Molecular Biology

Class of 2026

Theory (1 credit)

Molecular Biology

Course Description: How life began on this planet, what life is and how it has evolved into the complex interdependent web of life we see now will be thoroughly examined. There will be a focus on cladistics, molecular biology and evolutionary biology as we go from simple life to complex ecosystems. Students will examine modern techniques in molecular biology and discuss the ethical questions that arise with this technology. Students will take the Precision Exam in Biotechnology.

Textbooks:

Taylor, Martha et al. Campbell Biology Concepts and Connections 10th ed.. New Jersey: Pearson, 2021

Miller, Tyler. Living in the Environment 11th ed.. California: Brooks/Cole Publishing Company, 2000.

Brower, James, et al. Field and Laboratory Methods for General Ecology. Boston: McGraw-Hill, 1998.

Michell, Mark and William Stapp. Field Manual for Water Quality Monitoring An Environmental Education Program for Schools. Iowa: Kendall/Hunt, 1997.

Molecular Biology

1. What is science? A review of the scientific method, scientific thought and the peer review system. A particular focus is paid to the biology, ecology and environmental science.
2. Math in science: Includes; significant figures, accuracy and precision in measure, conversions using dimensional analysis and basic solution Chemistry including making solutions and dilutions in lab.
3. Organic molecules: Classification of the major biologically important molecules; carbohydrates, proteins, lipids and nucleic acids is studied. Questions such as; what the functions of these molecules in living things are and how they are created are thoroughly addressed.
4. Cells the building blocks of life: An in-depth look at prokaryotic and eukaryotic cells, organelles and organelle function. Why do plastids and mitochondria have their own genetic material? How is energy used in the cell? What do enzymes do in the cell? What can prevent an enzyme from working? How do cell membranes fit in to the energy picture?
5. Cellular respiration: A detailed study of the generation of ATP in the cell. What do mitochondria have to do with respiration? Why is aerobic respiration so important? What is chemiosmosis?
6. Photosynthesis: An overview of photosynthesis including the Calvin cycle. The role of plastids in photosynthesis and the efficiency of photosynthesis is examined.
7. Cellular reproduction: Mitosis, the cell cycle, and meiosis are studied in detail. What molecules control the cell cycle? What happens to the genetic material during the cell cycle?
8. Mendelian genetics: Monohybrid crosses, dihybrid crosses, dominance, incomplete dominance, genotype and phenotype ratios, the one gene, one polypeptide theory are studied.
9. From DNA to Protein: The structure of DNA, DNA replication and mutation are studied. How DNA codes for proteins, transcription, translation and mutation are studied in detail.
10. Turning genes on and off: Gene regulation and applications in DNA technologies are studied in detail including; plasmids, restriction enzymes, gel electrophoresis, PCR the human genome project, 23 and me.
11. General Evolution: Basic classification of life (the 6 kingdoms of life), how life emerged on the planet, from single cell to complex organism, from sea to land, the fossil record, cladograms, micro and macro evolution, speciation, coevolution are all examined.
12. Ecology I: Basic ecological principles and vocabulary, energy flow through a food web, niches, mineral cycles, limiting factors, population ecology are explored.
13. Ecology II: Characteristics of major biomes of the earth both terrestrial and aquatic are examined. Concepts such as succession, global climate, Hadley cells, El Nino are also explored.

Grading: (subject to change)

Classwork, Homework, Entry Questions, Tests Projects, and Papers will be assigned throughout the marking period with varying point values. Students will earn from 600-800 points per marking period.

Classwork: Students are expected to get to class on time, prepared to do work. Students are expected to participate in all classroom activities; including working together in groups when the assignment calls for it. Students will be assessed on attendance, preparedness and participation.

Entry/Exit Questions: Most days students will be given a question or series of questions upon entering the class or when leaving the class. Students will be able to use their class notes and outline books for these questions.

Homework: Homework questions and readings will be assigned approximately three times a week. Some homework will be submitted while others will be reviewed in class. In addition to regular homework students will keep a notebook with chapter outlines, review questions and vocabulary words. The outline book can be used on ALL tests.

Tests and Papers: Students will get two or three major exams each marking period. In few cases a paper may substitute for a test.

Teacher Availability: I am available for everyone after school on Tuesdays for extra help. I will also be available most days after school given a one or two-day notice. In addition I will arrange to meet with students in the morning before school and during periods 4,5 and 6.\*\* My phone number at school is 376-8150. My e-mail address is HHall@Yonkerspublicschools.org. Feel free to contact me anytime.

\*\* These extra help sessions are for students that arrive on time and are actively participating in class.

Molecular Biology Lab

A full list of labs would be impossible to provide

The following is a brief list of the topics to be covered this year. This list is subject to change. Upon completion of this class students should be prepared to pass the precision exam for CTE certification.

Biochem 11 Lab (2 credits)

1. Introductory lab: Safety, equipment, wastes management etc.
2. Grant writing and use of the internet for journal searches
3. Impact of environmental factors on catalase activity.
4. Introduction to compound microscope, slide preparation and generation of micrographs.
5. Isolation of chlorophyl and spectrophotometric analysis of chlorophyl in algae samples.
6. Impact of environmental factors on cell respiration rates.
7. Culturing soil bacteria and analyzing herbicide impact on soil bacterial growth.
8. Introduction to gel electrophoresis with food dye.
9. Isolation of DNA from plant tissue.
10. Gel electrophoresis of plant DNA.
11. PCR determination of the presence of antibiotic resistant bacteria in soil.
12. Tech Prep

Grading: Labs, Lab Maintenance, Lab tests, Tech Prep, Lab notebooks and Safety will be evaluated and assigned throughout the marking period with varying point values. Students will earn from 600-800 points per marking period.

Formal labs and Tech Prep: Each marking period one formally written lab (typed, double spaced) will be assigned. The formal lab consists of an abstract, introduction, materials, methods, data, conclusion and works cited section. In addition to the formal lab students must progress on their tech prep project.

Lab maintenance and safety: Each student must do his or her part in maintaining the lab. Each day two students will be assigned lab cleaning duties. They will be evaluated on the state of the lab at the end of the day. Students will be evaluated on how carefully they work in lab on a daily basis. Students acting unsafely will be removed from lab for the day. Please note if unsafe behavior is significant or repetitive the student will be ejected from the lab and fail for the year.

Class participation, informal labs and lab notebooks: Students in the Bio-Chem program will be given opportunities to work with outside organizations such as the Beczak center or Groundwork Yonkers. All students will be expected to work with an outside organization or do extra work around the lab. Students will be assessed on the work they do on these projects.

In addition to the one formal lab each marking period, several smaller labs will be assigned. Most often the student will be responsible for submitting data and conclusions for these labs.

Lab notebooks: Lab notebooks must be kept all year long. Two or three times a semester, lab notebooks will be checked in class. These checks will be performed without warning.

\* Late labs are penalized five points a day (including weekends) to a maximum of 35 points. Labs later then 7 days may be taken for half credit.