Unit 34: Human Inheritance for Health and Social Care

Unit code: Y/600/8991

QCF Level 3: BTEC Nationals

Credit value: 10

Guided learning hours: 60

Aim and purpose

This unit aims to enable learners to understand human reproduction and the mechanisms of human inheritance. They will be able to examine technologies that are available to assist individuals in relation to reproduction and inheritance, and ethical dilemmas related to their use.

Unit introduction

Initially, learners will gain an understanding of the anatomy of the male and female reproductive systems including the processes involved in the development of the reproductive cells (gameteogenesis), and factors that may influence their formation.

Learners will then examine human inheritance, reproductive and gene technologies including the role of genetic engineering. They will be encouraged to consider the ethical issues and potential dilemmas created by the use of these technologies, for example genetic screening and fingerprinting. Potential conflicts between individual choices and rights, benefits versus risk, and the impact on societies will be examined in the context of current and emerging regulatory frameworks.

The unit will provide valuable understanding of the mechanisms of inheritance for learners aiming to work with patients and users of services whose care needs may be affected by inherited traits.

Learning outcomes

On completion of this unit a learner should:

1 Understand human reproduction

2 Understand patterns of inheritance

3 Know about reproductive and gene technologies

4 Understand ethical dilemmas in relation to reproductive and gene technologies.

Unit content

1 Understand human reproduction

Reproduction: anatomy of male and female reproductive systems

Gametogenesis: spermatogenesis in testes, oogenesis in ovaries; significance of meiosis – reduction division, independent assortment of chromosomes, phases of meiosis; chromosome number – diploid, haploid

Chromosomes: structure, DNA, histones; autosomes, sex chromosomes; behaviour during meiosis, chromatids, chiasmata; influences on cell functioning

Genetic code: codons, genes, homologous chromosomes, alleles, genome

Conception: chromosomal behaviour during fertilisation, implantation, mitotic cell division, cell differentiation

Influences: role of reproductive hormones; other biological factors, eg parental genotype, age, diet, health; environmental, eg temperature, chemicals (eg nutrients, alcohol, other pharmacological agents, industrial); radiation, eg from X-rays; congenital influences in pregnancy and during birth and potential effects on foetus/newborn baby; role of the placenta in the protection of the foetus

2 Understand patterns of inheritance

Variation: discontinuous, continuous

Discontinuous variation: Mendelian inheritance, genotype, phenotype; homozygous, heterozygous; dominant and recessive alleles; autosomal recessive inheritance, eg cystic fibrosis, phenylketonuria; autosomal dominant inheritance; co-dominance, eg inheritance of blood groups, inheritance of sickle cell disorders; genetic determination of sex; sex-linked inheritance, eg haemophilia, colour blindness

Continuous variation: polygenic inheritance

Mutations: genes, eg sickle cell anaemia/trait; chromosomes – aneuploidy, eg Down's syndrome; screening programmes for genetic-related diseases

3 Know about reproductive and gene technologies

Reproductive technologies: contraceptive techniques; screening techniques; assisted reproduction – in vitro fertilisation, artificial insemination

Gene technologies: genetic engineering, eg recombinant DNA, Human Genome Project, gene therapy, DNA analysis, genetic profiling

Uses: production of useful chemicals, eg pharmaceuticals, industrial enzymes; agricultural, eg disease/pest resistance; other emergent uses if appropriate

Implications: genetic screening, diagnosis, genetic fingerprinting, genetic counselling; forensic evidence; identity disputes, eg paternity; tissue matching, eg for transplantation; others as relevant to technological advances

4 Understand ethical dilemmas in relation to reproductive and gene technologies

Regulation: in home country, European Union, United Nations; legislation, adjudicators, adapting to emergent technologies, changing society

Individuals: rights, responsibilities, confidentiality, quality of life, ownership, advocacy; others, eg scientists, parents/family members, carers, professionals, pressure groups, commerce; rights, responsibilities, beliefs

Society: values, benefits versus risks, support systems, resources, individual versus wider perspective

Wellbeing: developmental delay, disability, susceptibility to ill health, behavioural difficulty

Grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The criteria for a pass grade describe the level of achievement required to pass this unit.

Grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 explain the process of meiosis in relation to the production of sperm and ova [IE1; RL2]		
P2 explain factors that may affect the reproductive process in humans [IE1; RL2]	**M1** assess the relationship between dominant and recessive genotypes and inheritance	
P3 explain the structure of chromosomes and their role in reproduction [RL2]	**M2** discuss the impact on individuals and society of genotypes resulting in developmental delay or impairment of normal body functioning	**D1** evaluate support available for individuals and others when coping with difficulties associated with reproduction and inheritance
P4 explain key principles of genetics using examples relating to inheritance in humans [RL2]		
P5 outline principles of reproductive and gene technologies and their implications for individuals, society and the environment [RL2, IE3; IE5; CT2; CT4]	**M3** assess advantages and disadvantages of gene and reproductive technologies for individuals and society in relation to health and wellbeing.	**D2** analyse ethical dilemmas arising from reproductive and gene technologies.
P6 explain ethical dilemmas that may arise from reproductive and gene technologies. [RL2, IE3; IE5; CT2; CT4]		

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills which are embedded in the assessment of this unit. By achieving the criteria, learners will have demonstrated effective application of the referenced elements of the skills.

Key			
	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

It is recommended that the unit is delivered by a tutor with a sound understanding of the biochemical aspects of genetics and the ethical dilemmas arising from the use of technologies in human inheritance. If this is not possible, the unit can be delivered through carefully planned co-teaching. Whilst it is desirable that learners have a basic scientific understanding, it is important to recognise that learners may have little to no previous knowledge of the scientific principles addressed in this unit.

It is also important, in the first instance, that learners understand human anatomy, particularly the reproductive organs, and the physiology of reproduction.

Tutors will need to ensure that learners understand the detail of cell structure, cell behaviour and mitosis, including the role of DNA. Some practical laboratory work, if possible using a microscope to examine cells, would be helpful to those learners new to the area.

This could be followed by delivering the concepts of chromosome numbers and the role of meiosis in reducing diploid to haploid. An introduction to the structure of nucleic acids and their role in protein synthesis would be useful. Formative assessment would be helpful at this point to determine the knowledge and understanding gained to date.

The details of the roles of chromosomes and of meiosis in human reproduction can then be explored, along with the hormonal and environmental factors that can have a positive or negative influence on the process, including factors that can support successful fertilisation and implantation. An explanation for the effects of environmental factors that are known to have a negative effect on human reproduction, together with examples (drugs and medication, nuclear waste and heavy metals etc), would help to put this in context. Learners could undertake some information gathering and research to support this and provide a focus for an assignment.

Models and three-dimensional images of the structure of DNA during different stages of the reproductive process would assist learner understanding of the concepts. Learners should be helped to understand the role of base pairing and codons in the transference of traits from generation to generation. Using examples from life for example learners and their families would help to consolidate learning.

Similarly, when discussing inheritance, the use of examples from human genetics to illustrate principles would be appropriate. For example, the inheritance of blood groups and similarities between blood group compatibility for tissue matching, and the immune response, could be discussed.

Learners should be introduced to genetic engineering principles, and an overview of some of the techniques involved could be given. How genetic technologies are applied and their range of uses should be included and can provide a useful introduction to a discussion on the implications of these technologies. Guest speakers and/or visits relevant to reproductive or gene technology could be useful here.

Discussion could include formal debates as a means of raising awareness of different perspectives on the issues involved. Videos and documentaries can be useful to provide a focus for exploring the issues raised by reproductive and gene technologies. Consideration needs to be given to the potential challenge to learners' values and beliefs (such as religious beliefs) which may be raised by such debates. Tutors should facilitate consideration of a wide range of views in discussions over and above those that currently have a high profile at the time of study.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment
Unit introduction.
Tutor input: human anatomy overview; major systems; use of visual aids where possible.
Tutor input: Anatomy and physiology of the reproductive system; use of visual aids where possible.
Tutor input and learner research: cellular structure and cellular reproduction (miosis).
Tutor input: gametogenesis.
Laboratory visit: examining cellular structure using a microscope including living cells eg from skin scrapings.
Assignment 1: Human reproduction and the environment (P1, P2, M1)
Tutor input: conception.
Tutor input: patterns of inheritance – variation; mutations.
Learner research: dominant and recessive genotypes.
Group discussion: possible impact on individuals and society of genetic-related disorders or developmental delay.
Assignment 2: Human reproduction and the environment (P3, P4, M2, D1)
Tutor input: an exploration of genetic and environmental risks.
Tutor input and learner research: Reproductive technology – contraception, screening, in vitreo fertilisation.
Learner research: gene technology – genetic engineering and its application. Human Genome Project.
Regulation in UK and other countries – write up comparisons.
Group debate: ethical dilemmas arising from reproductive and gene technologies.
Assignment 3: Reproduction and technology (P5, P6, M3, D2)
Unit review and assessment.

Assessment

Two assignments could be used as the basis of assessment for this unit. Evidence is likely to be in the form of written assignments, for example Assignment 1 could ask learners to explain the detailed processes of cellular anatomy and physiology by using spermatogenesis in testes, oogenesis in ovaries and the significance of meiosis in the context of human reproduction and inheritance, including dominant and recessive genotypes. This could be expanded to demonstrate the factors affecting human reproduction on a macro level by asking learners to research the effects on human reproduction of an environmental disaster, for example Hiroshima, Bhopal, Chernobyl. This would include genetic inheritance and chromosomal abnormalities. Alternately, learners could examine the micro environmental impact, such as the use of substances or chemicals on foetal development.

Assignment 2 could deal with reproductive and gene technologies, the benefits and disadvantages to individuals and society and the ethical issues associated with the use of these technologies, using examples.

Initially, evidence for P1 should show that learners clearly understand how sperm and ova are formed and how these cells differ from other cells in their structure. Learners should be able to use diagrammatic representations to support their evidence but images should be fully referenced to their source and annotated in such a way that it is unique to the individual learner rather than taken directly from source material.

For P2 and P3, learners should explain the anatomy and physiology of the human reproductive system and show how different factors affect the reproductive process. The emphasis will be on normal human reproduction.

For M1, learners will, in addition to P1, P2 and P3, be expected to assess inheritance and the relationship between dominant and recessive genes, using human examples such as physical features.

P4, M2 and D1, can be met through researching how the environment, macro and micro, can affect human reproduction.

For P4, learners will clearly explain the principles of genetics by providing examples of inherited traits. M2 will use the findings from research which examine the impact on individuals and society of the different outcomes of reproductive processes.

For D1, learners will need to evaluate the support that is available for individuals who have difficulties associated with reproduction and inheritance and link the evidence to the understanding demonstrated in P4 and M2.

A second, scenario-based assignment could cover the criteria that are based on reproductive and gene technologies, P5, P6, M3, and D2.

For P5 and P6, learners will need to show that they are aware of the range of reproductive and gene technologies available and the purpose of regulation concerning how they are used.

For M3, learners will be able to assess the benefits and disadvantages of reproductive technologies for both individuals and society. For D2, this will be expanded to include an analysis of ethical dilemmas, using examples.

Programme of suggested assignments

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

Criteria covered	Assignment title	Scenario	Assessment method
Part A: P1, P2, M1 Part B: P3, P4, M2, D1	Human reproduction and the environment	Mrs X has just discovered she is expecting her first baby. She has been a heavy social drinker, frequently going out for drinks with colleagues after work and having wine every evening with her meal. Her doctor has warned her that her baby may be in danger from foetal alcohol syndrome. Prepare a report which outlines how the reproductive system may have been affected.	Written report.
P5, P6, M3, D2	Reproduction and technology	Susan and Martin have been married for eight years and have not yet managed to conceive. Prepare a leaflet and notes which explain what technological options are available to them and what regulations govern reproductive research and technology. Martin has a genetic disorder, how will this potentially affect the reproductive process and how ethical is it for Susan and Martin to be trying to conceive a child in such circumstance?	Leaflet and notes.

Links to National Occupational Standards (NOS), other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC Health and Social Care sector suite (see *Appendix A*) and has links with units from other qualifications in that suite. See *Appendix E* for NOS links and *Appendix G* for a mapping of the NHS Knowledge and Skills Framework against particular units in this qualification.

Essential resources

The following resources are essential for delivery of this unit:

- an appropriately qualified tutor
- library resources with key texts and other reference materials.

In addition, the following resources are considered to be highly valuable:

- laboratory access
- computer access
- case study materials
- audio and visual records.

Employer engagement and vocational contexts

Visits to relevant workplaces such as fertility clinics, hospitals or research facilities would be of great benefit to learners. In the absence of these, visiting speakers such as GPs, nurses or scientists would be useful.

Indicative reading for learners

There are many resources available to support this unit. Some examples are:

Textbooks

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

Gilbert P – *A-Z of Syndromes and Inherited Disorders* (Nelson Thornes, 2000) ISBN 9780748745296

Kent M – *Advanced Biology* (Advanced Science) (Oxford University Press, 2000) ISBN 9780199141951

Myers B – *The Natural Sciences* (Nelson Thornes, 2004) ISBN 9780748785834

Shaw L – *Anatomy and Physiology* (Nelson Thornes, 2005) ISBN 9780748785841

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 Level 3 Nationals in Health and Social Care Student Book 2* (Pearson, 2010) ISBN 9781846907470

Thomson H, Meggitt C, Aslangul S and O'Brien – *Further Studies for Health* (Hodder Arnold, 2002) ISBN 9780340804230

Toole A and S – *Understanding Biology for Advanced Level* (Nelson Thornes Ltd, 2000) ISBN 9780748739646

Tortora G – *Principles of Anatomy and Physiology* (John Wiley and Sons, 2005) ISBN 9780471718710

Ward J, Clarke R W and Linden R – *Physiology at a Glance* (Blackwell Publishing, 2005) ISBN 9781405113281

Journal

Journal of Physiology

Websites

www.bbc.co.uk/health	BBC health
www.innerbody.com/htm/body.html	Human anatomy online
www.nhsdirect.nhs.uk	NHS Direct patient information leaflets
www.womens-health.health-cares.net/female-fertility-tests.php	Fertility tests

Delivery of personal, learning and thinking skills

The table below identifies the personal, learning and thinking skills (PLTS) that have been included within the assessment criteria of this unit.

Skill	When learners are ...
Independent enquirers	[IE1] identifying questions to answer when researching reproductive processes [IE3,5] exploring issues from different perspectives and considering the influence of beliefs when researching and discussing the implications of reproductive technologies
Creative thinkers	[CT2] asking questions to extend their thinking about reproductive technologies [CT4] questioning own and others' assumptions when researching the ethical dilemmas that may arise from reproductive technologies
Reflective learners	[RL2] setting goals for assignment work.

Functional Skills – Level 2

Skill	When learners are ...
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	selecting and using a variety of sources when researching information on the principles of genetics
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	accessing ICT-based information on genetics and reproductive technologies, evaluating its relevance for assignment work
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: • text and tables • images • numbers • records	entering and developing information for assignments, eg when explaining the key principles of genetics – presenting text, tables, images etc
Present information in ways that are fit for purpose and audience	presenting information in the correct way taking into consideration the purpose and audience
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	contributing to group discussions about the principles of reproductive and gene technologies and the implications of these for individuals, society and the environment, presenting conclusions to the group
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	reading and synthesising information from a variety of sources on the factors that may influence the reproductive process in humans
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	writing different types of documents, eg an extended report and a leaflet; communicating ideas clearly and persuasively.