Unit 32: Understand the Principles of Animal Breeding and Genetics

Unit code: L/600/9426

QCF Level 3: BTEC National

Credit value: 10

Guided learning hours: 60

Aim and purpose

This unit aims to provide learners with an understanding of the principles of animal breeding and genetics. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or to further education and training.

Unit introduction

It is important that those working within the animal industries have an understanding of the science behind breeding as well as the skills required to responsibly select and manage breeding and juvenile animals.

Learning outcome one covers the basic genetics learners require in order to be aware of how animals inherit characteristics, allowing them to explain how knowledgeable breeding leads to a greater probability of producing desirable characteristics in offspring.

Outcomes two and three equip learners with knowledge of how to effectively care for and manage both breeding females and juvenile animals, including identification of the potential problems that may arise.

Outcome four 4 allows learners to discover the different types of animal breeding problems that may be encountered and the range of reproductive technologies that are available to assist breeding, including how the breeder may incorporate them into breeding programmes.

Learning outcomes

On completion of this unit a learner should:

1 Understand the principles of inheritance

2 Know how to manage breeding stock

3 Know how to manage young animals

4 Understand the uses of reproductive technology.

Unit content

1 Understand the principles of inheritance

Definitions: inheritance, phenotype, genotype, gamete, chromosome, loci, gene, allele, DNA, dominant, recessive, homozygous, heterozygous; species, breeds

Protein synthesis: DNA structure, DNA translation: base sequence, triplet code, tRNA, ribosomes; amino acids, protein structure

Stages of meiosis (diagrams and explanations): prophase I, prometaphase I, metaphase I, anaphase I, telophase I, (cytokinesis may or may not occur), interphase II, prophase II, metaphase II, anaphase II, telophase II, cytokinesis

Mendelian genetics: genetic diagrams to F2 (monohybrid and dihybrid crosses), analysis of genotypic and phenotypic ratios of offspring using simple probability tests and tables

Gene interactions: lethal alleles, incomplete dominance, co-dominance, multiple alleles, epistatic effects, sex-linkage and sex-influenced effects

2 Know how to manage breeding stock

Selection of breeding stock: reasons for breeding (pet trade, production, competition, endangered species conservation; use of pedigrees; desirable characteristics for breeding stock (temperament, fertility, health, performance)

Management of breeding stock: diet, housing, health, welfare; breeding female: oestrous cycle (hormone levels, effects on behaviour, identification of oestrus); purpose and methods of contraception; computerised and manual record keeping (identification of suitable records to keep, legislative requirements, uses of records), regulations for breeding establishments; fertility management strategies; culling/euthanasia

Conception and parturition: preparation for and carrying out of mating (including health and safety, assessing risks, personal protective equipment (PPE)); preparation for and stages in parturition (including monitoring the female and offspring).

3 Know how to manage young animals

Care plans: preparing for the first 24 hours of life, identification of the stages of development of the juvenile animal, staged adaptations to care plans (eg appropriate housing; nutrition; health maintenance: signs, symptoms, prevention, causes and treatments of common diseases) problems and solutions associated with orphans (eg hand-rearing, fostering)

Legislative requirements: minimum age for sale and breeding of animals, minimum age for ownership; restricted practices and domestic hybrids, regulations for breeding establishments, notifiable diseases and dangerous occurrences, animal welfare standards, stock identification and movement

4 Understand the uses of reproductive technology

Breeding problems (causes, treatments and prevention as applicable): infertility; inherited diseases and disorders; heritability of desirable traits; dystocia, post-partum difficulties (eg nutritional/metabolic disorders, retention of foetal membranes (retained placenta), metritis and endometritis)

Reproductive technology: DNA screening, genetic analysis; hormone therapy, devices and techniques to identify ovulation; artificial insemination; biotechnology: superovulation, synchronisation, embryo transfer; cloning and genetic engineering; pregnancy diagnosis

Ethics: justification for researching and using reproductive technologies, practicalities for breeders, implications for animal welfare, social and commercial viewpoints, codes of ethics

Assessment and 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 assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and 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 protein synthesis from DNA [RL]	**M1** explain the types of gene interaction and their effects	**D1** analyse the effect of the Agouti gene on coat colours in selected animals
P2 explain the stages of meiotic cell division [RL]		
P3 explain the principles of Mendelian genetics and the laws of inheritance [IE]		
P4 analyse breed data using simple probability tests [IE]		
P5 describe the factors to consider when selecting and managing breeding stock [IE]	**M2** explain how breeders may prevent, resolve and manage potential problems arising in the management of the female and offspring from conception to weaning of the offspring	
P6 describe the management of the female from conception to birth [IE]		
P7 identify potential problems that could occur in the management of the female from conception to birth [IE, SM]		

Assessment and 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:**
P8 describe the care requirements of offspring from birth to weaning [IE]	**M3** outline how breeders can ensure that they are aware of and comply with legislation relevant to breeding selected animals.	**D2** evaluate the significance of animal breeding records and reproductive technologies in livestock or breed improvement, including the ethical and moral responsibilities of animal breeders.
P9 identify problems that could occur in the offspring from birth to weaning [IE, SM]		
P10 explain the types of breeding problems that can occur [IE]		
P11 discuss the types of reproductive technologies that are available for animal breeders [IE]		
P12 explain how reproductive technologies can be used by animal breeders. [IE]		

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate 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

Delivery of this unit will involve practical assessments, written assessment, visits to suitable collections and will have links to industrial experience placements. Tutors delivering this unit have opportunities to use as wide a range of techniques as possible: lectures, demonstrations, seminar presentations, site visits and supervised practical work, guest speakers from breeding establishments, internet and library-based research should all play a part. Wherever possible, learners should have access to practical experience of breeding programmes and records, as well as husbandry.

Work placements should be monitored regularly in order to ensure the quality of the learning experience. It would be beneficial if learners and supervisors were made aware of the requirements of this unit prior to any work-related activities, so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to help with the selection of breeding stock or help maintain breeding records, and they should be encouraged to ask for observation records and/or witness statements to be provided as evidence of this. Guidance on the use of observation records and witness statements is provided on the Edexcel website.

Whichever delivery methods are used, it is essential that tutors stress the importance of animal welfare issues and the need to manage the resource using legal methods. It would be inappropriate for animals to be bred indiscriminately or a number of times consecutively for the sake of multiple learners' teaching and/or assessment.

Health and safety issues relating to working with animals must be emphasised and regularly reinforced; risk assessments must be undertaken prior to practical activities, for example, during visits to a breeding establishment. Adequate PPE must be provided and used following the production of suitable risk assessments.

Learning outcome 1 is likely to be delivered by formal lecture, discussion, laboratory practical work and use of interactive internet-based animations and games. Learners will become aware of meiotic cell division and the stages of meiosis, through practical investigation (eg microscopes and appropriate slides) and internet resources. Visits to breeding establishments will provide learners with the opportunity to meeting breeders and be able to compare results of observed genetic crosses with expected results.

Learning outcome 2 and 3 are directly linked and are likely to be delivered by formal lectures, discussion, site visits, practical activities and independent learner research. Learners will become aware of the methods and associated activities commonly used in the selection and management of breeding stock and the care of young animals. Visits could be made to animal breeding establishments with involvement in routine practical management of stock during their reproductive cycles (by using on/off site facilities and/or work experience placements).

Learning outcome 4 is likely to be delivered by formal lectures, discussions, site visits and independent learner research. Learners will become aware of the problems associated with breeding animals and the range of reproductive technologies that are available. Visiting expert speakers could add relevance of the subject for learners. For example, a breeding establishment manager or research scientist could talk about their work and research and the methods they use.

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 gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value.**

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Unit introduction and overview.
Assignment 1: Inheritance of Characteristics (P1, P2, P3, P4, M1, D1) Tutor introduces assignment.
Inheritance I – establish prior knowledge, quiz on key word definitions, introduction to DNA, genes and alleles.
Inheritance II – inheritance of characteristics and features, introduce meiosis, link back to genes and alleles, introduce Mendel.
Inheritance III – microscopy work, stages of meiosis. Use of modelling clay to represent chromosomes at each stage. Follow up with internet-based guided research on the processes occurring at each stage.
Individual support.
Inheritance IV – DNA structure: models, animated representations, learners creating model from paper 'jigsaw'. Link back to genes, alleles, chromosomes; introduce DNA translation, learners prepare for group presentations during next session.
Personal study.
Inheritance V – Learner presentations describing processes from DNA structure through to protein structure.
Inheritance VI – Genetic diagrams: introduction, theory and numeracy – simple probability, (extension work to introduce chi square test), heritability.
Individual support.
Personal study.
Inheritance VII – Applying Mendelian genetics and analysis of genotypic and phenotypic ratios, given offspring data.
Inheritance VIII – Genetic interactions, worked examples and group presentations.
Inheritance IX – the Agouti gene and its effects.
Individual support.
Section overview.
Assignment 2: Breeding to Weaning (P5, P6, P7, P8, P9, M2) Tutor introduces assignment.
Individual support.
Breeding VIII – learners visit a breeding establishment to observe the mating process, making notes on the practicalities of mating, health and safety issues and risks; discussions about legislation and record keeping.
Personal study.
Young animals I – discussion of rearing young animals, linking back to preparation of the female and looking forward to care of the neonate.
Young animals II – learners discuss preparations for the first 24 hours of life and put together a care plan (including any relevant timings, materials that may be required and how to identify and overcome common problems/disorders, including becoming orphaned).

Topic and suggested assignments/activities and/assessment
Personal study.
Young Animals III – Developmental stages: learners put together a timeline identifying stages in development for given species. Group discussion of requirements at each stage, then guided research into resulting care implications. This research is then presented by learners in a seminar format.
Individual support.
Personal study.
Young Animals IV – Rearing problems: learners use notes taken from the seminars, the care plan produced in earlier sessions and tutor information sheets in order to identify problems that may occur, along with prevention, treatment and management.
Assignment 3: Complying with Legislation (M3) Tutor introduces assignment.
Young Animals V – Legislation: learners are given summaries of the legislative requirements of breeding, then either a) create a poster linking them together for a given breeding establishment or b) put together a short report to describe how a hypothetical breeding establishment ensures that practices are compliant with legislations.
Personal study.
Section summary.
Assignments 4: Reproductive Technologies (P10, P11, P12) Tutor introduces assignment
Reproductive Technology I – establish prior knowledge of breeding problems and reproductive technology, including ethical and moral issues, leading to production of a mind/concept map.
Reproductive Technology II – learners carry out independent guided research into the breeding problems as listed in the specification along with any other the tutor would like to include. Learners report back in small groups, ensuring that all causes, treatments and preventions are covered (tutor to assist where necessary).
Personal study.
Reproductive Technology III – guest speakers from breeding establishments/representatives of reproductive technology companies describe the applications of reproductive technology to selected species, followed by questions from learners.
Reproductive Technology IV – discussion of previous session's points, including the ethical issues and practicalities for breeders. Tutor to cover other reproductive technologies not as yet discussed.
Reproductive Technology V – learners observe video footage of reproductive technologies being carried out and complete quiz; discussion of how records and technologies have been used to improve livestock and other breeds.
Personal study.
Reproductive Technology VI – incorporating reproductive technologies into breeding programmes. Learners research, discuss and finally put together a breeding programme for a hypothetical breeder of selected species.
Individual support.
Assignment 5: Breed Improvement (D2)
Section summary.
Unit review.

Assessment

For P1 learners must explain the process of protein synthesis from DNA. Molecular structure and function must be linked at all stages and an awareness of the importance of protein synthesis must be shown. Suitable evidence would be an annotated poster or illustrated essay.

For P2 the stages of meiotic cell division must be explained. Learners could be given pictures or slides of each meiotic stage, asked to recall the name and describe the processes that are or have occurred as appropriate. Suitable evidence would be an illustrated essay, annotated poster or observation sheets completed by both the learner and tutor.

For P3 learners are required to explain Mendelian genetics and the laws of inheritance. Both monohybrid and dihybrid inheritance of features must be explained along with annotated genetic diagrams constructed by the learner. Suitable evidence would be an illustrated essay, short report or pictorial presentation and handouts.

P4 requires learners to analyse breed data using simple probability tests. This is limited to calculation of the probability of parental genotype from information about the offspring, plus calculation of the probability of offspring inheriting genetic disorders, from data given by the tutor. Suitable evidence would be calculation sheets for each situation completed by learners.

For P5 tutors should identify a species or agree it through discussion with learners, who must describe fully at least seven factors that must be taken into consideration when breeding this species. This could be completed as part of a project (which could also incorporate P6, P7, P8 and P9), pictorial presentation with accompanying handouts or assessed orally, with observation records and/or witness statements as suitable evidence.

P6 requires learners to describe the management of the female from conception to birth. This could be in the form of detailed care plans for two species (identified by the tutor or agreed through discussion with learners) produced by the learner, as part of a project following on from P5, or as part of a case study following the pregnancy of a female. P6 could be assessed alongside P7.

For P7, learners must identify potential problems arising during management of the female from conception to birth. This could be in the form of detailed care plans, part of a project or case study, or assessed orally, in which case suitable evidence would be witness statements and/or observation records. It is assumed that the number of problems identified will be comparable to those that would be identified by a competent breeder of the selected species.

P8 requires the learner to describe the care of offspring from birth to weaning. Again learners may choose two species and produce detailed care plans. A presentation with handouts, an annotated poster, oral assessment or part of a project would also provide suitable evidence.

For P9, suitable evidence to identify problems that could occur in the offspring from birth to weaning would be similar to that described for P7. It is assumed that the number of problems identified will be comparable to those that would be identified by a competent breeder of the selected species.

For P10 learners must describe breeding problems that may occur with one species of animal (those listed in the specification as a minimum), as part of a project, illustrated essay, annotated poster or presentation with handouts. It is assumed that the number of problems identified will be comparable to those that would be identified by a competent breeder of the selected species.

P11 could be assessed as part of an illustrated essay including P10 and P12. As a minimum, each of the reproductive technologies listed in the specification must be described, including the situations in which each could be used with one species of animal.

P12 could follow on from assessment of P11, with learners explaining the processes involved in utilising each of the reproductive technologies. Consideration must be given to cost and availability to the breeder of each technology. Suitable evidence would be an illustrated essay or short video with accompanying timeline.

For M1 learners are required to explain the types of gene interaction and their effects. This can be linked directly to work being undertaken for P1 and P2. Evidence may be provided in the same format as P1.

M2 requires learners to take a holistic approach to the breeding process, identifying how to prevent problems occurring and how to deal with them if they arise. Assessment for M1 could take place at the same time as P5, P6, P7, P8 and P9. Suitable evidence would be an illustrated essay or report accompanying detailed care plans for both the female and offspring from conception to weaning of the offspring.

For M3, a species may be selected by the tutor or through discussion with the learners. Suitable evidence could be a leaflet advising breeders of their legal responsibilities while breeding, including how to ensure that they are complying with the relevant legislation and where they can get more information. An essay or short report would also be suitable. References to legislative sources must be included.

For D1 learners must describe and analyse the effect of the Agouti gene on the coat colour of two species of animal selected by the tutor or agreed through discussion with learners. Full explanation of the genetic interactions and Illustrations of the different phenotypes arising must be given. Consideration must be given to how this affects breeders who may wish to breed a particular coat colour. Suitable evidence would be a presentation with accompanying notes and handouts, a short film with accompanying time line, oral assessment, an illustrated essay or report

D2 requires learners to choose a species or breed, and then evaluate how significant the role of maintaining breeding records and utilising reproductive technologies has been in breed/livestock improvement. Learners must also evaluate of the ethical and moral responsibilities of breeders. Suitable evidence would be an essay, report, hypothetical magazine article or presentation with accompanying notes and handouts.

Programme of suggested assignments

The following table 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
P1, P2, P3, P4, M1, D1	Inheritance of Characteristics	Learners produce a portfolio of work explaining how characteristics are inherited from parents by offspring. Presentation should be of a good standard throughout. Included in the project should be the following: A brief description of genetic material (DNA structure, genes, alleles, chromosomes etc) An explanation of the function of DNA, including detailed description of DNA translation Outline of sexual reproduction, including sex cell production Practical observation sheet showing illustrations and explanations of each stage of meiotic cell division A description of Mendel's work and the laws of inheritance Annotated genetic diagrams explaining both monohybrid and dihybrid inheritance of characteristics Calculation sheets – probability of parental genotype and probability of inheriting a genetic disorder	Various.

Criteria covered	Assignment title	Scenario	Assessment method
		For M1: explanations and examples of each genetic interaction For D1: a description and analysis of the effect of the Agouti gene in two selected species, along with worked examples of its inheritance	
P5, P6, P7, P8, P9, M2	Breeding to Weaning	Learners assemble a hypothetical magazine article based on advice for potential breeders to select and manage their breeding stock. Accompanying the article must be supplements about breeding two species of animal, including how to arrange successful mating and detailed care plans: a) for management of the female from conception to birth and b) for management of the young animals from birth to weaning. A troubleshooting guide identifying potential problems should be included with each care plan. For M2, there should be a report accompanying each set of care plans and troubleshooting guide describing how prevent, manage and treat any problems that may arise with both the female and young animals.	Written.
M3	Complying with Legislation	Learners produce a leaflet aimed at breeders of a selected species, describing the legal responsibilities that breeders have while breeding animals. The leaflet must also include examples of how breeders can make sure they are complying, along with how they can gain more information about the legislation and keep up-to-date with any changes or additions.	Written.
P10, P11, P12	Reproductive Technologies	Learners put together a presentation with accompanying notes and handouts, explaining the types of breeding problems that may occur, discussing the types of reproductive technologies available and explaining how those technologies can be used by animal breeders of a selected species.	Presentation.
D2	Breed Improvement	Learners write an essay based on one breed, describing the impact of breeding records and reproductive technologies on the improvement on that breed. They should conclude the essay with a consideration of the improvements in the light of ethical and moral responsibilities of breeders.	Written.

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

This unit forms part of the BTEC Land-based sector suite. This unit has particular links with:

Level 3
029NLP48
029NLP25.1

Essential resources

Learners will ideally require regular supervised access to sites holding reasonable populations of animals (as many as possible from: companion, exotics, large and small).

internet access, good library facilities, microscopes, first-aid facilities, PPE and appropriately qualified tutors are essential.

Employer engagement and vocational contexts

Any breeding establishment, farms that breed livestock or other collection that carries out breeding programmes would be of great value to learners.

Indicative reading for learners

Textbooks

Association for the Advancement of Animal Breeding and Genetics – *Application of New Genetic Technologies to Animal Breeding* (CSIRO Publishing, 2005) ISBN 13: 9780643092334

Bourdon R – *Understanding Animal Breeding* (Prentice Hall, 1999) ISBN 13: 9780130964496

Boyle M – *Biology* (Collins Educational, 2008) ISBN 13: 9780007267453

Crew F – *Animal Genetics – The Science of Animal Breeding* (Read Books, 2006) ISBN 13: 97814067961 17

Dallas S – *Animal Biology and Care* (Blackwell Publishing Ltd, 2006) ISBN 13: 9781405137959

Fleig D – *The Technique of Breeding Better Dogs* (John Wiley and Sons Ltd, 1996) ISBN 13: 9780876057896

Kent M – *Advanced Biology* (Oxford University Press, 2000) ISBN 13: 9780199141951

Lane D, Cooper B and Turner L – *BSAVA Textbook of Veterinary Nursing, 3rd Edition* (British Small Animal Veterinary Association, 2007) ISBN 13: 9780905214894

Lochhead W – *An Introduction To Heredity And Genetics – A Study Of The Modern Biological Laws And Theories Relating To Animal And Plant Breeding* (Read Books, 2009) ISBN 13: 9781444602128

Mitchell J and Doak G – *The Artificial Insemination and Embryo Transfer of Dairy and Beef Cattle Including Information Pertaining to Goats, Sheep, Horses, Swine and Other Animals* (Prentice Hall, 2003) ISBN 13: 9780131122789

Ostrander E, Giger U and Lindblad-toh K – *The Dog and Its Genome* (Cold Spring Harbor Laboratory Press, US, 2007) ISBN 13: 9780879697815

Parry-Jones J – *Understanding Owls: Biology Management Breeding Training* (David & Charles plc, 2001) ISBN 13: 9780715312230

Turner J – *Animal Breeding, Welfare and Society* (Earthscan Ltd, 2010) ISBN 13: 9781844075898

Journals

British Journal of Animal Science

Journal of Animal Breeding and Genetics

Livestock Production Science

Genetics Selection Evolution

Journal of Animal Science

Journal of Dairy Science

Websites

www.bbsrc.ac.uk	Biotechnology and Biological Sciences Research Council
www.defra.gov.uk	Department for Environment, Food and Rural Affairs
www.defra.gov.uk/foodfarm/policy/index.htm	DEFRA – legislation, policy and regulations
www.dnatutorial.com	DNA Tutorial
www.fabretp.org/	Farm Animal Breeding and Reproductive Technology Platform
www.johnkyrk.com	Cell Biology Animations by John Kyrk
www.lantra.co.uk	Lantra Sector Skills Council
www.newscientist.com	New Scientist
www.rspca.org.uk	The Royal Society for the Prevention of Cruelty to Animals
www.the-kennel-club.org.uk	The Kennel Club
www.ufaw.org.uk	Universities Federation for Animal Welfare

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit.

Skill	When learners are ...
Independent enquirers	constructing genetic diagrams to explain monohybrid and dihybrid inheritance of characteristics describing important factors in selecting and managing breeding stock identifying problems that could occur in the management of females from conception to birth identifying problems that could occur in the offspring from birth to weaning discussing the types of reproductive technology available
Reflective learners	explaining protein synthesis from DNA explaining meiosis explaining the different types of breeding problems.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are ...
Independent enquirers	carrying out investigations into breed data identifying questions and problems about managing breeding establishments, using breeding data and implementing reproductive technologies drawing conclusions about care plans for females and young animals
Reflective learners	using different methods to communicate their learning, such as essays, short films, presentations and discussions
Team workers	discussing management techniques, fertility strategies and legislation
Self-managers	organising time and resources for practical work
Effective participators	discussing the ethical and moral responsibilities of breeders.

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	using the internet to research information for assignments
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	using online and offline databases and tools to investigate breeding records
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	producing word-processed assignments, pictorial presentations and short films
Bring together information to suit content and purpose	selecting and producing information for written assignments and pictorial presentations
Present information in ways that are fit for purpose and audience	selecting and producing information for written assignments and pictorial presentations
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	investigating probabilities, and analysing breed data
Interpret and communicate solutions to practical problems in familiar and unfamiliar routine contexts and situations	constructing genetic diagrams, interpreting inheritance ratios and analysing breed data to predict inheritance of genetic disorders
Draw conclusions and provide mathematical justifications	interpreting inheritance ratios and analysing breed data to predict inheritance of genetic disorders
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	discussing ethical and moral issues surrounding breeding and genetics giving presentations on unit topics
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	carrying out library-based research to produce assignments
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	producing written assignments.