I. **OVERVIEW**
   The following information will appear in the 2010 - 2011 catalog

   **BIO 115**  *Genetics, Evolution, and Society*  
   3 Units

   *Exploration of basic principles of genetics and evolution as unifying themes in the biological sciences. Emphasis on analysis of gene action, mutation, inheritance, natural selection, evolution of life and of species, biotechnologies and their implications for society.*

   Field trips might be required. (A-F or P/NP - Student choice) Lecture

   **Transfer:** (CSU, UC) **General Education:** (MJC-GE: A ) (CSU-GE: B2 ) (IGETC: 5B )

II. **LEARNING CONTEXT**
   Given the following learning context, the student who satisfactorily completes this course should be able to achieve the goals specified in Section III, Desired Learning:

   A. **COURSE CONTENT**

   1. **Required Content:**

   a. Introduction

   i. An overview of heredity

   ii. An overview of evolution

   iii. The impact of DNA technologies in modern life

   iv. The scientific method as a way of analyzing our world

   b. Life

   i. Some basics about chemistry and life

   ii. Cell theory, cell organelles; endosymbiosis

   iii. The species concept

   iv. The five kingdoms of life; viruses, viroids and prions

   c. Darwinism

   i. Some pre-Darwinian ideas

   ii. Some revolutions in thinking that developed into modern science

   iii. The essentials of Darwin and Wallace's reasoning
       Darwinian thought in modern biology

   d. The evolutionary record

   i. Modern cosmology: how the earth has developed to its present state
ii. The fossil record and how it is dated

iii. The origin of life

iv. The search for extraterrestrial life
   Past extinctions

e. Information mechanisms of the cell
   i. DNA as the hereditary material
   ii. How cells use DNA to make proteins and control cell activities
   iii. Mutations: changes in DNA
      Bacterial transformation and transduction

f. DNA technology
   i. Plasmids and making recombinant DNA
   ii. Making useful products from genetically engineered cells
   iii. Controversies over genetically engineered life forms
   iv. PCR technology and DNA "fingerprints" in forensics
   v. An evaluation of "Jurassic Park"
   vi. DNA sequencing and Human Genome Project

g. Transmitting hereditary information
   i. The human life cycle
   ii. Cell division: mitosis and meiosis
   iii. Some major patterns of inheritance: sickle-cell anemia, hemophilia, and Huntington's Chorea
   iv. ABO blood types and the Rh factor

h. Reproduction
   i. Why sexuality is ubiquitous
   ii. Human sex chromosomes
   iii. Human sex chromosome abnormalities
   iv. The human sex ratio: gamete selection schemes

i. Gene interactions and expression
   i. Chromosome structure and crossing over
   ii. Dihybrid crosses
   iii. Extrachromosomal DNA
iv. Polygenic inheritance  
v. Nature and nurture  
j. Human population growth and sustained development  
i. The human population explosion  
ii. The "Green Revolution"  
k. Population genetics  
i. Hardy-Weinberg equilibrium  
ii. Factors that disturb equilibrium  
iii. Balanced polymorphism  
l. Mutation  
i. Chromosomal mutations  
ii. Rates of point mutation  
iii. Repair of mutations  
iv. The Ames test  
m. Mutagenesis  
i. Radiation  
ii. Chemical mutagens  
iii. Mutations and cancer  
n. Selection  
i. Selection factors that operate on humans  
ii. Artificial selection in agriculture  
o. The evidence for evolution  
i. Natural selection as a creative force  
ii. Homology, development, and vestigial structures  
iii. Biogeography and convergent evolution  
iv. Human diversity  
v. Formation of new species  
vi. Using protein and DNA comparisons to infer evolutionary histories  
vii. Endosymbiotic theory
p. Managing the human gene pool
   i. Human diversity
   ii. Additional human genetic diseases
   iii. Eugenics efforts in Germany, the United States, and China
   iv. Gene therapy of humans
   v. Genetic counseling
   vi. The Human Genome Project and its implications

q. The future evolution of organisms
   i. The biological effects of climate change

B. HOURS AND UNITS

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<th>INST METHOD</th>
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C. METHODS OF INSTRUCTION (TYPICAL)

Instructors of the course might conduct the course using the following method:

1. Lecture and discussion
2. Films, videotapes, and projected computer CDs
3. Use of library and Internet/WWW resources in pursuit of the term report on a topic of the student’s choice, and in finding current events.
4. Collaborative learning exercises in working out genetics problems in-class, and making a hypothesis as to how horse evolution could have occurred, given a set of fossils.
5. Students will participate in online threaded discussions posted in WebCt.
6. Ten current events will be entered into a cumulative folder two at a time, and turned in to the instructor every two weeks. The student writes an analysis of each current event as well as the student’s more personal thoughts about event.

D. ASSIGNMENTS (TYPICAL)

1. EVIDENCE OF APPROPRIATE WORKLOAD FOR COURSE UNITS

   Time spent on coursework in addition to hours of instruction (lecture hours)

   a. 1-2 Chapters of reading from textbooks and additional readings per week
   b. Homework Packs - 3 per semester
   c. Genetics/Evolution Article Summary, students will summarize an article from a scientific journal publication - 1 per semester
   d. Online WEBct Discussion Questions, 12 per semester
2. EVIDENCE OF CRITICAL THINKING
Assignments require the appropriate level of critical thinking

a. Example Exam Questions:

i. If a child has type O blood, can his/her mother have type B blood and his/her father type A blood? Please prove your answer using a Punnett square to show the possible genotypes of the parents and their offspring.

ii. If both parents are heterozygous for the gene that results in Tay-Sachs disease, what percentage of their children will have the disease and what percentage will be carriers of the Tay-Sachs gene? Show your work.

iii. Use the codon/amino acids chart to transcribe and translate the following DNA sequence into its amino acid sequence for which it codes for. DNA: TACCGACTCAATAGAGGCATC

iv. What environmental forces (sometimes catastrophic) can segment an environment and put distance between the members of the same species allowing divergence into two populations

b. Example WebCt Questions:

i. State five arguments supporting and three arguments against the development and use of genetically modified organisms (GMOs). How are GMOs related to the study of evolution. Respond to at least two other classmate responses.

ii. Describe why evolution is a scientific theory. List and explain some of the key lines of scientific evidence that supports evolutionary theory. Would "hooded" rats, Tiktaalik roseae, melanic moths, sickle cell disease, or armor plating in stickle back fish be considered evidence? Respond to two other students.

iii. Pakicetus is an important link (evidence) in Whale evolution. Explore the Whale evolution web link found in the web links folder. Take a look at the family tree and ancestors of whales. Also important in the evolution of whales was the environments that they inhabited. Take a look at the maps of the plate tectonics and the Tethys Sea. Look at the areas that once had water. This shows us why we find fossils of Basilosaurus in Egypt and Pakicetus in Pakistan. Discuss some of your observations of the evidence for whale evolution that can be seen on this site and respond to the comments of at least one other student.

iv. Discuss some of the advancements that have occurred as a result of the discovery of the structure and function of DNA. Pictured below is Rosalind Franklin, the x-ray crystallographer who first accurately imaged DNA. It was her x-ray crystallograph that helped Watson and Crick to work out the Double helix shape of DNA. How has biotechnology changed our society? Answer and also respond to two other classmates.

c. Example Homework Questions:

i. Compare and contrast the similarities and differences between mitosis and meiosis.

ii. A plant that is heterozygous for tall stem length is crossed with a plant that has dwarf stem length. What percentage of the F1 generation would you expect to have dwarf stem length?

iii. How are Atlantic cod, Antarctic icefish, krill, and fish populations related to the health of the environment, climate change and evolution?

iv. List and describe the various scientific lines of evidence that have contributed to evolutionary theory. These were discussed in lecture and in your textbook.
E. **TEXTS AND OTHER READINGS (TYPICAL)**


III. **DESIRED LEARNING**

A. **COURSE GOAL**

As a result of satisfactory completion of this course, the student should be prepared to:

relate the basic principles of genetics and evolution as unifying themes in the biological sciences. Students should have a broad understanding of gene action, mutation, inheritance, natural selection, evolution of species, biotechnologies and their implications for society.

B. **STUDENT LEARNING GOALS**

Mastery of the following learning goals will enable the student to achieve the overall course goal.

1. **Required Learning Goals**

   Upon satisfactory completion of this course, the student will be able to:

   a. discuss the role that biology plays in Western society and culture.

   b. use the Scientific Method to formulate and answer questions.

   c. explain the fundamental principles of heredity at three levels of organization: molecular, cellular, and organismic.

   d. explain the fundamental principles of evolution and identify people involved in the development of this field.

   e. apply basic chemical reactions to the issues of the origin and propagation of life.

   f. discuss the evolution of life on Earth.

   g. interpret data from a scientific experiment and formulate conclusions.

   h. utilize biological principles in the analysis and possible solutions of current bioethical problems.

   i. review the hierarchical organization of life from the atom to the biosphere.

   j. contrast modes of reproduction and development in several organisms.

   k. discuss the processes involved in making recombinant DNA and how recombinant DNA technologies are used to create new products.

   l. evaluate the risks and benefits of recombinant DNA technologies.

   m. use biological principles to interpret phenomena such as the appearance of antibiotic resistance.

   n. apply genetic knowledge to two areas of medical genetics: genetic counseling and genetic engineering.

   o. describe our current knowledge of primate biology and fossils as it relates to human origins.

   p. show how astronomy and geology set the parameters of time for the evolution of Earth's life.

   q. evaluate the current knowledge of exobiology and the origin of life on Earth.
value the complex and diverse relationships between different organisms and between organisms and their environment.

IV. METHODS OF ASSESSMENT (TYPICAL)

A. FORMATIVE ASSESSMENT
   1. Unit exams
   2. Quizzes
   3. Online discussion participation

B. SUMMATIVE ASSESSMENT
   1. Term report on an issue within genetics or evolution or biotechnology
   2. A cumulative final exam