Population Genetics  BIOL 4371
Department of Life Sciences
Fall 2016

A. COURSE INFORMATION
Course number/section:  BIOL 4371.001  
Class meeting time:  W 1:00PM – 3:30PM  
Class location:  EN 316  
Course Website:  https://bb9.tamucc.edu/

B. INSTRUCTOR INFORMATION
Instructor:  Dr. Christopher E. Bird  
Office location:  CS 246  
Office hours:  T, W 3:30-5:45PM in CS 110 or by appointment, after 1 PM.  
Telephone:  361-825-6024 (Office)  
e-mail:  chris.bird@tamucc.edu  
Appointments:  Appointments made by email

C. COURSE DESCRIPTION
Catalog Course Description
This course is a comprehensive introduction to the principles of population and evolutionary genetics. Population genetics, more than most other biological disciplines, marries biological phenomena, mathematics, and statistics in one unifying field of study. As such, this course will primarily focus upon utilizing population genetic theory as a means of explaining biological phenomena. Students will learn about modeling & simulating the organization of genetic and phenotypic variation, genetic drift, the neutral theory, selection, inbreeding, population subdivision, gene flow, rates of molecular divergence, models of nucleotide evolution, molecular phylogenetics, molecular evolution of quantitative traits, population genomics, and human population genetics. Computer simulation and computation will be integrated into the lectures, homework, and exams. Emphasis will be placed on critical thinking and problem solving in the context of population genetic theory.

D. PREREQUISITES AND COREQUISITES
Prerequisites
Genetics (BIOL 2416) and Statistics (MATH 1442, 1470, or 2342)  
Recommended: Evolution, Computer Science
Corequisites
None

E. REQUIRED TEXTBOOK(S), READINGS AND SUPPLIES
Required Textbook(s)
Sinauer
Supplies
TAMUCC or Islander email account, 3 ring binder

Lecture Slides
Lecture slides for each topic we cover will be given to each student officially enrolled in the course as course packets.

F. STUDENT LEARNING OUTCOMES AND ASSESSMENT
Assessment is a process used by instructors to help improve learning. Assessment is essential for effective learning because it provides feedback to both students and instructors. A critical step in this process is making clear the course’s student learning outcomes that describe what students are expected to learn to be successful in the course. The student learning outcomes for this course are listed below. By collecting data and sharing it with students on how well they are accomplishing these learning outcomes students can more efficiently and effectively focus their learning efforts. This information can also help instructors identify challenging areas for students and adjust their teaching approach to facilitate learning.

Upon successful completion of this course, the student will:
A. Have increased her/his:
   1. Critical thinking skills
   2. Problem-solving skills
   3. Ability to use mathematics and computers to model biological phenomena

B. Be able to explain:
   A. The causes and organization of genetic and phenotypic variation
   B. Genetic drift and its relationship to population parameters
   C. The neutral theory of population genetics and molecular evolution
   D. The molecular underpinnings of selection
   E. Emergent models of inbreeding, population subdivision, and gene flow from the principles of the neutral theory and how they are affected by selection
   F. Modeling neutral molecular evolution, estimating the rates of sequence divergence, and identifying signatures of selection
   G. Molecular phylogenetics, evolution, and gene genealogies
   H. Molecular underpinnings of quantitative traits, identifying components of trait variance, emergent models of trait determination and evolution
   I. Scaling up population genetics to population genomics
   J. Application of theory to our understanding of human population genetics and molecular evolution

G. INSTRUCTIONAL METHODS AND ACTIVITIES
Independent assignments will be issued each week and are intended to reinforce concepts taught in lecture. These assignments will typically involve mathematical modeling and
computer simulation. The independent assignments may be worked upon in groups, but each individual must turn in their own work and keep a binder of their work.

Class participation involves being present at the lectures and actively contributing to discussions.

Exams will be comprised of essay questions, some of which could require the use of a computer to answer. All questions will require synthesis of concepts, critical thinking, and problem solving skills. The course is taught in a computer laboratory, so computers will be available.

All assignments and examination answers must be legible to the Instructor. Illegible answers will receive no credit. We strongly encourage the use of word processing software to draft your answers, after all, it is 2014 and it was standard to complete assignments as such when I was a student 20 years ago. That being said, I understand that drawings and figures may be completed by hand.

H. MAJOR COURSE REQUIREMENTS AND GRADING
The final grade will be based on the percentage you earn out of the total possible points. Individual extra credit is not possible, but extra points may be built into exams or other assignments. Statistical manipulations to adjust grades, if used (at the Instructor’s discretion), will be performed for each exam. A standard grading scale will be used:

- A = 90 - 100 %
- B = 80 - 89.9 %
- C = 70 - 79.9 %
- D = 60 - 69.9 %
- F = 0 - 59.9 %

Components of Course Grade
<table>
<thead>
<tr>
<th>Component</th>
<th>Points</th>
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<tbody>
<tr>
<td>Mid Term Exam</td>
<td>30 pts</td>
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<tr>
<td>Final Exam</td>
<td>30 pts</td>
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<tr>
<td>Independent Assignments</td>
<td>30 pts</td>
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<tr>
<td>Class Participation</td>
<td>10 pts</td>
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TOTAL = 100 pts

It is the student’s duty to attend each class session and be aware of all assignments, deadlines, etc.

I. COURSE CONTENT/SCHEDULE

BIOL 4371 SCHEDULE

<table>
<thead>
<tr>
<th>Date</th>
<th>Lecture Topic</th>
<th>Reading</th>
<th>Assignments Due Friday of Each Week</th>
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<table>
<thead>
<tr>
<th>Date</th>
<th>Lecture Topic</th>
<th>Reading</th>
<th>Assignments Due Friday of Each Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>08/24</td>
<td>Introduction Geno &amp; Pheno Variation</td>
<td>Preface, Ch 1</td>
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<tr>
<td>08/24</td>
<td>Random Mating &amp; HW</td>
<td>2.1-2.3</td>
<td>Ch 2 Qs: 3, 4, 7, 10</td>
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<tr>
<td>08/31</td>
<td>Extensions of HW</td>
<td>2.4</td>
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<tr>
<td>08/31</td>
<td>Linkage</td>
<td>2.5</td>
<td></td>
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<tr>
<td>09/07</td>
<td>Linkage Disequilibrium &amp; Genetic Drift</td>
<td>2.5-3.3</td>
<td>Due 2/13. Ch 2 Qs: 12, 14, Chapter 3 Qs: 4, 7, Recreate Fig 3.8. Pop G Exercise</td>
</tr>
<tr>
<td>09/07</td>
<td>Genetic Drift in Subdivided Populations</td>
<td>3.4</td>
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<tr>
<td>09/14</td>
<td>Effective Population Size &amp; The Coalescent</td>
<td>3.5-3.6</td>
<td>Due 2/19 Answer Qs posed in lecture excel sheets, Ch 3 Qs 9, 10, 12, 15</td>
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<tr>
<td>09/14</td>
<td>The Coalescent Theory</td>
<td>3.6-3.7</td>
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<tr>
<td>09/21</td>
<td>Review of Material Covered</td>
<td></td>
<td>Due 2/26 Answer Qs posed in lecture excel sheets, Ch 3 Qs 18, 19</td>
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<tr>
<td>09/21</td>
<td>Mutation, Genetic Drift, and the Neutral Theory</td>
<td>4.1-4.3</td>
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<tr>
<td>09/28</td>
<td>Infinite Alleles Model</td>
<td>4.4</td>
<td>Due 3/5. Answer Qs posed in lecture excel sheets. Ch 4 Qs 8, 11</td>
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<tr>
<td>09/28</td>
<td>Infinite Sites Model</td>
<td>4.5</td>
<td></td>
</tr>
<tr>
<td>10/05</td>
<td>Infinite Sites II, Mutation-Recombination</td>
<td>4.5-4.6</td>
<td>Due 3/13 Read Review Tollis 2012</td>
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<td>10/05</td>
<td>Midterm Review</td>
<td>5.6-5.7</td>
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<td>10/12</td>
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<td>Midterm Exam</td>
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<tr>
<td>10/19</td>
<td>Selection in Haploids &amp; Diploids</td>
<td>5.1-5.2</td>
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<tr>
<td>10/19</td>
<td>Selection Equilibria</td>
<td>5.3, 7 in Neilsen &amp; Slatkin</td>
<td>Due 4/2: Ch 5 Qs 3, 5, 6, 7</td>
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<tr>
<td>10/26</td>
<td>Mutation-Selection Balance</td>
<td>5.4, 7 in Neilsen &amp; Slatkin</td>
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<tr>
<td>10/26</td>
<td>Graduate Student Mini-Lectures: Complex Types of Selection</td>
<td>5.5-5.6</td>
<td>Due 4/9 In words describe how to create a model of drift, mutation and selection</td>
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<tr>
<td>11/02</td>
<td>Selection in a Finite Population</td>
<td>5.7, 8 in Neilsen &amp; Slatkin</td>
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<tr>
<td>11/02</td>
<td>Making a Wright-Fisher Model with Mutation, Drift, and Selection</td>
<td>Lecture 17 Excel Sheet</td>
<td>Due 4/16 Create population model of drift, mutation and selection</td>
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***Last Day to Drop***

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<table>
<thead>
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<th>Lecture Topic</th>
<th>Reading</th>
<th>Assignments Due Friday of Each Week</th>
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<tbody>
<tr>
<td>11/09</td>
<td>Inbreeding</td>
<td>6.1</td>
<td></td>
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<tr>
<td>11/16</td>
<td>Model Review Session</td>
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<tr>
<td>11/16</td>
<td>Wahlund Principle &amp; Migration</td>
<td>6.3-6.5</td>
<td>Due 4/30 Ch 6 Qs 21, 22, 23, 28</td>
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<tr>
<td>11/23</td>
<td>Migration 2 and Quantitative</td>
<td>6.5, 8.1-8.2</td>
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<tr>
<td>QT &amp; Artificial Selection</td>
<td>8.2-8.3</td>
<td>Due 5/5 Add migration to model</td>
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</tr>
<tr>
<td>11/30</td>
<td>Genetic Models For QT</td>
<td>8.4</td>
<td></td>
</tr>
<tr>
<td>12/09</td>
<td>Final Exam (1:45-4:15PM)</td>
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Note: Changes in this course schedule may be necessary and will be announced to the class by the Instructor. The assignments and exams shown are directly related to the Student Learning Outcomes described in Section F.

J. COURSE POLICIES
   Attendance/Tardiness
   Attendance is required for all lectures. You are responsible for the material covered in every lecture, even if it is not in the book, regardless of your attendance. Routine events (non-emergency medical visits, parent-teacher conferences, household or auto repairs) should be scheduled to avoid conflicts with class. Documentation is required for an absence to be excused. For example, if you are too ill to attend a lecture, you must provide a doctor’s excuse on official stationary or a prescription form with applicable dates. Dr. Bird will make the final determination as to whether an absence is excused or not. This policy also applies to students participating in University-sanctioned activities (such as athletics); however, in such cases, arrangements must be made at least two weeks ahead of time, and justification must be documented via a letter or memo on official university letterhead or an email from a university address by the supervising coach or faculty member. If you participate in University Athletics, please inform your coach that a form letter with a list of students on the team or on several teams is NOT acceptable. I need a letter or a list of students in Population Genetics only.

NOTE: If you are faced with an extensive illness or family emergency that keeps you out of all your classes for more than a day or two, you should contact the Vice President for Student Affairs, Dr. Eliot Chenaux. This office assists students in difficult circumstances. Take advantage of these and other University services as you may need!

K. COLLEGE AND UNIVERSITY POLICIES
   • Academic Integrity (University)
     University students are expected to conduct themselves in accordance with the highest standards of academic honesty. Academic misconduct for which a student is subject to penalty includes all forms of cheating, such as illicit possession of examinations or examination materials, falsification, forgery, complicity or
plagiarism. (Plagiarism is the presentation of the work of another as one’s own work.) In this class, academic misconduct or complicity in an act of academic misconduct on an assignment or test will result in a failing grade.

- **Classroom/Professional Behavior**
  Texas A&M University-Corpus Christi, as an academic community, requires that each individual respect the needs of others to study and learn in a peaceful atmosphere. Under Article III of the Student Code of Conduct, classroom behavior that interferes with either (a) the instructor’s ability to conduct the class or (b) the ability of other students to profit from the instructional program may be considered a breach of the peace and is subject to disciplinary sanction outlined in article VII of the Student Code of Conduct. Students engaging in unacceptable behavior may be instructed to leave the classroom. This prohibition applies to all instructional forums, including classrooms, electronic classrooms, labs, discussion groups, field trips, etc.

- **Statement of Civility**
  Texas A&M University-Corpus Christi has a diverse student population that represents the population of the state. Our goal is to provide you with a high quality educational experience that is free from repression. You are responsible for following the rules of the University, city, state and federal government. We expect that you will behave in a manner that is dignified, respectful and courteous to all people, regardless of sex, ethnic/racial origin, religious background, sexual orientation or disability. Behaviors that infringe on the rights of another individual will not be tolerated.

- **Deadline for Dropping a Course with a Grade of W (University)**
  The grade of W will be assigned to any student officially dropping a course. Please consult with the instructor before you decide to drop to be sure it is the best thing to do. Just stopping attendance and participation WILL NOT automatically result in your being dropped from the class. Should dropping the course be the best course of action, visit the Office of the University Registrar for the Course Drop Form that must submitted. No student is eligible to receive a W without completing the official drop process by this deadline. Please consult the Academic Calendar (http://www.tamucc.edu/academics/calendar/) for the last day to drop a course.

- **Grade Appeals (College of Science and Engineering)**
  As stated in University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures, a student who believes that he or she has not been held to appropriate academic standards as outlined in the class syllabus, equitable evaluation procedures, or appropriate grading, may appeal the final grade given in the course. The burden of proof is upon the student to demonstrate the appropriateness of the appeal. A student with a complaint about a grade is encouraged to first discuss the matter with the instructor. For complete details, including the responsibilities of the parties involved in the process and the number of days allowed for completing the steps in the process, see University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures. These documents are accessible through the University Rules website at
http://www.tamucc.edu/provost/university_rules/index.html, and the College of Science and Engineering Grade Appeals webpage at http://sci.tamucc.edu/students/GradeAppeal.html. For assistance and/or guidance in the grade appeal process, students may contact the chair or director of the appropriate department or school, the Office of the College of Science and Engineering Dean, or the Office of the Provost.

- **Disability Services**
  The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please call (361) 825-5816 or visit Disability Services in Corpus Christi Hall 116.

  If you are a returning veteran and are experiencing cognitive and/or physical access issues in the classroom or on campus, please contact the Disability Services office for assistance at (361) 825-5816.

  http://disabilityservices.tamucc.edu/

- **Statement of Academic Continuity**
  In the event of an unforeseen adverse event, such as a major hurricane and classes could not be held on the campus of Texas A&M University–Corpus Christi; this course would continue through the use of Blackboard and/or email. In addition, the syllabus and class activities may be modified to allow continuation of the course. Ideally, University facilities (i.e., emails, web sites, and Blackboard) will be operational within two days of the closing of the physical campus. However, students need to make certain that the course instructor has a primary and a secondary means of contacting each student.

L. **OTHER INFORMATION**
- **Academic Advising**
  The College of Science & Engineering requires that students meet with an Academic Advisor as soon as they are ready to declare a major. The Academic Advisor will set up a degree plan, which must be signed by the student, a faculty mentor, and the department chair. Meetings are by appointment only; advisors do not take walk-ins. Please call or stop by the Advising Center to check availability and schedule an appointment. The College’s Academic Advising Center is located in Center for Instruction 350 or can be reached at (361) 825-3928.

**GENERAL DISCLAIMER**
I reserve the right to modify the information, schedule, assignments, deadlines, and course policies in this syllabus if and when necessary. I will announce such changes in a timely manner during regularly scheduled lecture periods.