Undergraduate Certificate in Evolutionary Biology

2017-2018

Course code: 1718CCR205

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](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 specification.

The course aims to:

1. Introduce participants to the theory of evolution by natural selection 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 ones reasoning

**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 learning. 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 a protein biochemist with a long-standing interest in 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.

Administrative staff

Academic Programme Manager: Dr Liz Morfoot
t. 01223 746226 e. emm30@cam.ac.uk

Programme Administrator: Miss Ola Dlugokencka
t. 01223 746418 e. ad759@cam.ac.uk

Venue

Madingley Hall is an historic Tudor mansion on the outskirts of Cambridge with one of the finest gardens in the region and will be the venue for your classes unless otherwise specified.

The Hall is situated in the village of Madingley, three miles west of Cambridge with easy access from the M11 and the A14. Full directions are given on our website at www.ice.cam.ac.uk/directions.

Workshops are held at Madingley Hall, which has a variety of teaching rooms ranging from the newly refurbished Courtyard Suite to rooms in the historic Hall. Workshops may be scheduled in different teaching rooms each term.

Contact details of ICE

Institute of Continuing Education
University of Cambridge
Madingley Hall
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 VLE will also contain valuable information specific to your course.

Information correct as at 27 March 2017
### Darwin’s idea

**Start date** 14 October 2017  
**End date** 9 December 2017  
**Day** Saturday  
**Time** 10.00am – 5.00pm  

**Venues**  
(1) Department of Zoology, Downing Street, Cambridge, CB2 3EJ (14 October and 9 December)  
(2) Christ’s College, St Andrew’s Street, Cambridge CB2 3BU (28 October)  
(3) Madingley Hall, Madingley, Cambridge, CB23 8AQ (18 November)  

**Course Director** Dr Tom Monie  
**No of meetings** Four Saturday day-schools on 14 and 28 October, 18 November and 9 December 2017

**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 a behind-the-scenes tour of the Zoology Museum, which houses a wealth of specimens collected by Charles Darwin himself, and a fieldtrip to Down House, Darwin’s home in Kent. 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 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 use a range of teaching approaches including:

- Lectures illustrated by PowerPoint.
- Diagrams, models, video-clips and animations to illustrate concepts and molecular mechanisms wherever possible.
- Discussion and group working in class will facilitate an appreciation of the concepts under consideration.
- Tours, demonstrations and practical sessions.

**Provisional course structure**

<table>
<thead>
<tr>
<th>Date</th>
<th>Session</th>
<th>Venue</th>
<th>Indicative content</th>
</tr>
</thead>
<tbody>
<tr>
<td>28/10/2017</td>
<td>Day-school two</td>
<td>Christ’s College</td>
<td>Discussion of assignments and study skills session. The early theories of evolution and an expansion on Darwin’s theory. Assignment 1</td>
</tr>
<tr>
<td>18/11/2017</td>
<td>Day-school three</td>
<td>Madingley Hall</td>
<td>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.</td>
</tr>
<tr>
<td>09/12/2017</td>
<td>Day-school four</td>
<td>University Museum of Zoology (morning) and Department of Zoology (afternoon)</td>
<td>The origin and early evolution of life. The deep diversity of life. Reconstructing evolutionary history practical session (phylogeny practical). Assignment 2.</td>
</tr>
</tbody>
</table>

**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 is 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 8 January 2018 (GMT*)_

*Greenwich Mean Time

Students are expected to submit their assignments online and feedback on assignments is delivered online.
## Reading and resource list

<table>
<thead>
<tr>
<th>Author</th>
<th>Title</th>
<th>Publisher and date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Browne, Janet</td>
<td>Charles Darwin, Voyaging</td>
<td>Pimlico 1995</td>
</tr>
<tr>
<td>Carroll, Sean B</td>
<td>Endless forms most beautiful</td>
<td>Weidenfeld &amp; Nicolson 2006/ Quercus 2011</td>
</tr>
<tr>
<td>Coyne, Jerry</td>
<td>Why Evolution is True</td>
<td>Oxford University Press 2009</td>
</tr>
<tr>
<td>Darwin, Charles</td>
<td>The Origin of Species</td>
<td>Oxford World Classics Series 1859</td>
</tr>
<tr>
<td></td>
<td>Also available free through Darwin Online: <a href="http://www.darwin-online.org.uk/">www.darwin-online.org.uk</a></td>
<td></td>
</tr>
<tr>
<td>Darwin, Charles</td>
<td>Darwin Correspondence Project – Darwin’s correspondence</td>
<td><a href="http://www.darwinproject.ac.uk">www.darwinproject.ac.uk</a></td>
</tr>
<tr>
<td>Knoll, Andrew H</td>
<td>Life on a young planet</td>
<td>Princeton University Press 2003</td>
</tr>
<tr>
<td>Ridley, Mark</td>
<td>Evolution 3rd Edition</td>
<td>Blackwell 2003</td>
</tr>
<tr>
<td>Tudge, Colin</td>
<td>The variety of life</td>
<td>Oxford University Press 2000</td>
</tr>
<tr>
<td>Wallace, Arthur</td>
<td>Evolution, a developmental approach</td>
<td>Wiley-Blackwell 2011</td>
</tr>
</tbody>
</table>
Syllabus for second unit
Lent term 2018

Behaviour and biodiversity

Start date 13 January 2018
End date 24 March 2018
Day Saturday
Time 10.00am – 5.00pm

Venue(s)
(1) Madingley Hall, Madingley, Cambridge, CB23 8AQ (13 January, 10 February, 3 and 24 March)
(2) Sedgwick Museum of Earth Sciences, Downing Street, Cambridge, CB2 3EQ (24 February)

Course Director Dr Tom Monie,
No of meetings Five Saturday day-schools on 13 January, 10 and 24 February, 3 and 24 March 2018.

Aims
Expanding on aspects of the first term's material, this unit will examine how speciation and associated morphological changes can occur, species diversity in natural ecosystems, and 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 begin by looking at extant organisms and ecosystems and the impacts of species interactions on the way ecosystems operate. We will go on to 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 section will be complemented by a practical session in the Madingley Hall grounds focussing on behavioural research on rooks, crows and jackdaws, 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. We will finish by considering the biology and biodiversity of the past and evidence for evolution from the fossil record.

**Presentation of the unit**

The four (of the five) day-schools that are based at Madingley 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. Day-school 3 will be based at the Sedgwick Museum of Earth Sciences, 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  

<table>
<thead>
<tr>
<th>Date</th>
<th>Session</th>
<th>Venue</th>
<th>Indicative content</th>
</tr>
</thead>
<tbody>
<tr>
<td>13/01/2018</td>
<td>Day-school one</td>
<td>Madingley Hall</td>
<td>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 1.</td>
</tr>
<tr>
<td>10/02/2018</td>
<td>Day-school two</td>
<td>Madingley Hall</td>
<td>Optimal behaviour and evolution. Competition and defence. Mate choice and reproduction. Living in groups.</td>
</tr>
<tr>
<td>24/02/2018</td>
<td>Day-school three</td>
<td>Sedgwick Museum of Earth Sciences</td>
<td>Darwin and the fossil record. Biodiversity in the past. What makes a species?</td>
</tr>
<tr>
<td>03/03/2018</td>
<td>Day-school four</td>
<td>Madingley Hall</td>
<td>Development and evolution. Larval forms. Galapagos tales – beak shape in Darwin's finches, an interactive feedback session.</td>
</tr>
<tr>
<td>24/03/2018</td>
<td>Day-school five</td>
<td>Madingley Hall</td>
<td>Research in action – How to carry out research and focus on behavioural research in the Madingley Hall grounds. Assignment 2.</td>
</tr>
</tbody>
</table>
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 16 April 2018 (BST)**

*British Summer Time*

Students are expected to submit their assignments online and feedback on assignments is delivered online.
<table>
<thead>
<tr>
<th>Author</th>
<th>Title</th>
<th>Publisher and date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benton, Michael &amp;</td>
<td>Introduction to Palaeobiology and the Fossil</td>
<td>Wiley-Blackwell 2009</td>
</tr>
<tr>
<td>Briggs, Derek &amp;</td>
<td>Palaeobiology II</td>
<td>Blackwell Scientific 2001</td>
</tr>
<tr>
<td>Crowther, Peter</td>
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<tr>
<td>Dawkins, Richard</td>
<td>The Greatest Show on Earth</td>
<td>Bantam Press 2009</td>
</tr>
<tr>
<td></td>
<td>Edition</td>
<td></td>
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<tr>
<td>Lieberman, Bruce &amp;</td>
<td>Prehistoric life: evolution and the fossil</td>
<td>Wiley-Blackwell 2010</td>
</tr>
<tr>
<td>Kaeisler, Roger</td>
<td>record</td>
<td></td>
</tr>
<tr>
<td>Palmer, Douglas</td>
<td>Prehistoric</td>
<td>Dorling Kindersley 2009</td>
</tr>
<tr>
<td>Palmer, Douglas</td>
<td>Evolution: the story of life</td>
<td>Mitchell Beazley 2009, also available</td>
</tr>
<tr>
<td></td>
<td></td>
<td>as an app for iPads ‘NHM evolution’,</td>
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<tr>
<td></td>
<td></td>
<td>2013 iTunes app store</td>
</tr>
<tr>
<td>Ridley, Mark</td>
<td>Evolution 3rd Edition</td>
<td>Blackwell 2003</td>
</tr>
<tr>
<td>Tudge, Colin</td>
<td>The variety of life</td>
<td>Oxford University Press 2000</td>
</tr>
</tbody>
</table>
Syllabus for third unit  
Easter term 2018

Plants and people

Start date 14 April 2018  
End date 7 July 2018

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 14 April, 19 May, 16 June and 7 July 2018

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 with a session based in the University Botanic Garden, investigating evolution in plants, plant diversity, co-evolution between plants and animals, speciation in plants and domestication of crop plants. This will include a tour of the gardens to illustrate the diversity of plant life. There will also be a practical session in the Madingley Hall gardens, investigating the evolution of flowers and pollinators and a guest session investigating the evolution of infectious diseases. 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 will 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

<table>
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<th>Date</th>
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</thead>
<tbody>
<tr>
<td>14/04/2018</td>
<td>Day-school 1</td>
<td>Madingley Hall</td>
<td>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 <em>Homo sapiens</em>.</td>
</tr>
<tr>
<td>07/07/2018</td>
<td>Day-school 4</td>
<td>Madingley Hall</td>
<td>The evolution of flowers and pollinators. Assignment 2. Summing up of the course and a look forward to the Diploma in Evolutionary Biology.</td>
</tr>
</tbody>
</table>

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

1. Assignment 1: An essay discussing the theories, evidence and controversies of human evolution (1,500 - 2,000 words).
2. Assignment 2: An essay on co-evolution between plants and their pollinators in association with the practical session in the Madingley grounds (1,500 – 2,000 words).

If students wish to create their own titles, this must be agreed in writing with the tutor first.

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

Closing date for the submission of assignments: before 12 noon on Monday 30 July 2018 (BST)

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

Reading and resource list

<table>
<thead>
<tr>
<th>Author</th>
<th>Title</th>
<th>Publisher and date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oppenheimer, S</td>
<td>Out of Eden, the peopling of the world</td>
<td>Constable 2003</td>
</tr>
<tr>
<td>Petitt, Paul</td>
<td>The Palaeolithic origins of human burial</td>
<td>Routledge 2011</td>
</tr>
<tr>
<td>Ridley, Matt</td>
<td>Genome: the Autobiography of a Species in 23 Chapters</td>
<td>Fourth Estate 2000</td>
</tr>
<tr>
<td>Wells, Spencer</td>
<td>The Journey of Man: A Genetic Odyssey</td>
<td>Penguin 2002</td>
</tr>
</tbody>
</table>
# TIMETABLE

### Michaelmas 2017

**Darwin’s idea**

<table>
<thead>
<tr>
<th>Day-school 1</th>
<th>Museum of Zoology</th>
<th>14/10/2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day-school 2</td>
<td>Christ’s College</td>
<td>28/10/2017</td>
</tr>
<tr>
<td>Day-school 3</td>
<td></td>
<td>18/11/2017</td>
</tr>
<tr>
<td>Day-school 4</td>
<td>Museum &amp; Dept of Zoology</td>
<td>09/12/2017</td>
</tr>
</tbody>
</table>

### Lent 2018

**Behaviour and Biodiversity**

| Day-school 1 | 13/01/2018 |
| Day-school 2 | 10/02/2018 |
| Day-school 3 | Sedgwick Museum | 24/02/2018 |
| Day-school 4 | 03/03/2018 |
| Day-school 5 | 24/03/2018 |

### Easter 2018

**Plants and People**

| Day-school 1 | 14/04/2018 |
| Day-school 2 | 19/06/2018 |
| Day-school 3 | 16/05/2018 |
| Day-school 4 | 07/07/2018 |

University of Cambridge Institute of Continuing Education, Madingley Hall, Cambridge, CB23 8AQ
Tel 01223 746222 [www.ice.cam.ac.uk](http://www.ice.cam.ac.uk)

Assignment submission dates are normally 3 weeks after final teaching session of term.

Whilst every effort is made to avoid changes to this programme, published details may be altered without notice at any time. The Institute reserves the right to withdraw or amend any part of this programme without prior notice.