Cambridge TECHNICALS

Accredited

OCR LEVEL 3 CAMBRIDGE TECHNICAL

CERTIFICATE/DIPLOMA IN

HEALTH AND SOCIAL CARE

PHYSIOLOGY OF FLUID BALANCE

F/600/8967

LEVEL 3 UNIT 11

GUIDED LEARNING HOURS: 60

UNIT CREDIT VALUE: 10

OCR

PHYSIOLOGY OF FLUID BALANCE

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AIM OF THE UNIT

Water is vital for life. We will die from dehydration long before we die from starvation. This unit will help understand why this is. Life on Earth started in the oceans and as animals and plants gradually moved onto dry land they had to take their oceans with them. Millions of years down the line the same is true for us and so this unit explores why fluids are so important to us and what their role is in the body and how we avoid losing them. The unit explores the structure and function of body cells, their composition and how materials pass in and out of them. It allows learners to understand the role of fluids in the body and how the body maintains its fluid levels despite changes in both the internal and external environment. Learners will have the opportunity to appreciate the important part the kidneys play in this homeostatic process. As we grow older our kidneys become less efficient and in some individuals, at any age, these vital organs may stop working. This unit will also consider what happens if kidneys start to fail and the care strategies involved in such an eventuality.

PURPOSE OF THE UNIT

Working in the health and social care sector will often involve caring for individuals and providing them with their basic needs. One of these needs is a supply of fluids. Individuals are not always in a position to ask for assistance and so it is important for future carers to understand the significance and importance of body fluids and the consequences of dehydration. This unit will allow learners to develop a broad understanding of the distribution, functions and properties of the main body fluids and how they assist in the movement of materials in and out of body cells.

To this end learners will first gain an understanding of the structure of a typical animal cell as seen by an electron microscope and gain an overview of the functions of the various organelles found within a cell.

They will study the biochemical nature of a typical membrane and use this knowledge to demonstrate how it's structure influences the movement of materials in and out of cells. They will learn about a variety of transport mechanisms and relate this knowledge to, for example, phagocytes, epithelia of lung alveoli and cells of the proximal convoluted tubule in the kidney. Learners will also learn about those changes in conditions that can either help or hinder the movement of materials in and out of cells.

Studying the unit will allow the learners to appreciate the importance of water both in cells and as a transport medium throughout the body. They will gain knowledge of the types of molecules that water carries. They will learn how the composition of these important fluids changes around the body and how under normal conditions a constant flow of fluid is maintained through the various pipelines of the body, between cells and in and out of them.

They will learn about how water is both gained and lost by the body and the importance of maintaining the balance so there is neither net gain nor loss. To this end learners will study the renal system and in particular the microstructure of the kidneys and their physiology especially those functions that relate to the vital homeostatic balance of water. They will be able to apply the knowledge and understanding they have gained to develop an understanding of some relevant dysfunctions that interfere with the control of water balance. They will briefly investigate the care strategies involved in the management and treatment of these conditions.

This unit will build on any existing knowledge of human anatomy and physiology and the scientific principles gained will support learners and link with several other physiology or scientific units within a programme. Standing alone, this unit allows learners to develop a sound comprehension of the importance of maintaining hydration and how vital it is for the body to manage this. The unit will be useful for those learners intending to work in the health or social care sectors or who wish to progress to further or higher education.

ASSESSMENT AND GRADING CRITERIA

Learning Outcome (LO) The learner will:	**Pass** The assessment criteria are the pass requirements for this unit. The learner can:	**Merit** To achieve a merit the evidence must show that, in addition to the pass criteria, the learner is able to:	**Distinction** To achieve a distinction the evidence must show that, in addition to the pass and merit criteria, the learner is able to:
1 Know the microstructure and functions of a typical animal cell	P1 describe the microstructure of a typical animal cell and the functions of the main cell components		
2 Know the movement of materials into and out of cells	P2 describe the ways in which materials move in and out of cells	M1 describe factors that may influence the movement of materials across cell membranes	
3 Know the distribution and constituents of fluids in the human body	P3 describe the distribution and constituents of body fluids	M2 describe the formation of tissue fluid and lymph	
4 Understand homeostatic processes in relation to water balance.	P4 explain the role of the kidney in the homeostatic control of water balance		D1 summarise the importance of water balance
	P5 explain dysfunction in relation to water balance and its possible treatments	M3 assess the effect of dysfunction on an individual's daily life	D2 evaluate possible treatments for dysfunction

TEACHING CONTENT

1 Know the microstructure and functions of a typical animal cell

- *Cell structure:* the nature of nuclear and cell membranes, nucleus, nucleolus, chromosomes, endoplasmic reticulum (both rough and smooth), ribosomes, Golgi bodies, mitochondria, lysosomes, centrioles, cilia or flagellum
- *Functions:* nuclear and cell membranes, nucleus, chromosomes, endoplasmic reticulum (rough, smooth), ribosomes, Golgi bodies, mitochondria, lysosomes, centrioles.

2 Know the movement of materials into and out of cells

- *States of matter:* solid, liquid, gas
- *Materials:* particulate, ionic, in solution, colloidal sols
- *Movement of materials:* diffusion, facilitated diffusion, osmosis, active transport, endocytosis, exocytosis
- *Factors affecting movement:* size, distance, temperature, concentration gradient, osmotic potential, electrochemical gradient, permeability of cell membrane, channel proteins, carrier molecules.

3 Know the distribution and constituents of fluids in the human body

- *Constituents of body fluids:* water; solutes ,(e.g. glucose, amino acids, urea; electrolytes – acids, bases, salts)
- *Role of electrolytes:* essential minerals, in control of osmosis/osmotic pressure, maintenance of acid-base balance
- *Acid-base balance:* pH; importance of maintaining hydrogen ion concentration in body fluids; buffer systems, (e.g. carbonic acid, phosphate, protein)
- *Role of water:* constituent of body fluids; as a solvent; as a medium
- *Distribution of water:* intracellular, extracellular, for example, plasma, glomerular filtrate, urine, intercellular, for example, tissue fluid, lymph
- *Formation of intercellular fluids:* tissue fluid, lymph; roles of the heart and blood vessels; lymph vessels; role of blood albumin.

4 Understand homeostatic processes in relation to water balance

- *Water intake:* ingestion in diet; from metabolic processes, for example, respiration
- *Water output/loss:* through skin, lungs, gastrointestinal tract, kidneys; effect of water loss on cells
- *Renal system:* gross anatomy; associated blood supply; urine production, composition and storage, micturition.
- *Kidneys:* gross anatomy; structure and function of nephrons/kidney tubules; ultrafiltration, significance of the glomerular capillaries, basement membrane and podocytes; selective reabsorption; counter-current mechanism, principles of osmoregulation and role of hypothalamus and relevant hormones, (e.g. anti-diuretic hormone (ADH)
- *Dysfunctions in relation to water balance:* nephrotic syndrome: oedema, kidney failure; renal dialysis, hypertension.

DELIVERY GUIDANCE

LO1 Know the microstructure and functions of a typical animal cell

To deliver this unit tutors with specialist knowledge would be advantageous and whilst access to a laboratory would be useful, it is not essential. The unit begins with coverage of cell structure which some learners may have covered before in the Anatomy and Physiology unit. Whilst simple compound microscope investigations of cells might be a suitable introduction it is not essential. Learners need to be provided with source material of electron micrographs and other images of cells and their organelles and guided by tutors through the functions of the structures identified in the content section. Processes such as respiration occurring in mitochondria and protein synthesis at the ribosomes need only to be touched on simplistically in order to appreciate the processes and the need for glucose, oxygen and amino acids, as well as the removal of products such as carbon dioxide. Annotated posters, slide presentations and models can all be produced to reinforce learning and understanding.

The structure of the cell membrane as a bilayer of phospholipids with associated proteins and cholesterol needs to be covered. Again electron micrographs and images can be used and models made using, for example, table tennis balls and wire or pipe cleaners.

LO2 Know the movement of materials into and out of cells

Consideration of the structure of cell membranes can lead on to discussion of the means by which materials enter and leave cells, and the factors affecting this movement. It would be useful to carry out some practical investigation, if possible, using either plant cells such as onion or beetroot allowing learners to observe diffusion and osmosis. Experiments could be carried out with solutions separated by Visking tubing or by recording weight lost or gained by potato chips. All are standard investigations found in GCSE and A level books and resources.

Learners need to understand the various ways of transport across membranes as indicated in the content section. This is best done by illustrating specific examples such as reabsorption in the proximal tubules of the kidney, diffusion in alveolar walls and the role of the CFTR protein that can result in cystic fibrosis. This will help learners appreciate the significance of these chemicals and how vital they are. The effects of factors such as temperature can also be explored through practical investigations if possible and learners will understand the relationship between temperature and the motion of molecules. They can also be led to an appreciation that there is a limit to the effect of temperature on living tissue and that this is linked to the deformation of protein structure.

LO3 Know the distribution and constituents of fluids in the human body

Learners need to know the properties of water, the functions of water in relation to the structure of the water molecule and its role as a solvent. This could lead to a consideration of the importance of aqueous solutions as media for metabolic reactions. This is probably most effectively covered by tutor input.

The role of substances in solution needs to be studied as do: pH; the characteristics of acids and bases together with the role of buffers and the importance of maintaining the acid-base balance. This is best illustrated by relating to specific circumstances and/or locations within the body rather than merely discussing as abstract concepts. Some of the books indicated at the end of the section will help here. This does not need to be covered in depth. Posters, slide presentations or written reports could all be used, as could practical records, to consolidate learning and understanding. Most learners will probably think of blood as being the only transport system of the body and so they need to be introduced to the formation of tissue fluid and lymph and their vital roles in the body. Differences between the composition of these fluids and plasma need to be emphasised. The nature of capillaries should be studied and how blood, lymph and glomerular capillaries differ in structure and how these differences are related to their function can easily be illustrated through the use of quickly constructed paper models. Learners might like to discuss how the right ventricle of the heart is less muscular to prevent tissue fluid being formed in the alveolar capillaries and causing our lungs to become potentially waterlogged!

LO4 Understand homeostatic processes in relation to water balance

The composition of body fluids needs to be explored, including urine. How water is both gained and lost from the body also needs to be understood as does the need for maintaining equilibrium. Learners could discuss, for example, the effect of sweating on a hot day to the volume of urine produced. They need to appreciate why death from dehydration will occur long before the effects of

starvation. Learners might like to discuss how and why some individuals die from drinking excessive amounts of water. An introduction to the concept of homeostasis would be useful at this point. (It is quite likely that they will have met this before in the Anatomy and Physiology unit). This will enable learners to explore the adjustments individuals make to their fluid intake according to factors such as environmental temperature and exercise. Learners should be encouraged to relate this section to health or social care settings and some may observe in their placements how the fluid balance of people who use services is managed. Learners will need to appreciate how some individuals, for example, infants, young children and older people are particularly vulnerable to dehydration and therefore why conditions such as typhoid, dysentery and cholera with their symptoms of severe diarrhoea kill so many people worldwide. The use of intravenous drips for rehydration could also be explained. Much of this section can be covered through group, paired or individual research followed by feedback to the group. This feedback and any class discussion can be used to construct and consolidate the learner's notes.

The mechanism of how water balance within the body is achieved needs to be studied together with the anatomy and physiology of the renal system. Charts and models could be used to illustrate the gross anatomy of the renal system, including the kidneys. Dissection of a kidney would be a useful exercise although some learners may wish not to. The structure and functioning of the kidney and especially the role of the tubules and their role in water maintenance will require tutor input. Annotated posters, diagrams and paper models of the glomerular/Bowman's capsule interface could be used. The latter could be backed up by a demonstration of selective filtering using two kitchen colanders and a sieve and using them to separate a mixture of, for example, penne pasta, rice, flour and turmeric. The learners will need to be taught how the counter current multiplier system works. A comparison of the lengths of the loops of Henlé of humans with both aquatic and desert mammals will help illustrate the principles of this system. Learners need to understand the parts played by the distal tubule, vasa recta and collecting ducts as well as the roles of the hypothalamus and pituitary gland of the brain.

Kidney dysfunction would be best served by an investigation of nephrotic syndrome as it easily links much of the unit. This is a comparatively rare autoimmune condition that affects mainly children. It causes damage to the glomerular capillaries and basement membrane with a resulting loss of blood albumin. This cannot be reabsorbed in the proximal tubule (so reinforcing the section on methods of movement across membranes). The resulting drop in albumin causes tissue fluid to be reabsorbed more slowly resulting in oedema. Although this condition is usually treated successfully by medication, some individuals will suffer permanent damage resulting in kidney failure. This could lead learners onto an investigation of dialysis. Case studies or guest speakers, either a practitioner or an individual with kidney disease, could be used but sensitivity and the need for confidentiality should be observed. Learners would need to be primed with suitable questions and be prepared to summarise responses in their own words.

Learners should also understand the role that fluids and electrolytes play in creating hypertension and the damaging effects this has on body systems. Its treatment using diuretics can then be understood. Visiting speakers, for example a practice nurse or health visitor, together with medical encyclopaedias could be utilised.

ASSESSMENT GUIDANCE

Assessment is likely to be learning outcome based and written in nature. Display work or posters may be used for assessment, as could photographic records. It is advisable to have all evidence to hand when an external visit by a moderator is planned.

P1 – This criterion could be met through the construction of a labelled model which would need to be witnessed by the assessor and a record produced of how the learner has met both the learning outcome and the grading criteria. Alternatively the assessment could be in the form of a written report or could be as a poster or slide presentations. There must be adequate depth to the work to fulfil the term of description. If a learner has done the previous Anatomy and Physiology unit then it is likely that they will need to expand on their cell work from that unit as then they were asked to outline only the functions of organelles.

P2 and M1 – Could be approached as for the assessment of the previous assignment. The merit requirement could be achieved through an extended written report or based around some practical investigations of factors that affect movement in and out of cells. A learner would not be expected to investigate all factors practically but a minimum of two should be covered.

P3 – Could be met by the use of charts and tables supported by some descriptive prose.

M2 – Could be covered by a combination of written work, slide presentations, diagrams and simple models that illustrate the structure of the capillaries and the part they play in the formation of both tissue fluid and lymph.

P4 – Requires an explanation of the concept of homeostasis as applied to the control of water balance. This, too, is likely to be in the form of a written report although annotated posters could be used. P4 requires evidence of an understanding of the role of the kidney and to this end there must be a brief overview of both the gross anatomy of the renal system as well as the microanatomy of the kidney. This could be in the form of annotated posters, both flow and anatomical diagrams or slide presentations. This assignment could be 'stand-alone' or it could be subsumed into the next and final one.

D1 – Could be addressed by a written report or by an annotated poster as long as the detail was sufficient for distinction level. Learners need to demonstrate an understanding of how water is lost and gained by the body as well as the importance of maintaining an equilibrium.

P5 – What is likely to be the final assignment involves an examination of kidney dysfunction and could be covered through a study of nephrotic syndrome as described in the guidance section. This could revolve around an explanation to a family with a child suffering from nephrotic syndrome explaining what is happening in the kidney and how this then leads to oedema, which is likely to be the most obvious symptom. Untreated oedema can lead to respiratory and cardiac failure. The assessment could be achieved in the form of a leaflet or explanatory diagrams and models.

M3 – Involves a straightforward assessment of the effects of the dysfunction on the individual and will involve coverage of PIES. Again this could take the form of an information leaflet or a case study. It should cover the effects on daily life and routines as a result of the syndrome itself; side effects of any medication, for example the 'moon face' that develops as a result of using steroids that can result in bullying; dialysis; waiting for a transplant or living with a new organ should these last three apply.

D2 – Is likely to be covered as a written report but could again be done using an information leaflet. It would need to look at the benefits and disadvantages of the medication used –usually steroids, diuretics and immune-suppressants as well as assessing the benefits and disadvantages of both dialysis and transplants.

SUGGESTED ASSIGNMENTS

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

Criteria	Assignment title	Scenario	Assessment
P1	The structure and functions of a typical human cell.	The learner is producing an exhibition for non science specialists on the components of human cells.	Written report, posters and/or models on the structure and function of a typical human cell including a detailed description of membrane structure.
P2, M1	A description with examples of how materials move in and out of cells together with a description of those factors that can affect this movement.	A description of the movement of materials in and out of cells made to a non – specialist audience/reader.	A written report together with illustrations/images that uses a number of materials, for example, glucose, water, salt, oxygen together with a description of how factors, such as temperature or osmotic potential, affect this movement.
P3, M2	A comparison of blood, tissue fluid, lymph and urine, their formation and functions.	A family member has developed nephrotic syndrome and the learner wishes to research the condition, the physiology behind it and the possible treatments and their effects.	An illustrated written report and/or leaflets that describe the composition of body fluids, their formation, the roles of the kidney and a related dysfunction. It will also explain the importance of maintaining a correct water balance.
P4, D1, P5, M3, D2	An investigation into the homeostatic role of the kidney and a related dysfunction.		

RESOURCES

Text books

Adds J, Larkcom E and Miller R – *Molecules and Cells* (Nelson Thornes, 2003) ISBN 9780748774845

Clancy J and McVicar A – *Physiology and Anatomy: A Homeostatic Approach* (Hodder Arnold, 2002) ISBN 9780340762394

Jenkins M – *Human Physiology and Health* (Hodder and Stoughton, 2000) ISBN 9780340658529

Mader S – *Understanding Human Anatomy and Physiology* (McGraw, 2004) ISBN 9780071111607

Minett P, Wayne D, Rubenstein D – *Human Form and Function* (Hyman, 1989) ISBN 9780713527148

Seamons S *Applied Health & Social Care: A2 Student Book OCR* (Folens, 2007) ISBN: 1850082480

Stretch B and Whitehouse M – *BTEC Level 3 Nationals in Health and Social Care Student Book 1* (Pearson, 2010) ISBN 9781846907663

Stretch B and Whitehouse M – *BTEC National Health and Social Care Book 2* (Heinemann, 2007) ISBN 9780435499167

Stretch B A2 *GCE Health and Social Care Student Book for OCR* (Heinemann,2006) ISBN 97804353529

Journals

'Inside the human Body' Bright Star Publishing
Biological Science Review
New Scientist
Nursing Times
National Geographic Magazine

Websites

www.bbc.co.uk/schools/gcsebitesize/biology

www.bbc.co.uk/scotland/learning/bitesize/higher/biology

www.biologyguide.net

www.getbodysmart.com

www.educypedia.be/education/anatomyimages.htm

www.nhs.uk/conditions

DVDs

Inside the Human Body [DVD] (DVD - 2011)
The Human Body [DVD] [1998]

MAPPING WITHIN THE QUALIFICATION TO THE OTHER UNITS

Unit 5: Anatomy and physiology for health and social care

Unit 12: Physiological disorders

CONTACT US

Staff at the OCR Customer Contact Centre are available to take your call between 8am and 5.30pm, Monday to Friday.

We're always happy to answer questions and give advice.

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