POPULATION GENETICS AND MOLECULAR EVOLUTION 232

Semester 2, 2012

Unit study package number: 311422 (v.1)
Mode of study: Internal
Tuition pattern summary: 2 hr Lecture/Tutorial, 3 hr Practical
Credit value: 25
Pre-requisite units: Human Biology 133 or Human Structure and Function 100 or equivalent (as approved by the Unit Co-Ordinator)
Co-requisite units: None
Anti-requisite units: None
Additional Requirements: None
Core Unit Status: Core Unit
Result type: Grade and Mark
Approved incidental fees: All fee information can be obtained through the Fees Centre. Visit fees.curtin.edu.au for details.

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Learning Management System: Blackboard (lms.curtin.edu.au)
Introduction, Syllabus and Main Questions

Welcome to Population Genetics & Molecular Evolution 232. The diversity of life forms and functional biology is explained by evolution from a common ancestor by means of natural selection and other mechanisms. Population Genetics & Molecular Evolution 232 describes gene flow in populations together with evolutionary processes including drift, selection, mutation, and migration. The Unit includes evolutionary processes at the molecular level. These topics collectively underpin the foundations of biological science.

The topics above are illustrated by applications of DNA profiling in human diversity, and the evolutionary basis of disease and inherited disorders. Finally, the critical role of genetics in contemporary biology and its consequences and implications for society are addressed.

Specific learning outcomes are listed below. These outcomes are related to important questions in modern biology; the following are specifically addressed.

i. What is Evolution – do life forms share a common ancestry?
ii. What are the mechanisms of evolution by descent from a common ancestor; how has evolution evolved in the last 100 years?
iii. How is evolution observed and measured by studying nucleotide and protein sequences?
iv. What is the extent of human diversity and how is this measured?
v. How does modern genetics explain the evolutionary basis of disease and human behaviour?
vi. What are the consequences of molecular genetics for society and culture?

Unit Learning Outcomes

Successful completion of this unit will enable you to:

1. Describe how genetic variation in and between populations is measured; how to estimate genotype frequencies in populations manifesting evolutionary change.
2. Measure and analyse evolutionary change at the molecular level to solve problems in evolutionary biology.
3. Apply principles of population and evolutionary genetics to selected topics in contemporary biomedical science. Topics may include predisposition to life style diseases, DNA profiles for identification of individuals and family relationships, aspects of selection in humans etc.
4. Develop oral and written scientific communication skills and participate in class activities.
5. Critically appraise the influences and consequences of biological science on modern society and culture.

Learning Activities

In addition to concept development, lectures often include information relevant to the practical exercises and student presentations. Attendance at lectures is important for successful completion of this Unit. Lecture presentations and supporting documents will be available on Blackboard, however these supplement the lectures. If you have an attendance problem, please discuss this with the Unit Administrator. Students will be requested to commit in advance to attendance at two or three lectures by authoritative visiting lecturers. These lectures will be cancelled if less than half the class commit to attending.
Student presentations require students to explore, summarize and describe the assigned topics and appraise their relevance to the main themes arising in the Unit. The assignment provides students with an opportunity to critically analyse a fundamental connection between biological science and contemporary society and enhance their writing skills by engaging in accurate descriptions of complex concepts. On completion of this Unit students should be able to critically appraise and comment on the interface between biological science and contemporary society.

**Learning Resources**

**Textbook**

There are several excellent comprehensive textbooks on Genetics in circulation that contain separate chapters on introductory population genetics and molecular evolution. These are usually the last chapters in the tome. For those already own these texts these chapters may suffice as a textbook. These books are also available from the Library or Student bookshop. For those requiring a more detailed textbook the title below is recommended, however purchase is not essential.

**Introduction to Population Genetics by Richard Halliburton.**

- **List Price:** $105.33  
  **Edition:** Hardcover (640 pages).  
  **Publisher:** Prentice Hall; 1st edition (2003);  
  **ISBN:** 0130163805

An important book worthy of becoming a classic , May 5, 2005 Reviewer: pg (New York, USA):

This is a very clearly written book. Hallibuton is such a talented writer and presents sometimes very difficult concepts with such effortless simplicity. One important aspect of this book is the way in which different ideas and different chapters are tied together. For example, the writer explains the infinite-alleles model and then goes on to describe why such a model could be useless at the molecular level, hence the need for an infinitely-many sites model. All the chapters are classic reading; his Chapter 4 on Recombination, Linkage and Disequilibrium in particular is a real treat. Halliburton also gives a very decent treatment of Coalescent Theory and even goes on to describe extensions of it in the case of selection, population subdivision and recombination.

This is a very recent important book, and a most deserving competitor to Hartl and Clark's "Principles of Population Genetics". It has my highest recommendations.

**Other Useful Texts**

The introductory presentation for this Unit includes details on some of the more useful reference texts available in the Library.

1. **Principles of Population Genetics. Daniel Hartl and Andrew Clarke.** Hardcover: 640 pages  
   US$ 105.33 Publisher: Sinauer and Associates:  
   **ISBN:** 0878933085

Principles of Population Genetics, Fourth Edition is a thoroughly updated introduction to the field that is at last ascending to its rightful position of centrality to evolutionary genomics and human genetics. Rapid and inexpensive genotyping and sequencing have produced a profusion of data on genetic variation, along with a pressing need to inform students from many fields about the models that describe the underlying processes that give rise to observed patterns of genetic variation. This book provides a balanced presentation of theory and observation for students at the undergraduate and graduate levels as well as newcomers from fields like human genetics. The logical development of the models of population genetics encourages a deeper understanding of the principles, and the text has been rewritten with the goal to optimise its use as a teaching aid. It introduces the principles of genetics and statistics that are relevant to population studies, and examines the forces affecting genetic variation from the molecular to...
the organismic level. Integrated throughout the book are descriptions of molecular methods used to study variation in natural populations, as well as explanations of the relevant estimation theory using actual data.


**More specialized references:**


**Online Resources**

**GenepopWWW** is a web-based interface to GENEPOP provided by the School of Biomedical Sciences. GENEPOP is a suite of interrelated applications providing sophisticated analyses of population genetical data developed by Prof Francois Rousset and Prof Michel Raymond at the Laboratoire de Genetique et Environment, Montpellier, France. You will use this software for data analysis in the laboratory practicals.

The URL address for Genepop is - [http://genepop.curtin.edu.au/](http://genepop.curtin.edu.au/)

**Assessment Schedule**

<table>
<thead>
<tr>
<th>Task</th>
<th>Value (%)</th>
<th>Date due</th>
<th>Unit Learning Outcome(s) assessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignment 1:</td>
<td>10%</td>
<td>24th September</td>
<td>3, 4 and 5</td>
</tr>
<tr>
<td>Practical Exercises</td>
<td>40%</td>
<td>See tuition schedule</td>
<td>1, 2</td>
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<tr>
<td>(5 x 6 = 30 + 10)</td>
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<tr>
<td>Student Presentation</td>
<td>15%</td>
<td>See tuition schedule</td>
<td>1 - 5</td>
</tr>
<tr>
<td>Final Semester Exam</td>
<td>35%</td>
<td>Exam week</td>
<td>1, 3, 5</td>
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</table>
Pass requirements

Please note that to pass this unit you should achieve passing levels (ie ≥half the mark allocation) for EACH of the assessment tasks shown in the Assessment Schedule above.

Detailed information on assessment tasks

1. Assignment 1: <TOPIC TO BE ADVISED>. This assignment is allocated 10% of your final grade and is to be presented as a typed hardcopy with a maximum of 1500 words. This task is intended to enhance your scientific writing skills. Further details concerning this assignment, including the assessment criteria are contained in the supplementary document accompanying this unit outline.

2. Practical Exercises (7): Each practical exercise except for Exercise 1 is assessed by a computer test on the practical topic (including results) two weeks after the date of the practical exercise. Students may retake up to two computer tests. If a test is repeated, the grade recorded will be the grade obtained for the second attempt. There are five practical assessments at 6 marks each (Exercises 2-6) plus a final sixth practical and assessment on molecular evolution (Exercise 7) for 10 marks (total marks = 40%)

3. Student presentation (15%): Each student will be required to deliver a short illustrated presentation (with Powerpoint) on a topic to be allocated. Each presentation will be for 10 minutes plus 5 minutes for questions and comments. Further details concerning student presentations, including the topic allocations and assessment criteria are contained in the supplementary document accompanying this unit outline.

4. Final semester examination. This will be in a short answer examination of 2 hours duration and is allocated 35% of the total marks. The examination will cover conceptual knowledge and understanding of information contained in student presentations and lectures/tutorials/discussions over the semester. Information from the assignment and practical exercises will not be reassessed in the final examination.

Late penalties

Penalties will apply for late submission of the assignment or for requiring an extension of time for preparing a student presentation. In general, these penalties will be 10% of the maximum grade for the assessment task per day (or equivalent interval) at the Unit Administrator’s discretion.

Referencing style

Students should use the Chicago or Harvard referencing style when preparing assignments. More information can be found on this style from the Library web site: library.curtin.edu.au/research_and_information_skills/referencing

Supplementary information

Enrolment and HECS:

It is your responsibility to ensure that your enrolment is correct - you can check your enrolment through the eStudent option on OASIS, where you can also print an Enrolment Advice.

Supplementary/Deferred Exams:

Supplementary and deferred examinations granted by the School of Biomedical Sciences will be held in November, 2012 (actual dates/times TBA). Notification to students will be made after the School of Biomedical Sciences Board of Examiners meeting via the Official Communications Channel (OCC) in OASIS. It is the student’s responsibility to check their OASIS account for official Curtin
correspondence on a weekly basis. If your results show that you have been awarded a supplementary or deferred exam you should immediately check your OASIS email for details.

Plagiarism
Plagiarism occurs when work or property of another person is presented as one's own, without appropriate acknowledgement or referencing. Plagiarism is a serious offence. For more information refer to academicintegrity.curtin.edu.au

Plagiarism Monitoring
Some (or all) assessments in this unit may be monitored for plagiarism using Turnitin (see turnitin.com). Students who do not want assignments retained in the Turnitin database must lodge a special request prior to the submission date. For further advice see academicintegrity.curtin.edu.au/studentsturnitin.html

Student Rights and Responsibilities
It is the responsibility of every student to be aware of all relevant legislation, policies and procedures relating to their rights and responsibilities as a student. These include:

- the Student Charter,
- the University's Guiding Ethical Principles,
- the University's policy and statements on plagiarism and academic integrity,
- copyright principles and responsibilities,
- the University's policies on appropriate use of software and computer facilities,
- students’ responsibility to check enrolment,
- deadlines, appeals, and grievance resolution,
- student feedback,
- other policies and procedures
- electronic communication with students

See students.curtin.edu.au/rights for comprehensive information on all of the above.

Recent unit changes
We welcome feedback as one way to keep improving this unit. Students are encouraged to give unit feedback through eVALUate, Curtin’s online student feedback system (see http://evaluate.curtin.edu.au/info/index.cfm). Recent changes to this unit based on student feedback and experience include:

1. More interactive discussion and student participation
2. Linking of calculated results with included concepts
3. Decision to seek student consensus for attendance at lectures by special guest lecturers.
4. Recommendation of a Unit textbook.
5. Weighting of examination decreased
6. Lectures - more explanatory content than in the Powerpoint presentation.
7. Assignment topic more focussed.

26 September – 1st November in Semester 2, 2012
<table>
<thead>
<tr>
<th>Week No</th>
<th>WEEK DATE</th>
<th>Lectures</th>
<th>Lecture</th>
<th>Practicals (and assessment)</th>
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<tbody>
<tr>
<td>0</td>
<td>13-15th July</td>
<td>TIME-TABLE</td>
<td>Thursday 9.00-10.00 am Venue</td>
<td>Thursday 10.00-11.00 am Venue Practicals 308:104 Friday 9-12 am</td>
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<tr>
<td>1</td>
<td>16th July</td>
<td>Unit map and learning outcomes</td>
<td>Darwinian Evolution Weismann’s doctrine and Lamarck Human evolution</td>
<td>Evolution of evolution</td>
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<td>Assumed pre-knowledge for this Unit</td>
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<td>Documents - Assignment, Rules for probability, Student presentations</td>
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<td>Data sets used in Unit</td>
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<td>Prac 1: MENDELIAN GENETICS - Mendel, Back-cross and Recombination</td>
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<tr>
<td>2</td>
<td>23rd July</td>
<td>HWR for single locus</td>
<td>Model gene systems: genetic polymorphisms</td>
<td>Prac 2: Allele frequencies &amp; EM algorithm</td>
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<td>3</td>
<td>30th July</td>
<td>Causes of evolution: RGD, Selection, Mutation and Migration</td>
<td>STR DNA profiling</td>
<td>Prac 3: HWE for one locus</td>
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<tr>
<td>4</td>
<td>6th Aug</td>
<td>NRM &amp; Inbreeding: Pedigrees, Population structure &amp; Wright’s F statistics</td>
<td>HWR for two loci</td>
<td>Prac 2 assessment</td>
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<td>Discussion: Assisted reproduction – consequences and policy</td>
<td>Prac 4: Causes of Evolution &amp; population heterogeneity</td>
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<td>5</td>
<td>13th Aug</td>
<td>Measures of Linkage Disequilibrium</td>
<td>Human Identification - STR DNA profiles. A superb exemplar of human population genetics</td>
<td>Prac 3 assessment</td>
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<td>Prac 5: Linkage Disequilibrium</td>
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<td>6</td>
<td>20th Aug</td>
<td>Kinship with DNA Profiles (parentage)</td>
<td>Unit map &amp; LO’s 1 Unit Summary Discussion: Sex ratios in human populations</td>
<td>Prac 4 Assessment</td>
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<td>Prac 5: Linkage Disequilibrium (cont)</td>
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<td>7</td>
<td>27th Aug</td>
<td>STUDENT WEEK FREE</td>
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<td>8</td>
<td>3rd Sept</td>
<td>Molecular Evolution 1</td>
<td>DNA Profiling and Human ID</td>
<td>Prac 6: Human ID (STRs and Genepop)</td>
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<td>9</td>
<td>10th Sept</td>
<td>Molecular Evolution 2</td>
<td>Guest lecture Wildlife forensics Dr Peter Spencer</td>
<td>Prac 5 assessment</td>
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<td>Prac 7: Examples in Molecular Evolution</td>
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<td>17th Sept</td>
<td>Molecular Evolution 3</td>
<td>Guest lecture DNA in Court Dr Gavin Turbett</td>
<td>Prac 7: Molecular Evolution (cont.) Student Presentation - help</td>
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<td>Molecular Evolution 4</td>
<td>eValuate - Students</td>
<td>Prac 6 assessment</td>
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<td>eValuate – Student Assignment 1 due 24th September Molecular Evolution 5</td>
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<td>1st Oct</td>
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<td>Prac 7: assessment</td>
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<td>Review of Assignment Stud Presentations</td>
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<td>13</td>
<td>8th Oct</td>
<td>REVISION SESSION</td>
<td>Student Presentations</td>
<td>Student Presentations Practicalals repeat assessment(s)</td>
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<td>Unit Summary</td>
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<td>14</td>
<td>15th Oct</td>
<td>STUDY WEEK</td>
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<tr>
<td>15</td>
<td>22nd Oct</td>
<td>FINAL EXAMS – 2 weeks</td>
<td>Final Exam 35%</td>
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<td>Supplementary Exam</td>
<td>Mid November 2012</td>
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