



Institute of Continuing Education

Undergraduate Certificate in Evolutionary Biology

2018-2019

Course code: 1819CCR205

COURSE GUIDE

Welcome to the **Undergraduate Certificate in Evolutionary Biology**, a University of Cambridge award offered by the Institute of Continuing Education (ICE). The Certificate is taught and awarded at FHEQ level 4 (i.e. first-year undergraduate level) and attracts 60 credits. The award is completed in one academic year. For further information about academic credit please see our website: <http://www.ice.cam.ac.uk/studying-with-us/information-for-students/qualifications-that-we-offer>.

The course offers three termly units and a syllabus and reading and resource list for each of these units are included in this course guide.

The course aims to:

1. Introduce participants to the theory of evolution by natural selection and explain how evolutionary theory is integrated with modern genetics
2. Demonstrate how different branches of biology can provide insight into how evolutionary processes work
3. Explain how the interplay between species can influence evolutionary processes
4. Consider evolution in relation to humans and the impact of human-induced global change on evolutionary processes
5. Give participants experience of practical scientific methods

Transferable skills for further study and employability

- The capacity for independent thought and judgement
- The development of independent learning, study and time management skills
- The deployment of skills in critical reasoning
- The development of competence in using IT to support one's work
- The ability to work with others, productively and equitably
- The qualities necessary for employment requiring the exercise of some personal responsibility and the demonstration of high levels of motivation and personal commitment through part-time study
- The ability to reference sources of information to support one's reasoning
- The ability to understand how to approach a research question in evolutionary biology

Study hours

The award of academic credit is a means of quantifying and recognising learning, and within the UK, one credit notionally represents 10 hours of learning¹. Each of the units in this course attracts 20 credits so students should expect to need to study for approximately 200 hours in total to complete each unit successfully. However, it is recognised that students study at different paces and use a variety of approaches, so this is a recommendation, rather than a hard-and-fast calculation.

¹ 'Academic credit in higher education in England – an introduction'. The Quality Assurance Agency for Higher Education, 2009

Teaching staff

Academic Director

Dr Tom Monie is the Academic Director for Biological Sciences at the Institute. He is a protein biochemist with a long-standing interest in many areas of biology. His research career has addressed various topics relating to infection and immunity. He is a Fellow of Christ's College, University of Cambridge, where he also acts as a Tutor and the Director of Studies in Part 1A Biological Natural Sciences.

Tom's extensive experience in teaching within the University includes undergraduate supervisions, practical classes and lectures; he currently delivers the first year "Genes in Action" course for the Biology of Cells. Recent publication topics have included cat allergy - which was a global media story- Crohn's Disease, inherited auto-inflammatory genetic diseases, species variation in immunity and inflammation.

Many students have benefitted from his involvement in a wide range of teaching activities targeted at the provisions of subject-specific and transferable skills for graduate students. Tom is a firm believer that learning should be fun, that student participation is central to this process, and that successful teaching requires responsiveness to the needs of the students. He aims to instill these elements into his teaching and engagement activities.

Tutors

The course will be taught by a team of tutors whose expertise covers a wide range of different disciplines and a wealth of topics related to evolutionary biology. For a list of tutors who teach on the biological science programmes, please see the Biological and life sciences subject page on the Institute's website (<http://www.ice.cam.ac.uk/courses/courses-subject/biological-and-life-sciences>)

Administrative staff

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Venue

Madingley Hall is the University of Cambridge's campus dedicated to continuing education for adults. The magnificent Hall was built in the sixteenth century and acquired by the University in 1948. The Hall has been used by the Institute of Continuing Education as a venue since 1975.

You will be taught in one of 14 classrooms at Madingley Hall and, occasionally, at other venues. Classrooms are arranged and equipped to encourage effective small group learning and peer interaction. Technology-enhanced learning, including lecture capture where appropriate, is used in many classes and wi-fi is available throughout the site. We also provide a range of social learning spaces which you can make use of before, or after, your class. Seven acres of superb gardens and grounds designed by Capability Brown provide space to think, reflect and relax. We offer a range of catering including formal dining, sandwiches and snacks, and a full-service bar. If you are travelling a long distance you may wish to book accommodation in one of the Hall's 62 en suite bedrooms.

The Hall is situated three miles west of Cambridge with easy access from the M11 and the A14. There is ample free on-site car parking. Central London and Stansted Airport can be reached in under an hour by train from Cambridge railway station. Taxis from the railway station to Madingley Hall typically take around 20-25 minutes. Full directions are given on our website at: www.madingleyhall.co.uk/contact-us/how-to-find-us

Other teaching venues include the University Museum and Department of Zoology and Christ's College, both of which are located in the centre of Cambridge, within a 25 min walk of the railway station.

Lunch will be provided where day schools take place at Madingley Hall, but not where sessions are held at other venues.

Contact details of ICE

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Please also refer to the 'information for students' section on ICE's website www.ice.cam.ac.uk/studying-with-us/information-for-students and the 2017/18 Student Handbook for award-bearing courses for further information and guidance relating to all aspects of the course including study skills, assignments, assessment and moderation. The Course Information and Help and Guidance section of the ICE Virtual Learning Environment (VLE) will also contain valuable information specific to your course.

Information correct as at 03 October 2018

Syllabus for first unit

Michaelmas term 2018

Darwin's idea

Start date	6 October 2018	End date	8 December 2018
		Time	10.00am – 5.00pm
Venues	(1) Museum and Department of Zoology, Downing Street, Cambridge, CB2 3EJ (6 October and 8 December) (2) Christ's College, St Andrew's Street, Cambridge CB2 3BU (27 October) (3) Madingley Hall, Madingley, Cambridge, CB23 8AQ (17 November)		
Course Director	Dr Tom Monie	No of meetings	Four Saturday day-schools on 6 and 27 October, 17 November and 8 December 2018

Aims

Drawing on expertise from across Cambridge, this unit will introduce participants to the history of Darwin's discovery, provide evidence for evolution from living organisms and the fossil record, explain modern advances in evolutionary biology, and examine in detail the interplay between an organism's outward characteristics and its genetics.

Content

This unit begins with an overview of modern evolutionary biology and the history of Darwin's discovery. This includes sessions at the University's Museum and Department of Zoology, which houses a wealth of specimens collected by Charles Darwin himself, as well as Christ's College where Darwin studied as a student. The unit then goes on to examine evolutionary theory from a genetic perspective. This unit finishes by taking the long-term view of evolution in a series of talks devoted to the origin of life itself, early events in evolution, and the diversity of the major groups of living things.

Presentation of the unit

The first and last of the 4 day-schools will take place at the University Museum and Department of Zoology. Day-school 2 will be at Christ's College in Cambridge and day-school 3 will take place at Madingley Hall.

The day-schools will consist of a mixture of lectures illustrated by Powerpoint, group-based work, tours, demonstrations and practical sessions.

- Diagrams, models, video-clips and animations will be used to illustrate concepts and molecular mechanisms wherever possible.
- Discussion in class will facilitate an appreciation of the concepts and ethical issues of subjects under consideration.
- Practical sessions may involve practical and theoretical activities.

Provisional course structure

Date	Session	Venue	Indicative content
6/10/2018 10.00am – 5.00pm	Day-school one	University Museum and Department of Zoology	Introduction to the course, facilities available and learning tools. Natural Selection and the development of Darwin's theory; Sexual Selection; and Kin Selection. A behind the scenes tour of the Museum of Zoology introducing biological diversity and discussing Darwin's material housed in the collection.
27/10/2018 10.00am – 5.00pm	Day-school two	Christ's College	Discussion of assignments and study skills session. The early theories of evolution and an expansion on Darwin's theory and work. Assignment 1
17/11/2018 10.00am – 5.00pm	Day-school three	Madingley Hall	An introduction to Evolutionary Genetics, Natural Selection and Genetic Drift. Natural Selection in context and the genetics and evolution of quantitative traits. Adaption, apparent design and on-going debates in evolutionary genetics. On the origin of species and phylogenies over time.
08/12/2018 10.00am – 5.00pm	Day-school four	University Museum of Zoology and Department of Zoology.	The origin and early evolution of life. The deep diversity of life. Reconstructing evolutionary history practical session (phylogeny practical). Assignment 2.

Learning outcomes

As a result of the unit, within the constraints of the time available, students should be able to:

- demonstrate a broad understanding of evolutionary biology and evidence for this;
- discuss factors influencing the development of Darwin's theory;
- demonstrate a clear understanding of how evolutionary theory is integrated within modern genetics;
- understand how phylogenies can be used to reconstruct the evolutionary history of organisms;

- show a heightened ability to consider problems in a rigorous scientific manner and to discuss scientific ideas in an open forum;
- show a heightened ability to critically assess scientific papers and writing and place biological studies into the broad field of evolutionary biology;
- use scientific search engines, such as Web of Science, to access online publications.

Student assessment

The unit requires a commitment to reading and pre-class preparation, including some specific reading between class sessions.

There are a large number of introductions to various aspects of evolution and students are recommended to select those of particular personal interest from the reading list. Background reading will greatly increase appreciation of the course.

There are two assignments associated with the unit and these are equally weighted:

1. An essay discussing the history of Darwin's discovery and influences in the development of his theory - "What factors and people influenced Darwin's thinking about evolution? Why did Darwin take so long to publish his theory?" (1,500 - 2,000 words).

Students will be encouraged to discuss this with the course tutors and to read more about the development of the theory of evolution by natural selection and to access Darwin's and Wallace's letters available through the Darwin Correspondence Project (www.darwinproject.ac.uk) and Wallace Letters Online (<http://www.nhm.ac.uk/research-curation/scientific-resources/collections/library-collections/wallace-letters-online/index.html>).

2. A short scientific report associated with the phylogeny practical explaining the methods that can be used to reconstruct the evolutionary history of organisms (1,500 – 2,000 words).

Assignments word total (or equivalent): 3,000 - 4,000 words (or equivalent).

Closing date for the submission of assignments: before 12 noon on Monday 7 January 2019 (GMT*)

**Greenwich Mean Time*

Students are expected to submit their assignments online and feedback on assignments is delivered online.

Reading and resource list

Author	Title	Publisher and date
Barton, Nicholas et al.	Evolution	Cold Spring Harbor Laboratory Press 2007
Browne, Janet	Charles Darwin, Voyaging	Pimlico 1995
Browne, Janet	Charles Darwin, The Power of Place	Pimlico 1995
Carroll, Sean B	Endless forms most beautiful	Weidenfeld & Nicolson 2006/ Quercus 2011
Coyne, Jerry	Why Evolution is True	Oxford University Press 2009
Darwin, Charles	The Origin of Species Also available free through <i>Darwin Online</i> : www.darwin-online.org.uk/	Oxford World Classics Series 1859
Darwin, Charles	Darwin Correspondence Project – Darwin's correspondence	www.darwinproject.ac.uk
Dawkins, Richard	The Selfish Gene 2 nd Edition	Oxford University Press 1989
Futuyma, Douglas J	Evolution	Sinauer Associates, Inc. 2009
Knoll, Andrew H	Life on a young planet	Princeton University Press 2003
Ridley, Mark	Evolution 3 rd Edition	Blackwell 2003
Tudge, Colin	The variety of life	Oxford University Press 2000
Wallace, Alfred Russel	Wallace Letters Online – Wallace's correspondence	http://www.nhm.ac.uk/research-curation/scientific-resources/collections/library-collections/wallace-letters-online/index.html
Wallace, Arthur	Evolution, a developmental approach	Wiley-Blackwell 2011

Additional resources and reading will be provided through the VLE as the course progresses.

Syllabus for second unit
Lent term 2019

Plants and people

Start date	12 January 2019	End date	23 March 2019
Day	Saturday	Time	10.00am – 5.00pm
Venue	Madingley Hall, Madingley, Cambridge, CB23 8AQ		
Course Director	Dr Tom Monie	No of meetings	Four Saturday day-schools on 12 January, 2 February, 9 and 23 March 2019

Aims

This unit includes a detailed examination of evolution in plants and co-evolution with animals. It will consider evolutionary processes with respect to humans and the consequences of global change for evolutionary processes in the future.

Content

The unit begins by investigating evolution in plants, plant diversity, co-evolution between plants and animals, speciation in plants and domestication of crop plants. This will allow students to investigate the evolution of plants, especially flowering plants and their pollinators. The second half of the unit will then go on to investigate primate evolution and the complexities of understanding the evolution of our own species.

Presentation of the unit

The day-schools will be based at Madingley. These will consist of lectures illustrated by Powerpoint. Practical sessions in the Madingley grounds may be used to illustrate some of the concepts raised in the more-formal lectures.

- Diagrams, models, video-clips and animations will be used to illustrate concepts and molecular mechanisms wherever possible.
- Discussion in class will facilitate an appreciation of the concepts under consideration.

Provisional course structure

Date	Session	Venue	Indicative content
12/01/2019 10.00am – 5.00pm	Day-school one	Madingley Hall	Plant diversity and evolution. Diversity of flowering plants and speciation. Co-evolution with animals. Domestication of plants.
02/02/2019 10.00am – 5.00pm	Day-school two	Madingley Hall	The evolution of flowers and pollinators. Assignment.
09/03/2019 10.00am – 5.00pm	Day-school three	Madingley Hall	Meeting the primates: just who are our closest relatives? Standing up and the early hominids: Lucy, Ardi and our australopithecine ancestors. Homo, Neanderthals and ultimately <i>Homo sapiens</i> .
23/03/2019 10.00am – 5.00pm	Day-school four	Madingley Hall	Dispersal, language and complex culture: defining the human. Assignment. Guest Lecture: Evolution of infectious diseases.

Learning outcomes

As a result of the unit, within the constraints of the time available, students should be able to:

- demonstrate an understanding of evolution in plants and how evolutionary processes differ from those in animals;
- show an understanding of how interactions between species influence evolutionary processes;
- demonstrate an understanding of the parallels between artificial selection by humans and natural selection;
- demonstrate an understanding of evolutionary processes in humans;
- show a heightened ability to critically assess scientific papers and writing and place biological studies into the broad field of evolutionary biology;
- show a heightened ability to consider problems in a rigorous scientific manner and to discuss scientific ideas in an open forum.

Student assessment

The unit requires a commitment to reading and pre-class preparation, including some specific reading between class sessions.

There is a large number of eminently readable introductions to various aspects of evolution and students are recommended to select those of particular personal interest from the reading list. Selected background reading will greatly increase appreciation of the course.

There is one assignment associated with the unit. This consists of an essay of 3,000-4,000 words for which students have a choice of title:

Title 1: Discuss, with examples, the theories, evidence and controversies of human evolution.

Title 2: The evolution of plants is closely connected to the evolution of animals. Discuss the validity of this statement using specific examples.

Closing date for the submission of assignments: before 12 noon on Monday 15 April 2019 (BST)

Students are expected to submit their assignments online and feedback on assignments is delivered online.

Reading and resource list

Author	Title	Publisher and date
Berger, L & Hawks, J	Almost Human: The Astonishing Tale of Homo Naledi and the Discovery That Changed Our Human Story	National Geographic Society 2017
Oppenheimer, S	Out of Eden, the peopling of the world	Constable 2003
Petitt, Paul	The Palaeolithic origins of human burial	Routledge 2011
Raven, Peter et al.	Biology of Plants 8th Edition	W.H. Freeman & Company 2012
Ridley, Matt	Genome: the Autobiography of a Species in 23 Chapters	Fourth Estate 2000
Wells, Spencer	The Journey of Man: A Genetic Odyssey	Penguin 2002

Additional resources and reading will be provided through the VLE as the course progresses.

Syllabus for third unit
Easter term 2019

Behaviour and biodiversity

Start date	27 April 2019	End date	22 June 2019
		Time	10.00am – 5.00pm
Venue(s)	Madingley Hall, Madingley, Cambridge, CB23 8AQ		
Course Director	Dr Tom Monie,	No of meetings	Four Saturday day-schools on 27 April, 18 May, 1 and 22 June 2019

Aims

Expanding on aspects of the previous term's material, this unit will examine how speciation and associated morphological changes can occur, will look at species diversity in natural ecosystems, and examine the interplay between species in functioning communities. It will then take an evolutionary perspective on the behavioural characteristics that organisms display and their consequences for reproduction and survival.

Content

This unit will look at extant organisms and ecosystems and the impacts of species interactions on the way ecosystems operate. We will investigate the role of evolution in shaping different aspects of an organism's behaviour. This will include key topics in evolutionary behaviour including foraging behaviour, competition, reproduction and group living.

This unit will be complemented by a practical session in the Madingley Hall grounds focussing on behavioural research and encouraging participants to think about how evolutionary research is carried out. The course will then investigate how different structures and forms evolve in organisms, relationships between groups of organisms and speciation events (with a focus on Darwin's finches) and the importance of larval forms.

Presentation of the unit

The day-schools will consist of lectures illustrated by Powerpoint. The session in the Madingley Hall grounds will give students a chance to learn more about cutting edge research currently taking place at Cambridge.

- Diagrams, models, video-clips and animations will be used to illustrate concepts and molecular mechanisms wherever possible.
- Discussion and group working in class will facilitate an appreciation of the concepts under consideration.

Provisional course structure

Date	Session	Venue	Indicative content
27/4/2019 10.00am – 5.00pm	Day-school one	Madingley Hall	Research in action – How to carry out research and focus on behavioural research in the Madingley Hall grounds. Assignment 1.
18/5/2019 10.00am – 5.00pm	Day-school two	Madingley Hall	Why are there so many species? Species interactions and foodwebs. Ecosystem functioning and services. This session will also include a study skills session and brief introduction to Assignment 2.
01/06/2019 10.00am – 5.00pm	Day-school three	Madingley Hall	Optimal behaviour and evolution. Competition and defence. Mate choice and reproduction. Living in groups.
22/06/2019 10.00am – 5.00pm	Day-school four	Madingley Hall	Development and evolution. Larval forms. Galapagos tales – beak shape in Darwin's finches, an interactive feedback session.

Learning outcomes

As a result of the unit, within the constraints of the time available, students should be able to:

- demonstrate a clear understanding of how interactions between species influence evolutionary processes;
- apply evolutionary theory to an organism's behaviour;
- show a heightened understanding of research methods;
- show a heightened ability to critically assess scientific papers and writing and place biological studies into the broad field of evolutionary biology;
- show a heightened ability to consider problems in a rigorous scientific manner and to discuss scientific ideas in an open forum;
- show a heightened ability to critically assess scientific papers and writing and place biological studies into the broad field of evolutionary biology.

Student assessment

The unit requires a commitment to reading and pre-class preparation, including some specific reading between class sessions.

There is a large number of eminently readable introductions to various aspects of evolution and students are recommended to select those of particular personal interest from the reading list. Selected background reading will greatly increase appreciation of the course.

There are two assignments associated with the unit and they are equally weighted:

1. Critical review of a topical research paper. Students will be asked to read and critically review a recently published research paper in the field of evolutionary biology under guidance from the tutor. In particular students will be asked to consider how the paper fits within the published literature, whether it fulfils its aims and advances understanding of evolutionary biology and whether its design and methods are sound (1,500 - 2,000 words).
2. A piece of writing, discussing the design of scientific studies. After discussion with the tutor, students will be asked to design their own study investigating the behaviour of an organism of their choice from an evolutionary perspective. Students will be expected to introduce the system under study, what factors should be considered in the design of a scientific study and what particular hypotheses they are planning to investigate (1,500 – 2,000 words).

Assignments word total (or equivalent): 3,000 - 4,000 words (or equivalent).

Closing date for the submission of assignments: **before 12 noon on Monday 15 July 2019 (BST*)**

**British Summer Time*

Students are expected to submit their assignments online and feedback on assignments is delivered online.

Reading and resource list

Author	Title	Publisher and date
Benton, Michael & Harper, David	Introduction to Palaeobiology and the Fossil Record. Wiley-Blackwell.	Wiley-Blackwell 2009
Briggs, Derek & Crowther, Peter	Palaeobiology II	Blackwell Scientific 2001
Dawkins, Richard	The Greatest Show on Earth	Bantam Press 2009
Davies, Nicholas et al	An introduction to Behavioural Ecology 4 th Edition	Wiley-Blackwell 2012
Holland, P	The Animal Kingdom: A very short introduction	Oxford University Press 2011
Lieberman, Bruce & Kaesler, Roger	Prehistoric life: evolution and the fossil record	Wiley-Blackwell 2010
Palmer, Douglas	Evolution: the story of life	Mitchell Beazley 2009, also available as an app for iPads 'NHM evolution', 2013 iTunes app store
Ridley, Mark	Evolution 3 rd Edition	Blackwell 2003
Tudge, Colin	The variety of life	Oxford University Press 2000

Additional resources and reading will be provided through the VLE as the course progresses.

TIMETABLE

Michaelmas 2018

Darwin's idea

Day-school 1 Museum & Dept of Zoology	06/10/2018
Day-school 2 Christ's College	27/10/2018
Day-school 3 Madingley Hall	17/11/2018
Day-school 4 Museum & Dept of Zoology	08/12/2018

Lent 2019

Behaviour and Biodiversity

Day-school 1 Madingley Hall	12/01/2019
Day-school 2 Madingley Hall	02/02/2019
Day-school 3 Madingley Hall	09/03/2019
Day-school 4 Madingley Hall	23/03/2019

Easter 2019

Plants and People

Day-school 1 Madingley Hall	27/04/2019
Day-school 2 Madingley Hall	18/05/2019
Day-school 3 Madingley Hall	01/06/2019
Day-school 4 Madingley Hall	22/06/2019

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