BIOL381

Evolutionary Palaeontology

S2 External 2015

Dept of Biological Sciences

Contents

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General Information

Unit convenor and teaching staff
Unit Convenor
John Alroy
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Contact via john.alroy@mq.edu.au

Credit points
3

Prerequisites
39cp including BIOL261 and (BIOL262 or BIOL208 or BIOL227 or GEOS206)

Corequisites

Co-badged status
Biol904

Unit description
This unit investigates the evolution, classification, and techniques of preparation of stratigraphically important fossil invertebrate groups, particularly brachiopods, cnidarians, echinoderms, molluscs and trilobites; particular attention is given to functional morphology and evolutionary phylogeny. The unit integrates fieldwork, practical work, lecture material, and the reading of pivotal palaeontological papers so that students gain an in-depth appreciation of the types of problems that palaeontologists are currently coming to grips with. This unit is largely a hands-on unit where students learn how to identify invertebrate fossils using a range of traditional and modern taxonomic methods. The skills learned in this unit are equally applicable to biological materials. The unit has a compulsory weekend field excursion where students collect fossil material that forms the basis of ongoing practical work throughout the semester.

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

Learning Outcomes

On successful completion of this unit, you will be able to:

Utilise fossils combined with analytical skills to solve evolutionary problems

Outline, define and discuss the origins, radiation, biodiversity trends and evolutionary relationships of key animal groups in the fossil record.

Understand the importance of adaptive radiations and mass extinctions to animal evolution

Describe the form, function, morphology and phylogeny of the selected taxa in the fossil record

Conduct and interpret cladistic analyses

Work with basic numerical methods that involve palaeoecology, biostratigraphy, and extinction rates.

Use proper scientific techniques to collect fossil material in the field

Formulate, write and format primary manuscripts based on readings of the primary palaeontological literature.

General Assessment Information

Practical work (30%)

Practical work constitutes a large proportion of the unit, and the weekly prac sessions are intended to lead on from the lecture. All prac sessions will be up to 3 hours in duration. The prac sessions will held in E5A 220 on *Wednesdays from 12.00 - 3.00 pm* each week. Students are expected to attend the prac session every single week and *you must attend at least nine pracs to pass the unit*. If you attend fewer, you will automatically be failed.

Assessment of the prac sessions will be based on completion of an online quiz available after the end of each prac session. The quizzes also cover much information *only* to be found in the lectures. Therefore, if you do not attend the lectures you will likely not perform well on the quizzes.

The weekly pracs will alternate between hands-on surveys of fossils and more paper- and computer-based exercises that introduce the core methods of analytical palaeobiology. All students of palaeontology should have a basic understanding of these concepts and techniques. You will be provided with the skills to not only conduct your own analyses but to also critically assess those in the literature.

The week 1 prac involves quantifying rates of taxonomic description of dinosaurs through historical time. The lecture includes an introduction to the unit and a discussion of the history of palaeobiology.

Week 2's lecture and prac will detail a key method of producing time scales based on occurrences of fossils within stratigraphic sections.

Week 3 will involve surveying disparate marine invertebrate fossils in order to understand the timing and origins of multicellular animals during the Ediacaran, the development of animal body plans, and the dramatic radiation of phyla during the Cambrian Explosion. The lecture will concern the major approaches used to study large-scale patterns of morphological evolution.

Week 4 will introduce the form and functional morphology of the group that dominated the ocean floor during the Palaeozoic: the brachiopods. The accompanying lecture will describe large-scale patterns of diversification in the marine fossil record and explain how these patterns are

interpreted in an analytical framework.

Data similar to those used in the biostratigraphy prac will be used in week 5 to compute extinction rates using several simple equations. In addition to explaining how extinction rates are computed and interpreted, the lecture will survey the Big Five major mass extinctions.

Week 6 will involve reconstructing climate variables by studying tree leaves. The accompanying lecture will introduce plants and insects.

Weeks 7 and 8 will introduce cladistics, the primary means of elucidating evolutionary relationships amongst fossil organisms. Cladistics works by grouping organisms together based on the number of derived characters they share (i.e., synapomorphies). It has the advantage of allowing numerous characters to be analysed simultaneously and objectively. The lectures will introduce vertebrates in general (week 7) and then dinosaurs and other Mesozoic tetrapods (week 8).

In the week 9 prac you will use quantitative analyses of community data to infer water depth. The lecture will discuss general concepts in palaeoecology.

The week 10 prac involves the exciting new area of conservation palaeobiology. In this prac you will synthesize multiple environmental proxies to tackle the question of what has caused recent change in a major estuarine system. The lecture will also be on conservation palaeobiology.

The prac for week 11 will involve taking linear measurements of a set of specimens in order to figure out the number of species. The lecture will survey the early evolution of mammals.

Week 12 will focus on using the morphology of fossil horse teeth to infer precipitation and will complement the accompanying lecture on Cenozoic mammals.

Week 13 will explore key methods used by palaeoecologists to reconstruct climates and environments in ways that go beyond geochemistry, including pollen counts and annual growth rings of trees and corals. The lecture this week will concern human evolution and Quaternary extinctions, both of which have been discussed very often in relation to paleoclimate.

Minor Assignment (15%)

The Minor Assignment will provide an opportunity to read and evaluate recently published scientific papers. Your task will be to carefully read and evaluate the papers. You will have to discuss their strengths and weaknesses in a relatively short and succinct manner. Most journals only allow a maximum of 800 words for a technical comment or written opinion piece, so you need to marshall your arguments carefully and clearly. This task will allow you to become familiar with the way scientists communicate their ideas in published papers.

Policies that apply to the Major Assignment regarding attribution and use of your own words also apply to this one (see below). In brief, you will not receive credit for anything copied without attribution.

See the Minor Assignment link on the iLearn page for details of the papers you need to read.

Assignment marking criteria

Marks for the Minor Assignment will be allotted for the following:

Scientific evaluation, meaning how well you have organised and presented your own arguments concerning the references in your own words. Credit for discussing specific issues will also be given. **65%**

Presentation, meaning spelling, grammar, and conciseness. **25%**

Formatting of the references. **10%**

Major Assignment (25%)

Each BIOL381 student must submit one major assignment on one of three offered topics concerning current and controversial palaeobiological research. Detailed information on the assignment topics will be provided on iLearn.

Important note: you *must* hand in the Major Assignment in order to pass the unit. If you do not hand in the assignment *you will automatically fail*. You can still pass the unit if you hand the assigment in late, so don't give up just because you have missed the deadline.

Assignment format

For this assignment you are required to formulate your own ideas and conclusions regarding the strengths and weaknesses of the data presented in a series of published papers. *Do not* simply summarise each paper. For this assignment it is essential that you read a wide array of primary literature. It is *not sufficient* to refer to Web material.

The assignments also must be written *in your own words*. You must not copy material from any source without attribution. Any copied words, no matter how few, must be placed in quotation marks. If you copy anything without attribution *or* without using quotation marks *you will not receive credit* for the relevant part of the assignment. If you have copied without attribution, then depending on the severity of the case you may be reported to the Faculty Student Administration Manager, in accord with the Academic Honesty Procedure (see the Policies and Procedures section).

Please write in a concise, well-organised manner. If you are not feeling very confident in your ability to do so you may want to purchase the short, simple volume by W. Strunk and E.B. White, *The Elements of Style*, Macmillan (normally available in the Co-op bookshop).

Important points to note regarding the format and structure of the Major Assignment:

- Word limit is 2500 words ± 10%. Include an accurate word count on the front of the assignment.
- Assignments must be word processed using 12 pt font and double spaced – *hand written assignments will not be accepted*.
- The assignment *must* include at least one additional supporting figure, graph, or table and preferably more.

- The assignment should be written in the succinct, tight style of a scientific paper following the format of a mainstream science journal such as *Paleobiology* (see http://www.paleosoc.org/content/AuthorContribInstr.html).
- Make sure all primary information sources used are cited in the text in the appropriate manner. A full reference list in alphabetical order should be included at the end of the assignment. Only sources cited in the main text of the assignment should be listed in the reference list.
- Regardless of the details, you *must* use the Harvard Referencing Style when writing your assignments. This means use of footnotes or numbered reference citation (Oxford referencing style) should be completely avoided.

The Library Web page (http://www.library.mq.edu.au/) has a number of very useful databases for searching out relevant primary sources. Use databases such as Web of Knowledge or Scopus or publisher websites such as BioOne, JSTOR, ScienceDirect, Springer Link or Wiley Online Library when searching for information.

Note that a primary source is a paper published in a peer reviewed international scientific journal that presents new scientific data and is not simply a review of existing research. A secondary source is a review or compilation of the research work performed by other workers. Examples of secondary sources include Wikipedia, textbooks, popular science magazines (e.g. New Scientist), newspapers, and most other websites (though there are exceptions such as the online journal Palaeontologica Electronica).

Assignment marking criteria

Marks for the Major Assignment will be allotted for the following:

1. Scientific content, meaning how well you have researched and evaluated the evidence to support your answer written in your own words. **50%**
2. Logical organisation, spelling, grammar, and conciseness. Use sub-headings. **20%**
3. Comprehensiveness, relevance, and formatting of the references you have consulted in researching your topic and *cited in the text* (see Harvard Referencing Style Guide). **20%**
4. Relevance, effectiveness, and referencing of figures, graphs and/or tables. At least one figure, graph, or table *must* be included. **10%.**

Important note: anything not in your own words does not demonstrate researching the topic; evaluating the evidence; writing logically and grammatically; or finding references on your own. Therefore, if you copy extensively *you may receive little or no credit* in any or all of these areas.

Final Examination (30%)

The Final Examination will cover important concepts introduced in lectures and further developed during the practical activities. More information will be provided later in the semester.

Unit webpage and technology used and required

iLearn. BIOL381 has an online presence on iLearn. To access this site go to https://ilearn.mq.edu.au/login/MQ/. You will need your MQ ID and password to log in. You are expected to use iLearn to access the unit outline, resources, lectures, and other useful information and links for the unit. Any updates, announcements, or changes to the unit will be posted on iLearn. As such, it is strongly recommended that all students log into the BIOL381 iLearn site at least twice a week throughout the entire semester.

UniWISE. Everyone can enrol in this iLearn unit. It provides a number of resources for undergraduate students including what is expected of you as a student, how to succeed in learning, and what resources have been developed and compiled by the Learning Skills unit to enhance your academic performance and writing.

Turnitin. Macquarie University uses an online anti-plagiarism detection tool called *Turnitin*. All students enrolled in BIOL381 must submit the Minor Assignment and Major Assignment to *Turnitin*. This program works by comparing each student's work with the work of other students enrolled in the unit (both past and present) and with material found online (e.g. websites and scientific papers). Instructions for using *Turnitin*, including quickstart and step-by-step user manuals, can be found at http://mq.edu.au/iLearn/resources/turnitin.htm

Feedback and unit evaluation

In this unit you will receive a range of verbal and written feedback on your assessment tasks and work. This unit is offered every year, and the curriculum has been greatly revamped and revised to reflect a more evolutionary focus to the unit in line with recent changes in the palaeobiology staff.

To monitor how successful we are in providing quality teaching and learning, the Department of Biological Sciences also seeks feedback from students. One of the key formal ways students have to provide feedback is through unit and teacher evaluation surveys. This feedback is anonymous and provides the Department with evidence of aspects that students are satisfied with and areas that require improvement.

Extensions and penalties

If you require an extension for any work please discuss this with the convenor as soon as possible. Unless accompanied by a doctor's certificate (or direct approval from the convenor) late work will be penalised at the rate of 10% per day.

Queries, appeals, special consideration

In the first instance contact the convenor if there are any questions about the assessment tasks themselves, or about the feedback and grades that you received for your various assessment

tasks. You are permitted to appeal against your final grade in any of your units. Before initiating an appeal, discuss your unit grade fully with the convenor. More details of the Faculty of Science appeals procedures are available from the Science Centre – E7A Level 1 (e-mail: enquiries@science.mq.edu.au; ph: 9850 6000).

Special consideration requests

During semester. All requests for special consideration should be submitted through the Student Enquiry Service, Registrar and Vice-Principal's Office. You must also provide your Lecturer with a copy of the documentation lodged at the Student Enquiry Service when submitting assignments. We strongly recommend that you see your Lecturer or Tutor on all such occasions to discuss the matter with her/him.

During examination period. During the examination period, original requests for special consideration plus one copy must be submitted to the Registrar and Vice-Principal, through the Academic Program Section, Level 4, Lincoln Building. The copy will be forwarded to your Division of Registration which will in turn forward it to the Department. Full details, and forms, are available at http://www.reg.mq.edu.au/Forms/APSCons.pdf. As well as submitting the appropriate documentation through the Registrar and Vice-Principal's Office, if you miss an examination, YOU MUST CONTACT YOUR LECTURER WITHIN 72 HOURS OF THE DATE OF THE EXAMINATION so that alternative examination arrangements may be made without delay. Failure to do so will result in the award of an 'F' grade.

Please note that the submission of requests for special consideration is monitored by the Department. Repeated requests will result in referral of the student to the Dean of Students for discussion and advice.

Important information, including Undergraduate Student Forms and deadlines for submission, is available at: http://www.student.mq.edu.au/.

Assessment Tasks

Name	Weighting	Due
Practical Work	30%	varies
Minor Assignment	15%	Week 4 Prac 19 August
Major Assignment	25%	Week 11 Prac 21 October
Final Exam	30%	Exam Period

Practical Work

Due: **varies**
Weighting: **30%**

Weekly online quiz

On successful completion you will be able to:

- Utilise fossils combined with analytical skills to solve evolutionary problems
- Outline, define and discuss the origins, radiation, biodiversity trends and evolutionary relationships of key animal groups in the fossil record.
- Understand the importance of adaptive radiations and mass extinctions to animal evolution
- Describe the form, function, morphology and phylogeny of the selected taxa in the fossil record
- Conduct and interpret cladistic analyses
- Use proper scientific techniques to collect fossil material in the field

Minor Assignment

Due: **Week 4 Prac 19 August**
Weighting: **15%**

800 word comment on a current controversy in the primary palaeontological literature

On successful completion you will be able to:

- Utilise fossils combined with analytical skills to solve evolutionary problems
- Outline, define and discuss the origins, radiation, biodiversity trends and evolutionary relationships of key animal groups in the fossil record.
- Conduct and interpret cladistic analyses
- Formulate, write and format primary manuscripts based on readings of the primary palaeontological literature.

Major Assignment

Due: **Week 11 Prac 21 October**
Weighting: **25%**

2500 word assignment on current research. There will be 3 topics to choose from.

On successful completion you will be able to:

- Understand the importance of adaptive radiations and mass extinctions to animal evolution
- Describe the form, function, morphology and phylogeny of the selected taxa in the fossil record
- Conduct and interpret cladistic analyses
- Work with basic numerical methods that involve palaeoecology, biostratigraphy, and extinction rates.

- Formulate, write and format primary manuscripts based on readings of the primary palaeontological literature.

Final Exam

Due: **Exam Period**
Weighting: **30%**

The Final Exam will be based on lecture material and practical work

On successful completion you will be able to:

- Utilise fossils combined with analytical skills to solve evolutionary problems
- Outline, define and discuss the origins, radiation, biodiversity trends and evolutionary relationships of key animal groups in the fossil record.
- Understand the importance of adaptive radiations and mass extinctions to animal evolution
- Describe the form, function, morphology and phylogeny of the selected taxa in the fossil record
- Conduct and interpret cladistic analyses
- Work with basic numerical methods that involve palaeoecology, biostratigraphy, and extinction rates.
- Formulate, write and format primary manuscripts based on readings of the primary palaeontological literature.

Delivery and Resources

UNIT DELIVERY AND ATTENDANCE REQUIREMENTS

Workload. Since BIOL381 is a 3 cp unit, you are expected to spend ~9 hours per week (including face-to-face teaching time) working on this unit for the duration of the semester. Please note that Macquarie University defines a semester as being 15 weeks in duration – 13 weeks of face-to-face teaching plus the two week mid-semester break.

Lectures. There will be two hour lecture to be held in E8A 386 every Wednesday at 9 am. These will be recorded live and posted on Echo360 (access via the BIOL381 iLearn site). The weekly quizzes will include material from the lectures. Because there is only a one-hour gap between the lectures and pracs, this means that *if you do not attend the lectures you may receive poor grades on the quizzes*.

Weekly practical laboratory sessions: Each student *must* attend the 3 hour prac session each week. Sessions will be held in E5A 220 and will run from 12 – 3.00pm.

See the Unit Schedule for the topics to be covered each week. It is in your best interests to

attend the lectures each week. It has been my observation that *students who regularly attend lectures tend to perform better* than those students who attend lectures infrequently.

Occupational health and safety. Due to OH&S regulations, all students *must* wear fully enclosed footwear (i.e. no thongs) at all times during practical laboratory sessions in E5A 220. Students without proper footwear will be unable to enter the lab. Food and drink may not be consumed in the lab at any time either.

RECOMMENDED READING

Unfortunately there is no up-to-date textbook on palaebiology that covers the curriculum in this unit. The textbook M. J. Benton and D. A. T. Harper (2009), *Introduction to Palaeobiology and the Fossil Recor,d* is employed during BIOL263 *History of Life* and is also useful in this unit. I will provide relevant readings in the Unit Schedule where appropriate. Readings from the more advanced textbook *Principles of Paleontology* by M. Foote and A. I. Miller (2007) are also recommended. Complementary reading will be available in the Library in E-reserve.

If you want to do some background reading outside the nominated textbook check out some of the following items in the Special Reserve Section of the Library. Various introductory sources can be found in QE sections such as QE711 and QE770.

Adrain, J.M., Edgecombe, G.D. & Lieberman., B.S. (eds) 2001. *Fossils, Phylogeny, and Form: An Analytical Approach*. New York, Kluwer Academic. [QE719.8.F68]

Albert, V.A. (ed.) 2005*. Parsimony, Phylogeny, and Genomics*. Oxford, Oxford University Press. [QH441 .P37 2005]

Benton, M.E. (ed.) 1993. *The Fossil Record 2*. London, Chapman & Hall. [QE723.P67]

Cowen, R. 2005. *History of Life*, 4th edn. Boston, Blackwell Scientific Publications. [QE711.2.C68]

Erwin, D. H. & Wing, S. L. (eds) 2000. *Deep Time: Paleobiology's Perspective.* Paleobiology, Supplement to Volume 4, Number 6. http://www.bioone.org/toc/pbio/26/sp4

Fortey, R.A. 2002. *Fossils: the Key to the Past*. London, Natural History Museum Publication. [QE711.3.F67]

Jablonski, D., Erwin, D.H. & Lipps, J.H. (eds) 1996. *Evolutionary Paleobiology*. Chicago, University of Chicago Press. [QE721.2.E85.E96]

Louys, J. 2012. *Paleontology in Ecology and Conservation*. Berlin and New York, Springer. http://simsrad.net.ocs.mq.edu.au/login?url=http://link.springer.com/openurl?genre=book&isbn=978-3-642-25037-8

MacPhee, R. D. E. (ed) 1999. *Extinctions in Near Time: Causes, Contexts, and Consequences.* New York, Kluwer Academic/Plenum. [GN282.E87 1999]

Raup, D.M. & Stanley, S.M. 1978. *Principles of Paleontology*. San Francisco, W.H. Freeman. [QE711.2.R37]

THE RALPH FAULKNER PRIZE

For the person enrolled in a science degree who is judged the best student in BIOL381 there is a prize made possible by the generosity of the late Mr Ralph Faulkner, one of Macquarie's first intake of students in 1967. As an external student, Ralph completed all the palaeontology units on offer. His good cheer and wonderful sense of humour made him a very popular participant in class and especially on field trips. Sadly, Ralph passed away in 2001, a victim of cancer. Because he appreciated what Macquarie had done for him and he was especially interested in palaeontology, Ralph undertook to provide the Invertebrate Palaeontology Prize. He did this for many years, but when he knew his death with imminent, he organised to leave funds to Macquarie so the award would continue after his death. Ralph was, for many years, part of the Science Staff of Kiama High School

Unit Schedule

Week	Date	Lecture	Prac
1	29 July	The History of Palaeobiology	Taxonomic Description Rates
2	5 August	Time Scales	Graphic Correlation
3	12 August	Morphological Evolution	Invertebrate Body Plans
4	19 August	Diversity Dynamics	Brachiopod Diversity
5	26 August	Extinction	Extinction Rates
6	2 September	Plants and Insects	Leaf Margin Analysis
7	9 September	Introduction to the Vertebrates	Cladistics Part I
8	30 September	Dinosaurs	Cladistics Part II
9	7 October	Palaeoecology	Palaeocommunities
10	14 October	Conservation Palaeobiology	Conservation Palaeobiology
11	21 October	Mammals I	Species Discrimination
12	28 October	Mammals II	Body Mass Scaling
13	4 November	Human Evolution and Quaternary Extinctions	Climate Proxies

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central. Students should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy http://mq.edu.au/policy/docs/academic_honesty/policy.html

Assessment Policy http://mq.edu.au/policy/docs/assessment/policy.html

Grading Policy http://mq.edu.au/policy/docs/grading/policy.html

Grade Appeal Policy http://mq.edu.au/policy/docs/gradeappeal/policy.html

Grievance Management Policy http://mq.edu.au/policy/docs/grievance_management/policy.html

Disruption to Studies Policy http://www.mq.edu.au/policy/docs/disruption_studies/policy.html *The Disruption to Studies Policy is effective from March 3 2014 and replaces the Special Consideration Policy.*

In addition, a number of other policies can be found in the Learning and Teaching Category of Policy Central.

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/support/student_conduct/

Results

Results shown in *iLearn*, or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in eStudent. For more information visit ask.mq.edu.au.

Student Support

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to improve your marks and take control of your study.

- Workshops
- StudyWise
- Academic Integrity Module for Students
- Ask a Learning Adviser

Student Services and Support

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

IT Help

For help with University computer systems and technology, visit http://informatics.mq.edu.au/help/.

When using the University's IT, you must adhere to the Acceptable Use Policy. The policy applies to all who connect to the MQ network including students.

Graduate Capabilities

Creative and Innovative

Our graduates will also be capable of creative thinking and of creating knowledge. They will be imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

This graduate capability is supported by:

Learning outcome

- Work with basic numerical methods that involve palaeoecology, biostratigraphy, and extinction rates.

Assessment tasks

- Practical Work
- Minor Assignment
- Major Assignment

Capable of Professional and Personal Judgement and Initiative

We want our graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement. They will exercise initiative as needed. They will be capable of risk assessment, and be able to handle ambiguity and complexity, enabling them to be adaptable in diverse and changing environments.

This graduate capability is supported by:

Learning outcome

- Use proper scientific techniques to collect fossil material in the field

Assessment tasks

- Minor Assignment
- Major Assignment

Commitment to Continuous Learning

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships with others and the environment, learning from them, and growing - personally, professionally and socially.

This graduate capability is supported by:

Learning outcomes

- Conduct and interpret cladistic analyses
- Work with basic numerical methods that involve palaeoecology, biostratigraphy, and extinction rates.

Assessment tasks

- Minor Assignment
- Major Assignment

Discipline Specific Knowledge and Skills

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

Learning outcomes

- Outline, define and discuss the origins, radiation, biodiversity trends and evolutionary relationships of key animal groups in the fossil record.
- Understand the importance of adaptive radiations and mass extinctions to animal evolution
- Describe the form, function, morphology and phylogeny of the selected taxa in the fossil record
- Conduct and interpret cladistic analyses
- Work with basic numerical methods that involve palaeoecology, biostratigraphy, and extinction rates.
- Formulate, write and format primary manuscripts based on readings of the primary palaeontological literature.

Assessment tasks

- Practical Work
- Minor Assignment
- Major Assignment
- Final Exam

Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

This graduate capability is supported by:

Learning outcomes

- Outline, define and discuss the origins, radiation, biodiversity trends and evolutionary relationships of key animal groups in the fossil record.
- Understand the importance of adaptive radiations and mass extinctions to animal evolution
- Describe the form, function, morphology and phylogeny of the selected taxa in the fossil record
- Conduct and interpret cladistic analyses
- Work with basic numerical methods that involve palaeoecology, biostratigraphy, and extinction rates.

Assessment tasks

- Practical Work
- Minor Assignment
- Major Assignment
- Final Exam

Problem Solving and Research Capability

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

Learning outcomes

- Outline, define and discuss the origins, radiation, biodiversity trends and evolutionary relationships of key animal groups in the fossil record.
- Describe the form, function, morphology and phylogeny of the selected taxa in the fossil record
- Conduct and interpret cladistic analyses
- Work with basic numerical methods that involve palaeoecology, biostratigraphy, and extinction rates.
- Use proper scientific techniques to collect fossil material in the field

Assessment tasks

- Practical Work
- Minor Assignment
- Major Assignment
- Final Exam

Effective Communication

We want to develop in our students the ability to communicate and convey their views in forms effective with different audiences. We want our graduates to take with them the capability to read, listen, question, gather and evaluate information resources in a variety of formats, assess, write clearly, speak effectively, and to use visual communication and communication technologies as appropriate.

This graduate capability is supported by:

Learning outcomes

- Describe the form, function, morphology and phylogeny of the selected taxa in the fossil record
- Use proper scientific techniques to collect fossil material in the field
- Formulate, write and format primary manuscripts based on readings of the primary palaeontological literature.

Assessment tasks

- Minor Assignment
- Major Assignment
- Final Exam