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Course Summary

“Nothing in biology makes sense, except in the light of evolution”. Theodosius Dobzhansky.

All living organisms are the products of the selective pressures that shaped the form and function of their ancestors. Evolutionary biology traces the changes that have occurred to give rise to the diversity of modern organisms. Developmental biology provides information about how tissues, organs and ultimately organisms arise from the single, fertilised egg. We can now understand how changes at the genetic level can lead to changes in cell fate and morphogenesis that allow existing structures to change and adopt new configurations. This course will show how combining the two approaches of evolutionary and developmental biology allows an understanding of the mechanisms by which organisms evolve, which cannot be achieved by either discipline alone.

Course Coordinator: Professor Stefan Hoppler (Ext: 7383) s.p.hoppler@abdn.ac.uk

Deputy Coordination: Dr Silvia Mazzotta (Ext. 7496) silvia.mazzotta@abdn.ac.uk

Course Aims & Learning Outcomes

1. Know the major groups of animals and their interrelationships.
2. Understand how the interrelationships between extant animal phyla are determined.
3. Know the major developmental events associated with the evolution of different body plans.
4. Have an appreciation of the likely mechanisms by which specific organs and structures have evolved.

Course Teaching Staff

Course Co-ordinator(s):
Prof. Stefan Hoppler (SH), (Course Coordinator)
Dr Silvia Mazzotta (SM), (Deputy Course Co-Coordinator)

Other Staff:
Dr Marika Salonna (MS),
Prof. Lynda Erskine (LE)
Dr Anke Roelofs (AR),
Dr Silvia Mazzotta (SM)
Dr Alasdair MacKenzie (AMK)
Prof. Martin Collinson (JMC)
Dr Eunchai Kang (EK)
Assessments & Examinations

Students are expected to attend all lectures, laboratory classes, and tutorials, and to complete all class exercises by stated deadlines. The minimum performance acceptable is attendance at 75% of the lectures, seminars, practical classes, and presentation of all set course work, written and oral.

Assessment is derived from course work (30%) and a written examination (70%). The continuous assessment (CA) component is a problem-based assignment.

Written Examination: 70% of the total assessment is based on one 1.5 hour written paper. The student has to answer two questions of equal weighting selected from a list of four.

Common grading scale (CGS) grade: The overall performance of the student is expressed as a grade awarded on the common spine marking scale.

The degree examination is held in April, with the re-sit examination in July.

Class Representatives

We value students’ opinions in regard to enhancing the quality of teaching and its delivery; therefore, in conjunction with the Students’ Association we support the Class Representative system.

In the School of Medicine, Medical Sciences & Nutrition we operate a system of course representatives, who are elected from within each course. Any student registered within a course that wishes to represent a given group of students can stand for election as a class representative. You will be informed when the elections for class representative will take place.

What will it involve?

It will involve speaking to your fellow students about the course you represent. This can include any comments that they may have. You will attend a Staff-Student Liaison Committee and you should represent the views and concerns of the students within this meeting. As a representative, you will also be able to contribute to the agenda. You will then feedback to the students after this meeting with any actions that are being taken.

Training

Training for class representatives will be run by the Students Association. Training will take place within each half-session. For more information about the Class representative system visit www.ausa.org.uk or email the VP Education & Employability vped@abdn.ac.uk. Class representatives are also eligible to undertake the STAR (Students Taking Active Roles) Award with further information about this co-curricular award being available at: www.abdn.ac.uk/careers.
Problems with Coursework

If students have difficulties with any part of the course that they cannot cope with, alone they should notify the course coordinator immediately. If the problem relates to the subject matter general, advice would be to contact the member of staff who is teaching that part of the course. Students with registered disabilities should contact the medical sciences office, (medsci@abdn.ac.uk) (based in the Polwarth Building, Foresterhill) to ensure that the appropriate facilities have been made available. Otherwise, you are strongly encouraged to contact any of the following as you see appropriate:

- Course student representatives
- Course co-ordinator
- Convenor of the Medical Sciences Staff/Student Liaison Committee (Professor Gordon McEwan)
- Personal Tutor
- Medical Sciences Disabilities Co-ordinator (Dr Derryck Shewan)

All staff are based at Foresterhill and we strongly encourage the use of email or telephone the Medical Sciences Office. You may have a wasted journey travelling to Foresterhill only to find staff unavailable.

If a course has been completed and students are no longer on campus (i.e. work from second half session during the summer vacation), coursework will be kept until the end of Fresher’s Week, during the new academic year. After that point, unclaimed student work will be securely destroyed.

Course Reading List

Essential Developmental Biology by JMW Slack (Blackwell, 4th Edition, 2021) will be the main textbook used for the course (particularly chapter on Evolution and Development).

Additionally, Principles of Development (particularly Chapter 14) by Lewis Wolpert et al. (Oxford University Press, 5th Edition, 2015) and Developmental Biology (particularly chapters 1 and 26) by Scott F. Gilbert & Michael J.F. Barresi (Sinaur Associates Inc. 11th Edition, 2016) will be useful textbooks for some aspects of the course.

Additionally, books by Sean B. Carroll will be useful for some aspects of the course, such as “Endless Forms Most Beautiful: The New Science of Evo Devo and the Making of the Animal Kingdom”, Quercus; and together with Jennifer K. Grenier and Scott D. Weatherbee “From DNA to Diversity: Molecular Genetics and the Evolution of Animal Design” (2nd Edition, Blackwell Publishing).
Lecture Synopsis

Lecture 1: Introduction to Evolutionary Developmental Biology (Evo-Devo) — Prof. Stefan Hoppler (SH)

How do we know when biological systems in different organisms share a common ancestor? And why should we care? The evolution of multicellular organisms is fundamentally linked to embryonic development; and, as we will see in this course, embryonic development is fundamentally influenced by the evolutionary history of the organism. This lecture will introduce, and revisit important concepts involved in evolutionary biology as it relates to developmental processes, such as homology and analogy, and the surprising new discovery of so-called deep homology. The lecture will also cover the implications of gene, cell, tissue and organ-level views of biological systems.

Lecture 2: Evo-Devo in Action; Ancestor Worship and Tree Hugging – Prof. Stefan Hoppler (SH)

The relationship between humans and each member of the animal kingdom has been the subject of intense research since Darwin and his contemporaries formulated the concept that all life arises from a series of common ancestors. The lecture will discuss our current understanding of the evolutionary relationship between different animal groups (phyla) and why this is important for our understanding of human biology.

Lecture 3: Meet the ancestors I: Whatever happens, let's stick together; The evolution of multicellularity in animal evolution – Prof. Stefan Hoppler (SH)

The lecture will consider current evidence and hypotheses as to how the first animals evolved. Using recent evidence from a variety of genome projects it will illustrate how the diverse range of animal developmental strategies is based upon a common molecular toolkit that likely predated the evolution of the first animals.

Lecture 4: Meet the Ancestors II: Geoffroy's Lobster; The evolution of bilateral symmetry – Prof. Stefan Hoppler (SH)

The recent molecular insight into the mechanisms of embryonic development has revealed that the originally proposed body plans for different groups of animals is reflected in a conserved phylotypic stage; and that this molecular insight has quite unexpectedly also revealed a much deeper and remarkable conservation which we share with all animals in fundamental organisation, which is called the zootype. This lecture will explore the molecular hallmarks of the zootype, from the Hox cluster and possibly related clusters (which patterns the anteroposterior axis in different germ layers) to the conservation of dorso-ventral patterning (but with a twist as originally proposed in Geoffroy’s Lobster). We will go in search for our Urbilaterian ancestor and discover that the fundamental molecular zootype organisation is conserved even in animals in which asymmetry is not morphologically evident.

Lecture 5: Meet the ancestors III: Our Phylum; Chordates and the evolution of vertebrates – Dr Marika Salonna (MS)
We vertebrates can proudly consider ourselves special and maybe claim to be in some aspects, superior. A number of chordate developmental model systems (our invertebrate cousins) are used because of their position at the base of the vertebrate evolutionary tree. These have been used to shed light on the developmental innovations critical to vertebrate development, such as the notochord, the neural crest and the formation of somites.

**Lecture 6: Meet the Ancestors IV: If You Want to Get Ahead, Get a Head; the evolution of the vertebrate head – Professor Lynda Erskine (LE)**

Vertebrate evolution is characterised by formation of ever more sophisticated heads, to develop ever more sophisticated sense organs and jaws to find, catch and process our food. The prime example in evolution of modifying existing structures for new functions is the evolution from cranial neural crest-derived support structures for gill arches in jawless vertebrates first into integral components of jaws and then further into bones in the mammalian middle ear, which allow us to sense sound waves in the air in our terrestrial habitat.

**Lecture 7: Meet the Ancestors V: Let’s make it a bit harder: The Evolution of Bone tissue in Vertebrates (and how it affects human health today) – Dr Anke Roelofs (AR)**

Only vertebrates have evolved the ability to make bone, which we use during embryonic development to build a solid skeleton. Some bone develops during embryogenesis from cartilage, and maybe it evolved from cartilage, yet some skull bones develop directly from mesenchyme into bone (membrane bones). Cutting-edge recent research has shown how evolution of the skeleton in humans is linked to risk of getting medical conditions such as osteoarthritis.

**Lecture 8: Meet the Ancestors VI: Exploring dry land: The Evolution of Limb development – Professor Neil Vargesson (SH)**

Evolution of arms and legs from fish fins allowed our ancestors to step onto dry land. Limbs are complicated appendages; yet show an incredible range of diversity between species in the Animal Kingdom. This lecture will describe how the human limb has evolved into the structures we know and love, using examples from the animal kingdom and in an historical context.

**Lecture 9: The Dark Matter of the Genome: operating instructions for shaping the embryo – Dr Alasdair MacKenzie (AMK)**

Detailed studies of recent evolution, for instance of stickleback fish after the ice age, clearly reveals the importance of cis-regulatory DNA elements during evolution. In addition to the requirement for normally functioning proteins it is critical that these proteins be expressed at the right times in the right places and at the correct amounts. Understanding the systems that ensure normal gene expression lags many years behind our understanding of protein function. However, thanks to the sequencing of multiple vertebrate genomes and the new science of “Comparative Genomics” the regulatory sequences that control gene
expression during development are now being identified. This lecture will describe that instead of consisting of "Junk" DNA the non-coding vertebrate genome, often described as "genomic dark matter", contains a wealth of regulatory information that is required to shape the embryo and possibly provide the plasticity required to drive evolution.

**Lecture 10: Meet the Ancestors VII: Raising a family on dry land: The Evolution of Amniotes and Mammals – Dr Silvia Mazzotta (SM)**

While limbs allowed our ancestors to explore the land (to find new food sources and escape competition in the crowded pond) reproduction was initially still linked to water, as it is today in typical amphibians. The evolution of the amniotic egg broke the reproductive link with water and allowed our ancestors to embark on a truly terrestrial way of life. The amniotic egg nurtures the embryo a bit like a spacecraft nurtures the astronaut in outer space, with a protective hull, food storage and fuel supply, gas exchanger and yes, sanitary disposal; in the amniotic embryo this is respectively, the chorion (tough leathery membrane and in some animals with a hard shell), the large yolk sack, and the allantois, with the embryo itself floating in its own private mini-pond, the amnion. The evolution of the amniotic egg substantially changed the organisation of the early embryo and therefore gastrulation (during stages before the phylotypic stage), which also involved evolution of internal fertilisation and direct development (i.e. without any feeding larval stage). In most mammals the egg is nurtured internally to allow life birth (vivipary) by evolving close functional connections between the embryo’s chorion and the mother’s placenta. There is intense study of how this evolutionary history influenced early mammalian and human development and pluripotent stem cell biology.

**Lecture 11: Evolution of my favourite organ I: The Evolution of Eyes 1– Professor Martin Collinson (JMC)**

Ernst Mayr in 1961 stated that ‘It requires little persuasion to be convinced that the lens eye of a vertebrate and the compound eye of an insect are independent evolutionary events.’, in other words they were thought to be analogous. But both invertebrates and vertebrates use rhodopsin as a primary photosensory pigment, and in the last 15 years it has become apparent that at the genetic and cell biology level that there are many similarities between the development of eyes across diverse animal taxa. This lecture will explore the concept of deep homology as it applies to genes involved in eye development, and assess the evidence that the eyes of invertebrates and vertebrates are in fact homologous structures derived from a common ancestor that had an eye.

**Lecture 12: Evolution of my favourite organ II: The evolution of eyes 2 – Professor Martin Collinson (JMC)**

Among vertebrates there is an extraordinary range of extant eye morphologies, demonstrating eye developmental pathways are under strong evolutionary selection. This lecture will track some of the developmental specialisations that have been shown to underlie vertebrate eye evolution. The genetics of eye development and degeneration in Mexican cavefish will be used as an example of an animal that has traded in its eyes in exchange for better taste and smell. We will look at the specialisations of eyes in mammals that live underground – mole-rats and true moles – examine the genetic mutations that underlie their eye phenotypes and ask whether they are just ‘mammalian cavefish’.
Lecture 13: Evolution of my favourite organ III: Vertebrate Brain Evolution and Development – (Dr Eunchai Kang)

Increased cognitive and intellectual ability in humans is closely linked to the evolutionary expansion of the neocortex. Conversely, structural abnormalities of the cortex lead to various neurodevelopmental disorders such as autism spectrum disorder or intellectual disability. In this lecture, we will explore the cellular and molecular mechanisms behind human neocortical expansion with a specific focus on the behaviours of neural stem cells during cortical development.

Lecture 14: Human Evolution and Development I – Professor Martin Collinson (JMC)

There are a number of features that distinguish us from our closest-living relatives, the great apes.

Lecture 15: Human Evolution and Development II – Professor Martin Collinson (JMC)

Recent work has shown that it is possible to identify genes that may have been responsible for the increases in brain size and language acquisition.

Tutorial Work

Molecular Phylogeny Tutorial; Tutorial on Identification of Evolutionary Conserved Regulatory DNA sequences.

As part of the course there will be two computer tutorials to introduce practical applications of Evolution and Development. One computer tutorial will introduce you to phylogenetic analysis of gene and protein families, to practice dealing with phylogenetic trees in a context that is relevant to the modern developmental biologist. Another computer tutorial will introduce you to using evolutionary sequence conservation to probe for and identify cis-regulatory sequences for important developmental biology genes. Guidance on these tutorials will be provided during the tutorial session.

In Course Assessment, counts for 30% of Final Mark:

1. Coursework (30% of Final Mark)

Written Report in form of a Mini-Review on a topic relevant to Evolution and Development:

Your Mini-Review represents an important component of the course and will additionally provide you with the opportunity to acquire and practice transferable skills that will be useful to you later in the Honours year, and in your future professional career. Plan and write your Mini-Review carefully. We strongly recommend "A guide to scientific writing" by David Lindsay, (Longman Cheshire). This will help you with the writing of
the Mini-Review for this course and with the planning of essays and seminars, as well as with your Honours thesis later in the year.

Your Mini-Review document should be entirely your own work. Before starting to write it, you should discuss the topic with the course organiser. There will already be a list of suggested topics, but you are encouraged to suggest and discuss your own ideas for a suitable topic but be aware that the course organiser will want to make sure it is a topic relevant to Evolution and Development and in scope not too large or too specific, or too easy or too difficult to make it comparable with topics of other Mini-Reviews. The Mini-Review is an examined piece of work that will contribute 30% towards your final mark for this course and must be your own effort (see guidance to avoid Plagiarism below).

Mini-Review submission will be on Friday 29 October, 5pm. All Mini-Review documents should be saved as a PDF file and submitted to MyAberdeen.

Instructions and Guidance for Authors: Your Mini-Review must conform to the format described in this section. Please take the time to read this section carefully and refer to it often when writing your document. The Mini-Review should take the form of a small paper submitted for publication to a journal, whose instructions for authors are given below.

Sections of the Mini-Review manuscript:

• **Title page** – A concise, informative title that accurately conveys the subject matter or outcome of your project. The title should be around 100 characters in length (not including spaces). Your name and a word count should also be included. You may also include an image or the University crest on the front cover if you wish. Keep this a separate page from the following.

• **Abstract** – A concise (not more than 200 words) paragraph that allows the reader to understand the context, aims, results and main conclusions of the work without having to read the rest of the manuscript. Abbreviations and reference citations should be avoided. The overall aims of the Mini-Review should be briefly stated in this section. Keep this a separate page from the following.

• **Introduction** – This introduces maybe the historical background to the research and outlines the current state of knowledge. It points to the questions that remain to be answered and the specific question your Mini-Review tackles. It therefore should include, and lead naturally to, a clear statement of the aims and goals and the justification of your chosen topic for your Mini-Review. (Aim for an introduction section that is not more than 500 words.)

• **Choose your own subheadings** (at least two, maybe up to five) to guide the reader through the main part of your Mini-Review. Aim for each subsection to be approximately of somewhat similar length, though your chosen topic will of course determine this part of the structure of your Mini-Review.

• **Discussion and/or Conclusion** – This is where you make connections with the wider field of Evo-Devo or Developmental Biology more generally, speculate on overall mechanisms and suggest possibly extensions of your review. Make certain your Discussion is not just a reiteration of what has been introduced above. Include suggestions for possible scientific questions to be included in a future more comprehensive review. Finish your discussion by drawing some general take-home conclusion(s) from your Mini-Review. (Aim for a Discussion and/or Conclusion section that is not more than 500 words.)

• **Acknowledgements** (is optional) – If appropriate, briefly acknowledge those who have assisted you in any way to the successful completion of the Mini-Review.

• **References** – Make sure that you have read the references you quote and that the reference list is accurate. Where appropriate cite the most up-to-date references possible. Use the Harvard style of citation with a list of citations at the end of the Mini-Review (referencing of EMBO Journal articles is a good example). In the text a reference should be cited by author and date, e.g., 'Water is known to boil at 100°C (Jones and Brown, 1872; Brown et al., 1873) and freeze at...'. Not more than two authors
may be cited per reference; if there are more than two authors use et al. References should be listed alphabetically according to the initial letter of the surname of the first author. Where the same authors have published more than one paper, list them in the order in which their papers appeared. If necessary, use a and b (e.g., 1990a), with the authors' surnames and 25 initials inverted. References should include, in the following order: authors' names; year; article or chapter title; editors (books only); journal or book title; name and address of publisher (books only); volume number and inclusive page numbers. The name of each journal should be abbreviated according to the World List of Scientific Periodicals (see an EMBO J. paper for reference) and italicized. References should therefore be listed as follows: Tugendreich, S., Bassett, D.E., Jr, McKusick, V.A., Boguski, M.S. and Hieter, P. (1994) Genes conserved in yeast and humans. Hum. Mol. Genet., 3, 1509-1517 Gehring, W. (1994) A history of the homeobox. In Duboule, D. (ed.), Guidebook to the Homeobox Genes. Oxford University Press, Oxford, UK, pp. 1-10 Lewin, B. (1994) Genes V. Oxford University Press, Oxford, UK.

**Figures and Tables** (optional) – Figures/tables are encouraged in order to aid description and organisation, but make sure they are fully referred to from within the main text and numbered in the order in which they are cited in the main text. The reader will only notice trends in Figures and Tables that you bring to his/her attention so make sure you explain what to look out for. All figures and tables should be well annotated and contain informative legends with clear keys. The reader should not be expected to interpret tables or figures unaided. Figures and Tables go on separate pages, following as closely as possible after first mention in the text. Figure legends are an important component. Figures themselves should be on a separate page with their corresponding figure legends. Legends should give all keys to symbols and should also explain error bars and statistical tests.

**Length of the Minireview:** 2,000 – 2,500 words, but the word limits do not include sections such as: Title, Abstract, Acknowledgements (if you use acknowledgements), Figure legends (if you use figures), Text within tables or diagrams (if you use tables or diagrams), References (both the bibliography and in text citations). Your word-processor software will give you a word count for your document; please add this word count on the cover (title) page. As with any submission of a paper to a journal, you are expected to keep to the word count.

**General format:** Your Mini-Review manuscript should be legibly typed with an A4 page size. The manuscript must be double-spaced. Margins of at least 25 mm (1 inch) should be left at the sides, top and bottom of each page. (Please note the left-hand margin will need to be deeper (35 mm) if you would like to get your manuscript to be bound.) Number each page at the bottom (Title page is 1). Clearly identify unusual or handwritten symbols and Greek letters. Differentiate between the letter O and zero, and the letters I and l and number 1. Figures and tables, with their legends, should be included at the appropriate point in the manuscript where their corresponding text lies. Pictures need to be inserted as jpeg or tiff files into text. The manuscript should be typed (not less than 12 point). Nomenclature, abbreviations and units should follow internationally accepted rules and conventions. Particular care should be taken with genetic nomenclature.

**Technical notes on manuscript production:** 1. It is important to produce clear, well-planned diagrams. All graphs and diagrams should be clearly visible, preferably in black & white, or colours that are easy to tell apart. If you intend to reduce the size of diagrams to half the size of the original, lines and lettering in the original must be twice the size you require in the final copy – this is an important point to note when cutting and pasting diagrams into your word-processed documents from other sources. Avoid fine shading or stippling that will not reproduce well. Allow enough time for writing your Mini-Review document. Make an early start and be realistic about your speed of production. 2. Make back-up copies of your computer files as you go along. Computer problems will not be accepted as an excuse for late submission. 3. You should prepare images and figures as soon as possible. 4. Be careful of your use of punctuation. In general, titles
and headings do not require full stops. Use a spellchecker on your computer where possible. Use British spellings.

**Assessment of Mini-Review:** Your Mini-Review manuscript will be assessed by the course organiser and another member of staff. This assessment is not open to negotiation. If you are unhappy with the assessment, you must approach the assessors to gain further information.

**Plagiarism**

The University has strict regulations on plagiarism. Copying or plagiarising another person’s work, either from other students or published material in books or papers and submitted as your own for assessment is considered a form of cheating. This is considered by the University to be a serious offence and will be penalised according to the extent involved and whether it is decided there was an attempt at deliberate deception, or whether bad practice was involved. If you do use information or ideas obtained from textbooks or other published material, you must give a precise reference to the source both at the appropriate point in your narrative and in a list of references at the end of your work. Direct quotations from published material should be indicated by quotation marks and referenced in the text.

**University Policies**

Students are asked to make themselves familiar with the information on key education policies, available [here](#). These policies are relevant to all students and will be useful to you throughout your studies. They contain important information and address issues such as what to do if you are absent, how to raise an appeal or a complaint and how the University will calculate your degree outcome.

These University wide education policies should be read in conjunction with this programme and/or course handbook, in which School specific policies are detailed. These policies are effective immediately, for the 2022/23 academic year. Further information can be found on the University’s Infohub webpage or by visiting the Infohub.

The information included in the institutional area for 2022-23 includes the following:

- Assessment
- Feedback
- Academic Integrity
- Absence
- Student Monitoring/ Class Certificates
- Late Submission of Work
- Student Discipline
- The co-curriculum
- Student Learning Service (SLS)
- Professional and Academic Development
- Graduate Attributes
- Email Use
- MyAberdeen
- Appeals and Complaints
Where to Find the Following Information:

**C6/C7-** University of Aberdeen Homepage > Students > Academic Life > Monitoring and Progress > Student Monitoring (C6 & C7)
https://www.abdn.ac.uk/students/academic-life/student-monitoring.php#panel5179

**Absences-** To report absences you should use the absence reporting system tool on Student Hub. Once you have successfully completed and sent the absence form you will get an email that your absence request has been accepted. The link below can be used to log onto the Student Hub Website and from there you can record any absences you may have.

Log In - Student Hub (https://www.abdn.ac.uk/studenthub/loginbdn.ac.uk)

**Submitting an Appeal-** University of Aberdeen Homepage > Students > Academic Life > Appeals and Complaints
https://www.abdn.ac.uk/students/academic-life/appeals-complaints-3380.php#panel2109

**Academic Language & Skills support**
For students whose first language is not English, the Language Centre offers support with Academic Writing and Communication Skills.

**Academic Writing**
- Responding to a writing task: Focusing on the question
- Organising your writing: within & between paragraphs
- Using sources to support your writing (including writing in your own words, and citing & referencing conventions)
- Using academic language
- Critical Thinking
- Proofreading & Editing

**Academic Communication Skills**
- Developing skills for effective communication in an academic context
- Promoting critical thinking and evaluation
- Giving opportunities to develop confidence in communicating in English
- Developing interactive competence: contributing and responding to seminar discussions
- Useful vocabulary and expressions for taking part in discussions
More information and how to book a place can be found [here](#).

## Medical Sciences Common Grading Scale

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<th>Grade</th>
<th>Grade Point</th>
<th>% Mark</th>
<th>Category</th>
<th>Honours Class</th>
<th>Description</th>
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| A1    | 22          | 90-100 | Excellent| First         | - Outstanding ability and critical thought  
|       |             |        |          |               | - Evidence of extensive reading  
|       |             |        |          |               | - Superior understanding  
|       |             |        |          |               | - The best performance that can be expected from a student at this level |
| A2    | 21          | 85-89  |         |               | - Able to argue logically and organise answers well  
|       |             |        |         |               | - Shows a thorough grasp of concepts  
|       |             |        |         |               | - Good use of examples to illustrate points and justify arguments  
|       |             |        |         |               | - Evidence of reading and wide appreciation of subject |
| A3    | 20          | 80-84  |         |               | - Repetition of lecture notes without evidence of further appreciation of subject  
|       |             |        |         |               | - Lacking illustrative examples and originality  
|       |             |        |         |               | - Basic level of understanding |
| A4    | 19          | 75-79  |         |               | - Limited ability to argue logically and organise answers  
|       |             |        |         |               | - Failure to develop or illustrate points  
|       |             |        |         |               | - The minimum level of performance required for a student to be awarded a pass |
| A5    | 18          | 70-74  |         |               | - Weak presentation  
|       |             |        |         |               | - Tendency to irrelevance  
|       |             |        |         |               | - Some attempt at an answer but seriously lacking in content and/or ability to organise thoughts |
| B1    | 17          | 67-69  | Very Good| Upper Second | - Contains major errors or misconceptions  
<p>|       |             |        |         |               | - Poor presentation |
| B2    | 16          | 64-66  |         |               | - Token or no submission |
| B3    | 15          | 60-63  |         |               | - Not used for Honours |
| C1    | 14          | 57-59  |         |               | - Clear Fail |
| C2    | 13          | 54-56  |         |               | - Clear Fail/Abysmal |
| C3    | 12          | 50-53  |         |               | - Clear Fail |
| D1    | 11          | 47-49  |         |               | - Clear Fail |
| D2    | 10          | 44-46  |         |               | - Clear Fail |
| D3    | 9           | 40-43  |         |               | - Clear Fail |
| E1    | 8           | 37-39  |         |               | - Clear Fail |
| E2    | 7           | 34-36  |         |               | - Clear Fail |
| E3    | 6           | 30-33  |         |               | - Clear Fail |
| F1    | 5           | 26-29  |         |               | - Clear Fail |
| F2    | 4           | 21-25  |         |               | - Clear Fail |
| F3    | 3           | 16-20  |         |               | - Clear Fail |
| G1    | 2           | 11-15  |         |               | - Clear Fail/Abysmal |
| G2    | 1           | 1-10   |         |               | - Clear Fail/Abysmal |
| G3    | 0           | 0      |         |               | - Clear Fail/Abysmal |</p>
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<td>10:00-11:00</td>
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<td>Lecture 1: Introduction to Evo-Devo</td>
<td>Lecture (R)</td>
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<td>Lecture (R)</td>
<td>SH</td>
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<td>Thu 22 Sep</td>
<td>14:00-15:00</td>
<td>1M:001</td>
<td>Lecture 3: Meet the ancestors I: Whatever happens, let’s stick together; The evolution of multicellularity in animal evolution</td>
<td>Lecture (R)</td>
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<td>Fri 23 Sep</td>
<td>10:00-11:00</td>
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<td>Tutorial on Course &amp; general introduction to in course assessment Revision for Lectures 1-3)?</td>
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<td><strong>Week 9</strong></td>
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<td>Mon 26 Sep</td>
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<td>Molecular Phylogeny Tutorial</td>
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<td>Tue 27 Sep</td>
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<td>Wed 28 Sep</td>
<td>09:00-10:00</td>
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<td>Lecture 4: Meet the Ancestors II: Geoffroy's Lobster; The evolution of bilateral symmetry</td>
<td>Lecture (R)</td>
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<td>Thu 29 Sep</td>
<td>11:00-12:00</td>
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<td>Lecture 5: Meet the ancestors III: Our Phylum; Chordates and the evolution of vertebrates</td>
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<td>Lecture 6: Meet the Ancestors IV: If You Want to Get Ahead, Get a Head; the evolution of the vertebrate head.</td>
<td>Lecture (R)</td>
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<td>Fri 30 Sep</td>
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<td>Tutorial on in-course assessment</td>
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<td><strong>Week 10</strong></td>
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<td>Mon 3 Oct</td>
<td>10:00-11:00</td>
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<td>Lecture 7: Meet the Ancestors V: Let’s make it a bit harder: The Evolution of Bone tissue in Vertebrates (and how it affects human health today)</td>
<td>Lecture (R)</td>
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<td>Wed 5 Oct</td>
<td>12:00-13:00</td>
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<td>Lecture 9: The Dark Matter of the Genome: operating instructions for shaping the embryo</td>
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<td>Thu 6 Oct</td>
<td>10:00-11:00</td>
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<td>Revision Tutorial (for Lectures 7-9)?</td>
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<td>SH, AMK</td>
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<td>Thu 6 Oct</td>
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<td>Lecture 8: Meet the Ancestors VI: Exploring dry land: The Evolution of Limb development</td>
<td>Lecture (not yet recorded)</td>
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<td>Lecture 11: Evolution of my favourite organ I: The Evolution of Eyes 1</td>
<td>Lecture (R)</td>
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<td>Mon 10 Oct</td>
<td>10:00-11:00</td>
<td>Comp G21, OA</td>
<td>Functional annotation of the non-coding genome</td>
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<td>Lecture 10: Meet the Ancestors VII: Raising a family on dry land: The Evolution of Amniotes and Mammals</td>
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<td>Thu 13 Oct</td>
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<td>Lecture 13: Evolution of my favourite organ III: Vertebrate Brain Evolution and Development</td>
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<td>Fri 14 Oct</td>
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<td>Mon 17 Oct</td>
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<td>Mon 17 Oct</td>
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<td>Tue 18 Oct</td>
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<td>Lecture 12: Evolution of my favourite organ II: The Evolution of Eyes 2</td>
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<td>Tue 18 Oct</td>
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<td>Lecture 14: Human Evolution and Development I</td>
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<td>Thu 20 Oct</td>
<td>14:00-15:00</td>
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<td>Lecture 15: Human Evolution and Development II</td>
<td>JMC</td>
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<td>Fri 21 Oct</td>
<td>10:00-11:00</td>
<td>Online</td>
<td>Online Revision Tutorial (for Lectures 13-15)?</td>
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<td>Fri 21 Oct</td>
<td>17:00</td>
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<td>Submission Deadline: Mini-Review</td>
<td>ASSESS-</td>
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</tbody>
</table>

### Staff

- Prof. Stefan Hoppler (SH) (Course Coordinator)
- Dr Marika Salonna (MS)
- Prof. Lynda Erskine (LE)
- Dr Anke Roelofs (AR)
- Dr Silvia Mazzotta (SM)
- Dr Alasdair Mackenzie (AMK)
- Prof. Martin Collinson (JMC)
- Dr Eunchai Kang (EK)