carry out.
- Use a class discussion to draw together what tissue investigation involves, and how it is carried out and used. Conclude with discussing the need to take specimens at autopsy in order to discuss cause of death. You will need to be aware of any particular situations in the class where this may be inappropriate, and an alternative way of covering the material may be needed.
- The same applies when using case studies or group discussion about the implications once a diagnosis has been made.

**B2**

- Large amounts of data, not only from diagnostic tests but general information kept in patients' files, rapidly accumulate and your learners can give you their experiences of huge files, both paper-based and electronic, that they may have seen during medical visits. This is a good starting point for a discussion about record keeping and the topic of informatics.
- Your learners will give you numerous examples of lost records. Use this to get them to consider examples of redacted patient information that they can study. Ask them how they would organise and store the information. Set this as a practical exercise. Remind them of certain criteria they must allow for, such as confidentiality, accuracy and completeness.
- If possible, find a speaker/colleague who can demonstrate to your learners the processes involved in data storage and record keeping.
- Research, as a small group activity, the different systems used to store data, both paper-based and electronically. Ask your learners to summarise the basis of these data storage systems.
- As a follow-up, look at how information is used and communicated in their local health service.

## Learning aim C – Examine the use of urinalysis as an analytical and diagnostic tool

**C1**

- Introduce learners to this learning aim by researching the main constituents of urine (water, urea, hormones, carbohydrates, sodium, chloride and potassium ions), their biochemical sources in the body and the normal parameters expected in healthy individuals. Encourage learners to understand that these will often vary according to age and gender. Give different learners/small groups a constituent to research and then feed back to the rest of the class.
- Remind your learners of the urinary system, which they might have studied in previous work undertaken for International GCSE or similar programmes, and the role of the kidneys in helping to rid the body of chemicals that are not needed or are harmful.
- Use this task to introduce the composition of urine in a normal healthy person, which includes variations in the constituent parts. Discuss why these variations appear, such as an increase in hormone levels, sodium or potassium.

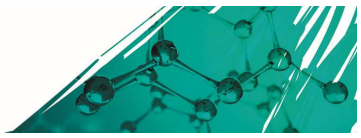
**C2**

- To capture the interest of your learners, refer to urine analysis carried out in all types of major sports. Encourage your learners to do some research on how samples are taken, what tests the sample undergoes and how the results are interpreted.
- Use the findings of your learners to make a flowchart of the processes, and indicate where there can be problems and why there can be misinterpretation of results. Include in your discussions what indicators are used in urine analysis, and relate this to how sampling is done in a hospital laboratory.
- Make learners aware of the key indicators and tests used in urinalysis:
  - visual tests for colour and clarity
  - chemical tests, using test strips
  - specific gravity for determining concentration, pH, blood, protein, glucose, bilirubin, urobilirubin, ketones, nitrite, human chorionic gonadotrophin (HCG)
  - microscopic examination for crystalline structures, trichomonads, blood cells, microorganisms, epithelial cells, casts.

  You will need to ensure learners can determine the most appropriate test (visual, chemical or microscopic).
- Learners must be aware of and understand the importance of the following:
  - cleanliness of genitalia
  - sterility of containers
  - mid-stream collection
  - the need for specific times of the day for collection of samples
  - the length of time between collection of samples and analysis
  - preservation methods if analysis does not occur immediately.
- Supply your learners with some case studies where symptoms and results of urine analysis are given and have your learners interpret them.
- Visits to relevant laboratories/visits from speakers working in such laboratories and work experience will make the aim vocationally interesting.
- Your learners are required to carry out urine analysis correctly. You must make sure you abide

by the local health and safety regulations that apply to your centre. You and your learners should do risk assessments before any practical work.

- If work experience is not possible then try to make your laboratory like an area where such urine analysis would be carried out for their local health service. You can give your learners a urine sample and ask them to test for specific things, such as pH, glucose, ketone. Chemical test strips are readily available from suppliers.
- Using microscopes to look at urine samples for cells and microorganisms is another aspect of practical work to be done and observed. Learners need to have the opportunity to carry out practical work on testing for the main constituents. They will need to be observed doing this as part of assessment (C.P8) once teaching and learning have been completed.
- As a whole-group activity, discuss how urine analysis helps in the diagnosis of health changes.



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

This unit links to:

- Unit 1: Principles and Applications of Biology I
- Unit 5: Principles and Applications of Biology II
- Unit 11: Functional Physiology of Human Body Systems
- Unit 14: Genetics and Genetic Engineering
- Unit 15: Diseases and Infections.

## Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC International L3 Qualifications in Applied Science. Check the Pearson website (http://qualifications.pearson.com/endorsed-resources) for more information as titles achieve endorsement.

### Textbooks

Hoffbrand, V and Mehta, AB – *Essential Haematology* (Wiley Blackwell, 2006) ISBN 9781405136495. This book introduces the formation and function of blood cells and diseases that arise from dysfunction and disruption of these processes. Basic science, diagnostic tests and clinical features are all easily explained.

Howard, M and Hamilton, P – *Haematology: An Illustrated Colour Text* (Elsevier Health Services, 2008) ISBN 9780443103629. A reference book for tutors and learners.

Iles, R and Docherty, S (eds) – *Biomedical Sciences: Essential Laboratory Medicine* (Wiley, 2012) ISBN 9780470997741. This covers all the major topics for this unit. You can also use it for other units.

Luxton, R – *Clinical Biochemistry*, 2nd edition (Scion Publishing, 2008) ISBN 9781904842415. This reference book focuses on the areas of body function required for the maintenance of health.

Ramakrishnan, S – *Manual of Medical Laboratory Techniques* (JP Medical Ltd, 2012) ISBN 9789350256343. This manual is a complete guide to medical laboratory techniques used in medical microbiology, haematology, clinical biochemistry, histopathology, human genetics and molecular biology.

Tortora, GJ and Derrickson, BH – *Principles of Anatomy and Physiology* (John Wiley & Sons, 2011) ISBN 9780470565100. A very well-known book which covers in detail all the information required for human biology – a standard reference book for learners.

### Journals

*New Scientist*

Articles from newspapers, television or radio transcripts or other scientific publications will be beneficial to aid the learning process.

**Websites**

The Association for Science Education

The Science Enhancement Programme

The Society of Biology website

You can find many other sites using a search engine of your choice and typing in the subject required. These sites do tend to change, with new ones appearing and taking the place of existing ones. Always check the site is still active before recommending it to your learners.

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