EVOLUTIONARY GENETICS – MARB 6371.001
Department of LIFE SCIENCES
FALL 2018

A. COURSE INFORMATION

Course number/section: MARB 6371.001
Class meeting time: F 1-3:30
Class location: OCNR 243
Course Website: BB9.TAMUCC.EDU

B. INSTRUCTOR INFORMATION

Instructor: Dr. Christopher E. Bird
Office location: CS 246
Office hours: MW 1-3:30
Telephone: 361-443-5676 (CELL)
e-mail: CBIRD@TAMUCC.EDU
Appointments: TEXT OR EMAIL

C. COURSE DESCRIPTION

Catalog Course Description
This course is a comprehensive introduction to the principles of evolutionary population genetics.

Extended Course Description
This course is a comprehensive introduction to the principles of evolutionary population genetics. Evolutionary genetics, more than most other biological disciplines, marries biological phenomena, mathematics, and statistics in one unified field of study. As such, this course will primarily focus upon utilizing evolutionary theory as a means of explaining biological phenomena. Students will learn to model & simulate 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, and the molecular evolution of quantitative traits. 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 evolutionary theory at the molecular level.

D. PREREQUISITES AND COREQUISITES

Prerequisites
Genetics (BIOL 2416) and Statistics (MATH 1442, 1470, or 2342); Recommended: Evolution (BIOL 2371)

Corequisites
NA
E. REQUIRED TEXTBOOK(S), READINGS AND SUPPLIES

Required Textbook(s)

Optional Textbook(s) or Other References
NA

Supplies
USB storage drive (Win compatible)

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 discuss population genetic concepts using scientific terminology and explain:
   1. The causes of genetic and phenotypic variation, and how to describe this variation
   2. The effect of random mating on genotype and allele frequencies
   3. Genetic drift and its relationship to population parameters
   4. The neutral theory of molecular evolution and its relationship to evolutionary mutation models
   5. Coalescent theory and its utility in population genetic studies
   6. How to test for neutrality and selection
   7. How to estimate genetic relatedness between individuals
   8. The relationship between identity by descent and inbreeding, population subdivision, and genetic structure
   9. Linkage disequilibrium, and the effects of recombination on haplotypes
10. The effects of selection on the genetic composition of a population
11. The molecular underpinnings of quantitative traits, identifying components of trait variance

G. INSTRUCTIONAL METHODS AND ACTIVITIES

We will meet one day a week for 2.5 hours. This time will be used for lectures, discussion, and instructor-led exercises that will be executed using computers. You may bring your own laptop, or use the provided computers in the lab. Class participation involves being present at the lectures, completing computer exercises, and actively contributing to discussions.

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.

Graduate students will present a lecture on selection (see section I). The length is typically 15 minutes but may vary depending upon the number of graduate students.

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.

All assignments and examination answers must be legible to the Instructor. Illegible answers will receive no credit. I strongly encourage the use of word processing software to draft your answers. 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 independently for each category in the table below. 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 %
### ACTIVITY % of FINAL GRADE

<table>
<thead>
<tr>
<th>Activity</th>
<th>% of Final Grade</th>
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<tbody>
<tr>
<td>Exam 1</td>
<td>12.5</td>
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<tr>
<td>Exam 2</td>
<td>12.5</td>
</tr>
<tr>
<td>Exam 3</td>
<td>12.5</td>
</tr>
<tr>
<td>Final Exam</td>
<td>12.5</td>
</tr>
<tr>
<td>Lecture Presentation</td>
<td>10</td>
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<tr>
<td>Independent Assignments</td>
<td>30</td>
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<tr>
<td>Class Participation</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
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</table>

### I. COURSE CONTENT/SCHEDULE

#### Section 1: Neutral Theory of Molecular Evolution

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Discussion Topics</th>
<th>Reading</th>
<th>Work Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>31-Aug</td>
<td>Phenotypic Variation &amp; Genetic Diversity</td>
<td>HC 1, NS 1</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>31-Aug</td>
<td>Random Mating, Allele, &amp; Genotype Frequencies</td>
<td>HC 2.1-3</td>
<td></td>
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<tr>
<td>2</td>
<td>7-Sep</td>
<td>Wright-Fisher Model of Genetic Drift</td>
<td>HC 3.1-5; NS 2</td>
<td>Assignment 1</td>
</tr>
<tr>
<td>2</td>
<td>7-Sep</td>
<td>Wright-Fisher Model of Genetic Drift</td>
<td>HC 3.1-3, 3.5; NS 2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>14-Sep</td>
<td>Mutation &amp; The Neutral Theory of Molecular Evolution</td>
<td>HC 4.1-3, 7.1; NS 2, 9</td>
<td>Assignment 2</td>
</tr>
<tr>
<td>3</td>
<td>14-Sep</td>
<td>Coalescent Theory of Population Genetics</td>
<td>HC 3.6-7; NS 3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>21-Sep</td>
<td>Modelling &amp; Describing Mutations</td>
<td>HC 4.4-5; NS 3</td>
<td>Assignment 3</td>
</tr>
<tr>
<td>4</td>
<td>21-Sep</td>
<td>The Neutral Theory II: Tests for Neutrality</td>
<td>HC 4.4-5, 7.5 ;NS 9</td>
<td></td>
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<tr>
<td>5</td>
<td>28-Sep</td>
<td>Review - Neutral Theory</td>
<td></td>
<td>Assignment 4</td>
</tr>
<tr>
<td>5</td>
<td>28-Sep</td>
<td>Review - Neutral Theory</td>
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</tbody>
</table>

TAKE HOME EXAM 1

#### Section 2: Biological Inferences Using Neutral Theory

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Discussion Topics</th>
<th>Reading</th>
<th>Work Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>5-Oct</td>
<td>Kinship</td>
<td></td>
<td>Exam 1</td>
</tr>
<tr>
<td>6</td>
<td>5-Oct</td>
<td>Inbreeding &amp; Non-random Mating</td>
<td>HC 6.1, NS 1</td>
<td></td>
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<tr>
<td>7</td>
<td>12-Oct</td>
<td>Population Subdivision</td>
<td>HC 6.2-6.3</td>
<td></td>
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<tr>
<td>7</td>
<td>12-Oct</td>
<td>Migration</td>
<td>HC 6.5</td>
<td></td>
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<tr>
<td>8</td>
<td>19-Oct</td>
<td>Linkage Disequilibrium Among Loci</td>
<td>HC 2.5-2.6; NS 6</td>
<td></td>
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<tr>
<td>8</td>
<td>19-Oct</td>
<td>Linkage Disequilibrium II</td>
<td>HC 3.7, 4.6, 9.2, 10.3-4; NS 9</td>
<td></td>
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<tr>
<td>9</td>
<td>26-Oct</td>
<td>Inferring Population History &amp; Demography</td>
<td>HC 6, 9, 10; NS 5</td>
<td>Assignment 5</td>
</tr>
<tr>
<td>9</td>
<td>26-Oct</td>
<td>Inferring Population History &amp; Demography</td>
<td>HC 6, 9, 10; NS 5</td>
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<tr>
<td>10</td>
<td>2-Nov</td>
<td>Review</td>
<td>HC 6, 9, 10; NS 5</td>
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<tr>
<td>10</td>
<td>2-Nov</td>
<td>Review</td>
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TAKE HOME EXAM 2
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**
It is important to attend all lectures. You are responsible for the material covered in every lecture, even if it is not in the book, regardless of your attendance. 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 office of the Associate Dean of Students: [https://cm.maxient.com/reportingform.php?TexasAMUnivCC&layout_id=20](https://cm.maxient.com/reportingform.php?TexasAMUnivCC&layout_id=20).

**Late Work and Make-up Exams**
10% is deducted for each day after an assignment or exam was due. Exams are take home. Contact me as early as possible if you have a conflict.

**Extra Credit**
Extra credit may be awarded on exams.

**Cell Phone Use**
I encourage students to use their cell phones to look up information, take notes, etc.

**Laptop Use**
You must use a computer in the lectures of this course; either your laptop or a provided desktop computer in the lab. Devices with a physical keyboard and Windows, OSX, or Linux operating systems are the type of computer necessary in this course. Chromebooks, iPads, and Androids will not be supported.

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<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Discussion Topics</th>
<th>Reading</th>
<th>Work Due</th>
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</thead>
<tbody>
<tr>
<td>11</td>
<td>9-Nov</td>
<td>Selection In Haploids &amp; Diploids</td>
<td>HC 5.1-5.2, NS 7</td>
<td>Exam 2</td>
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<tr>
<td>11</td>
<td>9-Nov</td>
<td>Selection Equilibria</td>
<td>HC 5.2</td>
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<td>12</td>
<td>16-Nov</td>
<td>Mutation-Selection Balance</td>
<td>HC 5.4</td>
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<tr>
<td>12</td>
<td>16-Nov</td>
<td>Selection in Finite Populations</td>
<td>HC 5.7</td>
<td></td>
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<tr>
<td>13</td>
<td>30-Nov</td>
<td>Selection Du Jour - Grad Student Presentations</td>
<td>HC 5.5</td>
<td>Assignment 6</td>
</tr>
<tr>
<td>13</td>
<td>30-Nov</td>
<td>Genetic Tests for Selection</td>
<td>HC 7.5, NS X</td>
<td></td>
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<tr>
<td>14</td>
<td>7-Dec</td>
<td>Quantitative Traits I</td>
<td>HC 6.5-8.1-8.2</td>
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<tr>
<td>14</td>
<td>7-Dec</td>
<td>Quantitative Traits II</td>
<td>HC 8.3</td>
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<td>TAKE HOME EXAM 3</td>
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<td></td>
<td>7-Dec</td>
<td>Review</td>
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<td>TAKE HOME FINAL</td>
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<td></td>
<td>12-Dec</td>
<td>Final Due 11am-1:30pm</td>
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Food in Class
No food is allowed in the computer lab.

Missed Exam
Exams are take home. Contact me as early as possible if you have a conflict.

Participation
You are expected to participate in classroom discussions and exercises.

Others
Don’t plagiarize on your assignments and exams. Consult your student handbook for the definition of plagiarism. I’ve caught numerous students doing this in a variety of courses, including this one. In this course, it is impossible to get the correct answer from Wikipedia or other online resources.

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)**
  I hope that you never find it necessary to drop this or any other class. However, events can sometimes occur that make dropping a course necessary or wise. **Please consult with your academic advisor, the Financial Aid Office, and me, before you decide to drop this course.** Should dropping the course be the best course of action, you must initiate the process to drop the course by going to the Student Services Center and filling out a course drop form. Just stopping attendance and participation WILL NOT automatically result in your being dropped from the class. 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.

• **Other important policies**
  Have fun! You are a senior and should be enjoying the courses you are taking at this point.

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.