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| HC Logo | **Course Title: Biotechnology**  **Credit(s): 2 Credit / 2 Semesters**  **Teacher: Ms. McQuade** |

EXPECTATIONS

Biotechnology is both a challenging and a rewarding course. It provides students with an opportunity to develop a conceptual framework for modern biotechnology, emphasizing applications of biological knowledge through successful completion and analysis of lab procedures. It is also designed to encourage critical thinking about environmental and social concerns that are currently the topic of bioethical debate. This course was designed to challenge students who are planning a major/career in science. Students will be held to high expectations, should be self motivated, and must maintain a mature and disciplined demeanor. This course will require a great deal of time and effort both inside and outside of the classroom, students unwilling to devote this time and put forth the effort are strongly discouraged from taking it. Furthermore, due to the expensive and in some cases hazardous nature of the equipment and reagents to be used, there is a zero tolerance policy for inappropriate or unsafe behavior. Finally, many of the labs we will do require particular reagents that once opened must be used and cannot be stored. Because of this it is imperative that students make sure they are not absent on lab days. ***Any missed labs cannot be made up later, students will either receive a zero for the lab or they will have to write a research paper to compensate***.

GOALS OF THE COURSE:

Biotechnology is a relatively new field developed from the understanding of heredity and the desire to manipulate it. It is a lab based course whose focus will be to learn and understand the basic laboratory techniques utilized in the scientific community for studying DNA, RNA, and proteins. To facilitate this students will study the following topics:

* Principles of Heredity
* DNA structure & Function
* Transcription & Translation
* Techniques for extracting, purifying, and amplifying DNA
* Principles of Recombinant DNA Technology & Cloning techniques
* Basic Microbiology & Protein Purification
* Bioethics

THE MAJOR CONCEPTS

We will study them in a different order than listed below, but the percentages are roughly equivalent in most cases to how much time we will spend during the year on these topics:

* 1. Molecular Genetics
     1. RNA and DNA structure and function
     2. DNA Replication
     3. Transcription
     4. Translation
     5. Gene regulation
     6. Epigenetics
     7. Viral structure and replication
  2. Heredity
     1. Gregor Mendel & Heredity
     2. Eukaryotic Chromosomes
     3. Prokaryotic Chromosomes
  3. Nucleic Acid Technology and Applications
     1. DNA extraction
     2. Gel Electrophoresis
     3. Bacterial Growth and aseptic technique
     4. Bacterial Transformation
     5. Protein Purification
  4. Proteomics
     1. Protein structure and function
     2. Methods for studying proteins
     3. Proteomics
  5. Environmental Biotechnology
     1. Plant Anatomy and Propagation
     2. Hydroponics, plant made pharmaceuticals, and GMO’s
     3. Alternative Energy
  6. Pharmacogenomics & Personalized Medicine
     1. New technologies in medicine
     2. Tailoring Medical Care to individual genomes
     3. Personalized medicine and the role of epigenetics and proteomics
     4. Cancer Biology

REQUIRED STUDENT MATERIALS

* Lab notebook (bound composition)
* Three-ring binder/folder to organize notes and handouts (provided)
* Consistent reliable access to the internet

COURSE PLANNER

The following table lists the topics we’ll be studying, in sequential order throughout the year. Also listed are the labs we will be doing that correspond to the topics

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| --- | --- |
| Topic | Lab |
| Introduction to Biotechnology |  |
| Lab Design & Safety | Setting up a Legal Scientific Notebook |
| Biotechnology: A Historical Perspective |  |
| Emerging Fields in Biotechnology |  |
| Biology with a Conscience: An Introduction to Bioethics |  |
| Introduction to Molecular Biology |  |
| DNA the Genetic Material | DNA Extraction |
| Structure & Replication of DNA |  |
| Restriction Enzymes & Gel Electrophoresis | Restriction Enzyme Cleavage of DNA & Electrophoresis |
| Review |  |
| **Test** |  |
| In-vitro DNA Replication: Fundamentals of PCR |  |
| Biotechnology and Forensics | Crime Scene Investigation & Sample Collection |
|  | CSI PCR Lab |
|  | Gel Electrophoresis of Samples from Crime Scene |
| Prokaryotes vs Eukaryotes |  |
| Eukaryotic Chromosomes | Microbes & Health Kit (basic microbiology skills, aseptic technique, and microbial; metabolism) |
|  | Gram Staining for Bacterial Isolation |
| Prokaryotes Chromosomes |  |
| Review |  |
| **Test** |  |
| Transcription |  |
| Translation |  |
| Protein Structure, Folding, & Isolation Techniques | Got Protein Lab: an introduction to proteomics and quantification using Bradford Protein Assay |
| Review |  |
| **Test** |  |
| Gene Regulation in Eukaryotes |  |
| Epigenetics |  |
| Gene regulation in Prokaryotes: Operons | Temperature Dependant Gene Expression in Prokaryotes |
| Gene Regulation/ Lab results | Temperature Dependant Gene Expression |
| review |  |
| **Test** |  |
| Introduction to Environmental Biotechnology |  |
| Plant Anatomy & Propagation (sexual & asexual methods) | Plant Breeding Experiment |
| Hydroponics, plant made pharmaceuticals, and GMO’s | Bacterial Transformation with GFP |
| Other roles of Biotechnology in the Environment | Isolation of GFP from transformed bacteria |
| Using microbes to clean up oil spill |  |
| Fueling our Future: Exploring alternative sources of Energy | Yeast mobile |
| Enzyme Kinetics | Biofuel Enzyme Lab |
| Review |  |
| **Test** |  |
| Introduction to Pharmacogenomics & Personalized Medicine |  |
| Recent advances in medicine |  |
| ELISA as a Tool in: Biodefense, Immunology, and Health Sciences |  |
|  | ELISA Antibody Test or  Antigen Detection with ELISA or  Tracking Disease Outbreaks |
| Proteins |  |
| Methods for studying proteins |  |
| Methods of proteomics |  |
|  | Protein Profiler Module |
| Review |  |
| Test |  |
| Introduction to Genetics & Evolution: Build on Protein Profiler Lab |  |
| Extranuclear DNA |  |
|  | Mitochondrial DNA Extraction & Purification |
| SNP’s | PCR |
| Genetics & Evolution | Gel Electrophoresis |
| Genetics & Evolution | Submission of DNA to Dolan Learning center for sequencing |
| Genetics & Evolution |  |
| Review |  |
| **Test** |  |

**FORMS OF ASSESSMENT/WEIGHTING**

Grades will be calculated on a percentage basis. The value of each individual assignment varies. Students earn a grade based on the quality of the work they complete. Overall class grades are based on a straight percentage, not on a curve. This is how class grades are distributed:

**Exams and Quizzes 50%**

**Labs and Lab Reports 30%**

**Scientific Writing Projects & Presentations 15%**

**Homework/Daily Discussion/Readings 5%**

**Semester Formula for 1st & 2nd Semester:**

First 9 weeks = 45% of the semester grade

Second 9 weeks = 45% of the semester grade

Final Exam = 10% of the semester grade