



Institute of Continuing Education

Undergraduate Certificate in Evolutionary Biology

2021-2022

Course code: 2122CCR205

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>.

During the 2021-2022 Academic Year the **Undergraduate Certificate in Evolutionary Biology** is taught using remote methods. There will be no face-to-face teaching on the course. Teaching is via asynchronous, self-paced approaches facilitated by the course Virtual Learning Environment (VLE) along with scheduled synchronous delivery using remote learning platforms such as Zoom. You are encouraged to attend synchronous sessions to maximise your learning. However, as this may not always be possible we will record these sessions and place them in the Virtual Learning Environment.

Examples of asynchronous teaching approaches on the course include, but are not limited to: structured reading within the VLE and through external recommended sources; utilisation of podcasts or videos; engagement with virtual practical and laboratory resources; quizzes and activities in the VLE; pre-recorded lectures and seminars; online discussion forums; and your own self-directed learning. Synchronous teaching may include: delivery of lectures, seminars and their associated discussion; group-based activities; journal clubs; debates; discussions based around pre-reading; and practical demonstrations.

The precise content details for each synchronous session scheduled will be confirmed, via the VLE, in advance. This allows the teaching staff to maximise the effectiveness of the synchronous sessions for the material they are covering. For example, they might consist of separate sessions on different topics, discussion, group work, group feedback or other activities.

Asynchronous material in the VLE, along with your own self-directed learning, will supplement and complement the synchronous sessions.

Course Overview

The course offers three termly units aimed at providing an introduction to some of the core concepts in Evolutionary Biology. These units cover Evolutionary Theory, Plants and People and Behaviour and Biodiversity. Each unit has a range of topics it will cover and suggested readings and resources.

Overall 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

Learning Outcomes

Within the overall aims of the course the following learning outcomes will be delivered through the taught material and assessed via the unit assignments.

Knowledge and understanding:

- A good understanding of evolutionary biology
- A clear understanding of how evolutionary theory is integrated with modern genetics
- Knowledge of the impact of evolutionary thinking in all branches of biology
- An understanding of how interactions between species influence evolutionary processes
- An understanding of evolutionary processes in humans

Skills and other attributes:

- A heightened ability to consider problems in a rigorous scientific manner
- The ability to apply evolutionary theory to biological systems
- The ability to critically assess scientific papers and writing and place biological studies into the broad field of evolutionary biology
- An understanding of practical data collection methods
- An ability to use scientific search engines, such as Web of Science, to access online publications
- A heightened ability to discuss scientific ideas in an open forum

Transferable skills for further study and employability

In addition to academic skills and knowledge you will gain a broad range of widely applicable skills. These include:

- 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

A range of academic experts teach on the course. This gives you access to and involvement with people who have extensive subject knowledge and who are, in many cases, actively involved in research in evolutionary biology and its related disciplines. Further details of the teaching staff are on the course website. The overall Academic Director is Dr Tom Monie. He is Deputy Director of Academic Centres at the Institute of Continuing Education. Tom is a firm believer that learning should be fun, that learner participation is central to this process, and that successful teaching requires responsiveness to the needs of the learners. The Course Director is Dr Mircea Iliescu.

The Course Director is Dr Florin Mircea Iliescu who studies variation in human populations and is deeply fascinated by the amazing nature of human diversity. As a biologist interested in the history and variation of human populations, he works in the interdisciplinary space defined by the boundaries between genetics, evolution and anthropology.

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>).

Arts and Sciences Enquiries
e. artscience@ice.cam.ac.uk t. 01223 746418 / 746236

Venue

The Institute of Continuing Education's administrative headquarters are at Madingley Hall, an elegant country house built in the 16th century and set in gardens of about seven acres, designed in the 18th century by Capability Brown. Please visit www.ice.cam.ac.uk and www.madingleyhall.co.uk for further information.

The course is being taught entirely remotely during the 2021-22 Academic Year.

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 2021-22 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 31 August 2021

Syllabus for first unit

Michaelmas term 2021

Darwin's idea

Start date 8 October 2021 **End date** 15 December 2021

Synchronous Sessions
Saturday 16 October 2021 10:00 – 16:00 (BST)
Saturday 30 October 2021 10:00 – 16:00 (GMT)
Saturday 13 November 2021 10:00 – 16:00 (GMT)
Saturday 27 November 2021 10:00 – 16:00 (GMT)

Delivery
Synchronous via Zoom
Asynchronous via VLE

Summary

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. The unit goes on to examine evolutionary theory from a genetic perspective and finishes by taking the long-term view of evolution by considering topics such as the origin of life itself, early events in evolution, and the diversity of the major groups of living things.

Provisional unit structure

The unit is structured around the following broad topics

Topic	Indicative content for synchronous and asynchronous delivery
Evolutionary Theory	The development of evolutionary theory including Darwin's Theory of Natural Selection. A consideration of sexual selection and kin selection.
Evolutionary Genetics and Natural Selection	An introduction to these topics in the context of the genetics and evolution of quantitative traits. Consideration of adaptation and ongoing debates in evolutionary genetics. Discussion of the origin of species and phylogenetic development over time.
The Origin and Early Evolution of Life	Consideration of how life came about and the early evolutionary steps involved. The deep diversity of life and an exploration of reconstructing evolutionary history.

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 self-directed study.

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 (1,500 - 2,000 words) discussing one of the following two questions:
 - i. What factors and people influenced Darwin's thinking about evolution?
 - ii. Why did Darwin take so long to publish his theory?

Students will be encouraged to discuss their choice 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 reconstruction of evolutionary history that includes an explanation of the methods that can be used to reconstruct the evolutionary history of organisms (1,500 – 2,000 words).

Closing date for the submission of assignments: **12 noon on Wednesday 5th January 2022 (GMT)**. 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 4 th Edition	Oxford University Press 2016
Futuyma, Douglas J	Evolution	Sinauer Associates, Inc. 2013
Knoll, Andrew H	Life on a young planet (updated edition)	Princeton University Press 2017
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 2022

Plants and People

Start date 10 January 2022 **End date** 23 March 2022

Synchronous Sessions

Saturday 22 January 2022 10:00 – 16:00 (GMT)
Saturday 5 February 2022 10:00 – 16:00 (GMT)
Saturday 19 February 2022 10:00 – 16:00 (GMT)
Saturday 5 March 2021 10:00 – 16:00 (GMT)

Delivery

Synchronous via Zoom
Asynchronous via VLE

Summary

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.

Provisional unit structure

Topic	Indicative content for synchronous and asynchronous delivery
Plant Diversity and Evolution	The diversity of flowering plants and speciation, the co-evolution of plants with animals and plant domestication. The evolution of flowers and pollinators.
Human and Primate Evolution	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> . Dispersal, language and complex culture: defining the human.

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 self-directed study.

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 Wednesday 23rd March 2021 (GMT). 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 2022

Behaviour and biodiversity

Start date 28 March 2022 **End date** 10 June 2022

Synchronous Sessions
Saturday 9 April 2022 10:00 – 16:00 (GMT)
Saturday 23 April 2022 10:00 – 16:00 (GMT)
Saturday 7 May 2022 10:00 – 16:00 (GMT)
Saturday 21 May 2021 10:00 – 16:00 (GMT)

Delivery
Synchronous via Zoom
Asynchronous via VLE

Summary

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. The course will investigate how different structures and forms evolve in organisms, relationships between groups of organisms and speciation events as well as the importance of larval forms.

Provisional unit structure

Topic	Indicative content for synchronous and asynchronous delivery
Behaviour and Behavioural Research	What is optimal behaviour and evolution? The importance of competition and defence. The impact of mate choice, reproduction and living in groups. How does one carry out behavioural research?
Biodiversity	Why are there so many species? Species interactions and foodwebs. Ecosystem functioning and services. The connection between development and evolution. Larval forms.

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 self-directed study.

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 that applies principles of how scientific research is conducted. 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 their proposed scientific study and what particular hypotheses they are planning to investigate (1,500 – 2,000 words).

Closing date for the submission of assignments: before 12 noon on Friday 10 June 2022 (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
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.

Synchronous session timetable

Please note that the synchronous sessions will take place on the dates listed and will generally fall within the time window of 10am to 4pm UK time. The precise start and finish times and the pattern of the session will vary depending on the material being covered and the activities planned. These will be shared in advance via the VLE.

Unit 1 – Darwin’s Idea

Saturday 16 October 2021 10:00 – 16:00 (BST)
Saturday 30 October 2021 10:00 – 16:00 (GMT)
Saturday 13 November 2021 10:00 – 16:00 (GMT)
Saturday 27 November 2021 10:00 – 16:00 (GMT)

Unit 2 – Plants and People

Saturday 22 January 2022 10:00 – 16:00 (GMT)
Saturday 5 February 2022 10:00 – 16:00 (GMT)
Saturday 19 February 2022 10:00 – 16:00 (GMT)
Saturday 5 March 2021 10:00 – 16:00 (GMT)

Unit 3 – Behaviour and Biodiversity

Saturday 9 April 2022 10:00 – 16:00 (GMT)
Saturday 23 April 2022 10:00 – 16:00 (GMT)
Saturday 7 May 2022 10:00 – 16:00 (GMT)
Saturday 21 May 2021 10:00 – 16:00 (GMT)

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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.