Subject Modules

The Subject Modules for the Agricultural Science pathway are:

- Agricultural Science
- Chemistry
- Applied Mathematics for Agriculture
- Economics (only for students not required to take the Academic Skills module)

General learning outcomes

Having completed each subject module, students will be able to:

- understand key concepts and subject-specific vocabulary
- demonstrate knowledge and understanding of subject content
- apply theoretical knowledge to real world issues
- analyse and interpret information from a variety of sources
- evaluate sources of information and make balanced and informed judgements
- communicate ideas effectively using a range of language skills

Agricultural Science Module

1. Scientific Practices

- Hypothesising and experimenting
- Evaluating evidence and communicating
- Working safely

2. Soils

2.1 Soil formation and classification:

- Parent material: types of rocks
- Weathering and decomposition of rock
- Organic parent material
- Factors affecting soil formation
- Soil profiles
- Systems of classification

2.2 Physical Characteristics of soil:

- Texture
- Structure
- Porosity
- Colour
- Temperature
- Impact of erosion, sedimentation and weathering

2.3 Chemical and biological characteristics of soil:

- Flocculation
- Cation exchange
- pH
- Availability of soil nutrients
- Soil microbiome
- The rhizosphere
- Organic matter
- Organic carbon
- Carbon and nitrogen cycles
- Macro-organisms

2.4 Soil management:

- Essential elements, macronutrients (N, P, K, Ca, Mg, S) and micronutrients (Fe, Zn, Mn, Cu, B, Mo)
- Soil testing
- Fertilisers and manures
- Fertilisers and essential elements
- Calcium ammonium nitrate
- Compound fertilisers
- Drainage
- Conservation & sustainable land use

3. Crops

3.1 Plant physiology:

- Vascular Tissue
- Photosynthesis
- Respiration
- Water Transport

- Nutrient Absorption

3.2 Applied plant genetics:

- Genetic improvement and selection
- Genotyping and genomic selection
- Agricultural biotechnology
- Protein production for disease prevention
- Ethical and economic considerations in crop development

3.3 Plant classification:

- Identifying plant families
- Plant life cycles
- Plant breeding
- Reproductive technologies

3.4 Principles of crop production and management:

- Seed certification In the UK and Ireland
- Factors affecting crop management
- Impact of crop management on animals
- Winter vs Spring sowing
- Germination: the influence of soil on productivity
- Crop rotation
- Bacterial diseases
- Sustainable development
- Organic farming

4. Crop studies

4.1 Grazing and grassland management:

- Uses of grassland
- Methods of grazing
- Complementary practices
- Impact of grassland management on livestock and other animals
- Fertilisation

4.2 Students study 2 crops and prepare presentations, either:

- Barley & Kale
- Potatoes & Miscanthus

5. Animals

5.1 Animal nutrition:

- Nutrients and their function in growth and development
- Energy requirements of animals
- Animal feeds

5.2 Animal physiology:

- The digestive process
- Chemical digestion in the mouth
- The ruminant digestive system
- The monogastric stomach

5.3 Animal reproduction:

- The male reproductive system
- The female reproductive system
- Methods of fertilisation (dairy, sheep)
- The importance of genetics for food production and breeding stock (dairy, pig, sheep)

5.4 Applied animal genetics:

- Genetic improvement
- Physical traits
- Performance and progeny testing
- Genotyping and genomic selection

6. The farming of animals: students choose dairy farming OR sheep farming OR pig farming

6.1 Dairy farming:

- Dairy breeds and crossbreeds
- Life cycle of a replacement heifer (colostrum, housing, weaning, overwintering)
- Selecting replacement heifers
- The production cycle of a dairy cow
- Factors that determine output and quality of produce
- Nutritional management (before calving, early lactation, mid & late lactation)
- Dairy parlours
- Winter housing
- Farm safety
- Milk composition, production, quality and price
- Hygiene and testing

- Dairy farm economics
- Sustainability
- Traceability and animal welfare

6.2 Sheep farming:

- Factors affecting output and production
- Breeds (mountain and hill, lowland)
- Replacement ewes
- The breeding year Easter and mid-season lamb)
- Flushing, sponging, ram effect, scanning, steaming up
- Lambing
- Fostering
- Ewe and lamb mortality
- General management of sheep: vaccination, dosing, dipping, dagging, docking, foot care, shearing)
- Sheep farm economics
- Optimising health and welfare
- Sustainability

6.3 Pig farming:

- Breeds
- Integrated pig production units
- Production cycle
- Nutrition in different stages of production
- Management practices (handling, housing, environment enrichment, noise control, reducing lameness)
- Weaning and feeding
- Fattening
- Live weight gain and feed conversion ratio
- Innovation and biotechnology in pig production
- Sustainable and environmentally friendly pig production
- Pig farm economics

The coursework for this module will involve spending time on a real farm or in an Agri business, and producing a report with recommendations.

Guest speakers

In addition to the core, examined content of this module (as detailed above), guest speakers will deliver talks as follows:

1. The production of stem celled proteins globally (white meat, red meat & fish)
   Cellular Agriculture Society (CAS)
2. Stem celled produced breast milk: a new alternative to powdered milk
   Biomilq
3. Waste Not: the upcycling of mis-shaped and leftover fruit into added value products
   Fooditive
4. From cooperative society to global multinational
   Kerry Group
5. The seasonality of loans: the relationship between banks and farmers
   Cara Credit Union
6. Healthy animals = healthy humans: animal food research to produce healthier food for people
   Devenish Group
7. Life on Mars: the design of habitats for NASA for MARS, and Space Agritecture.
   SpaceXarch
8. The secret power of seaweed: using bioprocessed seaweed to produce natural products which can replace and enhance anti-biotics and chemical fertilisers
   Bio-Atlantis
9. Success in modern farming: adding value to the humble potato and production of fruit year-round
   Keoghs Potatoes and Keeling's horticulture
10. Creating a buzz: insect farming for animal consumption and as an alternative protein source for fish
    Hexafly
11. Market Systems Development
    Trocaire
12. Climate and Environmental Justice
    Trocaire
13. Agroecology
    Trocaire
14. The gift of life: giving livestock as a means of long-term development aid
    Bothar NGO
15. Achieving global reach: promoting Irish food brands around the world
    Bord Bia

16. Is Covid just the beginning? Zoonotic animal diseases that can be transferred from animals to humans
    Dr. Leo O'Brien, Microbiologist and Chairman of O'Brien Associates, Applebee International College and Applebee Research Institute
17. The power of innovation: new ways to generate solar power, and the emergence of hydrogen energy
    Amerenco
18. Meeting demand in a changing world: growing food with 90% less water, and year-round cropping
    Urban Crop Solutions
19. Improving lives and the environment through waste water recycling
    Clean Water Wave
20. Grazing and grassland management
    Michael Egan, Agricultural Scientist, CEO Sustainable Development in Agricultural Programmes and Rural/Urban Crop Production Systems, O'Brien Associates
    Director, Applebee International College and Applebee Research Institute
21. The EU and farming part 1: The Water Framework Directive, The Nitrates Directive and The Rural Environmental Scheme
    Michael Egan, Agricultural Scientist, CEO Sustainable Development in Agricultural Programmes and Rural/Urban Crop Production Systems, O'Brien Associates
    Director, Applebee International College and Applebee Research Institute
22. The EU and farming part 2: The Leader Programme, The European Green Deal and The Common Agricultural Policy.
    Michael Egan, Agricultural Scientist, CEO Sustainable Development in Agricultural Programmes and Rural/Urban Crop Production Systems, O'Brien Associates
    Director, Applebee International College and Applebee Research Institute

Module learning outcomes

Having completed this module, students will be able to:

- Assess the validity, reliability and credibility of scientific information within the field of agricultural science
- Apply scientific practices to the study of agriculture
- Make, record and communicate reliable and valid observations and measurements with appropriate precision and accuracy
- Explain the various characteristics of soils and how to manage them

- Apply their knowledge of plants and crop production to suggest effective farm management practices
- Apply their knowledge of sheep, dairy and pig farming to suggest effective farm management practices
- Explain the environmental impact of different types of farming on the environment and suggest ways to minimize it and make farming more sustainable

Text: Breaking Ground - Agricultural Science (C. Cronin & S. Tiernan) Edco 2019

Chemistry Module

This module aims to develop students' skills, knowledge and understanding in chemistry in preparation for entry to studies in this subject and related subjects at undergraduate degree level. It offers the opportunity to develop skills of investigation through laboratory based practical work, and includes tutorial-based teaching of theory and problem-solving seminars. The content has been chosen for its relevance to Agricultural Science and potential applications in related fields.

1. Physical chemistry:

1.1 Atomic structure:

- Fundamental particles
- Mass number and isotopes
- Electron configuration
- Periodic

1.2 Amount of substance:

- Relative atomic mass and relative molecular mass
- The mole and the Avogadro constant
- The ideal gas equation
- Empirical and molecular formula
- Balanced equations

1.3 Bonding:

- Ionic bonding
- Covalent and dative covalent bonds
- Metallic bonding

- Bonding and physical properties
- Shapes of simple molecules and ions
- Bond polarity
- Forces between molecules

1.4 Energetics:

- Enthalpy change
- Calorimetry
- Hess's law
- Bond enthalpies

1.5 Kinetics:

- Collision theory
- Maxwell-Boltzmann distribution
- Effect of temperature on reaction rate
- Effect of temperature and pressure
- Catalysts

1.6 Chemical equilibria, Le Chatelier's principle and Kc

1.7 Oxidation, reduction and redox equations

1.8 Acids and bases:

- Acid base equilibria in aqueous solutions
- Definition and determination of pH
- The ionic product of water
- Weak acids and bases
- pH curves, titrations and indicators
- Buffer action

1.2 Equilibria and Redox

- Equilibrium mixtures
- Equilibrium constants
- Electrode potentials

2. Inorganic Chemistry

2.1 Periodicity:

- Classification
- Physical properties of period 3 elements

2.2 Group 2: the alkaline earth metals

2.2 Group 7 (17): the halogens:

- Trends in properties
- Uses of chlorine and chlorate

3. Organic chemistry

3.1 Introduction to organic chemistry:

- Nomenclature
- Reaction mechanisms
- Isomerism

3.2 Alkanes:

- Fractional distillation of crude oil
- Modification of alkanes by cracking
- Combustion of alkanes
- Chlorination of alkanes

3.3 Halogenoalkanes:

- Nucleophilic substitution
- Elimination
- Ozone depletion

3.4 Alkenes:

- Structure, bonding and reactivity
- Addition reaction of alkenes
- Addition polymers

3.5 Alcohols:

- Alcohol production
- Oxidation of alcohols
- Elimination

3.6 Organic analysis:

- Mass spectrometry
- Infrared spectroscopy

The coursework for this module will require students to conduct and write up an experiment within the field of Agricultural Science.

Module learning outcomes

Having completed this module, students will be able to:

- understand specific chemical facts, terminology and principles
- assess the validity, reliability and credibility of scientific information within the field of chemistry
- make, record and communicate reliable and valid observations and measurements
- with appropriate precision and accuracy
- analyse, interpret, explain and evaluate the methodology and results
- organise information clearly and coherently using specialist vocabulary appropriate.

Mathematics Module

The module aims to provide students with a good working knowledge of mathematics to enable them to continue their development in this area at undergraduate level. It covers key areas of pure mathematics and statistics to develop a problem-solving approach, and helps students to develop awareness of the relevance of mathematics to other fields of study. Throughout the course, students will learn to apply Mathematics to real-world farming situations.

Module content

1. Pure Mathematics:

- Algebra and functions
- Quadratic functions
- Sketching functions
- Coordinate geometry
- Arithmetic and geometric series
- Differentiation
- Integration
- Radian measure
- Trigonometric functions
- Trigonometric equations and identities
- Exponentials and logarithms

2. Statistics:

- The statistical problem-solving cycle
- Types of data
- Data interpretation: measures of location and dispersion
- Data interpretation: skewness and correlation
- Correlation and regression
- Probability and probability distributions
- Discrete random variables
- Binomial distribution
- Normal distribution

3. Mathematical applications in agriculture:

- Conversions
- Area & volume
- Special triangles
- Land measurements
- Scale drawings
- Applications in soil preparation
- Applications in planting, harvesting, storage
- Applications in livestock production
- Agribusiness Finances

The coursework element of this module will require students to apply Level 3 Mathematics to a scenario within Agricultural Science

Learning outcomes

Having completed this module, students will have developed:

- an understanding of the language and concepts of mathematics
- a greater range of mathematical skills and techniques
- an ability to identify and analyse mathematical problems
- an ability to gather information from a variety of sources including statistical data
- an ability to apply mathematics to real world situations in farming and agri-businesses

Learning materials

Attwood et al, 2009. Edexcel AS and A Level Modular Mathematics: Core Mathematics 1 & 2, Edexcel.

Pledger et al, 2009. Edexcel AS and A Level Modular Mathematics: Statistics 1, Edexcel

Mathematical Applications in Agriculture, 2nd edition, Nina H Mitchell, Cengage

Economics Module

Students joining the Agricultural Science Foundation from countries where the curriculum is taught in English, and who also score 7.5 or above on the IELTS test upon entry, will take the Economics module instead of the Academic Skills module.

The module is intended to provide students with an understanding of the core elements of micro and macro Economics and an introduction to a range of concepts and terminology central to the study of this subject. It provides students with the knowledge and understanding to study of Economics at undergraduate level, and how it applies to agricultural businesses.

Module content

1. Basic concepts:

- Definitions of Economics and the economic problem
- Opportunity cost and the factors of production
- Distinguishing micro- and macroeconomics
- Sectors of an economy: primary, secondary and tertiary
- The circular flow of income
- The Production Possibility Frontier curve
- Demand, the demand curve and changes in demand
- Determinants of demand
- Supply, the supply curve and changes in supply
- Determinants of supply
- Demand, supply and elasticity
- The market equilibrium point

2. Introduction to the economics of agriculture:

- Free trade among nations
- Producers and consumers
- Macro and micro economics in farming
- Positive and normative economics

- Farm sizes
- Absolute vs relative prices
- Price units
- Constant quality prices

3. Microeconomics:

- Production and costs of firms
- The law of diminishing returns
- Short-run and long-run average costs
- Production and revenues of firms
- Representing cost and revenue in market structure models
- Profits and other objectives of firms
- Market structures: perfect and imperfect competition, oligopoly and monopoly
- Market structures and efficiency
- Government intervention in the markets

4. Macroeconomics:

- Macroeconomic indicators
- Aggregate demand and its determinants
- Financial bubbles
- Aggregate supply and its determinants
- Objectives of national economic policy
- Globalisation and trade
- International competitiveness
- Exchange rate systems
- Trade blocs and single currencies

5. The economics of production in agriculture:

- Case study: wheat production in the High Planes of North Dakota
- Immediate, short and long runs
- Fixed and variable inputs
- Constant, increasing, decreasing, and negative returns
- Total, average and marginal physical product

6. The costs of production in agriculture:

- Profits
- Opportunity costs
- Costs and output
- Cost curves
- Case study: opportunity cost of a wheat grower

7. Profit maximisation in agriculture:

- Perfect competition
- The profit-maximising levels of input and output
- Profits and losses, break even, and shutdown points
- Case study: Feedlot in Abilene, Texas

The coursework element of this module will require students to apply economic theory to a real Agri business that they will visit as part of the course.

Learning outcomes

Having completed this module, students will have:

- an understanding of how Economics can be used to describe, analyse and propose solutions to problems faced by economies
- an appreciation of the inter-relationship between micro and macro-economics and the role of government in the economy
- an understanding of the value and limitations of economic models in analysing an economy
- Be able to apply economics to suggest how to effectively manage the profitability of a real-world agricultural business

Learning materials

Edexcel A Level Economics A1 & A2, Smith, Peter, 2015, Hodder

Principles of Agricultural Economics 3rd Edition, A. Barkley & P.W. Barkley, 2020, Routledge